ECOLOGIC: JOURNAL OF ENVIRONMENTAL AND POLICY STUDIES
E-ISSN: 3123-3597 | Volume 1 No 1 2026

Navigating Geopolitics and Economic Complexity in Global Energy Transitions

Assel K. Zholdasbayeva[1]
Department of Economics and Public Policy, Al-Farabi Kazakh National University, Almaty, Kazakhstan
Corresponding Author Email: a.zholdasbayeva@kaznu.kz

Abstract
The global shift toward sustainable energy is increasingly hampered by entrenched socio-political resistance and institutional legacies within advanced industrial economies. Despite rapid technological advancements, the transition remains uneven due to the persistence of fossil-centric infrastructure and complex political-economic dependencies. This study aims to evaluate how institutional commitment and structural path dependencies influence the effectiveness of energy transition policies in G20 and OECD nations. Adopting a qualitative research design, the study utilizes a literature-based approach relying exclusively on the synthesis of secondary data. The analytical framework is rooted in a geographical political economy perspective to examine the multidimensional nature of energy landscapes. Data were collected from high-impact peer-reviewed journals and comprehensive policy reports, utilizing thematic categorization to map variables across institutional, economic, and technological dimensions. The results indicate that high-quality governance and strong environmental compliance are primary catalysts for transition, yet their impact is frequently neutralized by geopolitical risks and social imbalances. The study concludes that a successful structural energy transition requires a profound reconfiguration of the state-market relationship rather than purely technocratic fixes. This research contributes to the field by providing a nuanced socio-political framework that fills the gap between high-level climate rhetoric and ground-level institutional implementation.

Keyword
Energy Transition; Political Economy; Institutional Governance; Sustainable Development.

1. Introduction
Advanced economies have historically served as the primary engines of global industrialization, albeit at the cost of significant environmental degradation (Hou et al., 2020). Consequently, these nations have increasingly committed to international environmental agreements to mitigate the adverse effects of climate change (Falcone, 2020). Nevertheless, the actual shift toward sustainable energy remains a complex and inconsistent process across the industrialized world (Kuzemko et al., 2019). Structural dependence on fossil fuels continues to dominate the economic landscape of many high-income countries (Bridge & Gailing, 2020). This persistent reliance indicates that the energy transition is far more than a technical problem to be solved with new technology alone (Lockwood, 2016). Instead, it involves deep-seated political and economic transformations that challenge the status quo of established energy regimes (Bashir et al., 2023). The transition toward a low-carbon economy necessitates a fundamental

Received: 12 Oct 2026 Revised: 10 Dec 2026 Published: 4 March 2026

reorganization of industrial and power structures (Bakhsh et al., 2024). Thus, the energy transition is increasingly recognized as a structural challenge influenced by a variety of institutional and economic factors (Svobodova et al., 2020).

A significant dilemma exists in the growing disconnect between formal institutional commitments and the actual structural transformation of energy systems. While advanced economies frequently ratify environmental protocols, the domestic implementation of these goals often lags behind established targets. The central research problem focuses on how institutional mandates interact with the rigid economic structures of fossil-fuel-dependent nations. There is an inherent tension between high-level policy objectives and the practical realities of industrial sectors that rely on carbon-intensive energy. This friction is particularly pronounced when fossil fuel interests are deeply integrated into the political and economic fabric of a nation. Investigating whether international agreements can effectively disrupt these entrenched systems is critical for understanding future energy trajectories. Without such an inquiry, the risk remains that institutional signals will fail to generate the necessary structural shifts in the energy landscape. Therefore, analyzing the relationship between governance signals and economic rigidities is a vital step toward achieving global climate targets.

Existing research has identified numerous determinants that play a role in the adoption of renewable energy technologies (Bashir et al., 2023). Environmental governance and economic complexity have been shown to facilitate the transition to greener energy systems (Bakhsh et al., 2024). Furthermore, technological innovation and the expansion of renewable sources significantly mitigate environmental pollution in G-20 countries (Han et al., 2025). Economic freedom, trade openness, and digitization are also cited as positive influences on renewable energy consumption (Qamruzzaman, 2025). It is also established that environmental compliance and energy innovation are essential for reducing the dominance of fossil fuels (Bashir et al., 2023). However, industrialized nations continue to face challenges such as high costs and the persistent growth of carbon emissions (Hou et al., 2020). Historical institutionalism provides a framework for understanding how past policy decisions create path dependencies in the energy sector (Lockwood, 2016). Research further suggests that high-emission countries must navigate difficult trade-offs between economic viability and environmental security (Svobodova et al., 2020). Institutional factors, economic conditions, and social dynamics are all recognized as critical components of the global energy transition (Falcone, 2020).

Despite these findings, there is a lack of clarity regarding the specific political economy mechanisms that govern energy restructuring. It remains unknown how international institutional commitments are domesticated to overcome the influence of fossil fuel interests. The precise conditions under which governance signals translate into tangible structural reforms in the energy sector are not fully understood. Scholars have yet to explain the wide variance in transition performance among nations with comparable institutional obligations. The interaction between a state's fiscal capacity and its political resolve to phase out fossil fuels remains a largely unexplored area. Furthermore, the role of economic power restructuring during the transition process has not been adequately addressed in current literature. There is a need to understand the internal processes that either facilitate or block the implementation of green policies at the domestic level. Addressing these uncertainties is essential for developing a more comprehensive theory of structural energy transitions.

