

The Determinants of Greenhouse Gas Emissions (GHE) in European Economies

Lavinia Maria ILOIE *

Politehnica University Timisoara, Timisoara, Romania

**Corresponding author, lavinia.iloie@upt.ro*

Claudiu-Tiberiu ALBULESCU

Politehnica University Timisoara, Timisoara, Romania

claudiu.albulescu@upt.ro

Anca DRAGHICI

Politehnica University Timisoara, Timisoara, Romania

anca.draghici@upt.ro

Abstract. *The European Commission targets to achieve zero gas emissions by 2050. However, there is no single element or policy that allows us to achieve this target. Greenhouse emissions (GHE) are largely influenced by economic dynamics and energy use, as well as strategic positioning of businesses and technological advancement in renewable energy consumption. Against this background, our research aims to analyze the influence of foreign direct investment, renewable energy and economic growth on greenhouse gas emissions and how important and statistically significant these influences are. The paper analyses the determinants of the decrease in gas emissions in European economies over the period 1990-2023. In a quantitative panel data analysis, we examined the impact of renewable energy, labor force, gross domestic product growth per capita, and foreign investment inflows on greenhouse gas emissions. The Pooled Ordinary Least Squares method, with fixed and random effects, was used in our empirical analysis. The study's findings suggest that economic growth continues to be a significant contributor to emissions. The use of green energies influences the decrease of greenhouse gas emissions. More precisely, 1% increase in the use of green energy results in a 0.19% annual reduction in greenhouse gas emissions. To better understand the results reported for the group of EU countries, gas emissions in Romania are analyzed as a case study. In 2023, Romania was one of the top EU members in terms of renewable energy integration and used more than 33% green sources in its total energy consumption.*

Keywords: Greenhouse gas emissions (GHE), green energy consumption, foreign investment, sustainable strategies.

Introduction

Recent industrial development, high energy consumption, and rising living standards are driving the production of ever-increasing greenhouse gas emissions (GHE). The atmosphere is composed mostly of nitrogen and oxygen, but also of argon, carbon dioxide, hydrogen or helium. Some gases are harmless, but some are dangerous for human activity, such as ammonia, carbon monoxide (CO), sulfur dioxide, ozone (O₃), and methane (CH₄). The natural balance of atmospheric gases, which has been maintained within some limits, is now threatened by inhabitants and companies. The risks involve acid rain, climate heating, and atmospheric pollution. Environmental pollution has reached worrying proportions and encompasses a range of issues. Atmospheric pollution has increased the planet's average temperature by half a degree.

In the last decades, due to the growth of global consumption, it has become a pressing necessity to develop solutions that maintain sustainability. All sides of the effects of pollution on the habitat and public well-being should be integrated into programs, especially at the European level.

Sources of air pollution can be fixed or mobile. Fixed sources include industrial and household combustion devices that emit dust, carbon oxides, sulfur oxides, nitrogen oxides, and other pollutants; the lower the fuel quality, the less efficient the combustion and the greater the number of pollutants released. Thus, lower-grade coals (lignite, brown coal, peat, bituminous shale) leave large amounts of ash, carbon dioxide, and carbon monoxide during combustion; industrial facilities in chemistry, metallurgy, construction materials, etc., release oxides of Fe, Mn, Cr, Ni, Zn, Pb, Cd, Cu, CO₂, C; volcanoes and stagnant waters (ponds, swamps) emit various gases and vapors; - Residues of any origin, spread on the ground, as well as decaying animals and plants, also constitute fixed sources of air pollution.

The dispersal of pollutants is always influenced by air movement driven by temperature differences between adjacent regions. Since temperature drops with altitude, when cold air is trapped beneath warm air, a temperature inversion occurs, causing pollutants to accumulate on the Earth's surface and become much more harmful to human health. Along with this phenomenon, the ozone layer is also being destroyed, which helps filter harmful ultraviolet radiation from the Sun; When these rays are not blocked, the greenhouse effect occurs, increasing the planet's average temperature, with carbon dioxide being the primary contributor. Therefore, in such an atmosphere, the concentration of pollutants is uniform in all directions, regardless of the particle's position within the atmospheric mass, and the temperature is equal to that of the atmosphere; thus, the dispersal and transport of pollutants are not affected.

