A GREEN FUTURE FROM AN ENERGY POINT OF VIEW

IORGOVAN DANIELA
PH.D. STUDENT, UNIVERSITY OF CRAIOVA, DOCTORAL SCHOOL OF ECONOMICS "EUGENIU CARADA", CRAIOVA, ROMANIA
e-mail: iorgovandaniela@yahoo.com

STEGĂROIU CARINA-ELENA
LECTURER PH.D., "CONSTANTIN BRÂNCUŞI" UNIVERSITY, TÂRGU-JIU, ROMANIA
e-mail: carinastegaroiu@yahoo.com

CHIRTOC IRINA-ELENA
ASSOC. PH.D., "CONSTANTIN BRÂNCUŞI" UNIVERSITY, TÂRGU-JIU, ROMANIA
e-mail: irina.chirtoc@utgjiu.ro

Abstract

Society looks with hope to the future that future generations will live in. The responsability of behavior and actions towards the environment affects future generations. The main objective of this article is to analyze the dynamics of 4 indicators: Domestic net greenhouse gas emissions, Gross available energy by product, Investments in environmental protection in the total economy, Share of renewable energy in gross final energy consumption by sector. By choosing these indicators, this article aims to show how each contributes to a green future. The research result shows that each of these underlines the general trend of sustainable development for a green future.

Keywords: green energy, digitalization, sustainable development, digital economy, Romania,

Clasificare JEL : *M40, M41*

1. Introduction and context of the study

In susteinable development, energy performance is an important pillar that leads to emission reduction. Efficienty used energy contributes to a green, clean and sustainable future.

Song et al. (2024), shows that market demand for sustainable and energy-efficient products and processes has driven the development of green technologies.

For this article, the research method consists of descriptive analysis and graphical representation of the dynamics of each chosen indicator.

The 4 indicators chosen are Share of renewable energy in gross final energy consumption by sector, Investments in environmental protection in the total economy, Domestic net greenhouse gas emissions, Gross available energy by product. This paper presents the average at the European Union level of the chosen indicators over the analyzed period.

2. Literature review

Advanced energy technologies offer prospects for replacing traditional energy with renewable energy sources (Ramakumar et al., 2025). New technologies aim to support the introduction of sustainable energy sources and improve energy efficiency.

MXenes are a recently discovered class of two-dimensional materials consisting of nitrides, carbides and carbonitrides (Amani et al., 2024). These MXenes have undergone extensive research and development for a number of applications, including energy storage and clean energy converters. More recently, scientific progress is making partially oxidized MXenes useful for energy storage application (Hussain et al., 2025).

Buonomano et al. (2022) study analyzes technolohies designed to enhance the sustainable development of energy systems.

3. Dynamic indicators

Global energy volatility is explained by an energy uncertainty index (Işık et al., 2024). Renewable energy, with its development, reduces energy dependence and uncertainty in energy markets.

Figure no. 1 records the share of renewable energy in gross final energy consumption by sector for the period 2004-2023 for the average in the European Union. It is highlighted that in the European Union, the average consumption of renewable energy out of the total energy consumed registered an increasing trend during the years 2004-2023.

