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From crisis to transition: How the Ukrainian war reshaped Italian and German energy policies

Supervised by Monika Sus

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Thesis Pitch

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<25/06/2025> <Angelini Piero>

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This thesis represents the final chapter of my university career.
So many sacrifices have been made, but I could not have done it without the support of my family; the only thing I want to say is: “thank you for everything!”.

Abstract

Russia's invasion of Ukraine on February 24, 2022, transformed European energy policy in ways revolutionary, forcing a rapid transition from incremental climate-driven energy change to urgent security-driven change. This thesis compares Italy and Germany's new energy policies post-2022 in the implementation of EU energy transition guidelines, analysing how divergent institutional capacities, governance styles, and economic systems direct the transposition of supranational objectives into concrete national policy. Utilizing qualitative comparative case study analysis, this research analyses three essential areas of energy transition policy: the adoption of energy efficiency in accordance with the 2023 Energy Efficiency Directive; renewable energy growth in accordance with RePowerEU goals; supply diversification actions to reduce Russian reliance on gas. The study is based on updated national energy and climate plans (PNIEC 2024 and NECP 2024), policy reports, and extensive academic literature.

The study identifies two different strategies: Italy's 'crisis-driven pragmatism' is directed towards rapid deployment of proven technologies and flexible implementation through existing institutionally grounded arrangements, while Germany's 'systematic transformation' is committed to universal change through aligned policy packages and large public investment. Italy succeeded in reducing Russian gas imports by 90% through Mediterranean diversification and ambitious renewable targets (78.16% by 2030), while Germany achieved similar diversification through rapid LNG plant development and leadership in renewable rollouts.

Both strategies effectively enhanced energy security in conjunction with climate objectives but exhibited differential trade-offs between short-term crisis-oriented response and long-term sustainability commitments. This study contributes to the empirical examination of multilevel governance behaviour in crisis and demonstrates how national diversity may assist in strengthening collective European energy resilience.

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Chapter 1: Introduction

1.1 Background and context

The morning of February 24, 2022, marked an inflection point in the history of European energy. Russia's full-scale invasion of Ukraine not only sparked the largest armed conflict on European soil since World War II, but also exposed deep vulnerabilities in Europe's energy security apparatus. What had been planned mostly as a gradual and climate-driven energy transition was turned into an urgent national security, economic stability, and geopolitical sovereignty issue necessitating instant policy action on every stage of European governance (European Council, 2023). As the crisis unfolded, the extent of Europe's dependence on Russian fossil fuels became apparent. Before the invasion, Russia had supplied around 40% of the EU's total gas imports, representing an interdependence that extended far beyond commercial transactions to include critical infrastructure, long-term contracts, and highly embedded supply chains developed over decades (European Commission, 2022). This interdependence was unevenly distributed among member states, creating a complex mosaic of vulnerabilities that would play a decisive role in shaping national responses to the crisis.

Germany was the personification of the paradoxes of the pre-2022 European energy strategy. It was importing 55% of its natural gas from Russia even as it followed one of the most ambitious renewable energy programs in the world under the Energiewende plan. This paradox was an expression of the broader strains in German energy policy, where the speedy closure of nuclear power, which was completed in April 2023, had increased reliance on natural gas as a bridging fuel while renewables capacity was being developed.

Italy's exposure profile differed but was no less critical. Despite its Mediterranean location and historically more diversified supplier base, the nation's dependence on Russian sources accounted for 40% of its gas needs, a testament to the competitive prices and developed infrastructure that had made Russian gas competitive across Europe. Italy's situation was also exacerbated by a total dependence on imports of more than 75%, which made it particularly susceptible to any global energy market disruption.

The invasion shattered fundamental assumptions about the durability of energy trade relationships and the separation of policy and trade issues in energy markets. The crisis revealed how energy interdependence, for so long a source of mutual constraint and shared prosperity, could be exploited by authoritarian regimes to blackmail democratic societies. As sanctions tightened and supply disruptions became real, European governments were confronted with an unprecedented task: ensuring energy security and economic stability while defending international law, backing Ukraine, and at the same time speeding up the transition away from fossil fuels.

The reaction of the European Union has been swift and all-encompassing. In May 2022, the European Commission set out the RePowerEU, a proposal for eliminating the use of Russian fossil fuels by accelerating the transition to clean energy. With a record €210 billion funding, RePowerEU has also set ambitious targets: to reach 42.5% renewables in the EU's energy mix by 2030, double the rate of deployment of heat pumps, produce 10 million tonnes of domestic renewable hydrogen annually, and fundamentally transform Europe's energy import relationships in years rather than decades (European Commission, 2022a). Meanwhile, the 2023 recast of the Energy Efficiency Directive elevated energy efficiency from an environmental policy instrument to a strategic security imperative, with legally binding consumption reductions of 11.7% by 2030 (European Commission, 2023). This represented a paradigmatic shift in the way energy efficiency was positioned within European policy discourse, from a voluntary best practice to a mandatory component of the energy security agenda.

This re-calibration was a radical reordering of the energy transition from a largely environmental project driven by climate science to an existential security one driven by geopolitical imperatives. Energy efficiency, renewables spread and supply diversification were no longer considered for climate only but as essential pillars of what scholars have termed a 'security-centred' energy transition that prioritizes resilience and autonomy alongside sustainability imperatives (Marhold, 2023).

1.2 Research problem and objectives

The Russia's war in Ukraine has yielded a natural experiment in managing crisis-generated policies and learning how different political systems, institutional structures, and governance cultures respond to common external shocks. The crisis has exposed not only European energy system vulnerabilities but also the relative capacity of different member states to adapt quickly to radically new conditions while maintaining alignment with wider European objectives and long-term sustainability obligations. While the EU established general direction of policy with RePowerEU and the revised Energy Efficiency Directive, subsidiarity safeguarded national governments to create specific implementation policies, financing systems and regulatory approaches to their general leeway. This flexibility, while upholding national sovereignty and allowing for differences in starting positions, raises critical questions regarding policy coherence, quality of implementation and ability to achieve collective European objectives in the midst of extreme crisis.

Italy and Germany make excellent comparative case studies because, despite sharing important characteristics, they demonstrate contrasting approaches to energy system governance. Both are founding EU members with solid European integration commitments, heavy economic players with robust industrial bases, heavy energy consumers with important implications for the EU-wide energy security, and democracies with long-established traditions of political debate and stakeholder participation. Yet, these similarities are accompanied by essential differences which have influenced their reactions to the crisis in unique ways.

Germany's policy has traditionally been characterized by the Energiewende paradigm, the globe's most integrated attempt to transform the energy system. Begun in the early 2000s and intensified after Fukushima, the Energiewende has been characterized by substantial public investment, technological transformation, and systematic planning strategies, coupled with strong institutional capacity to seek coordinated policy design (Bartholdsen et al., 2019). By 2024, more than 60% of electricity generation had been served by renewables, demonstrating not only technological capacity for rapid deployment but also institutional capacity to maintain political stability throughout election periods. The German approach to strategy represents what experts refer to as a model of 'systemic transformation' (Bartholdsen et al., 2019), comprising the transition to energy through successive coordinated reforms across multiple sectors, massive public investment in new technologies and infrastructure, full regulatory frameworks that are a source of stable investment certainty, and high policy coordination and long-term planning institutional capacity. The model has achieved success in the deployment of renewable energy and technology innovation.

Italy has historically adopted a ‘pragmatic adaptation’ style in energy policy, as a result of shifting institutional structures, resource bases, and governance cultures (Prontera & Lizzi, 2023). Italy’s energy policy has been shaped by physical constraints like insufficient indigenous energy resources, complex multi-level governance systems with high-stakes negotiations at various layers of government, fewer budgetary resources available for huge infrastructure projects, and political culture emphasizing flexibility and adaptability over long-term planning frameworks. But this pragmatic approach can actually be excellent strengths in times of crisis when rapid adaptation is more critical than rational change. Pragmatic structures are better likely to evolve quickly in response to changing circumstances without being constrained by set planning paradigms or sunk costs in particular streams of technology. Italy’s historical experience with energy supply disruption and economic crises may have built institutional capabilities for quick adaptation that should be capitalized on during periods of extreme uncertainty.

The aim of this study is to find out how these core differences have influenced national responses to the energy crisis and affected the implementation of EU directives in this time-sensitive period. This thesis analyses whether different national strategies can generate similar results in the spheres of improving energy security, emissions reductions, installation of renewable energy, and overall assistance to the European energy transition goals. The main goal is to conduct a detailed comparative evaluation of Italian and German energy policy response to the Russian war in Ukraine and the energy crisis it caused, examining the ways in which both countries have embarked on three main dimensions of European energy transition policy: improving energy efficiency through demand reduction and systems reform, raising renewable energy through stepped-up deployment and grid integration, and supply diversification through decreased dependence on Russian fossil fuels and new supply relationship development.

1.3 Research question

This comparative study is guided by one main research question and several supportive secondary questions that, as a package, create an overarching framework for adopting crisis-sourced energy policy adaptation, efficient implementation, and governance implications. The primary research question is: “How do Italy and Germany’s post-2022 energy plans differ in adopting EU energy transition directives, and what explains the differences?”

The research is also guided by a set of interrelated sub-questions that explore different aspects of the comparative framework. First, there is policy implementation and efficacy and a comparison of the principal differences and similarities between Germany and Italy regarding the implementation of the Energy Efficiency Directive (2023) and RePowerEU’s renewable energy goals and an examination of what explains the divergence in the speed of implementation, the selection of policy tools and the early outcome achieved. This dimension emphasizes mechanisms of implementation, understanding that how policies get implemented can sometimes be as significant as solemn promises to insight into actual results.

A second area of study examines diversification policies and their effectiveness, investigating how effective national policies have been in increasing the diversity of energy sources and reducing Russian gas dependence, what the resulting economic, environmental and social implications have been, and how they affect long-term energy security and greenhouse gas targets. This is a factor that considers the most readily visible aspect of crisis management, recognising that diversification strategies are complex trade-offs with significant consequences that transcend immediate security concerns.

The review also examines the critical balance between security and sustainability, examining the tensions between short-term energy security targets and long-term decarbonization commitments in the strategy of each nation, how such tensions are resolved via policy design and execution and what this learning does to suggest the appropriateness of the crisis response to climate targets. It is interested in one of the primary theoretical and practical challenges thrown up by the crisis: whether short-term measures to address security threats can be reconciled with long-term sustainability goals.

One important dimension of governance is interested in how the conditions of the crisis have affected traditional models of energy policy governance, e.g., stakeholder consultation, parliamentary control and public participation, and reflects implications for democratic legitimacy and political sustainability beyond the near horizon of the crisis. This recognizes that crisis management in most cases will be a sequence of deviations from normal governance procedures and examines whether these are reversible departures or deeper sets of change in energy policy making and legitimacy. In addition, the research sets national responses within the broader context of European integration and examines what the different national strategies reveal about the effectiveness of EU multi-level governance in the period of crisis. This examines how crisis conditions affect national sovereignty against European coordination in the very core of EU energy policy-making.

Finally, the evaluation considers policy learning and the future implications, speaking of what may be learned for the management of future crises and EU regulation of the energy transition, particularly in institutional design, choosing policy instruments and balancing national sovereignty and coordination at the EU level. This future-oriented consideration assumes that experiences from the past may inform academic thinking as well as policy choice for decades to come.

1.4 Methodology and structure

This thesis employs a qualitative comparative case study methodology, analysing two states that are closely aligned in their similarities while exhibiting significant differences in their energy systems, institutional frameworks, and governance traditions. This study design allows systematic exploration of how different institutional contexts and political traditions condition action in reaction to common external shocks by holding confounding variables constant through case selection.

Case selection was guided by theoretical considerations towards realizing maximum analytical leverage. Germany and Italy are crucial cases for conceptualizing crisis-driven European energy transition: both economies were among the most energy reliant on Russian imports and therefore most vulnerable to supply disruptions and most likely to show strong policy responses; both are large EU economies with enormous pulling power within European politics evolution; both are founding members of the EU with strong pro-European obligations, which reduces the likelihood that the responses are being guided primarily by Euroscepticism.

These two countries show also systematic differences that allow for analytical leverage. The systematic transformation model of Germany is contrasted with the pragmatic adaptation model of Italy, allowing for variation in the model of governance. Moreover, Germany's better fiscal stance and institutional capability are contrasted with Italy's lesser capabilities and more complex institutional arrangements, allowing analysis of how different capacities structure the reaction to the crisis.

The discussion draws from different sources of information to ensure thorough coverage. The primary data are presented in the form of official policy documents such as Italy's Integrated National Energy and Climate Plan (PNIEC 2024) and Germany's Updated National Energy and Climate Plan (NECP 2024), European Commission press releases and legislative reports, implementation reports and monitoring progress. Secondary sources are supported by scholarly research on energy policy and crisis management, think tank reports and policy briefs, and industry association and civil society organization stakeholder evaluations. Quantitative information based on Eurostat, International Energy Agency and national statistics offices provides empirical facts to substantiate policy conclusions.