Identification of several research gaps reveals a need for a more integrated approach to studying energy transitions. First, many studies focus on the drivers of renewables without treating the transition as a fundamental change in economic power.

Second, institutional commitment is often analyzed as a static variable, which overlooks the complex political processes within domestic structures. This simplification prevents a deeper understanding of how political-economic factors shape the effectiveness of environmental treaties. Third, there is a scarcity of research that synthesizes institutional commitment, fossil fuel dependence, and economic capacity in a single analysis. Most existing literature examines these three factors in isolation, missing the critical interactions between them. As a result, there is no holistic framework that describes how these variables together influence the speed of decarbonization. Bridging these gaps is necessary to create a more realistic model of the structural challenges facing advanced economies.

Filling these identified research gaps is justified by the need to move beyond simple statistical correlations toward an understanding of structural change. A literature-based study using a political economy lens can provide the necessary depth to explain the slow pace of transition. This research is important because it highlights the systemic barriers that qualitative and quantitative models often fail to capture. By focusing on the restructuring of power, the study accounts for the political dynamics that often stall environmental progress. Moreover, a comprehensive synthesis provides a clearer pathway for policymakers to address the rigidities of fossil-fuel-based economies. Understanding the enabling conditions of innovation and fiscal capacity is essential for ensuring that transitions are economically sustainable. This study therefore provides a valuable theoretical framework for analyzing the disconnect between climate policy and industrial reality. Ultimately, this approach is necessary for formulating more effective strategies to achieve meaningful energy transformation.

This research aims to examine the relationship between institutional commitments and structural energy transitions in fossil-fuel-dependent economies. One specific objective is to determine how international governance signals impact the domestic political and economic landscape. The study also seeks to evaluate the role of innovation and fiscal capacity as catalysts for structural change in the energy sector. Another goal is to analyze how path dependence on fossil fuels acts as a primary constraint against renewable energy adoption. The research will explore the negotiation process between carbon-intensive industries and national environmental mandates. Furthermore, it aims to synthesize existing empirical evidence to provide a comprehensive political economy interpretation of these transitions. The study intends to map the various enabling and disabling factors that influence the speed of the transition process. These objectives are designed to provide a cohesive understanding of the structural barriers to decarbonization in advanced economies.

The urgency of this research is driven by the immediate need for advanced economies to meet their global climate commitments. As major historical contributors to global emissions, these nations bear a primary responsibility for leading the energy transition. This study contributes to the field by providing a thematic synthesis that integrates political, economic, and institutional perspectives. It offers a new interpretation of empirical findings by focusing on the structural and power-related aspects of energy shifts. The research helps clarify the specific conditions under which institutional commitment leads to actual policy success. By highlighting the interdependencies of innovation and fiscal capacity, it provides a practical guide for future policy development. Furthermore, the findings will assist international bodies in refining their governance strategies to ensure better compliance from member states. Ultimately, this work contributes to the global effort to achieve a sustainable and low-carbon future for the next generation.

2. Research Method

This research utilizes a qualitative research design based on a literature review approach that relies exclusively on the synthesis of secondary data (Ruggiano & Perry, 2017). The analytical framework is rooted in a geographical political economy perspective, which facilitates a multi-dimensional examination of energy landscapes and the legacies of industrial infrastructure (Bridge & Gailing, 2020). A qualitative approach is justified because the transition from fossil-centric to renewable systems is a complex socio-political process involving entrenched power dynamics and institutional path dependencies that cannot be captured by statistics alone (Azungah, 2018; Lockwood, 2016). This design is effective for the current study as it allows the researcher to move beyond numerical correlations to understand the underlying mechanisms of policy effectiveness and structural resistance through the interpretation of existing empirical evidence (Bashir et al., 2023).

The primary data sources for this investigation comprise high-impact, peer-reviewed journal articles and comprehensive reports focusing on energy transition drivers within major industrialized economies (Hou et al., 2020). Data collection was conducted through targeted searches of academic databases, prioritizing studies that evaluate environmental governance, economic complexity, and fossil fuel cost dynamics (Bakhsh et al., 2024). The units of analysis are predominantly G20 and OECD member states, chosen for their significant roles in global energy demand and climate policy formulation (Han et al., 2025). The analytical instruments utilized include a thematic categorization matrix where variables are mapped across dimensions of institutional commitment, economic capacity, and technological innovation (Kiger & Varpio, 2020; Qamruzzaman, 2025). This systematic approach facilitates a comparative analysis of how different high-emission countries balance economic viability with environmental security requirements (Svobodova et al., 2020).

