
Regional Differences in Energy Policy Changes of EU Countries in 2012-2021

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Abstract:

Purpose: Among EU countries, there is a widespread consensus regarding the necessity of implementing specific changes in the field of energy policy. However, due to political, economic, and social factors, the extent of changes introduced by individual countries varies. The aim of the article is to assess the degree of diversity in the changes implemented by individual EU countries between 2012 and 2021.

Design/Methodology/Approach: The assessment of changes in the energy policy pursued by individual countries was based on the examination of changes that occurred during the analyzed period among selected 15 variables. Using the k-means method, homogeneous groups of countries were identified based on the recorded changes in diagnostic variables. The study covered all 27 EU member states.

Findings: The decision-making by individual countries related to their energy policy is significantly linked to the specific socio-economic conditions of each country. Analyzing the decisions made by other countries and the information about the consequences of these decisions can largely contribute to objectivity in the pursued energy policy.

Practical Implications: Identifying differences in the energy policies of individual EU countries and describing the effects of their actions can contribute to a revision of the existing policies in this area by other countries. This can lead to the development of a more effective energy policy for the EU as a whole.

Originality/Value: The issues related to energy security, especially in the context of the armed conflict between Russia and Ukraine, are significant elements of the EU's energy policy. Individual countries, taking into account their internal conditions, approach this matter in various ways, especially regarding the goal of reducing dependence on external energy sources.

Keywords: Energy policy, EU, statistical analysis.

JEL codes: C1, Q4, F59.

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1. Introduction

The evolution of the European Union's (EU) energy policy is in response to changing energy-related challenges and goals. As global priorities shift and progress is made, the EU's energy policy continues to evolve, focusing on sustainable, secure, and competitive energy. This evolution contributes to combating climate change and improving the quality of life for EU citizens.

In the early years of European integration, the focus was on securing energy supply. In the 1950s and 1960s, the European Coal and Steel Community and Euratom were established to ensure the stability of energy resource supplies and support nuclear technology development.

In the 1990s, the EU introduced directives to liberalize the energy market, promote competition, and create a single energy market, opening the energy sector to competition and providing consumers with more choices of energy providers.

In the early 21st century, the EU focused on promoting sustainable energy development. In 2007, a climate and energy package was adopted, setting targets for reducing greenhouse gas emissions, increasing the share of renewable energy, and improving energy efficiency.

In subsequent years, the EU concentrated on increasing the share of renewable energy sources in the energy mix by systematically introducing directives and goals related to renewable energy sources. Simultaneously, efforts continued to improve energy efficiency in all sectors of the economy.

The EU played a crucial role in international climate negotiations. In 2015, the EU contributed to the achievement of the Paris Agreement, which aims to limit global temperature rise to below 2 degrees Celsius. Within this agreement, the EU continues to work towards reducing greenhouse gas emissions and promoting sustainable energy.

Currently, the cornerstone of the EU's energy policy is the European Green Deal. It is a strategic initiative aimed at transforming the European economy into a climate-

neutral one by 2050. Within the Green Deal³, the EU seeks further emission reductions, the development of renewable energy, the implementation of sustainable mobility, the modernization of energy infrastructure, and the creation of green jobs.

2. Literature Review

There is a wealth of publications and literature on the energy policy of the European Union. Comprehensive reviews of EU energy policy, analyzing both political and economic aspects, have been presented by authors such as Morata and Sandoval, (2012) and Rozwadowska, (2023). Sovacool, Sidortsov, and Jones, (2013) focused on energy security aspects in the context of the EU, examining equality and justice in energy access and sustainable energy development.

Siksnylyte-Butkiene, Karpavicius, Streimikiene, and Balezentis, (2022) highlighted that the efforts of countries toward a green economy are more critical than ever, given the current global energy crisis and economic uncertainty resulting from various challenges, such as the COVID-19 pandemic and Russia's invasion of Ukraine.

Dumitrescu, Horobet, Tudor, and Belaşcu, (2023) pointed out that replacing fossil fuels in electricity generation with low-carbon sources, especially wind and water, is a beneficial path to decarbonization while reducing the EU's dependence on foreign oil and gas sources (Pociovalisteanu *et al.*, 2010; Thalassinos *et al.*, 2022).

