

Article

Progress Towards Affordable and Clean Energy: A Comparative Analysis of SDG7 Implementation

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Abstract

Progress towards Sustainable Development Goal 7 (SDG7) is currently insufficient to achieve. It is particularly important to ensure that all people have access to sustainable, reliable and affordable energy. As SDG7 is linked to other goals, a lack of progress in its implementation could disrupt the entire sustainable development process. The aim of our article is to compare selected countries around the world in terms of the degree of SDG7 implementation and its dynamics in the years 2000–2022. We assessed the degree of SDG7 implementation using Hellwig's method in the dynamic approach, and we compared the dynamics of the degree of implementation using the dynamic time warping (DTW) method and hierarchical clustering. The cluster of countries with the highest degree of SDG7 implementation included the European countries of Norway, Sweden and Iceland. The lowest degree of implementation was observed in Belarus, Uzbekistan and Turkmenistan. The dynamic approach to the problem allowed us to conclude that there was an increase in the synthetic measure in all the countries analysed in the period 2000–2022, with the strongest increase observed in the countries with the lowest initial degree of SDG7 implementation (Belarus, Uzbekistan, Turkmenistan).

Keywords: SDG7; Hellwig's method; dynamic time warping (DTW); hierarchical clustering

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1. Introduction

On 25–27 September 2015, in New York, all 193 UN member states signed the document “Transforming Our World: The 2030 Agenda for Sustainable Development” by resolution of the General Assembly [1]. The agenda contains 17 Sustainable Development Goals (SDGs) and 169 related targets. They concern achievements in five areas (the so-called 5 × P): people, planet, prosperity, peace, and partnership. The SDGs cover a wide range of challenges, such as hunger, poverty, education, health, gender equality, climate change, sustainable development, social justice, and peace. An important assumption has been made that these goals are to be achieved by the world by 2030. In line with this assumption, the implementation of the goals and tasks is constantly monitored worldwide using appropriate indicators [2]. They were adopted by a General Assembly resolution on 10 July 2017 [3]. The Sustainable Development Goals are a continuation of the Millennium Development Goals (MDGs) implemented as part of the United Nations Millennium Project with a time span from 2000 to 2015 [4].

The implementation of Sustainable Development Goal 7 is to ensure access to affordable, reliable, sustainable and modern energy for all (in short: Affordable and Clean

Energy). Investments in clean and renewable energy are a key to achieving a sustainable future. The continuous growth of the world's population requires increased energy production. Unfortunately, this energy is still largely based on fossil fuels, which leads to adverse climate change. The SDG7 focuses on modernising technology and expanding renewable energy infrastructure. Sustainable development goals are interlinked. Energy is central to most global issues, and access to energy is directly linked to human development. Access to affordable and clean energy contributes to poverty eradication (SDG1), food security (SDG2), health (SDG3), education (SDG4), gender equality (SDG5), employment (SDG8), transport (SDG9), sustainable cities (SDG11), or climate action (SDG13).

As Zavřelová and Pelikánová [5] point out, the ubiquitous term “sustainable development” is an ephemeral term with ambiguous and contradictory meanings, used in a specific way in current EU policies. The literature widely emphasises the importance of effective economic policy for achieving Sustainable Development Goal 7 (SDG7). In his research, Zarghami [6] points out that governments need to increase the coherence of their economic policies, promote prosperity and innovation opportunities, and implement international financial regulations to facilitate energy investment.

Despite progress, the world in 2022 was not on track to achieve SDG7 in European countries. Progress towards this goal was not faster due to the third year of the COVID-19 pandemic and the Russian invasion of Ukraine, which led to one of the largest refugee crises in history [7].

Many social, economic and environmental factors influence the achievement of sustainable development goals. Kuc-Czarnecka et al. [8] demonstrated that there is no correlation between higher levels of economic development and more effective implementation of SDG7, nor is there any correlation between social factors and the level of implementation of SDG7. They justified the impact of environmental factors and the negligible impact of economic factors on the development of affordable and clean energy in the EU-27 countries. Balancing economic, social and environmental goals is becoming a priority in business [9]. In particular, innovations in alternative resources and energy are at the heart of how companies promote sustainable development and support SDGs. Leonavičienė et al. [10] point to another factor influencing the degree of SDG implementation. This is a cultural factor, which in the case of the EU-27 countries has a negative impact on the implementation of SDG7.

The aim of our research is to compare selected countries around the world in terms of the degree of SDG7 implementation and its dynamics in the years 2000–2022. We assessed the degree of SDG7 implementation using Hellwig's method in the dynamic approach, and we compared the dynamics of the degree of implementation using the dynamic time warping (DTW) method and hierarchical clustering.

In our study, we propose an assessment of the degree of SDG7 implementation in selected countries around the world in a dynamic approach. Based on the values for the composite measure, it is possible to both provide rankings and examine the dynamics of the analysed phenomenon. However, the same position of a country in the ranking in individual years does not usually correspond to the same value of the composite measure for the entire analysed period. This is because countries at the bottom of the ranking may improve their SDG7 implementation throughout the period. Similarly, it may happen that countries at the top of the rankings experience a systematic deterioration in their SDG7 implementation. In addition, the countries selected for the study allow for an assessment of SDG7 implementation in European countries belonging and not belonging to the European Union, the G7 and the Commonwealth of Independent States (CIS) in the years 2000–2022. Both the methodological approach and the temporal and geographical scope of the study fill an existing research gap.

We formulate the following research questions:

Q1: Were there any significant changes in the rankings of countries in regard to the degree of SDG7 implementation during the period under review?

Q2: Are there similarities between countries in terms of the degree of SDG7 implementation?

The article is structured as follows: in Section 2 (Literature Review), we present the recent research in the field of sustainable development, mainly in the area of SDG7 implementation. In Section 3 (Materials and Methods), we outline the data used and the research methodology applied: the Hellwig's method and the Dynamic Time Warping (DTW) method. In Section 4 (Results), we report the results of the analyses. In Section 5 (Discussion), we conduct a discussion based on former studies in this area. In the Section 6 (Conclusions), we present the main findings and directions for future research.

2. Literature Review

According to the Sustainable Development Goals Report 2025 [11], the world has made significant progress towards SDG7. Global access to electricity reached 92% in 2023. This is an increase of 8 percentage points compared to 2010. It is predicted that, in 2025, renewable energy will overtake coal as the main source of electricity. 85 per cent of the global electricity deficit refers to Sub-Saharan Africa. Globally, 84 per cent of people without electricity in 2023 lived in rural communities. Current trends indicate that 645 million people will remain without electricity in 2030. Access to clean cooking fuels and technologies increased from 64 per cent (2015) to 74 per cent (2023). Approximately 2.1 billion people still rely on polluting fuels for cooking. In Sub-Saharan Africa, only 21 per cent of the population has access to clean cooking solutions. Renewable energy is currently the fastest growing energy source. Its share in total global final energy consumption has increased from 15.6% in 2015 to 17.9% in 2022. Hydropower remains the dominant renewable source of electricity. Wind and solar energy, on the other hand, have seen the largest absolute growth, with total consumption in 2022 tripling compared to 2015. Achieving SDG7 requires increased investment in clean energy, particularly in developing economies. Integrated interventions and policy measures are essential for a successful energy transition and the achievement of climate goals.

The report by Sachs et al. [12] indicates that none of the seventeen Sustainable Development Goals will be achieved by 2030. SDG2, SDG11, SDG14, SDG15, and SDG16 are particularly far from being achieved at the global level. There are only five years left until 2030, when the SDGs are to be achieved. Given such a short time frame, progress in achieving the SDGs is insufficient.