Validity and trustworthiness are ensured through the triangulation of diverse literature sources and the application of a consistent analytical strategy across all selected texts (Farquhar et al., 2020). Reliability is maintained by utilizing established empirical findings from reputable international journals, ensuring that the synthesis is built upon a high-quality and verified data foundation (Hou et al., 2020). The credibility of the research is further bolstered by aligning thematic interpretations with existing theoretical constructs in political economy and historical institutionalism (Bridge & Gailing, 2020). Ethical considerations are integrated throughout the research process, primarily through the rigorous application of APA Style 7 for all citations and references to ensure academic integrity (Cheong et al., 2023). While direct informed consent is not required for a study based on secondary data (Ruggiano & Perry, 2017), the researcher maintains high ethical standards by ensuring objective reporting of all reviewed literature and avoiding the selective use of data. This commitment to research integrity ensures that the study provides a reliable and ethically sound perspective to the global discourse on structural energy transitions.

3. Result and Discussion

3.1 The Political Economy of Structural Energy Transitions: Institutional Constraints and Economic Path Dependencies

The analytical inquiry into structural energy transitions is fundamentally framed by the lens of historical institutionalism and geographical political economy, which posits that energy landscapes are not merely technical arrangements but products of entrenched

power relations and institutional legacies. By utilizing the conceptual dimensions of institutional commitment and path dependency, this analysis evaluates how the "lock-in" of fossil fuel infrastructure creates a structural resistance that complicates the shift toward renewable systems. Historical institutionalism provides a crucial framework for understanding these politics, offering insights into how existing institutional configurations either facilitate or delay sustainable energy transitions (Lockwood et al., 2017). Furthermore, geographically differentiated political economies are essential to understanding the diverse pathways to decarbonization and how existing local geographies impact emission reduction efforts (Bridge & Gailing, 2020). The role of global governance institutions and the state must be reconsidered through an international political economy lens to transform orthodox understandings of energy processes (Newell, 2018). Consequently, the interpretation of findings explores the friction between emerging environmental mandates and the resilient logic of industrial-era economic structures. Strong political institutions and civil society participation are identified as significant contributors to the acceleration of these transitions in top-polluting economies (Omri & Ben Jabeur, 2024). This theoretical framing ensures that the analysis remains conceptually grounded in the socio-political complexities of energy governance.

Empirical evidence indicates that in many advanced economies, the trajectory of the energy transition is heavily dictated by the historical reliance on carbon-intensive industries, which has created a sophisticated web of economic and political interdependencies. National institutions and technology life cycles jointly influence transition pathways, often shaping the slow phasing out of fossil fuel-based technologies in favor of low-carbon alternatives (Rentier, 2025). Research suggests that while technological innovation has significantly lowered the cost of renewable energy, the sheer scale of existing fossil fuel assets presents a formidable barrier to rapid decarbonization. This institutional inertia is often reinforced by domestic political coalitions that prioritize short-term economic stability and energy security over long-term environmental sustainability. High-emission nations frequently face severe trade-offs between maintaining economic viability and achieving climate security targets (Svobodova et al., 2020). The transition involves a delicate balance of ensuring energy access and affordability while simultaneously reducing environmental impacts (Genc & Kosempel, 2023). Analysis reveals that countries with decentralized energy governance often face different challenges compared to those with centralized mandates. The findings demonstrate that the "stickiness" of institutional arrangements often slows the implementation of carbon pricing and other market-based instruments designed to disincentivize fossil fuel use.

The transition process is further complicated by the divergent economic capacities of states to absorb the costs associated with decommissioning old infrastructure while simultaneously investing in a new, smart grid. Environmental governance and economic complexity generally impact energy transition positively, yet the introduction of geopolitical risks can transform these positive influences into significant challenges (Bakhsh et al., 2024). Secondary data analysis highlights a significant correlation between a state's level of economic complexity and its ability to foster green innovation, though the outcomes remain varied across different OECD contexts (Wu & Hussain, 2025). Even high-capacity states struggle with the socio-economic fallout in regions traditionally dependent on coal or gas extraction. The narratives within current policy reports suggest that the "just transition" framework is often invoked as a discursive tool, yet institutional commitment frequently lacks the fiscal depth required. In the G7 economies, government expenditures and traditional taxation revenues have been found to hinder the energy

transition, whereas renewable energy development facilitates it (Bashir et al., 2023). As a result, the transition remains uneven, characterized by isolated "green islands" of innovation within broader landscapes of industrial stagnation. This suggests that the primary obstacle is the absence of institutional mechanisms capable of breaking the political-economic cycle of fossil fuel dependency.

The interaction between global climate regimes and domestic institutional frameworks reveals a tension between international environmental compliance and the protection of national industrial competitiveness. Evidence shows that while international agreements provide a normative direction, the actual pace of transition is governed by the "domestic filter" of national political economy. In several advanced economies, environmental regulations are often subverted through lobbying efforts by entrenched industrial actors who benefit from the status quo. Research and development investment plays a leading role in promoting renewable energy consumption, particularly where environmental pressure is applied effectively in high-income countries (Wang et al., 2020). This highlights a critical gap between high-level policy rhetoric and the ground-level reality of regulatory capture. Governance quality is a critical factor, as it enhances the positive impacts of transition drivers while social imbalances tend to dampen them (Sinha et al., 2023). The analysis further suggests that the integration of renewable energy into the national grid is as much a challenge of reforming electricity market designs as it is a challenge of installing hardware. Ultimately, environmental compliance and innovation are the primary facilitators of transition in industrialized economies (Bashir et al., 2023).

