The Impact of Economic, Environmental and Social Variables in the Consumption of Green Energy. A Comparative Approach of the Balkan Countries

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Abstract: - Governments and businesses in many countries are orienting their strategies in accordance with meeting the sustainable development goals (SDGs), due to current global development. In a dynamic environment and competitive markets, this strategy orientation is seen as a way to succeed and ensure long-term sustainability. In this context, renewable energy has gained a lot of attention and interest. The promotion and use of renewable energy depend crucially on government policies. Different incentives such as subsidies, tax incentives, renewable energy targets, and regulations that encourage or require the use of renewables can significantly boost their adoption. Renewable energy technologies, such as solar panels, wind turbines, and energy storage systems, have advanced and have made their use a more attractive option for consumers and businesses because of their accessibility, affordability, and efficiency. This study aims to present and give a comparative overview of renewable energy investments in the Balkan Countries with a focus on green energy. Green energy is a sub-category of renewable energy that refers only to two sources: sun and wind. Even though green energy is part of renewable energy, it might have specific characteristics that are interesting to be known. The objective of this study is to analyze the relationship of the main factors that impact the consumption of green energy in Albania compared to four EU countries. Following the previous research conducted and after identifying the main factors that impact the consumption of green energy, a panel data regression model is used to analyze how these factors are related to the consumption of green energy in 5 countries: Albania (non-EU country), Croatia, Bulgaria, Greece, Slovenia (EU countries). The study results found that the electricity price and education index positively impact the consumption of green energy, while CO_2 emissions negatively impact it.

Key-Words: - Renewable energy, Green energy, SDGs, Regulatory framework, Environment protection, Energy markets.

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1 Introduction

Energy is one of the most debated issues in recent decades. The 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change have determined a set of requirements for countries to ensure environmental protection. First of all, the use of green energy sources aims to protect the environment as a result of reducing the emission of carbon dioxide. The Paris Agreement has defined the target of reducing 3.5% every year of the carbon dioxide released during energy production until 2050, to achieve this objective, [1]. Moreover, the Paris Agreement emphasizes the importance of financing investment projects in the area of climate change and energy production plants. Such investments require a lot of funds, that often, are impossible to be financed and afforded by governments and private investors only. In this context and considering the importance of this sector, international donors and development banks play a major role in financing projects, [2]. The main donor in terms of funding and the key stakeholder in terms of policy dialogue is the European Union. During the last decade, more than €185 million in grants have been provided by the EU to support energy efficiency and renewable energy, actually attracting about €850 million in loans, [3].

In a macroeconomic context, the above objective is not only environmental but also has an impact on the economic and social development of countries. Thus, changes in the energy sector are expected to increase gross domestic production by 2.5% and employment by 0.2% until 2050 globally, [4].

Balkan countries have started to adopt new technologies and to use sustainable sources of energy which aim to achieve the Sustainable Development Goals (SDGs). SDG 7 "Affordable and Clean Energy" defines specific targets and indicators for countries to achieve by 2030 regarding the energy sector: a) Ensure universal access to affordable, reliable, and modern energy services, b) Increase substantially the share of renewable energy in the global energy mix, c) Double the global rate of improvement in energy efficiency, d) Enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology, e) Expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, by their respective programs of support.

New sources of energy production have been the focus of many scholars and researchers, especially in the last decade when there is increased attention on environmental protection and compliance with SDGs towards a sustainable energy sector. The vast literature is related to renewable sources of energy, which include sun, wind, water, earth heat, and plants. Green energy is a smaller category of renewables which refers only to two sources: sun and wind. The availability of renewable energy resources, such as sunlight, wind, and hydropower, in a particular region can influence the use of green energy. Areas with abundant renewable resources are more likely to invest in these technologies. There is a lack of theoretical and empirical evidence related solely to green energy. Even though green energy is part of renewable energy, it might have specific characteristics that are interesting to know. Therefore, we will bring in this section an overview of studies related both to renewable and green energy and then we will derive our specific study oriented towards green energy.

The paper is organized as follows. The first section provides a brief review of previous research and findings regarding the factors that influence the usage and impact the consumption of renewable and green sources of energy. Second, a general overview of the regulatory framework and investments in green energy in the Balkan Countries is presented in comparison with each other. In section three, a short description of the methodology used in this study is given, explaining the sampling, measures, and data analysis. The findings, discussions, implications, and limitations conclude the study.