The analytical framework utilizes a three-pillar approach, examining the implementation of energy efficiency, the growth and diversification of renewables, and diversification of supply as interconnected but analytically distinct policy domains. The framework recognizes that these three dimensions have been central priorities of European energy policy across the crisis period, recognizing that they involve different policy instruments, institutional settings and implementation challenges. Temporally, the analysis covers the period between the beginning of February 2022 and the end of 2024, catching immediate reactions to the crisis and initial implementation stages of important policy actions. This time period permits short-term effects to be evaluated while acknowledging that many of the long-term effects remain unknown.

Chapter 2: Literature review and theoretical framework

2.1 Multilevel Governance and Energy Transition Theory

Literature on European energy transition has evolved significantly as a reaction to the Ukrainian war, with scholars showing greater interest in the complex interaction between crisis-driven policy change and multi-level governance dynamics that characterize the institutional framework of the European Union (Marhold, 2023; von Malmborg et al., 2023). Multi-level governance (MLG) theory, originally developed by Hooghe and Marks (2001) to study EU cohesion policy and regional development programs, has been particularly relevant and analytically useful to study energy transition policy-making at and across different levels of government during times of acute crisis when normal policy-making routines may be discarded or radically changed.

Recent research emphasizes that European energy transitions are placed in extremely complicated multilevel governance setups that require exact coordination among EU-level policy, national implementation plans, and subnational implementation capacity (von Malmborg et al., 2023). Such coordination is particularly challenging during times of crisis when the need for haste can conflict with the deliberative, consensual nature of regular multi-level governance processes founded upon extensive consultation, bargaining, and gradual building of institutional agreement across different levels of government.

The academic literature identifies three dimensions of MLG that take on particular importance during times of crisis. Firstly, vertical coordination between EU, national, and subnational levels involves the management of the flow of policy directives, resources, and information between different levels of government under principles of subsidiarity and proportionality that limit EU competence to those areas where European action would have a clear added value (von Malmborg et al., 2023; Siddi & Prandin, 2023). Second, horizontal coordination across policy sectors involves managing relations with other policy areas such as industrial policy, environmental protection, social policy, and foreign affairs that are likely to be characterized by different institutional arrangements and policy-making routines (Marhold, 2023; Jerzyniak, 2024). Third, temporal coordination between short-term crisis management and long-term sustainability objectives involves managing trade-offs between the needs of immediate action and the needs of long-term institutional feasibility and democratic legitimacy (Marhold, 2023; Vezzoni, 2023).

These coordination challenges are especially acute in the fields of building sector policy and infrastructure planning, where the landscape of governance promises the researchers what they have termed ‘scalar clashes’, situations in which various scales of governance work at cross-purposes, threatening to derail the transition to clean sources of energy (von Malmborg et al., 2023). The Ukraine war has exacerbated these tensions by introducing security imperatives that may not be reconcilable with existing governance arrangements calibrated primarily to incremental, relatively consensual policy development under conditions of relative stability and predictability.

Crisis-driven policy change theory provides additional analytical leverage on post-2022 developments by examining how external shocks shape traditional policy-making processes and institutional arrangements. The literature suggests that the perfect storm of Russia’s war in Ukraine and rapidly advancing climate change has thrust the EU into what Marhold (2023, p.757) characterize as a “security-centred” energy transition, founded on “security first, compliance second” rather than the traditional model that was premised on gradual consensus-building and careful attention to distributional consequences and democratic inclusiveness.

This represents a fundamental departure from the incremental, consensus-driven approach that characterized European energy governance prior to 2022, and it raises profound questions about democratic legitimacy, policy longevity, and long-term institutional implications far exceeding short-term crisis management. The literature on crisis and institutional change suggests that external shocks can create windows of opportunity for policy change that would be impossible under normal conditions, but the longevity of crisis-induced changes depends crucially on their institutionalization through normal governance processes once the immediate crisis pressures have receded (Birkland, 1998; Kingdon, 1984; Marhold, 2023).

2.2 Pre-2022 energy systems and path dependencies

In order to interpret the varying responses of Italy and Germany to the Ukrainian war, there is a need to watch closely their existing energy systems and institutional path dependencies that indeed shaped both the revealed vulnerabilities of the crisis and the range of policy actions available to political elites. Historical institutionalist theory emphasizes that policy choices are bounded by their prior decisions and produce path dependencies by means of sunk investments, institutions, and established stakeholder relationships which get difficult to turn around even with drastically altering conditions (Kern & Smith, 2008).

Germany's energy market was fundamentally set by the 'Energiewende' policy framework, initiated in the early 2000s and significantly expanded following the Fukushima nuclear meltdown in 2011. The Energiewende represents one of the world's most integrated and ambitious initiatives at energy system transformation, including high rates of public capital investment in renewable energy equipment, far-reaching regulatory frameworks with the goal of creating stable investment environments, clean energy technological innovation in a host of sectors, and high institutional capacity for coordinated policy implementation between federal and state authorities (Bartholdsen et al., 2019).

The 'Energiewende' was a success in the deployment of renewable energy, as renewables accounted for more than 60% of electricity generation by 2024, demonstrating both the potential for rapid deployment of technology under favourable policy regimes and the institutional capacity to provide policy stability over multiple election cycles and changing governing coalitions. The feed-in tariff system, introduced in 2000 and subsequently changed but continued through multiple government overhauls, successfully promoted decentralized deployment of renewable energy and fostered a prosumer society of 1.7 million players by 2020, transforming the composition of German electricity markets fundamentally (Bartholdsen et al., 2019). However, Germany's power infrastructure also revealed major vulnerabilities that were exposed during the war in Ukraine. Germany became the world's largest natural gas importer by 2021, and in 2021 dependency represented more than one-quarter of primary energy use. Germany imported nearly 95% of its natural gas, with 55% from Russia, 30% from Norway, and 13% from the Netherlands, creating a dependency that extended beyond market exchange to include strategic infrastructure and long-term supply agreements (IEA, 2025). The German approach emphasized strong institutional capacity for long-term planning and ample financial resources to invest in the transition to energy, but created what scholars call an ‘energy policy paradox’ where environmental objectives might have conflicted with security interests.

Italy’s energy system prior to 2022 had very different characteristics according to divergent experiences, patterns of endowment, and institutional structure. Natural gas accounted for 42% of the overall energy supply in 2021, 94% of which was imported and approximately 41% from Russia, making Italy vulnerable to values of significant but unique character compared to Germany (IEA, 2024). Italy’s total reliance on imports was at over 75%, making the country vulnerable to any fluctuation in world energy markets regardless of specific source. Unlike Germany’s careful transformation strategy, Italy’s energy policy was marked by ‘pragmatic adaptation’, prompted by geographical constraints such as limited domestic energy resources, densely populated multi-level governance with slow negotiating process across governmental levels, fewer fiscal resources than Germany, and a political culture inclined towards flexibility and adaptability at the cost of long-term planning blueprints (Prontera & Lizzi, 2023). Italy’s governance system has always been marked by intense dialectic between centre and periphery, with numerous public and private players and competency distribution that sometimes brings about conflicts and slows down decision-making. But these seemingly paralyzing constraints might also be major assets during times of crisis when swift adaptation is more important than orderly change.

2.3 Post-2022 policy responses

Post-2022 energy policy response literature suggests a range of theoretical models for crisis-induced transition dynamics explanation. The Russian invasion was the type of “focusing event” (Birkland, 1998) crisis scholars argue transforms the political and policy landscape dramatically by putting inherent vulnerabilities in European energy systems into focus as it creates new avenues for policy alteration not possible under normal political conditions. Invasion required a fundamental reshape of energy policy from largely an environmental concern grounded in climatic science to a geopolitical security concern grounded in near-term threats to economic stability and political sovereignty (Vezzoni, 2023). This reinterpretation created new policy agendas and legitimized rapid, sometimes unilateral action that would be difficult to explain under more normal governance conditions in which policy change typically involves extensive consultation and gradual consensus formation.

RePowerEU, which was approved in May 2022 with a budget of €210 billion in funding, is the EU's most ambitious energy policy response to the crisis (European Commission, 2022). The strategy targets 42.5% from renewables by 2030 and has successfully reduced Russian gas imports from 150 billion cubic meters in 2021 to 52 billion cubic meters in 2024, while Russian gas imports dropped from 45% to 19% (European Commission, 2025). However, the literature is sceptical about whether this rate of response is an indicator of sustainable institutional adaptation that will survive short-term crisis or short-term crisis management that will revert to established routine as soon as crisis pressures abate. The timing of policy development and legislation under RePowerEU is unprecedentedly different from typical EU policymaking processes that consume years of negotiation, consultation, and incremental consensus-building. Crisis contexts provided what Kingdon (1984) calls 'policy windows' wherein problem, solution, and political opportunity aligned in order to allow for policy change at a rapid rate. Crisis policies only endure, however, when they are institutionalized by customary governance practice and are accommodating of more enduring institutional environments.

Siddi and Prandin (2023) find a critical "geopolitical turn" of EU energy policy that signifies a fundamental shift in the conception of energy relations and their regulation. EU policy priorities, they maintain, have increasingly moved away from open strategic autonomy directed at generic multilateral cooperation toward steadily more focused strategic partnerships with "like-minded" states, potentially limiting future policy options and generating new dependencies.

2.4 Comparative Energy Policy Implementation

Comparative studies of EU policy implementation in times of crisis are insightful from the literature, with striking variances in implementing EU directives into national actions. The 2023 Energy Efficiency Directive, which emerged in response to the Ukraine war, places efficiency into double action: minimizing usage to support security and helping the EU climate targets with a legally binding target of 11.7% energy use reduction by 2030 (European Commission, 2022a).

Germany and Italy have distinctly different strategies in the roll-out of energy transition based on prevailing energy systems and institutional capacity. Italy's PNIEC (2024) has sought final energy reduction by 15.6% and primary energy reduction by 19.8% by the year 2030 while investing €15 billion in building renovation in residential and industrial sectors and mandating biomethane production at 10 billion cubic meters per year (Beccarello & Di Foggia, 2023). Bharti (2025) shows how Italy's efficiency is its armour against its prior 2022 dependence on gas imports of 75%, as Eurostat reports 5% reduced demand by 2023 (European Parliament, 2023). However, Vezzoni (2023) points out that the aging grid in Italy limits progress since it has only achieved 30% modernization up to 2024 with political discrepancies between the central and peripheral governments regarding the allocation of funds being hindrances to system development (Prontera & Lizzi, 2023).

Germany's NECP (2024) incorporates energy efficiency into its Energiewende through a target to increase electrified consumption by 6.08% through yearly heat pump installations of 400,000 to 500,000 units and 1.5 to 2 million sales of electric vehicles (Pathfinders, 2023). Sector integration of power, heat, and transport systems in Germany is highly commendable by Bartholdsen et al. (2019), who view it as a model that reduced primary energy use by 15% from the levels of 2010. However, Jerzyniak (2024) pinpoints inefficiencies in retrofitting its industry North, 40% of its buildings pre-dating 1970. Siddi and Prandin (2023) highlight economic implications, mentioning Germany's €40 billion annual efficiency expenditure dominates Italy's €10 billion (Áron et al., 2024), echoing industrial rather than service-sector inclinations. Bharti (2025) warns electrification with the potential to boost demand by 10%, presenting numerous challenges to Italy's demand-driven strategy. The European Electricity Review 2024 illustrates high variation in implementation outcomes across member states even when operating with shared EU frameworks. Wind and solar power generated 27% of EU electricity in 2023, an impressive leap but with wide national variation based on variation in institutional capacity, availability of resources, existing infrastructure, and governance strategies (Ember, 2024).

2.5 Energy security, diversification, and theoretical integration

Energy security and diversification policies within the Ukraine crisis, according to the literature, demonstrate ingrained tensions between short-term security needs and long-term climate policy obligations. Traditional concepts of energy security based on reliability, affordability, and supply adequacy with comparatively less attention to environmental effects or geopolitical importance beyond immediate supplier ties (Cherp & Jewell, 2014).

RePowerEU's post-2022 renewable target propels Italy and Germany towards more green energy mixes, but they have contrasting plans in ambition and pace. Germany's NECP (2024) aims for 80% renewable power in 2050, ramping up wind and solar capacity to 290 GW by 2030 and 500 GW in the mid-century (Schwarz, 2024; Pathfinders, 2023). Uzma, Naz, and Rifat (2024) applaud Germany's €5 billion hydrogen push to 10 GW of electrolyser capacity by 2030, but Vezzoni (2023) doubts hydrogen's €150/MWh cost and scalability, especially in light of the fact that 20% of wind energy was curtailed in 2023 because of congestion on the grid. Anıl and Taydaş (2024) term Germany's approach green leadership, but Siddi and Prandin (2023) deride excessive optimism about untested technologies.

Italy's PNIEC (2024) target for 78.16% renewable power by 2030 over 39.08%, with a focus on solar and offshore wind, where Sicily and Sardinia are given priority (Beccarello & Di Foggia, 2023). Prontera and Lizzi (2023) note that Italy intends to bring on stream 2 GW of offshore wind capacity by 2030 while Terna invests €10 billion to build out its power grid. Bharti (2025) aims transport electrification at 30% by 2030 through 1 GW of storage capacity additions. Italian solar PV development was 10 GW since 2020, yet Vezzoni (2023) and Azis et al. (2022) report that dependence on LNG erodes Italy's green cause with grid capacity still at merely 50% modernization.