Furthermore, the data points to a growing contradiction between the pursuit of environmental security and the maintenance of short-term economic viability in high-emission nations. While technological advancements are promising, these innovations are often marginalized within institutional frameworks that prioritize base-load stability provided by traditional sources. Technological innovation significantly boosts renewable energy adoption and reduces emissions across G20 countries, promoting long-term sustainability (Han et al., 2025). The research identifies that institutional commitment is frequently reactive rather than proactive, often responding to exogenous shocks. Environmental policy stringency and energy transitions together significantly reduce greenhouse gas emissions, highlighting the need for more integrated climate action (Fatima et al., 2024). Strengthening climate action through resilient environmental policies is essential for OECD countries to move from crisis management to long-term sustainability (Ma et al., 2023). This pattern of "crisis-driven" transition underscores the fragility of current energy governance systems and the difficulty of maintaining policy coherence. The result is a fragmented transition process that lacks necessary integration between environmental goals and industrial policy.

Critical interpretation of these findings suggests that the current research extends existing theories of path dependency by demonstrating that institutional lock-in is a deeply political phenomenon. This study confirms the assertions regarding the resilience of fossil fuel regimes while refining the understanding of how economic and trade freedoms influence renewable energy consumption (Qamruzzaman, 2025). By explaining the contextual dynamics of G20 and OECD energy governance, the findings reveal that high institutional capacity does not automatically translate into effective transition without dismantling legacy power structures. This analysis directly addresses the identified research gap by moving beyond simple barrier identification to examining the institutional mechanisms of resistance. Many G20 nations are progressing toward a green economy, yet they require further technological innovations to truly transform from

"brown" to "green" economic structures (Shah et al., 2023). Barriers such as economic dependence on fossil fuels and a lack of political will continue to hinder progress despite the implementation of transition policies (Gribkova & Milshina, 2022). This study contributes to filling the empirical gap by synthesizing how institutional commitment is filtered through pre-existing economic complexities.

Ultimately, the findings challenge the optimistic view that market forces and technological innovation alone will drive a smooth transition, suggesting instead that a profound restructuring of the state-market relationship is required. The contribution of this research lies in its synthesis of how institutional commitment is filtered through pre-existing economic complexities, providing a more nuanced explanation for the uneven success of climate policies. By filling the theoretical gap regarding the socio-political "friction" of transitions, the study emphasizes that the future of energy landscapes depends on reforming the institutional architectures of the modern industrial state. Energy transitions in major industrialized countries face persistent challenges like high costs and emissions, necessitating better inter-governmental experience sharing (Hou et al., 2020). The research provides a critical foundation for future studies to examine specific conditions under which institutional path dependency can be broken. This synthesis underscores that achieving a sustainable political economy requires more than just technical fixes; it requires a systemic reconfiguration of political priorities. By addressing these gaps, the research offers a robust framework for navigating the complexities of global energy governance in the 21st century.

3.2 The Interplay of Geopolitics, Economic Complexity, and Environmental Governance

The analytical examination of structural energy transitions must be contextualized within the volatile nexus of global geopolitics and domestic economic structures. This section is theoretically framed by the concept of "geopolitical risk" and its capacity to act as a significant intervening variable that disrupts the linear progress of environmental governance. While economic complexity typically serves as a catalyst for green innovation, the introduction of geopolitical instability can fundamentally reconfigure this relationship, often transforming a nation's technological sophistication from an asset into a strategic vulnerability. By employing the principle of "geographically differentiated political economies," this analysis clarifies how external systemic shocks interact with internal industrial capacities to dictate the velocity of decarbonization. Consequently, the following narrative explores how the strategic imperative of energy security often clashes with the normative goals of climate sustainability, particularly in advanced industrialized nations.

The relationship between a state's economic architecture and its transition potential is deeply nuanced, as evidenced by the varying impacts of economic complexity across OECD member states. Empirical findings suggest that while environmental governance generally exerts a positive influence on the shift toward renewables, high levels of economic complexity do not always guarantee a seamless transition (Wu & Hussain, 2025). In contexts characterized by high geopolitical tension, the strategic value of existing energy assets may be prioritized, leading to a temporary stagnation in renewable deployment. Research indicates that geopolitics can effectively neutralize the benefits of economic sophistication, sometimes even reversing the positive trajectory of energy innovation (Bakhsh et al., 2024). This phenomenon suggests that the "rational" economic path toward low-carbon systems is frequently subverted by the "irrational" necessities of state survival and resource competition.

The empirical data highlights that for many G20 nations, the pursuit of energy innovation is inextricably linked to their position within the global trade hierarchy. Economic freedom and trade liberalization have been shown to positively influence renewable energy consumption, but these benefits are contingent upon a stable international order (Qamruzzaman, 2025). When global supply chains for critical minerals or energy components are weaponized, even the most institutionally committed states may retreat toward legacy energy sources to ensure short-term grid stability. This highlights a critical tension where the "global" logic of climate action is filtered through the "national" logic of strategic autonomy. Analysis reveals that environmental compliance becomes a secondary priority when a state perceives an existential threat to its industrial output or energy sovereignty.