Carbon dioxide (CO₂) and methane (CH₄) are the two most negatively impacting gases on to climate warming and human well-being. The indicators analyzed in the study are intuitive, reflecting trends in information on global warming gases, GDP growth, and the use of green energies in European economies. Particulate matter is made up of a mixture of solid particles and liquid particles.

Although particle matter PM₁₀ (having a diameter of 10 µm or less) comes from natural sources, it also includes dust from construction, agriculture, as well as waste burning, industrial sources, wind-blown dust in open fields, and even pollen or bacterial fragments. Particle matter PM_{2.5} comes mainly from the combustion of solid fuels, household heating, industry, and transportation. Different emission sources and chemical compositions contribute to the presence of both PM₁₀ and PM_{2.5} particle matter. In addition, the transport sector is a significant source of air pollution worldwide, but is documented about the implication of transport infrastructure on air quality. In the centres of some European cities, 24% of atmospheric air pollution originates from road transport. As a result of the long-distance transfer of PM₁₀, which also comes from road transport, an additional 17% of particulate pollution is formed (Iorga, 2016).

Furthermore, studies conducted in 2024 by the European Environment Agency show that the biggest challenge is reducing ammonia (NH₃) emissions. Meanwhile, 25 countries reduced sulphur dioxide (SO₂) emissions (EEA, 2025). According to Eurostat in 2021, Bulgaria was the "leader" in atmospheric air pollution with PM₁₀ and PM_{2.5} particles. The increase in industrial activities and vehicle emissions in cities is the primary cause of air pollution.

Today, in urban environments, people suffer from many health problems due to air pollution. Human health requires clean air. Today, several diseases are caused by air pollution. The deaths observed around the world are due to air pollution. In Romania, efforts to reduce air

pollution through control measures and lower pollutant levels have led to significant improvements in air quality. With the increase in air pollution, studies have found an increase in morbidity and mortality from all natural causes. In the city, air pollution can be reduced through various measures identified in recent years. However, to further reduce air pollution, more efforts are needed.

In this context, *the research aims to analyze the influence of foreign direct investment, renewable energy and economic growth on GHE and how important and statistically significant these influences are at the EU level.* To better understand the implications of our findings, we consider Romania as a case study. The importance of the subject and the research approach have been underlined by Jianu et al. (2022) and Gibba (2024) too. The novelty of the presented approach lies in its focus on total GHE, whereas most previous works have analyzed the determinants of carbon emissions.

Literature review

The exposure to air pollutants and life expectancy are strongly correlated variables. GHE have a significant impact on life expectancy at 65 years of age, as supported by previous research by (Meghisan & Toma, 2017). PM_{10} concentrations below $100 \mu g/m^3$, taken as a daily average, influence the mortality rate, as well as the number of hospitalizations due to respiratory diseases, heart diseases, etc., related to population health. Several authors have reported the primary effects of PM_{10} and $PM_{2.5}$ particle matter on population health (Chai et al., 2022). Furthermore, the results of the Maciejewska (2020) research demonstrated a 0,7% increase for each $10 \mu g/m^3$ related to $PM_{2.5}$ caused premature deaths in Poland. A European study on Central-Eastern economies found that reducing PM_{10} levels to $20 \mu g/m^3$ could prevent dozens of post-neonatal deaths and respiratory illness among children (Páldy et al., 2006).

Other studies reveal that various factors influence GHE, including foreign direct investment (FDI) (Iamsiraro, 2016; Lin et al., 2023), economic growth (Giba et al., 2024), population density (Petre et al., 2025), and human activity (Yao et al., 2020; Mahmood et al., 2020). The link between economic growth, pollution, and foreign investment is explained by different models such as the Environmental Kuznets Curve (EKC), the Pollution Haven Hypothesis, the Halo Pollution Hypothesis, and the Triple Bottom Line. The EKC suggests that the initial phase of economic expansion generates more pollution. However, after a certain point, because of the adoption of clean technologies and environmental regulations, the rate of decrease slows. In this way, the inverted U-shaped curve is created (Abassi et al., 2023). The Pollution Haven Hypothesis explains the situation of countries with weaker environmental protection rules that attract foreign investments to target economic growth. In other words, international companies move their production to countries with a more relaxed system regarding pollution (Bagchi & Sahu, 2025). The 3Ps Framework of Sustainability (known as the Triple Bottom Line, TBL model) is used to express an equilibrium among People, Planet, and Profit in sustainability (Elkington, 1997).