Ossowska (2019) conducted research on the diversification of renewable energy consumption in individual EU member states, and Kopnina (2016) focused on the significance of various types of renewable energy in the context of sustainable development in Europe. The analysis of the diversity of actions taken by EU countries in energy policy, stemming from climate and energy goals, was also carried out by Luty and Ziolo, (2022).

Kowalik, Zawada, Szajt, and Kucęba (2018) assessed the current implementation of the fundamental principles of the Community in energy policy, and Osička and Černoch, (2022) indicated the possible use of gas supplies to Europe as a tool of influence by Russia, along with the associated efforts of EU countries to reduce energy vulnerability and accelerate decarbonization (Thalassinos and Pociovalisteanu, 2007).

³*More on this topic in: Communication From The Commission To The European Parliament, The European Council, The Council, The European Economic And Social Committee And The Committee Of The Regions The European Green Deal, 2019; Going climate-neutral by 2050. A strategic long-term vision for a prosperous, modern, competitive and climate-neutral EU economy, European Commission, 2018; EU Climate Law - Proposal for a Regulation Of The European Parliament And Of The Council. European Commission, 2020; Fit for 55 Package. European Commission, 2021.*

3. Methodology

To conduct an analysis of changes in EU countries regarding their energy policy and its effects on the energy balance of these nations, diagnostic variables describing the following were adopted: energy intensity of GDP in chain-linked volumes (2010) (Kilograms of oil equivalent (KGOE) per thousand euro – X1), share of final energy consumption in primary energy consumption (% - X2), final consumption - energy use (KGOE per capita – X3), final consumption - households - energy use (KGOE per capita – X4), final consumption - industry sector - energy use (KGOE per capita – X5), final consumption - commercial and public services (KGOE per capita – X6), final consumption - transport sector - energy use (KGOE per capita – X7), final consumption - other sectors - energy use (KGOE per capita – X8), energy imports dependency - Total (% - X9), energy imports dependency - Natural gas (% - X10), energy imports dependency - Crude oil (% - X11), energy imports dependency - Oil and petroleum products (excluding the biofuel portion) (% - X12), energy imports dependency - Solid fossil fuels (% - X13), gross available energy (KGOE per capita – X14), and renewable energy sources (% - X15).

Data on the values of these variables for the years 2012 and 2021 were collected, and the dynamics of changes for these variables in the analyzed period were calculated. Based on these variables, an internal division of the EU member states into more homogeneous subgroups was carried out using the Ward method and Euclidean distance.

4. Results

Analyzing the changes in the diagnostic variables adopted, it should be noted that all EU countries reduced the energy intensity of their economies (X1), except for Belgium and the Netherlands. They also increased the share of renewable energy in the energy mix (X15), except for Hungary. As for the other variables, the changes in their values varied among individual countries (Table 1).

As a result of grouping all EU countries into more homogeneous groups based on the changes in energy policy during the analyzed period, two subgroups of countries were identified (Figure 1). Group I included Austria, Italy, Slovenia, the Czech Republic, Spain, Romania, Belgium, Cyprus, Finland, Slovakia, Bulgaria, Croatia, Portugal, Hungary, Latvia, Poland, Lithuania, and Malta. Group II consisted of the remaining EU countries, including Denmark, France, Germany, Greece, Estonia, the Netherlands, Sweden, Iceland, and Luxembourg.

Analyzing the changes in the adopted diagnostic variables in both groups (Table 2), it is important to note a slightly greater decrease in the energy intensity of economies (X1) in Group II of countries, along with an improvement in energy transmission losses (X2) in Group I. In Group I, there was a clear increase in total

energy consumption (X3), including energy consumption in industry (X5) and transportation (X7).

However, during the same period, Group II saw a decrease in energy consumption. Despite the overall increase in energy consumption in Group I, these countries experienced a decrease in energy import dependency (X9), while in Group II, this dependency increased.

These differences are particularly evident in the case of gas imports (X10) and solid fossil fuels (X13). It's worth noting that in the second group of countries, there was an almost twofold increase in the share of renewable energy in the energy mix compared to the other countries.

5. Discussion

The energy policy of the European Union has undergone continuous evolution from the very beginning, adapting to changing external and internal requirements, with a particular focus on areas related to security and environmental considerations. Despite the central EU authorities adopting various recommendations, guidelines, and even universally applicable legal regulations, the scope of changes implemented by individual EU countries varies.

