

Structural Drivers of Energy Import Dependency and Fiscal Resilience: Evidence from the European Union

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Abstract

This study examines the structural drivers of energy import dependency among EU member states over the period 2015–2024, with a focus on how energy transition promotes long-term financial sustainability. As transitional and emerging economies within the EU face increasing pressure to decouple growth from fossil fuel imports, understanding the structural determinants of energy security is crucial for fiscal resilience. Drawing on energy security theory and demand–supply frameworks, the research employs panel data models to empirically assess the impact of energy intensity, renewable energy share, gross available energy, final energy consumption, and economic development on energy import dependency. The results reveal that the share of energy from renewable sources is the most robust and consistent factor reducing energy import dependency, confirming the role of renewables for reducing external vulnerability.

The paper demonstrates that lowering energy import dependency is not merely a security concern but a fundamental requirement for financial sustainability, as it reduces trade deficits and mitigates the impact of global price volatility on national budgets. The results provide evidence-based recommendations for policymakers to prioritise energy-based structural reforms as a mechanism for achieving macroeconomic stability and institutional resilience in a changing global landscape.

Keywords: energy import dependency; structural reforms; renewable energy; panel data; European Union.

JEL Classification: Q41; Q43; Q48; F18; P28.

Introduction

Energy has a central role in modern economies, functioning as both a fundamental production input and a driver of social welfare. However, the uneven global distribution of energy resources has resulted in substantial disparities between energy-producing and energy-consuming countries. As a result, many economies rely heavily on imported energy to meet domestic demand. Energy import dependency, defined as the proportion of energy consumption met through net imports, has become a critical issue in economic and energy policy debates. High energy import dependency exposes countries to multiple risks, including price volatility in global energy markets, geopolitical tensions, supply disruptions, and macroeconomic instability. These risks are particularly pronounced in the context of fossil fuel imports, such as oil and natural gas, which remain dominant in global energy consumption. For energy-importing regions like the European Union, dependency on external suppliers has historically shaped policy priorities related to diversification, security of supply, and sustainability. Recent geopolitical developments, combined with energy market disruptions and climate policy pressures, have further intensified concerns regarding energy import dependency.

Economies that rely heavily on imported energy, particularly fossil fuels priced on international markets, are systematically exposed to external price volatility. When global energy prices rise sharply, the transmission of higher import costs into public finances occurs through multiple channels, including deteriorating trade balances, increased fiscal outlays, and heightened external financing needs. These mechanisms can substantially weaken fiscal sustainability, especially in countries with limited domestic energy resources or constrained fiscal space.

High energy import dependency amplifies budgetary pressures during price shocks by directly increasing government expenditures and indirectly eroding public revenues. Governments often respond to energy price surges through subsidies, tax reductions, or price caps to mitigate social and political costs. While such measures can temporarily cushion households and firms, they frequently generate sizable fiscal burdens and reduce revenue from energy taxation. At the same time, higher production costs associated with expensive energy inputs can suppress economic activity, further weakening the tax base. The combined effect is a widening fiscal deficit, particularly acute in emerging and developing economies with less diversified energy mixes.

The external debt channel is a central component of the energy–fiscal nexus. Energy price shocks increase the import bill and worsen current account balances, raising the demand for foreign currency financing. Countries with persistent energy import dependency may resort to external borrowing to finance higher energy costs, leading to faster accumulation of external debt. This dynamic becomes especially problematic when price shocks coincide with global monetary tightening, as higher interest rates and currency depreciation increase debt servicing costs. The 2022 global energy crisis illustrates this vulnerability: the sharp increase in oil and natural gas prices significantly strained public finances and external debt sustainability in energy-importing economies, where fiscal interventions were large and energy import bills surged simultaneously. So, reducing import dependency through energy diversification, efficiency improvements, and domestic renewable deployment can therefore enhance fiscal resilience and debt sustainability by weakening the transmission of external price shocks into public budgets.

Ensuring secure, affordable, and sustainable energy supply has become one of the most pressing challenges for the European Union, particularly in the context of increasing geopolitical uncertainty, volatile energy markets, and the ongoing transition toward climate neutrality. Recent energy crises have further highlighted the vulnerability of European economies to high energy import dependency, underscoring the urgency of identifying effective strategies to enhance energy security and resilience. At the same time, EU member states exhibit substantial heterogeneity in their levels of economic development, energy system structures, and historical reliance on imported energy. Developed EU–14 countries generally display higher income levels, more advanced energy infrastructure, and earlier adoption of renewable energy technologies, yet they often remain highly dependent on imported fossil fuels due to limited domestic energy resources and high consumption levels. In contrast, EU–13 countries, many of which are post-transition economies, face challenges related to higher energy intensity, aging infrastructure, and lower renewable energy penetration, while also exhibiting diverse patterns of domestic energy production and import reliance. These persistent structural differences suggest that the determinants of energy import dependency may vary significantly across country groups, requiring differentiated analytical and policy approaches. Although a growing body of literature examines energy security, renewable energy deployment, and energy import dependence, empirical evidence comparing the drivers of energy import dependency between EU–14 and EU–13 countries over recent years remains limited. In particular, there is a lack of comprehensive panel-based analyses that jointly consider energy intensity, renewable energy share, energy efficiency, consumption patterns, domestic energy availability, and economic development within a unified empirical framework. Addressing this gap is essential for designing effective, evidence-based energy policies that align with the EU’s energy security, decarbonization, and cohesion objectives.

The aim of this research is to identify and empirically assess the key determinants of energy import dependency in European Union countries, with a specific focus on differences between developed EU–14 and less developed EU–13 member states over the period 2015–2024 with the implications of these dependencies for fiscal resilience and budgetary stability.

To achieve this aim, the study addresses the following research tasks:

- to analyse the dynamics and structure of energy import dependency across EU member states and classify countries according to their level of import reliance;
- to examine differences in energy import dependency and energy system characteristics between EU–14 and EU–13 countries;
- to empirically evaluate the impact of energy intensity, renewable energy share, energy efficiency, gross available energy, final energy consumption, and GDP per capita on energy import dependency using fixed-effects panel data models;
- to assess whether the determinants of energy import dependency differ between EU–14 and EU–13 country groups;
- to derive policy-relevant implications for reducing energy import dependency and strengthening energy security within the European Union.

The study contributes to the existing literature by providing updated empirical evidence on the heterogeneous drivers of energy import dependency in the EU and by offering insights that support differentiated and context-specific energy policy design.

1. Literature Review

Energy Import Dependency and Vulnerability

A substantial body of literature identifies import dependency as a core determinant of energy vulnerability. Le Coq & Paltseva (2009) demonstrate that dependence on a limited number of suppliers significantly increases the risk of supply disruptions. They develop a composite index aimed at assessing short-term vulnerabilities related to the external energy supply of European Union Member States. The index integrates indicators capturing the degree of import diversification, the political stability of supplier countries, risks linked to energy transit routes, and the potential economic consequences of supply interruptions. Separate indices are constructed for the main primary energy sources (oil, natural gas, and coal), revealing substantial heterogeneity across Member States in their exposure to supply risks depending on the type of energy considered.

Streimikiene *et al.* (2023) further present an energy import diversification and security index and show that EU member states exhibit varying levels of import dependency and vulnerability, reflecting differences in energy mix, infrastructure, and domestic resource endowments. Countries with high dependency and low diversification are found to be particularly exposed to external shocks.

Emerging market economies exhibit a high degree of reliance on imported energy. Yadav & Mahalik (2024) using a panel dataset covering 16 emerging economies over the period 1996–2019 examine the effect of renewable energy consumption on energy import dependence. The results indicate that the expansion of renewable energy sources provides a limited but measurable substitution effect for energy imports. Carfora *et al.* (2022) conducts a comprehensive analysis of the determinants of energy import demand across European Union countries. The findings suggest that substituting energy imports with domestic energy production can yield significant benefits, particularly through a reduction in overall energy dependence. Furthermore, when import substitution is achieved via domestic renewable energy sources, additional advantages emerge, including improvements in energy security, lower dependency levels, and enhanced progress toward sustainable development objectives.