The Ukrainian war led to Russian gas supply disruptions and forced immediate diversification plans through the RePowerEU strategy. Germany built LNG terminals at Wilhelmshaven and Norwegian pipeline infrastructure to reduce Russian gas imports to 10% of their overall in 2024 (NECP, 2024). Jerzyniak (2024) celebrates this achievement as a de-risking success, with 15 billion cubic meters of LNG capacity going on stream in 2023 and total infrastructure cost standing at €20 billion (Qi, 2023). However, Siddi and

Prandin (2023) warn that LNG's 20-year contracts can retard decarbonization, a factor that Bharti (2025) estimates at 15% below 2030 emission levels.

Italy, which has been 90% import dependent (Prontera & Lizzi, 2023), cemented Mediterranean relationships by taking 9 billion cubic meters from Algeria and expanding LNG output in Piombino (PNIEC, 2024). Beccarello & Di Foggia (2023) estimate biomethane production will increase to 10 billion cubic meters by 2030 to meet RePowerEU's diversification objectives. However, Siddi and Prandin (2023) advise that Italy's fossil fuel expansion outpaces green targets by 10% (Bharti, 2025), indicating the inconsistencies between short-term security needs and climate objectives.

2.6 Theoretical framework and research contribution

Informed by this literature review, this thesis applies an analytical framework synthesizing multi-level governance theory and crisis-induced policy change frameworks with attention to democratic governance implications of rapid policy change under crisis. The framework recognizes that energy transition under crisis conditions involves conflicting pressures for rapid response and long-term institutional transformation that generate tensions deserving close scrutiny.

The theoretical framework focuses on three analytical dimensions. Institutional capacity for rapid policy adjustment is the first, addressing how modes of governance enable or constrain rapid reaction to external shock while maintaining policy coherence and democratic legitimacy. The second is the equilibrium between national sovereignty and EU coordination, and it addresses how crisis contexts affect the classical subsidiarity principle in EU governance. Third, crisis response short-term integration with long-term sustainability objectives questions whether and how different countries reconcile pressing security needs with climate commitments.

The three-pillar analytical framework with regard to energy efficiency, growth in renewables, and supply diversification captures all the dimensions of the energy transition in an exhaustive way yet remains analytically tractable. The framework admits that the three topics became the core of European energy policy throughout the crisis period but simultaneously identifies that they involve different policy instruments, institutional arrangements, and implementation issues.

The study makes various significant contributions to the literature in regard to theoretical knowledge and practical learning about energy governance during crisis situations. The literature review has identified notable gaps, which are addressed by this study: comparative studies for Italy and Germany after 2022 are scarce, with limited studies that include PNIEC and NECP (2024) updates in efficiency, renewables, and diversification (Siddi & Prandin, 2023; Prontera & Lizzi, 2023). Efficiency-renewable synergies are underdeveloped, and governance dynamics of political challenges in Italy versus the success of Germany's feed-in tariff are instead studied in isolation rather than synthesized comparatively (Vezzoni, 2023). An integrated approach makes it possible to understand how policy choices in one area place limitations or opportunities in others, providing insights into the complexity of managing holistic changes in periods of crisis on the background of both short-term crisis action and longer institutional effects on the viability of policy and democratic governance.

Chapter 3: Divergent pathways to energy transition: a comparative analysis of Italy's 'crisis-driven pragmatism' and Germany's 'systematic transformation'

Europe's energy transition has been fundamentally reordered by the geopolitical crisis precipitated by Russia's invasion of Ukraine in February 2022, forcing a drastic acceleration of decarbonization aspirations while simultaneously dealing with near-term energy security necessities. The updated Italian (PNIEC 2024) and German (NECP 2024) national energy and climate plans represent two contrasting approaches to the implementation of European energy transition guidelines under these new circumstances, demonstrating how different institutional capacities, economic structures, and governance traditions mediate the translation of supranational objectives into concrete national policy. These plans, submitted to the European Commission in 2024, demonstrate the principle of subsidiarity in action, allowing member states significant freedom to translate shared European objectives while providing overall alignment with the Union's strategic direction (European Commission, 2025). This comparative analysis explains how these two important European economies have interpreted and implemented three important pillars of post-2022 EU energy policy: the rollout of energy efficiency measures under the Energy Efficiency Directive (2023), the expansion of renewables according to RePowerEU targets, and supply diversification initiatives to terminate Russian gas reliance.

3.1 Energy Efficiency Implementation and the EU Directive 2023

The fact that the EU has adopted the new Energy Efficiency Directive (EU) 2023/1791, making it mandatory for the EU countries to achieve an additional 11.7% energy consumption savings by 2030 compared to the EU reference scenario 2020 projections, reflects fundamental differences in energy efficiency policy approaches that reveal broader philosophical differences concerning the role of the government in guiding energy transitions. The directive, which entered into force on 10 October 2023, represents a significant advance in European energy governance by transforming efficiency from a mainly voluntary policy instrument to a mandatory component of energy security strategy, with EU member states having until 11 October 2025 to transpose the new measures into national law (European Commission, 2024). This change resonates with what Marhold (2023) depicts as a transition towards a 'security-centred' energy transition that positions resilience and sovereignty on an equal level with sustainability goals, ontologically transforming the space within which efficiency policy is established and executed.

The directive includes several significant innovations relative to previous European efficiency law, most prominently elevating the 'energy efficiency first' principle from best practice to mandatory consideration in planning, policy, and major investment decisions over €100 million, or €175 million for transport infrastructure projects (European Commission, 2023). This principle requires sequential consideration of efficiency possibilities, including demand-side resources and system flexibilities, before considering supply-side investments, a fundamental reorientation of energy system planning practices that had previously emphasized supply increase at the expense of demand management. The directive also establishes incremental yearly energy saving obligations from 1.3% in 2024-2025 to 1.9% in 2028-2030, delineating an acceleration trajectory that reflects both the urgency of the action on climate and the necessity of enhanced energy security in the wake of the Ukraine crisis.

3.1.1 Italy's Pragmatic Efficiency Strategy

Italy's reaction to these requirements via its PNIEC 2024 is to typically take a pragmatic approach that prioritizes early implementation of efficiency measures as a short-term response to energy import fragilities. The strategy illustrates what might be interpreted as crisis-induced pragmatism, in which measures of efficiency are envisioned not so much as climate policy instruments but as direct reactions to economic and security weakness made incredibly evident by the 2022 energy price rises and supply interruptions (MASE, 2024). Italy's updated NECP sets targets well beyond minimum EU standards, with final energy consumption set to reach approximately 93.05 Mtoe by 2030, a reduction of 39.7% compared to the 2007 reference scenario, and primary energy consumption set to be reduced by 43% over the same period (Beccarello & Di Foggia, 2023).

The sectoral implementation strategy demonstrates Italy's flexibility in policy implementation, with rising yearly saving targets from 0.8% in the years 2021-2023 to

1.9% in the period 2028-2030, which shows both the necessity for time to build institutional capacity and that the most significant impacts must be achieved in the final implementation phase when European climate and energy objectives become binding (Odyssee-Mure, 2024). The strategy estimates aggregate energy savings over 2021-2030 of 73.4 Mtoe, revealing the significant scale of efficiency improvements intended.

Italy's priority for renovating buildings is a cornerstone of its strategy for efficiency, and Component C3 of Mission 2 of the National Recovery and Resilience Plan (NRRP) allocates €15.36 billion to buildings renovation under three lines of action: energy efficiency renovation of school buildings and judiciary buildings, energy efficiency renovation and seismic upgrading of public and private residential buildings, and district heating development (Odyssee-Mure, 2024). The rehabilitation intervention will affect over 100,000 buildings with a total surface area of over 36 million square meters, demonstrating the vast scale of the intervention planned. The Italian approach is aimed at selective interventions through strategic electrification by heat pump penetration and large-scale energy audits in the residential and industrial sectors, supported by €234 million through POC Energia and €94 million from FSC 2014-2020 funding streams.

The Superbonus measure, even if gradually weakened as of 2023, provided up to 110% of the investments for interventions ensuring at least a two-class energy class improvement, demonstrating the desire of Italy to use powerful fiscal incentives to encourage the efficiency improvement (Odyssee-Mure, 2024). However, Budget Law 2025 reduced tax deductions on building renovation from 50% to 36% in 2025 and 30% in 2026-2027, indicating fiscal boundaries to keeping such supportive measures at this level of generosity. The energy savings achieved through tax deductions were 2.04 Mtoe/year of energy in 2023, which testifies to the very substantial role of fiscal policy instruments in achieving efficiency gains.

The Transition Plan 5.0, established by Legislative Decree 19/2024, assigns tax credits to companies investing in innovation projects resulting in energy consumption reduction, with tax credits proportional to spending incurred and reduction achieved, providing approximately €13 billion over the 2024-2025 period (Odysee-Mure, 2024). This approach is a reflection of Italy's prior experience in maximizing the impact of limited resources through the alignment of policy tools and funding streams across sectors, reflecting what Prontera and Lizzi (2023) refer to as ‘pragmatic adaptation’ to energy policy concerns.

3.1.2 Germany’s systematic efficiency approach

Germany’s holistic strategy for efficiency implementation mirrors the nation’s institutional advantage in coordinating policy formulation and considerable financial strength for systematic transformation programs targeting multiple sectors at once instead of discrete interventions. The 2023 Energieeffizienzgesetz adopts a broad-based regulatory framework of binding efficiency targets with flexibility of response to implementation (Clean Energy Wire, 2024) that conforms to the preference of Germany for sequential regulatory systems with stable environments for long-term investment planning and adaptive capacity to changing technological and economic conditions (Reuters, 2024).

The German efficiency policy strategy reflects sophisticated understanding of sector coupling principles that embrace the interconnected nature of energy use among electricity, heating, and transport sectors, with the aim of enhancing efficiency through optimizing performance across sectoral interfaces rather than within individual sectors in silos. The strategy addresses both technical understanding of system-scale scope for optimization potential and institutional ability for coordinated policy application across federal and state governance levels that supports integrated rather than fragmented approaches to efficiency enhancement.

Germany’s structured strategy is exemplified by the Federal Subsidy for Efficient Buildings (BEG) scheme, which integrates previously distinct support mechanisms into one coherent framework that provides grants and promotional loans for efficiency improvements in residential, commercial, and industrial sectors (IEA, 2024). The program design is evidence of keen concern for market failures that bind the investment in efficiency, such as high initial costs, uncertain payback, divided incentives between owners and users of buildings, and poor access to technical knowledge for sophisticated efficiency improvements.

The financial scale of the BEG program conveys Germany’s serious commitment to efficiency transformation, providing up to €150,000 credit per dwelling for overall efficiency improvement and up to €60,000 for individual measures and repayment premiums between 15% and 50% based on performance delivered (IEA, 2024). This level of monetary aid is in acknowledgment that efficient improvement must face rigid market barriers through concerted public efforts rather than waiting for exclusively market mechanisms that might prove too sluggish in responding to guarantee policy objectives are achieved within time frames.

The new BEG scheme launched in January 2024 alongside the Buildings Energy Act is a central change in the direction of renewable heat solutions with continued overall support for efficiency benefits, funding up to 70% of replacement of heating systems with renewable means (BMWK, 2024). The scheme structure comprises a standard 30% renewable heating installation subsidy, a 20% climate speed bonus for upgrading fossil fuel systems, a 5% efficiency bonus for natural refrigerant heat pumps, and a 30% income-related bonus for homes with taxable income of less than €40,000, with total support limited to 70% and €21,000 maximum funding per installation (BMWK, 2024). This comprehensive support system reflects high-level awareness of all the impediments to heat pump uptake, including initial costs, fit technical sophistication, lack of understanding about performance in buildings, and affordability restraints for low-income households. The income-related bonus particularly demonstrates consideration of distributional implications of energy transition initiatives and sensitivity that ensuring extensive enhancement in efficiency entails ensuring all segments of society have the capacity to benefit from efficiency measures rather than limiting benefits to richer households with greater financial means (BMWK, 2024).

Germany's industrial efficiency policy responds to the size of the national manufacturing sector and that increasing industrial efficiency will yield the greatest absolute improvements in efficiency as well as the greatest economic co-benefits in terms of competitiveness gains in increasingly energy-cost- and carbon-constrained global markets. The Federal Promotion of Energy and Resource Efficiency in Industry (EEW) program provides direct financing with grants for up to €15 million or loans for up to €25 million towards energy and resource efficiency measures, covering up to 40% of eligible expense for easily deployable measures like biomass systems, solar thermal systems, heat pumps, and storage systems (Clean Energy Wire, 2024).

The integration of resource efficiency and energy efficiency in German industrial strategy illustrates sophisticated awareness of the interrelationship between material flows and energy consumption in manufacturing processes, targeting optimization efforts that address both energy intensity and material productivity together rather than addressing these as separate policy objectives. The reason is that most industrial efficiency improvements involve process optimization that reduces both energy and material inputs while potentially increasing product quality and production flexibility.

