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Energy Transition and Economic Resilience in Europe: Challenges and Opportunities in the Post-Ukraine War Era

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Abstract:
This paper examines the interconnection between Europe's energy transition and its economic resilience in the aftermath of the Ukraine war. The disruption of fossil fuel supplies revealed structural vulnerabilities in European energy markets, accelerating the urgency of diversifying energy sources and investing in renewable technologies. The study synthesizes key challenges—such as supply chain disruptions, insufficient investment, and regulatory barriers—while also identifying growth opportunities in technological innovation, shifting market dynamics, and public-private partnerships. A resilience framework is proposed, emphasizing indicators like supply security, price stability, and market flexibility. Case studies from Germany, France, and Scandinavia illustrate contrasting pathways to resilience through different policy choices and energy mixes. Findings suggest that while the transition enhances long-term resilience, short-term economic vulnerabilities persist due to inflated costs, political uncertainties, and uneven regulatory landscapes. The paper concludes that Europe's ability to reconcile the pace of transition with economic stability will determine its success in achieving climate neutrality and energy security by 2050.

Keywords: Energy Transition; Economic Resilience; Europe; Opportunities; Ukraine War.
Jel codes : E32, F51, L95, O52, Q42, Q43, Q48, Q54.

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1. Introduction

The transition from fossil fuels to renewable energy constitutes a critical shift in Europe's energy landscape, particularly in the aftermath of the Ukraine war. The conflict exposed structural vulnerabilities in energy markets, aggravating supply shortages of critical resources and slowing the pace of transition. Despite these challenges, opportunities have emerged through technological innovation, evolving market dynamics, and stronger cooperation between European and non-European partners. The European Union plays a pivotal role by mobilizing funding, supporting regulatory reforms, and fostering public–private partnerships that enhance both energy security and economic resilience. This paper investigates the challenges and opportunities of Europe's energy transition, with a focus on its implications for economic resilience in the post-Ukraine war era.

2. Context of the Energy Transition

Energy policies in Europe have remained largely business-as-usual over the past decade, with energy only gradually returned to the political agenda since 2020. Despite significant resources allocated to the development of renewables, the transformation of energy markets was encouraged, as it was expected to provide more interconnections and greater diversity of suppliers. Renewable energies thus focused on various sustainable development objectives, including climate change mitigation, energy security, and economic development, without special consideration of economic resilience. The strategic partnership with Russia contributed to the initiatives that reduced dependence on the middle east and allowed Europe to access abundant and competitive energy sources to satisfy its energy needs. It therefore came as a great surprise when the conflict between Ukraine and Russia disrupted the energy supply chain. Following the shock, a more profound and determined energy transition was put back on the agenda. A new focus emerged on the resilience of the energy transition and, in particular, on the ability of the energy sector to absorb, recover, and still retain its basic functions. (Toygar and Yildirim2023)

2.1. Historical Overview of Energy Policies in Europe

Europe's history of energy transition policy provides valuable background for understanding the impact of the Ukraine war on energy supply chains. The 2014 Crimean annexation highlighted the vulnerability of the European Union (EU) to disruptions in Russian gas supplies, given Ukraine's role as a major transit route (Alfredo Uribe, 2014). Since then, the EU has sought to increase energy interdependence through mechanisms aimed at enhancing resilience to supply shocks, encouraging the responsible use of existing resources, reducing reliance on external supplies, and broadening the range of producers and transit countries with influence over its energy landscape. However,

energy policy remains an area of contested competence between member states and the European Commission, with climate priorities increasingly integrated since the 2009 Copenhagen summit and the 2015 Paris Agreement. The EU's ambition to achieve carbon neutrality by 2050 has been affirmed through legislative packages such as the 2020 Climate and Energy Package, the 2030 Climate and Energy Framework, and the 2016 Energy Union and Clean Energy for All Europeans proposals. Yet a comprehensive overview of policy and governance options is lacking; further research into competitive and collaborative approaches in the context of contemporary energy security challenges is therefore needed. (Guarascio et al.2025)

2.2. Impact of the Ukraine War on Energy Supply Chains

The Ukraine War has exposed the inherent vulnerability of global energy supply chains and highlighted the necessity for a rapid roll-out of sustainable and renewable energy supply chains in Europe to prevent economic growth from becoming dependent on a handful of national suppliers. Consequently, energy resilience has emerged as a key challenge of the transition process. Energy resilience, defined as the ability to resist and recover from the impact of a disruptive event, remains only partially understood, in particular in the context of global energy supply chains. Resilience indicators in energy markets account for the impact of adverse events and signals that alterations in underlying market structures have occurred. The supply chain bottlenecks that hinder the development of sustainable energy delivery create an opportunity for targeted policies, which could unlock the potential for more robust and versatile energy provision as the current urgent need for broad and effective diversification becomes an ever-increasing priority (Wiertz et al., 2022).

3. Economic Resilience Framework

Economic resilience in the context of energy denotes the capacity of an economy to uphold or restore its pre-disturbance level of output following an energy shock . In energy markets, various policies aim to secure supplies, manage prices, maintain market equilibrium, and pursue balanced development (Mazur et al., 2018). The economic security of markets is increasingly examined through the lens of resilience.

