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ENERGY SECTOR OF AZERBAIJAN AND ITS POTENTIAL TRANSITION TOWARDS RENEWABLES

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CHAPTER 1: INTRODUCTION

1.1 Azerbaijan's Energy transition

Humans have utilized renewable energy sources since the earliest days of civilization. In the beginning, wood served as a primary resource for heating and cooking, while wind power was harnessed for transportation. Afterwards, they utilized mechanical energy for the development of at that time new - machinery equipment during pre-industrial time (Gritsevskyi 2008). There is currently so much discussion regarding the transition from conventional energy sources to a renewable and sustainable energy system all over the world (Wang et al. 2018). A White paper for governments from International Solar Energy Society states that renewable energy transition should be carried out on the occasion that economic and environmental crisis have to be passed untouched once fossil fuel use should shrink due to rising resource scarcity or worldwide environmental restrictions or when conventional energy resources happen to be unreasonably costly prior to reaching those limits (ISES, Aitken 2003).

In the modern era, society is confronted with major challenges that demand prompt and creative responses. Among them, climate change stands out as a critical issue, prompting nations worldwide to reassess their energy consumption habits and sources. This global agenda provides a framework for countries to pursue sustainability, with each adapting its approach based on its historical, geographical, and economic conditions. The strategies countries adopt to tackle these challenges vary greatly, reflecting their unique circumstances and resources. In this context, the experience of post-Soviet nations like Azerbaijan offers valuable insights into the complexities of energy transition, shaped by historical legacies, geopolitical factors, and economic realities.

This thesis explores Azerbaijan's energy transition, reflecting both its extensive energy heritage and its commitment to a future powered by renewable energy. Through exploring various dimensions in this transition, this research has mapped out a potential future for Azerbaijan, while also offering broader lessons applicable beyond its borders. The results highlight the intricate challenges involved in transitioning from an economy reliant on hydrocarbons to one that adopts renewable energy sources, underscoring the critical roles of policy, technology, and public involvement in this transformative journey.

With a population of approximately 10.51 million in 2023 (UN Data, 2023), Azerbaijan stands as the largest nation within the South Caucasus region. Since gaining independence in 1991, the nation has embarked on a path marked by notable economic, social, and technological

advancements, while achieving a considerable level of political stability (Ismailov, 2016). This progress, however, has been accompanied by internal challenges and ongoing tensions with neighboring Armenia, primarily over the disputed Nagorno-Karabakh region (Mammadov, 2021).

Azerbaijan's energy sector has undergone remarkable development, symbolizing the broader transformation of the nation since 1991. The growth in energy infrastructure and its pivotal role in driving economic expansion mirrors trends observed across other former USSR countries in the area. Modernization of Azerbaijan's energy industry underscores its strategic significance in the worldwide energy landscape and highlights the state's increasing the integration with Western markets.

Additionally, Azerbaijan has embraced new avenues for economic collaboration and development, particularly with the European Union. These partnerships signify a notable shift from its Soviet-era alignment, demonstrating Azerbaijan's strategic positioning and aspiration to assume a leading position in global energy dynamics.

Due to its strategic geographical location and proximity to the resource-rich Caspian Sea, Azerbaijan boasts significant oil reserves, which are central to its economy (Hasanova, 2023). A significant share of Azerbaijan’s Gross Domestic Product (GDP) is derived from its oil and gas sector. In 2023, the country produced an average of 560,000 barrels of oil per day, contributing approximately 45% of its GDP (SSCRA, 2023).

In addition to its hydrocarbon wealth, Azerbaijan has considerable alternative energy resources. The State Agency on Renewable Energy estimates that Azerbaijan has approximately 25,500 MW of renewable energy potential that is both economically and technically viable. This includes 2,800 MW from wind energy, 22,000 MW from solar energy, 400 MW from bioenergy, and 300 MW from hydropower harnessed from mountain rivers (State Agency on Renewable Energy of Azerbaijan, 2023). These resources underscore Azerbaijan’s capacity to broaden its energy mix and promote greater sustainability in its energy industry.

This thesis argues that Azerbaijan’s shift toward sustainable energy remains at an initial phase, largely because fossil fuels continue to dominate the nation’s energy generation and usage. However, both internal and external pressures are increasingly challenging Azerbaijan's dependence on oil, prompting the development of sustainability-focused policies and accelerating the shift towards renewable energy. Given the volatility of oil prices and the global emphasis on sustainability, Azerbaijan’s shift in energy strategy is driven not only by economic needs but also by its obligations to national security and environmental stewardship.

