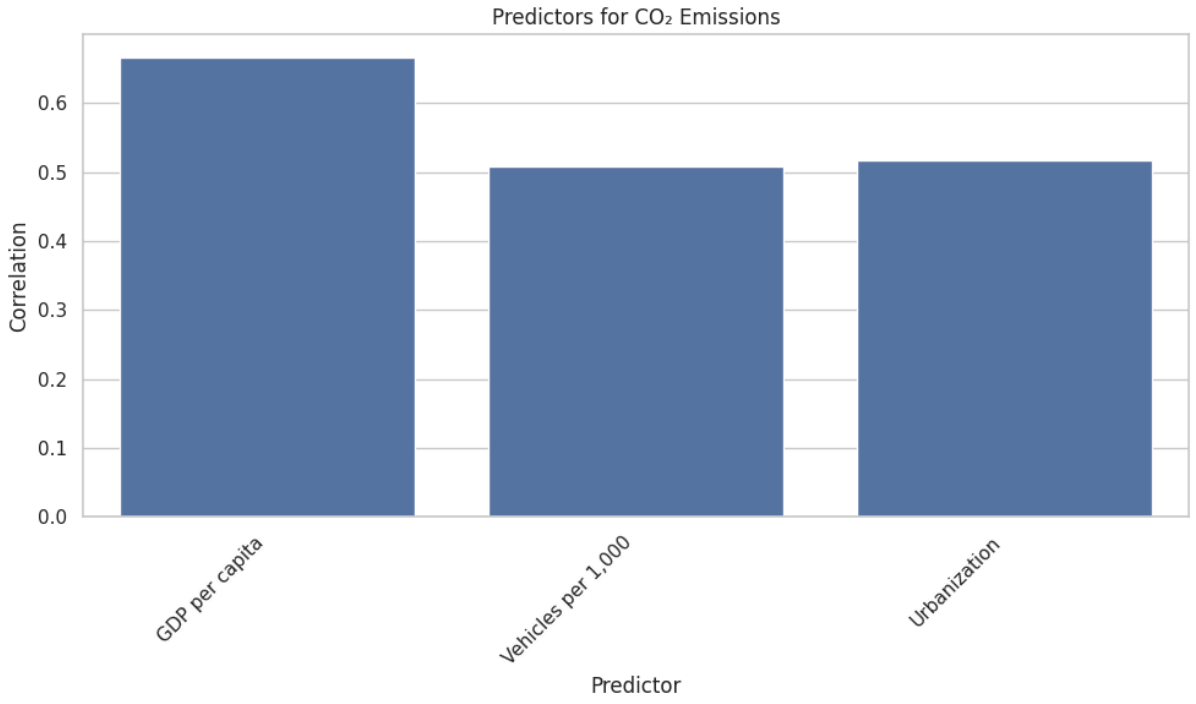
PROJECT WORK
10 August, 2024

(i) What is the biggest predictor of a large CO_2 output per capita of a country?

To be able to provide an answer to this question, we need to choose several indices and study correlations between them to select the highest. For the purpose of this task, we have chosen the following metrics: GDP per capita, the number of vehicles per 1,000 people, and urbanisation in different countries. The results are displayed below in Table 1:

Indicator	Correlation coefficient
GDP per capita	0.666
Vehicles per 1,000 people	0.508
Urbanisation	0.517

Comparing those correlation coefficients, we find that GDP per capita (r = 0.666) is the best overall predictor for CO_2 emissions as compared to either the vehicle-to-population ratio (r = 0.508) or the share of urban population (r = 0.517), although both the latter indices remain statistically significant. It is probably explained by the fact that GDP per capita is the most aggregated index that directly or indirectly includes a lot of secondary factors. We can summarise the relative impact of the chosen metrics in the following Graph 1:



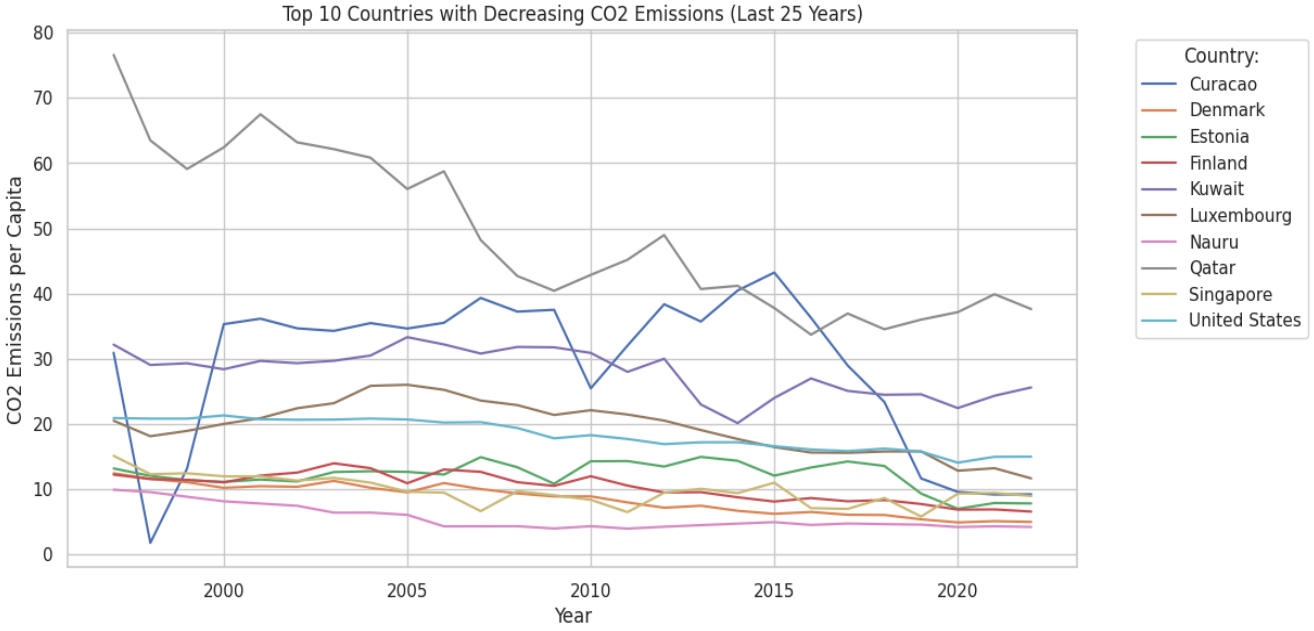
(ii) Which countries are making the biggest strides in decreasing CO_2 output?