An economic resilience framework generally comprises a set of indicators designed to measure performance across the dimension of interest. Within energy systems, economic resilience indicators can include the security of energy supply, supplier diversity, price stability, and the flexibility of markets. Tracking these indicators provides insight into the systems' capacity to withstand or recover from disruptions. Economic challenges and energy disruptions thus represent a breakdown in or insufficient development of resilience. (De Rosa et al., 2022)

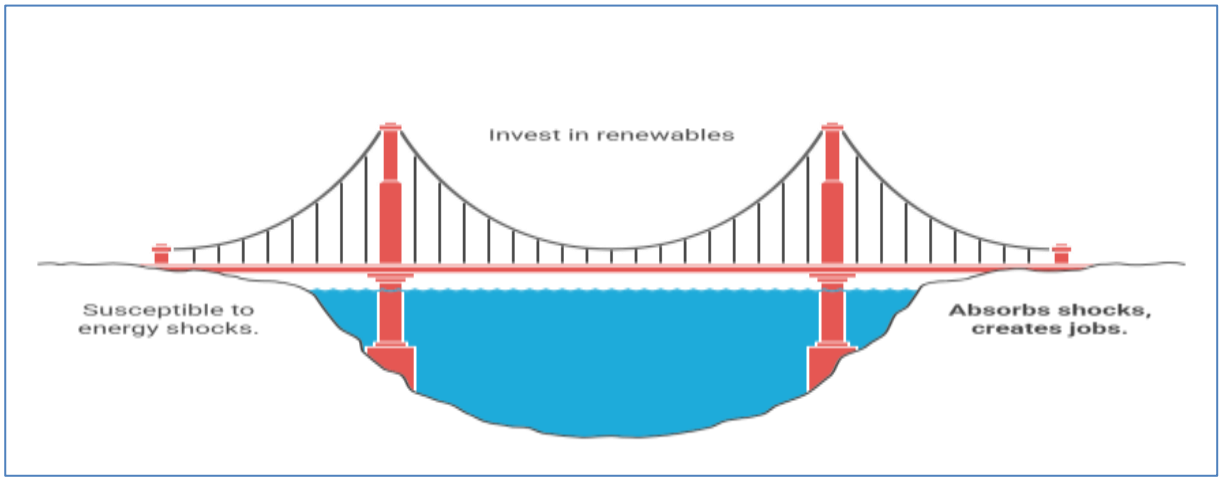
Distinct categories of economic resilience include:

- enhanced investment and production capacity;
- increased social stability;
- a broader multilevel economic structure.

3.1. Defining Economic Resilience

Distance to equilibrium as a resilience indicator characterises relatively slow drawdown and rapid replenishment of the equilibrium level. The ability of a system to limit displacement following an external shock has been employed by a number of authors . The measure captures the resonance effect generated by a temporary external shock as well as the orientation of the system to absorb or to amplify the shock. The advantage of this indicator relies in its explicit elasticity character and its straightforward interpretation in the full range of values (i.e. values smaller than one indicate resilience, whereas values larger than one represent a shock-amplifying capacity). The present article explores how the transition towards cleaner energy in Europe generates opportunity for the regional economy to become more resilient. More specifically, it investigates whether structural change in the energy industry may open up jobs in the post-Ukraine war period. While recent resumption of energy links with Russia adds uncertainty about the transition pace, the longer-term direction of Europe's energy policy remains broadly unchanged. With a neglected renewable energy sector, the Ukraine war has strengthened the case for higher investments and still represents a window of opportunity to accelerate the transition. Europe's policy challenge now rests in raising and sustaining energy investments without altering the course of the transition towards cleaner energy. (Heffron et al.2021)

Figure 1: Conceptual Framework of Economic Resilience in the European Energy Transition



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3.2. Key Indicators of Resilience in Energy Markets

In examining the economic resilience of countries subject to an energy transition, the framework proposed by offers valuable insights for identifying relevant indicators of resilience within energy markets. The existing literature on economic resilience provides general concepts without extensive elaboration on the specificity of energy markets. The unexpected and disruptive onset of the COVID-19 pandemic underscored the consequences of vulnerability across supply chains and economic activities. Economic resilience, defined as the capacity to absorb external shocks while maintaining functionalities with limited destruction, extends this definition by including the capacity to recover and adapt by reconfiguring former structures in the aftermath of shocks. Alignment between economic resilience and the associated time frame following an energy transition is achieved as limiting violence on the system enables a smooth economic transformation during this period. Analyzing economic resilience is best conducted by identifying suitable metrics or key variables that allow for an accurate economic description. These key indicators enable the characterization of resilience across various spatial and temporal scales, contingent upon the type, origin, and magnitude of shock, as well as the specifics of the energy transition. (Ngouhouo & Nchofoung, 2022)

4. Challenges of Energy Transition

International energy markets are strained by disruptions to supplies of raw materials and equipment, alongside concerns over inflation and higher interest rates in many countries. Investment in new wind parks and photovoltaic plants has decreased since 2021. The ongoing war and uncertainties generated by the pandemic continue to impact the availability of raw materials and the extension of supply chains, while projects are impeded by long-lasting permit procedures and complex regulatory environments (Bouzarovski et al., 2024).