Dirma *et al.* (2024) research findings confirm that the development of renewable energy resources supports long-term economic growth by driving technological innovation, job creation, and investment, while also enhancing energy security and environmental sustainability. Although initial costs and technological barriers exist, strategic planning, supportive policies, and education can ensure that renewable energy becomes a key driver of both economic and environmental progress.

Sterling *et al.* (2025) analyse the evolution of the European Union's energy import dependence over time. The authors document a persistent increase in the reliance of EU member states on imported energy over the past three decades. This development has occurred despite a non-monotonic pattern in total energy consumption, which initially expanded and subsequently declined. Over the same period, the energy efficiency of the European economy improved substantially. The growing dependence on energy imports is primarily attributable to a sustained reduction in domestic energy production, a trend that has intensified during the last ten years.

Moreover, although renewable energy output has increased, it has not been sufficient to compensate for the contraction in energy generation from hydrocarbons and nuclear sources, resulting in an overall decline in domestic production. The analysis further includes a scenario-based projection of Europe's energy import dependence over the next decade. Under the simplifying assumption that total energy demand and non-renewable energy production remain constant at their 2023 levels, alternative growth trajectories for renewable energy generation are considered. The results suggest that, even under favourable assumptions, the European Union is likely to continue relying on energy imports to satisfy a substantial share of domestic demand in the medium term, thereby maintaining exposure to economic and geopolitical risks.

Economic Impacts of Energy Dependency

The relationship between energy dependency and economic performance has been widely examined. Awerbuch & Sauter (2006) argue that fossil fuel dependency increases macroeconomic risk due to fuel price volatility, which can undermine long-term investment and growth. Empirical evidence suggests that energy price shocks have significant negative effects on GDP growth, especially in import-dependent economies. Recent studies in energy economics indicate that energy security risks, driven partly by import dependency, are associated with lower economic growth and higher inflation rates. These effects are amplified during periods of geopolitical instability, underscoring the macroeconomic significance of energy dependency.

The findings of Sahu & Mahalik (2024) indicate that dependence on imported energy adversely affects macroeconomic resilience. From a policy perspective, the study emphasizes the need for a gradual reduction in energy import dependence to strengthen the macroeconomic stability of emerging economies. Policy measures such as increasing tariffs on energy imports and promoting domestic energy self-sufficiency are identified as potential strategies for mitigating reliance on external energy sources.

Arnone & Leogrande (2024) investigate the interconnections between energy system efficiency, banking system stability, and climate-related risks at the global scale. Their objective is to assess whether these three dimensions can be simultaneously achieved, a condition referred to as the Green Trilemma. The empirical findings indicate that growth in environmental, social, and governance (ESG) performance is inversely related to energy efficiency, while exhibiting a positive association with banking stability and climate risk. Consequently, the Green Trilemma hypothesis is not supported by the results. The evidence suggests that, within ESG-oriented frameworks, countries are able to pursue improvements in banking stability and climate risk mitigation, but not energy efficiency concurrently.

Building resilient energy systems requires integrating physical infrastructure, information flows, and human behaviours across social, economic, and security domains. A resilience-based approach encourages coordinated, adaptive, and flexible strategies, enabling communities and stakeholders to anticipate, respond to, and learn from complex energy-related challenges (Roeger *et al.*, 2014).

Energy Security in the European Union

The EU represents a compelling case study due to its high aggregate import dependency and diverse national energy systems. According to Vošta (2023), declining domestic production and sustained demand have entrenched import reliance, particularly for oil and natural gas. EU energy policy has increasingly focused on reducing dependency through renewable energy deployment, energy efficiency improvements, and regional market integration.

The surge in energy prices and concerns over natural gas supply shortages during the winter of 2021–2022 revealed the limited effectiveness of existing energy policy instruments in ensuring energy security within the European Union. In addition, the absence of a coordinated external energy security strategy constrained the EU's ability to adopt a unified energy stance in response to the start of the war in Ukraine in February 2022. Although accelerating decarbonisation is essential for meeting the Union's 2050 climate objectives, it remains necessary to safeguard the energy security of member states, including its external dimension, throughout the transition phase, until domestic low-carbon energy systems can adequately fulfil this role (Mišík, 2022).

Alam *et al.* (2025) examine the impact of energy security risks on economic growth, with particular emphasis on the influence of geopolitical tensions. Their analysis reveals that energy security risks exert a negative and statistically significant effect on economic growth, most notably in the short term. These adverse effects intensify during episodes of heightened geopolitical tension and are especially pronounced in emerging market and developing economies. Additionally, the results indicate heterogeneity in the growth response to energy security shocks across countries, reflecting differences in national energy structures, with net energy exporters and economies heavily reliant on fossil fuels exhibiting distinct patterns of vulnerability.

Gaps in Research

Despite the extensive literature on energy import dependency, energy security, and their economic implications, several important gaps remain that justify the present study. First, although existing research highlights energy import dependency as a key source of energy vulnerability, much of the literature focuses on composite indices, diversification measures, or short-term supply risks (Le Coq & Paltseva, 2009; Streimikiene *et al.*, 2023). While these approaches provide valuable insights into vulnerability and exposure, they offer limited empirical evidence on the specific economic and energy-system determinants driving energy import dependency over time. In particular, there is a lack of panel-based studies that simultaneously examine demand-side factors (energy consumption, energy intensity), supply-side factors (domestic energy availability, renewable energy share), and economic development within a unified econometric framework.

Second, empirical studies analysing the role of renewable energy in reducing energy import dependency have produced mixed and context-dependent results. While Yadav & Mahalik (2024) find only a marginal substitution effect in emerging economies, Carfora *et al.* (2022) emphasize the potential benefits of renewable-based import substitution in EU countries. However, these studies generally treat the EU or emerging economies as relatively homogeneous groups, overlooking persistent structural and developmental differences across countries. Consequently, there is limited evidence on whether the impact of renewable energy

deployment on energy import dependency differs systematically between more developed and less developed EU member states.

Third, although the macroeconomic consequences of energy dependency, such as reduced economic growth, increased inflation, and lower resilience are well documented (Awerbuch & Sauter, 2006; Sahu & Mahalik, 2024; Alam *et al.*, 2025), considerably less attention has been paid to the upstream determinants of energy import dependency itself within the EU context. Most studies focus on the outcomes of dependency rather than on identifying the structural factors that shape import reliance, particularly in the post-2015 period marked by intensified climate policy ambitions and heightened geopolitical risks.

Fourth, the European Union's internal heterogeneity remains underexplored in empirical energy security research. While EU-wide analyses are common, few studies explicitly differentiate between EU-14 and EU-13 countries, despite well-documented differences in income levels, energy intensity, infrastructure quality, and historical energy system development. Ignoring this heterogeneity may lead to aggregation bias and obscure group-specific relationships between energy import dependency and its determinants.

Finally, recent geopolitical developments and accelerated energy transitions have fundamentally altered the EU energy landscape, yet much of the existing empirical evidence relies on earlier data periods. There is a clear need for updated analyses covering recent years to capture the evolving interaction between renewable energy deployment, energy consumption patterns, economic growth, and import dependency. Addressing these gaps, the present study contributes to the literature by providing an updated, disaggregated, and empirically robust assessment of the determinants of energy import dependency across EU-14 and EU-13 countries, thereby offering more nuanced insights for energy security and policy design in the European Union.

2. Research Methodology and Data

Drawing on energy security theory, demand–supply mechanisms, and structural differences between EU member states, this study formulates the following testable hypotheses regarding the determinants of energy import dependency.

- H1: A higher share of energy from renewable sources reduces energy import dependency. Renewable energy is predominantly domestically produced and substitutes imported fossil fuels.
- H2: The impact of renewable energy share on reducing energy import dependency is stronger in EU-14 countries than in EU-13 countries. EU-14 countries possess more advanced renewable technologies and institutional frameworks, enhancing substitution effects.
- H3: Greater gross available energy per capita decreases energy import dependency. Higher domestic energy availability strengthens supply capacity and reduces reliance on external sources.
- H4: Higher final energy consumption per capita increases energy import dependency. Rising energy demand outpaces domestic supply expansion, especially in resource-constrained economies.
- H5: Higher GDP per capita is positively associated with energy import dependency. Economic growth and higher income levels increase energy demand, which often exceeds domestic production capacity.