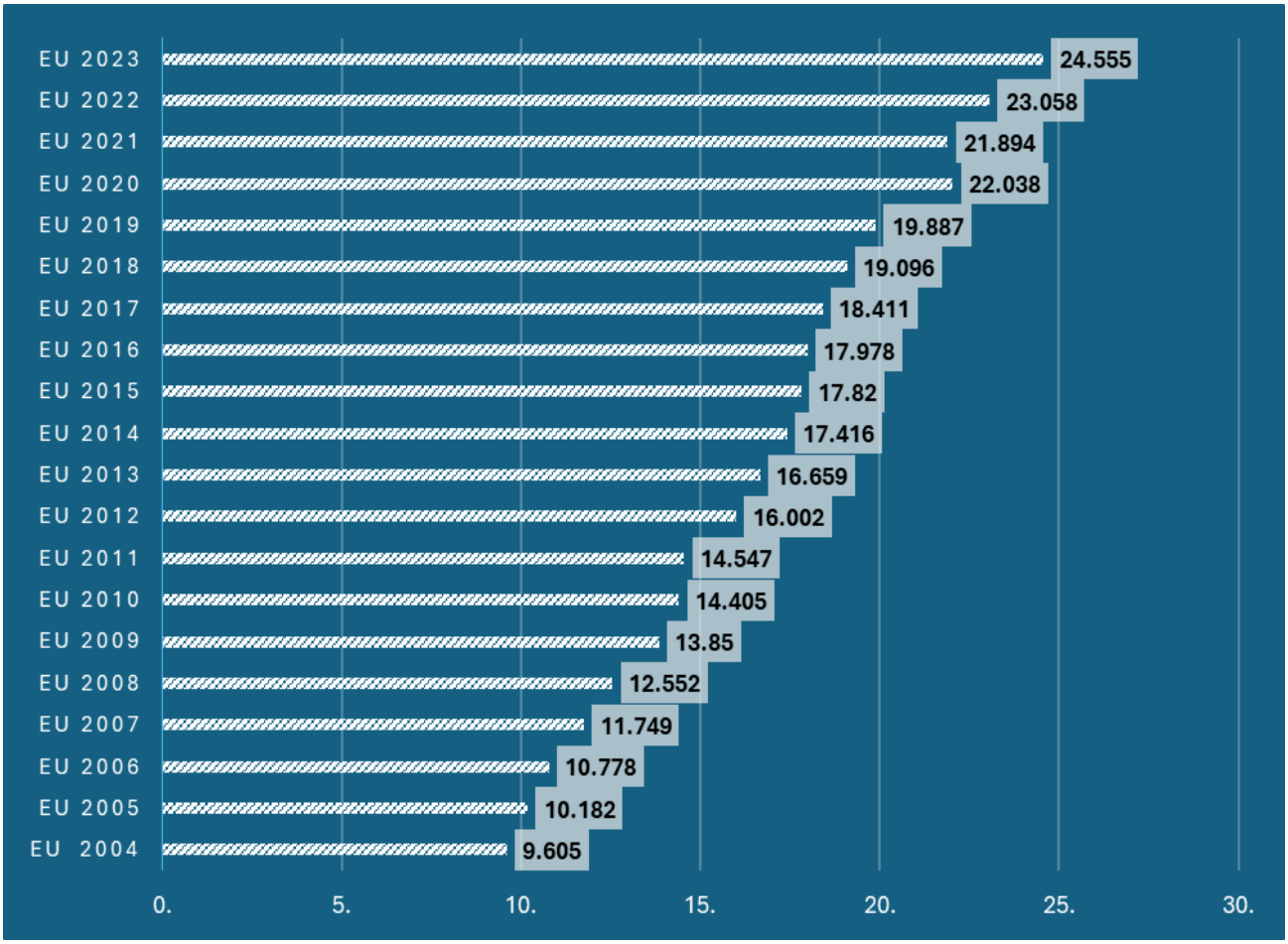

Fig. no. 1: Share of renewable energy in gross final energy consumption by sector, European Union, 2004-2023

Source: Created by authors using Eurostat datebase

The increase is obvious, from 9.605% in 2004, this indicator reached a percentage of 24.555 in 2023. Therefore, in 2023 almost a quarter of the energy consumed will come from renewable sources. This indicator still has potential for growth and indicates that interest in sustainable development and green energy has grown streadily. This fact indicates the clear direction towards energy from alternative sources and also marks the trend towards sustainable development.

Hassan et al. (2024) indicates that renewable energy sources could account for up to 2/3 of global primary energy supply by 2025.

Another indicator analyzed is Domestic net greenhouse gas emissions. Figure no. 2 leds the fluctuation of the European Union average over the period 2004-2023. This indicator is measured in tonnes per capita.