2 Literature Review

Nowadays the use of green energy sources represents a competitive advantage for businesses. Corporate Sustainability Goals can be regarded as a factor that influences the use of green energy. Many businesses and corporations are setting sustainability goals and commitments to reduce their carbon footprint. This often involves procuring a significant portion of their energy from renewable sources. Nevertheless, small and medium enterprises face more difficulties because investments in such systems need the mobilization of large amounts of capital and are highly dependent on R & D expenditure, [5]. The study of [6], found that the cost of solar panel systems and the pressure of competitors negatively affected SMEs to invest in this type of green energy. Financing is a key constraint towards the use of solar panels and both governments and financial system institutions should do more regarding green financing, [7]. Access to financing options and investment in renewable energy projects can facilitate their development and deployment.

The factors that have an impact on renewable energy consumption are generally categorized into three groups: economic, environmental, and social factors. The influence of such factors on renewable energy demand is sometimes controversial in literature. From the cost-effective perspective, the cost of green energy technologies has been decreasing over time, making them increasingly competitive with fossil fuels. Dependence on fossil fuels, which are subject to price fluctuations and geopolitical tensions, can be a motivation to shift towards green energy sources that are more reliable and domestically available. As green energy becomes more cost-effective, businesses and consumers are more likely to adopt it.

GDP is one of the main economic indicators which boost the use of renewable energy both in the short and long run, [8]. Most of the studies in developed and developing countries have found a positive impact of GDP in consumption of renewable energy, [9]. At the same time, it is identified that also renewable energy contributes to the improvement of the economic condition of countries, thus having a vice-versa effect, [10].

Other economic factors such as labour force, the gross capital formation have been identified to have a negative relationship with renewable energy, [9], [11].

Environmental factors have also been identified as drivers for renewable energy consumption. Growing awareness of environmental issues, such as climate change and air pollution, has led to an increased interest in green energy sources. People are more inclined to support and use renewable energy to reduce greenhouse gas emissions and minimize their ecological footprint.

CO_2 emissions are the most used indicator to represent this group of indicators. In most studies it is identified a negative relationship between this factor and the demand for renewable energy, [5], [8], [12]. Other studies differentiate the impact of CO_2 emissions between developing and developed countries. The negative correlation is found for developing countries, while in developed countries the influence is positive, [13].

International agreements and commitments can influence a country's energy policies and commitment to transitioning to renewable energy sources. The Paris Agreement marked a significant impact on policies related to environmental issues thus affecting the energy sector. [14], concluded that the energy consumption structure was the main indicator influencing the demand for renewable energy before the agreement. Meanwhile, FDIs and trade openness became important in increasing the demand for renewables after the Paris Agreement.

Social acceptance and cultural attitudes towards green energy can affect its adoption. Community support and collaboration can be crucial in implementing renewable energy projects. Public awareness and support for green energy play a vital role in its adoption. As consumers become more conscious of their energy choices, they may demand cleaner energy sources from utility providers. Moreover, the energy sector has a significant social impact since it directly affects the well-being of families and businesses, but there are also social factors that contribute to the renewable energy demand. Renewable energy is positively affected by the improvement of the education index and negatively affected by the life expectancy index, [8].

In summary, the use of green energy is influenced by a complex interplay of environmental, economic, technological, regulatory, and social factors. As these factors continue to evolve, the adoption of green energy is likely to increase, helping to reduce greenhouse gas emissions and promote a more sustainable energy future.

2.1 Regulatory Framework and Investments in Green Energy in Balkan Countries

Investment levels and priorities in green energy can vary among Balkan countries based on their available renewable resources, regulatory frameworks, and economic conditions. Each Balkan country has its unique regulatory approach and support mechanisms for green energy development. We analyzed different reports conducted through the years by International Organizations and Stakeholders, [15], [16], [17], [18], [19], to conduct the following comparative approach between Balkan Countries based on main indicators of regulatory framework development and investments support mechanisms.

Greece stands as a leading advocate for energy development in its region. Investors find this country very attractive due to stability in the regulatory environment. The country has effectively deployed support mechanisms such as feed-in tariffs, auctions, and a renewable energy certificate system. Greece's commitment to expanding wind and solar energy installations has yielded investments while ambitious targets have been set to increase the share of renewables in its energy mix.

Croatia has developed an incentive system for Renewable Energy Sources through a new act on this source in 2016. Croatia's government has adopted a new Energy Strategy in 2020 until 2030, that includes a wide range of energy policy initiatives that will improve energy security, increase energy efficiency, lower dependence on fossil fuels, increase local production, and increase renewable resources. Croatia aims to become a sustainable and energy-independent country by counting on its abundant renewable energy sources.

