

ENERGY TRANSFORMATION IN THE EUROPEAN UNION: THE SHIFT TOWARDS RENEWABLE SOURCES AND GEOPOLITICAL CHALLENGES

DOI: 10.58867/RKLU3548

This article examines the transatlantic region's energy transformation, focusing on the European Union's shift towards renewable energy sources amidst geopolitical instability. It explores how recent geopolitical disruptions, particularly the Russia-Ukraine conflict, have accelerated Europe's transition to renewables to enhance energy security and reduce dependence on fossil fuels. The rise of renewable energy, challenges associated with intermittency, the resurgence of nuclear power, and the Scandinavian and Baltic countries' leadership in heating and cooling innovations are discussed. The paper highlights opportunities for achieving energy security through sustainable energy solutions while addressing policy and technological challenges.

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Keywords: Green Energy, Renewable Sources, Transformation,
Energy Security, Geopolitical Instability.



TPQ

Summer 2024

Change, Security, and Sustainability in Energy

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The global energy landscape has witnessed profound and transformative changes over the last few decades, driven by a combination of factors including rapid technological advancements, shifting patterns of energy demand, and significant geopolitical events that have disrupted traditional energy supply chains. These disruptions have been particularly acute in the transatlantic region, comprising Europe and North America, which has historically been dependent on fossil fuel imports from geopolitically volatile areas. As the world's energy supply has increasingly been used as a political tool, the transatlantic region's reliance on external sources for oil and gas has exposed its vulnerabilities. The recent geopolitical environment, marked by conflicts, sanctions, and shifts in global power dynamics, has exacerbated these vulnerabilities, creating new challenges for energy security.

In response to these challenges, many transatlantic countries have accelerated their efforts to transition toward a more sustainable energy model that is less reliant on fossil fuels and more dependent on renewable energy sources. This energy transition is not just a necessity driven by environmental concerns such as climate change, but also a strategic imperative for enhancing energy security, reducing geopolitical risks, and fostering economic resilience. The intersection of energy security and sustainability has thus become a defining feature of contemporary energy policy in the transatlantic region. This article explores the key factors shaping the energy transition, analyzes the role of geopolitical instability, and discusses the challenges and opportunities for achieving energy security through adopting renewable energy sources.

Geopolitical Instability and the Impact It Has Over Energy Security

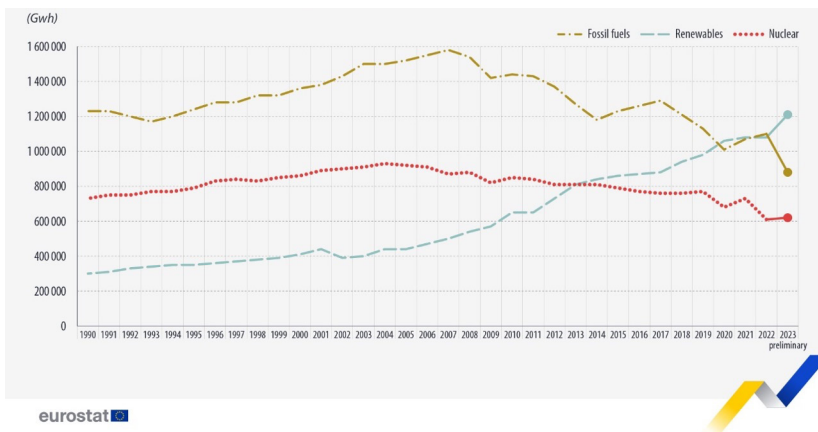
Over the past two decades, geopolitical instability has emerged as a significant factor influencing global energy markets, with profound implications for the transatlantic region. The energy supply chains upon which Europe and North America have traditionally relied have been disrupted by a range of geopolitical events, including conflicts, economic sanctions, and shifts in alliances. One of the most significant recent events affecting energy security in Europe has been the escalation of the conflict between Russia and Ukraine in 2022. Russia, a major supplier of natural gas and oil to Europe, faced sweeping sanctions from the European Union and the United States following its military actions in Ukraine. This led to a sharp reduction in energy supplies to Europe, triggering a full-scale energy crisis in the region. For decades, Europe had depended heavily on Russian energy imports, especially natural gas, which was viewed as a cleaner alternative to coal in the context of the region's transition toward a low-carbon economy. Russian gas had been a cornerstone of Europe's energy mix, accounting for around 40 percent of its total gas consumption