Furthermore, generating profit by attracting foreign investments should not come at the expense of harming the habitat or affecting the health of people. However, increasing foreign direct investments in an economy also brings green technologies and strategies to reduce greenhouse gases, creating the Halo effect (Pilatin et al., 2025). In a study covering 12 countries that produce and export large amounts of oil over the period 1983-2022, Gibba (2024) shows that for every 1% increase in GDP growth, GHE increases by approximately 7.47%, while foreign investments have no impact. Studies have shown that economic growth and foreign investment can accelerate GHE (Lin et al., 2023; Yao et al., 2020).

Furthermore, Jianu et al. (2022), analyzing 27 European countries between 2010 and 2019, found that final consumption of households per capita, GDP per capita, and waste generation

increase air pollution. The share of renewable energy helps to decrease GHE slightly. Moreover, for example, Apergis et al. (2022) demonstrated, using a dataset of 19 developed economies, that renewable energy consumption is associated with reduced GHE. Studying 163 countries by dividing them into five groups according to their income dynamics from 2000 to 2019, Dharmapriya (2025) shows that economic growth is positively associated with higher emissions, mainly in high-income countries where the reliance on fossil fuels is high.

Based on existing studies (and the arguments provided by different authors on the determinants of GHE in different European economies), the following hypotheses were elaborated and tested.

H1: Renewable energy consumption hurts GHE.

H2: Economic growth has a positive impact on GHE.

H3: Foreign direct investment has either a negative or a positive impact on GHE.

Methodology

Research design and sample size

The data set used in the present investigation consists of four variables collected from the World Bank, covering all 27 European economies and spanning the period 1990 to 2023.

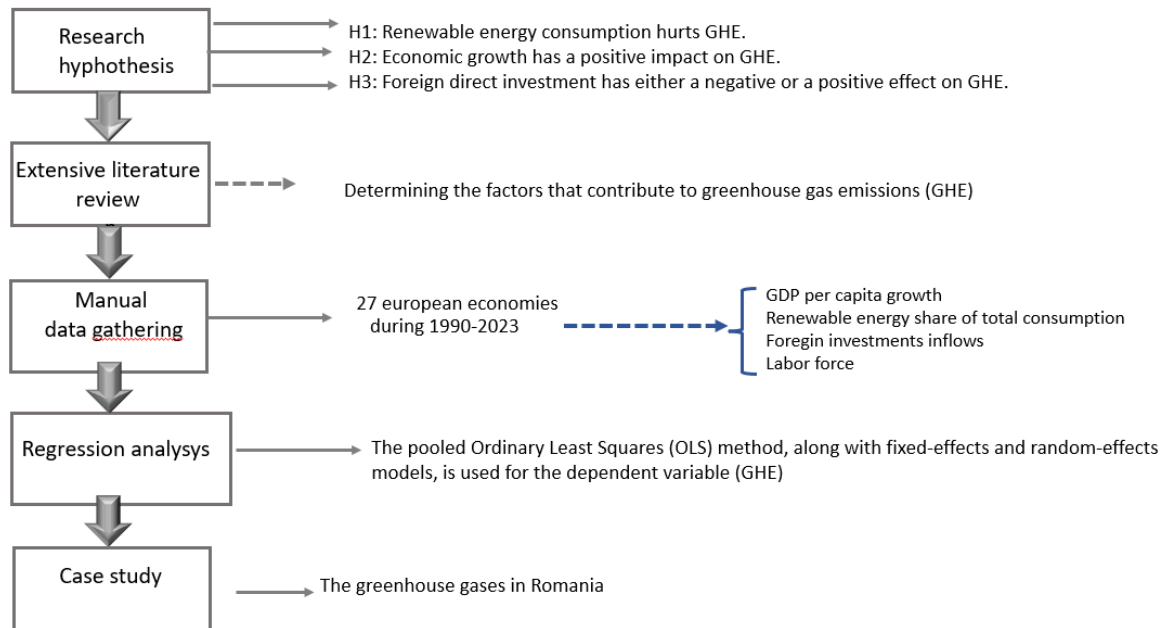


Figure 1. The methodological framework

Source: Authors' own development.