The lack of reliable data limits potential research in this area. Statistical systems are underfunded and treated as technical add-ons rather than fundamental investments. Without reliable data, it is impossible not only to conduct a thorough analysis but also to properly monitor progress and identify problems. In 2022, approximately 70% of all financial support for data and statistics was provided by nine donors. The World Bank had the largest share (26%), followed by the United States of America (14%) and the Inter-American Development Bank (10%) [11]. The emergence of new data and new methodologies means that data series presented in different reports may not be comparable with each other. This is particularly true if these reports are produced in different years.

Zhao et al. [13] developed the Energy Sustainability Index (ESI) with 5 dimensions and 12 indicators to measure progress towards SDG7 in 140 countries worldwide between 2011 and 2020. Their findings show that, although the global average ESI score increased by 6.7% between 2011 and 2020, this increase was largely dependent on the rapid development of a few emerging economies. The pace of growth in the rest of the world continues to lag behind. The strongest growth was achieved in South Asia, followed by East Asia

and the Pacific. The slowest growing region was the Middle East and North Africa. Low electrification levels in many Sub-Saharan African countries were identified as the most pressing barrier to economic growth [14]. Despite numerous initiatives to promote energy access in Africa and the Sustainable Development Goals (SDGs) calling for universal energy access by 2030, Africa may still not be able to achieve universal energy access by 2030 [15]. Increased energy assistance to low-income Sub-Saharan African countries can directly support climate-friendly economic growth and indirectly stimulate improvements in access to electricity. Such assistance will contribute to poverty reduction in the region [16].

Rybak et al. [17] point out that the process of energy transition in the EU-27 countries is so complex and diverse that it has led to the emergence of new, autonomous and unique clusters. The aim of their research was to examine the progress made by the EU-27 countries in reforming their economies and energy systems in line with the idea and objectives of sustainable development. Expert assessments showed that the most important indicator in the study was the import of energy raw materials. Only some European countries possess sufficient energy resources or enough developed renewable energy sources to become autonomous with respect to energy sources from outside the EU. This represents a substantial challenge to the energy security for EU countries.

Walesiak and Dehnel [18] used Eurostat indicators assessing progress towards SDG7 in the EU-27 countries to create an aggregate indicator. In their analysis, they applied dynamic relative taxonomy with the geometric mean. The study revealed systematic progress in achieving Sustainable Development Goal 7 in the EU between 2010 and 2021. The differences between individual EU countries clearly decreased. The smallest gap in relation to the SDG7 target was observed in Sweden, Denmark, Estonia, and Austria. Malta achieved the greatest progress between 2010 and 2021, with Cyprus, Latvia, Belgium, Ireland, and Poland also making significant progress.

Gebara and Laurent [19] noted that current SDG7 indicators have a number of gaps and limitations, which hinder effective policy making. In their article, they proposed a holistic framework that allows for the assessment of national SDG7 implementation using 29 indicators that take into account environmental, social and technical-economic aspects. They conducted the study using data from 176 countries. They compared the results of the indicators with absolute thresholds and sustainable development goals. This approach allowed them to assess how far current energy systems are from achieving a truly sustainable level. In their research results, they point to various efficiency patterns across countries and also trade-offs between environmental and social indicators.

Many studies qualitatively analyse interactions between SDGs, characterising them as synergies or trade-offs, often focusing on specific goals. Understanding the interactions (synergies and trade-offs) between SDGs is crucial for increasing policy coherence across different sectors [20]. Interactions between SDGs can lead to divergent outcomes. A significant positive correlation between a pair of SDG indicators is classified as a synergy, while a significant negative correlation is classified as a trade-off. The analysis by Pradhan et al. [21] indicates the existence of negative correlations between indicators within the same goal. These are mainly observed in SDGs 7, 8, 9, and 15. For example, the “percentage of population with access to electricity” (Indicator 7.1.1) has increased in some countries as a result of the development of non-renewable energy sources [22], but this may not support the growth of the “share of renewable energy in total final energy consumption” (Indicator 7.2.1). Fusco Nerini et al. [23] found evidence of synergies between 143 targets and efforts to achieve SDG7 (of relationships between 143 targets and efforts to achieve SDG7). Warchold et al. [24] showed that SDGs 1, 5 and 6 are associated with linear synergies, while SDGs 3 and 7 are associated with non-linear synergies. Linear synergies are related to the fact that progress in one indicator is proportionally linked to progress in another indicator

within the same goal. Non-linear synergies reflect a disproportionate improvement in one indicator through a change in another. Kuc-Czarnecka et al. [25] assessed the degree of SDG implementation in EU countries and examined the connections between the goals. Their study pointed to a peculiarity of SDG7. The authors showed that SDG7 was the only goal that was not linked to other SDGs (according to data for 2020).

In their article, Cheba and Bık [26] proposed measuring the relationship between SDG7 and environmental production efficiency. Their research shows how diverse the development paths of countries within a single economic community can be. Even Scandinavian countries that have succeeded in decoupling economic growth from adverse environmental effects are unable to foresee all the risks associated with their economic development. The larger the GDP per capita, the better the results should be in the context of SDG7 and environmental production efficiency under the Green Growth Strategy. However, the findings of the research presented in the article show that these dependencies are not so clear. Countries such as Belgium and the Netherlands, despite their relatively high GDP per capita, are successfully implementing SDG7, but their environmental production efficiency is lower than that of lower-income EU countries. In the case of Latvia, Spain, Romania, and Croatia, despite a lower than average EU GDP per capita, these countries reached relatively strong results in both analysed aspects.

Firoiu et al. [27] analysed the dynamics of the SDG7 implementation in EU Member States five years after the adoption of the Paris Agreement. EU countries were clustered in 2015 and 2019 on the basis of Eurostat data. The results of this study identified groups of countries with high performance and also countries that need more attention and support to assist their shift towards a greener economy. In 2015, four EU Member States (Romania, Denmark, Finland, and Sweden) were among the best-performing countries. In 2019, this number grew to eight EU member states (Czechia, Denmark, Bulgaria, Finland, Estonia, Sweden, France, and Romania), which was accompanied by an improvement in indicators. This demonstrates a real interest and commitment of the EU Member States to achieving the Sustainable Development Goals, in particular SDG7.

It is important to research the impact of globalisation on sustainable development in the Commonwealth of Independent States (CIS). Most of these countries are in a transition period from socialism to capitalism. Gasimli et al. [28] analysed the impact of economic, political and social globalisation on sustainable development in CIS countries. Economic growth in the economies undergoing transition results in increased demand for energy. Conventional energy sources are not adequate to guarantee energy security. Therefore, they aim to satisfy their energy demands from both conventional and renewable sources. Some transforming economies have varying levels of environmental problems, which prevent them from properly managing nuclear and fossil energy sources. Their study showed a negative and significant impact of the consumption of energy on sustainable development. This might be associated with the negative influence on the environment in comparison with other components of sustainable development, such as health, income, and education. This finding also suggests that CIS countries do not use energy efficiently in terms of production, consumption, and distribution of goods and services. Sobirov et al. [29] analysed the impact of energy consumption, foreign direct investment, openness to trade, and renewable energy consumption on economic development in CIS countries between 1992 and 2022. For sustainable development and environmental improvement, the CIS region should consider switching to alternative energy sources to meet the ever-growing demand for electricity.

Etxeberria Arano [30] points out in his study that the Sustainable Development Goals, including SDG7 in particular, do not fully take into account the realities of each country. According to him, more detailed goals, divided, for example, according to the level of de-

velopment, would be better. Furthermore, the goals are not binding on national legislation, so countries may choose not to comply with them. The situation is slightly different in the case of the EU countries. The EU has its own environmental protection regulations, which are legally binding in the Member States.

