Analysis of the Sustainable Development of the Eastern European Countries from the Perspective of the Transition to the Green Economy

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Abstract

The current geopolitical context has accentuated the energy crisis that has once again motivated the need for the transition to the green economy. In this context, the objectives of the European Agenda require greater attention to sustainable development about the transition to a green economy. Eastern European countries face major economic disadvantages that slow down the implementation of this objective in the region. We intend to develop an econometric representation of sustainable development from the perspective of the green economy in eastern European countries. The methods used are empirical (literature analysis) and analytical, respectively the design of a sustainable development model from the perspective of the transition to the green economy of the Eastern European countries. The results of the study highlight the differences in the development of Eastern European countries compared to the European average and identify the possibilities of their recovery in relation to the difficulties observed.

Key words: green energy, sustainable development, transition, econometric model, South East Europe
J.E.L. classification: E17, F63

1. Introduction

The current context has created significant challenges for sustainable development. A global feature is the increase in inequalities between countries with significant disparities in opportunities, population health and economic development.

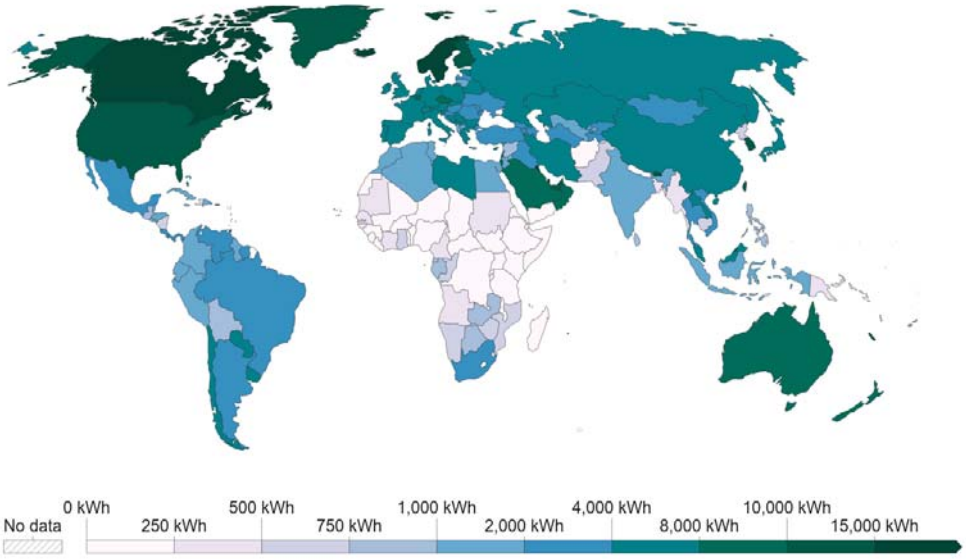
Other challenges include the depletion of natural resources, environmental degradation including desertification, land degradation, depletion of drinking water sources and reduction of biodiversity. Climate change is evident and is producing adverse effects that may reduce the capacity of countries around the world to achieve sustainable development targets.

These global threats need to be monitored and mitigated in terms of impact through globally owned sustainable development goals that take advantage of the following opportunities: unprecedented technological progress, increased access to education, high rates of information transfer of communications and technology, global interconnections that can accelerate human progress, develop the knowledge society, and foster innovation in areas such as medicine and energy.

The Sustainable Development Goals are permanently monitored through monitoring indicators, structured by topics and chapters of interest structured within each objective, the trend being that these indicators are reported by each member country of the United Nations in order to consolidate global statistics and adjust sustainable development policies.

Access to electricity in 2022 was for most continents one in the parameters of 90 and 100%, in exchange for the African continent, in countries such as South Sudan only 7.24% of the population had access to electricity(Ritchie, Roser, Mispy, 2022). In other states of Central Saharan Africa, Burkina Faso, Niger, Mali, Chad, Burundi, the Central African Republic and the Democratic Republic of the Congo, no more than 20% of the population had access to a source of electricity(Ritchie, Roser, Mispy, 2022).