In Slovenia, the legal framework for the promotion and use of renewable energy sources is regulated by Renewable Energy Act. This legislation has set rules regarding grid connection for green energy to efficiently integrate green energy into the current electricity grid. Slovenia Government has provided some support through different incentives such as feed-in tariffs and other financial incentives to promote the development of renewable energy projects and to attract more investors in solar energy infrastructure. Considering the geographical position of Slovenia, the government has made efforts to utilize the potential that the country has for wind energy, mainly in mountainous and coastal areas. There has been an increase in solar photovoltaic installations, including investments from both residents and businesses that have benefited from government incentives and feed-in tariffs. The support and access to EU funding programs that support renewable energy projects have played a very important role for Slovenia in financing green energy initiatives. The engagement of the country in international

partnerships and collaborations has advanced its green energy goals. This includes participation in regional energy projects and cooperation with neighboring countries.

Bulgaria has made efforts to advance the utilization of energy sources. The government has implemented support mechanisms like feed-in tariffs and a quota system for electricity production from renewables. Over the years Bulgaria has successfully attracted investments in both wind and solar energy projects.

Romania has been highly engaged in driving energies specifically focusing on wind and solar power sources. There is a well-established regulatory framework for renewable energy. Romania has put in place a support program that relies on certificates and has conducted auctions for scale renewable projects. This approach has led to investments in the country's energy sector.

Serbia has introduced regulations to promote renewable energy, supervised by the Energy Agency of the Republic of Serbia. Serbia has focused on hydropower and wind energy investments. Feed-in tariffs and incentives were used to attract investments, with grid infrastructure development being a priority.

North Macedonia is actively pursuing measures to promote energy about European Union integration. The government has introduced enticing incentives like feed-in tariffs and other schemes aimed at attracting investments into energy projects. The country's objective is to elevate the proportion of renewables, within its energy consumption.

Albania has expressed its keenness to promote energy with a focus on hydropower. To encourage investments in energy projects the country has put in place feed-in tariffs as incentives. The regulatory framework for renewables is continuous due to different challenges observed in this regard such as grid infrastructure and permitting processes The government aims to boost the proportion of energy in the overall energy mix of the nation. In this context, best practices may be followed by other Balkan countries that have more experience to accelerate the transition to greener and more sustainable energy in the future.

3 Methodology

The analysis of factors influencing green energy consumption in the Balkans is carried out by using a panel data regression model, which is used in similar studies, [5], [8]. We have tested for fixed / random effects and the final regression is based on the results of the Hausman test which determines which test is more appropriate. The analysis is carried out in E-views 12.

Data was retrieved from different databases: World Bank, UNSD, Eurostat, and INSTAT for the period 2010 – 2019 on an annual basis. The aim of the study is to analyze the drivers of green energy in Balkan countries. The final panel data refers to five countries: Albania (non-EU country), Croatia, Bulgaria, Greece, and Slovenia (EU countries). The other countries have not been involved in the study because they have started to use green energy sources in a few years and such a short period is not sufficient for econometric analysis.

Although a large set of indicators has been considered at the first stage of analysis (GDP, private financing, inflation, energy productivity, etc), after performing the required testing procedures and eliminating the problems of autocorrelation, we have included in the final model the following variables:

Dependent variable: The green energy ratio is the dependent variable, which is measured as the share of sources such as sun and wind in the final energy consumption. Most previous research has a broader focus, using all renewable energy sources as the dependent variable, which refers to all sources steaming from the earth's ecosystem, such as biomass, hydropower, marine, geothermal, wind, and solar energy. As mentioned in the previous sections, hydropower is the main source of energy in Balkan countries, thus the existing studies' results are dominated by this energy source and do not refer solely to green energy. Therefore, this study brings a valuable and new contribution to the related field.

The explanatory variables are selected based on literature results and taking into consideration the characteristics of the countries in the study. These variables are grouped into three categories:

Economic variables: In this category, foreign direct investment and electricity prices are included. FDIs refer to the net inflows of capital from other countries towards countries involved in the study based on annual data from the World Bank database. FDIs play a crucial role in the economic development of Balkan countries and are an important source of funding in the energy sector. It is expected to have a positive relationship between this indicator and the demand for green energy.

The price of electricity refers to the average price a medium-size household pays in a year. The higher the price of electricity from traditional sources of energy, the higher the expected demand for green energy. Therefore, a positive expected impact of this indicator on the dependent variable.