The research implements the panel data analysis of 27 EU countries for 2015-2024. During the research we analyse such indicators as EID (energy imports dependency, percentage); EIN (energy imports, net (% of energy use)); EIT (energy intensity of GDP in chain linked volumes (2015), kilograms of oil equivalent (KGOE) per thousand euro); SRS (share of energy from renewable sources, %); EEF (energy efficiency, primary energy consumption, Energy Efficiency Directive, million tonnes of oil equivalent); GAE (gross available energy, kilograms of oil equivalent (KGOE) per capita); FCE (final consumption, energy use, kilograms of oil equivalent (KGOE) per capita); GDP (GDP per capita (current US\$)); IDT (total import dependency on third countries by fuel type, %); IDN (import dependency on third countries by fuel type, natural gas, percentage); INO (import dependency on third countries by fuel type, oil and petroleum products (excluding biofuel portion, %)). Descriptive statistics of the variables used in the analysis are shown in Table 1.

Table 1. Descriptive Characteristics of the Indicators for All EU Countries

Characteristic	EID	EIT	SRS	EEF	GAE	FCE	GDP
Min.	1.229	32.07	4.987	0.71	1,611	971.4	7,269
1 st Qu.	41.109	98.33	15.085	6.64	2,615	1,704.6	19,582
Median	58.343	142.51	19.907	22.23	3,070	1,961.9	29,338
Mean	57.485	147.94	23.569	48.37	3,511	2,198.5	37,091
3 rd Qu.	73.883	187.88	30.402	45.74	3,980	2,393.6	48,894
Max.	103.052	409.80	66.393	298.12	7,410	6,205.8	137,782

Source: Authors' processing based on Eurostat Database (2025).

We examine factors influenced energy imports dependency in developed EU-14 countries and less developed EU-13 countries to analyse which factors had a greater impact across country groups. In this study, dividing EU member states into EU-14 and EU-13 groups is methodologically justified due to substantial and persistent differences in their levels of economic development, energy system structures, and historical integration into EU energy and climate frameworks. EU-14 countries generally exhibit higher GDP per capita, more advanced technologies, greater energy efficiency, and earlier adoption of renewable energy policies, which result in lower energy intensity and more diversified domestic energy mixes, thereby influencing their energy import dependency differently than in EU-13 countries. In contrast, EU-13 countries, many of which are post-transition economies, tend to have higher energy intensity, older infrastructure, lower renewable penetration, and a stronger reliance on imported fossil fuels, making their energy import dependency more sensitive to changes in energy consumption, economic growth, and efficiency improvements. These structural and developmental disparities imply heterogeneous relationships between energy intensity, renewable energy share, gross available energy, final energy consumption, GDP per capita, and energy import dependency, meaning that pooling all EU countries into a single homogeneous group would risk aggregation bias and econometric misspecification.

Therefore, separating the sample into EU-14 and EU-13 allows for more accurate estimation, improved model stability, and more meaningful policy conclusions, while remaining fully consistent with established academic literature and EU energy and cohesion policy frameworks. Also, many empirical studies in economics, energy, inflation, and development use this exact classification (Alsaleh & Abdul-Rahim, 2021; Alsaleh & Abdul-Rahim, 2025; Brodny & Tutak, 2024; Borović *et al.*, 2024).

The list of countries that are included in EU–14 and EU–13 is shown in Table 2.

Table 2. List of EU–14 and EU–13 Countries

Group title	List of EU countries
EU–14 (developed, high-income, advanced economies)	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden
EU–13 (less developed, emerging economies)	Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Republic, Slovenia

Source: Authors 'processing

Descriptive characteristics of the indicators in EU–14 countries and in EU–13 countries are presented in Table 3.

Table 3. Descriptive Characteristics of the Indicators for EU–14 and EU–13 Countries

Characteristic	EID	EIT	SRS	EEF	GAE	FCE	GDP
EU–14 countries							
Min.	11.34	32.07	4.987	3.62	2,063	1,353	17,887
1 st Qu.	46.54	83.49	14.864	20.61	2,726	1,865	35,221
Median	67.97	100.21	19.370	37.05	3,544	2,323	48,537
Mean	62.32	101.05	24.945	74.86	3,895	2,591	51,804
3 rd Qu.	75.45	120.52	34.001	114.90	5,040	2,946	56,740
Max.	96.28	158.40	66.393	298.12	7,410	6,206	137,782
EU–13 countries							
Min.	1.229	89.38	5.119	0.710	1,611	971.4	7,269
1 st Qu.	38.181	169.66	15.198	4.593	2,542	1,612.1	15,587
Median	48.971	189.16	20.980	8.240	2,859	1,832.3	20,151
Mean	52.282	198.43	22.087	19.838	3,099	1,775.3	21,247
3 rd Qu.	65.562	218.68	27.153	24.475	3,319	2,013.5	25,870
Max.	103.052	409.80	45.535	104.060	6,335	2,407.9	43,899

Source: Authors 'processing based on Eurostat Database (2025).

3. Research Results

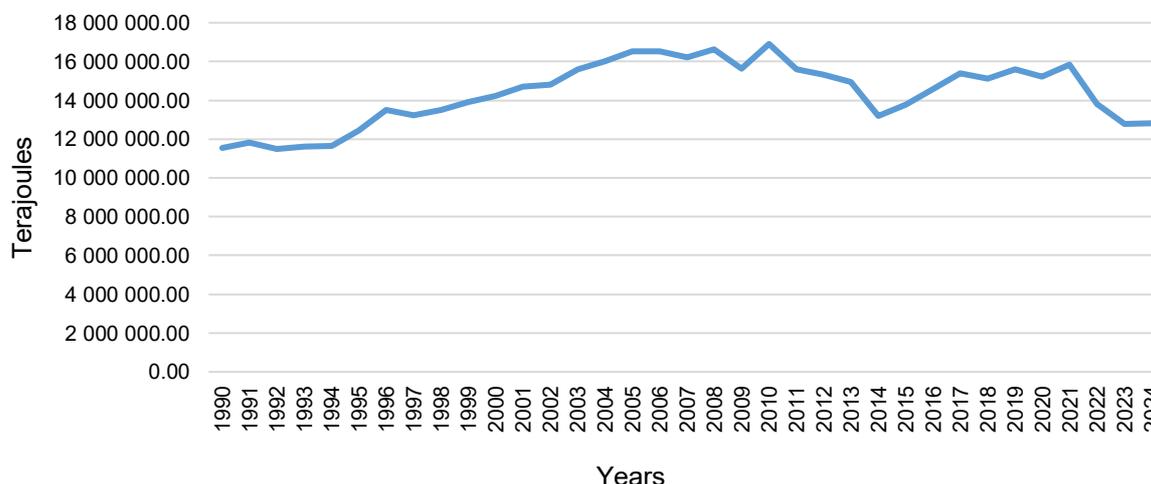
Trends in Energy Demand and Import Dependency in the European Union

A country's level of energy import dependence is determined by a combination of factors including the availability and accessibility of domestic energy resources, the structure and size of its economy, patterns of energy consumption and efficiency, population size and growth, industrial composition, and the balance between energy production and demand. It is also influenced by geographic conditions, technological capabilities, and investment in energy infrastructure, as well as the extent of diversification across energy sources such as fossil fuels, nuclear power, and renewables. Government policies, regulatory frameworks, and long-term energy strategies play an important role, alongside historical development paths and legacy infrastructure.

Also, international market conditions, energy prices, geopolitical relationships, and access to stable trade routes can significantly shape a country's reliance on imported energy. Emerging trends, such as the transition to renewable energy and the implementation of energy efficiency measures, are gradually reshaping import patterns and reducing dependence in some regions. Technological innovation, including smart grids and energy storage, enhances energy security and flexibility in meeting demand. Furthermore, regional cooperation and integration within the EU, such as cross-border energy infrastructure and shared strategic reserves, play a growing role in mitigating import risks. At the same time, economic shocks, supply chain disruptions, and extreme weather events can temporarily increase import dependence, highlighting the need for resilient energy systems. Continuous monitoring and adaptive policymaking are therefore essential to anticipate and respond to changing conditions in the global energy landscape.