3. Materials and Methods

3.1. Materials

The analysis covers the period 2000–2022. The data comes from global, regional, and national databases, as well as metadata for SDG indicators maintained by the United Nations Economic Commission for Europe (UNECE) [31] and available at <https://w3.uncece.org/SDG/en/Contents> (accessed on 24 July 2025).

In 2016, only one-third of indicators had good data coverage, and 39% did not have internationally agreed methodologies. Currently, nearly 70% have good coverage, and all 234 indicators now have established methodologies. Significant progress was made between 2019 and 2025 in collecting data on SDG3, SDG6 and SDG7. Access to information on SDG5, SDG13, SDG14, and SDG16 still lags behind.

SDG7 has five targets to be achieved by 2030. Progress towards the targets is measured by six indicators (Table 1). Three of the five targets are the outcome ones (7.1, 7.2, 7.3), while the other two are means of implementation targets (7.A, 7.B). These goals involve access to affordable and reliable energy while expanding the proportion of renewable energy in the global energy mix. Their implementation involves improving energy efficiency, increasing international co-operation, investing in clean energy infrastructure, and equalising rights to energy distribution. Not all indicators can be used in a comparative study for countries. It should be noticed that the indicator 7.A.1 refers to relevant official loans, grants, and equity investments from donor countries and multilateral agencies to countries eligible to receive official development assistance. These are the countries that are included on the OECD's Development Assistance Committee (DAC) list and the International Renewable Energy Agency (IRENA) list.

In view of the above, the following variables were used in the study:

- x_1 —population with access to electricity (%);
- x_2 —population with primary reliance on clean fuels and technology (%);
- x_3 —renewable energy share in the total final energy consumption (%);
- x_4 —energy intensity level of primary energy (megajoules per constant 2011 purchasing power parity GDP);
- x_5 —installed renewable electricity-generating capacity, all renewables (watts per capita).

Of the above-presented variables, x_4 is the destimulant (for which the lowest possible values are the most preferable). The other variables are stimulating factors (for which the highest possible levels are the most preferable).

Not all countries report the above indicators. Therefore, 51 countries worldwide were included in the study. The names of these countries, together with their abbreviations, are presented in Table 2.

The analysed countries included the EU-27 (excluding Bulgaria), the G7 countries (excluding Japan) and all countries belonging to the Commonwealth of Independent States (CIS). The data necessary to conduct the analysis was not available for Bulgaria and Japan. Figure 1 presents the world map. The analysed countries are marked in blue.

Table 1. SDG7—targets and indicators.

Targets	Indicators
7.1 By 2030, ensure universal access to affordable, reliable and modern energy services	7.1.1 Proportion of population with access to electricity 7.1.2 Proportion of population with primary reliance on clean fuels and technology
7.2 By 2030, substantially increase the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in the total final energy consumption
7.3 By 2030, double the global rate of improvement in energy efficiency	7.3.1 Energy intensity measured in terms of primary energy and GDP
7.A By 2030, 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	7.A.1 International financial flows to lower-income countries in support of clean energy research and development and renewable energy production, including in hybrid systems
7.B By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular developed countries, small island developing States and landlocked developing countries, in accordance with their respective programs of support	7.B.1 Installed renewable energy-generating capacity in developing and developed countries (in watts per capita)

Source: elaborated on the basis of Titova et al. [32].

Table 2. Names of countries and their abbreviations.

Abbr.	Country	Abbr.	Country	Abbr.	Country
AL	Albania	DE	Germany	PT	Portugal
AD	Andorra	GR	Greece	MD	Republic of Moldova
AM	Armenia	HU	Hungary	RO	Romania
AT	Austria	IS	Iceland	RU	Russian Federation
AZ	Azerbaijan	IE	Ireland	XS	Serbia
BY	Belarus	IL	Israel	SK	Slovakia
BE	Belgium	IT	Italy	SI	Slovenia
BA	Bosnia and Herzegovina	KZ	Kazakhstan	ES	Spain
CA	Canada	KG	Kyrgyzstan	SE	Sweden
HR	Croatia	LV	Latvia	CH	Switzerland
CY	Cyprus	LT	Lithuania	TJ	Tajikistan
CZ	Czechia	LU	Luxembourg	TR	Turkiye
DK	Denmark	MT	Malta	TM	Turkmenistan
EE	Estonia	NL	Netherlands	UA	Ukraine
FI	Finland	MK	North Macedonia	GB	United Kingdom
FR	France	NO	Norway	USA	United States
GE	Georgia	PL	Poland	UZ	Uzbekistan

3.2. Method

The research covers the period from 2000 to 2022. The data comes from global and regional databases. The study was conducted in two stages. Each stage was an attempt to answer the research questions. In the first stage, we used a dynamic version of Hellwig's method [33] to rank countries in terms of their progress towards SDG7. This method enabled comparisons between countries and an assessment of the dynamics of SDG7 implementation. In the second stage of the study, Hellwig's composite measure values obtained in the first stage were used to compare the situation and changes in the implementation

of SDG7 in the analysed countries. For this purpose, the DTW (Dynamic Time Warping) method was used to examine the similarity of time series.

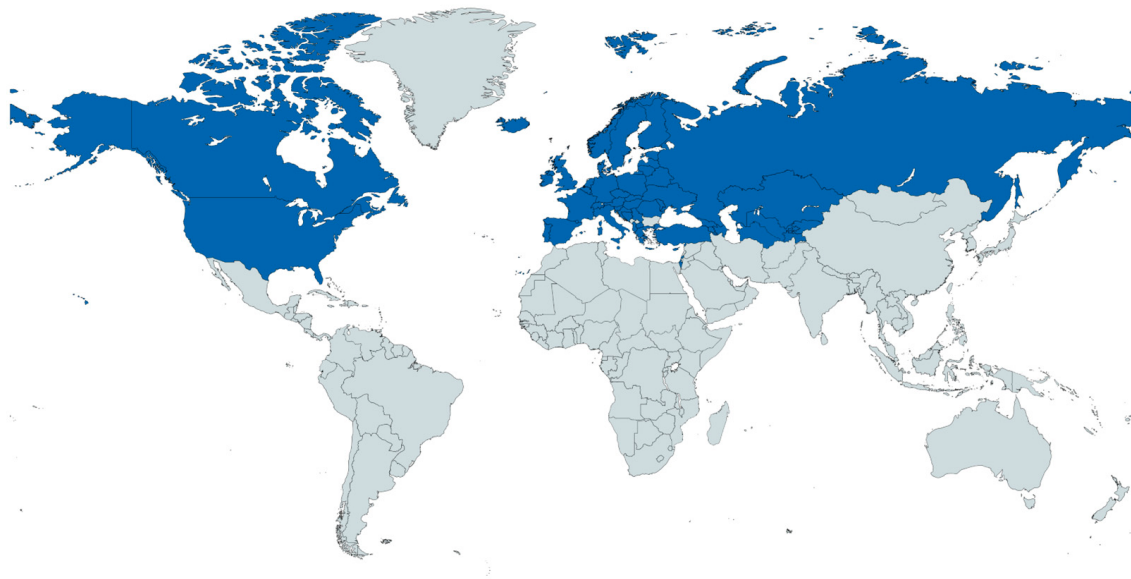


Figure 1. World map with marked countries under analysis.