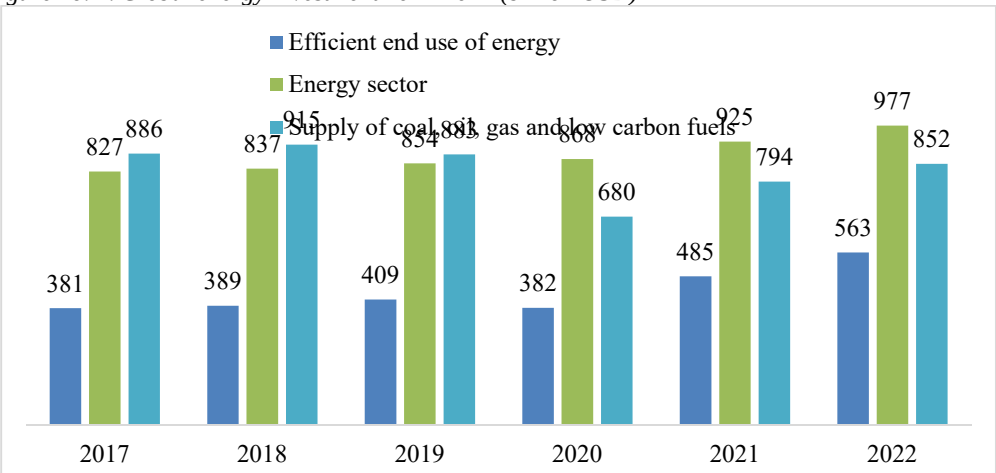
Figure no. 1. Per capita electricity generation,2022



Source: https://ourworldindata.org/grapher/per-capita-electricity-generation

Investment in energy is more necessary as the international economic climate becomes more vulnerable amidst economic uncertainty, energy security concerns and climate change. Thus, a total investment of 2.4 trillion dollars has been estimated for 2022, mainly for energy efficiency(IEA, 2022).

Figure no. 2. Global energy investment 2017-2022 (billion USD)



Source: Elaborated by the authors according to IEA data available at(IEA, 2022)

Investments in low-carbon fuels are on an upward trend, this aspect was generated by the uncertain political climate that has led companies to behave prudently regarding capital investments in the field.

The objectives of the study are:

1. Identification of the main stages of sustainable development for the energy sector
2. Study of the sustainable development literature for Sustainable Development Goal 7;
3. The development of a new model for assessing sustainable development at European level, starting from the achievements achieved by the Eastern European states regarding this desideratum in the period 2000-2021.

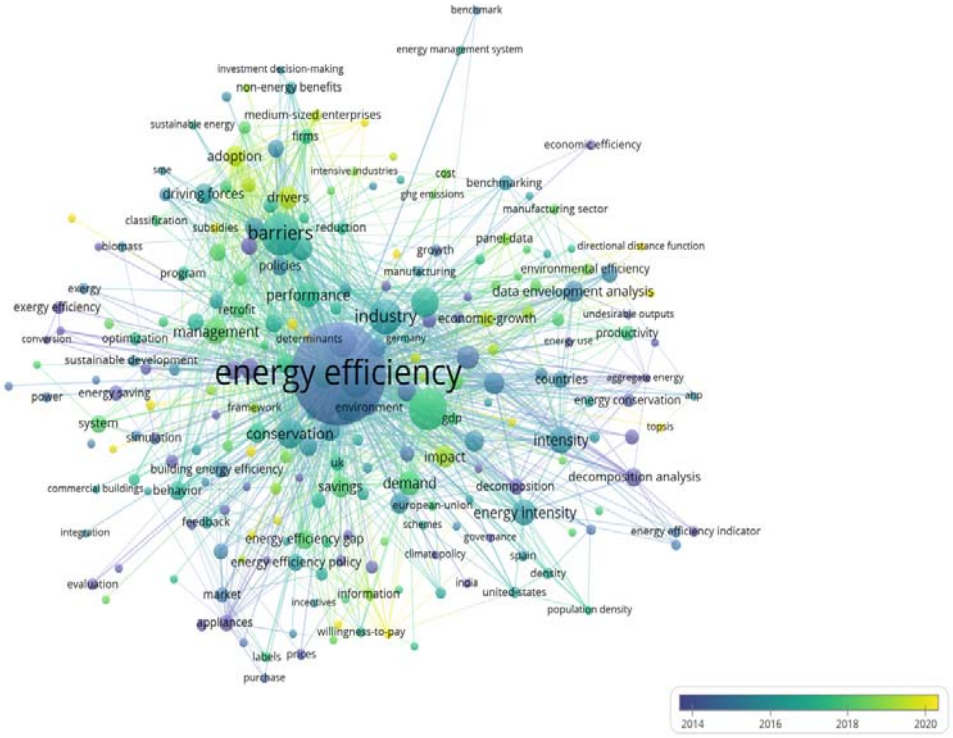
The study continues with the presentation of the main directions of economic development in the context of the transition to the green economy, presentation of the main methodological approaches, presentation of the research results and discussion and dissemination of relevant research findings.

