Emission Mission: Charting Europe's Carbon Footprint and Aviation Ascent

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Climate change is one of the most pressing issues of our time, with CO2 emissions driving global warming. As the world strives to cut down its carbon footprint, understanding the detailed patterns of CO2 emissions is crucial. This article explores the power of data science by examining global CO2 emissions. By analyzing a comprehensive dataset of emissions from countries around the world, the purpose is to reveal important insights and patterns that can shape policy decisions and further research. Focusing on Europe, this paper evaluates the monthly and yearly CO2 emissions of countries such as France, Germany and Albania to name a few. Through this regional analysis, one of the main aims is to uncover trends and seasonal variations in emissions, providing a clearer picture of how different countries contribute to the overall climate change narrative. By examining both yearly averages and monthly breakdowns, we can identify significant patterns that highlight the unique environmental and

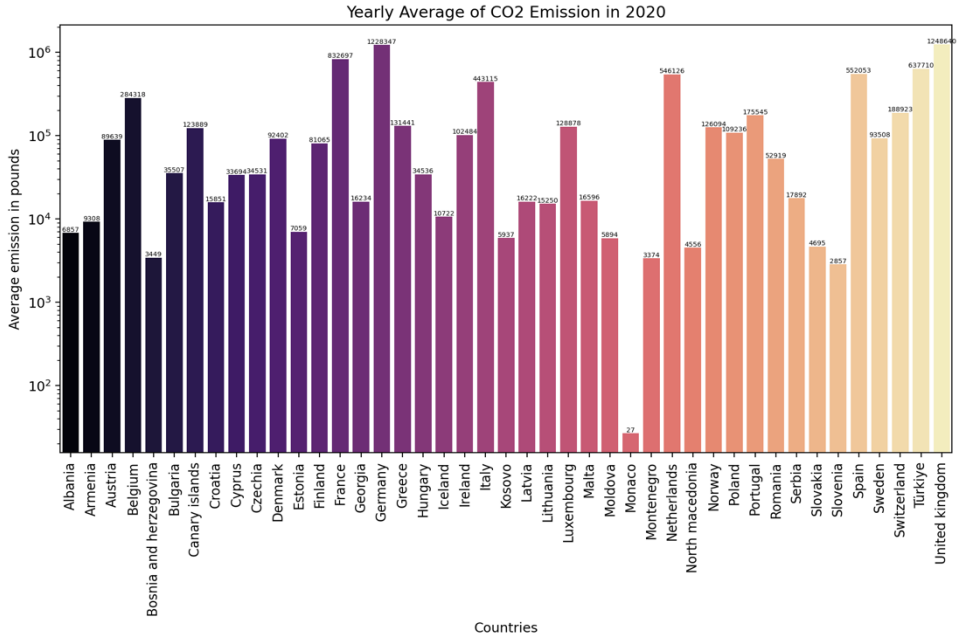

Figure 1: Yearly Emissions from 2020

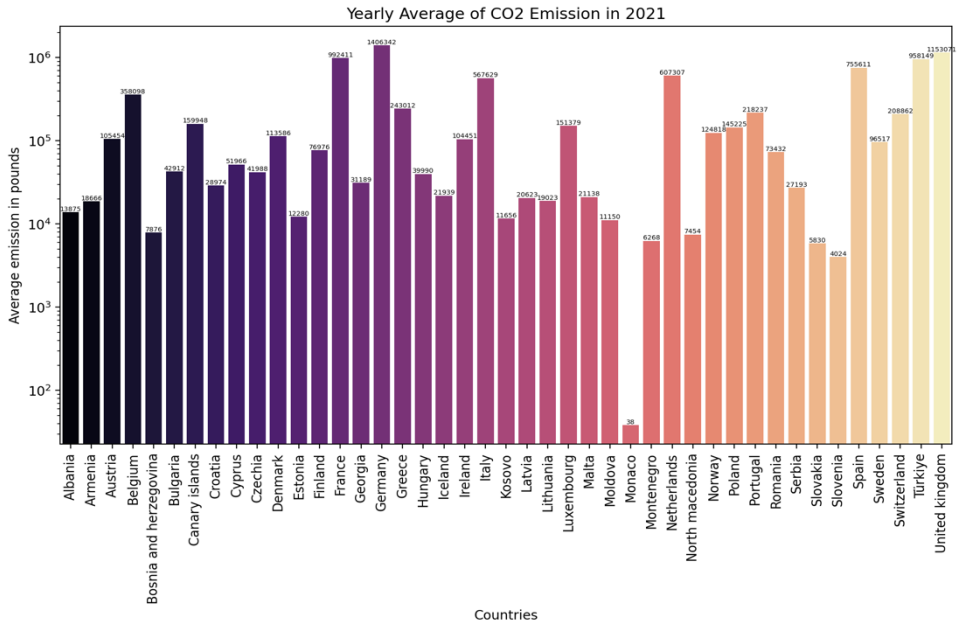

Figure 2: Yearly CO2 Emission from 2021

economic factors influencing each country's carbon footprint and find methods to help from allowing these emission to rise higher and higher each year.

