

Final assignment - CO2 emissions

Erwin de Brouwer, 19-05-2023

1. Overview

This report answers the following questions:

- a. What is the biggest predictor of a large CO2 output per capita of a country?
- b. Which countries are making the biggest strides in decreasing CO2 output?
- c. Which non-fossil fuel energy technology will have the best price in the future?

2. Data and model

- a. What is the biggest predictor of a large CO2 output per capita of a country?

To answer this question, the following datasets were used:

1. OWID CO2 and Greenhouse Gas emissions:
<https://ourworldindata.org/co2-and-greenhouse-gas-emissions>
2. OWID Meat Production data:
<https://ourworldindata.org/meat-production#global-meat-production>
3. OWID Meat Consumption:
<https://ourworldindata.org/meat-production#per-capita-meat-consumption>
4. OWID Obesity: <https://ourworldindata.org/obesity>
5. Fossil fuel consumption:
<https://ourworldindata.org/fossil-fuels#fossil-fuel-consumption>

In total, six factors were investigated:

1. GDP per capita
2. Mean production per capita
3. Meat consumption per capita
4. Obesity percentage
5. Fossil fuel consumption

To determine to what extent a factor is an accurate predictor of a large CO2 output, correlation coefficients between the factor and the CO2 output per capita were calculated. These factors were then visualized using a bar chart.

b. Which countries are making the biggest strides in decreasing CO2 output?

To answer this question, the OWID CO2 dataset was again used. The focus here is on CO2 output per capita per country. To answer this question, we looked at the average percentage change in CO2 per capita per country over the period between 2000 and 2021.

To calculate this, the data was first grouped per country. Then, per country the percentage change in CO2 output per capita per year was calculated. Then, the mean of the percentage change was calculated.

c. Which non-fossil fuel energy technology will have the best price in the future?

To answer this question, the “Levelized cost of energy per technology” of OWID is used: <https://ourworldindata.org/grapher/levelized-cost-of-energy>

A linear regression was used to predict future prices of all renewable energy technologies, based on historical data. So time was chosen as the independent variable, where the costs of an energy technology was the dependent variable. A prediction was made up until the year 2050. One important note about the data is that the amount of data is limited. For most energy technologies, only data from 2010 onwards is available. The analysis was not focused on specific countries, but on general world costs. All data points are in dollars per kWh.

3. Results

a. What is the biggest predictor of a large CO2 output per capita of a country?

Calculating the correlation coefficients for each predictor resulted in the table below.

	co2_per_capita
gdp_per_capita	0.601832
meatproduction_kg_per_capita	0.236659
meat_consumption_per_capita	0.454293
fossil_fuels_per_capita	0.692582
overweight_obese_percentage	0.408308

Fig 1: Table of correlation coefficients per factor

The values in the table above are visualized in the horizontal bar chart below. The fossil fuel per capita correlates the strongest with the CO2 output per capita, followed closely by the GDP per capita.