Furthermore, the findings suggest that the integration of environmental governance within national policy frameworks is often unevenly distributed across different economic sectors. In advanced economies, the manufacturing and high-tech sectors may lead in green innovation, yet the overall national transition remains hampered by fossil fuel dependencies that are guarded by powerful political-economic blocs. While environmental policy and energy transitions have been proven to reduce climate change impacts effectively, non-environmental factors such as rapid GDP growth and foreign direct investment can paradoxically accelerate carbon emissions (Ma et al., 2023). This suggests that without a robust institutional "guardrail" to align economic growth with ecological limits, the transition process remains vulnerable to the cyclical fluctuations of the global market.

The data also points to a significant divergence in how high-emission and low-emission nations manage the trade-offs between economic viability and climate security. Nations with high CO2 outputs often face a "complexity trap," where their deeply integrated fossil-centric systems require a more radical—and thus more politically risky—structural overhaul compared to their less developed counterparts (Svobodova et al., 2020). The findings indicate that in these high-emission settings, environmental policy stringency must be paired with specific institutional reforms to be effective. Integrated climate action policies are essential for OECD countries to ensure that the transition to a sustainable environment does not compromise their economic competitiveness (Fatima et al., 2024). This complexity underscores the necessity of moving beyond a "one-size-fits-all" approach to global energy governance.

Critical interpretation of these findings suggests that the current research refines the "green growth" hypothesis by demonstrating that technological and economic capacity are insufficient without a stable geopolitical environment. This study challenges prior empirical models that ignore the "geopolitical filter," showing instead that external shocks can derail even the most sophisticated environmental governance systems. By explaining the contextual dynamics of OECD and G20 energy policies, the analysis reveals that the transition is a non-linear process characterized by frequent setbacks and strategic realignments. This discussion directly addresses the theoretical gap regarding the "friction" between global energy security and environmental sustainability, emphasizing that energy policy is a subset of broader national security strategies.

Ultimately, these results confirm that a state's ability to transition is not merely a function of its "green" commitment but of its capacity to navigate the complexities of a fragmented global order. The contribution of this research lies in its synthesis of how economic complexity and geopolitical risk interact to shape the boundaries of the possible in energy governance. By filling the empirical gap concerning the strategic dimensions of transitions, the study posits that future climate policy must incorporate "geopolitical

resilience" as a core pillar. This perspective shifts the focus from purely technical or economic solutions toward a more holistic understanding of energy as a central theme in the contemporary political economy. The findings provide a robust basis for understanding why some advanced economies succeed in decarbonizing while others remain trapped in carbon-intensive trajectories despite possessing the necessary technological tools.

3.3 Social Imbalances, Governance Quality, and the "Just Transition" Framework

The transition to a sustainable energy regime is not merely an economic or technological shift but a profound social restructuring that is theoretically framed by the imperatives of distributive justice and institutional quality. This analysis utilizes the conceptual indicators of "social imbalance" and "governance quality" to interpret how socio-economic disparities can either obstruct or facilitate the implementation of climate policies. The theoretical prologue suggests that the effectiveness of energy transition drivers is heavily contingent upon the social stability and institutional integrity of the state; specifically, high-quality governance is required to mitigate the friction caused by social inequality. Consequently, the following discussion examines the empirical reality that social imbalances often act as a "dampening" force on transition efforts, necessitating a governance model that integrates social equity with environmental mandates.

Empirical evidence from advanced economies indicates that social imbalances significantly impede the positive impacts of energy transition drivers, particularly within the OECD context. Findings suggest that when segments of the population are economically marginalized or excluded from the benefits of green growth, political resistance to carbon-intensive phase-outs intensifies. Analysis reveals that governance quality plays a mediating role; nations with high levels of transparency and civil society participation are better equipped to navigate the socio-political challenges of decarbonization (Sinha et al., 2023). Conversely, in settings where governance is weak, the transition is often perceived as an elitist project, leading to "trasformismo" where radical environmental goals are diluted to preserve the status quo of the prevailing political economy (Newell, 2018). The data implies that the technical success of a transition is inseparable from its social legitimacy.

The pursuit of a "just transition" is further challenged by the internal dynamics of political institutions and the influence of the financial sector. Strong political institutions, characterized by robust corruption control and democratic participation, have been shown to significantly accelerate the adoption of renewable energy in the world's leading economies (Omri & Ben Jabeur, 2024). However, the findings also highlight that in many G20 nations, social imbalances create a fertile ground for regulatory capture, where entrenched fossil fuel interests exploit social anxieties to maintain institutional lock-in. Secondary data indicates that without a concurrent focus on social welfare and equitable resource distribution, environmental policy stringency can lead to regressive economic outcomes for vulnerable communities. This underscores the necessity of a governance framework that prioritizes "inclusive" institutional commitment over purely market-driven approaches.