Data collection

The dependent variable considered in the research is GHE, while the independent variables are economic growth (GDP per capita growth), foreign direct investment, and the share of renewable energy consumption. The labor force is used as a control variable.

In line with the approach presented by (Albulescu et al., 2020), the general mathematical equation for the fixed effects is the following:

$$Y_{i,t} = \beta_0 + \beta_1 A_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

where Y_{it} is the dependent variable (GHEs for the country i at time t);
 β_0 - the intercept;
 β_1 - the coefficient;
 α_i - all the stable characteristics of countries;
 A_{it} - the independent variables for country i at time t ;
 ε_{it} - the error term.

The estimated econometric model will be as follows:

$$d(ghg) = c + \alpha * d(rnw) + \beta * d(eg) + \lambda * d(fdi) + \delta * d(lf_lg) + \varepsilon \quad (2)$$

where $d(ghg)$ is the GHEs in the first difference level;

$d(rnw)$ - the use of renewable energy consumption;

$d(eg)$ - the economic growth per capita;

$d(fdi)$ - foreign investments;

$d(lf_lg)$ - the labor force in logarithms;

$\alpha, \beta, \lambda, \delta$ - coefficients;

c - the intercept.

ε - the random error.

The Pooled Ordinary Least Squares method with fixed and random effects was used to analyze the data. Meanwhile, gas emissions, economic growth, and renewable energy transitions unfold gradually.

The data was tested for stationarity, and subsequently, given the lack of stationarity, all variables are used in first generation unit root. For the cross-sectional analysis, we employed a stepwise approach, where each variable was added to the models progressively.

Results and discussions

The factors influencing the GHE at the European level

Figure 2 presents the trend of air pollutants emissions in the 27 countries from the European Union, by outlining the long-term trends and cycle progress toward the EU's climate targets (particularly under the European Green Deal) while the short-term cycles indicate fluctuations caused by economic activity, energy demand, and policy changes between 1990 and 2023.

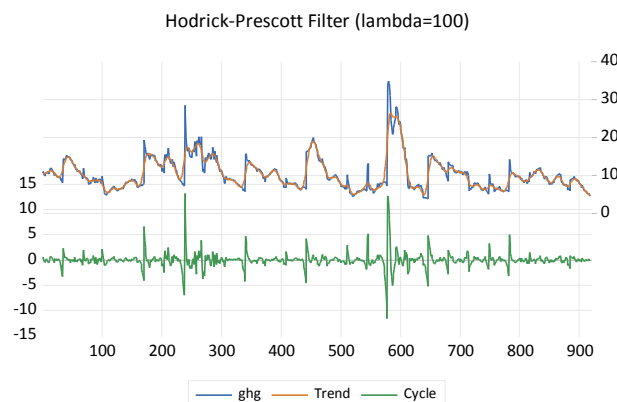


Figure 2. Trend of GHE in EU (1990-2023)

Source: Authors' own research results.

In the 1990s, greenhouse gas emission levels were high, outlining an economy based on fossil fuels. In the period 2005-2009, the trend began to decrease notably, as a reflection of

European climate policies adopted (the Kyoto Protocol, and later the Paris Agreement). After 2019, the trend decreased, indicating a use of green sources for an increased energy efficiency. The long-term trend reveals a more pronounced reduction in pollutant emissions in the European Union after 2010, when member states implemented all measures to enforce energy efficiency regulations.