4.1. Supply Chain Disruptions

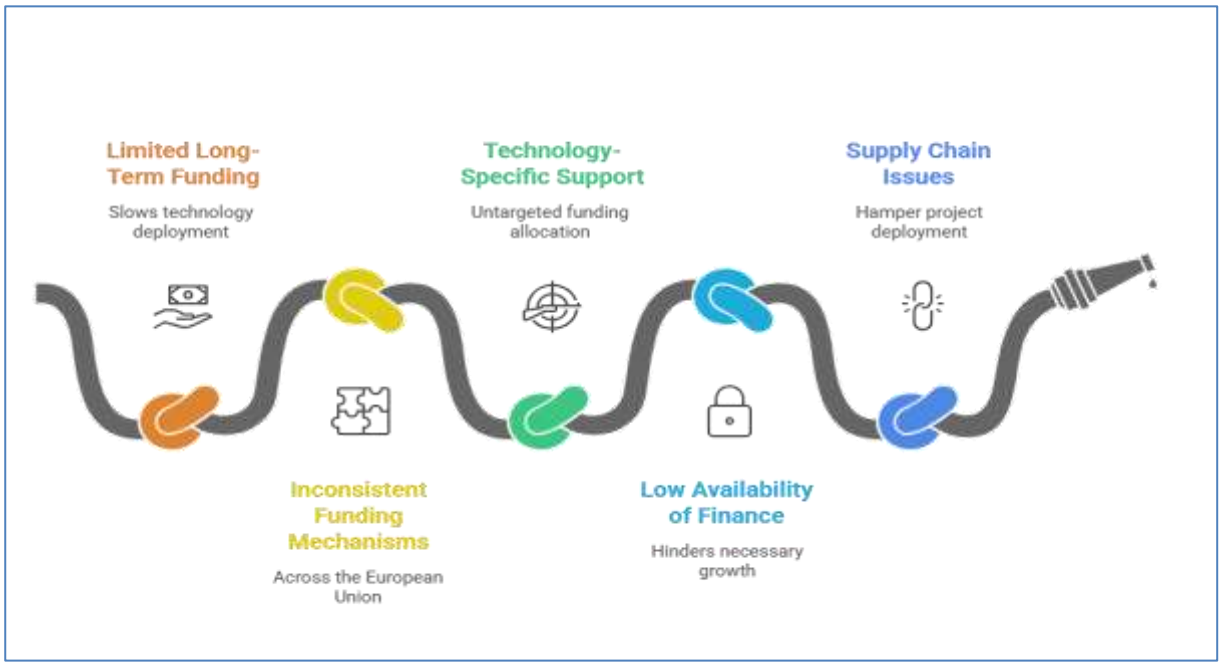
European economies, still recovering from COVID-19, faced another severe energy shock following Russia's invasion of Ukraine in 2022. Prices of oil, gas, and coal surged, eroding household purchasing power and pressuring industry and employment, while governments confronted mounting social and political unrest. In response, the EU launched unprecedented emergency measures, including cohesion funds to mitigate social impacts. Despite short-term hardships, the crisis accelerated momentum toward an energy-independent economy built on efficiency and renewable.

The European Green Deal and REPowerEU agenda aim to cut emissions by 55% by 2030 and achieve climate neutrality by 2050, fostering new technologies, business models, and green jobs. Several states—France, Spain, Italy, and the UK—fast-tracked renewable projects, supported by subsidies, loans, and regulatory reforms. However, the crisis also exposed the limits of intermittency-management technologies, alongside high investment costs and restrictive regulatory frameworks. Achieving targets requires at least doubling renewable investment, while overcoming lengthy permit processes and risk-averse investor climates. Investment conditions remain the decisive factor for strengthening Europe's energy security and resilience (Resch et al., 2023).

4.2. Investment Gaps in Renewable Energy

Investment in renewable energy generation is insufficient to meet policy targets and growing demand. A significant increase in investment is required to support continued deployment and growth. The current policy landscape provides relatively limited long-term funding and investment support for renewable technologies. Available support is concentrated largely among the more mature technologies, with specific gaps in funding for a number of key emerging technologies, which are central to the transition to a sustainable energy system devoid of greenhouse gas emissions. Funding resources and mechanisms to facilitate investment in renewable energy coverage across the EU are inconsistent. The existing and planned support remains largely technology-specific and untargeted toward the installations and locations where funding is most needed. Low-cost finance for a variety of renewable energy technologies is also less widely available than is required to achieve the speed and scale of growth necessary to meet the 2020 and 2030 targets. The transition to a sustainable energy system meeting climate and energy goals is compromised by substantial barriers. Supply chain issues, material costs, skills shortages, land acquisition challenges, consenting delays, planning issues, and grid connection restrictions hamper the deployment of renewable energy projects. It is unclear whether these barriers can be overcome quickly enough to allow the rapid deployment of the diverse set of renewable technologies required. Consequently, the transition to sustainability appears to be stalled. Policy and regulatory barriers, coupled with low investor confidence, exacerbate the difficulties. The war in Ukraine has accelerated the energy transition, subsequently highlighting investment requirements. Stated sustainability targets are not matched by sustained investment signals. Given current prices and market risks, the benefits of investment in generation are not sufficiently compelling. Investment needs are magnified as several gas-fired generation stations, intended as transitional measures, are now less viable. (Falcone, 2023).

Figure 2: Investment Gaps in Renewable Energy to Achieve REPowerEU Targets



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4.3. Policy and Regulatory Barriers

The transition to new energy technologies involves complex industrial, commercial, and regulatory relationships born of a long, legible history. The stabilization of oil prices and the 1986 crime of distribution in electricity production help explain why a variety of European countries, including Germany, Italy, and Sweden, chose to embrace nuclear technology over cleaner coal or fuel-efficient gas alternatives. Renewables, for instance, from zero to only 10% penetration over the past decade, create a marginal, often non-scalable supply chain of conditions not broadly interoperable with existing industry. Thus, wind, for example, may operate when clouds shut down solar, but photovoltaic remains mutually exclusive with coal and gas, requiring complex storage and disruption of national and local procurement systems. The supply chain implications alone have eliminated hundreds of thousands of jobs in the coalmining majors and tens of thousands of posts in the steel industries—and millions more on both sides of the broader procurement chain. Renewed investment in fossil fuels still exceeds renewable credits by about 250 billion USD annually. Regulations, rent-seeking, limitations of a concealed price mechanism, and inadequate spread of renewal funds compound the challenge. (Kennedy et al.2023)

5. Opportunities for Growth

Energy technology and the EU's 'top runners' policy are creating options for smarter demand management, distributed generation, low-temperature applications, and wider

integration of renewables, which can provide more resilience in the long term. Price-responsive demand is increasing. Publicly engaged purchasing mechanisms are unlocking new supply and new sources of finance. Public–private partnerships can deploy infrastructure (microgeneration, district heating) and energy efficiency schemes on a wider scale, and the void left by incumbent suppliers can be filled by more local or decentralised providers (NARBONE & GINSBORG, 2019).