Furthermore, the research identifies a critical intersection between financial development and institutional control. While the expansion of the green finance sector is essential for funding the transition, its efficacy is limited if the underlying political institutions are unresponsive to social demands. Evidence suggests that environmental policy and energy transitions are most effective at reducing climate impacts when they

are supported by a stable and high-quality governance environment (Ma et al., 2023). In many cases, the findings show that social imbalances lead to a lack of political will, as governments fear the electoral consequences of rising energy costs or industrial displacement. This pattern of institutional hesitation is particularly evident in high-emission economies where the trade-off between short-term social stability and long-term environmental security is most acute (Svobodova et al., 2020).

Critical interpretation of these findings suggests that this research extends existing theories by identifying "governance quality" as the primary determinant of whether social imbalances will derail climate action. This study confirms that purely technical or economic solutions are insufficient if they ignore the social fabric of the state, thereby refining the "Just Transition" discourse to include specific institutional indicators such as corruption control and democratic accountability. By explaining the contextual dynamics of OECD and G20 nations, the findings reveal that social equity is not just a moral goal but a functional requirement for structural energy transitions. This discussion directly addresses the identified gap regarding the socio-political "friction" of transitions, explaining why high-capacity states often struggle with implementation when social trust is low.

Ultimately, these results challenge the notion that energy transition is a neutral administrative process, asserting instead that it is a deeply political struggle over the distribution of costs and benefits. The contribution of this research lies in its synthesis of how social and institutional variables interact to shape the boundaries of environmental policy effectiveness. By filling the empirical gap concerning the role of governance quality, the study posits that the future of sustainable energy landscapes depends on the state's ability to manage social imbalances through inclusive institutional reform. This analysis suggests that the most successful transitions will be those that integrate social justice into the core of their industrial policy. These findings provide a robust framework for policymakers to understand that the path to a low-carbon future must be paved with both institutional integrity and social equity.

3.4 Synthesis of Comparative Trajectories: G20 and OECD Governance in Structural Energy Transitions

This concluding subsection integrates previous findings through a comparative lens to evaluate how distinct institutional configurations yield diverse transition outcomes. Theoretically, this section is framed by the principles of "policy learning" and "regulatory convergence," asserting that transition success depends not only on domestic resources but also on a state's ability to adopt best practices from international peers (Hou et al., 2020). Through the dimensions of institutional commitment and environmental compliance, this analysis clarifies why some advanced economies successfully align economic growth with decarbonization, while others remains trapped in the dilemma between energy security and climate targets (Bashir et al., 2023). Consequently, the following narrative synthesizes empirical data into functional categories to demonstrate how political-economic variables interact systemically on a global scale.

Secondary data reveals significant divergence between the transition trajectories of G20 and OECD nations based on their levels of institutional "rigidity." Research findings suggest that in countries characterized by high levels of economic freedom and digitalization, the adoption of renewable energy tends to be more rapid, driven by dynamic private sector innovation (Qamruzzaman, 2025). Conversely, in nations with a heavy fiscal reliance on fossil fuel revenues, government expenditures often act as a barrier due to implicit subsidies that maintain the dominance of conventional energy

(Bashir et al., 2023). This indicates that policy instruments alone are insufficient without structural reforms to national economic incentive systems.

To provide a comprehensive overview of these dynamics, the table below summarizes the core arguments regarding the interaction between political-economic variables and transition outcomes based on the literature synthesis:

Table 1. Analytical Framework of Institutional and Economic Drivers in Structural Energy Transitions.

Analytical Dimension	Political Economy Argument	Impact on Energy Transition
Innovation Capacity	Technological innovation and digitalization accelerate green energy distribution efficiency.	Significantly reduces environmental pollution and increases renewable energy adoption.
Institutional Strength	Governance quality (corruption control, democracy) determines the efficacy of climate regulations.	Accelerates transition by minimizing bureaucratic hurdles and fossil-elite resistance.
Policy Stringency	Strict environmental standards compel industries to diversify their energy sources.	Consistent reduction of greenhouse gas emissions across OECD nations.
Fiscal Barriers	High government spending on traditional energy subsidies hinders new investments.	Creates economic "lock-in" that slows the market penetration of clean energy.

Source: Processed by the author based on literature synthesis (2026)

This comparative analysis confirms that energy transitions in major industrialized economies face common challenges of high initial costs and path dependency. Empirical evidence shows that despite global commitments through international agreements, national implementation remains heavily influenced by "domestic filters" in the form of sectoral economic interests (Hou et al., 2020). In high-emission countries, there is a clear contradiction between pursuing short-term GDP growth and long-term environmental security requirements (Svobodova et al., 2020). This reinforces the argument that structural energy transitions require more than technical innovation; they necessitate a political consensus capable of redistributing the costs of transition equitably.

A critical interpretation of these findings suggests that this research extends historical institutionalism theories by showing that policy learning between nations is often obstructed by geopolitical interests. The study confirms that transparency and governance quality are absolute prerequisites for the success of market-based instruments such as carbon taxes or emissions trading. By explaining the governance dynamics in the G20 and OECD, these findings reveal that policy convergence toward a green economy can only occur if these nations address internal social imbalances. This discussion directly addresses the literature gap regarding why high economic capacity does not always correlate linearly with the speed of decarbonization.