Table 1. Panel data analysis

d(GHE)	Model I.1 <i>Random Effects</i>	Model I.2 <i>Random Effects</i>	Model II.1 <i>Fixed Effects</i>	Model II.2 <i>Fixed Effects</i>
<i>c</i>	-0.044	-0.013	-0.018	-0.022
<i>d(rnw)</i>	-0.191***	-0.175***	-0.173***	-0.173***
<i>d(eg)</i>	0.030***	0.029***	0.028***	0.028***
<i>d(fdi)</i>		8.25E-05	8.25E-05	7.29E-05
<i>d(lf lg)</i>		-2.158		1.753
Note: ***, **, * means significance at 99%, 95% and 90% respectively. <i>d(rnw)</i> -renewable energy use in first generation unit root <i>d(eg)</i> - economic growth in first generation unit root <i>d(fdi)</i> - foreign direct investments in first generation unit root <i>d(lf lg)</i> - labor force in logarithm in first generation unit root				

Source: Authors' own research results.

Firstly, from the data analysis, it has been observed that the use of green energy has a notably adverse impact on gas emissions, suggesting that energy transition may have a positive environmental effect; 1% increase in the share of renewable energy use results in a 0.19% annual decreasing in greenhouse pollutants. The first hypothesis is supported at a 99% confidence level. Secondly, the effect of economic growth on gas atmospheric release is considerable, in line with previous studies (Dharmapriya, 2025). We conclude that the second hypothesis is supported with a confidence level of 99%.

In accordance with previous studies (Albulescu et al., 2022; Onofrei et al., 2022), the variation in GDP (economic growth) has a positive effect among the four models, suggesting that, in the short term, economic activity expansion leads to an increase in emissions.

Thirdly, we find that the third hypothesis is not supported in line with Albulescu et al. (2022). Our data did not validate either the Halo Pollution Hypothesis or the Pollution Haven Hypothesis. The active labor force (used as a proxy for the country's size) has no significant impact on GHE.

The GHE situation in Romania

To better understand the composition of greenhouse gases, a case study was conducted on the situation in Romania.

Figure 3 shows the overall trend in emissions of the primary pollutants: sulfur oxides (SO_x), nitrogen oxides (NO_x), PM₁₀ and PM_{2.5}, and carbon dioxide (CO₂) in Romania between 1990 and 2018. On one hand, the most significant variation is observed for SO₂, which ranged from 828 kt/year in 1990 to less than 100 kt/year in 2018. Before 2007, sulfur dioxide (SO₂) levels fluctuated: between 1996 and 1999, they decreased, whereas between 2000 and 2003, emissions increased. Since 2008, SO₂ emissions have dropped dramatically. This was mainly due to the use of low-sulfur fuels and the regulatory obligation regarding the maximum fuel content in diesel/motor transport, too. NO₂ emissions decreased by 47% from 1990 and by 31% from 2005, mainly due to the adoption of the climate mitigation program and a decrease in liquid fuel consumption. The trend reflects several factors: economic growth in Romania between 2002 and 2008, prior to the worldwide financial

collapse, which triggered a decline in industrial production, as well as a decrease in energy production at power plants. PM_{2.5} has the highest value during the period analyzed.