2. Literature review

The most challenging and vulnerable elements of SDG 7 policy have been triggered by the geopolitical conflicts that have generated the energy crisis, affecting many EU Member States. Thus, although European countries have developed the energy sector in a sustainable manner, the geopolitical crisis and the pandemic have reduced previous achievements, both in terms of energy availability and existing alternatives for its transport, as alternative sources increase the pressure of transport costs (IRENA, 2021).

According to the analysis of the Web of Science database, the concept of energy within the field of sustainable green science and technology shows in the period 2014-2022 a number of 26,539 articles were studied showing recognized in 49,365 specialized papers that cited them, with a citation rate of 9.07 times per article and a Hirsch index of 79 points.

Figure no. 3. Bibliometric analysis of energy efficiency



Source: Elaborated by the authors using VOSviewer software

Research by energy experts(Madurai Elavarasan et al., 2021) is concerned with assessing the impact of the global energy market on the economy in the context of economic, political and energy security uncertainties with analysis of the challenges for technological development, so that a multilateral approach is often proposed with the pursuit of changes in economic sustainability in the global context, with the authors focusing on multilateral development strategies for boosting the

transition to renewable energy consumption, digitisation of the energy sector and energy security.

Thus, some authors have focused in the study of energy efficiency on strategic development with a 2030 horizon, proposing new economic models for growth and digitalization of the industry(Yu et al., 2021).The proposed models aim at the distributive economy, increasing prosumers (personal carbon footprint), reducing social disparities and energy poverty and increasing the rate of investment in green energy. Another study proposes a framework for optimizing the hybrid energy system based on the key characteristics of SDG 7, namely affordability, reliability, sustainability and timeliness (Kumar et al., 2020). The authors use indicators such as biological capacity, ecological footprint, energy consumption, Gini and financial development indices and the impact of trade in goods on economic growth for their Nexus analysis of environmental, social and economic factors.The research focus area is South Asia(Bansal et al., 2021).Motivated by the Sustainable Development Goals (SDGs) and their impact by 2030, examine the relationship between energy consumption (SDG 7), climate (SDG 13), economic growth and population growth in Kenya, Senegal and Eswatini.The authors used Kernel least squares (KRLS) automation technique and econometric methods such as dynamic ordinary least squares (DOLS) and mean group estimation (PMG) models. The econometric techniques confirm the Environmental Kuznets Curve (EKC) hypothesis between income levels and CO2 emissions, while the machine learning method confirms the scale effect hypothesis(Sarkodie et al., 2020).The authors find that while CO2 emissions, population growth and income levels drive energy demand and use, economic growth is driven by energy consumption and population dynamics. This demonstrates that income, population growth, energy and CO2 emissions are inseparable, but require a collective participatory decision in achieving the SDGs(Sarkodie et al., 2020).