Figure 1 indicates that EU inland demand for natural gas increased steadily from about 11.5 million terajoules in 1990 to a peak of nearly 16.9 million terajoules in 2010, following strong growth throughout the 1990s and early 2000s. After this peak, demand entered a generally declining and more volatile phase, with reductions after the financial crisis, a partial recovery in the late 2010s, and a marked drop from 2022 onward. By 2024, natural gas demand had fallen to around 12.8 million terajoules, remaining well below its historical highs and suggesting a long-term downward trend consistent with efficiency gains, structural changes in energy use, and the EU's transition toward lower-carbon energy sources.

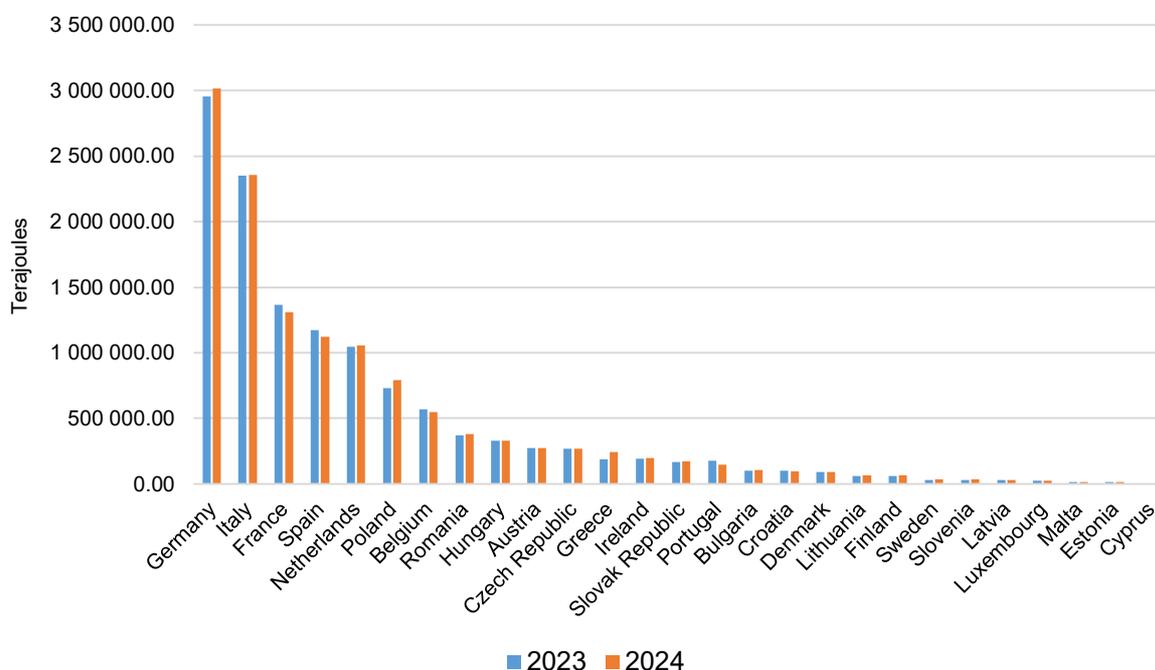
Figure 1. Inland Demand of Natural Gas, EU, 1990-2024 (Terajoules, Gross Calorific Value)



Source: Authors' processing based on Eurostat Database (2025).

Figure 2 shows that in both 2023 and 2024 inland natural gas demand in the EU was highly concentrated in a few large economies, with Germany and Italy by far the largest consumers, followed by France, Spain, the Netherlands, and Poland. The demand increased in several countries, including Germany, Italy, the Netherlands, Poland, Greece, Romania, etc. It declined in France, Spain, Belgium, Austria, Portugal, Croatia, etc. Higher demand was observed in larger, more industrialized countries, while significantly lower levels were recorded in smaller economies.

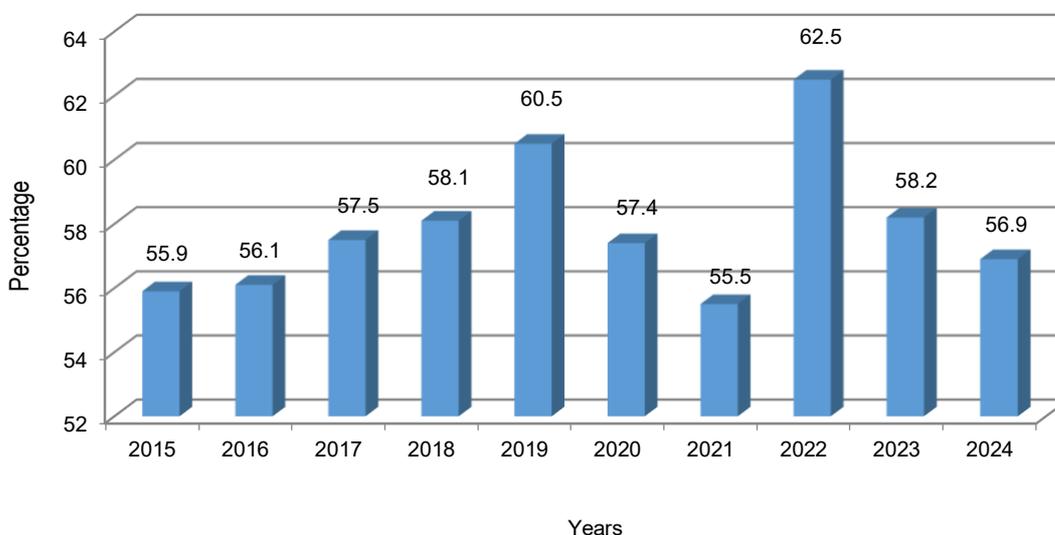
Figure 2. Inland Demand of Natural Gas, by Country, 2023-2024 (Terajoules (Gross Calorific Value))



Source: Authors' processing based on Eurostat Database (2025).

The EU's energy import dependency fluctuated between 2015 and 2024, increasing gradually from 55.9% in 2015 to a peak of 60.5% in 2019, before declining in 2020 and 2021. A sharp rise occurred in 2022, when dependency reached its highest level at 62.5%, followed by a decrease in 2023 and 2024 to 58.2% and 56.9%, respectively (Figure 3).