This variation primarily arises from the internal political, economic, and environmental conditions of these countries, including their ability to obtain energy carriers from natural resources.

Striving for greater energy security while simultaneously considering socio-economic requirements, the EU's energy policy faces many challenges, including those related to decarbonization, ensuring energy supply security, modernizing infrastructure, maintaining affordable energy prices for consumers, and promoting the development of new energy production technologies.

6. Conclusion

At various times and with varying intensity, discussions have arisen in EU countries regarding the concept of the so-called two-speed European Union, in which some member states move forward in the process of European integration faster than others. Regardless of one's assessment of this idea, it should be noted that this process is taking place in various areas.

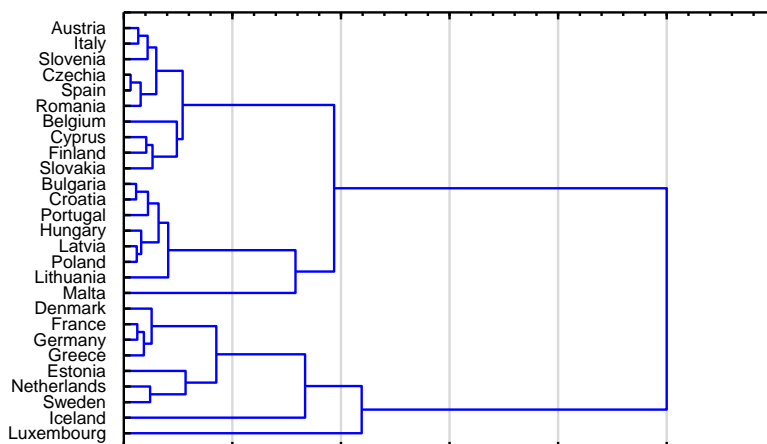
This applies not only to the most visible areas of EU functioning, such as the establishment of the eurozone by some countries, cooperation in areas related to defense or migration policy, but also in the energy policies pursued by individual member states.

Table 1. Evolution of changes in the adopted diagnostic variables in the years 2012-2021