As a final contribution, this analysis offers a deeper understanding of the crucial role of the financial sector in funding sustainable transitions. Data suggests that financial sector development, combined with political stability, is a primary driver for accelerating transitions in major polluting economies (Omri & Ben Jabeur, 2024). However, the efficacy of this capital remains dependent on the ability of national institutions to manage shifting geopolitical risks. Therefore, the future success of structural energy transitions will heavily depend on the integration of technology policy, social justice, and institutional stability as a coherent whole.

Ultimately, these findings challenge technocratic views that oversimplify energy transition as merely a matter of hardware installation. Instead, this research asserts that transition is a total overhaul of the relationship between the state, the market, and society. The primary contribution of this study lies in its synthesis showing that non-technical variables, such as governance and geopolitics, carry equal weight to technological efficiency in determining the future of the global energy landscape. By filling the theoretical gap regarding socio-political "friction," this research provides a robust foundation for future studies to explore more adaptive and inclusive governance models in the era of climate crisis.

4. Conclusion

The synthesis of findings indicates that structural energy transitions in advanced economies are predominantly governed by the tension between institutional path dependencies and emerging environmental mandates. This research has demonstrated that while technological innovation and economic complexity provide the necessary tools for decarbonization, their efficacy is frequently undermined by geopolitical risks, social imbalances, and entrenched fossil fuel "lock-ins." The analysis reveals that high-quality governance—characterized by robust corruption control and democratic participation—acts as a critical mediator in translating climate policy into tangible emission reductions. Furthermore, the comparative trajectory of G20 and OECD nations underscores that the transition is a non-linear process, where the "domestic filter" of national political economy often prioritizes short-term economic stability and energy security over long-term sustainability goals.

This study contributes to the field of geographical political economy by refining the understanding of the "friction" inherent in systemic energy shifts. By moving beyond a purely technocratic or market-driven analysis, the research provides a nuanced framework that integrates social equity and governance quality as core pillars of the "Just Transition" discourse. The primary theoretical contribution lies in the identification of how external geopolitical shocks interact with internal institutional rigidities to create unique barriers to decarbonization in industrialized states. Empirically, the study fills a critical gap by synthesizing fragmented secondary data into a coherent narrative that explains why high economic capacity does not automatically correlate with rapid structural change. This provides scholars and practitioners with a more robust lens through which to evaluate the socio-political feasibility of global climate commitments.

Moving forward, future research should prioritize the longitudinal examination of how specific "green" institutional reforms survive shifts in political leadership and economic cycles. There is a pressing need for more granular case studies on the sub-national level to understand how regional industrial identities influence national transition coherence. Additionally, future inquiries should investigate the evolving role of digital infrastructure and artificial intelligence in mitigating the technical barriers of renewable integration while accounting for the new political-economic dependencies these technologies may create. Research into the intersection of global financial regulation and domestic environmental policy will also be essential to ensure that capital flows are effectively aligned with structural de-risking strategies. Ultimately, bridging the gap between high-level policy rhetoric and ground-level implementation remains the most urgent frontier for both academic inquiry and global climate action.

References

Assarroudi, A., Nabavi, F. H., Armat, M., Ebadi, A., & Vaismoradi, M. (2018). Directed qualitative content analysis: The description and elaboration of its underpinning methods and data analysis process. *Journal of Research in Nursing*, *23*(1), 42–55. https://doi.org/10.1177/1744987117741667.

Azungah, T. (2018). Qualitative research: Deductive and inductive approaches to data analysis. *Qualitative Research Journal*, *18*(4), 383–400. https://doi.org/10.1108/qrj-d-18-00035.

Bakhsh, S., Zhang, W., Ali, K., & Oláh, J. (2024). Strategy towards sustainable energy transition: The effect of environmental governance, economic complexity and geopolitics. *Energy Strategy Reviews*, *52*, 101330. https://doi.org/10.1016/j.esr.2024.101330.

Bashir, M. F., Rao, A., Sharif, A., Ghosh, S., & Pan, Y. (2023). How do fiscal policies, energy consumption and environmental stringency impact energy transition in the G7 economies: Policy implications for the COP28. *Journal of Cleaner Production*, *434*, 140367. https://doi.org/10.1016/j.jclepro.2023.140367.

Bashir, M. F., Shahbaz, M., Ma, B., & Alam, K. (2023). Evaluating the roles of energy innovation, fossil fuel costs and environmental compliance towards energy transition in advanced industrial economies. *Journal of Environmental Management*, *348*, 119709. https://doi.org/10.1016/j.jenvman.2023.119709.

Bridge, G., & Gailing, L. (2020). New energy spaces: Towards a geographical political economy of energy transition. *Environment and Planning A: Economy and Space*, *52*(6), 1037–1050. https://doi.org/10.1177/0308518x20939570.

Cheong, H., Lyons, A., Houghton, R., & Majumdar, A. (2023). Secondary qualitative research methodology using online data within the context of social sciences. *International Journal of Qualitative Methods*, *22*. https://doi.org/10.1177/16094069231180160.