Table 1. Variables of the study

Type of variable	Variable name	Description	Abbreviation	Expected impact
Dependent variable				
	Green energy	Share of green energy in final energy consumption (%)	GE	
Independent variables				
Economic variables	Foreign Direct Investment	Net inflow of Foreign Direct Investment (log)	FDI	+
	Price of electricity	Electricity prices by type of user - medium-sized households	PE	+
Environmental variables	CO2 emissions	CO2 emissions (kg per PPP $ of GDP)	CO2	
Social variables	Education Index	Education index - component of the Human Development Index	EI	+

Source: Authors considerations based on literature

Environmental variables: In this category, CO2 emissions are considered to express the impact on green energy consumption. This indicator is expressed in kg per PPP $ of GDP. Based on the literature, the impact of CO2 emissions on green energy consumption is controversial.

Social variables: The social impact is expressed through the education index, which is one of the components of the Human Development Index published every year by the United Nations Development Programme. The index takes values from 0 to 1, where higher values mean better performance of countries in education.

Table 1 summarizes the variables of the study.

Considering these explanatory variables, green energy determinants can be expressed:

$$GE_{it} = \beta_0 + \beta_1 FDI_{it} + \beta_2 PE_{it} + \beta_3 CO2_{it} + \beta_4 EI_{it} + \varepsilon_{it}$$

(1)

Where β_0 is the intercept and ε_{it} is the error term.

The econometric analysis is carried out in E-views 12. First some descriptive statistics and the correlation matrix of the variables included in the study are given. Then, the results of the least square for panel data regression analysis are presented, following these tests:

- Breusch Pagan statistics in Lagrange Multiplier Test for Random Effect to check the null hypothesis that the panel least square (PLS) is appropriate and there is no cross-section or time effect.
- Hausman test to determine the appropriate model between fixed and random effects.

- Residual statistics to test the appropriateness of the model.

3.1 Analysis of the Results

The summary of the descriptive statistics is given in Table 2. As mentioned in the previous sections, green energy comprises a small share of the energy market share in Balkan countries. For the analyzed period, it amounts to only 0.8% of the final energy consumption on average. It has an increasing trend in all reported countries but remains at low levels. This variable has the highest standard deviation because of significant differences among countries. The highest value is 8.8% of final energy consumption and it refers to Greece, which has the best indicators in green energy consumption.

Table 2. Descriptive statistics

	GE	FDI	PE	CO2	EI
Mean	1.96	20.89	0.12	0.22	0.81
Median	0.80	20.97	0.13	0.20	0.80
St. Dev.	2.15	0.99	0.03	0.07	0.056
Minimum	0.10	17.32	0.08	0.12	0.68
Maximum	8.80	22.33	0.17	0.42	0.91

Source: Authors calculations in E-views 12

Table 3. Correlation matrix

	GE	CO2	EI	FDI	PE
GE	1	0.05	0.24	0.40	0.49
CO2	0.05	1	-0.07	0.08	-0.15
EI	0.24	-0.07	1	-0.11	0.77
FDI	0.40	0.08	-0.11	1	-0.03
PE	0.49	-0.15	0.77	-0.03	1

Source: Authors calculations in E-views 12

Table 4. Estimation of PLS, FE, and RE models

	Panel Least Square (PLS)		Fixed effects (FE)		Random effects (RE)	
Variable	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
FDI	0.8550	0.0009*	0.0458	0.6514	0.8550	0.0000*
PE	51.9912	0.0001*	35.9216	0.0001*	51.9912	0.0000*
CO2	3.4598	0.2892	-5.8790	0.0480*	3.4598	0.0046*
EI	-10.8956	0.1093	22.4098	0.0001*	-10.8956	0.0000*
C	-14.4206	0.0462*	-20.5079	0.0004*	-14.4206	0.0000*
Adjusted R^2		0.4198		0.5898		0.4671
Prob (F-stat)		0.0000		0.0000		0.0000

* p < 5%, Source: Authors calculations in E-views 12

Foreign direct investments have fluctuations among countries. On average for the past 10 years, the highest amount of foreign capital has been granted to Greece and the lowest level to Slovenia. Regarding the price of electricity, the average value is 0.1274 euro/kwh. The highest price for the period is 0.1767 euro/kwh. In almost all countries, there is an increasing trend for the period.

Emissions of CO_2 fluctuate in a decreasing trend between 0.4289 to 0.1214 kg per PPP of GDP with an average of 0.2212 kg per PPP, which is higher than the standard for fossil CO_2 emissions. Referring to the social indicator, the average education index is 0.8139, with variations between 0.68 and 0.92.

Based on the correlation matrix coefficients (Table 3), all variables are positively correlated to green energy, even though the correlation is not very strong (values below 0.5). The strongest positive relation of green energy is identified with the electricity price and FDI. In addition, there is no indication for autocorrelation, because also the coefficients among other variables are not very high.