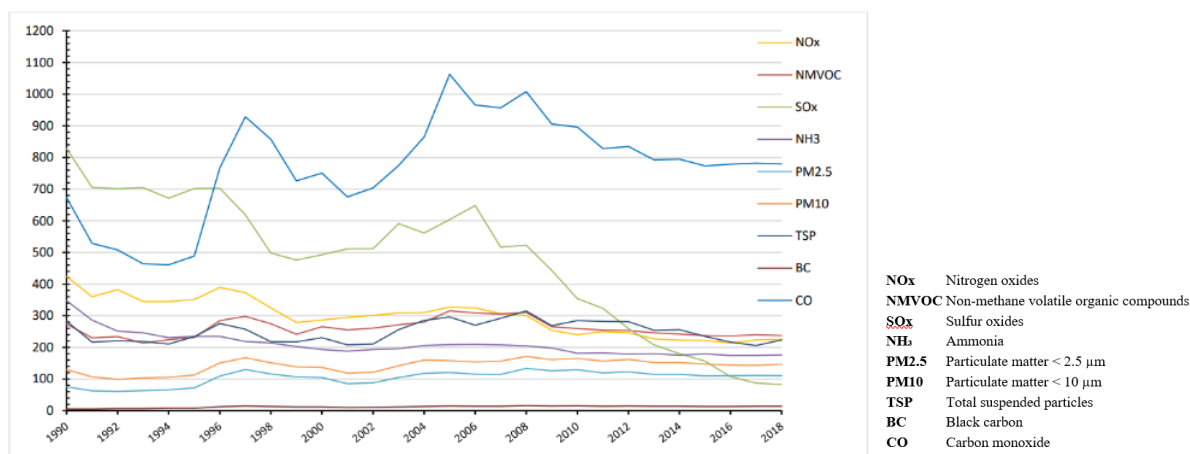


Figure 3. The evolution of the primary air pollutants in Romania during the period 1990-2018

Source: <https://www.eea.europa.eu/data-and-maps/dashboards/air-pollutant-emissions-data-viewer>.

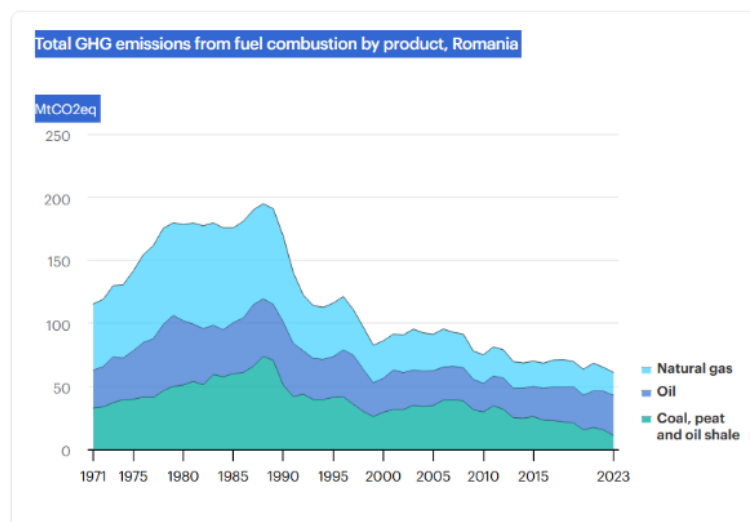


Figure 4. Fuel Combustion by Energy Source in Romania

Source: <https://www.iea.org/countries/Romania>.

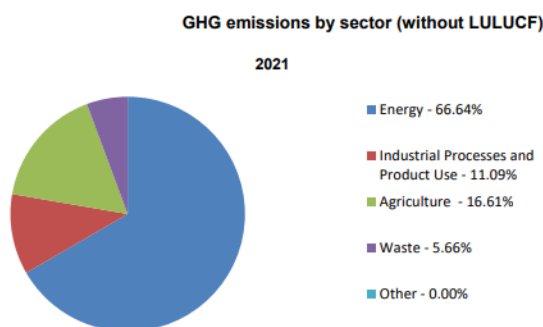


Figure 5. Sectoral CO₂ Emissions from Fuel

Source: <https://www.iea.org/countries/Romania>.

Figures 4 and 5 present the source of the fuel combustion in Romania as well as the main sectors. It can be observed that in 2021, the primary sector with the highest level of gas emissions was the energy sector, followed by agriculture. The primary source of pollution is oil. Since 2006, the idea of environmentally sustainable growth has been included in the Strategy for Enlarged Europe. In 2016, through Government Decision No. 739/2016, the National Strategy on Climate Change and Low-Carbon Economic Growth for the period 2016–2020, along with the National Action Plan for implementing the National Strategy on Climate Change and Low-Carbon Economic Growth for the same period, were approved. Adopted in 2008 at the legislative level, the National Strategy for Sustainable Development 2013-2020-2030 has 17 objectives.

According to the National Strategy for Sustainable Development 2030, the target set for the year 2030 regarding Objective 13 (Climate Action) is: to enhance shift to green' economy, reduce gas emissions. The target set for 2030 is to boost the use of green energy sources and reduce considerably the use of carbon fuels in the transport sector (by adopting electric vehicles. In 2023, renewables accounted for 33% of Romania's total electricity generation and approximately 25% of its total final energy consumption, positioning the country among the top EU members in terms of renewable integration.

By analyzing the situation in Romania, we find that the agricultural and energy sectors should utilize more renewable energy sources.