5.1. Technological Innovations in Energy

Innovations in energy storage, conversion, and efficiency technologies underscore a potential pathway for improving the economic resilience of European economies under post-Ukraine war conditions. Innovation has taken place in battery technologies, fuel cells, compressors, heat pumps, and high-efficiency lighting. The development of advanced materials and manufacturing techniques has markedly enhanced energy storage capabilities, which are a critical component of an efficient energy transition. Innovation also can facilitate the integration of the energy system through the aggregation of distributed energy sources and provide tools for cost-effective and high-impact energy-efficiency investments. Distributed energy-supply systems contribute to economic resilience by lowering vulnerabilities to supply disruptions. However, inefficiencies in production, distribution, transportation, and consumption accompanying rare materials shortages, fluctuations in financial markets, traditional and digital threats, and other factors weigh on economic resilience. Moreover, an insufficient level of investment in renewables, energy infrastructure, and networks leaves European countries vulnerable to fossil-fuel shortages amid the ongoing European energy crisis. Regulatory frameworks and energy policies remain the cornerstone for the functioning of the sector; consequently, policy uncertainty affects investor trade and discourages the development of renewable energy technologies. (Shi and Zhao2025)

5.2. New Market Dynamics and Consumer Behavior

The European Union's ambitious climate and energy strategies established a theoretical framework to achieve a complete energy transition by 2050. Geopolitical events, notably the Russian military aggression in Ukraine, abruptly transformed energy markets and the general economic framework, rendering prior analyses obsolete and underscoring the uncertainties associated with qualitative predictions. Although the long-term goals of the European energy transition have remained intact, actual economic phenomena must be reexamined as indicators of economic resilience in energy markets. (Nuhu et al.2023)

5.3. Public-Private Partnerships

Public-private partnerships continue to play a significant role in near-term infrastructure investment amid economic uncertainty. Public-private partnerships (PPPs) constitute contractual arrangements between governmental bodies and private firms to finance, design, construct, operate, and maintain public infrastructure projects. In exchange, the public sector commits to funding costs and furnishing long-term profit expectations. PPPs enable governments to leverage private capital and defer public outlays while still realizing benefits, rendering them especially appealing under fiscal constraints.

6. Role of the European Union

The European Union has actively sought to fortify the energy transition following the war outbreak in Ukraine through a new energy strategy channelling investments and reforms. The strategy aims to help Member States become independent from Russian fossil fuels well before 2030 and at the least cost. The European Commission announced a European Solar Rooftops initiative and a new European Hydrogen Bank to increase the uptake of clean energy and speed up the green transition. According to the REPowerEU plan, €20 billion of the 2021-2027 EU budget and the NextGenerationEU recovery plan will be mobilised in grants to finance investments and reforms. An additional €5 billion is earmarked for a new Solarly Fund to stimulate investments in solar energy to reach 320 GW of solar photovoltaic capacity by 2025. The Plan identifies three enabling factors that will accelerate investments, mitigate risks, and lower the cost of the clean energy transition: grids, permitting, and innovation. The EU is actively engaged in a dedicated dialogue with industry to finalize these guidelines.

Two important initiatives at the EU level provide further support to Member States: the Platform for Electro-mobility and the Gateway for Sustainable Energy Investments. The Platform for Electro-mobility is a Political Declaration among 28 countries and more than 50 stakeholders on the deployment of electro-mobility charging points and rolling out smart charging solutions. It is complemented by the commitment outlined in the Declaration of Amsterdam concerning the deployment of alternative fuels infrastructure in the Trans-European Transport Network. These initiatives will raise the deployment of green alternatives in transport, reducing external dependency while decarbonizing the transport sector. The Gateway for Sustainable Energy Investment and Funding provides support for flagship projects, streamlining the development of sustainable energy projects and access to financing. To pursue these objectives, Member States launched a Green Deal Industrial Plan for the Net-Zero Age to provide a predictable and simplified regulatory environment, faster access to funding, enhanced skills, and open trade for European clean tech. Concurrently, the EU has reached a political agreement on the

Energy Efficiency Directive, and a provisional agreement will soon be concluded on the Renewable Energy Directive to accelerate renewables deployment and cut red tape. (Skovgaard et al.2023)

6.1. EU Energy Policies Post-Ukraine War

The European Union has demonstrated leadership in global energy transition, facilitated by strong commitment, international cooperation, and an integrated internal energy market. In the post-Ukraine war era, the European Union mobilized substantial funding to advance its energy transition and economic resilience objectives.

Several new initiatives were launched to accelerate the energy transition and introduce innovative solutions and technologies. Eight flagship initiatives foster cooperation among member states covering critical areas such as low-emission mobility, energy-efficient heating and cooling, renewable hydrogen, energy storage, circular economy, critical raw materials, grid technologies, and sector integration. Ongoing joint undertakings that facilitate public-private sector collaboration include Clean hydrogen, Electricity networks, Batteries and alternative fuel cells, and Fuel Cells and Hydrogen. Additionally, the Net-Zero Industry Act, the Critical Raw Materials Act, and the Green Deal Industrial Plan support industrial leadership and supply chain resilience in net-zero technologies . (Holechek et al., 2022)

6.2. Funding Mechanisms for Energy Transition

The energy transition involves the reconfiguration of the energy markets and reallocation of flows between energy resources, demand sectors and consumers. Its financing brings a set of challenges, from lack of long-term funding—particularly for renewables—and on-going technological development, to supply-chain bottlenecks and regulatory inadequacy. Larger projects in energy efficiency and lower-carbon generation should unlock new segments with significant growth potential. Technological disruption is reshaping the landscape of energy players and value-chain structures, opening avenues for new sources of cross-sector corporate financing, additional equity issues and further company bond issuance . Belgian listed firms, for instance, have been issuing sizeable investment-linked debt since the onset of the Ukraine War, and expanding their equity base to exploit the opportunities created by the energy transition. (Jäger-Waldau, 2023)