3.2.1. Linear Ordering of Objects

The dynamic version of Hellwig's method was used to rank countries in terms of the degree of SDG7 implementation. This approach enabled the creation of rankings and the assessment of dynamics. The stages of this method are as follows:

- Dynamic normalisation of variables using the formula:

$$z_{ijt} = \frac{x_{ijt} - \bar{x}_j}{s_j} \quad (1)$$

where

x_{ijt} —value of j -th ($j = 1, \dots, m$) variable for the i -th object ($i = 1, \dots, n$) in t -th period ($t = 1, \dots, T$);

m —number of variables;

n —number of objects;

T —number of periods;

$\bar{x}_j$ —average value of j -th variable;

s_j —standard deviation for j -th variable, $s_j \neq 0$.

- Determination of the pattern co-ordinates:

for stimulants: $z_{0j}^+ := \max_{i,t} z_{ijt}$, for destimulants: $z_{0j}^+ := \min_{i,t} z_{ijt}$.

- Determination of the anti-pattern co-ordinates:

for stimulants: $z_{0j}^- := \min_{i,t} z_{ijt}$, for destimulants: $z_{0j}^- := \max_{i,t} z_{ijt}$.

- Calculation of Euclidean distances of objects from the pattern according to the formula:

$$d_{i0t} = \sqrt{\sum_{j=1}^m (z_{ijt} - z_{0j}^+)^2}, \quad t = 1, \dots, T \quad (2)$$

- Calculation of the distance between the pattern and the anti-pattern:

$$d_0 = \sqrt{\sum_{j=1}^m (z_{0j}^+ - z_{0j}^-)^2} \quad (3)$$

- Final calculation of the aggregate variable:

$$q_{it} = 1 - \frac{d_{i0t}}{d_0}, \quad t = 1, \dots, T \quad (4)$$

Hellwig's method is often used in socio-economic research [34]. Walesiak et al. [35] proposed a composite indicator based on dynamic relative taxonomy to present the varying distances of every European Union member state from both EU and national Europe 2020 Strategy targets. Walesiak and Dehnel [36] applied relative taxonomy in its dynamic approach to interval data for measuring the degree of social cohesion in NUTS2 regions in Poland in the period 2010–2019. Roszkowska and Jefmański [37] proposed a synthetic measure based on the Hellwig's approach and the interval-valued intuitionistic fuzzy set theory, which allows for the measurement of complex social phenomena under conditions of uncertainty, including survey data. Using this method, they assessed the subjective quality of life of residents of selected municipalities in Poland.

3.2.2. Comparison of Dynamics

The values of the Hellwig's composite measure obtained based on dynamic normalisation form the basis for the last stage of the research—a comparison of the dynamics of SDG7 implementation in the analysed countries. We perform this comparison using the dynamic time warping (DTW) method. This method was suggested by Bellman and Kalaba [38] for speech recognition [39]. We use the DTW algorithm to measure the similarity between time series. The DTW method allows us to find the optimal fit between two time series $X = (x_1, x_2, \dots, x_N)$ and $Y = (y_1, y_2, \dots, y_M)$. Its stages are as follows:

- We define the local measure of cost for elements X and Y using the equation:

$$c(x_i, y_j) = |x_i - y_j| \text{ for } i = 1, 2, \dots, N, \quad j = 1, 2, \dots, M \quad (5)$$

- After determining the local cost measure for each pair of elements, we create a local cost matrix $LCM \in R^{N \times M}$. The optimal match between time series X and Y is one with minimal total cost.
- The point-to-point match between time series X and Y is represented by a time warping path, i.e., a sequence [40,41]:

$$p = (p_1, \dots, p_L) \quad (6)$$

where

$$p_l = (n_l, m_l) \in \{1, \dots, N\} \times \{1, \dots, M\} \text{ for } l \in \{1, \dots, L\} (L \in \{\max(N, M), \dots, N + M - 1\}).$$

- The total cost $c_p(X, Y)$ of a warping path p is defined as:

$$c_p(X, Y) = \sum_{l=1}^L c(x_{n_l}, y_{m_l}) = \sum_{l=1}^L |x_{n_l} - y_{m_l}| \quad (7)$$

- We calculate the optimal match between X and Y by means of the formula:

$$DTW(X, Y) = c_{p^*}(X, Y) = \min\{c_p(X, Y) | p \in P\} \quad (8)$$

where P is the set of all possible warping paths.

We then find the optimal path p using a dynamic programming algorithm. The resulting value $DTW(X,Y)$ is a measure of the distance between time series X and Y .

The DTW distances between countries were used as the basis for hierarchical clustering of countries in terms of similarities in the dynamics of SDG7 implementation. The complete linkage method [42] was used to construct the tree.

The DTW method was initially used in many fields of technical science [43]. Currently, this algorithm is increasingly used in the study of time series describing economic and social phenomena [44–46], including comparisons of energy commodity time series [47] and in the field of sustainable energy [48].

4. Results

4.1. Rankings of Countries Obtained Using Hellwig's Method

As the results we obtained rankings of countries based on the degree of SDG7 implementation. Analysis of the rankings in Table 3 allows us to identify the countries that have implemented this goal to the greatest or least extent. Throughout the entire analysed period, the countries with the highest synthetic measure values occupy the top five places. These are: Norway (2000–2022), Iceland (2000–2022), Sweden (2000–2022), Austria (2000–2022), Canada (2006, 2008–2015), Switzerland (2000–2005, 2007, 2016), Finland (2017–2018, 2020–2022) and Denmark (2019). The last five places in the rankings for 2000–2022 were occupied by: Uzbekistan (2000–2022), Turkmenistan (2000–2022), Azerbaijan (2000–2001, 2019–2022), Belarus (2000–2017), Bosnia and Herzegovina (2006–2021), Kazakhstan (2007–2009, 2011–2013, 2016–2022), Romania (2000–2005), Ukraine (2002–2006, 2010, 2014) and Russia (2017, 2022). There were also countries with the largest changes in their ranking positions. The largest increases in ranking positions between 2000 and 2022 were recorded by Albania (from 37 to 11), Romania (from 48 to 23) and Tajikistan (from 43 to 19). On the other hand, the largest decline in ranking was recorded by Andorra (from 11 to 28), Israel (from 25 to 43) and Turkey (from 14 to 35).

The consistency of the rankings was assessed by means of Spearman's rank correlation coefficient. The results are presented in the form of heatmaps in Figure 2. The darker the colour, the greater the consistency of the rankings in the compared years. All values obtained are positive and above 0.7798. This indicates that the rankings were very similar in all years. However, the greater the time interval between the analysed years, the lower the consistency.

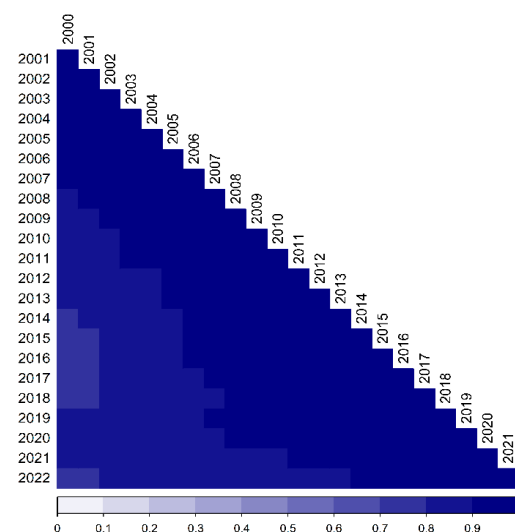


Figure 2. Heatmap presenting correlations between rankings.

Table 3. Rankings of countries in terms of SDG7 implementation in the period 2000–2022.