Figure 3. EU's Energy Imports Dependency

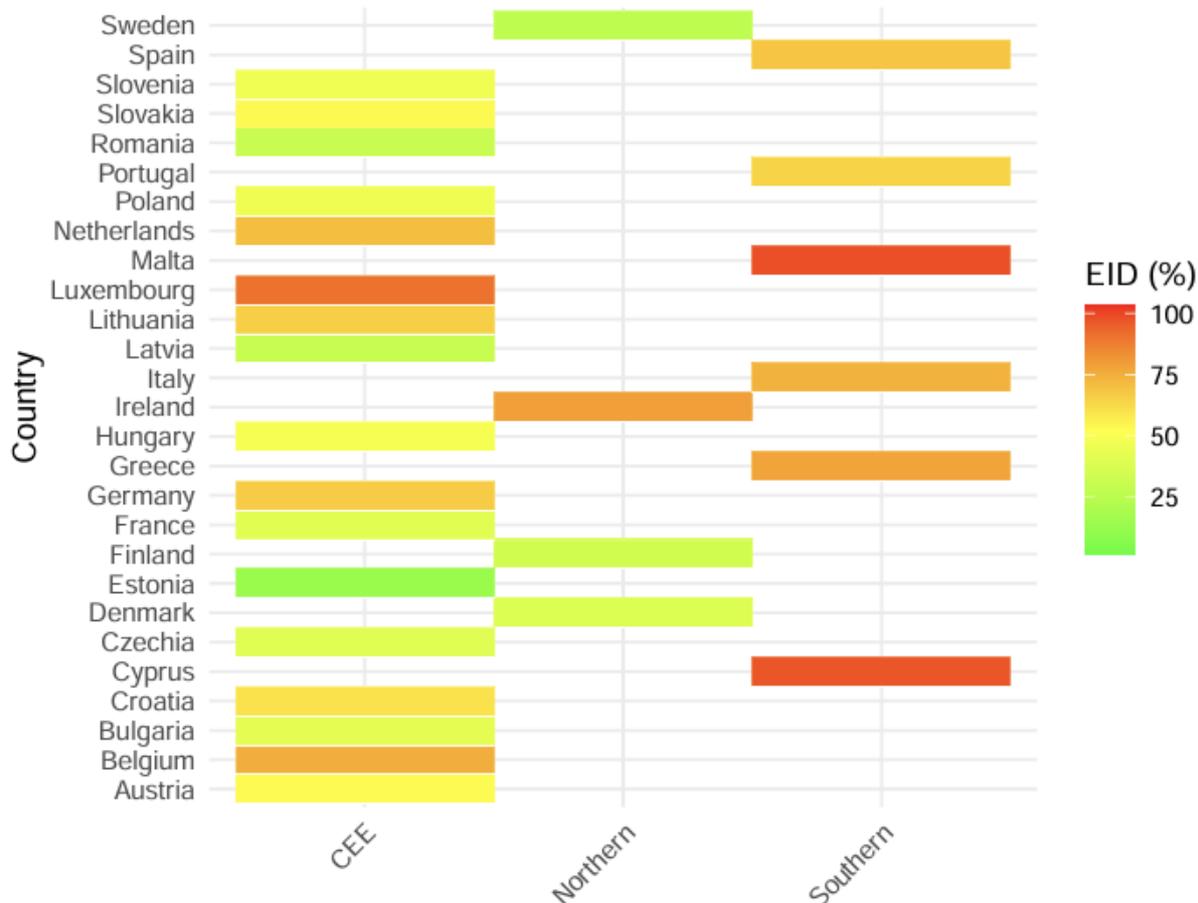


Source: Authors' processing based on Eurostat Database (2025).

We analyse energy imports dependency and divide EU countries on countries with low energy import dependency level (0-25%), moderate (26-50%) and high (51–100%). Countries grouping in 2024 are shown in Annex 1.

The heatmap presented in Figure 4 clearly illustrates the variation in energy dependency across EU regions: Northern Europe, Southern Europe, and Central and Eastern Europe (CEE). This visual emphasizes the structural drivers behind regional energy vulnerabilities and supports the argument that energy reliance is unevenly distributed across Europe.

Figure 4. Energy Import Dependency Across EU Regions



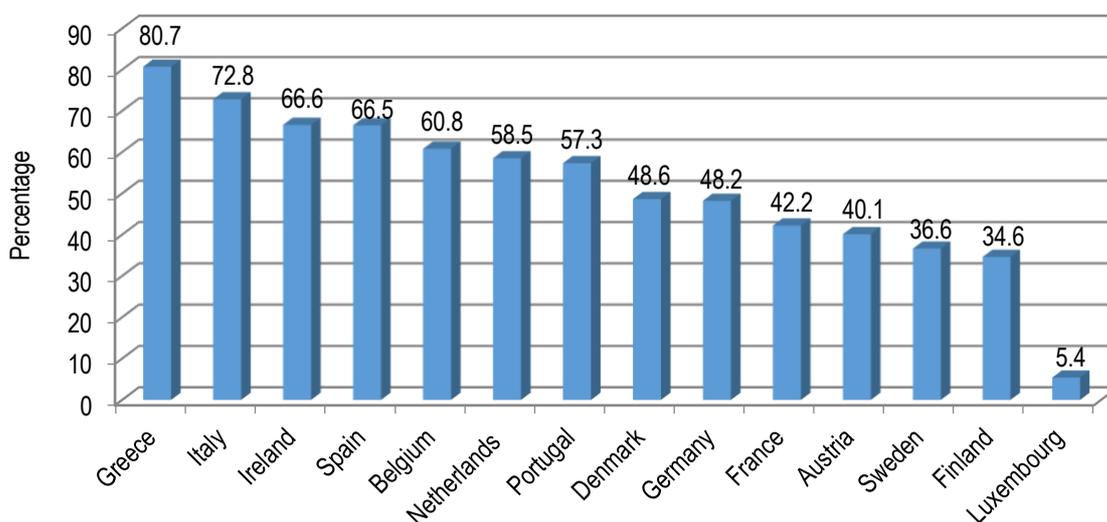
Source: Authors' processing based on Eurostat Database (2025).

The lowest level of energy import dependency is in Estonia. The highest levels of energy import dependency are observed in Malta (98.39% in 2024) and Cyprus (96.84% in 2024). In the Slovak Republic energy import dependency equals 53,5% means that 53,5% of the country's energy consumption comes from imports.

The analysis of total energy import dependency in EU-14 countries in 2023 (Figure 5) and EU-13 countries (Figure 6) shows a persistent structural reliance on third-country energy supplies across the European Union, particularly among EU-14 countries, which generally exhibit higher and more uniform dependency levels. In contrast, EU-13 countries show greater heterogeneity, ranging from very high dependency (e.g., Lithuania) to minimal reliance (e.g., Estonia and Latvia).

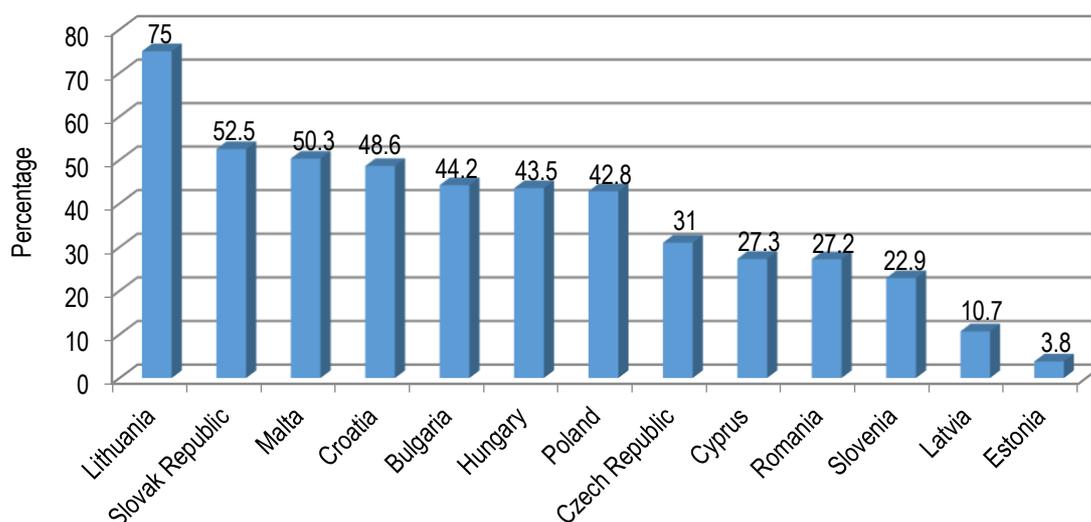
Countries with high IDT values may face increased exposure to external supply disruptions and price volatility, underlining potential energy security risks. Conversely, lower dependency levels may reflect greater domestic energy production, diversified energy mixes, or reduced overall energy demand.

Figure 5. Total Energy Import Dependency on Third Countries in EU–14 Countries



Source: own processing based on Eurostat Database (2025).

Figure 6. Total Energy Import Dependency on Third Countries in EU–13 Countries



Source: Authors' processing based on Eurostat Database (2025).

Table 4 presents the import dependency on third countries for natural gas (IDN) and oil and petroleum products (INO) in EU–14 and EU–13 countries, highlighting substantial variation both across countries and between fuel types.

In the EU–14 group, natural gas import dependency (IDN) is generally high, exceeding 80% in most countries. Portugal (97.53%), Greece (96.79%), Spain (92.95%), Austria (92.66%), and Finland (90.78%) show particularly strong reliance on external gas supplies. In contrast, Sweden (18.71%) and Luxembourg (37.06%) display relatively low gas import dependency, indicating greater domestic supply or alternative energy structures.

For oil and petroleum products, dependency is also substantial across EU–14 countries. Greece (91.71%), Italy (87.72%), Spain (87.19%), and France (78.86%) exhibit very high levels of oil import dependency. An exceptional case is Luxembourg, with an INO value of only 0.12%, suggesting minimal reliance on third-country oil imports, likely due to unique trade or accounting structures. Germany stands out among EU–14 countries with moderate gas dependency (49.94%) but relatively high oil dependency (70.47%), reflecting a more diversified gas supply mix.