Europe has long supported a gradual approach to energy transition underpinned by a brokerage model to manage the passage to a low-carbon equilibrium point. This strategy, based on continuous adjustment of arrangements, actors, organisations and institutional settings, was adequate until the Ukraine War. The catastrophic disruption to global energy markets and severe supply shocks brought about by the war and sanctions

currently impede this approach by exacerbating economic uncertainty and threatening energy security. Disorderly change may therefore force the transition onto an entirely different trajectory at the political and social levels, threatening recovery prospects and severely impinging on economic resilience. These circumstances make it timely to establish an economic-resilience framework for analysing the challenges and opportunities that arise at the market, sector and firm levels. Effective transition strategies need to clarify the requirements not only to maintain uninterrupted supplies of energy but also to protect all sound strategies for energy saving, efficiency gains and decarbonisation.Details concerning small modular reactors have also emerged in Europe. Alternative incentives likely to restore economic resilience should be accompanied, where appropriate, by a range of measures aiming to overcome potential risk averse behaviour, encourage learning and foster innovation and experimentation. The mobilisation and reallocation of financial flows will be critical to managing the energy transition in a manner consistent with the realisation of broader macroeconomic objectives. For many firms, the opportunity cannot be grasped without a long and costlier ramp-up phase, which calls for alternative liquidity- and debt-funding mechanisms during such a period. (Holechek et al., 2022)

6.3. Collaborative Efforts Among Member States

Strengthening integration initiatives is essential to ensuring energy security while accelerating the decarbonization of the energy infrastructure. Through the European Green Deal and the REPowerEU plan, numerous funding channels and investment options have recently been made available, generating a highly conducive environment for the energy transition. This regulatory and financial support further catalyzes technology improvement and innovation activities and contributes to the development of large-scale energy infrastructure and cross-border interconnection projects. Such projects, critical for securing the supply of clean energy resources such as green hydrogen, will strongly benefit from multinational collaboration among industry players, market operators, and policymakers. An immediate focus remains the scaling up and acceleration of projects that can deliver tangible results in the next three to five years, such as offshore wind farms, solar parks, and hydrogen electrolyzers.

The significant disruption in energy supply chains, triggered by the ongoing war between Russia and Ukraine, has renewed the urgency for a swift transition towards renewable energy sources. This shift should not exacerbate economic disruption, yet renewable capacities currently remain insufficient to maintain the present standard of energy supply. Energy markets and political authorities across the continent are therefore engaged in a widespread effort to foster innovation, increase efficiency, and reduce

carbon emissions, thereby strengthening their economic resilience. Lasting resolution of energy insecurity requires pan-European regulatory mechanisms and governance frameworks, alongside improved interconnections and cooperation among all Member States and energy markets. The EU's REPowerEU plan, adopted by the European Commission in May 2022, enshrines this political commitment and targets an ambitious expansion of renewable power and hydrogen generation capacities, accelerated deployment of electric vehicles, and an overall reduction in demand for fossil fuels. (Hayati et al.2023)

7. Social Implications of Energy Transition

Energy transition has complex social consequences in Europe. It shapes public perception and societal acceptance of new policies and disruptive technologies. It alters regional labor market conditions, with the growth of renewable-energy sectors partially mitigating losses in traditional energy industries.

Empirical analysis of the 1990–2019 period demonstrates that energy-market policies require a general equilibrium perspective. Problems in one segment of energy production ripple through the energy value chain and the broader economy. Better economic conditions help weather the upheaval associated with the energy transition and increase public support for decarbonization efforts. When transitions involve sizeable cost increases, the economic damage may also jeopardize sustainability.

7.1. Public Perception and Acceptance

This chapter examines public perceptions and acceptance of the energy transition in the aftermath of the Ukraine war.

Social acceptance determines whether a technology is adopted and continues to be used. Energy technologies are either accepted or rejected by communities, groups, or individuals over time. Individuals' opinions are conditioned by three factors: awareness of impacts and knowledge of consequences, personal norms motivating decisions, and situational conditions that influence their willingness or ability to change. Perceived risks and benefits and fairness in their distribution also matter, with individuals more likely to accept a project (or transition) if benefits are fairly distributed and expectations met. These factors underpin the widespread, persistent, and open opposition to infrastructure (pipelines, wind farms, solar parks) required to maintain existing fossil asset values and integrate and extend renewables. Opposition arises because continuing to use existing fossil infrastructure perpetuates emissions at 2030 cost-plus levels that exceed the maximum sustainable levels for building a zero-carbon society (Wiertz et al., 2022).

7.2. Job Creation in Renewable Sectors

The number of jobs created by the energy transition remains uncertain . The development of renewable-resource-based businesses in rural areas can generate jobs in construction, operation, supervision, and distribution, offering the opportunity to better use human capital and to increase the incomes of rural populations, especially in poorer regions. New green investments could generate entrepreneurial opportunities and enhance the capacity for local innovation and adaptation. Employment gains in renewables might also compensate for losses in agriculture attributable to land use changes.

8. Case Studies

Germany was the first country in the world to adopt ambitious decarbonisation targets and the first industrialised country to develop a systematic approach to a low-carbon energy system, known as the Energiewende. Framed by the government as an energy transition, the Energiewende refers to a continual process of decarbonising the electricity and heat sector, broadening the capacity of renewable energy supply and networks, and improving energy efficiency. France offers a largely contrasting example, with an energy system shaped over many decades by a commitment to nuclear energy, resulting in the lowest energy sector emissions per capita in the EU, and an outstanding record in decarbonisation at the national level. Finally, the Scandinavian countries provide interesting examples of energy transition strategies that are strongly reliant on renewables but that differ markedly from each other. Sweden's electricity mix has been shaped by a combination of hydropower and nuclear, and its carbon emission factor is among the lowest in the world, whereas Denmark's electricity has historically been dominated by coal and natural gas but has made a rapid shift towards renewables over the last two decades (Bouzarovski et al., 2024).