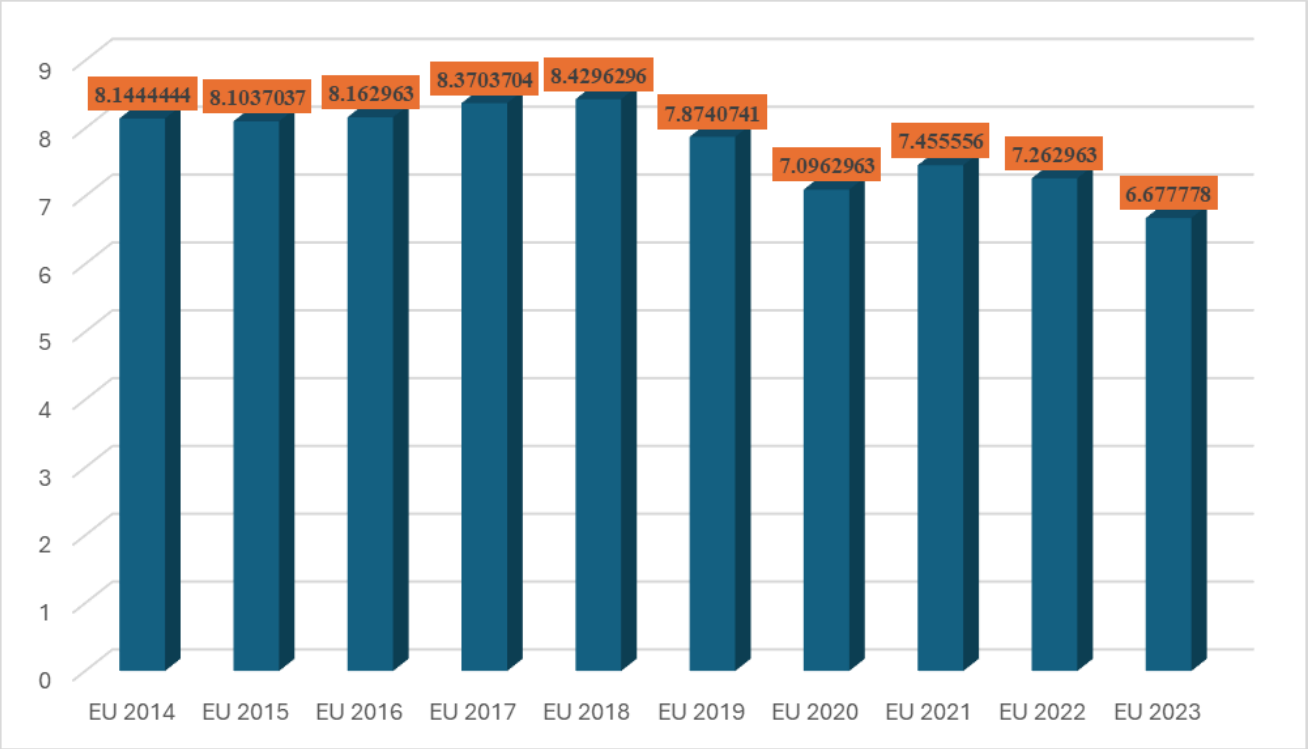

Fig. no. 2: Domestic net greenhouse gas emissions, European Union, 2014-2023

Source: Created by authors using Eurostat datebase

From Figure no. 2 it is illustrated the fact that domestic net greenhouse gas emissions have decreased over the years from 8.14 tonnes per capita in 2014 to 6.68 tonnes per capita in 2023 at the level of EU states. Reducing gas emissions implies increasing the degree of sustainable development and moving towards a sustainable future.

By issuing green bonds, European governments are trying to aspire to a sustainable future (Chesini, 2024). Green projects have become strategic objectives for European governments, but also for other private sector entities concerned with combating climate change.

Another indicator analyzed that has implications for the green future is represented by Investments in environmental protection in the total economy. This is measured as a percentage and is represented for the European Union average for the years 2014-2023.

Figure no. 3 leds the level of investments in environmental protection. The value of this indicator in 2014 was 54.4% and reached 75.58% in 2023. Over the years, it is noted that the trend was generally increasing. The year 2016 is an exception, recording a decrease to 48.3% compared to 2015, which had a percentage of 57.8% investments in environmental protection in the total economy.