Table 4. Import Dependency on Third Countries by Fuel Type in EU–14 and EU–13 Countries

EU–14 countries	IDN	INO	EU–13 countries	IDN	INO
Austria	92,66	56,11	Bulgaria	82,43	88,13
Belgium	83,4	68,7	Croatia	69,84	57,51
Denmark	81,91	52,12	Cyprus	0	31,11
Finland	90,78	74,36	Czech Republic	97,74	64,34
France	89,1	78,86	Estonia	0	18,25
Germany	49,94	70,47	Hungary	75,14	57,23
Greece	96,79	91,71	Latvia	0	28,92
Ireland	77,46	76,67	Lithuania	94,62	91,66
Italy	90,21	87,72	Malta	93,34	46,83
Luxembourg	37,06	0,12	Poland	73,41	73,02
Netherlands	69	59,71	Romania	0,83	64,13
Portugal	97,53	79,89	Slovak Republic	98,91	79,44
Spain	92,95	87,19	Slovenia	28,14	39,56
Sweden	18,71	82,94			

Source: Authors 'processing based on Eurostat Database (2025).

Among EU–13 countries, natural gas import dependency varies widely. Several countries report near-zero dependency, including Cyprus, Estonia, Latvia, and Romania, indicating domestic production or alternative fuels. Conversely, Slovak Republic (98.91%), Czech Republic (97.74%), Lithuania (94.62%), and Malta (93.34%) exhibit extremely high reliance on third-country gas imports. For oil and petroleum products, dependency is consistently high across most EU–13 countries. Lithuania (91.66%), Bulgaria (88.13%), and the Slovak Republic (79.44%) show particularly elevated INO values. Even countries with low gas dependency, such as Estonia (18.25%) and Latvia (28.92%), still demonstrate significant reliance on imported oil products.

The findings highlight a structural dependence on third-country energy imports across both EU–14 and EU–13 member states, particularly for oil and petroleum products. While natural gas dependency varies more significantly, especially among EU–13 countries, oil import dependency remains uniformly high, underscoring oil's limited substitutability and continued importance in national energy systems. EU–14 countries generally exhibit high and consistent dependency levels for both fuels, whereas EU–13 countries show greater heterogeneity, especially for natural gas.

Countries with extremely high gas import dependency may face increased vulnerability to external supply disruptions, while those with near-zero dependency may rely on alternative fuels or domestic resources. So, the results emphasize the importance of energy diversification, increased renewable energy deployment, and regional cooperation to reduce import dependency and strengthen energy security across the European Union.

High energy intensity means the economy requires more energy to produce the same level of output. Higher energy demand increases pressure on energy supply. If domestic energy production is insufficient, additional demand must be met through imports. Thus, more energy-intensive economies are expected to show higher energy import dependency, all else equal. However, the relationship may be weak if energy-intensive countries also possess abundant domestic energy resources.

Renewable energy sources (wind, solar, hydro, biomass) are largely domestically produced. An increase in the renewable energy share substitutes imported fossil fuels and lowers exposure to international energy markets. Therefore, a higher renewable energy share systematically reduces energy import dependency. Greater energy efficiency implies less energy required to meet the same level of economic activity. Lower energy demand reduces the need for imported energy. Efficiency improvements act as a demand-side energy security mechanism. Thus, improvements in energy efficiency are expected to reduce energy import dependency.

Gross available energy per capita (GAE) reflects the amount of energy available from domestic sources relative to population size. Higher GAE per capita typically indicates stronger domestic energy production capacity and a more diversified energy system, which reduces the need to rely on imported energy. Therefore, an increase in gross available energy per capita is expected to be negatively associated with energy import dependency. The countries with higher GAE per capita are expected to have lower energy import dependency.

Higher final energy consumption reflects greater energy demand. If domestic production does not scale proportionally, imports must increase. Consumption growth typically precedes supply expansion. Therefore, higher energy consumption per capita is expected to increase energy import dependency, especially in resource-poor economies. GDP per capita reflects the level of economic development and influences energy import dependency through both demand- and supply-side channels. Higher income levels tend to increase energy consumption for transport, housing, and industrial activity, which often raises reliance on imported energy, particularly in economies with limited domestic resources. Although wealthier countries can invest more in renewables and energy efficiency, in practice the demand effect usually dominates, leading to an overall positive relationship between GDP per capita and energy import dependency.

Empirical Outcome

To assess the influence of energy intensity of GDP in chain linked volumes (2015) (EIT); share of energy from renewable sources (SRS); gross available energy (GAE); final consumption – energy use (FCE); GDP per capita (GDP) on energy imports dependency, a panel data approach was used. Energy efficiency (EEF) was excluded due to high Variance Inflation Factor ($VIF > 5$). The final estimation results of the fixed-effects panel model, assessing the impact of factors on energy imports dependency, in EU-14 countries are presented in Table 5.

Table 5. Results of the Factors' Model Impact on Energy Imports Dependency for EU–14 Countries

Balanced Panel: n=14, T=10, N=140					
Residuals:					
Min.	1 st Qu.	Median	3 rd Qu.	Max.	
-38.617	-5.435	2.322	7.564	24.040	-38.617
Coefficients:					
	Estimate	Std. Error	t-value	Pr(> t)	
EIT	0.4606714	0.0782526	5.887	3.00e-08	***
SRS	-0.9710116	0.0717158	-13.540	< 2e-16	***
FCE	0.0157315	0.0026138	6.019	1.59e-08	***
GAE	-0.0185412	0.0022324	-8.306	9.59e-14	***
GDP	0.0004855	0.0001114	4.360	2.57e-05	***
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					
R-Squared: 0.6772					
Adj. R-Squared: 0.6651					
F-statistic: 56.21 on 5 and 134 DF, p-value: < 2.2e-16					

Source: Authors' processing

The fixed-effects panel model was estimated to examine the determinants of energy import dependency among the EU–14 countries during 2015-2024. The model demonstrates a strong explanatory power, indicating that approximately 68% of the variation in energy import dependency across the EU–14 countries is accounted for by the included factors. The overall model is highly significant, confirming the joint relevance of the predictors. All independent variables are statistically significant at the 0.001 level. The coefficient for energy intensity of GDP (EIT) is positive ($\beta = 0.461$, $p < 0.001$), indicating that countries with higher energy intensity tend to have greater energy import dependency. This suggests that economies that require more energy per unit of GDP rely more heavily on imported energy. The share of energy from renewable sources (SRS) has a strong negative effect on EID ($\beta = -0.971$, $p < 0.001$), demonstrating that a higher proportion of energy derived from renewables significantly reduces dependency on imports. This result underscores the critical role of renewable energy development in enhancing energy security.

Similarly, gross available energy per capita (GAE) has a negative coefficient ($\beta = -0.0185$, $p < 0.001$), indicating that countries with greater domestic energy availability tend to rely less on imports. Conversely, final energy consumption per capita (FCE) has a small but positive effect on EID ($\beta = 0.016$, $p < 0.001$), suggesting that higher per capita energy consumption slightly increases import dependency. Finally, GDP per capita is positively associated with EID ($\beta = 0.00049$, $p < 0.001$), reflecting that wealthier countries tend to have marginally higher reliance on imported energy, likely due to higher energy consumption demands that exceed domestic production capacity. The results indicate that energy import dependency is primarily influenced by the energy intensity of the economy and the share of renewable energy, with domestic energy availability, final consumption, and economic wealth also contributing significantly. These findings highlight the importance of improving energy efficiency and expanding renewable energy sources as effective strategies for reducing reliance on imported energy in the EU context.

The final estimation results of the fixed-effects panel model, assessing the impact of factors on energy imports dependency, for EU–13 countries are presented in Table 7.