With the growing popularity of air travel, the environmental impact of aviation is becoming increasingly noticeable. From 2020 to 2022, there was a large increase in CO2, a 2.1% increase in emissions (Figures 1-3), from air travel, adding to global warming. If this trend continues, it might have serious repercussions, including ozone depletion and increased production of water vapor, soot, sulfur aerosols, and contrails. The largest emissions are recorded in major European countries such as Germany, France, and the United Kingdom. This is understandable considering the high population density and tourist influx in these countries. Germany, for example, produces significant emissions due to its massive economy and major international airports in Frankfurt and Munich, which are both among the world's busiest. Emissions were reduced in 2020 due to the epidemic, but they increased in 2021 and 2022, especially during the summer when traffic is at its peak. Taking a look at the graph, Germany has had a 1.7% increase in emissions from the start of 2020 to the end of 2022. France: the world's greatest agricultural producer and a major industrial power, has high emissions. Paris and the French countryside are popular tourist sites, making France the most visited country worldwide. Monthly data from 2020 to 2022 (Figure 5) reveal a pattern comparable to Germany's, with higher emissions during the summer. This can be linked to higher tourist and aviation travel during these months. The comparison shows that, while Germany produces larger emissions, factors such as the presence of major international airports have a substantial impact.

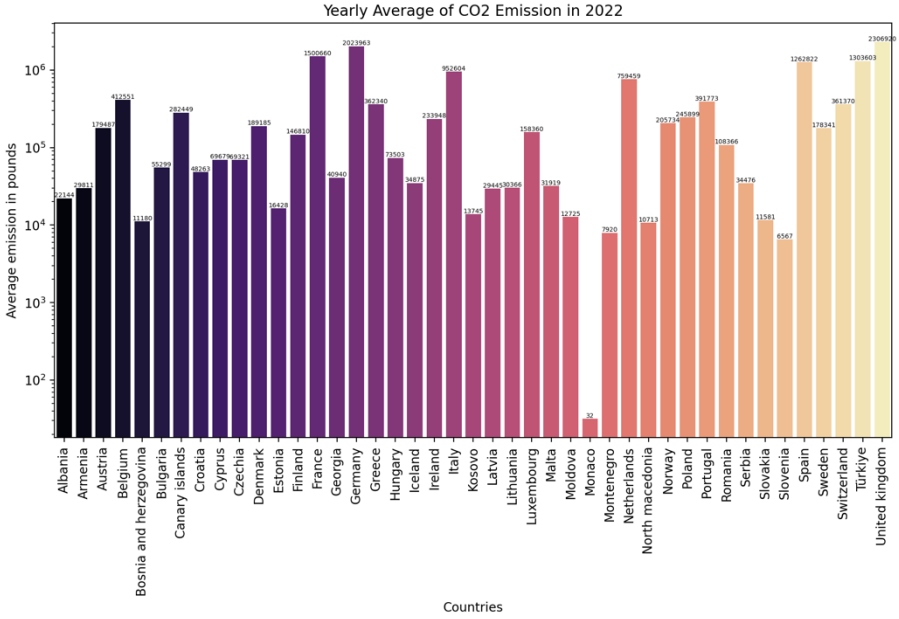

Figure 3: Yearly CO2 Emission from 2022

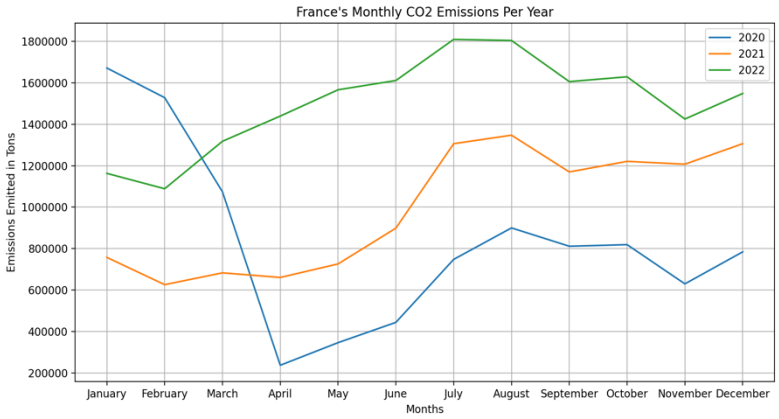

Figure 5: Monthly Breakdown of CO2 for France

Even while the annual emissions in a yearly forecast are relatively high, it is inaccurate to suggest that all European countries are the same because several factors influence the quantity of CO2 produced by each country, including size, infrastructure, and the quality of aviation facilities. Take Albania, for example: while considered a poor country in Europe's southeastern reaches, it is now a somewhat developed country with a stronger economy. With only one major airport in the capital city of Tirana, the Tirana airport is responsible for a significant portion of the country's CO2 emissions. The graph below depicts a monthly breakdown of CO2 emissions in Albania (Figure 5). In 2020, emissions were minimal, as expected, given that a global epidemic was on the rise and the whole population was aware that traveling anywhere would be harmful. In 2021, emissions skyrocketed when the entire world woke up and people resumed their pre-COVID travel habits, and the quantity grew even more in 2022 as more people began to travel again. However, there are some important patterns in the yearly breakdown. In 2021 and 2022, there was a significant increase in the fall, with their being a 4.2% increase in emissions from April to August in 2021 and a 6.7% increase in 2022. This could be due to an increase in tourists, given the weather is pleasant in Albania at that time, and summer vacations are still in effect throughout Europe.