To answer this question, we decided to study CO_2 emissions per capita rather than the general output of entire countries to properly account for the possible changes in the populations of corresponding

countries. We focused on the dynamics of CO_2 emissions over the last 25 years when the available data is the most consistent and meaningful. As the result of our analysis, a list of 10 countries that managed to decrease their CO_2 output the most has been compiled, as shown below in Table 2:

Country	CO_2 Emissions Change
Qatar	-39.011
Curacao	-21.709
Luxembourg	-8.849
Denmark	-7.460
Kuwait	-6.566
Singapore	-6.176
Unites States	-5.932
Nauru	-5.708
Finland	-5.671
Estonia	-5.367

As we can see, the list mostly represents smaller countries (and Curacao is a constituent country of the Kingdom of the Netherlands) with limited industrial output. Only the US can be regarded as a significant industrial power, which makes its progress especially noticeable.
Let us summarise the dynamics of CO_2 emissions for the chosen countries in a single Graph 2 below:

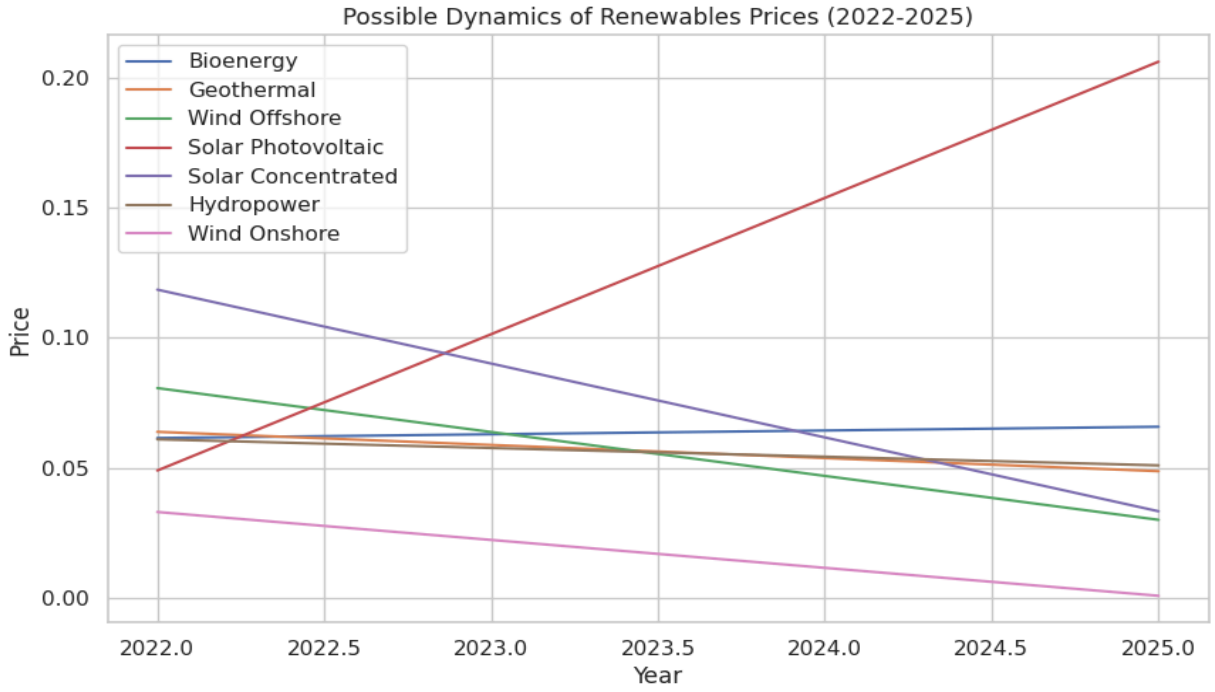


(iii) Which non-fossil fuel energy technology will have the best price in the future?

Answering this question requires analysing the current prices for different sources of renewable energy and building a predictive model. However, we are somewhat limited by the scarcity of the available data and restrictions of the computer model. Based on the aggregated prices in the world over 12 years (from 2010 to 2022), our best assumptions can be found in Table 3 below:

Predicted Renewables Prices for 2025, US dollars per kilowatt-hour	
Bioenergy	0.066
Geothermal	0.049
Offshore Wind	0.030
Photovoltaic Solar	0.206
Concentrated Solar	0.033
Hydropower	0.051
Onshore Wind	0.001

Our results suggest that onshore wind technologies are likely to become the cheapest source of renewable energy for consumers. However, it must be noticed that the created model might be possibly miscalculating the dynamic for solar energy, as a future increase in its costs seems unlikely, at least based on the current trends. Perhaps refining the model and having a bigger data set will make photovoltaic solar power a much stronger contender for the cheapest source of energy. Let us illustrate the simulated dynamic in prices in the following Graph 3:



Please find the link to a Google Colab notebook with the code below:
https://colab.research.google.com/drive/1H7jn_04RmgivTQOvpA9Lk_4St_1qMjoQ?usp=sharing