Table 6. Determinants of Energy Import Dependency in EU–13 Countries

Balanced Panel: n=13, T=10, N=130					
Residuals:					
Min.	1 st Qu.	Median	3 rd Qu.	Max.	
-34.561	-12.116	3.382	13.077	30.490	
Coefficients	Estimate	Std. Error	t-value	Pr(> t)	
EIT	-1.600e-01	4.350e-02	-3.679	0.000347	***
SRS	-1.126e+00	1.990e-01	-5.657	1.01e-07	***
FCE	1.959e-02	4.547e-03	4.308	3.32e-05	***
GAE	-3.145e-03	3.033e-03	-1.037	0.301833	
GDP	5.807e-04	4.288e-04	1.354	0.178076	
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					
R-Squared: 0.5284					
Adj. R-Squared: 0.5094					
F-statistic: 27.78 on 5 and 124 DF, p-value: < 2.2e-16					

Source: Authors' processing

The share of energy from renewable sources (SRS) has the strongest negative effect on energy import dependency ($\beta = -1.126$, $p < 0.001$), indicating that countries with a higher proportion of renewables tend to rely less on imported energy. Energy intensity of GDP (EIT) has a negative and statistically significant effect ($\beta = -0.160$, $p < 0.001$), suggesting that more energy-intensive economies may rely more on domestic energy sources. Final energy consumption per capita (FCE) is negatively and significantly associated with energy import dependency ($\beta = 0.0196$, $p < 0.001$), which may indicate that countries with higher end-use efficiency or more optimized consumption structures can limit import reliance despite higher consumption levels. In the EU-14 countries, rising final energy consumption per capita, coupled with limited capacity to increase domestic production, is leading to increased dependence on energy imports. In the EU-13 countries, rising final energy consumption reflects economic growth and modernization of energy infrastructure, accompanied by expanding domestic energy production, which ultimately reduces relative dependence on energy imports.

Gross available energy per capita (GAE) and GDP per capita do not show statistically significant effects, implying that overall energy availability and income levels alone do not directly determine import dependency once country-specific characteristics are controlled for. The results highlight the importance of energy efficiency improvements and renewable energy expansion as key mechanisms for reducing energy import dependency in EU–13 countries.

4. Discussion and Policy Implications

This study provides empirical evidence on the determinants of energy import dependency across European Union member states, with a particular focus on structural differences between the EU–14 and EU–13 country groups. The findings confirm that energy import dependency is a multidimensional phenomenon shaped by economic structure, energy system characteristics, and the level of technological and institutional development.

Role of Renewable Energy in Reducing Import Dependency and Public Finance Sustainability

Across both EU–14 and EU–13 countries, the share of energy from renewable sources emerges as the most robust and consistent determinant of energy import dependency. The negative and highly significant coefficients confirm that increased deployment of renewable energy substantially reduces reliance on imported energy. This result aligns with energy security theory, which emphasizes domestic energy production as a key mechanism for mitigating exposure to external supply risks and price volatility. Notably, the magnitude of the renewable energy effect is strong in both groups, suggesting that renewables serve as an effective import substitution mechanism regardless of a country's development level. However, the policy implications differ. In EU–14 countries, renewable expansion complements already diversified energy systems, reinforcing energy security. In EU–13 countries, renewables appear to play a more transformative role by compensating for structural vulnerabilities and legacy dependence on imported fossil fuels. These findings are consistent with prior studies (Carfora *et al.*, 2022) highlighting renewable energy as a central pillar of EU energy security and decarbonization strategies.

The renewable energy sources are largely domestically produced and characterized by low marginal costs and price stability once installed. By substituting imported fossil fuels, higher renewable penetration weakens the transmission of international price shocks into domestic energy costs and public budgets.

From a fiscal perspective, this mechanism enhances resilience in several ways. First, lower import dependency reduces the likelihood that governments must intervene fiscally to shield households and firms from energy price surges. Second, renewables stabilize energy-related tax revenues by reducing volatility in consumption prices. Third, reduced reliance on external suppliers lowers the need for external borrowing during energy crises, thereby supporting debt sustainability.

Energy Intensity and Structural Differences between EU–14 and EU–13

The impact of energy intensity of GDP on energy import dependency differs notably between EU–14 and EU–13 countries. In the EU–14, higher energy intensity is associated with increased import dependency, indicating that energy-intensive economies place greater pressure on energy supply systems, which often rely on imported resources. This result aligns with theoretical expectations and previous research on advanced economies, where high energy use per unit of economic output cannot be fully met by domestic production. By contrast, in the EU–13, higher energy intensity is linked to reduced import dependency, reflecting structural differences in these economies. Many EU–13 countries still rely on domestic energy production from coal, nuclear, or legacy infrastructure, so higher energy consumption per unit of output does not necessarily increase reliance on imports. These contrasting patterns highlight the importance of considering historical, infrastructural, and structural characteristics when analyzing energy security, and caution against assuming uniform effects of energy intensity across EU member states.

Energy Consumption, Domestic Availability, and Demand Pressures

Final energy consumption per capita has divergent effects on energy import dependency in the two country groups. In the EU–14, final energy consumption exhibits a positive and significant effect, suggesting that higher per capita energy demand increases reliance on imports, consistent with demand-driven pressures in advanced economies characterized by high living standards, extensive transport networks, and energy-intensive lifestyles.

In contrast, in the EU–13, FCE is also statistically significant but reflects a slightly different mechanism: while higher consumption exists, it coincides with expanding domestic energy production and modernization of energy infrastructure, which helps contain import dependency. Similarly, gross available energy per capita significantly reduces import dependency in the EU–14, but is not statistically significant in the EU–13, indicating that domestic energy availability plays a larger role in mitigating import dependency in more developed economies. The negative effect of gross available energy per capita confirms that stronger domestic energy supply capacity reduces import dependency and, by extension, fiscal exposure. Countries with higher domestic availability are better positioned to absorb external shocks without resorting to costly fiscal measures. These results emphasize that energy efficiency improvements, optimized consumption structures, and renewable energy expansion are critical for reducing import dependency, while the effects of energy demand and domestic availability vary depending on the structural and developmental context of the country group.

Economic Development, Fiscal Resilience and Energy Import Dependency

GDP per capita shows a positive and significant relationship with energy import dependency in EU–14 countries, confirming that higher income levels tend to increase energy demand beyond domestic supply capacity. Despite greater financial capacity to invest in renewables and efficiency, demand effects appear to dominate in advanced economies. In EU–13 countries, however, GDP per capita does not exert a statistically significant influence on energy import dependency. This suggests that income growth alone does not automatically translate into higher import reliance and those other structural factors, such as energy mix composition, infrastructure quality, and policy frameworks, play a more decisive role. This result underscores the importance of targeted energy policies rather than income-driven assumptions in less developed EU economies.

Countries with high energy import dependency are structurally required to finance a substantial share of their energy consumption through imports priced on global markets. As a result, increases in global oil and gas prices directly translate into higher import bills, deteriorating trade balances, and increased demand for foreign currency financing. These external pressures spill over into the fiscal domain by raising public expenditures (through subsidies, price stabilization measures, and social compensation schemes) and weakening public revenues via lower economic activity and reduced energy tax bases. The energy system characteristics that increase import dependency simultaneously heighten fiscal exposure to external shocks, while those that reduce dependency strengthen fiscal resilience.

Policy Implications and Energy Security Considerations

The findings emphasize that reducing energy import dependency requires differentiated policy approaches across EU member states. While renewable energy expansion emerges as a universally effective strategy, complementary measures, such as improving energy efficiency, modernizing infrastructure, and diversifying energy source, must be adapted to national contexts. For EU–14 countries, policies should prioritize demand-side management, efficiency improvements, and accelerated renewable integration to offset consumption-driven import pressures. For EU–13 countries, strengthening domestic energy production capacity, upgrading infrastructure, and supporting renewable deployment can significantly enhance energy security while facilitating convergence with EU climate objectives. The results support the EU's strategic emphasis on energy diversification, renewable energy expansion, and

efficiency improvements as key instruments for reducing vulnerability to external energy shocks and strengthening long-term energy security.

Relevance and Applicability of the Findings for Non-EU Transitional Economies

Although the empirical analysis focuses on European Union member states, the findings hold substantial relevance for non-EU transitional and emerging economies, particularly EU-oriented countries in Eastern Europe and the Caucasus (Ukraine, Georgia, Moldova), as well as the Western Balkans. The core mechanisms identified within the EU context, especially the roles of renewable energy deployment, energy intensity, and consumption patterns, exhibit strong external validity for these economies, which face structurally similar challenges in energy security, fiscal sustainability, and economic modernization.