before the conflict. This dependency left Europe vulnerable when Russian gas supplies were curtailed due to the imposition of sanctions. In response, European countries were forced to diversify their energy sources quickly, turning to liquefied natural gas (LNG) imports from countries like the United States and Qatar, while also accelerating investments in renewable energy and reconsidering the role of nuclear energy in their energy mix. The geopolitical crisis in Ukraine thus exposed the fragility of Europe's energy security, highlighting the risks associated with an overreliance on a single supplier for critical energy resources. It also accelerated the drive toward renewable energy to reduce Europe's vulnerability to future energy supply disruptions. In this context, renewable energy sources, which are locally produced and do not require the same level of geopolitical risk management as fossil fuels, have gained increasing importance in the region's energy strategy. However, the transition to renewables presents its own challenges, particularly in ensuring that energy systems remain reliable and resilient as they shift away from traditional energy sources.

The Rise of Renewable Energy in Europe

Despite the challenges posed by geopolitical instability, Europe has made remarkable progress in its transition toward renewable energy. By 2023, the European Union achieved a historic milestone when, for the first time, electricity generation from renewable sources surpassed that from fossil fuels (see Chart 1).

Picture 1. Electricity production in the EU (1990-2023)¹



1) Chart is sourced from Eurostat, See <https://ec.europa.eu/eurostat/web/main/data/database>

This achievement was the result of years of concerted efforts to promote renewable energy as part of the EU's broader climate and energy goals, which include reducing greenhouse gas emissions by at least 55 percent by 2030,² achieving a 42.5 percent share of energy from renewable sources by 2030,³ and becoming climate-neutral by 2050. Several factors, including advances in renewable energy technologies, a supportive regulatory framework, and a strong political commitment to decarbonization have driven the European energy transition. The cost of renewable energy technologies, particularly solar and wind power, has declined significantly over the past two decades,⁴ making them increasingly competitive with traditional fossil fuels. This cost reduction has been a key driver of the rapid expansion of renewable energy capacity across Europe. Nevertheless, despite major expansions in photovoltaic (PV) manufacturing in the United States and India, largely fueled by policy incentives, China is projected to retain its substantial 80-95 percent share of global supply chains across different manufacturing stages. In addition, the European Green Deal, adopted in 2019, set the political and regulatory foundation for an accelerated shift toward clean energy, with ambitious targets for deploying renewables, energy efficiency measures, and developing a green economy. Solar and wind power have emerged as the cornerstones of Europe's renewable energy strategy. Wind energy, in particular, has become a dominant source of electricity generation in several EU countries, including Germany, Spain, and Denmark. Offshore wind power has also gained traction, with countries like the United Kingdom and the Netherlands leading the way in developing large-scale offshore wind farms. Solar power has also seen significant growth, particularly in southern European countries such as Spain, Italy, and Greece, where favorable weather conditions make solar energy a highly viable option. However, the transition to renewable energy is not without its challenges. One of the key issues is the intermittent nature of renewable energy sources, such as wind and solar, which are dependent on weather conditions. This intermittency requires developing energy storage solutions, such as batteries and hydrogen, and grid modernization to ensure a reliable and stable energy supply. In addition, the expansion of renewable energy capacity has raised concerns about the environmental and social impacts of large-scale wind and solar farms, particularly in terms of land use, biodiversity, and local community opposition.