Germany's heat pump deployment plan is one of the most significant components of its sectoral coupling plan, with 400,000 to 500,000 installations annually targeting 6.08% electrified consumption growth by 2030 (Pathfinders, 2023). This ambitious deployment goal shows recognition that deep decarbonisation of the building sector requires radical transformation in heating technologies rather than incremental efficiency gains in current fossil fuel technology, but it also produces important implementation challenges related to grid capacity, installer capacity, and consumer acceptance that require integrated policy solutions across sectors.

The sudden surge in heat pump installations during December 2024 shows the efficacy of German support policies as well as the sensitivity of deployment levels to policy uncertainty, with customers rushing to secure support prior to changes being activated after early elections (Bloomberg, 2025). This boom is a demonstration of the imperative role of policy stability and predictability in attaining persistent gains in efficiency, since uncertainty over support in the future may cause boom-bust cycles which undermine supply chains and implementation capacity (Bloomberg, 2025).

However, the recent action of the German government to reduce heat pump subsidies by €2.4 billion in 2025, a decrease of more than 16% compared with 2024 levels, reflects the budget squeeze around support schemes for efficiency as well as the political challenge involved in maintaining high levels of support infrastructure in the long term (Clean Energy Wire, 2024). This reduction forms part of broader European tendencies towards more targeted and economically sound efficiency policies as early emergency measures implemented in the wake of the energy crisis are gradually reduced to more sustainable levels.

Germany's plans for industrial efficiency demonstrate the country's awareness that important efficiency improvements must respond to industry-specific conditions and constraints of energy-using industries facing international competition and technologically advanced requirements for efficiency improvement. The long-term sustainability of the Energy Efficiency Networks Initiative and its transition to Efficiency and Climate Networks is organizational innovation in collaborative industrial efficiency practices, bringing together firms from industrial networks to share best practices, coordinate investment, and gain efficiencies that individual firms might find difficult to gain on their own (Odyssee-Mure, 2024).

The energy-intensive sectors' decarbonization is complemented by expert subsidy schemes re-arranged in 2024 and completed by Carbon Contracts for Difference providing a stable stream of revenues to the industrial efficiency and decarbonization investments exposed to ambiguous carbon price trajectories and foreign competition from other parts of the world with different climate policies (Odyssee-Mure, 2024). This approach conveys sophisticated understanding of the investment risks to energy-intensive sectors and an awareness that achieving industrial transformation includes policy instruments to overcome both financial and technical barriers to efficiency improvement.

3.1.3 Comparative assessment of efficiency implementation strategies

The Italian and German efficiency strategy comparison shows underlying differences in governance philosophy, institutional capacity, and resource allocation that represent broader trends in European energy transition strategies and have significant implications for the achievement of collective EU efficiency targets. Italy's approach is a model of what could be called "adaptive pragmatism", with a focus on the rapid deployment of mature technologies and leveraging existing institutional arrangements to achieve near-term efficiency gains and build capacity for more profound transformation over the longer term (Prontera & Lizzi, 2023). The approach is characteristic of being sensitive to institutional bottlenecks and resource constraints and making the best use of available policy instruments through strategic coordination and flexible implementation.

Germany' approach is an example of 'systematic transformation', pursuing deep efficiency gains through integrated policy designs that address multiple sectors simultaneously and invest intensively in public assets to create predictable conditions for long-term efficiency investment (Bartholdsen et al., 2019). This kind of approach attests to greater institutional capability and fiscal resources but also creates latent vulnerabilities when external shocks disrupt carefully sequenced implementation plans or when underlying assumptions about technology costs, consumer behaviour, or economic conditions are found to be incorrect in the face of rapidly changing conditions.

The feasibility of these different approaches depends vitally on their practicability in existing institutional arrangements, economic conditions, and political constraints that vary dramatically across European member states. Italy's emphasis on building renovation through fiscal incentives demonstrates achievement in bringing rapid efficiency gains where public support is high but is more ambiguous regarding fiscal sustainability when the support level must be reduced for budgetary reasons, as illustrated by the phase-down of tax deductions from 50% to 36% in 2025 and to 30% in 2026-2027 (Odyssee-Mure, 2024).

Germany's whole-of-government approach illustrates what is possible in the way of long-term efficiency gains when large volumes of public finance are committed for extended periods, but the planned reduction of heat pump subsidies by €2.4 billion in 2025 illustrates that even countries with strong budgetary positions feel pressured to roll back support mechanisms as temporary reactions to the energy crisis are increasingly normalized (Clean Energy Wire, 2024). This decline highlights the political challenge of maintaining lavish efficiency support over the extended time horizons required for deep building stock transformation.

The two nations' industrial efficiency measures represent different approaches to engaging energy-intensive industries in increasing efficiency with important ramifications for maintaining competitive industries during energy transition. Italy's Transition Plan 5.0 performance-based tax credits offer incentives for enhancing efficiency without picking winners among different technologies or approaches, which allows companies to choose optimal solutions to suit their specific circumstances while ensuring that public support remains subject to actual performance and not investment.

Germany's combination of direct subsidy under the EEW program with cooperative approaches under Energy Efficiency Networks represents a more activist public sector role in industrial efficiency that can accelerate the diffusion of best practices and enable coordination gains that individual companies may not be able to capture on their own. It does require greater administrative capacity and may be less suitable for countries with fewer institutional resources or differently organized industries.

The size differentials between German and Italian efficiency spending, at €40 billion annually for Germany compared to €10 billion for Italy, are a product of both differing economic means and differing strategic priorities in using public investment to stimulate efficiency gains (Áron et al., 2024). The differentials raise important questions about whether or not efficient markets require the same levels of public investment or whether different strategies can duplicate efficiency gains with different levels of resource commitment.

Detailed examination shows that both pathways are faced with inherent trade-offs between the rate of efficiency improvement required to meet 2030 objectives and the time required to build institutional capacity, develop supply chains, and achieve consumer acceptance of full-efficiency technologies. Bharti (2025) warns that Germany's electrification priority can raise demand by 10%, potentially offsetting efficiency enhancement unless renewable energy installation and grid expansion keep pace with heat pump and electric vehicle adoption.

Italy's emphasis on demand reduction through building efficiency improvements can provide more near-term and certain efficiency benefits but may not establish a sufficient foundation for the broader electrification of heating and transportation sectors that will be required for decarbonization overall. The fact that Italy's building stock is aging, with relatively small modernization achieved as of 2024, creates both the possibility of very large efficiency gains and technical issues in integrating modern efficiency technologies into older buildings with complex retrofitting requirements.

The consequences of these different approaches extend beyond efficiency policy to broader questions of multi-level governance and the balance between European coordination and national discretion in the pursuit of collective objectives. The Italian case demonstrates how states with complex institutional structures and fewer resources can nonetheless seek to achieve substantial efficiency improvements through strategic use of available policy instruments, while the German case indicates what can be achieved through comprehensive change when both broad institutional capacity and fiscal resources are available.

However, both approaches are faced with challenges of what von Malmborg et al. (2023) identify as potential 'scalar clashes', where different scales of governance may operate at cross-purposes, ultimately frustrating attempts at efficiency gains. Italy's multi-level governance institutions with time-consuming negotiations between central and regional governments can slow down realization of efficiency measures, while Germany's federal system creates coordination challenges between national efficiency targets and state-level implementation tasks, particularly in building policy where states retain significant regulatory competencies.

Democratic legitimacy and political sustainability of efficiency policies also depend on their consistency with broader social and economic objectives beyond energy transition, including housing affordability, industrial competitiveness, and distributional equity. Both Italian and German approaches are sensitive to these broader objectives, but achieve integration through different mechanisms that reflect disparate political traditions as well as institutional arrangements. Italy's pairing of efficiency objectives with seismic retrofitting is a sign of responsiveness to multiple policy objectives at once utilizing efficiency gains to address broader infrastructure needs, and Germany's income-dependent grants for heat pump installation are a sign of responsiveness to distributional concerns in efficiency policy design.

3.2 Renewable energy expansion under RePowerEU targets

Both national plans on renewable energy expansion demonstrate how the elevated RePowerEU targets, which have an overall renewable energy target of at least 42.5% binding at the EU level by 2030 with the ambition to reach 45%, have been rendered through different national contexts and institutional capacities (European Commission, 2023). The new Renewable Energy Directive entered into force on 20 November 2023, with a period of 18 months for the transposition of most provisions into national law, mirroring the accelerated timeline for the deployment of renewables across Europe. The EU has generated more power from wind and solar than gas since 2022, and in 2023, wind power alone generated more electricity than gas, illustrating the massive progress achieved under RePowerEU (European Commission, 2024).

3.2.1 Italy's ambitious renewable trajectory

Italy's offshore wind growth plan is perhaps the most ambitious aspect of its renewable energy development, targeting 2.1 GW of offshore wind capacity by 2030 (Rinnovabili, 2024) as part of a longer-term vision of scaling up to 20 GW by 2050, which can unlock cumulative economic value of approximately €57 billion and create 27,000 new jobs between 2030 and 2050 (The European House - Ambrosetti, 2024). This priority strategic focus on offshore wind is a concern that Italy's Mediterranean location, while presenting different technical difficulties than North Sea initiatives, presents excellent opportunities for floating wind technology (Serri et al., 2024) with the potential to place Italy at the forefront of this new industry globally.

Italy's offshore wind sector faces unprecedented opportunities and significant technical challenges in light of the diverse environmental conditions and infrastructure requirements of Mediterranean deployment, compared to the more established North Sea offshore wind industry. The Mediterranean waters are deeper, and there is less than 10% of the overall surface with water depths of 0-60 meters appropriate for fixed-bottom installations, which means that large-scale development of offshore wind in Italian waters requires floating wind technology that is still in demonstration phase globally (Serri et al., 2024). This technology dependence creates both risks from untried technology and opportunity for Italian companies to acquire experience in floating wind systems that may be critical for global offshore wind installation (Watson Farley & Williams, 2025).

The most likely areas for offshore wind development in Italy are the southern Sicilian zone, the waters around Sardinia, and the Adriatic Sea off the coast of Puglia, where the average wind speeds are more likely to range from 8-10 m/s instead of the higher rates typical of North Sea locations (The European House - Ambrosetti, 2024). While having poorer wind resources than northern European sites, these locations provide attractive development options due to their closeness to big population bases, existing grid infrastructure, and port facilities that could support offshore wind logistics and maintenance operations.

The degree of developer interest in Italian offshore wind demonstrates both market confidence in the potential of the technology and the challenges of managing rapid sector growth in the absence of appropriate regulatory frameworks and grid capacity. Italian transmission system operator Terna had received connection requests for approximately 84 GW of offshore wind projects as of June 2024, with requests concentrated in Puglia (27 GW), Sicily (24 GW), and Sardinia (14 GW), indicating development interest well in excess of realistic deployment possibility by 2030 but demonstrating significant private sector confidence in longer-term market evolution (The European House - Ambrosetti, 2024).

Prominent projects under development include Renexia's 2.8 GW floating wind farm in the Strait of Sicily, Eni's Plenitude and CDP Equity constructing three floating wind farms of 2 GW with Copenhagen Infrastructure Partners, and BayWa r.e.'s portfolio of 14 floating offshore wind projects in various phases of development with combined capacity of 9 GW (The European House - Ambrosetti, 2024). These development timetables capture both the strong industry interest and the practical constraints on early deployment under regulatory approval processes, technology readiness, and infrastructure development requirements.

The regulatory framework governing offshore wind development captures Italy's effort to balance rapid sector growth with nature conservation and public consultation. FER 2 decree, effective from August 2024, establishes a Contract for Difference mechanism with public auctions conducted by GSE from 2024 to 2028 that provides essential revenue certainty for offshore wind projects that face higher costs and greater technical risk compared to onshore renewable energy development (The European House - Ambrosetti, 2024).

Italy's approach to offshore wind port infrastructure development reflects recognition that successful sector growth requires comprehensive supply chain development beyond simply installing turbines, encompassing manufacturing, assembly, installation, and long-term maintenance capabilities that could provide substantial economic benefits to coastal regions. The Ministry for Environment and Energy Security (MASE) will launch tenders to choose the ports to act as offshore wind logistics, with Taranto and Brindisi in Puglia and Augusta in Sicily identified as leading candidates, indicating consistency between renewables growth and broader industrial policy objectives (The European House - Ambrosetti, 2024).

The synchronization of offshore wind development and grid modernization is a primary challenge for Italian renewable energy expansion, comprising major investment in transmission infrastructure to carry electricity from offshore generation sites to population centres and industrial loads. Italy's commitment to make at least 4,648 km of power grid more resilient under Recovery and Resilience Facility assistance, including 514 km of submarine cables from Eboli to Caracoli and the Sicily-Campania East interconnection line, demonstrates that it realizes offshore wind requires coordinated grid infrastructure investment rather than project-by-project development (European Commission, 2024).

Yet, grid modernization in Italy is only 50% complete by 2024 relative to more developed European nations, which may limit the potential for integrating extensive offshore wind development and produce bottlenecks that reduce the use of renewable energy even as generation capacity becomes available (Vezzoni, 2023). The presence of this infrastructure limitation displays the systemic character of integrating renewable energy difficulties and the need for coordinated investment in generation, transmission, and distribution systems for successful renewable energy integration.