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15
Austria	-6.82	2.23	-32	-36.6	-69.2	-1.8	78.8	-41.6	-11.83	-36.28	2.31	-2.28	-2.59	-85.8	3.71
Belgium	-7.89	-0.02	-129.3	-75.4	-50.4	-11.9	0.4	-79.3	-5.75	1.28	-0.58	-3.39	-1.85	156.2	5.93
Bulgaria	-63.43	0.04	145.7	-12.3	32.2	35.7	90.6	22.9	-0.72	12.90	-1.26	-0.68	-11.18	188	1.18
Croatia	-32.32	0.03	120.1	49	31.4	28.3	104.6	-15.9	4.69	37.44	-6.77	3.26	12.88	126.1	4.57
Cyprus	-28.94	0.02	92.7	-1.6	55.3	57.3	-21.2	58.7	-7.22	0	0	-2.53	-2.40	86.7	11.31
Czechia	-49.32	0.06	50	-21.8	-21.2	9.3	83	-11.8	14.58	3.14	-1.11	1.47	26.27	-93.6	4.85
Denmark	-15.92	0.04	-91.9	-42.2	-19.8	-19.9	9.3	-81.4	35.45	80.89	87.93	66.75	-82.70	-245.7	9.25
Estonia	-124.1	0.08	-24.8	-21	-86	30	50.8	10.4	-19.24	0	0	-45.37	-55.60	-708.7	12.42
Finland	-15.56	0.03	60.7	15.3	90.8	-11.5	-16.2	-13.9	-9.12	-0.38	-2.52	-0.13	-14.38	-53.2	8.87
France	-21.1	0.02	-155.6	-76.5	-39.3	-18.3	-17.1	-99.2	-4.03	-0.68	-2.14	-0.96	-23.32	-304	6.10
Germany	-21.16	0.07	-100.8	-39.6	-33.3	-70.5	17.2	-84.7	2.28	3.93	-1.60	-1.60	8.24	-352.9	5.62
Greece	-33.71	0.11	-56.5	-80.2	-31.4	22.6	52.9	-78.1	7.93	-0.91	-2.33	-8.30	7.32	-255	8.19
Hungary	-41.06	0.06	225.7	-62.3	135.4	-26.9	146.5	-56.3	3.96	-5.07	-1.75	4.86	4.41	235.4	-1.42
Iceland	-100.42	0.03	-24.5	2	-609	442.5	148	436.6	1.53	0	0	3.81	-4.78	-643.3	12.06
Italy	-7.41	0	-32.3	-46.4	-28.1	41.5	-0.3	-4.0	-5.57	3.52	-0.21	-5.74	0.41	-111.8	3.59
Latvia	-46.54	0	125	-58.7	37.5	-10.3	118.1	-30.5	-18.06	-13.83	0	-8.02	-6.20	226.5	6.40
Lithuania	-48.71	0.03	316.7	-1.1	35.3	17.9	259.5	21.9	-4.26	0.76	1.51	8.59	-4.07	311.7	6.79
Luxembourg	-24.39	0.03	-984.3	-172.1	-270.1	112.4	-644.8	-69.5	-5.04	0	0	-0.61	-0.47	-1008	8.62
Malta	-71.92	0.24	106.4	26.9	3.3	16.8	64.2	38.9	-3.92	103.48	0	-3.53	0	1056	9.29
Netherlands	-30.13	-0.0	-236.3	-113	-47.6	-36.6	-44.4	-144.4	27.74	109.59	-1.37	-12.29	0.64	-581.1	8.34
Poland	-46.31	0.03	161.3	-67	75.3	-13.9	162.6	-76.6	8.82	10.17	-2.74	-0.23	2.82	176	4.67
Portugal	-16.06	0.04	143.2	23.1	8	52.8	52.1	83.1	-12.54	0.311	-1.43	-1.28	-98.79	218.7	9.41
Romania	-69.32	0.08	98.9	-0.8	8.2	13.7	75.3	15.5	9.18	1.48	9.98	16.01	7.04	-30.4	0.77
Slovakia	-25.95	0.04	178.2	101.8	37.1	-44.2	86.2	54.8	-9.04	-20.77	-0.18	-1.17	-1.55	61.2	6.96
Slovenia	-48.84	0.03	-71.2	-106.6	42.7	-5.6	-5.5	-108.3	-3.20	-0.32	0	-4.70	-10.57	-117.8	3.45
Spain	-19.69	0.04	29.4	-22.5	-6.1	8.1	56.6	-21.1	-3.70	1.83	-0.58	-1.15	30.86	-113.4	6.49
Sweden	-29.65	0.04	-341.4	-127.6	-119.1	-32.8	-75.8	-146.5	-9.16	0	-1.94	-23.94	11.65	-463.5	13.17

Source: Own analysis based on Eurostat.

Figure 1. Dendrogram of European Union countries illustrating the similarity of changes in energy policy between 2012 and 2021.



Source: Own analysis.

Table 2. Development of basic numerical statistics for the adopted diagnostic variables in individual groups of EU countries.

	średnia		mediana		odch. Stand	
	grupa 1	grupa 2	grupa 1	grupa 2	grupa 1	grupa 2
X1	-35.8939	-44.509	-36.6900	-29.650	21.1498	39.2431
X2	0.1648	0.045	0.0352	0.037	0.5179	0.0344
X3	88.2889	-224.011	102.6500	-100.800	108.7596	303.4869
X4	-21.9444	-74.467	-22.1500	-76.500	47.9472	55.7224
X5	23.1944	-139.511	31.8000	-47.600	49.8494	192.5301
X6	8.6278	47.711	8.7000	-18.300	27.3929	157.1147
X7	74.1833	-55.989	77.0500	9.300	71.2338	230.0079
X8	-9.0833	-28.533	-12.8500	-81.400	51.6712	180.3762
X9	-2.9828	4.164	-4.0885	1.534	8.4523	17.4509
X10	5.5366	21.424	1.0215	0.000	28.5148	42.4831
X11	-0.2968	8.728	-0.3945	-1.368	3.1988	29.7160
X12	-0.0363	-2.501	-1.1580	-1.599	5.5632	30.1446
X13	-3.8269	-15.446	-1.7020	-0.470	26.4546	32.8024
X14	124.3000	-506.933	106.4000	-463.500	273.0681	253.6194
X15	5.3795	9.309	5.3905	8.623	3.2733	2.7094

Source: Own analysis.

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