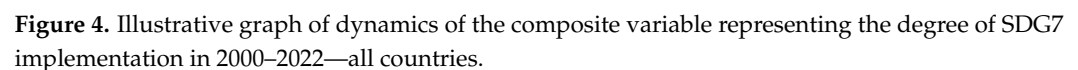
Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AL	37	34	34	26	26	20	21	17	16	15	15	13	13	13	13	12	11	11	12	11	11	11	11
AD	11	11	11	12	13	13	12	13	13	14	14	14	15	17	18	20	19	22	23	23	23	26	28
AM	35	30	30	24	25	26	26	26	26	28	27	32	35	37	39	33	33	32	35	37	41	41	41
AT	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5
AZ	47	47	46	46	46	45	41	40	41	42	42	43	43	44	45	44	44	46	46	47	47	49	49
BY	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	48	48	47	45	45	45	45	45
BE	36	37	38	39	39	39	39	37	38	39	35	34	32	33	32	32	34	31	28	30	29	28	27
BA	40	39	42	41	41	43	47	48	48	48	48	49	49	49	48	47	51	51	49	48	49	47	46
CA	6	6	6	6	6	6	5	6	5	5	5	5	5	5	5	5	6	8	8	8	8	8	8
HR	9	9	9	9	9	9	10	10	10	11	11	12	12	12	11	11	12	12	11	12	13	12	14
CY	31	32	33	34	35	37	37	36	36	40	39	37	37	35	40	40	40	39	40	41	38	36	38
CZ	29	29	26	32	32	31	30	29	28	29	29	27	27	29	28	30	30	30	33	32	34	34	37
DK	13	13	13	13	12	10	11	11	11	12	12	11	9	10	9	8	8	7	6	5	6	6	6
EE	21	22	18	19	19	21	24	24	20	18	22	20	20	22	23	17	22	20	19	15	12	13	13
FI	8	8	8	8	8	8	8	8	7	8	9	8	8	8	8	7	7	5	5	6	5	5	4
FR	15	18	17	17	18	22	23	20	21	22	23	24	24	24	25	25	24	24	24	24	25	25	25
GE	17	14	12	11	11	19	15	14	14	13	13	16	17	14	14	16	14	15	15	17	19	18	21
DE	24	23	23	25	24	25	20	18	18	20	18	18	16	18	17	13	15	14	13	13	14	14	12
GR	19	20	19	22	22	23	22	25	25	25	24	23	22	21	22	23	23	23	21	19	17	15	17
HU	30	31	31	33	33	30	29	28	30	26	31	28	28	30	33	35	37	37	41	40	39	39	33
IS	2	2	2	2	2	2	2	2	2	3	2	3	3	3	3	2	2	2	2	2	2	2	2
IE	27	28	29	30	29	28	28	30	29	30	33	30	31	32	29	29	31	27	26	26	26	27	26
IL	25	25	24	27	27	27	31	33	32	35	38	38	44	43	43	43	43	43	43	43	43	43	43
IT	22	21	21	23	23	24	25	22	19	19	20	19	19	19	19	21	21	19	20	21	21	22	24
KZ	42	41	41	42	42	42	45	47	47	47	46	47	47	47	46	45	47	48	48	49	48	48	48
KG	20	17	22	18	17	17	18	19	24	21	21	25	29	26	24	28	27	25	27	25	27	31	34
LV	7	7	7	7	7	7	7	7	8	7	7	7	7	7	7	9	9	9	9	9	9	10	9
LT	18	19	20	21	20	18	19	21	22	23	19	21	21	20	20	19	16	16	16	16	18	17	15
LU	23	24	32	31	31	33	34	32	33	37	40	39	39	38	36	34	26	26	25	27	24	21	20
MT	34	36	37	38	40	40	40	41	43	43	44	44	42	42	42	42	41	42	42	42	42	42	42
NL	32	33	35	35	37	36	36	35	35	38	41	41	41	41	41	41	42	41	39	34	28	23	18
MK	38	40	40	40	36	34	33	38	37	32	28	35	34	31	30	26	29	36	32	39	36	35	36
NO	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
PL	28	26	27	29	30	32	35	34	34	36	37	36	36	36	37	39	39	40	38	38	37	38	31
PT	10	10	10	10	10	11	9	9	9	10	8	9	10	9	10	10	10	10	10	10	10	9	10
MD	45	45	45	45	44	46	43	44	44	44	32	31	30	27	27	27	28	29	30	36	40	40	40
RO	48	48	49	48	48	47	46	45	40	34	30	29	25	23	21	22	18	17	18	20	22	24	23
RU	44	44	44	44	45	44	44	43	45	45	45	45	45	45	44	51	45	45	47	46	46	46	47
XS	41	43	43	43	43	41	42	42	42	33	36	42	38	39	34	38	38	38	37	35	31	29	32
SK	39	38	39	37	34	35	32	27	27	27	25	22	23	25	26	24	25	28	29	28	32	33	39
SI	12	12	14	14	14	12	13	12	15	16	17	17	18	16	16	18	20	21	22	22	20	20	22
ES	16	16	16	16	16	16	16	16	17	17	16	15	14	15	15	15	17	18	17	18	15	16	16
SE	3	3	3	3	3	3	3	3	3	2	3	2	2	2	2	3	3	3	3	3	3	3	3
CH	5	5	5	5	5	5	6	5	6	6	6	6	6	6	6	6	5	6	7	7	7	7	7
TJ	43	42	25	20	21	14	14	15	12	9	10	10	11	11	12	14	13	13	14	14	16	19	19
TR	14	15	15	15	15	15	17	23	23	24	26	26	26	28	31	31	32	34	34	31	35	37	35
TM	49	49	48	49	49	49	49	49	49	49	49	48	48	48	49	50	50	49	50	51	50	51	51
UA	46	46	47	47	47	48	48	46	46	46	47	46	46	46	47	46	46	44	44	44	44	44	44
GB	33	35	36	36	38	38	38	39	39	41	43	40	40	40	38	37	36	33	31	29	30	30	29
USA	26	27	28	28	28	29	27	31	31	31	34	33	33	34	35	36	35	35	36	33	33	32	30
UZ	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	49	49	50	51	50	51	50	50

4.2. Results of Clustering of Countries Based on the DTW Distance

The use of the DTW method allowed countries to be clustered according to changes in the synthetic measure describing the degree of SDG7 implementation. Six homogeneous clusters of countries with similar situations and directions of change in SDG7 implementation were identified. The results of the clustering are presented in Figure 3. Due to the

A circular phylogenetic tree representing the relationships between 40 languages. The tree is rooted at the bottom and branches outwards. Languages are labeled with two-letter codes around the perimeter, color-coded by family: Indo-European (blue), Balto-Slavic (orange), Germanic (yellow), Celtic (green), and others (red). The tree shows a clear hierarchical structure with major clades and sub-clades.

Figure 3. Clusters of countries by the degree of implementation and dynamics of SDG7—radial dendrogram.



Figures 5–7 present detailed graphs for the composite measure in individual groups of countries.