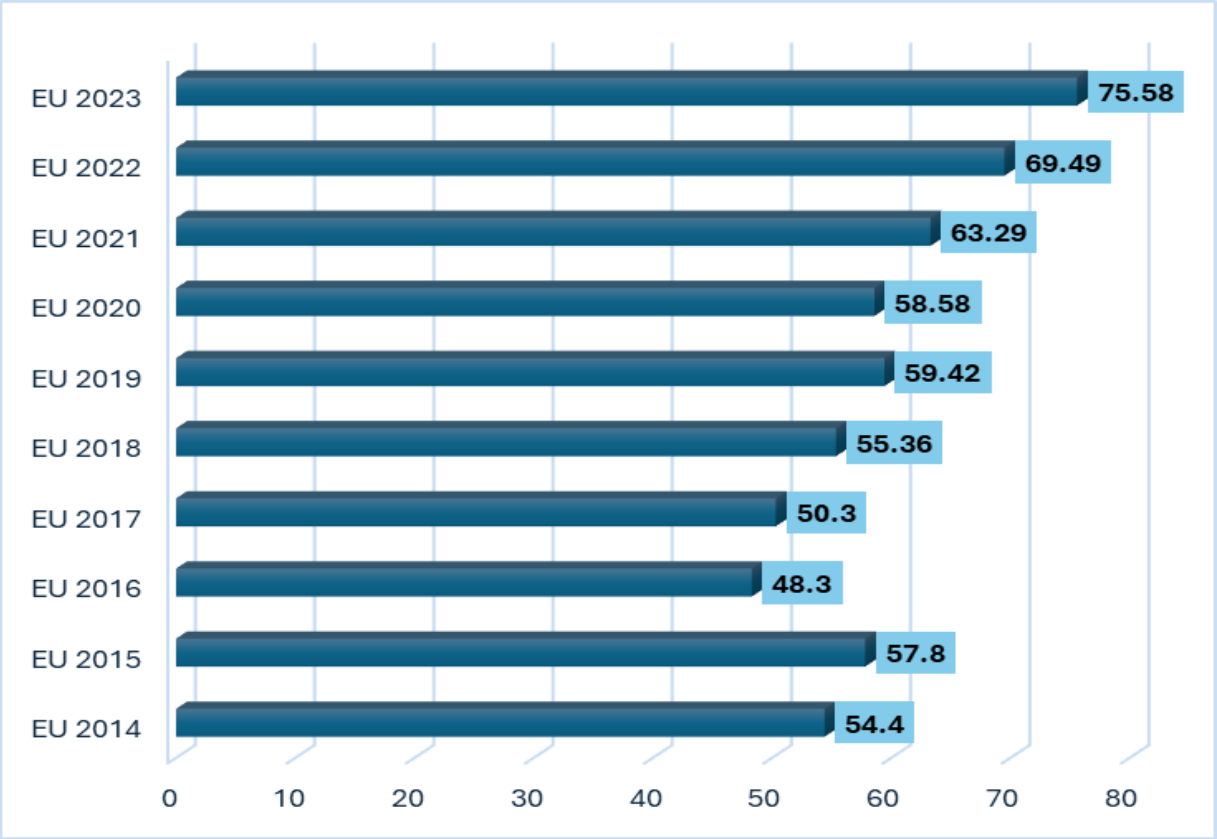

Fig. no. 3: Investments in environmental protection in the total economy, European Union, 2014-2023

Source: Created by authors using Eurostat datebase

Hong et al. (2025) highlights how environmental taxes impact corporate environemtal investment. The result leds that environmental taxes expenditures have a negative effect on green corporate investments, influenced by pollution emissions. Circular economy models offer advantages at the microeconomic level, and the model results investigate positive effects on the environment (Sgroi, 2022).

Climate change and environmental pollution demonstrate the need for more environmentally friendly production through efficient methods and increased economic greening (Khumarova et al., 2025).

The last indicator analyzed is Gross available energy by product. Fig. no. 4 details the values of this indicator for the European Union average, measured in thousand tonnes of oil equivalent.

Ziolo et al. (2024) indicates that sustainable energy sources and financial development differ by country size for EU states and energy autonomy.