8.1. Germany's Energiewende

Shifting priorities in German energy politics mean energy infrastructures can now be justified as crucial to national security and freedom. This geopolitical context has opened a new chapter for German and European energy strategies, in which environmental and economic rationalities are increasingly interwoven with imperatives of war, sovereignty, and supply security (Wiertz et al., 2022). Four discursive shifts illuminate this transition. First, the previous consensus over the Energiewende's desirability has weakened amid debate over whether renewable energy primarily causes or resolves gas import dependency. Second, a new moral imperative for reducing fossil-fuel reliance has emerged alongside economic considerations, rendering renunciation a politically conceivable means of addressing the crisis. Third, the discourse has grown more receptive to non-renewable technologies promising enhanced supply security, with

proposed expansions of LNG imports and the domestic use of lignite and nuclear power threatening an infrastructural commitment and potential lock-in. Fourth, the framing of the Energiewende as a matter of peace, freedom, and national security justifies additional funding and accelerated infrastructure development despite local opposition. These shifts are critical to understanding the political future of the Energiewende and German energy politics more broadly.

8.2. France's Nuclear Strategy

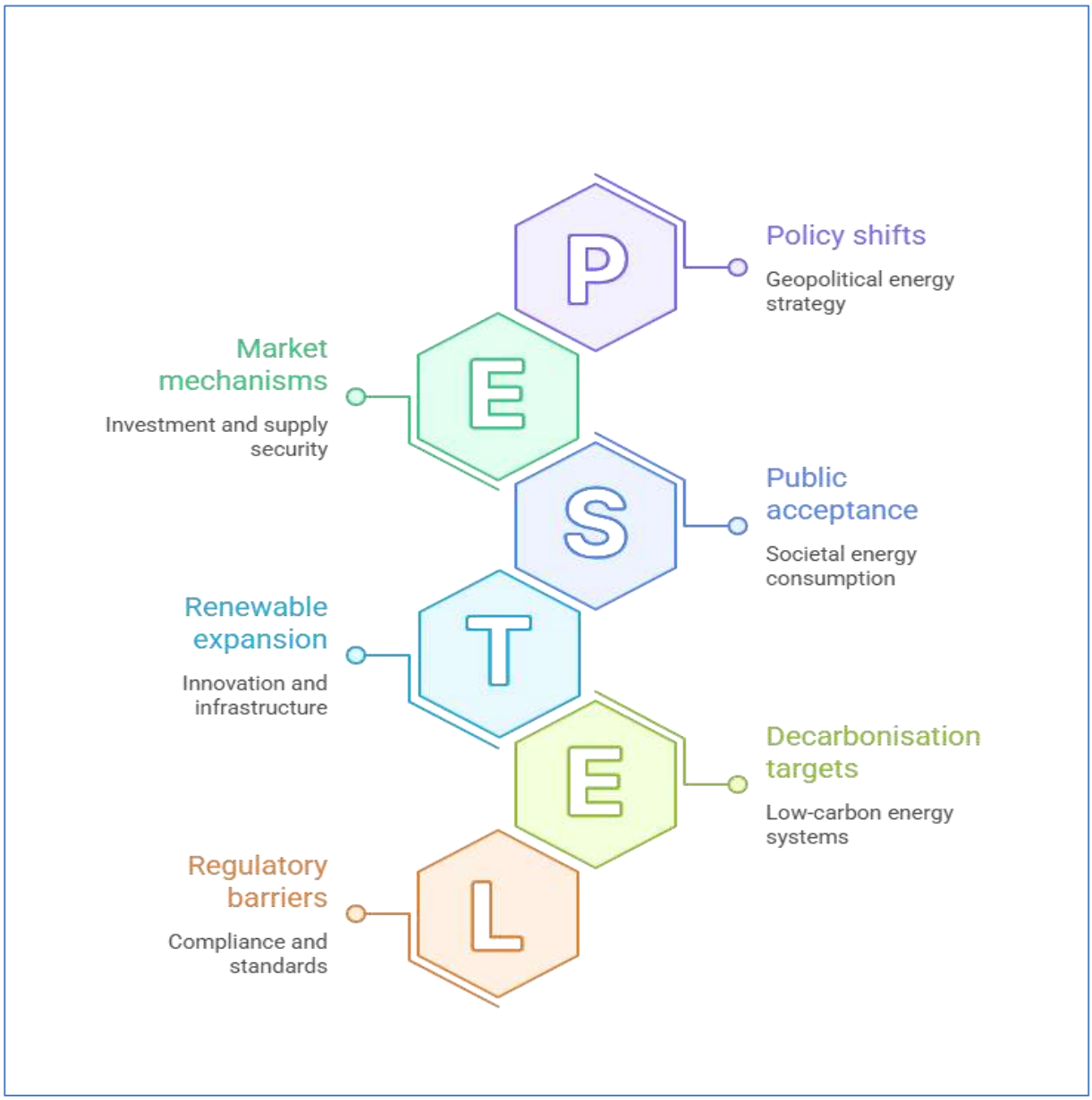
France’s energy policy following the 2022 invasion of Ukraine and the deployment of Russian gas supply cuts exemplifies the complexities of the ongoing transition to a low carbon future. Since the late twentieth century, European countries have sought alternatives to fossil fuels. The 2009 Climate and Energy Package stipulated a 20% emissions reduction target for the European Union by 2020 via targets on emission trading schemes, renewable energy and biofuels, and energy efficiency . The war in Ukraine therefore represents one among several disruptions to a transition that is perceived to be moving very slowly. Policies adopted during the crisis effectively seek to accelerate agreed energy transitions rather than to delay them. However, the transition has been challenged by supply chain disruptions, a shortfall of investment, and a host of policy and regulatory barriers that are not easily removed. (Kennedy et al.2023)