2) European Green Deal, See <https://www.consilium.europa.eu/en/policies/green-deal/#:~:text=The%20package%20includes%20initiatives%20covering,it%20during%20its%20December%20meeting>

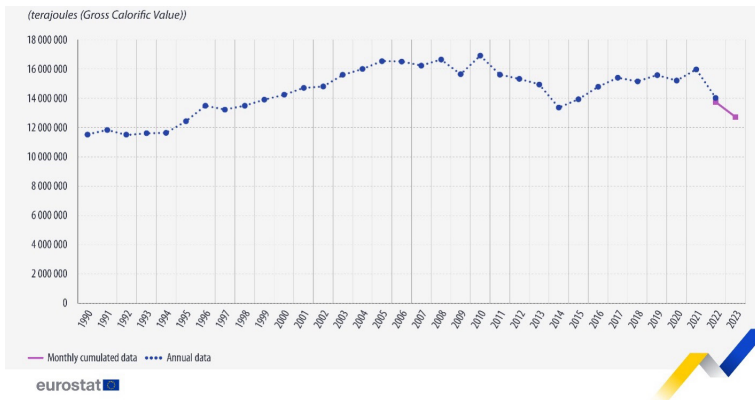
3) European Environment Agency, "Share of energy consumption from renewable sources in Europe". <https://www.eea.europa.eu/en/analysis/indicators/share-of-energy-consumption-from?activeAccordion=>

4) Our World in Data, Hannah Ritchie "Solar panel prices have fallen by around 20% every time global capacity doubled". <https://ourworldindata.org/data-insights/solar-panel-prices-have-fallen-by-around-20-every-time-global-capacity-doubled>

The Decline of Natural Gas in the European Energy Mix

The geopolitical tensions and the resulting cutback in Russian gas supplies have significantly diminished the role of natural gas in Europe's energy mix (see Chart 2). This shift became apparent quickly, as imports from Russia steadily declined, while gas supplies from Norway and the United States saw substantial growth between 2021 and 2023.⁵ Natural gas, once seen as a "bridge fuel" that could help Europe transition away from coal and toward a low-carbon future, has increasingly been viewed as a liability due to its association with geopolitical risk. In the wake of the energy crisis, many European countries have sought to reduce their reliance on natural gas by turning to alternative energy sources, including renewables, nuclear power, and LNG imports from more stable regions.

Chart 2. Inland demand of natural gas in the EU (1990-2023)⁶



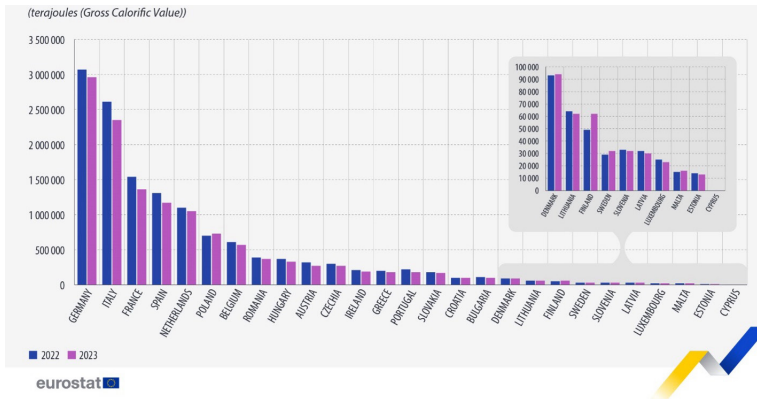
Between 2022 and 2023, natural gas demand in Europe declined sharply, with several EU countries reporting significant reductions in gas consumption (see Chart 3).

5) European Council, "How EU countries weathered a Russia-induced crisis and are reshaping energy supply".

<https://www.consilium.europa.eu/en/energy-leap-how-eu-countries-russia-crisis-supply/>

6) Chart is sourced from Eurostat, See <https://ec.europa.eu/eurostat/web/main/data/database>