Another important aspect is the transition to the green sector of car manufacturing, the creation of electric vehicle power grids. The energy sector is, in the researchers' view, conducive to environmentally, economically and socially sustainable development, in the same way that technologies will complement efforts to achieve SDG7 targets, compatible with action to combat climate change. The complexity of the interlinkages between SDG7 and the other sustainable development goals motivates the development of scenarios for shifting energy consumption towards consumption from renewable energy sources and halting carbon emissions associated with the energy industry.

3. Research methodology

The methodological research aims to develop an econometric model to anticipate regional differences in the perspective of transition to the green economy based on sustainable development indicators monitored by Eurostat through SDG 7 target (Table no.1).

Table no. 1 Model variables and descriptive statistics

INDICATORS MONITORED FOR EASTERN EUROPEAN COUNTRIES 2000-2021	MEAN	STD. DEVIATION	N
SDG7_ PACCTG Population with access to clean fuels and cooking technology (%)	82.759	7.2837	22
SD Demographic surplus (%2000)	92.7850	4.12603	22
SDGI SDG Index score (%)	71.677	2.3003	22
SDGI7 SDG Index score for Goal 7 (%)	68.882	3.7032	22
SDG7_ECO2 CO_2 emissions from fuel combustion on total electricity generation ($MtCO_2/TWh$)	82.159	1.6317	22

Source: Authors' calculations using SPSS v 25

The model based on sustainability variables shows that carbon emission reductions are in direct dependence (over 96%) on the variation of the predictor variables in the sustainable development spectrum related to Goal 7. Statistical tests show that there is a slight asymmetry for the Eastern European region in terms of homogeneity of data, with the asymmetry on the left side according to the Durbin-Watson test results being less than 2.

Table no. 2 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson Statistic	
					R Square Change	F Change	df1	df2	Sig. F Change	Country (Selected)	Country (Unselected)
1	0.983a	0.966	0.958	1.4909	0.966	121.053	4	17	0.000	1.668	0.127
a. Predictors: (Constant), sdg7_ECO2, SDG Index score (%), Demographic surplus (%2000), SDG Index score for Goal 7 (%)											
b. Unless noted otherwise, statistics are based only on cases for which Country = 1.00.											
c. Dependent Variable: sdg7_ PACCTG											

Source: Authors' calculations using SPSS v 25

The results of the proposed model were statistically validated by the one-sided critical likelihood test, the null hypothesis was rejected, and the alternative hypothesis was retained, the range of errors being less than the chosen significance threshold $\alpha = 0.05$.

The number of degrees of freedom of the regression is 17 out of 21 possible.

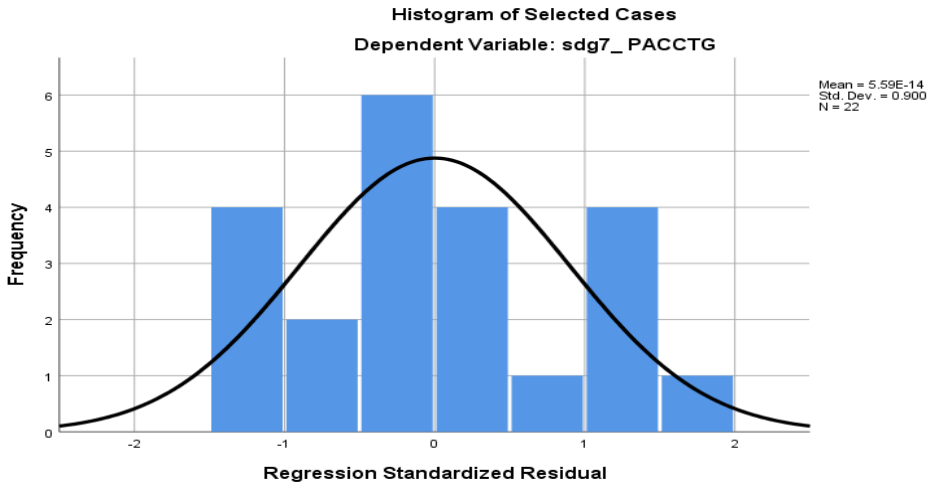
Table no. 3 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1076.306	4	269.076	121.053	.000c
	Residual	37.788	17	2.223		
	Total	1114.093	21			
a. Dependent Variable: sdg7_ PACCTG						
b. Selecting only cases for which Country = 1.00						
c. Predictors: (Constant), sdg7_ECO2, SDG Index score (%), Demographic surplus (%2000), SDG Index score for Goal 7 (%)						

Source: Authors' calculations using SPSS v 25

The histogram representation of the regression variable shows high variability with respect to the trend curve, with errors on both the upward slope of the graph and the downward slope of the graph.