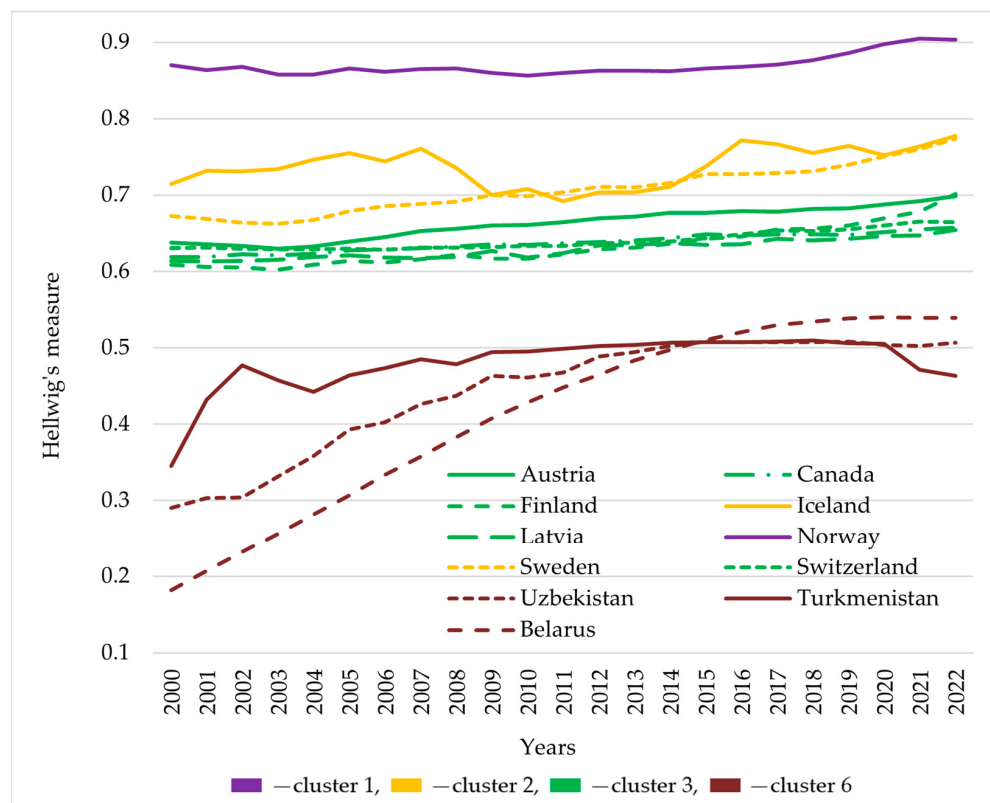


Figure 5. Illustrative graph of dynamics of the composite variable representing the degree of SDG7 implementation in 2000–2022—clusters 1, 2, 3, 6.

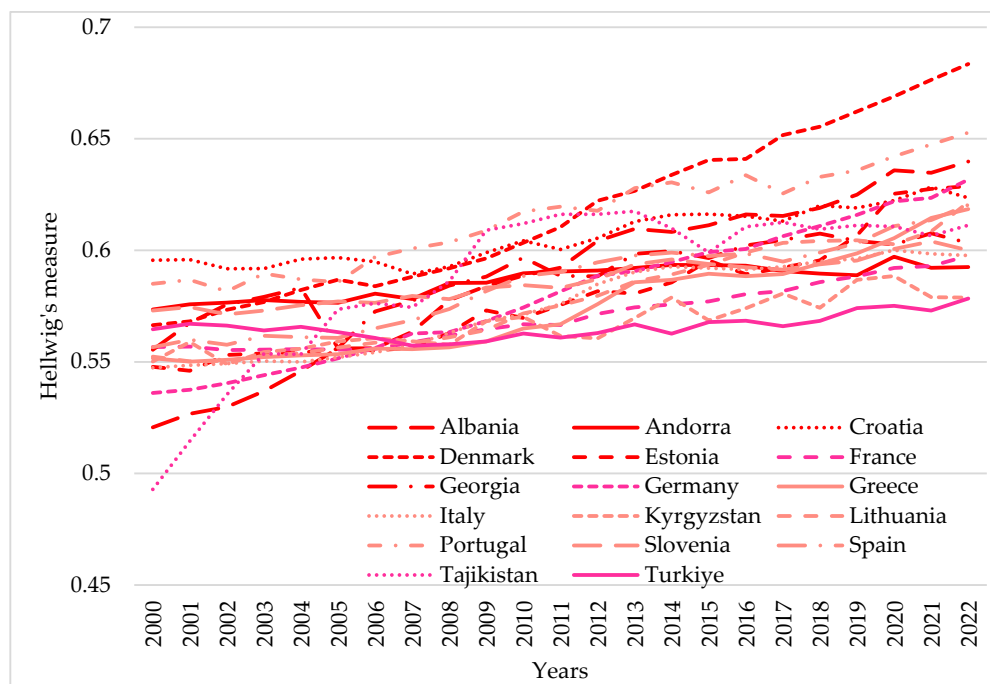


Figure 6. Illustrative graph of dynamics of the composite variable representing the degree of SDG7 implementation in 2000–2022—cluster 4.

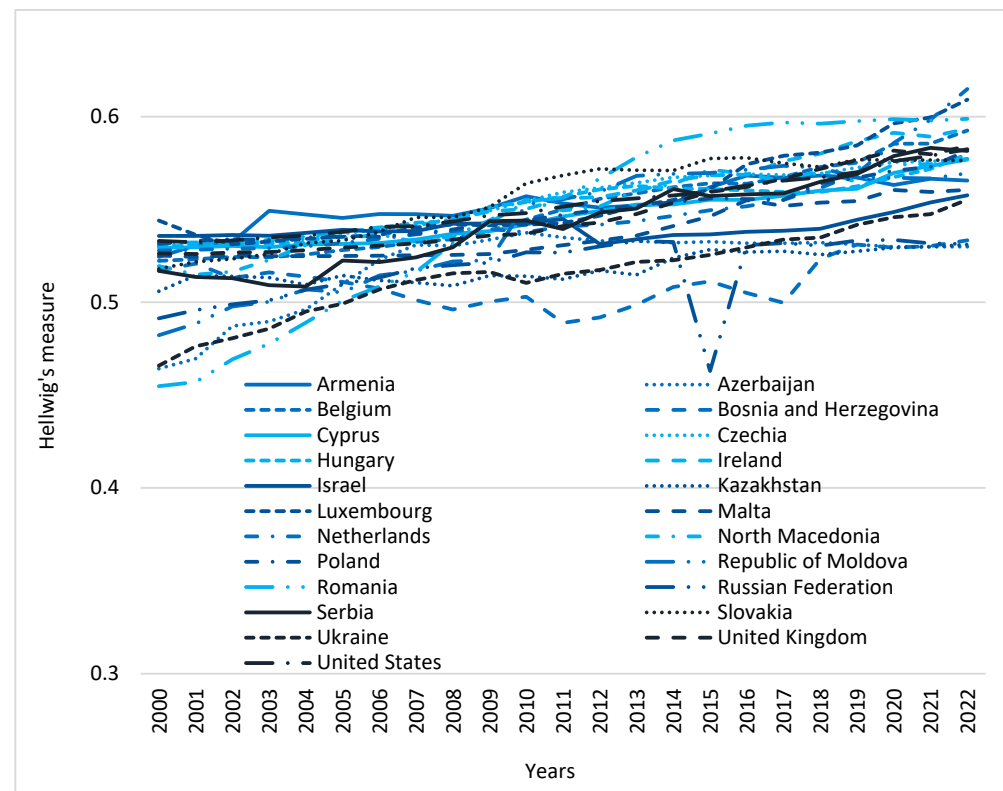


Figure 7. Illustrative graph of dynamics of the composite variable representing the degree of SDG7 implementation in 2000–2022—cluster 5.