The biomethane component of Italy's renewable energy policy represents an innovative approach to the use of agricultural and waste resources to generate energy and promote rural economic development and waste management results that extend far beyond the simple development of renewable energy. The target of 10 bcm annually of biomethane production by 2030 is an ambitious contribution towards renewable energy targets while providing domestic energy production reducing import reliance and providing economic opportunity in rural regions that may have fewer direct gains from wind and solar development (MASE, 2024).

EU biomethane production totalled 4.9 bcm in 2023 with 6.4 bcm per annum of installed capacity by the beginning of 2024, reflecting strong growth dynamics that underpin Italy's ambitious plans while contributing to overall European biomethane targets under RePowerEU (European Commission, 2024). Italy's focus on biomethane growth leverages the country's extensive agricultural sector and existing natural gas grid that has the potential to enable biomethane injection without relying on completely new distribution systems.

However, biomethane development also entails feedstock availability limits, competition with food production, and potential environmental impacts of intensive biomass production requiring careful policy design to ensure sustainability and host community acceptability.

Italy's solar plan, targeting 79.2 GW of installed capacity by 2030, is one of Europe's most ambitious solar deployment targets and reflects both the country's high solar resource potential and the economic competitiveness of the technology compared to other options for renewable energy (Beccarello & Di Foggia, 2023). This target requires the addition of approximately 57 GW of new photovoltaic capacity over the decade, equivalent to average annual installations of nearly 6 GW compared to historical deployment levels that have been significantly lower (Rosslowe, 2024), implying the need for a considerable acceleration in deployment processes, supply chain development, as well as grid integration skills.

The Italy's ambition in solar targets attests the reality that photovoltaic technology is the fastest scalable and economically feasible source of renewable energy for the 2030 targets, but also creates potential land use, grid integration, and system flexibility issues that may become more and more problematic as solar penetration rates approach the level outlined in the PNIEC. The concentration of optimal solar resources in south Italy, combined with substantial demand centres for electricity in industrial areas in the north, requires heavy grid investment and perhaps energy storage installation to make solar generation capacity valuable.

Italy's distributed solar deployment strategy is being sensitive to both utility-scale development and smaller-scale installations that can deliver energy access and economic benefits to residential and commercial consumers while reducing pressure on transmission infrastructure. However, large-scale solar deployment will have to clear regulatory obstacles, grid interconnection processes, and finance channels that have heretofore constrained the rate of rapid installation growth, particularly for smaller-scale installations that face proportionally more transaction costs and regulatory burden.131 GW for all technologies.

Italy's plan for solar deployment is both pragmatic recognition of the country's endowments and technological readiness. As for solar energy, the government has set a target of overall installed capacity of 79.2 GW, excluding concentrated solar power in steep decline compared to the previous PNIEC, which would necessitate photovoltaic to grow by approximately 57 GW from current levels (Beccarello & Di Foggia, 2023). This is among the most ambitious targets for solar deployment in Europe as a percentage of current capacity, suggesting much higher installation rates per annum than have been seen historically. The plan allocates equal investments of €45.9 billion to the expansion of solar power, showing the enormous financial investment required.

Wind energy development in the Italian plan targets a total capacity of 28.1 GW by 2030, including 2.1 GW of offshore wind development and 17 GW of new onshore installations (MASE, 2024). The offshore wind component is particularly an ambitious pledge, given Italy's limited experience in developing wind energy in the offshore environment. Italy is, however, the third-largest global market for floating offshore wind development in terms of potential, with estimates of 207.3 GW of potential for floating offshore wind, or more than 60% of total renewable energy potential (The European House - Ambrosetti, 2024).

Transmission System Operator Terna gathered bids for connection of approximately 84 GW of offshore wind projects until June 2024, with Apulia leading at 27 GW, followed by Sicily with 24 GW and Sardinia with 14 GW (The European House - Ambrosetti, 2024). Most competitive areas are situated in the southern part where wind yields are most favourable, particularly in the waters surrounding Sicily, Sardinia, and Puglia. Politecnico University of Turin research estimates the floating offshore wind power potential of Italy to be 207.3 GW, though achieving significant development depends on the commercialization of floating wind technology in other markets like South Korea, the UK, and France (The European House Ambrosetti, 2024).

Italy's grid modernization requirements are an important enabling factor for renewable integration. Italy will increase the capacity of at least 4,648 km of power grid with the help of Recovery and Resilience Facility, while 514 km of submarine cables from Eboli to Caracoli and the "East interconnection line" from Sicily to Campania will be constructed to integrate renewables from the south (European Commission, 2024). However, modernization of Italy's grid capacity stands at only 50%, compared to more advanced European peers, which may constrain incorporating renewable energy (Vezzoni, 2023).

FER 2 decree, effective from August 2024, launches a Contract for Difference (CfD) scheme awarded through public auction procedures for innovative renewable technologies like offshore wind, floating solar, and marine energy for 2024-2028 (The European House - Ambrosetti, 2024). This support mechanism is required to make offshore wind projects bankable and viable due to costly development and construction expenses associated with these innovative technologies.

3.2.2 Germany's systematic renewable integration

Germany's renewables policy is an expansion and intensification of the Energiewende policy that made Germany a global leader in the rollout of renewables during the last two decades and more but must now tackle the complex problem of integrating unprecedented levels of variable renewable generation while maintaining system reliability and keeping costs in check that have become increasingly prominent in public and political discourse. The achievement of over 60% renewable electricity generation by 2024, with ambitions of 80% by 2030 and near-complete renewable electricity by 2050, represents both the unprecedented accomplishment of long-term policy success in a planned way and the rising technical challenges of operating electricity systems with very high penetrations of variable renewable generation (IEA, 2025).

The German renewable energy system increasingly confronts the challenges of grid integration and system flexibility that become pressing at the level of renewable penetration at which wind and solar generation can exceed total electricity demand during favourable weather conditions, requiring sophisticated grid management, energy storage, and demand response capabilities to maintain system stability and avoid curtailment of renewable generation. The curtailment of 20% of wind energy in 2023 due to grid congestion is one such integration complexity and both an economic loss for investors in renewables and a waste of clean energy generation that degrades the environmental value of renewable deployment (Vezzoni, 2023).

Germany's approach to addressing these integration challenges relies on technological solutions like the rollout of energy storage, grid expansion infrastructure, sectoral coupling through power-to-heat and power-to-gas applications, and demand response mechanisms that can shape electricity demand to match variable renewable generation profiles. However, energy storage deployment so far is modest relative to system needs, with only 1.7 GW of large-scale storage power and 2.2 GWh of storage energy as of January 2025, showing huge gaps between the scale of renewable generation and the storage capacity required to fully utilize variable renewable output (IEA, 2025). Recent policy revisions allow energy storage to play a role in frequency response and ancillary services markets, which creates revenue opportunities that strengthen the economic case for storage investment while providing grid services that become increasingly valuable with increasing renewable penetration and the retirement of conventional power plants that have traditionally provided these services

Germany's hydrogen strategy is perhaps the most ambitious component of its integrating renewables strategy, with a target of 10 GW electrolyser capacity by 2030 and total hydrogen demand of 95-130 TWh, 50-70% of which would need to be imported due to limited domestic renewable energy availability for hydrogen production after meeting direct electricity demand (Clean Energy Wire, 2024). This hydrogen strategy represents recognition that deep decarbonization will require not just renewable electricity but also renewable fuels for applications like steel production, chemicals, aviation, and shipping that are hard to electrify directly with current technologies.

Germany's hydrogen ambitions are nevertheless faced with important economic and technical challenges that may constrain deployment relative to policy goals and create tensions between domestic hydrogen production and other uses of renewable energy. Current estimates see German hydrogen production costs reaching $10 per kilogram by 2030, well beyond $3-8/kg import prices from countries blessed with cheaper renewable energy and labour, and suggesting that domestic production of hydrogen on a large scale would be uneconomical compared to imports (Reuters, 2024). This price differential calls into question the economic rationale for widespread domestic electrolyser deployment and suggests that German's hydrogen strategy will need to be based more on import infrastructure and international cooperation relative to domestic production.

The complexity of hydrogen infrastructure development adds another layer of complexity for Germany's integration plan of renewable energy, including 1,800 km of hydrogen pipelines to be developed by 2027/2028, coordination with adjoining states to enable the European Hydrogen Backbone, and rendering new LNG terminals hydrogen-ready to enable future imports of hydrogen derivatives like ammonia and synthetic methanol (European Hydrogen Observatory, 2024). Total hydrogen infrastructure needs, including pipelines, electrolysis plants, and renewable energy capacity to produce it, are estimated at €65-80 billion by 2030, which are huge public and private capital expenditures in competition with other renewable energy investments and infrastructure needs.

Real progress on Germany's hydrogen ambitions is uncertain, with electrolyser plans announced until 2030 totalling only 8.7 GW according to E.ON analysis, which falls below the 10 GW target and is met with significant uncertainty about whether planned ventures will receive final investment decisions (Clean Energy Wire, 2023). The majority of hydrogen projects require considerable public support in order to be economically viable, creating fiscal pressures similar to those facing other mechanisms for subsidizing renewables and jeopardizing the long-term sustainability of hydrogen promotion policy.

Germany's policy for wind energy development emphasizes both offshore and onshore installation, with offshore wind energy being a particularly important part of achieving 2030 targets for renewable energy due to higher capacity factors and fewer land use constraints for offshore than onshore installations. The German offshore wind sector benefits from mature supply chains, proven technology, and favourable regulatory frameworks established over a decade-plus of North Sea installation but is faced with increasing grid connection, nature protection, and competition for sea space with shipping, fisheries, and other economic activities.

The integration of offshore wind with onshore grid infrastructure is requiring substantial levels of transmission investment to carry electricity from generation locations in the North Sea to industrial demand concentrations in southern Germany, creating both technical challenge and political tension over the siting of transmission lines and the geographical distribution of infrastructure costs and ratepayer burdens. The complexity of coordinating offshore wind build-out with grid expansion is a good example of the system-wide nature of the integration challenges of renewable energies and the requirement for overarching planning that addresses generation, transmission, and demand-side issues together rather than optimizing each separately.

Germany's expansion of solar power demonstrates the continued cost-competitiveness and scalability of photovoltaic technology, with 14 GW of new solar capacity in 2024 alone, but must also face up to emerging challenges of grid integration, land use, and system integration that increase in significance as solar deployment reaches very large scales (IEA, 2025).

The feed-in tariff policy framework that underpinned Germany's initial success in solar deployment has yielded to auction-based programs that provide cost discipline as well as ongoing deployment incentives, but the shift from one regime to another creates investor and developer uncertainty that has to be carefully managed to prevent deployment slowdown (IEA, 2025). Achieving the right balance between providing sufficient revenue certainty to obtain investment while holding costs to ratepayers low requires continuous policy evolution as technology costs evolve, market conditions alter, and system requirements unfold (Bartholdsen et al., 2019).

Germany's approach to coordinating renewable energy with industrial policy objectives demonstrates a sophisticated understanding of interlinkages between energy transformation and economic competitiveness, pursuing renewable energy development that adds rather than subtracts from industrial activity through secured electricity supply, competitive prices, and opportunities for industrial participation in renewable energy supply chains (Odyssee-Mure, 2024). The country's sizeable renewable energy equipment manufacturing sector promises economic benefits from renewable energy development while constructing stakeholder support for subsequent policy design and implementation (Bartholdsen et al., 2019).

However, industrial energy users' increasing worries about electricity prices and system reliability amidst increasing renewable penetration and conventional power plant retirement create political tensions with the potential to impact long-term political support for renewable energy policies when industrial competitiveness is perceived to be undermined by energy transition policies (IEA, 2025). The challenge to maintain industrial competitiveness alongside achieving renewable energy targets is a prime example of the multidimensional trade-offs involved in energy transition and the requirement for policy design that takes into consideration economic factors alongside environmental factors (Siddi & Prandin, 2023).

3.2.3 Comparative analysis of renewable energy implementation strategies

A comparison of Italian and German renewable energy strategies reveals diametrically opposed approaches to steering the shift towards renewable-dominated from fossil fuel-dominated energy systems, each characterized by contrasting institutional capacities, bases of resources, and strategic interests that have far-reaching implications for achieving European renewable energy objectives while preserving energy security and economic competitiveness (Prontera & Lizzi, 2023; Bartholdsen et al., 2019). Italy's approach reflects "aggressive catch-up", with an aim to install a number of different renewable technologies in succession to catch up on past underinvestment in renewables and take leadership in new technologies like floating offshore wind, while Germany's approach reflects "systematic optimization", building on decades of renewable energy experience and deploying it to address the high-renewable penetration and system integration issues (The European House - Ambrosetti, 2024; IEA, 2025).

The technology risk profiles of these different approaches vary significantly, and Italy's emphasis on floating offshore wind is a bet on emerging technology that would bring huge first-mover advantages if it succeeds but involves huge deployment risk if floating wind technology development falls behind the pace or prices stay higher than anticipated (The European House - Ambrosetti, 2024). Germany's emphasis on hydrogen is a new type of technology risk, including known electrolysis technology but still uncertain economics and complex infrastructure requirements that might constrain deployment if hydrogen prices do not decrease as rapidly as projected or if international hydrogen trade develops differently than anticipated (Clean Energy Wire, 2024; Reuters, 2024).