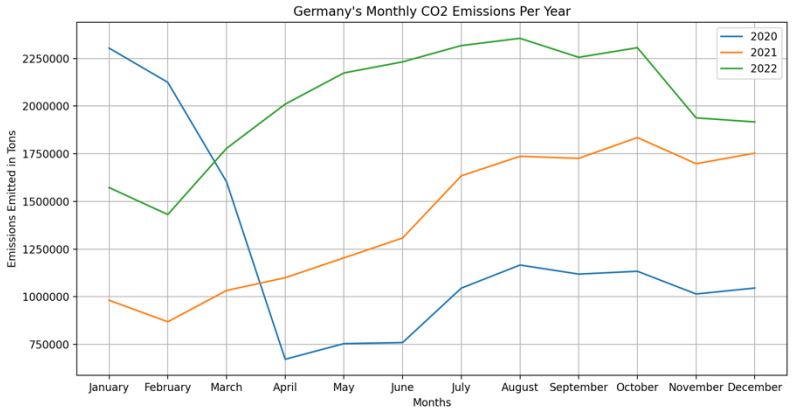

Figure 5: Monthly Breakdown of CO2 for Germany

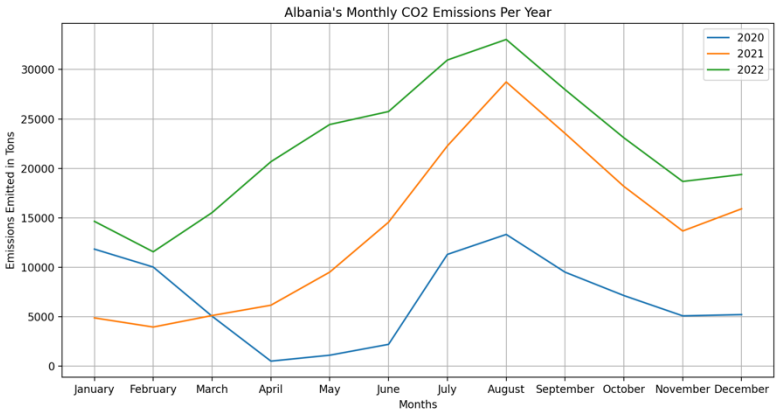

Figure 6: Monthly Breakdown of CO2 for Albania

Based on these three countries, the trends are no different: low emissions during the winter months but a sharp increase in the summer months. How can nations start to lower these emissions and keep a green Earth? Now, luckily, airlines and the nations are realizing the tremendous impact that they have on the world and are now starting to take small steps to help

remedy the damage they did, and this starts with flying new types of aircrafts. 20 years ago, the staple of aviation was the Boeing 747, Boeing 767, MD-11 airplanes. Even though they were engineering marvels and are considered to have revolutionized the aviation industry forever, they also were very fuel inefficient and lead to producing high amounts of CO2. Airlines are now taking the shift to retire these planes slowly and start introducing more fuel-efficient planes such as the Airbus A350, Boeing 787 Dreamliner, Boeing 737 MAX and the Airbus A320 Neo with the latter two being more common in the aviation industry and upcoming for their fuel-efficiency. Along with these measures, the European Union as put in place Emission Trading System (ETS) which in turn require airlines to monitor, report and verify the number of emissions they produce as well as turning in the revenue they create from these emissions to the EU. Along with this, they have implemented a program called the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The purpose of this program was to make the airlines offset their own CO2 production by helping them participate in many activities to promote a greener Earth such as planting trees.

The substantial influence of aviation on global warming is highlighted by the examination of CO_2 emissions from different European nations. Seasonal changes in emissions are most pronounced in countries with large numbers of tourists and international airports, such the UK, France, and Germany, especially in the summer. The opposite is true for countries like Albania, which have less aviation facilities but still see a significant rise in emissions following the pandemic. Efforts to reduce aviation's negative effects on the environment must prioritize the development of more fuel-efficient planes and the implementation of regulation programs like as the European Union's Emission Trading System (ETS), which forces the airlines to pay taxes to the European Union based on the amount of CO2 that they emit, and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which is a program that engages the airline industry in activities to help promote a greener Earth. Achieving substantial reductions in global CO_2 emissions and effectively combating climate change will need persistent efforts and creative solutions.

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