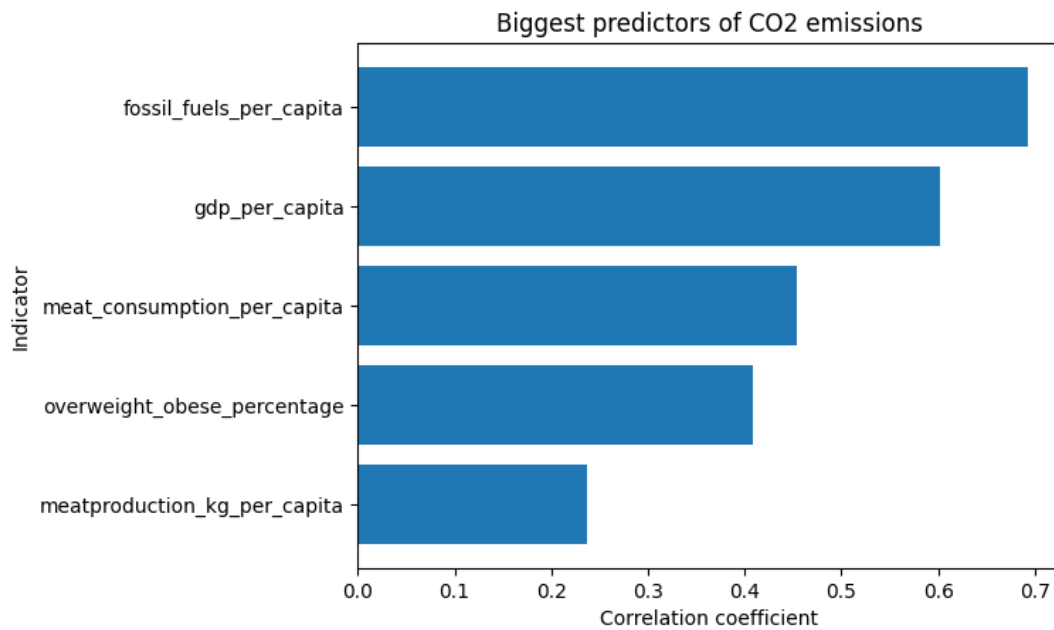


Fig 2: Correlation coefficients per factor visualized in a bar chart

b. Which countries are making the biggest strides in decreasing the CO2 output?

Aruba and Curacao show the biggest decrease in percentage CO2 output per capita in the period between 2000 and 2021. Both show a decrease of more than 4 percent per year on average. All other countries in the top 10 show an average decrease of between 2.5 and 3.5 % per year.

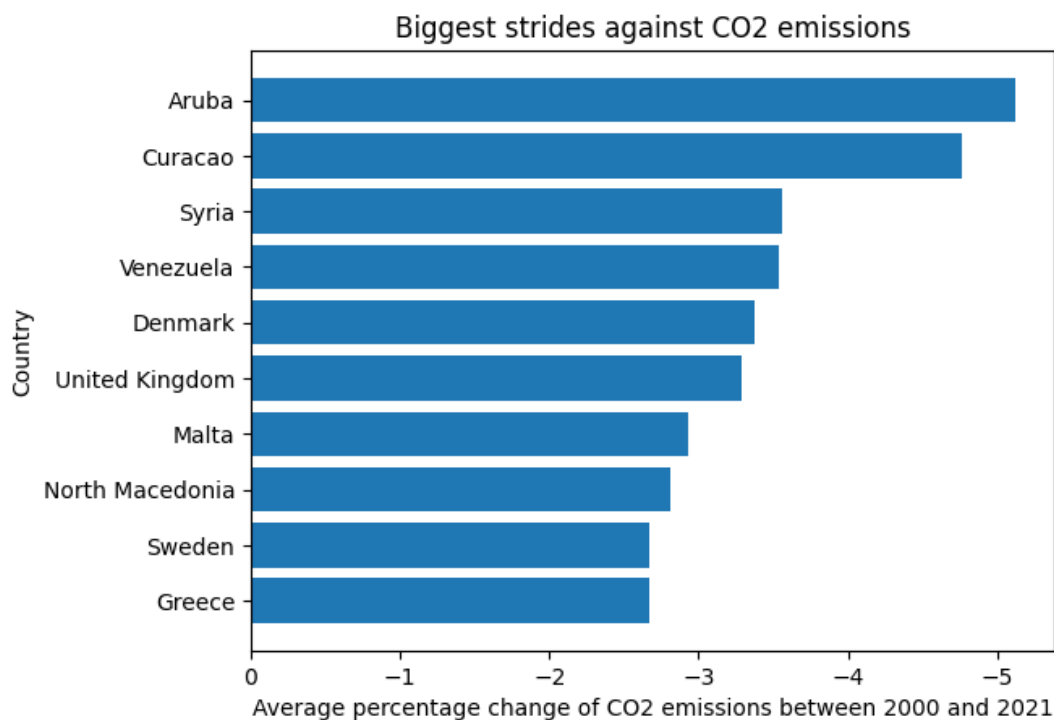


Fig 3: Top 10 of countries showing the biggest decrease in CO2 output per capita between 2000 and 2021

- c. Which non-fossil fuel energy technology will have the best price in the future?

In the graph below, historical and predicted costs of renewable energy sources are displayed. The predicted costs of some energy costs turn negative, which would mean that it would become profitable to produce some types of energy. That is very unrealistic. In reality, costs will probably become very low, but rarely below zero. However, the model does give an indication of the development of the costs of every energy type. So we can say that solar photovoltaic energy technology has the largest decrease compared to the other energy types since the measurements began.

