AN OVERVIEW OF FACTORS INFLUENCING CO_2 EMISSIONS IN EU COUNTRIES

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Abstract. *Green gas emissions increased after the Industrial Revolution, which began in 1750. The industrial development of the last period, the high energy consumption, and the increase in the population's standard of living have determined the production of increasingly large amounts of greenhouse gases. Due to the natural disasters encountered in this period, reducing global warming has become the first priority of each country, especially in the European Union. Air pollution has many sources, mainly from industry, transport, energy production, and agriculture. Even though the population and companies use renewable energy sources to reduce carbon dioxide (CO2) emissions, the problem is still stringent. Population growth in urban cities is related to energy, distribution, health, education, and pollution. Air pollution results in various health hazards and also leads to global warming. It can cause cardiovascular and respiratory diseases, as well as cancer, and is the leading environmental cause of premature death in the EU. The present study takes an empirical production-consumption approach and analyses factors like economic growth and renewable energy consumption influencing carbon emissions per capita in 27 European countries. The data covers the period 1990-2020. The limitations and managerial implications, especially for policy actors, are provided at the end of the paper.*

Keywords: *CO_2 emissions per capita; renewable energies consumption; economic growth.*

INTRODUCTION

In challenging times where economic growth is targeted, there is a stringent worldwide need to identify solutions for a sustainable environment. This politics involves the effects of pollution on the environment, energy consumption, and the population's health.

The European Union established the Kyoto Protocol in 1997 with the purpose of reducing carbon emissions . In 2015, the Paris Agreement was adopted to address climate change. European Climate Law from 2021 target was reducing with 55% the carbon emissions by 2030.

Sadik-Zada and Ferrari (2020) argue that more than 50% of the population in OECD countries is worried about climate change's consequences for their livelihoods. Air pollution is a well-known public health hazard. Numerous epidemiological studies have found associations between high concentrations of air pollutants and increased mortality (Chen et al., 2012; Chen et al., 2017; Dehbi et al., 2017; Huang, 2018).

Bowen and Hepburn (2014) find that Colby mentioned “green growth” in 1989 in ‘The Evolution of Paradigms of Environmental Management in Development’. Although it has been more than 33 years, researchers recently manifested interest in the problem. Since 1994 (Barde, 1994), air pollution taxes have been paid in many countries, including France, Sweden, and the Netherlands.

Certain substances such as arsenic, cadmium, nickel, and polycyclic aromatic hydrocarbons are genotoxic human carcinogens, and no thresholds can be identified below that do not pose risks. Air pollution also hurts water and soil quality and damages ecosystems, for example, through eutrophication (excess nitrogen pollution) and acid rain. Therefore, agriculture, forests, materials, and buildings are affected.

CO2 emissions from human activities increase global warming, and temperature changes decrease agriculture production (Yoro and Daramola, 2020).

Air pollutants are divided into sulfur dioxide (SO2), carbon monoxide, Lead (Pb), and other toxic metals cadmium (Cd), arsenic (As), nickel (Ni), and mercury (Hg), Benzene (C6H6), Nitrogen oxides (NOx/NO2), and Ozone (O3).

Volcanic eruptions, marine phytoplankton, bacterial fermentation in swampy areas, and the oxidation of sulfur gas resulting from the decomposition of biomass are natural sources that lead to the appearance of sulfur dioxide (SO2). Sulfur dioxide visibly affects many species of plants, with a negative effect on their structure and tissues noticeable to the naked eye.

Some of the most sensitive plants are pine, vegetables, red and black acorns, white ash, alfalfa, and blackberries. It contributes to the acidification of precipitation in the atmosphere, with toxic effects on vegetation and soil. The incomplete combustion of fossil fuels mainly forms carbon monoxide. This toxic gas is lethal (at concentrations of about 100 mg/m3) because it reduces the oxygen transport capacity in the blood. This has consequences for the respiratory and cardiovascular systems.

Greenhouse gasses such as CO2, CH4 and N2O occur as a result of agricultural activities (Doğan, H.G., Kan, 2023) and can also be found in agriculture in the fertilizers of soil and irrigation process (Chataut et al. 2023). Toxic metals come from the combustion of coals, fuels, household waste, etc., and from specific industrial processes. They are generally found in the form of particles (except for mercury, which is gaseous). Metals accumulate in the body and cause short-term and long-term toxic effects. In case of exposure to high concentrations, they can affect the nervous system, kidney, liver, and respiratory functions. 90% of benzene in ambient air comes from road traffic. Nitrogen oxides are responsible for acid rain affecting the earth's surface and the aquatic ecosystem.