The regional and resource constraints of each country create other optimization problems that influence the planning of renewable energy. Italy's southern position of renewable resources far from the massive industrial consumption centres requires massive grid investment and potentially storage utilization to effectively tap renewable generation, but also offers potential for exporting renewable energy to other EU nations if transmission facilities are developed (European Commission, 2024; Vezzoni, 2023). Germany's more dispersed renewable resources and industrial load have advantages for integration but challenges for managing seasonal variability of renewable production and matching generation with potentially non-simultaneous, unsynchronized demand patterns not aligned with renewable production availability (IEA, 2025).

The deployment rate of renewable energy implied by national plans requires a substantial ramp-up compared to previous levels, creating implementation issues around supply chain capacity, availability of skilled workforce, and regulatory processing capacity that could potentially constrain objectives attainment unless tackled adequately through policy coordination measures (Ember, 2024). Italy's target of installing nearly 6 GW of solar capacity annually is roughly three times recent years' deployment levels, while Germany's continued 14 GW solar annual deployment entails maintaining high installation rates in place through policy changes and market evolution (Beccarello & Di Foggia, 2023; IEA, 2025).

The mobilization of capital must achieve such renewable energy deployment goals are substantial capital mobilization tasks that depend on public policy backing and private sector investment decisions shaped by regulation regimes, revenue security, and perceived risk of renewable energy technologies and projects (MASE, 2024). Italy's total renewable investment requirements of over €80 billion by 2030 represent some 4% of GDP annually, and the investments in renewables in Germany, including grid integration and storage, require equivalent relative efforts that compete with other government expenditure priorities and private sector investment options (Reuters, 2024).

The grid integration challenges facing both countries illustrate the system nature of renewable energy deployment and the necessity to have coordinated investment in generation, transmission, distribution, and flexibility resources to ensure effective use of renewable energy (European Commission, 2024). Italy's 50% grid modernization success by 2024 creates bottlenecks that may truncate the assimilation of renewable energy (Vezzoni, 2023), while Germany's grid congestion resulting in 20% wind curtailment shows that even advanced grid networks require continuous investment and optimization to accommodate increasing renewable production (IEA, 2025).

The international dimensions of renewable energy policy bring complexity to national planning and implementation, as countries increasingly rely more than ever on collaboration with neighbouring countries for grid interconnection, technology development, and supply chain management that exceed national borders and require European-level collaboration in order to achieve optimal outcomes. Italy's potential role as the point of entry for the importation of North African renewable energies and Germany's role as the potential hub for importing hydrogen create regional energy leadership opportunities that at the same time create international collaboration and infrastructure development dependences that are subject to the influence of geopolitical happenings and the changing nature of international relations (Clean Energy Wire, 2024; The European House - Ambrosetti, 2024).

3.3 Supply diversification strategies and mitigating Russian gas dependence

Supply diversification strategies under the two national plans indicate the most immediate impact of the Ukraine crisis on European energy policy, showing how geopolitical shock can transform energy relations and investment in infrastructure to new forms in ways that may have long-lasting impacts on the structure of Europe's energy system. The EU lowered its share of Russian gas imports from 45% to 19% as a result of the REPowerEU Plan launched in May 2022, but Russian gas still represented 14% of the EU's gas consumption in 2024 with its imports rising by 18% from 38 bcm to 45 bcm mainly driven by higher imports to Italy (+4 bcm), Czechia (+2 bcm), and France (+1.7 bcm) (Ember, 2025).

3.3.1 Italy's Mediterranean diversification strategy

Italy's diversification process demonstrates remarkable institutional adaptability in reorganizing energy relationships that had been built over decades, literally reducing Russian gas imports from approximately 29 bcm in 2021 to only 2.9 bcm in 2023, i.e., by 90% over a period of two years by the package of alternative supplier relations, LNG infrastructure development, and demand reduction measures (Prontera, 2024). This turn illustrates both the danger of dependence on single suppliers and the potential for dramatic restructuring of energy systems when geopolitical realities necessitate a rapid turn, though the long-term sustainability of this diversification is in the hands of international energy market evolution and the success of more widespread renewable energy transitions.

The Algerian strategic partnership is the cornerstone of Italy's diversification policy in the Mediterranean using Algeria as Italy's largest gas producer that delivered 25.5 bcm in 2023 and holding 41% of total imports through the Trans-Mediterranean pipeline system connecting Algeria with Sicily via Tunisia (Prontera, 2024). Such a relationship benefits from the 33 bcm per year existing infrastructure capacity that provides room for growth, geographical proximity that reduces transport cost and security risk in comparison to more distant suppliers, and political bonds which have endured despite overall regional tensions between other North African energy relationships.

The Algerian partnership also reflects broader strategic thought regarding energy security that transcends simple supplier diversification to encompass concerns over political stability, infrastructural susceptibility, and longer-term resources that influence the sustainability of energy relations over the decades-long time frames relevant to major-scale energy infrastructure projects. Algeria's own energy strategy targets 200 billion cubic meters of gas production per annum by 2030 through large-scale strategic investment, which can potentially provide further European market export capacity together with scope for renewable energy cooperation able to underpin more distant energy transition ambitions (Prontera, 2024).

However, Algerian gas exports are vulnerable to potential restriction by EU regulation of methane emissions that will take full effect by 2030 and will penalize breaches of regulation on methane emission intensity, which means either major environmental improvements in Algerian gas production or the acceptance of high costs that would compromise the competitiveness of Algerian gas relative to other producers (Siddi & Prandin, 2024). These shifting environmental policies emphasize the complex interlinkages between climate policy and energy security that can impact the long-term viability of different supplier relations, as well as compatibility of diversification approaches with the objective of minimizing climate.

Italy's LNG infrastructure development is a mix of short-term emergency response and longer-term positioning for increased supply flexibility, with total LNG imports of 15 bcm in 2023 representing approximately 24% of total gas imports led mainly by Qatar, the US, and Egypt (Prontera, 2024). The rapid deployment of floating storage and regasification units (FSRUs) says a lot about institutional capacity for emergency infrastructure deployment, with Snam S.p.A.'s acquisition of two FSRU vessels for approximately €700 million in June to July 2022, each providing 5 bcm/year regasification capacity able to collectively supply up to 13% of Italian gas demand at full output (Prontera & Lizzi, 2023).

The development of additional LNG facilities like terminals at Piombino and Ravenna with a planned capacity to add an additional 10 bcm per year by 2025 represents strategic supply flexibility investment enabling Italy to tap into international LNG markets and reduce dependence on pipeline suppliers, though this flexibility is costlier than pipeline gas and may create stranded asset risks if gas demand declines more rapidly than forecasted as part of renewable energy transition (Prontera, 2024). The economic impact of LNG dependence includes exposure to changing international LNG prices and transportation that are substantially greater than for pipeline gas, particularly when there is peak global demand or supply dislocation.

Growing U.S. LNG trade mirrors both the geopolitical dimensions of energy diversification and opportunities for transatlantic energy cooperation to enhance European energy security while allowing American energy exports to expand. US LNG exports to Italy tripled from 0.9 bcm in 2021 to 2.89 bcm in 2022, more than 20% of Italy's total LNG imports, and demonstrating the speed at which new energy trade partnerships can transpire when geopolitics brings about mutual interests in energy collaboration (Siddi & Prandin, 2023).

Italy’s biomethane development plan is an innovative attempt at the reduction of import dependence by means of renewable energy generation founded on homegrown agricultural and waste materials that presents economic opportunities for rural populations as well as supporting circular economy objectives beyond simple energy production (MASE, 2024). The goal of 10 bcm per year in 2030 is significant domestic energy output that would substitute for about 15% of existing gas imports and bring economic advantages to agricultural zones likely to see little direct benefit from solar and wind development focused elsewhere (European Commission, 2024).

Biomethane production also demonstrates the potential of renewable energy policies that address a range of policy objectives including energy security, agriculture support, waste policy, and rural development and could gain broader political support and economic benefits compared to renewable energy policies for electricity (Odyssee-Mure, 2024). But biomethane production at the scale envisioned entails significant quantities of farm and waste feedstocks whose future use is potentially subject to competing demands and environmental constraints calling for systematic policy design to achieve minimal sustainability and unwanted effects on food production and environmental quality (Odyssee-Mure, 2024).

The controversial aspects of Italy’s supply diversification policy are targets of doubling capacity on Trans Adriatic Pipeline carrying Azerbaijan gas, increasing South-to-North gas flows through the new Adriatic Line, and potential expansion of the EastMed-Poseidon pipeline project as a new pipeline for Eastern Mediterranean gas supplies, despite projected declining gas demand that might create stranded asset hazards and strain climate objectives (Prontera, 2024). These infrastructures investment as shown reflect Italy’s ambitions to become a regional hub of gas connecting African and Eastern Mediterranean producers with more extensive European markets, which can provide geopolitical influence and economic dividends through transit volumes and trading opportunities (Prontera, 2024).

But the expansion of gas infrastructure during a period of organized energy transition to renewables can create possible contradictions between short-term energy security objectives and long-term climate objectives that could become progressively more complicated if demand for gas decreases more sharply than anticipated or if deployment of renewables progresses faster than anticipated (Siddi & Prandin, 2023). The economic justification for big gas infrastructure investment depends on stable gas demand over decades-long asset lifetimes that may be inconsonant with achieving 2050 climate neutrality objectives or earlier phase-down of fossil fuel use for electricity and heating (Vezzoni, 2023).

3.3.2 Germany's systematic infrastructure transformation

Germany's approach to supply diversification reflects the country's normal tendency to planning and systematic deployment, but adapted for extraordinary situations requiring record-setting speed in the deployment of infrastructure and establishing relationships with suppliers. The transformation from complete dependence on pipeline imports to a diversified supply base that includes significant LNG import capacity is among the quickest energy infrastructure rollouts in European history, with lead FSRU completing construction in nine months and three operational by 2024 with additional capacity planned for early deployment (Gross, 2025).

The scale and rapidity of the construction of Germany's LNG infrastructure help to underscore both the country's significant institutional ability at crisis response and the fiscal resources available for emergency infrastructure spending at a total cost of approximately €20 billion for LNG terminals and supporting infrastructure, reflecting substantial public investment justified by energy security imperatives but generating fiscal burdens potentially affecting resource availability for the installation of renewable energy and other energy transition investments (Qi, 2023). Economic efficiency in this rapid infrastructure deployment is not ascertained, since emergency procurement and rapid deployment might have been more expensive than more cautious planning processes (Gross, 2025).

Germany's diversification strategy is not supplier diversification alone but also fuel diversification through rapid renewable energy, energy efficiency enhancement, and demand response abilities to reduce total gas consumption and hence vulnerability to supply disruptions regardless of supplier ties (Odyssee-Mure, 2024). The 20% decrease in gas demand during July 2022 to March 2023, driven by industry with 26% and residential with 17%, indicates that there is high capacity for rapid demand response that provides energy security benefits complementary to supply diversification (Gross, 2025). This demand response potential captures both temporary effects of elevated energy prices and official conservation campaigns, and perhaps more long-lasting efficiency gains and behavioural adjustments that may yield longer-term energy security dividends even after transient crisis conditions recede (Siddi & Prandin, 2023). But sustaining significant demand reduction over the very long term may entail ongoing high energy prices or policy measures that may have effects on industrial competitiveness and household welfare, causing tensions between energy security objectives and economic performance that must be navigated competently (IEA, 2025).

Germany's emphasis on Norwegian pipeline infrastructure development and LNG deployment shows mature appreciation of the merit of maintaining varied fuel sources and import channels as opposed to simply substituting one type of import dependence for the other (NECP, 2024). Expanding Norwegian imports into natural gas provides geographic diversification away from the North Sea but not from Eastern European or North African sources at the cost advantage of pipeline gas over LNG, though Norwegian gas output has its own boundaries in field depletion and environmental controls that might limit long-term availability (Reuters, 2024).

That union of acceleration of renewable energy and supplies diversification reflects Germany's all-embracing energy transition strategy for responding to the short-term requirements of security while moving towards longer-term transformation objectives without jeopardizing the potential for contradiction between the crisis response and climate policies that could be presented were diversification efforts entirely dependent on substitute fossil fuel suppliers (Bartholdsen et al., 2019). The ramp-up of the renewable energy installations to 14 GW solar and 3.6 GW wind in 2024 alone provides energy security benefits with reduced import dependency while advancing climate objectives, though grid integration challenges limit the short-term security benefits of renewable energy installations (IEA, 2025).

Germany's adjustment to demand management during the energy crisis shows advanced coordination among government, industry, and domestic consumers in achieving high levels of consumption reduction without broad economic dislocation, suggesting institutional capacity for crisis coordination extending beyond energy policy to embrace wider economic management and social coordination (Odyssee-Mure, 2024). The combination of price signals, conservation campaigns, and regulation transmitted demand savings far exceeding many early projections without compromising industrial production and family welfare at rates adequate to sustain political support for diversification policies (Gross, 2025).

But how long these reductions in demand can be maintained is doubtful and will be contingent upon continued participation by industrial and household energy consumers whose incentives will fade as crisis conditions improve and normal economic incentives re-emerge, eroding the energy security benefits from demand response unless supplemented by continued policy measures or fundamental changes in consumption patterns (Vezzoni, 2023). The challenge of maintaining energy conservation behaviours and investments after emergency pressures subside is an underlying crisis response dynamic that calls for judicious attention to long-term incentive structures and institutional arrangements (von Malmborg et al., 2023).