Conclusion

Reducing air pollution is the European Union's main priority, and substantial grants are allocated to address the analyzed macroeconomic issues through different national programs. The Green Deal has the objective to attain carbon neutrality by 2050, increase the share of green energies in total energy consumption to at least 42.5%, and reduce transport emissions by 90% by 2050.

The econometric model outlines an inverse relationship between changes in the share of renewable energy and variations in GHE. This result confirms the hypothesis that the expansion of green sources contributes to decouple economic growth from pollution. At the same time, the positive effect of economic growth on gas emissions shows that economic development, without investments in green energy, continues to exert pressure on the environment. Foreign direct investments do not have any influence on gas emissions.

In Romania, particle matter PM_{2.5} has the highest value during the period 1990-2018 and is a leading cause of premature deaths. The primary sector with the highest level of GHE is energy, followed by agriculture.

The study also has some policy implications. The transition to green energy sources can boost the quality of air, hinder pulmonary illnesses, and maintain individual health, especially in densely inhabited or industrialized places. Green policy strategies lead to the creation of inclusive job opportunities in the renewable sector. Decision-makers should promote the use of green energy among residents and businesses.

The research presents some limitations regarding the number of variables examined in the sample, only the long-time effects are captured. Another limitation is regarding the Pooled Ordinary Least Squares with fixed and random effects, which provides a linear interpretation of GHE. In addition, this approach does not allow the treatment of endogeneity bias that can influence our results. However, given the small number of observations included in our sample, the approach is recommended for a primary analysis.

Meanwhile the methodological approach adopted assumes that the effect of each variable is uniform for all countries. The relationship between energy use, economic growth, and

greenhouse gas emissions is likely heterogeneous across economies. In developed economies the use of renewable energy exerts a more pronounced impact in reducing GHE rather than in developing economies, which promote more flexible environmental regulations for industry.

Further studies should incorporate more variables into the research, such as industrial influence, environmental regulations, urbanization. Another direction could be the correlation between premature deaths and respiratory diseases with GHE.

References

- Abbasi, K., Ali, P., Barbour, V., Benfield, T., Bibbins-Domingo, K., Hancocks, S., & Zielinski, C. (2023). Time to treat the climate and nature crisis as one indivisible global health emergency. *Current Climate Change Reports*, 9(3), 41–44. <https://doi.org/10.1007/s40641-023-00191-3>
- Albulescu, C. T., Artene, A. E., Luminosu, C. T., & Tamasila, M. (2020). CO₂ emissions, renewable energy production, and environmental regulation in the EU countries. *Environmental Science and Pollution Research*, 27, 33615–33635.
- Apergis, N., Payne, J. E., Menyah, K., & Wolde-Rufael, Y. (2022). On the causal dynamics between emissions, nuclear energy, renewable energy, and economic growth. *Ecological Economics*, 69, 2255–2260.
- Bagchi, P., & Sahu, S. K. (2025). The conundrum of Porter hypothesis, pollution haven hypothesis, and pollution halo hypothesis: Evidence from the Indian manufacturing sector. *Clean Technologies and Environmental Policy*, 27(1), 205–217. <https://doi.org/10.1007/s10098-024-02886-z>
- Chai, G., Guo, J., Song, X., Li, Z., Hui, X., Feng, X., & Yang, K. (2022). The chronic effects of particulate matter (PM_{2.5}, PM₁₀ and PM₁) on the morbidity and mortality of cardiovascular and respiratory diseases in LMICs: A systematic review and meta-analysis [preprint] DOI: <https://doi.org/10.21203/rs.3.rs-1137443/v1>
- Dharmapriya, N., Gunawardena, V., Methmini, D., Jayathilaka, R., & Rathnayake, N. (2025). Carbon emissions across income groups: exploring the role of trade, energy use, and economic growth. *Discover Sustainability*, 6(1), 621. <https://doi.org/10.1007/s43621-025-01261-2>
- Elkington, J. (1997). *Cannibals with forks: The triple bottom line of 21st century business*. Oxford: Capstone Publishing.
- European Topic Centre on Human Health and the Environment. (2024). *Status report of air quality in Europe for the year 2023, using validated data (ETC/HE Report 2024/1)*. European Environment Agency. Retrieved from <https://www.eionet.europa.eu/etc/etc-he/products/etc-he-products/etc-he-reports/etc-he-report-2024-1-status-report-of-air-quality-in-europe-for-year-2023-using-validated-data>
- European Environment Agency. (2024). *Air quality status report 2025*. Retrieved from <https://www.eea.europa.eu/en/analysis/publications/air-quality-status-report-2025>
- European Environment Agency. Air pollutant emissions data viewer (Gothenburg Protocol, LRTAP Convention). Retrieved from <https://www.eea.europa.eu/data-and-maps/dashboards/air-pollutant-emissions-data-viewer>
- Gibba, A., Jammeh, L., & Jallow, M. A. (2024). Effect of energy consumption, foreign direct investment, and economic growth on greenhouse gas emissions in OPEC member states: evidence from panel data analysis. *Frontiers in Environmental Economics*, 3, 1428754. <https://doi.org/10.3389/frevc.2024.1428754>