There are different factors affecting the high level of carbon emissions relating to human activities: economic growth (Onofrei et al., 2022; Fávero et al., 2022; Yılmaz and Şensoy, 2022); human capital level (Yao et al. 2020; Mahmood et al. 2019); urbanization (Sufyanullah et al., 2022; Nayaga et al., 2022).

It is well-documented that renewable energy consumption decreases carbon emissions (Chen et al., 2022).

On a panel date in Brazil, India, China, and South Africa, Adedoyin et al. (2020) show that coal rents negatively impact CO_2 emissions.

MATERIAL AND METHODS

The present research used annual data from 1990 to 2020 (World Bank statistics) to analyze carbon emissions in metric tons per capita, focusing on 20 countries. These data were extracted from the World Development Indicators (World Bank).

To convey the biggest polluters in the EU countries, we draw an image of 2019, but CO2 emissions are shown as kt from each country.

After that, we analysed two main factors influencing CO2 emissions per capita: economic growth rate per capita and renewable energy consumption.

We coded the variables as it follows:

- EN.ATM.CO2E.PC refers to CO2 emissions (metric tons per capita);

- NY.GDP.PCAP.KD.ZG refers to GDP per capita growth (annual %);
- EG.FEC.RNEW.ZS refers to renewable energy consumption (% of total final energy consumption.

RESULTS AND DISCUSSION

Figure 1 shows CO2 emissions (kt) in 27 UE countries for 2019, before the lockdown of COVID-19. Germany, Italy, France and Poland are the highest polluters, while Malta and Cyprus pollute less.

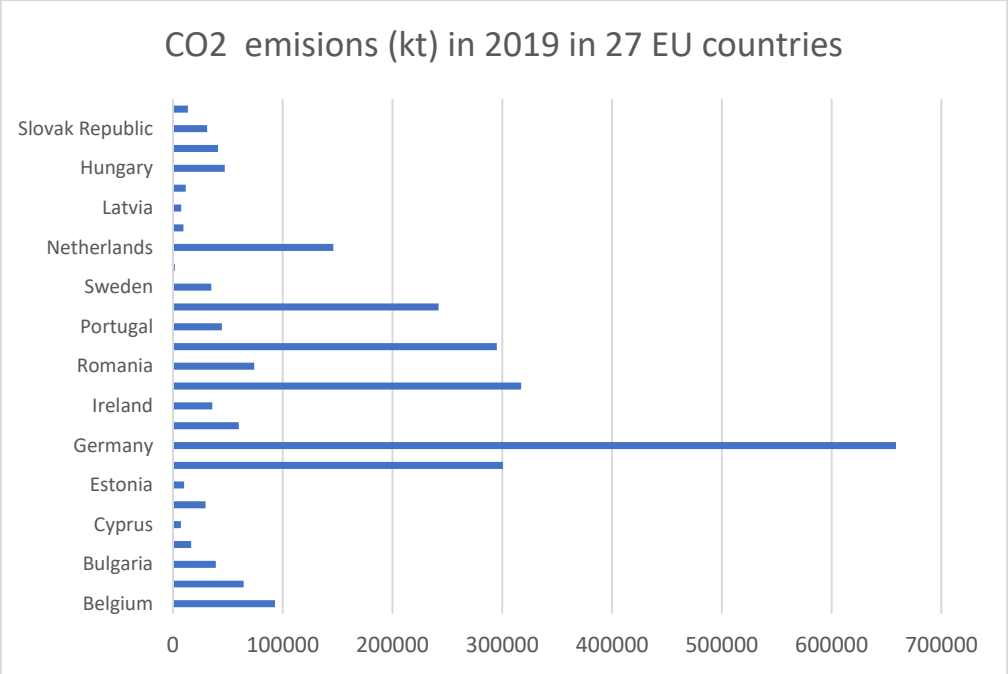

Fig. 1. CO2 emissions (kt) in European countries in 2019

In 2019, Romania registered higher carbon emissions (kt) than Bulgaria and Hungary. Romania does not have a climate framework legislation, and the institutional capacity for environmental management is low. The population does not use public transport, and the number of cars driven has increased (OECD, 2024).