- Cluster 1 (purple colour): Norway—the synthetic measure values are stable in the years 2000–2022 and remain at a very high level (Figure 5).
- Cluster 2 (yellow colour): Iceland and Sweden—composite measure values are high. In Sweden, these values increased, while, in Iceland, there was a noticeable decline in values between 2008 and 2014 (Figure 5).
- Cluster 3 (green colour): Finland, Canada, Latvia, Austria, Switzerland—the composite measure values are at a medium-high level and show a slight increase between 2000 and 2022. Austria ranks highest in this group (Figure 5).
- Cluster 4 (red colour): Albania, Andorra, Croatia, Denmark, Estonia, France, Georgia, Germany, Greece, Italy, Kyrgyzstan, Lithuania, Portugal, Slovenia, Spain, Tajikistan, Turkey—average synthetic measure values showing slight increase. The largest increases in this group were recorded in Tajikistan (by 24%, despite a sharp decline in 2015), Albania (by 23%) and Denmark (by 21%) (Figure 6).
- Cluster 5 (blue colour): Armenia, Azerbaijan, Belgium, Bosnia and Herzegovina, Cyprus, Czechia, Hungary, Ireland, Israel, Kazakhstan, Luxembourg, Malta, Netherlands, North Macedonia, Poland, Republic of Moldova, Romania, Russian Federation, Serbia, Slovakia, Ukraine, United Kingdom, United States—medium-low synthetic measure values, showing slight increase. The largest increases in this group were recorded in Romania (32%), Ukraine (19%) and the Republic of Moldova (18%). For some countries, the changes were not smooth. In 2015, Russia recorded a large decline in the synthetic measure (by 13%), followed by a return to its previous high value in 2016. The synthetic indicator for Azerbaijan increased from 2000 to 2010 and then began to decline. Bosnia and Herzegovina recorded a sharp decline in the indicator between 2000 and 2011, followed by a sharp increase between 2012 and 2022 (Figure 7).
- Cluster 6 (brown colour): Belarus, Turkmenistan, Uzbekistan—synthetic measure values are low and show significant growth between 2000 and 2022. The largest

increase was in Belarus (by 197%), followed by Uzbekistan (by 74%) and Turkmenistan (by 34%) (Figure 5).

Figures 5–7 also present illustrative charts. These are time series for the calculated composite measure. Since, in many cases the composite measure values are similar to each other, the clusters presented in Figure 4 have been divided into three charts. Figure 5 shows charts for clusters 1, 2, 3 and 6. Figure 6 shows the countries belonging to cluster 5, and Figure 7 shows the countries belonging to cluster 6. The benefits of such a dynamic approach to the problem are particularly evident in the example of Belarus (cluster 6). Between 2000 and 2014, Belarus was ranked last (51). However, observing the changes in the composite measure (Figure 5), it can be seen that its situation was constantly improving.

The EU-27 countries were clustered as follows: 2 (Sweden), 3 (Austria, Finland, Latvia), 4 (Croatia, Denmark, Estonia, France, Germany, Greece, Italy, Lithuania, Portugal, Slovenia, Spain), and 5 (Belgium, Cyprus, Czechia, Hungary, Ireland, Luxembourg, Malta, Netherlands, Poland, Romania, Slovakia). Among these countries, Sweden, Finland, Austria, Denmark, and Portugal had the highest values of the composite indicator in 2022. The lowest values were recorded in Malta, Slovakia, Hungary, Cyprus, and the Czech Republic. The highest percentage increases in the indicator were recorded in Romania (32%), Denmark (21%), and Germany (18%).

The G7 countries were grouped into the following clusters: 3 (Canada), 4 (Italy, France, Germany), and 5 (United States, United Kingdom). These are clusters with medium-high, medium and medium-low composite measure values, respectively. The increase in the composite measure between 2000 and 2022 varied across these countries. It was high in Germany (18%), fairly high in the United Kingdom (11%), and fairly low in the other G7 countries. In 2020, Canada, France and Italy had above-average synthetic measure values, while, in 2022, only Canada and Germany did. This shows that, in the G7 countries, the degree of SDG7 implementation was average in 2000–2022.

The CIS countries were included in the following clusters: 4 (Kyrgyzstan, Tajikistan), 5 (Armenia, Azerbaijan, Kazakhstan, Republic of Moldova, Russian Federation), and 6 (Belarus, Turkmenistan, Uzbekistan). It should be added here that Turkmenistan is an associate member of the CIS. Among these countries, Tajikistan had the highest composite measure value in 2022, while Turkmenistan had the lowest. The largest value increases were recorded in Belarus (197%), Uzbekistan (74%), and Turkmenistan (34%). Georgia (cluster 4, CIS member until 1993) and Ukraine (cluster 5, CIS member until 2018) used to be members of the CIS. Due to their current non-membership, they were not included in the CIS group during the analysis.

5. Discussion

Ranking countries and clustering them on the basis of certain characteristics are among the basic methods used to assess progress towards set goals. The results of such studies vary depending on the applied methodology, the analysed characteristics, the research units and the research period. Our study covered a long period (2000–2022) and a relatively large number of countries. This allows us to refer to many similar studies assessing the degree of SDG7 implementation.

In our study, Norway ranks first in terms of sustainable energy development in all years. Sweden and Iceland occupy the subsequent highest positions. Similar leaders were indicated by Elavarasan et al. [49]. They developed an index for monitoring the SDG7 implementation and used it to assess the performance of 40 European countries in terms of sustainable energy development in 2018. Elavarasan et al. applied different weights to the indicators in their study. If the weights were equal, Norway would also be in first place in

their ranking. Luxembourg, Poland and Cyprus ranked lowest in their study, while our study indicated Belarus, Ukraine and Malta.

The conducted research indicated that Sweden and Denmark ranked high in 2015. Romania was in the middle of the ranking, while Malta, the Netherlands and Cyprus ranked lowest. Slightly different results were obtained by Fura and Skrzypek [50]. The ranking of 27 EU countries was created in terms of the degree of SDG7 implementation in 2015–2023. The research confirmed the diversity of EU countries in terms of the degree of SDG7 implementation. Denmark, Romania, and Sweden were the three highest-ranked countries in 2015, and Denmark, Sweden, and Estonia were the three highest-ranked countries in 2023. The weakest performers in SDG7 implementation in 2015 were Cyprus, Belgium, and Luxembourg, and in 2023 Belgium, Lithuania, Cyprus, and Luxembourg. Luxembourg, Ireland and Malta made the most progress in SDG7 implementation, while the largest decline was observed in Spain. The results of the study highlighted problems with the implementation of SDG7 not only in lower-income countries (Central, Eastern and Southern Europe), but also in higher-income Western countries. Our study confirmed that only Sweden and Denmark ranked high in 2015. Romania was in the middle of the ranking. In 2015, Malta, the Netherlands and Cyprus ranked lowest in our study.

Our study points to uneven progress in the SDG7 implementation in EU countries. Similar results were obtained by Rybak et al. [16]. Their conducted cluster analysis showed that, between 2000 and 2019, the actions of EU Member States did not result in the harmonisation of clusters within the EU. By contrast, the rate and direction of change in particular countries resulted in the emergence of additional clusters.

If the study were limited to the years 2013–2020 and to the EU-27 countries, the results for the best countries would be similar to those obtained by Kuc-Czarnecka et al. [51]. Sweden and Denmark ranked high in the rankings. However, the low rankings of Bulgaria, Cyprus, and Lithuania were not confirmed by our study. In our study, which used a different set of variables, Hungary and Malta had the worst positions in the rankings among the EU-27 countries. In addition to the variables, other research methods may also have influenced the results. Our study, limited to the years 2010–2021 and the EU-27 countries, confirms the high position of Sweden, Denmark, and Austria. This is consistent with the results obtained by Walesaik and Dehnel [18]. However, our set of variables indicates that, between 2010 and 2021, the greatest progress in achieving SDG7 was made in Luxembourg, the Netherlands, Denmark, Estonia, and Finland. This result differs from the results described in [18], where it was presented that Malta, Cyprus, Latvia, Belgium, Ireland and Poland made significant progress between 2010 and 2021.