Chart 3. Inland demand of natural gas, 2022 and 2023⁷



Germany, the largest consumer of natural gas in Europe, saw a dramatic decrease in gas imports from Russia, leading to a push for alternative energy sources. The German government accelerated plans to phase out coal and expand renewable energy capacity, while also revisiting the role of nuclear power in the country's energy strategy. Other European countries, including France, Italy, and Spain, also experienced declines in natural gas demand as they shifted toward renewables and diversified their energy imports. However, some countries, particularly in Eastern Europe, continue to rely on natural gas for a significant portion of their energy needs. Poland, for example, has increased its LNG imports from the United States and Qatar to offset the loss of Russian gas,⁸ while also pursuing investments in renewable energy and nuclear power. The decline of natural gas in Europe marks a significant turning point in the region's energy transition. While natural gas had been a critical component of Europe's energy system for decades, its future role is increasingly uncertain in light of geopolitical instability, climate policy, and the growing competitiveness of renewable energy. The challenge for European policymakers is to manage this transition in a way that ensures energy security, affordability, and sustainability.

The Role of Nuclear Energy in Ensuring Energy Security

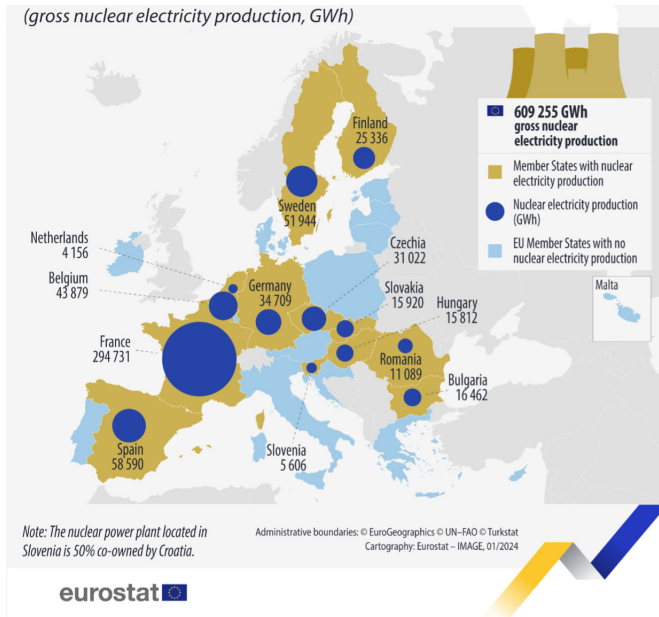
As Europe grapples with the challenges of energy security and the energy transition, nuclear power has reemerged as a key component of the region's energy strategy. Nuclear energy offers several advantages in the context of the energy transition: it is a low-carbon source of electricity, it provides a stable and reliable supply of baseload power, and it can help reduce dependence on imported fossil fuels. However, nuclear

7) Chart is sourced from Eurostat, See <https://ec.europa.eu/eurostat/web/main/data/database>

8) ACER, European Union Agency for the Cooperation of Energy Regulators, “Analysis of the European LNG Market Developments 2024 Market Monitoring Report”. https://www.acer.europa.eu/sites/default/files/documents/Publications/ACER_2024_MMR_European_LNG_market_developments.pdf

energy also faces significant challenges, including concerns about safety, waste management, and the high upfront costs of building new nuclear power plants. France has long been a leader in nuclear energy, with around 70 percent of its electricity generated from nuclear power (See Picture 1).

Picture 1. Nuclear energy in the EU, 2022⁹



In response to the energy crisis, the French government has reaffirmed its commitment to nuclear energy, announcing plans to build new reactors and extend the life of existing ones. Other European countries, including the United Kingdom, Finland, and Poland, have also signaled their intention to invest in nuclear energy as part of their long-term energy security strategies. However, the role of nuclear energy in Europe remains a contentious issue. Germany, for example, has pursued a policy of phasing out nuclear power following the Fukushima disaster in 2011, and the last of its nuclear plants is set to close by 2023. Despite the energy crisis, Germany has remained committed to its nuclear phase-out, focusing instead on expanding renewable energy and LNG imports. The debate over nuclear energy in Germany reflects broader concerns about nuclear power's safety and environmental impact, as well as the political and social opposition to nuclear energy in some parts of Europe. The future of nuclear energy in Europe will depend on a range of factors, including public opinion, regulatory frameworks, and the availability of financing for new projects. While nuclear power is likely to play a role in ensuring energy security in