- Iamsiraroj, S. (2016). The Foreign Direct Investment–Economic Growth Nexus. *International Review of Economics & Finance*, 42, 116–133.
- International Energy Agency (IEA). Energy system of Romania. Retrieved from <https://www.iea.org/countries/Romania>
- Iorga, G. (2016). Air pollution monitoring: A case study from Romania. In P. Sallis (Ed.), *Air quality – Measurement and modeling* (pp. 135–162). Intech.
- Jianu, I., Jeloica, S. M., & Tudorache, M. D. (2022). Greenhouse gas emissions and its main drivers: A panel assessment for EU-27 member states. arXiv [preprint arXiv:2205.00295] Retrieved from <https://arxiv.org/abs/2205.00295>
- Lin, C. C., Huang, A. Y. Q., & Lu, O. H. T. (2023). *Artificial intelligence in intelligent tutoring systems toward sustainable education: A systematic review. Smart Learning Environments*, 10(1), 41. <https://doi.org/10.1186/s40561-023-00260-y>
- Maciejewska, K. (2020). Short-term impact of PM_{2.5}, PM₁₀, and PM_c on mortality and morbidity in the agglomeration of Warsaw, Poland. *Air Quality. Atmosphere & Health*, 13, 659–672.
- Mahmood, N., Wang, Z., & Hassan, S. T. (2019). Renewable energy, economic growth, human capital, and CO₂ emission: An empirical analysis. *Environmental Science and Pollution Research*, 26, 20619–20630.
- Meghisan, G. M., & Toma, D. (2017). Public health management: life expectancy and air pollution. In *Proceedings of the International Conference on Business Excellence* (Vol. 11, No. 1, pp. 111–120). Warszawa: Sciendo.
- Onofrei, M., Vatamanu, F., & Cigu, E. (2022). The relationship between economic growth and CO₂ emissions in EU countries: A cointegration analysis *Frontiers in Environmental Science*, 10.
- Páldy, A., Bobvós, J., & Lustigová, M. (2006). Health Impact Assessment of PM₁₀ on Mortality and Morbidity in Children in Central and Eastern European Cities. *Epidemiology*, 17(6, Suppl.), S131.
- Petre, I. L., Sbircea, R. S., & Campeanu, C. (2025). Analysis of greenhouse gas emission dynamics in the EU: Economic and demographic factors. *Annals of “Constantin Brancusi” University of Targu-Jiu. Economy Series/Analele Universității “Constantin Brâncuși” din Târgu-Jiu Seria Economie*, (1). <https://ideas.repec.org/a/cbu/jrnlec/y2025v1p89-100.html>
- Pilatin, A., Barut, A., Hernández Soto, G., & Ullah, S. (2025). Foreign direct investment and growth impact on pollution in the EU countries: Empirical analysis of the EKC and Pollution Halo Hypothesis [Working paper]. SSRN. <https://doi.org/10.2139/ssrn.5174310>
- Yao, Y., Ivanovski, K., Inekwe, J., & Smyth, R. (2020). Human capital and CO₂ emissions in the long run. *Energy Economics*, 91, 104907.