Our analysis showed that G7 countries have an average position in terms of SDG7 implementation. This is consistent with the research by Zhao et al. [52]. They draw attention to the environmental policies of the G7 countries. This scenario can be attributed to the fundamental problem of fossil fuel use in these countries, as well as difficulties in implementing renewable energy in practice. In the US, the current energy infrastructure for renewable energy production may not be sufficient to meet long-term energy demand growth [53]. As a result, fossil fuel consumption in the US will increase. In such circumstances, in addition to increasing the use of renewable energy, the US government should also focus on increasing energy productivity. This will allow energy demand to be met with a smaller volume of both renewable and non-renewable energy resources. Research by Ofori and Appiah-Opoku [54] also showed that, in the G7 countries (as well as in the BRICS countries), the reason for the lack of spectacular successes in achieving SDG7 (as well as SDGs 3, 4, 8 and 13) is a lack of synergy and coordination.

The conducted research covered the CIS countries in terms of their geographical scope. Progress in the SDG7 implementation in these countries varied. Kyrgyzstan and Tajikistan

rank quite high in terms of SDG7 implementation. This is because these countries have the largest (after Russia) per capita hydropower resources among the CIS countries and among the highest in Asia. On the other hand, Turkmenistan's low ranking may be due to the fact that it relies almost entirely on fossil fuels. Turkmenistan has some of the world's richest natural gas reserves, as well as oil reserves. The results of our analysis in this area coincide with the research by Güler and Aydinbaş [55]. They analysed the persistence of consumption-based and production-based CO₂ emissions belonging to CIS countries between 1991 and 2019. In these countries, the demand for energy necessary for urbanisation, transportation, and heating is met by fossil fuels. All of these countries, with Russia to the highest degree, have high potential for renewable energy. Their research indicates that Azerbaijan, Armenia, Belarus, Kyrgyzstan, Russia, and Ukraine possess the persistent power to enact laws and policies to mitigate CO₂ emissions. Our study also indicates an increase in the SDG7 implementation in these countries between 2000 and 2022, and a worse position for Belarus (despite a significant increase in the value of the indicator) and the Russian Federation. A study by Bianco et al. leads to similar conclusions [56]. They assessed energy inequalities, which are at the heart of SDG7, in the Eurasian Economic Union (EEU). The union was established on 29 May 2014 and currently comprises Belarus, Kazakhstan, Armenia, Kyrgyzstan, and the Russian Federation. Access to affordable, reliable and modern energy for all is only fully ensured in Armenia. In Kazakhstan and Kyrgyzstan, current progress suggests that it will be achieved by 2030. In Belarus and Russia, the pace of change is increasing, but it is not sufficient to achieve SDG7 by 2030.

It can be noted that, despite methodological differences, in most cases, the same countries were identified as leaders in achieving SDG7. Differences emerged in the case of countries with lower rankings. This is due to the fact that the leading countries have better indicators in each of the analysed areas. Therefore, the selection of indicators does not affect their high position. On the other hand, countries with lower rankings have better results only in specific areas. In this case, the selection of analysed indicators affects their position in rankings.

6. Conclusions

The article provides a comparative analysis of selected countries' progress toward Sustainable Development Goal 7 (SDG7) and the temporal evolution of its implementation between 2000 and 2022. The entire analysis was carried out in relation to two research questions. The first stage of the study provided an answer to the first of these, Q1. A static approach involving the creation of rankings and their comparison using Spearman's rank correlation coefficients seemingly indicates no significant changes in the degree of SDG7 implementation in the analysed countries. However, a dynamic approach to the composite measure allowed for a proper overall assessment of the degree of implementation of this goal in the years 2000–2022 and not only in relation to individual years. The values of this measure indicate that all countries in the analysed period experienced an increase in the value of this indicator. Even countries that are still at the bottom of the ranking have seen a significant improvement in the achievement of SDG7. The final answer to this question is therefore affirmative.

The second stage of the analysis referred to question Q2. The applied DTW method enabled a comparison of changes in time series created from a composite measure. It was shown that there are similarities between countries in terms of the degree of SDG7 implementation. However, the analysis revealed considerable diversity in this area, as six clusters of countries with similar levels of change were identified. It seems that the common policy of EU countries and their commitments contribute to the high degree of

achievement of SDG7. European countries outside the EU that have access to alternative energy sources and have been using them for many years (Norway, Iceland) also rank high. Access to hydropower enables a high degree of SDG7 implementation in countries with low GDP per capita, such as Kyrgyzstan and Tajikistan. These countries rank higher than some higher-income countries. This is mainly due to the fact that highly industrialised countries largely rely on fossil fuels.

Our findings have significant implications for both theory and practice. Theoretically, the use of Hellwig's dynamic method combined with DTW provides a new, more holistic perspective for assessing progress on development goals, which can serve as valuable inspiration for future research. The method used shows that static comparisons are insufficient and that examining the dynamics of change is crucial for understanding global trends. The observed catch-up effect provides a valuable insight for development researchers, suggesting that countries starting from a lower baseline have the potential for faster progress, possibly due to technology transfer, increased investment, or the adoption of effective policies from other nations. Practically, these results can serve as a tool for policymakers. The group of leaders (Norway, Sweden, Iceland) can be a model to emulate, while the strong growth in countries with the lowest scores (e.g., Belarus, Uzbekistan, Turkmenistan) shows that appropriate investments and strategies can yield tangible results. This highlights the urgent need to increase international cooperation, especially in technology transfer and financing for countries that are still facing the biggest challenges in energy access. Understanding which countries are performing best and which show the strongest growth allows for better targeting of aid and resources.

As mentioned earlier, access to reliable and complete data is a major limitation in research, and this was also the case in our analysis. The selected data set is a reliable source, but it does not cover all countries, which limits the possibility of full global generalization of the results. Furthermore, it should be remembered that, in this type of research, the results obtained largely depend on the methodological approach adopted, both in the selection of features and the adoption of a specific standardization formula, as well as the variants of reference points considered [57].

In this context, our study, while providing valuable conclusions, has inherent weaknesses that must be openly discussed. First, Hellwig's method, although powerful, is highly dependent on the quality of the input data. While we considered the main SDG7 indicators, not all nuances, such as the affordability of energy for the poorest segments of society or the quality of supply, could be fully included. Second, the application of the DTW method allows for a comparison of change trajectories but does not explain their causes. Our results show what happened, but they do not explain why some countries saw strong growth while others stagnated. A full understanding of these processes would require a deeper qualitative analysis that considers the specifics of national policies, geopolitical conditions, and investments. Therefore, future research should focus on a deeper cause-and-effect analysis. It is necessary to investigate what specific policies, investments, or geopolitical factors led to such dynamic growth in the countries with the lowest initial scores. Including a wider range of SDG7 indicators and analyzing recent data that might reflect the impact of global crises would certainly enrich our understanding of progress towards this key sustainable development goal.

It is worth noting, however, here that our results concerning the countries with the highest degree of SDG7 implementation largely coincide with the results obtained by other researchers using different variables, different methods, and different weights. This confirms the high position of these countries. The differences, on the other hand, mainly concern the countries with the worst positions in the rankings.

In future studies, it would be worthwhile to expand the group of countries analysed and extend the list of variables. Continuous monitoring of the degree of SDG implementation is very important in order to pursue the right sustainable development policy. As our research shows, a country's economic development does not always contribute to the SDG7 implementation. Lower-income countries often use the cheapest energy sources available to them or outdated low-energy technologies, which in many cases are fossil fuels. Highly industrialised countries also continue to have high CO₂ emissions. This is very often due to the prioritisation of economic benefits over environmental benefits, which disrupts or slows down the entire process of sustainable development.

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