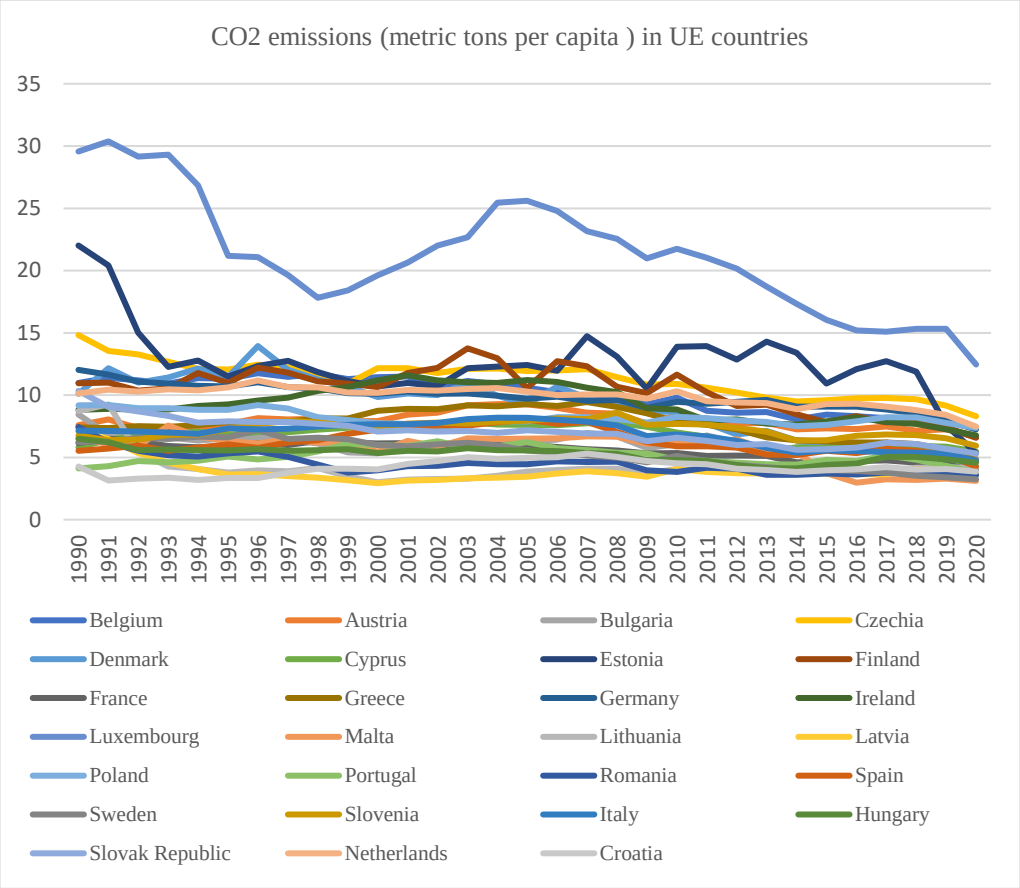

Fig. 2. CO2 emissions (metric tons per capita) in European countries in the period 1990- 2020

Figure 2 shows CO2 emissions (metric tons per capita) in 27 UE countries from 1990 to 2020.

Luxemburg, followed by Estonia, registered the highest CO2 emissions per capita in the period analysed, while Latvia and Lithuania registered the lowest levels.

In 2019 and 2020, Romania registered lower levels of CO2 emissions per capita.

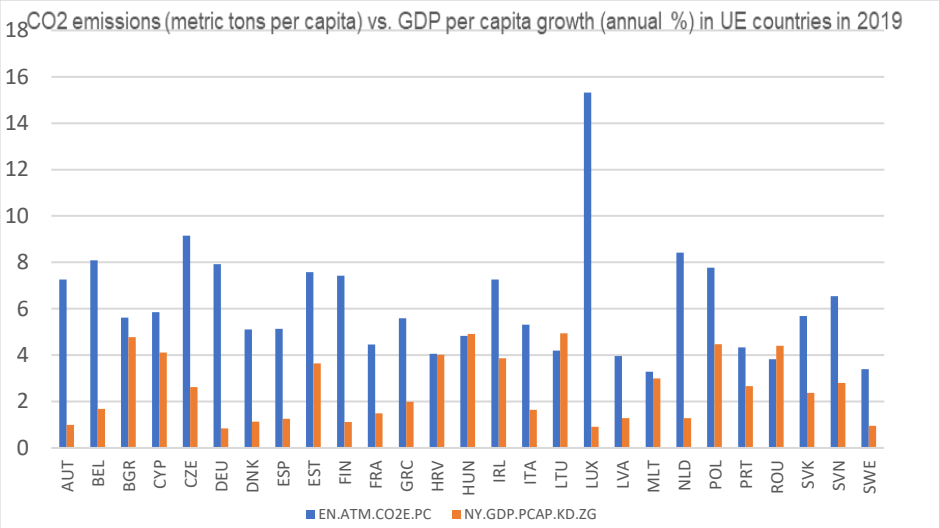

Fig. 3. A comparative analysis of CO2 emissions (metric tons per capita) vs. GDP per capita growth (annual %) in UE countries in 2019

Figure 3 highlights that in 2019, the highest CO2 emissions (metric tons per capita) were registered in Luxemburg, which has a lower GDP per capita growth (annual %), followed by Czechia. Meanwhile, Lithuania, Romania, and Hungary are examples of the fact that economic growth does influence the level of CO2. These results show that economic growth surpasses the level of CO2 emissions.