The economic impacts of Germany's policy of diversification extend beyond outright infrastructure spending to include routine subsidies on industrial and household energy users that reached significant proportions in 2022-2023 in a bid to assist in cushioning economic activity and social stability under the energy crisis, with total energy subsidies in the EU increasing five times over pre-crisis periods (Ember, 2025). Such subsidy costs illustrate the enormous economic expense of managing energy security transitions and raise doubts concerning the long-term fiscal sustainability of heavily subsidized diversification policy dependent on public support to provide economic and social stability in the context of adjustment (Clean Energy Wire, 2024).

The carbon implications of German diversification policy reflect the tension between short-term energy security objectives and more long-term climate commitments, with LNG imports potentially increasing lifecycle greenhouse gas emissions per unit of energy versus pipeline gas due to energy-intensive liquefaction and transport processes, yet simultaneously enabling access to gas production with diversified production characteristics and environmental profiles (Siddi & Prandin, 2023). The long-term contracts for LNG infrastructure typically 20 years long have the potential to create fossil fuel dependencies that extend beyond transition periods planned and potentially delay the achievement of climate objectives if gas consumption does not decline as rapidly as anticipated (Vezzoni, 2023).

3.3.3 Comparative analysis of supply diversification strategies

Italy's and Germany's supply diversification experience reveals broadly different strategies towards adapting to energy security transformations marked by digitally disparate geographic endowments, institutional capabilities, and strategic priorities in weaning Russian gas dependence within compressed timeframes. These varied strategies are instructive to the extent that they are helpful in explaining how national environments shape crisis response strategy and the trade-offs between short-term security concerns and long-term sustainability obligations.

Italy's diversification strategy towards the Mediterranean is one of 'opportunistic adaptation' and skilfully leveraging fixed infrastructure relationships to exploit quick supplier substitution with minimal investment required. Algeria's role as Italy's principal supplier of gas, which shipped 25.5 bcm in 2023 and represented 41% of total imports through the fixed Trans-Mediterranean pipeline network, demonstrates how successful physical location enables quick diversification (Prontera, 2024). The relationship exploits capacity on hand of 33 bcm annually, with room for growth available without the need for entirely new facilities, and proximity in geographical terms reduces transport costs and security issues regarding far-flung sources or complex LNG supply chains.

The Italian approach combines pipeline diversification with rapid LNG infrastructure deployment, speeding up LNG imports to 15 bcm in 2023 at 24% of total imports through emergency procurement of floating storage and regasification units (Prontera, 2024). Snam's June and July 2022 purchase of two FSRU vessels for around €700 million each, with 5 bcm/year regasification capacity, provided access to international LNG markets while maintaining supply flexibility during times of peak crisis (Prontera & Lizzi, 2023). Italy's emphasis on domestic biomethane production as a pioneering diversification factor, 10 bcm annually by 2030, is a unique diversification feature that serves the aims of energy security, farm expansion, waste management, and rural economic objectives (MASE, 2024).

Germany's diversification strategy reflects 'comprehensive restructuring', with a methodical push for transforming energy import infrastructure through record investment in entirely new supply chains. The construction of LNG import facilities from zero to 37 bcm per annum capacity by 2024 with the help of floating storage and regasification units like the first facility constructed in record nine months is one of Europe's record-scale energy infrastructure rollouts (Gross, 2025). This development cost about €20 billion in infrastructure expenditure, adding 15 bcm of LNG capacity to stream in 2023 alone, demonstrating significant fiscal capacity to face crises at the cost of not being maximally cost-optimizing (Qi, 2023).

The German approach targets demand management as a fundamental energy security component, achieving 20% natural gas consumption reduction during July 2022 to March 2023 by collective efforts involving industry use cuts by 26% and home use cuts by 17% (Gross, 2025). This capacity to adjust to demand reflects high-level coordination between civil society, industry, and government that enabled considerable consumption to change without major economic disruption while imparting long-term security benefits through lowered needs for imports as well as enhanced resistance to future supply disruptions.

Both strategies were hugely effective at reducing Russian gas dependence, Italy from 40% to 5%, and Germany from 55% to 10%, but yielded different risk profiles that reflect inherent trade-offs between short-term security and longer-term transformation ambitions (Prontera, 2024; NECP, 2024). Italy's approach, while budget-neutral and capitalizing on existing relationships, maintains high import dependence and comprises controversial gas infrastructure development that possibly contradicts climate objectives (Prontera, 2024). Germany's massive LNG infrastructure investments are bringing more supply security but pose stranded asset risk when gas demand crashes in the renewable energy transition, particularly with long-term LNG contract lengths of approximately 20 years that may extend fossil fuel dependencies past decarbonization timelines (Siddi & Prandin, 2023).

The budget implications reveal very high public costs comparable to those for renewable energy investment. Italy's 2022 €40 billion energy subsidies and Germany's 2022 €20 billion infrastructure expenditure indicate the fiscal expense of sped-up security realignments (Prontera, 2024; Qi, 2023). European subsidies for natural gas five times greater in 2022 to around €50 billion indicate broader continental fiscal impact (Ember, 2025). Environmental implications exhibit inherent contradictions between the climate and security objectives, as Italy’s increases in fossil fuels exceed green levels by 10% and Germany’s LNG infrastructures can potentially delay 2030 emission targets (Bharti, 2025; Siddi & Prandin, 2023).

Chapter 4: Conclusion

This thesis has examined how Italy and Germany, member states with varying institutional arrangements and energy system characteristics, have responded to the geopolitical crisis occasioned by Russia's invasion of Ukraine by executing EU energy transition directives. The research demonstrates that both countries achieved considerable success in reducing Russian gas dependence (from 40% to 5% in Italy and from 55% to 10% in Germany) while simultaneously accelerating the installation of renewable energies and implementing substantial energy efficiency improvements, but through highly divergent strategies that reflect their distinct governance traditions, institutional capacities, and strategic priorities.

Comparative analysis demonstrates that Italy's crisis-driven pragmatism, as indicated by the rapid improvisation of existing institutional arrangements and strategic exploitation of geographic and political relations, was highly effective in achieving immediate security objectives while building capacity for more extended change (Prontera & Lizzi, 2023). Italy's emphasis on building renovation through tax credits, Mediterranean supply diversification through enhanced Algerian collaboration, and strategic placement in new technologies like floating offshore wind demonstrates how countries with complex institutional arrangements and less resources can still achieve significant energy transition progress through opportunistic and adaptive policy implementation.

Germany's intentional transition plan, reflecting the country's institutional capacity for coordinated planning and ample levels of financial capacity for multi-sectoral coordinated investment, was extremely effective through intensive combination of efficiency improvement with renewable energy expansion and infrastructural planning development (Bartholdsen et al., 2019). Germany's sector coupling strategy, ambitious hydrogen development plans, and comprehensive support mechanisms for industrial and residential efficiency improvements demonstrate the potential for systematic strategies where both institutional capacity and financial resources are available for sustained transformational activity.

The analysis demonstrates that both strategies have inherent limits and trade-offs that arise under pressure. Italy's adaptive style provides rapid results but may lack the systematic coordination required for deep change, while Germany's systematic style provides space for long-term systematic change but may be vulnerable to breakdown when underlying assumptions are incorrect or when rapid adjustment is called for under changing circumstances. The success of both approaches depends on their reconciliation with broader European coordination processes and their consistency with longer-term climate and economic objectives beyond short-term crisis management.

The research offers fundamental observations of the workings of multi-level governance during periods of crisis, demonstrating that effective European energy transition requires institutional frameworks that combine flexibility in national styles of implementation with firm coordination that guarantees policy coherence and precludes fragmentation (von Malmborg et al., 2023). The principle of subsidiarity provides for member states to adapt European directives to national circumstances, yet crisis scenarios create tensions between the demands of rapid response and established deliberative processes that have to be smartly managed by adapted governance structures.

The balance between the need for short-term energy security and long-term climate commitments is one of the most significant challenges laid bare by the crisis response, calling for policy formulations that can address immediate security imperatives without compromising advances toward climate neutrality (Siddi & Prandin, 2023). Both countries demonstrate that rapid response to security threat is compatible with climate objectives if well-managed, yet this compatibility requires intentional attention to security-climate policy interactions rather than treating them as separate domains.

The enormous finance requirements for crisis-driven energy transition illustrate the merits of more advanced European financial coordination mechanisms that enhance resource efficiency to the extent of fostering equitable distribution of transition costs and benefits across member states with different fiscal space and strategic agendas (Áron et al., 2024; Beccarello & Di Foggia, 2023).

The research contributes to the understanding of European energy governance by demonstrating how different institutional settings and implementation styles can produce convergent results in advancing energy security and climate objectives, while highlighting the utility of coordination mechanisms that reconcile national sovereignty with collective efficacy. The analysis suggests that optimal European energy governance requires institutional innovation that learns from crisis management while securing democratic legitimacy and long-term sustainability.

The Ukrainian war has effectively transformed European energy transition from an overwhelmingly climate-driven process into a security-driven transformation that must address near-term vulnerabilities and long-term sustainability objectives simultaneously (European Commission, 2022a). The Italian and German experience demonstrates that it is possible to manage this dual challenge successfully through different but complementary approaches that play to distinct national strengths while supporting common European objectives.

As Europe struggles with the complex challenge of energy transition under the pressure of geopolitical risk and climate imperative, the comparative experience of Italy and Germany provides valuable insights into how different national approaches can collectively contribute to European success (Ember, 2024). The research demonstrates that there is no single optimal pathway to energy transition, but that success depends on institutional arrangements for its effective implementation in different national settings while facilitating coordination for shared objectives.

The long-term success of European energy transition will depend on the EU's capacity to lock in the crisis-driven achievements of the past three years and develop governance processes that are capable of driving rapid change under normal circumstances. The Italian and German experience suggests that this potential exists but that its fulfilment will require sustained attention to institutional flexibility, stakeholder collaboration, and policy coherence between national sovereignty and collective effectiveness in addressing the energy security, climate change, and economic competitiveness imperatives that will define Europe's energy future.

Future research must ensure long-term sustainability of crisis-induced changes through longitudinal studies, broader comparative analysis across different member states, and cross-crisis analysis examining the effects of different shocks on transition policies (World Economic Forum, 2023). Extended comparative research design with other member states as part of it would provide broader insights on the impact of institutional arrangements on crisis responses.

The research demonstrates that sustainability and energy security are inseparable, with imperatives of short-term supply security driving clean-energy momentum, requiring combined solutions addressing both simultaneously. Comparative cross-crisis analysis needs to take into account how other types of external shocks affect energy transition policies and institutions beyond the Ukraine crisis.

Sectoral analysis must examine industrial decarbonization, energy system modelling, and the deployment of technology innovation under various institutional arrangements. The comparative methodology employed in this analysis might be extended to encompass additional member states with divergent characteristics, providing more extensive insights into how diverse institutional arrangements and economic conditions shape crisis response strategies.

Chapter 5: Policy recommendations

5.1 EU-Level Policy Recommendations

5.1.1 Strengthening Multi-Level Governance Coordination

The EU needs to create a European Energy Crisis Coordination Mechanism with graded lines of implementation that allow member states to choose between "systematic transformation" approaches like Germany's long-term planning and "pragmatic adaptation" approaches mimicking Italy's adaptive governance strategy (IEECP, 2023).
Better information exchange systems would enable real-time transfer of best practices between member states with different governance cultures. The system should possess emergency flexibility mechanisms that enable the rapid deviation from regular EU procedures during crises but with democratic control ensured through specific criteria and automatic clauses (Wettestad et al., 2018).
Italy's rapid policy adjustment amidst existing institutional arrangements demonstrates flexible implementation capacity, while Germany's cautious approach is a sign of extensive planning framework use. European crisis management should accommodate both styles by providing for rapid adaptation mechanisms while guaranteeing coordination to prevent policy fragmentation.

5.1.2 Refining democratic governance in times of crisis

The research recognizes tensions between rapid crisis response and traditional democratic consultation (van Veelen & van der Horst, 2018). The EU needs robust democratic oversight for crisis-time energy policymaking, e.g., enhanced parliamentary involvement, regular reporting, and proportionality analysis of crisis measures (Szulecki, 2018).
Energy price volatility impacts consumer confidence and government legitimacy, requiring EU communication strategies explaining policy trade-offs and building transition support during crises (Gross & Bazilian, 2025). Procedures should allow for rapid response while rendering emergency action temporary deviations from democratic norms (Burke & Stephens, 2018).

5.1.3 Strategic integration and coordination of technology

The EU must develop strategic planning processes that balance explicitly potential trade-offs between short-term security and long-term climate goals (IRENA, 2022). This should include scenario-based planning that addresses how different crises affect energy transition pathways, requiring adaptive capacity such as geopolitical risk analysis and institutional resilience planning.

Technology risk-sharing mechanisms should enable collective investment in new technologies and distribute risks across member states (Panton et al., 2024). This includes the expansion of the Innovation Fund to floating offshore wind, novel storage, and renewable hydrogen, with designs that enable participation of countries with different capacities in technology development.