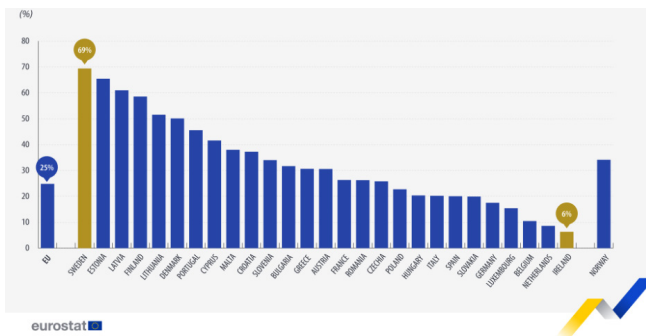
9) Chart is sourced from Eurostat, See <https://ec.europa.eu/eurostat/web/main/data/database>

the short to medium term, its long-term viability will depend on the development of next-generation nuclear technologies, such as small modular reactors (SMRs), which promise to be safer, more flexible, and more cost-effective than traditional nuclear reactors.

The Scandinavian and Baltic Model: A Blueprint for Energy Transition

The Scandinavian and Baltic countries have emerged as leaders in the transition to renewable energy, particularly in the area of heating and cooling (see Chart 4). These countries have adopted innovative technologies, such as district heating systems, geothermal energy, and heat pumps, to reduce their reliance on fossil fuels for heating and cooling. Environmental concerns, energy security considerations, and technological innovation have driven this transition.

Chart 4. Share of energy from renewable sources for heating and cooling, 2022¹⁰



Sweden, Finland, and Denmark, in particular, have made significant progress in integrating renewable energy into their heating and cooling systems. District heating, which uses waste heat from power plants and industrial processes to heat buildings, has become a common feature of urban energy systems in these countries. Geothermal energy, which harnesses heat from beneath the Earth's surface, is also widely used for heating in Iceland and parts of Finland. Heat pumps transfer heat from the air or ground into buildings and have become a key technology in the region's heating and cooling systems. Heat pumps are highly energy-efficient and can be powered by renewable electricity, making them a sustainable alternative to traditional fossil fuel-based heating systems. The widespread adoption of heat pumps in Scandinavia and the Baltic states has helped reduce the region's carbon footprint and enhance its energy resilience. The success of the Scandinavian and Baltic countries in transforming their energy systems offers important lessons for other regions seeking

10) Chart is sourced from Eurostat, See <https://ec.europa.eu/eurostat/web/main/data/database>

to reduce their reliance on fossil fuels. Their experience demonstrates the importance of government support for renewable energy, the need for public acceptance of green technologies, and the value of investing in energy-efficient solutions. As Europe and North America continue their energy transition, the Scandinavian and Baltic model provides a blueprint for achieving a sustainable and secure energy future.

Concluding Remarks

In summary, the energy transition within the European Union and the broader transatlantic region has reached a pivotal moment, driven by a convergence of geopolitical challenges and an increasing demand for sustainable energy solutions. The disruption of traditional energy supply chains, particularly in Europe, has accelerated the transition toward renewable energy and highlighted the critical need for diversification to ensure long-term energy stability. The growing reliance on renewable energy and a renewed focus on nuclear power offers a clear pathway for diminishing dependence on fossil fuels and enhancing energy resilience. While challenges such as the intermittency of renewable sources, the high costs associated with nuclear energy, and the necessity for advancements in energy storage and grid modernization persist, these obstacles also create new opportunities. The urgent need to address energy security has spurred the expansion of renewable energy production and increased the proportion of green energy within the energy mix. As policymakers navigate the intricate geopolitical landscape, they must strike a balance between ensuring energy security and the pressing obligation to reduce greenhouse gas emissions and combat climate change. The achievements of countries like Sweden, Finland, and Denmark in successfully integrating renewable energy provide valuable lessons for the transatlantic region. By persistently investing in clean energy technologies, enhancing energy efficiency, and implementing comprehensive policy frameworks, the region can secure a sustainable and resilient energy future that meets the needs of both current and future generations.