Figure no. 4. Histogram of the model



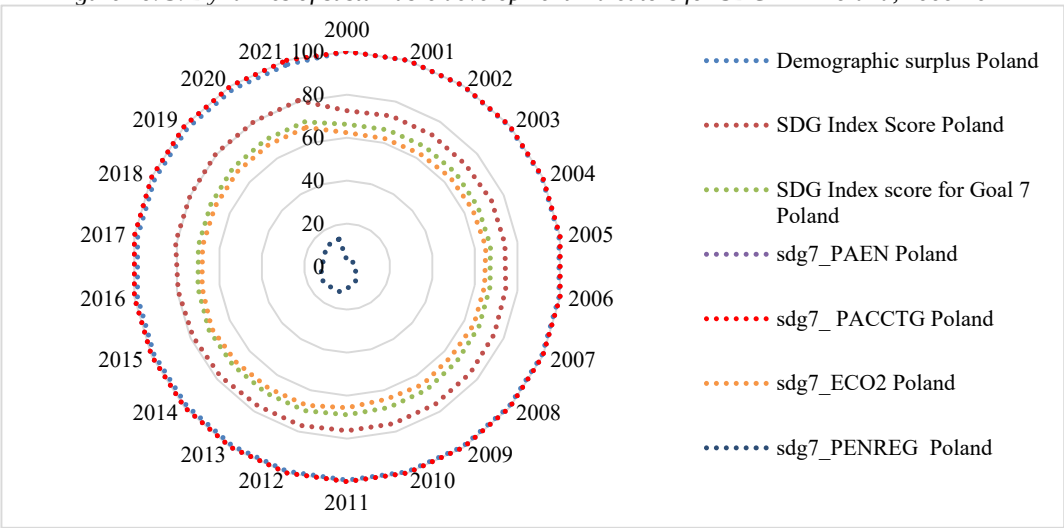
Source: Authors' calculations using SPSS v 25

The errors are assimilated to a dispersion of the SDGs in the South-East European region, which leads us to the conclusion that the SDG7 targets in the context of the new geopolitical challenges have emphases in relation to the level of development of each country, the most significant vulnerabilities being observed for Bulgaria.

4. Findings

The SDG Index score for Poland's Goal 7 shows that on average it recorded a value of 68.5%, with the highest value recorded in 2015 (70.7%), and the minimum threshold for the lowest index score for Poland's Goal 7 was reached in 2000 (66.2%).

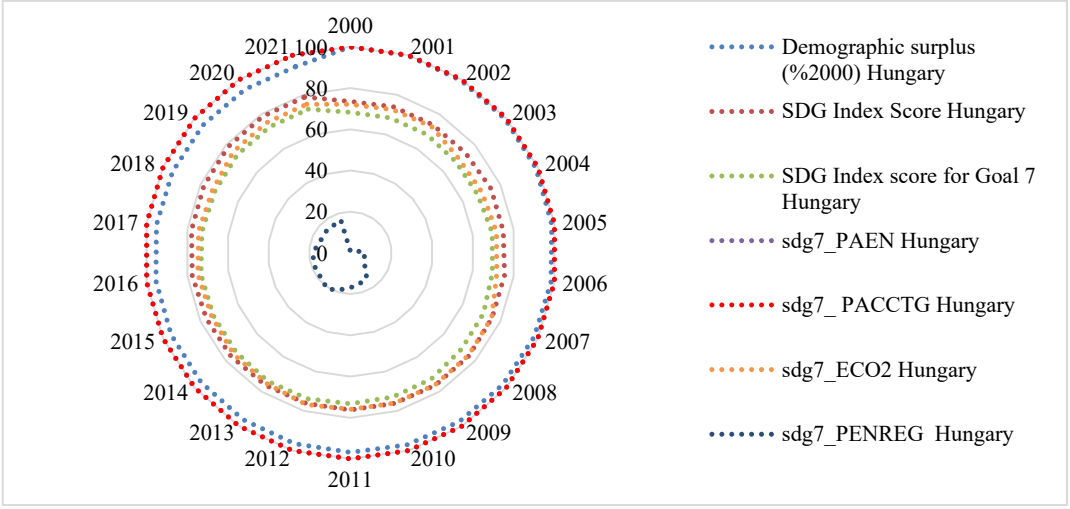
Figure no. 5. Dynamics of sustainable development indicators for SDG 7 in Poland, 2000-2021