To clarify the comparative relevance of the empirical findings for non-EU transitional economies, Table 7 summarizes the key determinants and their corresponding policy implications.

Table 7. Comparative Policy Implications of Energy Transition Determinants: EU vs. Non-EU Economies

Determinant	Findings in EU Countries	Structural Conditions in Non-EU Transitional Economies	Policy Implications for Non-EU States
Renewable energy share	Strongest determinant of reduced energy import dependency	High renewable potential; strong fossil fuel import reliance	Accelerate renewable deployment to substitute imports and improve energy security
Energy intensity	Mixed effect; not always increasing import dependency	High energy intensity; legacy infrastructure	Combine efficiency improvements with domestic renewable expansion
GDP per capita	Limited role in explaining import dependency	Rapid growth with structural vulnerabilities	Align economic growth with energy transition investments
Energy system structure	Diversified domestic energy mix	High fossil fuel dependence, limited diversification	Prioritize energy diversification and grid modernization
Fiscal vulnerability	Lower exposure due to economic resilience	High sensitivity to energy price shocks	Use energy transition to enhance fiscal and macroeconomic stability

Source: Authors' synthesis based on empirical findings and comparative energy transition literature

First, the study identifies renewable energy share as the most robust and consistent determinant of reduced energy import dependency. This result is particularly relevant for transitional economies, where fossil fuel imports account for a large share of total energy consumption and are often concentrated among a limited number of suppliers. Such structural dependence increases vulnerability to geopolitical disruptions, currency depreciation, and international price volatility. Expanding domestically produced renewable energy thus functions as a powerful import-substitution mechanism, reducing exposure to external shocks while simultaneously supporting climate commitments and long-term development objectives. For countries such as Ukraine and the Western Balkan states, which possess significant wind, solar, hydro, and biomass potential, renewable deployment offers a direct pathway toward enhanced energy security and fiscal resilience without the necessity of large-scale fossil fuel investments.

Second, the heterogeneous role of energy intensity observed across EU countries provides important policy insights for non-EU transitional economies. In the EU context, higher energy intensity does not necessarily translate into greater import dependency, particularly in countries with substantial domestic coal, nuclear, or hydro resources. A comparable structural pattern exists in many transitional states, where energy-intensive production systems coexist with domestic energy assets. This implies that policies targeting energy efficiency alone, without parallel investments in clean domestic energy production, may not automatically reduce import dependency. Instead, a coordinated strategy combining gradual efficiency improvements with accelerated renewable energy expansion is more likely to yield durable reductions in external reliance and structural vulnerability.

Third, the limited explanatory role of GDP per capita in shaping energy import dependency among EU–13 countries carries important implications for emerging economies. Economic growth, in isolation, does not predetermine increased dependence on energy imports. Rather, the configuration of the energy system, the composition of domestic supply, and institutional capacity play decisive roles. Transitional economies such as Ukraine, Moldova, and Western Balkan countries can therefore strategically steer their energy transitions, ensuring that economic growth is accompanied by investments in renewable energy infrastructure, grid modernization, and institutional strengthening. Without targeted reforms, growth may either alleviate or exacerbate import dependency depending on the policy environment.

More broadly, the findings support the conclusion that reducing energy import dependency constitutes not merely an energy security objective but a fundamental prerequisite for long-term macroeconomic and fiscal sustainability. Many non-EU transitional economies face constrained fiscal space, limited access to international capital markets, and heightened sensitivity to external price shocks. By lowering import dependency through renewable energy deployment, efficiency improvements, and diversification of domestic supply, these countries can reduce persistent trade deficits, mitigate the fiscal burden of energy price surges, and enhance overall macroeconomic stability and debt sustainability. In this context, energy transition policies become central instruments of economic resilience and sustainable development.

Conclusion

This study examined the determinants of energy import dependency across European Union member states over the period 2015–2024, with particular emphasis on structural heterogeneity between developed EU–14 countries and less developed EU–13 countries. Using fixed-effects panel data models and a comprehensive set of energy, economic, and consumption indicators, the analysis provides new empirical insights into how energy system characteristics and economic factors shape energy import dependency within the EU.

The results show that the share of energy from renewable sources is the most influential and consistent factor in reducing energy import dependency across both country groups. Higher renewable energy penetration significantly lowers reliance on imported energy, confirming its critical role as an import substitution mechanism and reinforcing the importance of renewable deployment for energy security. Other factors exhibit distinct patterns between EU–14 and EU–13 countries, highlighting structural heterogeneity. In the EU–14, higher energy intensity of GDP, final energy consumption per capita (FCE), and GDP per capita are all associated with increased energy import dependency, reflecting demand-driven pressures

typical of advanced economies with high energy consumption and limited capacity to fully satisfy demand from domestic sources. Conversely, greater domestic energy availability and higher renewable shares effectively reduce import reliance, emphasizing the importance of supply-side diversification and efficiency improvements in mature energy systems.

In contrast, in the EU–13, renewable energy penetration remains the primary determinant of import dependency, while GDP and domestic energy availability have weaker or statistically insignificant effects. Notably, higher energy intensity and final energy consumption are associated with lower import dependency, suggesting that several less developed EU economies can meet increasing energy demand through domestic production, legacy infrastructure, or alternative energy sources, thereby mitigating reliance on imports.

These findings underscore the heterogeneity of energy security dynamics within the EU and caution against uniform policy prescriptions. They highlight the need for differentiated energy policies tailored to each country's structural and developmental context. While renewable energy expansion is a common strategic priority, complementary measures, such as improving energy efficiency, modernizing infrastructure, and managing energy demand, should be aligned with national energy system maturity and economic characteristics. By addressing these factors, EU countries can reduce import dependency, strengthen energy security, and advance broader objectives of sustainable development and climate neutrality. Energy systems characterized by high fossil fuel dependence, high energy intensity, and limited domestic supply capacity amplify the transmission of global energy shocks into public budgets, fiscal deficits, and external debt accumulation. Conversely, energy diversification, renewable deployment, and efficiency improvements weaken this transmission channel and enhance fiscal resilience. Future research could extend this analysis by examining fuel-specific import dependencies, geopolitical risks, and dynamic adjustment processes, providing a deeper understanding of how energy policy, economic development, and structural characteristics interact to shape energy import dependency in the European Union.

Credit Authorship Contribution Statement

Tatar, M. contributed to the data curation, investigation, methodology, resources, software, validation, visualization, writing - original draft, editing. Buleca, J. contributed to the conceptualization, supervision, formal analysis, investigation, methodology, project administration, validation, writing - original draft, editing.

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Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data Availability Statement

The data supporting the findings of this study are publicly available from the Eurostat Database at: <https://ec.europa.eu/eurostat/data/database>. All datasets used in the analysis are accessible without restriction. Additional information regarding data processing or replication procedures can be obtained from the corresponding author upon reasonable request.

Ethical Approval Statement

This study does not involve human participants, personal data, or experimental procedures requiring ethical approval. The research is based exclusively on secondary data obtained from publicly available sources, primarily the Eurostat Database. All data used in the analysis are aggregated at the country level and fully anonymized. Therefore, according to institutional and international research ethics standards, formal ethical approval was not required for this study.

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Annex 1

Energy Imports Dependency

Level of energy imports dependency	Share	Country grouping in 2024	Percentage
Low energy import dependency	0–25%	Estonia	12,999%
		Iceland	16,153%
Moderate energy import dependency	26–50%	Sweden	26,541%
		Latvia	29,538%
		Romania	30,356%
		Finland	32,973%
		Denmark	38,229%
		Czech Republic	39,32%
		France	40,06%
		Bulgaria	41,936%
		Poland	45,669%
		Slovenia	46,381%
		Hungary	48,997%
High energy import dependency	51–100%	Austria	53,322%
		Slovak Republic	53,501%
		Croatia	60,247%
		Portugal	64,524%
		Lithuania	66,014%
		Germany	66,802%
		Spain	68,872%
		Netherlands	70,564%
		Italy	73,854%
		Belgium	75,448%
		Greece	77,714%
		Ireland	79,533%
		Luxembourg	91,087%
		Cyprus	96,842%
Malta	98,388%		

Source: Authors' processing based on Eurostat Database (2025).