The panel data least square has been employed to test the statistical impact of the independent variables on the dependent variable. At a 95% significance level, only FDI and PE influence the demand for green energy. But, based on the Breusch Pagan statistics in the Lagrange Multiplier Test for Random Effect, we rejected the null hypothesis that the panel least square (PLS) is appropriate (P-value less than 5%) and concluded that we should check for fixed or random effects. Below we have summarized the results of the panel least squares, fixed effect, and random effect tests.

As can be seen in Table 4, the three models are statistically significant, and the regression results are different in each model. To check which model is more appropriate, the one with fixed effects or random effects, we have used the Hausman test. The null hypothesis is that the random effects model is

preferred. This hypothesis is rejected because the p-value resulted less than 5%, thus the fixed effects model is more suitable, and we can explain the demand for green energy based on the coefficients of this model. The R^2 of the model is 58.98% which is acceptable in cases where we use macroeconomic indicators.

So, for a p-value = 0.05, the factors that influence green energy consumption are the price of electricity, the CO_2 emissions, and the education index. The foreign direct investments are not statistically significant. The impact of electricity price and education index is positive while the relationship between CO_2 emissions and green energy is negative.

4 Conclusion and Discussion

In recent years, Balkan countries have undertaken measures and policies towards the shift from traditional energy sources to renewable ones. However, the results are still not very positive, especially compared to Western Europe countries. According to data from the International Energy Agency (IEA) and UN Statistics Division (UNSD), Albania still focuses on providing energy from hydro sources, which in 2019 accounted for 25.9% of total energy consumption. Whereas, referring to green energy sources, they constituted only 0.8% of the total energy consumed, [20]. This level is similar to the performance of the energy sector in Serbia and Slovenia in 2019. In Croatia and Bulgaria, the use of green energy was less than 3% of total energy consumption. Countries with the lowest percentage of green energy in the Balkans are Bosnia Herzegovina and Kosovo (0.3% and 0.5% respectively). The use of green energy in these countries is significantly below the average of the countries of Western Europe (4.3%) or Southern Europe (5%). Only Greece had a higher use of green

energy reaching 8.8% of total consumption in 2019, [21].

Considering the low level of green energy consumption, it is of high importance to understand the driving forces of this energy source to design the proper policies to boost its demand. Regarding electricity prices, Balkan countries are characterized by higher prices and inefficiencies compared to Western Europe. Generally, an increase in energy produced by sun and wind reduces electricity prices, [22], [23], but the reverse impact is not always known. In our study, an increase in electricity prices results in a higher share of green energy. This is expected because electricity prices refer mainly to other sources of energy and an increase in such prices will motivate customers to shift towards green energy. Foreign direct investments are positively linked with green energy, but this relationship is not statistically significant.

An expected result refers also to the positive relationship between the education index and the consumption of green energy. Education plays a significant role in economic development and directly impacts well-being. A high education index means a high human development stage. The average value for the countries we have included in our study is above the world average (0.7). In the context of our study, education positively affects green energy consumption because an improvement in education level means a better quality of life and improved well-being of people. Moreover, the more educated the customers, the easier it will be for them to accept new technologies. According to [6], the ease of using solar panel systems is one of the factors that strongly impacts the acceptance of such systems by small and medium enterprises.

The increase in CO_2 emissions decreases the consumption of green energy. As emphasized in the theoretical background, the CO_2 impact is controversial. The negative relationship may result because of the main sources that cause CO_2 emissions. In Albania, Croatia, and Slovenia the fossil CO_2 emissions are coming mostly from transport, while in Greece and Bulgaria from the power industry, [24]. Since these sectors are very crucial in the economies of all countries and will continue to produce CO_2, this may discourage investments in green energy. This result is in line with conclusions from [8], [12], [25], [26].

4.1 Limitations of the Study and Directions for Future Research

Future research is needed in the field of green energy to enrich both theoretical and practical frameworks. This study takes into consideration secondary data on macroeconomic variables that have a significant impact on green energy demand. A valuable contribution could be to analyze the sector from the investor or business perspective by using primary data. This could lead to more appropriate results and suggestions for intervention consequently. Moreover, the analysis can be extended to the remaining countries in the Balkans and for a longer period, so it may be replicated to see also if other factors serve as driving forces of green energy consumption. The economic situation is changing rapidly, taking into consideration the increase in inflation, the war in Ukraine, etc., so it is important to analyze other variable impacts in the future.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)
The authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solution.

Conflict of Interest
The authors have no conflicts of interest to declare.