Source: Elaborated by the authors according to(Cambridge University, 2022)

As regards the analysis of the SDG Index score for Hungary's Goal 7, it shows that, on average, it recorded a value of 71.4%, which is equivalent to a sub-unit development score, the maximum value being recorded in 2013 (74.1%). The minimum threshold for the lowest index score for Objective 7 Hungary is reached in 2003 (67.7%).

Figure no. 6. Dynamics of sustainable development indicators for SDG 7 in Hungary, 2000-2021

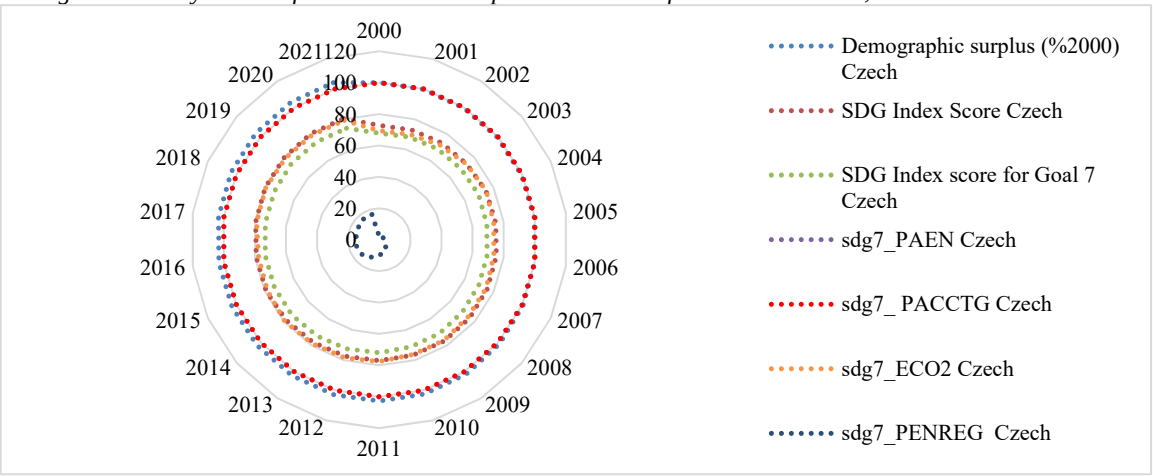


Source: Elaborated by the authors according to(Cambridge University, 2022)

The analysis of the achievements of SDG7 in Hungary, with reference to the population with access to electricity (%) (sdg7_PAEN), reveals that on average it registered 100% throughout the period under review, as well as the population with access to clean fuels and cooking technology (%) (sdg7_ PACCTG). The analysis of SDG7 achievements with reference to the share of renewable energy in total primary energy supply (%) (sdg7_PENREG), shows that on average it recorded the value of 11.7%, the maximum value being recorded in 2013 (20.9%). In contrast, the minimum threshold for the lowest score of the indicator is reached in 2000 (0.7%).

The analysis of the Czech SDG Index score shows that the average score is 76.9%, with the maximum value in 2020 (80.4%) and the minimum threshold for the lowest index score in 2000 (72.8%).