Elbardan, H., & Kholeif, A. (2017). *An interpretive approach for data collection and analysis*. Springer. https://doi.org/10.1007/978-3-319-54990-3_5.

Farquhar, J., Michels, N., & Robson, J. (2020). Triangulation in industrial qualitative case study research: Widening the scope. *Industrial Marketing Management*, *87*, 160–170. https://doi.org/10.1016/j.indmarman.2020.02.001.

Fatima, N., Xuhua, H., Alnafisah, H., Zeast, S., & Akhtar, M. R. (2024). Enhancing climate action in OECD countries: The role of environmental policy stringency for energy transitioning to a sustainable environment. *Environmental Sciences Europe*, *36*(1), 1–18. https://doi.org/10.1186/s12302-024-00978-7.

Genc, T., & Kosempel, S. (2023). Energy transition and the economy: A review article. *Energies*, *16*(7), 2965. https://doi.org/10.3390/en16072965.

Gribkova, D., & Milshina, Y. (2022). Energy transition as a response to energy challenges in post-pandemic reality. *Energies*, *15*(3), 812. https://doi.org/10.3390/en15030812.

Han, S., Peng, D., Guo, Y., Aslam, M., & Xu, R. (2025). Harnessing technological innovation and renewable energy and their impact on environmental pollution in G-20 countries. *Scientific Reports*, *15*, 85182. https://doi.org/10.1038/s41598-025-85182-0.

Hou, J., Ruoyu, Z., Liu, P., & Lyuyang, Z. (2020). A review and comparative analysis on energy transition in major industrialized countries. *International Journal of Energy Research*, *44*(15), 11110–11130. https://doi.org/10.1002/er.5866

Kiger, M. E., & Varpio, L. (2020). Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*, *42*(8), 846–854. https://doi.org/10.1080/0142159x.2020.1755030

Lockwood, M., Kuzemko, C., Mitchell, C., & Hoggett, R. (2017). Historical institutionalism and the politics of sustainable energy transitions: A research agenda. *Environment and Planning C: Politics and Space*, *35*(2), 312–333. https://doi.org/10.1177/0263774x16660561.

Ma, R., Abid, N., Yang, S., & Ahmad, F. (2023). From crisis to resilience: Strengthening climate action in OECD countries through environmental policy and energy transition. *Environmental Science and Pollution Research*, *30*, 1–15. https://doi.org/10.1007/s11356-023-29970-z.

Newell, P. (2018). Trasformismo or transformation? The global political economy of energy transitions. *Review of International Political Economy*, *26*(1), 1–23. https://doi.org/10.1080/09692290.2018.1511448.

Omri, A., & Ben Jabeur, S. (2024). Climate policies and legislation for renewable energy transition: The roles of financial sector and political institutions. *Technological Forecasting and Social Change*, *200*, 123347. https://doi.org/10.1016/j.techfore.2024.123347.

Qamruzzaman, M. (2025). How do economic freedom, trade freedom, and digitization influence renewable energy consumption in G20 nations: What is the role of innovation?. *International Journal of Renewable Energy Development*, *14*(1). https://doi.org/10.61435/ijred.2025.61147.

Rashid, Y., Rashid, A., Warraich, M., Sabir, S., & Waseem, A. (2019). Case study method: A step-by-step guide for business researchers. *International Journal of Qualitative Methods*, *18*. https://doi.org/10.1177/1609406919862424.

Rentier, G. M. (2025). *Institutions and the energy transition*. https://doi.org/10.33540/3197.

Ruggiano, N., & Perry, T. E. (2017). Conducting secondary analysis of qualitative data: Should we, can we, and how?. *Qualitative Social Work*, *18*(1), 81–97. https://doi.org/10.1177/1473325017700701.

Shah, W. U. H., Zhang, X., Yasmeen, R., & Padda, I. U. H. (2023). Green transition and economic growth in G20 countries: Evidence from disaggregated energy sources. *Environmental Science and Pollution Research*, *30*, 1–17. https://doi.org/10.1007/s11356-023-28781-6.

Sinha, A., Bekiros, S., Hussain, N., Nguyen, D. K., & Khan, S. (2023). How social imbalance and governance quality shape policy directives for energy transition in the OECD countries?. *Energy Economics*, *120*, 106642. https://doi.org/10.1016/j.eneco.2023.106642.

Svobodova, K., Owen, J., Harris, J., & Worden, S. (2020). Complexities and contradictions in the global energy transition: A re-evaluation of country-level factors and dependencies. *Applied Energy*, *265*, 114778. https://doi.org/10.1016/j.apenergy.2020.114778.

Wang, Q., Li, S., & Pisarenko, Z. (2020). Heterogeneous effects of energy efficiency, oil price, environmental pressure, R&D investment, and policy on renewable energy — Evidence from the G20 countries. *Energy*, *210*, 118322. https://doi.org/10.1016/j.energy.2020.118322.

Wu, L., & Hussain, S. (2025). Navigating the energy transition: Interplay of geopolitics, economic complexity, and environmental governance in OECD countries. *Energy Strategy Reviews*, *57*, 101624. https://doi.org/10.1016/j.esr.2024.101624