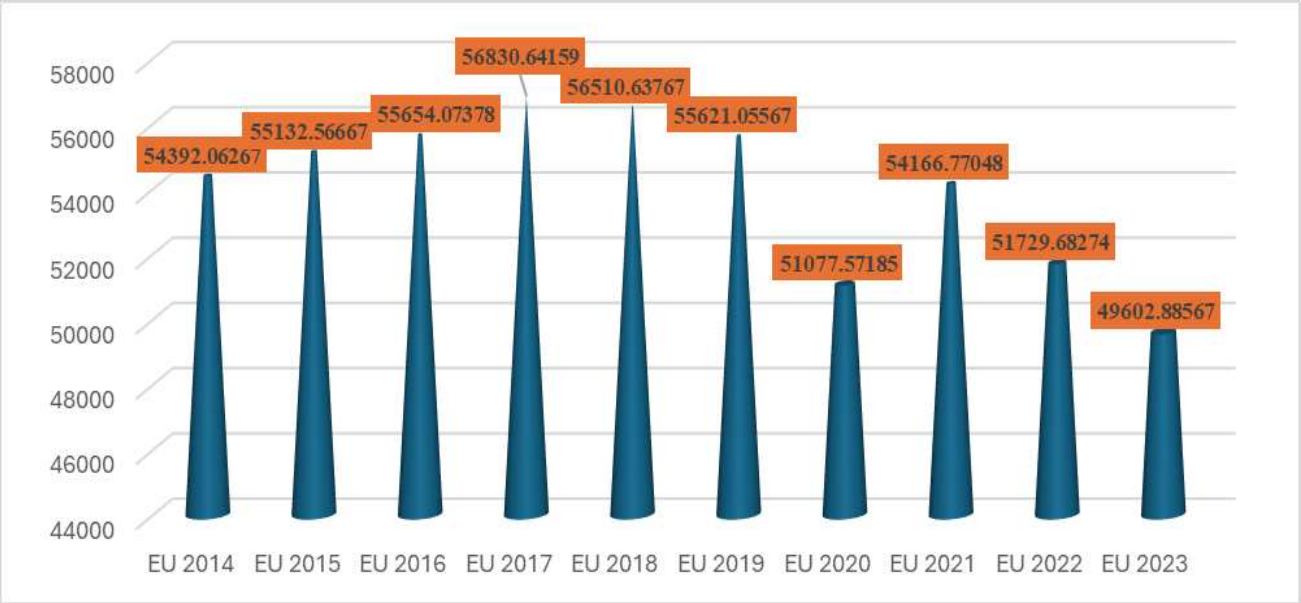

Fig. no. 4: Gross available energy by product, European Union, 2014-2023

Source: Created by authors using Eurostat datebase

Fig. no.4 highlights that the European Union has an average gross energy available by product which increased from 54392.06 thousand tonnes of oil equivalent in 2014 to 49602.89 in the year 2023.

5. Conclusions

A green future starts from common and recurring actions to reduce pollution. Specifically for the energy sector, the more energy sources rely coal, combustion and fossil fuel, the further we move away from the green future we are aiming for. This is achieved through the consumption of energy from renewable sources and the production of renewable energy.

Moreover, investments in environmental protection in the total economy and domestic net greenhouse gas emissions were a cause for concern for decision-makers regarding the environment, it is protection and maintenance throughout the analyzed period.

The four interpreted indicators raise the quality level of the article by identifying the fluctuations that EU states had during the analyzed periods.

Public policies are implementing encouraging measures for the transition to green energy and a cleaner environment. Balanced approaches to existing regulations have a real chance of reducing environmental, air and water pollution.

6. Bibliography

[1.]Amani, A. M., Tayebi, L., Vafa, E., Abbasi, M., Vaez, A., Kamyab, H., ... & Bazargan-Lari, R. (2024). On the horizon of greener pathways to travel into a greener future portal: Green MXenes, environment-friendly synthesis, and their innovative applications. Journal of Cleaner Production, 436, 140606.

[2.]Buonomano, A., Barone, G., & Forzano, C. (2022). Advanced energy technologies, methods, and policies to support the sustainable development of energy, water and environment systems. *Energy Reports*, *8*, 4844-4853.

[3.]Chesini, G. (2024). Can Sovereign Green Bonds Accelerate the Transition to Net-Zero Greenhouse Gas Emissions?. *International Advances in Economic Research*, *30*(2), 177-197.

[4.]Hassan, Q., Viktor, P., Al-Musawi, T. J., Ali, B. M., Algburi, S., Alzoubi, H. M., ... &

Jaszczur, M. (2024). The renewable energy role in the global energy Transformations. *Renewable Energy Focus*, *48*, 100545.

[5.] Hong, Y., Jiang, X., Shi, B., & Yu, C. (2022). Do fiscal environmental protection expenditures crowd out corporate environmental protection investments?. *Sustainability*, *14*(20), 13608.

[6.] Hussain, I., Bibi, F., Pandiyarajan, S., Hanan, A., Chuang, H. C., & Zhang, K. (2025). Partially oxidized MXenes for energy storage applications. *Progress in Materials Science*, *147*, 101351.

[7.] Işık, C., Kuziboev, B., Ongan, S., Saidmamatov, O., Mirkhoshimova, M., & Rajabov, A. (2024). The volatility of global energy uncertainty: Renewable alternatives. Energy, 297, 131250.

[8.] Khumarova, N., Mahats, N. și Kakabadze, G. (2025). Evaluarea eficienței economice a ecologizării în managementul resurselor de apă. *Economics Ecology Socium* , *9* (1), 1-14.

[9.] Ramakumar, R., Butler, N. G., Rodriguez, A. P., & Venkata, S. S. (2002). Economic aspects of advanced energy technologies. *Proceedings of the IEEE*, *81*(3), 318-332.

[10.] Song, A., Rasool, Z., Nazar, R., & Anser, M. K. (2024). Towards a greener future: How green technology innovation and energy efficiency are transforming sustainability. *Energy*, *290*, 129891.

[11.] Sgroi, F. (2022). Economia circulară și protecția mediului. *AIMS Environmental Science* , *9* (2).

[12.] Zioło, M., Bąk, I. și Spoz, A. (2024). Surse de energie durabilă și legătura dintre dezvoltarea financiară - perspectiva țărilor Uniunii Europene în perioada 2013-2021. *Energies* , *17* (13), 3332.