Figure no. 7. Dynamics of sustainable development indicators for SDG 7 in Czech, 2000-2021



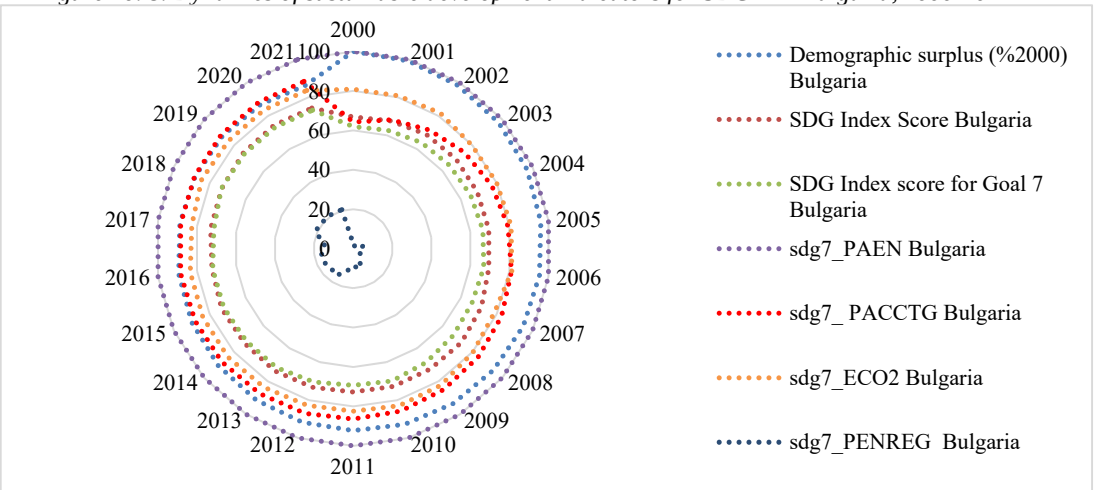
Source: Elaborated by the authors according to(Cambridge University, 2022)

The analysis of the achievements of SDG7 with reference to the population with access to electricity (%) (sdg7_PAEN), shows that it recorded a value of 100%, throughout the period under review.

The assessment of SDG7 achievements with reference to the share of renewable energy in total primary energy supply (%) (sdg7_PENREG), shows that on average it recorded a value of 9.3%, the highest value being recorded in 2019 (16.7%) and the minimum threshold for the lowest score of the indicator being reached in 2000 (1.9%).

It is found that the SDG Index score for Bulgaria's target 7, on average it recorded the value of 68.9%, the maximum value being recorded in 2018 (73.5%). On the contrary, the minimum threshold for the lowest score of the index for objective 7 Bulgaria is reached in 2000 (61.9%).

Figure no. 8. Dynamics of sustainable development indicators for SDG 7 in Bulgaria, 2000-2021

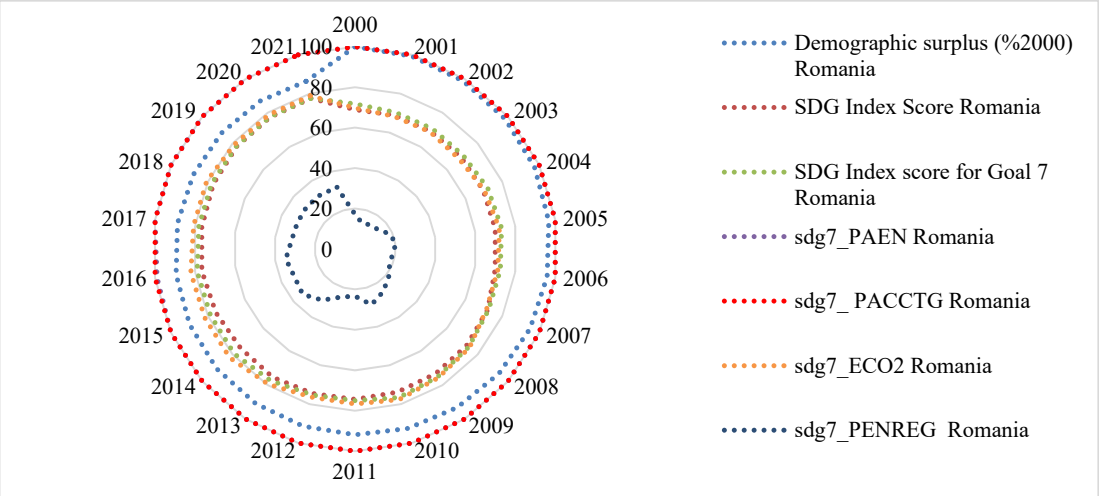


Source: Elaborated by the authors according to(Cambridge University, 2022)