This research seeks to outline potential pathways for Azerbaijan's energy future, contributing to the ongoing global dialogue on sustainability and energy security in post-Soviet countries.

Although sustainability transitions have garnered significant scholarly attention across various disciplines, the current state of energy transitions—specifically the potential for renewable energy, the state's role, along with the prospects and obstacles confronting the renewable energy industry remains underexplored in countries outside the Western context, such as Azerbaijan. This study utilizes a wide range of sources, including policy analysis, stakeholder interviews, and statistical data, to offer a detailed and comprehensive view of Azerbaijan's energy landscape. By placing the state's energy transition within the framework of post-Soviet legacies, geopolitical factors, and economic realities, this thesis not only enhances our understanding of energy transitions in unique geopolitical contexts but also establishes a valuable foundation for future research.

Since gaining independence from the Soviet Union, Azerbaijan has undergone profound economic, social, and political shifts. These transformations have extended to various sectors, including energy policy. Despite significant changes since the Soviet era, many policies and strategies implemented during that time continue to shape Azerbaijan's contemporary energy and environmental strategies (Aliyev, 2019; Karimov, 2020; Rustamov, 2022). The lasting impact highlights the need to explore how Soviet-era governance continues to shape the energy sector.

Understanding the interplay between historical, economic, and political factors in Azerbaijan's energy transition is critical in order to comprehensively grasp the challenges and opportunities within the sector. This research investigates how the 74 years of Soviet influence have left a lasting imprint on Azerbaijan's energy industry and examines the role of institutional inertia, governance challenges, and historical legacies in shaping current energy policies.

This research adds to the expanding body of knowledge on energy transition processes through focusing on post-Soviet states, a context often overlooked in existing literature. It highlights how transitions unfold in environments characterized by weak institutional frameworks, political complexities, and historical continuities. Furthermore, the research provides a framework for analyzing energy transitions in similar socio-political and historical contexts globally, shedding light on how historical legacies can inform contemporary policy-making and energy practices.

Azerbaijan's engagement with Western nations following the collapse of the Soviet Union, along with the increased global exchange of ideas and expertise, has significantly contributed to heightened environmental awareness and a shift toward more proactive environmental policies at both governmental and societal levels (Hajiyev, 2015). Additionally, civic engagement has emerged as a vital domestic factor driving the growth of Azerbaijan's renewable energy sector.

This study seeks to explore the contextual and transformative dynamics that shape the emergence and progression of grassroots social initiatives. Adopting a geographical perspective, this study examines the factors that shape the advancement of these initiatives within Azerbaijan's distinct post-Soviet institutional, socio-economic, and political context.

This thesis makes a dual enrichment of the existing body of academic literature. To begin with, the study contributes to the literature on energy transitions through a comprehensive examination of a post-Soviet context, thereby addressing the Western-centric focus prevalent in existing research. Second, it adopts a multidisciplinary approach that integrates economic geography, policy analysis, and sustainability studies, offering a holistic framework for analyzing energy transitions in geopolitically and socio-economically complex settings.

In the meantime, the study delivers useful recommendations for accelerating Azerbaijan's transition to renewable energy. By identifying key obstacles and enabling factors, it offers a strategic roadmap to address challenges in policy development, infrastructure improvements, and public participation.

In summary, this thesis provides a valuable perspective on the complex dimensions of Azerbaijan's energy transition, contributing to the wider assessment of global energy sustainability. Through suggesting a roadmap for Azerbaijan's future energy strategies, it delivers insights that extend beyond the nation's borders, enriching global policy and practice in the pursuit of a sustainable energy landscape. The findings from this research hold the potential to guide the development of customized strategies that leverage the strengths and address the challenges unique to transitioning economies. In doing so, this work underscores the significance of interdisciplinary approaches in tackling the pressing challenges of our era, making a meaningful advancement in the study of energy transition studies.

The following sections outline the fundamental structure of this thesis: Section 1.2 presents the research questions, Section 1.3 discusses the theoretical framework adopted, and Section 1.4 offers an overview of the dissertation's layout while introducing the main argument developed throughout the subsequent chapters.

1.2 Research questions

This study seeks to investigate the dynamics of Azerbaijan's energy transition within a post-communist context. It explores how historical legacies of the communist era, together with the

country's institutional, political, economic, and social structures, have influenced the present energy landscape.