8.3. Scandinavian Approaches to Renewable Energy

The Nordic countries possess the greatest shares of low-carbon energy, albeit through varying energy mixes. Iceland capitalizes on its geothermal and hydropower resources; Sweden relies on hydropower and nuclear power; Denmark leads in wind power; Finland utilizes hydro, nuclear, and biofuels; and Norway predominantly uses hydropower. While Iceland's aggregate energy consumption has increased, per capita emissions have decreased, reinforcing the sustainability of its energy system. Low-carbon transitions in these countries have been shaped by a combination of policies, technological innovations, and abundant natural resources. Hungary could derive valuable insights from the experiences of Denmark, Iceland, and Sweden02018ref_id043910658-75bc-4797-b0e8-700ef07989fb. Conversely, Norway's persistent dependence on oil for transportation may impede a comprehensive, economy-wide shift to low-carbon energy . Assigning transmission capacity rights through market mechanisms better accommodates the inherent uncertainty and variability of renewable energy sources compared to fixed quota obligations. The deliberate development of systems to trade forward transmission rights introduces market flexibility that complements the variability encountered in fuel availability at the supply source. Auctioning such rights during the capacity tendering process creates fundamental

incentives for suppliers to invest in generation and transmission simultaneously, fostering coherence in low-carbon energy infrastructures. At supply points, the dynamics of fuel availability for renewable technologies lead to predictable variability; thus, support mechanisms that provide accompanying market venues for forward transmission rights can effectively mitigate this challenge. Auction-based allocation of transmission rights, linked ex ante to capacity tenders, aligns support for generation and transmission in a manner that accommodates supply-side variability. (Hayati et al.2023).

Figure 3: Comparative Case Study of Energy Strategies in Germany, France, and Scandinavia



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9. Future Outlook

Energy transition, resumption of economic growth, and maintenance of macroeconomic stability are key policy goals for post-crisis recovery. Energy transition and economic resilience are often regarded as complementary. On the one hand, energy transition facilitates the recovery of the economy through energy resiliency. On the other hand, the energy transition process can be a source of economic vulnerability by creating new pressures on the economy. Energy transition is therefore complementary to the goal, but not to the extent that energy transition contributes to improving economic resilience. Severe disruptions in downstream supply chains, difficulties in mobilizing additional investment in renewable energy, and stricter regulations and higher taxes on energy compounds reduce economic resilience.

Simultaneously, the post-disaster extension of technological innovation and the gradual change in the economic structure for the past three decades constitute a promising intergenerational opportunity for economic growth. Embracing innovation will play an essential role in taking advantage of emerging opportunities (Wiertz et al., 2022). Europe is in the early stages of such a structural change, where markets for new energy technologies and related industries continue to expand rapidly. Nevertheless, numerous market imperfections and policy barriers prevent the efficient implementation of new energy technologies by the private sector. Public and private organizations have unique roles in addressing such imperfections and in exploiting the opportunities offered by energy transition. The European Union (EU) holds a pivotal position in this effort.

9.1. Predictions for Energy Markets

Energy-transition predictions encompass the diverse EU response to the Ukraine War energy disruption. Future EU energy consumption prospects are constrained by energy availability considerations and include the post-national Supply Chain Act's effect on long-term supply-chain reflections. Trends that will affect the energy transition are outlined, revealing a significant shortfall in new renewable-energy investment that raises the likelihood of future energy crises, an emerging market preference for energy-dense fuels like nuclear fission, and extensive, as yet untranslated, energy end-use technology innovations. Indicators of energy-market economic resilience can quantify the scope for a continued energy transition and the energy-economy risks associated with different energy technologies. Those indicators can also assess the effectiveness and impact of market intervention. Several existing EU policies are likely to hinder economic resilience, particularly the envisaged phase-out of nuclear energy in Germany, France, and Spain.

Far-reaching innovations in energy-technology systems and complementary use of multiple energy technologies create possibilities for a robust and affordable energy

market and hence a resilient economy. The opportunity for a major, faster, and more cost-effective transition remains. Insights from the Netherlands ("Policy options for the energy transition to 2050"), Great Britain ("Plant turnovers and energy-transition scenarios in Great Britain") and Germany ("Impact of the Energiewende on the energy-market economic resilience in Germany") further guide a European response to the reconfigured global energy landscape. (Aysan et al.2025)

9.2. Long-Term Economic Impacts

The post-Ukraine war era has a critical impact on Europe's energy transition and economic resilience. Europe's energy challenges affect the ability to resist and recover from shocks in energy markets and infrastructure, and to maintain sufficient energy without economic disruptions—energy resilience (Cassetti et al., 2022). Key indicators include: a) stability of supply and demand balance; b) diversity of supply sources; c) robustness of infrastructure and institutions; d) energy affordability and equality of access; e) flexibility to shift among energy supplies and modes; and f) energy efficiency and conservation.

Europe's pursuit of climate neutrality faces potential adverse economic consequences from accelerating the energy transition without a corresponding increase in investment in low-emission technologies. Renewables are projected to provide more than half of electricity by 2030, requiring a tripling of annual private investment and a doubling of the public budget for energy technology demonstration and deployment. Supply-chain disruptions and inflated prices after the war in Ukraine further exacerbate investment challenges. Russia's invasion brings new challenges where long-term economic and technological dynamics set the framework for possible responses. The EU has adopted several initiatives to advance the green transition, including the REPowerEU strategy. Beyond ongoing investments, recent developments include a surge in investment interest, high prices, supply concerns, party political competition, the return of nuclear power in some countries, and a return to fossil fuels—long before the war in Ukraine. Extreme volatility in wholesale prices and power availability negatively impacts economic resilience through diminished purchasing power, increased inflation, reduced demand in other sectors, uncertainty inhibiting investment, and erosion of public support for the transition.