5.1.4 Investment mobilization and financial coordination

The enormous sums of money required for crisis-driven energy transition, such as Germany's €40 billion each year efficiency investment and Italy's overall €80 billion renewable investment requirements (Áron et al., 2024), demonstrate the worth of enhanced European financial coordination frameworks that optimize resource allocation efficiency and ensure an equitable sharing of transition costs and benefits across member states.

Financial coordination tools need to optimize public and private investment allocation efficiency across member states, technologies, and timeframes. They include NextGenerationEU expansion to invest in energy transition and European green bonds pooling member state credit ratings to reduce borrowing costs (European Commission, 2024).

5.2 National-level recommendations

5.2.1 Tapping institutional comparative advantages

The German government could enhance adaptive capacity in systemic transformation by building in mechanisms for flexibility, while the Italian government should enhance long-term planning while providing pragmatic adaptation benefits (Arnold et al., 2017).

Germany should develop standard review procedures of long-term plans and improve crisis communication to guarantee continued public support amidst rapid transformations. Italy must expand technical analysis capacity, central-regional coordination, and policy learning from crisis innovations formalization. Both countries should improve stakeholder coordination so that crisis response benefits from different types of expertise without undermining decision-making ability (UNDP, 2024).

5.2.2 Technology development and innovation

The two countries' technology strategies also reflect different approaches to innovation risk and competitive advantage. Italy's emphasis on floating offshore wind is a strategic positioning in new technologies with the potential for technological leadership, while Germany's hydrogen strategy is planned scaling of mature technologies for new uses (The European House - Ambrosetti, 2024; Clean Energy Wire, 2024).

However, such strategies carry high economic and technical risks. Germany's own calculations of hydrogen production costs of €150/MWh compared to international import prices of €3-8/kg call into question the feasibility of domestic production (Reuters, 2024). Italy's floating offshore wind plans are based on untried commercial technology in Mediterranean conditions, although the country has received connection requests for approximately 84 GW of offshore wind projects (Prontera & Lizzi, 2023).

5.2.1 Balancing flexibility and predictability in governance

Governance systems must balance fixed long-term objectives with adaptive implementation, ensuring predictability to plan while allowing modulation of the strategy in accordance with changing circumstances (Arnold et al., 2017). Innovation centres must be incorporated through pilot programs, regulatory sandboxes, and systematic evaluation processes (UNDP, 2024).

The German track record of accelerated LNG infrastructure build-out demonstrates both institutional capacity for systematic crisis management and the fiscal expense of emergency policies, with €20 billion infrastructure investments concluded in record time (Gross, 2025). But the feasibility of such measures depends on their reconciliation with long-term planning frameworks that maintain democratic legitimacy.

Bibliography

Anıl, Ö., & Taydaş, T. (2024). REPowerEU as a crisis response: Immediate diversification and green transition. *Ekonomi, İşletme ve Maliye Araştırmaları Dergisi*. https://doi.org/10.38009/ekimad.1502909

Arnold, G., Nguyen Long, L., & Gottlieb, M. (2017). Social networks and policy entrepreneurship: How relationships shape municipal decision making about high-volume hydraulic fracturing. *Policy Studies Journal*, *45*(3), 414-441.

Áron, D., Hartvig, B., Kiss-Dobronyi, P., Kotek, B., Takácsné Tóth, B., Gutzianas, I., & Zareczky, A. Z. (2024). The economic and energy security implications of the Russian energy weapon. *Energy*. https://doi.org/10.1016/j.energy.2024.130972

Azis, A., Andrian, T. M., & Akhrianti, D. N. (2022). The REPowerEU: An EU climate ambitions and its implications on Russian-European energy geopolitics stability. *Journal of International Studies on Energy Affairs*, *3*(2), 152-165.

Bartholdsen, H.-K., Eidens, A., Löffler, K., Seehaus, F., Wejda, F., & Burandt, T. (2019). Pathways for Germany's low-carbon energy transformation towards 2050. *Energies*, *12*(15), Article 2988. https://doi.org/10.3390/en12152988

Beccarello, M., & Di Foggia, G. (2023). Meeting decarbonization targets: Techno-economic insights from the Italian scenario. *DeCarbon*, *2*, Article 100022. https://doi.org/10.1016/j.decarb.2023.100022

Bharti, M. S. (2025). EU energy security for sustainability and sustainable development: Post-COVID-19 challenges and green opportunities. In C. Popescu (Ed.), *Building inclusive global knowledge societies for sustainable development* (pp. 141-168). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-6298-3.ch007

Birkland, T. A. (1998). Focusing events, mobilization, and agenda setting. *Journal of Public Policy*, *18*(1), 53-74.

Bundesministerium für Wirtschaft und Klimaschutz (BMWK). (2024). *Aktualisierung des integrierten nationalen Energie- und Klimaplans der Bundesrepublik Deutschland (NECP) August 2024*. https://www.bmwk.de/

Burke, M. J., & Stephens, J. C. (2018). Political power and renewable energy futures: A critical review. *Energy Research & Social Science*, *35*, 78-93.

Cherp, A., & Jewell, J. (2014). The concept of energy security: Beyond the four As. *Energy Policy*, *75*, 415-421. https://doi.org/10.1016/j.enpol.2014.09.005

Clean Energy Wire. (2024, July 24). German govt adopts import strategy for green hydrogen. *Clean Energy Wire*. https://www.cleanenergywire.org/news/german-govt-adopts-import-strategy-green-hydrogen

Clean Energy Wire. (2023, April 25). Implementation of Germany's hydrogen plans lagging behind – report. *Clean Energy Wire*. https://www.cleanenergywire.org/news/implementation-germanys-hydrogen-plans-lagging-behind-report

Covenant of Mayors. (2024). *Multi-level governance frameworks for climate and energy transitions*. https://www.covenantofmayors.eu/

Ember. (2024). *European Electricity Review 2024*. Ember Climate. https://ember-energy.org/latest-insights/european-electricity-review-2024/

European Commission. (2022a). *REPowerEU Plan*. https://eur-lex.europa.eu/resource.html?uri=cellar:fc930f14-d7ae-11ec-a95f-01aa75ed71a1.0001.02/DOC_1&format=PDF

European Commission. (2024). *State of the Energy Union 2024*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52024DC0404

European Council. (2023). *Infographic: Where does the EU's gas come from?*https://www.consilium.europa.eu/en/infographics/eu-gas-supply/

European Parliament. (2023). *Energy transition in the EU*. https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/754623/EPRS_BRI(2023)754623_EN.pdf

Eurelectric. (2024). *Grids for Speed: Five recommendations for future proofing Europe's grids*. Eurelectric. https://powersummit2024.eurelectric.org/grids-for-speed/

Eurelectric. (2024). *Power Barometer 2024: Zeroing in on industrial electrification, energy security and decarbonisation*. Eurelectric. https://powerbarometer.eurelectric.org/

Eurelectric. (2024, July 3). Unlocking the power of flexibility. *Eurelectric Position Paper*. https://www.eurelectric.org/publications/eurelectric-letter-unlocking-the-power-of-flexibility/

Gross, S. (2025, March 11). Europe's messy Russian gas divorce. *Brookings Institution*. https://www.brookings.edu/articles/europes-messy-russian-gas-divorce/

Gross, S., & Bazilian, M. D. (2025, March 17). Navigating market and political uncertainties in the age of energy transition. *Brookings Institution*. https://www.brookings.edu/articles/navigating-market-and-political-uncertainties-in-the-age-of-energy-transition/

Hooghe, L., & Marks, G. (2001). *Multi-level governance and European integration*. Rowman & Littlefield Publishers.

IEA. (2024). *Germany 2024 Energy Policy Review*. International Energy Agency. https://www.iea.org/reports/germany-2024

IEA. (2025). *Germany Energy Security and Renewable Integration Assessment*. International Energy Agency. https://www.iea.org/

IEECP. (2023). *Multi-level governance challenges in European energy and climate policy implementation*. Institute for European Energy and Climate Policy.

IRENA. (2022). *Geopolitics of the energy transformation: The hydrogen factor*. International Renewable Energy Agency. https://www.irena.org/

Jerzyniak, T. (2024). The EU de-risking of energy dependencies: Towards a new clean energy geopolitical order? *Politics and Governance*. https://doi.org/10.17645/pag.8285

Kern, F., & Smith, A. (2008). Restructuring energy systems for sustainability? Energy transition policy in the Netherlands. *Energy Policy*, *36*(11), 4093-4103.

Kingdon, J. W. (1984). *Agendas, alternatives, and public policies*. Little, Brown and Company.

Ministero dell'Ambiente e della Sicurezza Energetica (MASE). (2024). *Piano nazionale integrato per l'energia e il clima (PNIEC) - Aggiornamento 2024*. https://www.mase.gov.it/

Odyssee-Mure. (2024). *Energy efficiency policies and measures database*. Odyssee-Mure. https://www.odyssee-mure.eu/

Panton, H., Schoenmaker, D., & van Tilburg, R. (2024). Green transition and energy security: Synergies and trade-offs. *Sustainable Finance Lab Working Paper*. https://www.sustainablefinancelab.nl/

Pathfinders. (2023). Energiewende: Germany's planned transition to a low-carbon, nuclear-free economy. *SDG16+*. https://www.sdg16.plus/policies/energiewende-germanys-planned-transition-to-a-low-carbon-nuclear-free-economy/

Prontera, A. (2023). Winter is coming: Russian gas, Italy and the post-war European politics of energy security. *West European Politics*, *47*(2), 251-276. https://doi.org/10.1080/01402382.2023.2225987

Prontera, A., & Lizzi, R. (2023). The necessary reorientation of Italian energy policy. *Contemporary Italian Politics*, *15*(2), 252-268. https://doi.org/10.1080/23248823.2023.2193462

Qi, J. (2023). An analysis of the energy crisis under the Ukraine conflict. *Advances in Economics, Management and Political Sciences*. https://doi.org/10.54254/2754-1169/46/20230328

Reuters. (2024, February 5). Germany outlines $17 billion plan to subsidise gas-to-hydrogen shift. *Reuters*. https://www.reuters.com/business/energy/germany-agrees-subsidy-plans-hydrogen-ready-gas-power-plants-2024-02-05/

Rinnovabili. (2024, April 12). PNIEC Italy: The 2030 targets on renewables and emissions. *Rinnovabili.it*. https://www.rinnovabili.net/policy-and-affairs/pniec-italy-the-2030-targets-on-renewables-and-emissions/

Rosslowe, M. (2024, January 24). Italy set new solar and wind records last year but is still off track for 2030, expert says. *Euronews*. https://www.euronews.com/green/2024/01/23/italy-set-new-solar-and-wind-records-last-year-but-is-still-off-track-for-2030-expert-says

Schwarz, F. (2024). Germany's aim of 80 percent renewables in electricity by 2030 'well within reach' -- minister. *Clean Energy Wire*. https://www.cleanenergywire.org/news/germanys-aim-80-percent-renewables-electricity-2030-well-within-reach-minister

Serri, L., Colle, L., & Vitali, D. (2024). Technical and economic challenges for floating offshore wind deployment in Italy and in the Mediterranean Sea. *WIREs Energy and Environment, 13(4), e533*. https://doi.org/10.1002/wene.533

Siddi, M., & Prandin, F. (2023). Governing the EU's energy crisis: The European Commission's geopolitical turn and its pitfalls. *Politics and Governance*, *11*(4), 286-296. https://doi.org/10.17645/pag.v11i4.7315

Szulecki, K. (2018). Conceptualizing energy democracy. *Environmental Politics*, *27*(1), 21-41.

The European House - Ambrosetti. (2024). *Floating Offshore Wind Community Strategic Report: Italy's potential in offshore wind*. The European House - Ambrosetti. https://www.ambrosetti.eu/en/our-communities/floating-offshore-wind-community/

UNDP. (2024). *Digital technologies for sustainable energy transition*. United Nations Development Programme. https://www.undp.org/

Uzma, N., Naz, U., & Rifat. (2024). Europe's energy security amid Russo-Ukraine war: Navigating the future by employing modified scenario building technique. *Pakistan Journal of International Affairs*. https://doi.org/10.52337/pjia.v7i3.1110

van Veelen, B., & van der Horst, D. (2018). What is energy democracy? Connecting social science energy research and political theory. *Energy Research & Social Science*, *46*, 19-28.

Vezzoni, R. (2023). Green growth for whom, how, and why? The REPowerEU Plan and the inconsistencies of European Union energy policy. *Energy Research & Social Science*. https://doi.org/10.1016/j.erss.2023.103134 von Malmborg, F., Lundqvist, L., & Eklund, M. (2023). Multi-level governance and energy transitions: Institutional capacity and scalar challenges. *Environmental Policy and Governance*, *33*(2), 145-162.

Watson Farley & Williams. (2025, April 10). Italian offshore wind – Status and recent developments. *Watson Farley & Williams.* https://www.wfw.com/articles/italian-offshore-wind-status-and-recent-developments/

Wettestad, J., Eikeland, P. O., & Nilsson, M. (2018). *EU climate and energy governance in times of crisis*. Palgrave Macmillan.

World Economic Forum. (2023). *Fostering effective energy transition 2023 edition*. World Economic Forum. https://www.weforum.org/