From the analysis of the SDG7 achievements regarding the population with access to electricity (%) (sdg7_PAEN), it is noted that on average it recorded the value of 100% throughout the period under review (the level of achievement of the sustainable development indicator being in this case 100%. The assessment of the achievements of SDG7 with reference to the population with access to clean fuels and cooking technology (%) (sdg7_ PACCTG), shows that, on average, it recorded the value of 82.8%, assimilated to a sub-unit score of evolution, the maximum value being recorded in 2016 (88.4%).

The evaluation of the SDG Index score for Romania's Goal 7 (Cambridge University, 2022), reveals that, on average, it recorded a value of 75.2%, assimilated to a sub-unit evolution score, the highest value being recorded in 2014 (79.1%). The minimum threshold corresponding to the lowest index score for Goal 7 Poland, is reached in 2001 (70.4%).

Figure no. 9. Dynamics of sustainable development indicators for SDG 7 in Romania, 2000-2021



Source: Elaborated by the authors according to(Cambridge University, 2022)

From the analysis of the achievements of SDG7 about the population with access to electricity (%) (sdg7_PAEN), it shows that, it recorded the value of 100%, throughout the period under review.

From the analysis of SDG7 achievements on the share of renewable energy in total primary energy supply (%) (sdg7_PENREG), it can be seen that, on average, it recorded the value of 25%, the highest value being recorded in 2016 (34.6%). At the opposite pole, the minimum threshold for the lowest score of the indicator is reached in 2001 (13.1%).

5. Conclusions

In terms of the sustainable development index developed by Cambridge University(Cambridge University, 2022) researcher the highest level of development among the countries analysed is recorded by Poland, which in 2021 ranks 12th out of 163 signatories to the Paris Agreement, with an overall sustainable development index score of 80.5%, an increase of 11.3% compared to 2000, when the calculated index level was 72.5%. The Czech Republic ranks second in terms of sustainable development, 13th out of 163 countries in the Cambridge ranking, with an overall increase in sustainable development between 2000 and 2021 of 10.44%, from 72.8% in 2000 to 80.4% in 2021. In third place is Hungary, which ranks 21st out of 163 signatories to the Paris Agreement. It has the lowest sustainable development growth rate of the five countries analysed, respectively 7.35% from 73.5% in 2000 to 78.9% in 2021. Romania ranks 4th in the ranking of the 5 countries with a sustainable development index of 76.6% in 2021 and a maximum growth rate for the sample analysed of 12.63%. In last place is Bulgaria with an overall index value of 74.3%, giving it 42nd place in the ranking of the 163 countries monitored by Cambridge.

The growth rate of the general index is 11.23% in the period under review, as in the case of Romania, the difference with the other countries being the low score recorded for objective 9, respectively 58.8%, the increase being 258.54% compared to the index level in 2000.

The paper is set in a broad context of global uncertainty amid the onset of multiple economic, health, environmental, energy and political crises. During our research we found that this topic is intensely debated in the literature, especially in terms of sustainable development models. The research aimed to develop and improve current concepts of sustainable development by adding summary components resulting from the process of objective assessment of the phenomenon. The research is focused on the assessment of the current situation regarding the implementation of the Sustainable Development Goals (SDGs) in general and the most topical SDGs in particular, this usefulness being determined by the need to implement the various SDGs in relation to the conditions of uncertainty triggered in the global economy by the multiple crises and the unstable geopolitical context, made vulnerable by the outbreak of war in Ukraine.

6. Acknowledgement

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7. References

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