Our research, by Dong et al. (2018), demonstrates that economic growth increases carbon emissions per capita.

The table above shows that in 2019, economic growth influenced CO2 emissions per capita in 13 out of 27 countries.

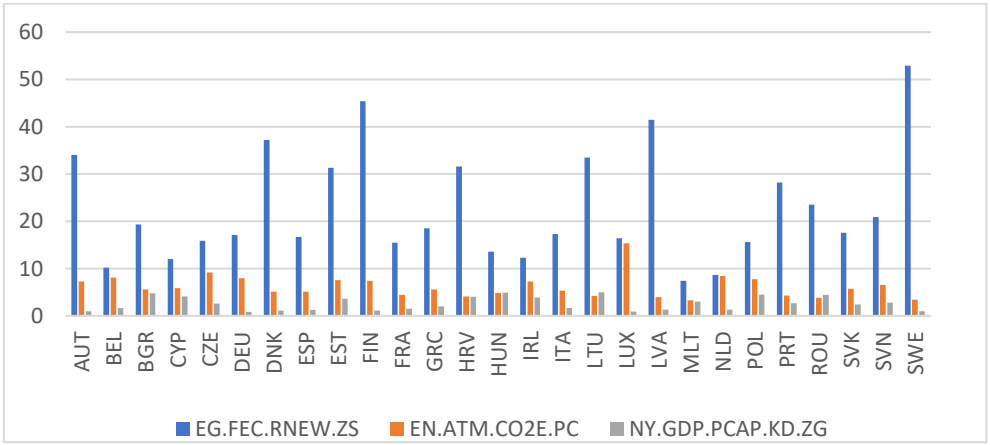

Fig. 4. The influence of economic growth and renewable energies on CO2 per capita in 2019

Fig. 4 presents the main empirical results relating GRD per capita (NY.GDP.PCAP.KD.ZG), renewable energy consumption (%) of total final energy consumption (EG.FEC.RNEW.ZS) and CO2 emissions per capita (EN.ATM.CO2E.PC).

As we can see, Sweden, Latvia, Finland, Denmark, and Austria are the countries using renewable energies.

First, we notice that the impact of economic growth on carbon emissions per capita is significant in most countries and does increase the level of CO2 emissions in line with previous studies (e.g. Albulescu et al., 2020; Chen et al., 2019; Inglesi-Lotz and Dogan, 2018; Sinha and Shahbaz, 2018).

Second, figure 4 demonstrates the positive impact of using renewable energies on the level of CO2 emissions per capita. Mundaca et al. (2015) underlined that mitigation policies immediately decreased the carbon level in Sweden, targeting for 2050 a country with zero emissions.

Finland is a well-known leader in environmental strategies where air quality is excellent. The country implements many environmental awareness campaigns, and the green industries are expanding. In education programs, ecological competence is integrated into each job (OECD, 2021).

Different innovative tools are developed to capture CO2 emissions and transform them into car fuel (Attia et al., 2020). Plank et al. (2021) highlight that climate policy integration is crucial in establishing economic strategies for a European country.

CONCLUSIONS

CO2, N2O, and CH4 are the most harmful green gases, impacting climate change and individual health. The indicators analysed in this research are intuitive, reflecting information trends of carbon emissions, economic growth, and usage of renewable energies in some European countries. In 2019, Sweden, Finland, and Latvia were the leaders in using renewable energies before the breakdown of COVID-19, with low carbon emissions.

During 2013-2019, Romania's CO2 emissions per capita increased, while GDP per capita annual growth fluctuated, and renewable energy consumption slightly increased. In 2019, only 23,3% of Romanians used renewable energy sources, similar to Bulgaria, with 19,3%, and Slovenia, with 20,9%.

Romania should learn from the environmental politics of countries like Sweden and Finland to reduce carbon emissions. Policymakers should implement environmental competencies into each university's educational curriculum. Awareness campaigns regarding the usage of renewable energies should be organized, and green travel should be promoted. The national carbon tax is among the lowest in Europe.

Another political measure that could be efficient is to increase the absorption of European funding focusing on green energy. Policymakers should promote renewable-based hydrogen and adapt the legislation to green sources.

In Romania, the legislation stipulates 6.5 years for an onshore wind permit, above the level specified by the European Union Directive. The legislative context has to be adaptive regarding the licensing process in different types of green energy sources.

Further studies should focus on environmental regulations' impact on European countries' carbon emissions.

The research's limitation is that the data is presented from an empirical point of view, and further statistical analyses should be run to test the correlation between the three indicators used in the empirical research.

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