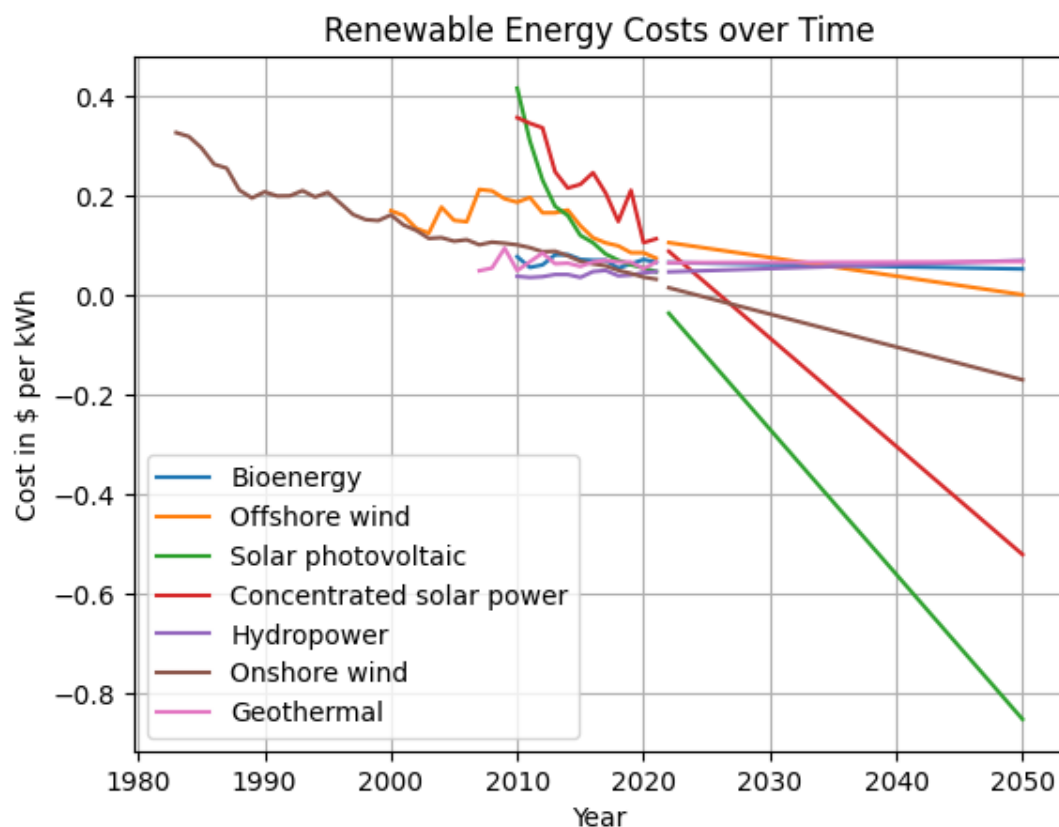


Fig. 4: Renewable energy costs over time, including historical and predicted values up until 2050.

4. Conclusions

- a. What is the biggest predictor of a large CO₂ output per capita of a country?

The biggest predictor of a large CO₂ output per capita is the amount of fossil fuels (coal, oil and gas) consumed per capita, closely followed by the GDP per capita. Though 5 factors were investigated, it is likely there are other factors which also are accurate predictors of CO₂ emissions output per capita.

b. Which countries are making the biggest strides in decreasing the CO2 output?

The two countries showing the biggest decrease in CO2 output per capita between 2000 and 2021 are Aruba and Curacao. The top 5 also includes Syria and Venezuela. For these (and possibly other) countries that 'rank high' on this list, it's likely that the big decrease in emissions is not purely the result of government policies to tackle climate change. Instead, these countries have been in unstable political situations or even war.

c. Which non-fossil fuel energy technology will have the best price in the future?

Solar photovoltaic energy has the lowest price in the future, followed by concentrated solar power and onshore wind.

However, there are some limitations to this conclusion.

1. There was little historic data available for most energy sources, which leads to inaccuracy regarding predictions in the future because there is not enough data to predict future prices on.
2. We have used a linear regression to predict prices. The model assumes a simple linear relationship between time and costs. Though in reality, energy prices are influenced by various complex factors such as technological advancements, governmental policies and market dynamics. Though a linear regression can in this case provide a basic estimation of future costs, using this method oversimplifies the relationship between time and costs because no other factors are taken into account. The method is therefore not the most appropriate method to accurately predict future prices, but it does give an indication of the development of the different energy costs in comparison to each other.