Geopolitics shift the Energiewende discourse, elevating security, freedom, and sovereignty. These considerations justify and challenge energy transition measures, affecting political consensus. Domestic lignite, nuclear, and LNG become more popular as bridging technologies despite conflicting with renewable goals. The Energiewende emerges as a matter of security and sovereignty, warranting faster implementation and

increased funding. Without substantial acceleration, the energy transition cannot match the pace of European climate ambitions. (Shi and Zhao2025)

10. Conclusion

The European Union has embarked on a pronounced energy transition in response to climate change, energy security concerns, and the disruption of traditional energy supply chains following the Ukraine war. However, the scale, speed, and complexity of the ongoing transition impinge on economic resilience, while at the same time the imperative of building resilience from new sources, technologies, policies, and infrastructures delivers both fresh impetus and lasting constraints on the energy transition. Europe passes through key junctures on route to a longer-term equilibrium, in which the war's consequences remain influential and, through the same candidate adaptation pathways, the forces bearing on the energy transition. Against this background the main options for a sustained strengthening of economic resilience in Europe demand an exploration of the technological, economic, political and social dimensions of that process, while challenges and opportunities can only be distinguished by reference to the technical realities and economic outcomes that Chinese and Indian policies have begun to reveal and to EU strategies – developed in the progressively more fraught post-war context – to compare and contrast.

References:

- BIHUN, U. (2018). Conceptualization of economic security in the context of energy markets' integration. [PDF]
- Toygar, A., & Yildirim, U. (2023). Examining the effects of the Russia-Ukraine conflict on global supply chains. In Handbook of research on war policies, strategies, and cyber wars (pp. 184-199). IGI Global. researchgate.net
- Alfredo Uribe, G. (2014). Energizing Europe: The Geopolitics of Energy Security and Energy Diversification in the European Union. [PDF]
- Guarascio, D., Reljic, J., & Zezza, F. (2025). Energy vulnerability and resilience in the EU: concepts, empirics and policy. Journal of Industrial and Business Economics, 1-44. springer.com
- Wiertz, T., Kuhn, L., & Mattissek, A. (2022). A turn to geopolitics: shifts in the German energy transition discourse in light of Russia's war against Ukraine. osf.io
- Mazur, C., Hoegerle, Y., Brucoli, M., Van Dam, K., Guo, M., Markides, C., & Shah, N. (2018). A holistic resilience framework development for rural power systems in emerging economies. [PDF]
- De Rosa, M., Gainsford, K., Pallonetto, F., & Finn, D. P. (2022). Diversification, concentration and renewability of the energy supply in the European Union. Energy. sciencedirect.com
- Heffron, R. J., Körner, M. F., Schöpf, M., Wagner, J., & Weibelzahl, M. (2021). The role of flexibility in the light of the COVID-19 pandemic and beyond: Contributing to a

sustainable and resilient energy future in Europe. Renewable and Sustainable Energy Reviews, 140, 110743. sciencedirect.com

- Ngouhouo, I. & Nchofoung, T. N. (2022). Economic resilience in Sub-Saharan Africa: Evidence from composite indicators. Journal of the Knowledge Economy. researchgate.net
- Bouzarovski, S., Brajković, J., Robić, S., Brown, C., & Vuchkova, I. (2024). Energy poverty in the Energy Community region: Interrogating policy formulation and coverage. ncbi.nlm.nih.gov
- Resch, G., Liebmann, L., Geipel, J., Wien, F. H. T., Hendricks, D., Vollmer, J., & Fouquet–EREF, D. (2023). Study on 2030 Renewable Energy and Energy Efficiency Targets in the European Union. European Renewable Energies Federation: Brussels, Belgium. eref-europe.org
- Falcone, P. M. (2023). Sustainable energy policies in developing countries: a review of challenges and opportunities. Energies. mdpi.com
- Kennedy, C. A., Sers, M., & Westphal, M. I. (2023). Avoiding investment in fossil fuel assets. Journal of Industrial Ecology, 27(4), 1184-1196. wiley.com
- NARBONE, L. & GINSBORG, L. (2019). What economic model for a postconflict Donbas? : how economic measures could play a role in exiting the negative scenario. [PDF]
- Shi, J., & Zhao, Y. (2025). Challenges and Pathways for Tripling Renewable Energy Capacity Globally by 2030. Chinese Journal of Urban and Environmental Studies, 13(01), 2550004. worldscientific.com
- Nuhu, S. K., Emmanuel, E. O., & Manan, Z. A. (2023). Global challenges to sustainable renewable energy expansion: the funding and incentives structures. Chemical Engineering Transactions, 106, 553-558. cetjournal.it
- Skovgaard, J., Finkill, G., Bauer, F., Åhman, M., & Nielsen, T. D. (2023). Finance for fossils–The role of public financing in expanding petrochemicals. Global Environmental Change, 80, 102657. sciencedirect.com
- Holechek, J. L., Geli, H. M. E., Sawalhah, M. N., & Valdez, R. (2022). A global assessment: can renewable energy replace fossil fuels by 2050?. Sustainability. mdpi.com
- Jäger-Waldau, A. (2023). Snapshot of photovoltaics− May 2023. EPJ Photovoltaics. epj-pv.org
- Hayati, M. R., Ranjbar, S., Abdar, M. R., Molaei Nasab, M., Homayounmajd, S., & Esmaeili Shayan, M. (2023). A comparative analysis of solar energy strategies in Middle East with rich fossil resources. Iranica Journal of Energy & Environment, 14(3), 271-288. ijee.net
- Aysan, A. F., Kayani, U., Canga, M., Ozturk, O., & Nawaz, F. (2025). Financing renewable energy investments: strategies and models. In Renewable Energy Projects and Investments (pp. 73-91). Elsevier. [HTML]
- Cassetti, G., Boitier, B., Elia, A., Le Mouël, P., Gargiulo, M., Zagamé, P., Nikas, A., Koasidis, K., Doukas, H., & Chiodi, A. (2022). The interplay among COVID-19 economic recovery, behavioural changes, and the European Green Deal: An energy-economic modelling perspective. ncbi.nlm.nih.gov