The frameworks and concepts utilized in this project have been carefully selected to structure the study and guide the development of the research questions. The primary research questions are as follows:

- What is the current status of the energy transition in Azerbaijan?
    - How do public perceptions and levels of civic engagement influence the development and implementation of renewable energy policies in Azerbaijan?
    - What technological barriers and infrastructural limitations are currently constraining the growth of renewable energy deployment in Azerbaijan?

This question will be examined through three main dimensions: analyzing the present state of Azerbaijan's energy market, including its structure, key stakeholders, and equilibrium between conventional and renewable energy forms; evaluating major policies and initiatives undertaken by the Azerbaijani government to advance renewable energy; and identifying the challenges and opportunities that shape the pace and trajectory of the transition. The findings related to this question will be detailed in Chapter 5, which lays the groundwork for subsequent historical analysis of Azerbaijan's energy transition and an investigation into niche social dynamics associated with this process.

- How has Azerbaijan's communist heritage influenced its shift toward renewable energy?
    - In what ways have Soviet-era public governance practices and institutional cultures affected societal attitudes toward energy reform and decentralization?
    - How have technological legacies from the Soviet period contributed to lock-in effects that impede the adoption of renewable energy systems in Azerbaijan today?

This question serves as the foundation for Chapter 7, which explores the historical impact of Azerbaijan's Soviet-era experience on its current energy governance and strategies, emphasizing the transition to renewable sources. The research is structured around three main analytical frameworks: examining the energy landscape during the Soviet period, emphasizing the centralization of energy management and reliance on fossil fuels, to uncover the underlying structures and ideologies; assessing the changes in Azerbaijan's energy sector since 1991 to determine whether and how the transition from Soviet influence has facilitated the shift toward

renewable energy; and analyzing specific Soviet-era legacies to evaluate their lasting influence on shaping and executing renewable energy policies in contemporary Azerbaijan.

Following hypothesizes are suggested.

Hypothesis 1: Path Dependency and Historical Legacies: Azerbaijan's communist-era institutional frameworks and centralized governance structures create significant path dependency that hinders the nation's transition to renewable energy

Hypothesis 2: Fossil fuel dominance and centralized governance: The stronghold of the fossil fuel sector, coupled with top-down decision-making and administrative inefficiencies, continues to hinder the advancement and integration of renewable energy technologies in Azerbaijan.

Hypothesis 3: Gaps in policy and institutional infrastructure marked by an insufficient regulatory framework and fragile administrative capacity—pose significant obstacles to the implementation of renewable energy projects in Azerbaijan."

Hypothesis 4. Although the development of renewable energy in Azerbaijan is still at a nascent stage, there is growing momentum—driven by pilot projects, international partnerships, and evolving stakeholder networks—that suggests a gradual but promising integration of renewable innovations into the dominant socio-technical regime.

1.3 Theoretical framework

This research adopts an economic geography perspective, grounded in the multi-level perspective (MLP) framework. The MLP is particularly well-suited for investigating the dynamics of transitions toward sustainable development" within the distinctive post-Soviet context of Azerbaijan. Several factors support its application in this study.

Firstly, the MLP provides a robust theoretical foundation for exploring the complex processes of transition, including technological innovations, policy evolution, and societal transformations in specific contexts like Azerbaijan (Smith, 2014; Geels, 2011). Secondly, the MLP provides a detailed and layered interpretation of transition processes, as it acknowledges the interplay of diverse actors and multiple levels—ranging from niche innovations to broader societal systems—that shape sustainability transitions.

Furthermore, the MLP’s emphasis on the the effect of exogenous variables underscores the importance of global interconnectedness in shaping regional transitions. This approach facilitates

insight into the ways international dynamics drive spatial disparities in sustainability transitions, making it an invaluable approach for examining the unique socio-political and economic landscape of Azerbaijan.

While MLP framework provides valuable insights, it is necessary to understand its shortcomings to fully achieve the objectives of this project. The MLP does not sufficiently account for geographically and historically specific factors, such as institutional structures, actor agency, and pre-existing socio-economic conditions, each of which significantly influences the course of transition processes. To address these gaps, concepts from evolutionary economic geography (EEG), such as path dependence and lock-in, are integrated into the analysis. Understanding these concepts is key to examining the ways in which past legacies and cumulative decisions affect the trajectory of sustainability transitions, particularly in relation to infrastructure and its lasting influence (e.g., Boschma, 2015; Neffke et al., 2018; Martin & Sunley, 2006).

EEG enhances the MLP by emphasizing both historical and spatial contexts, elements often underrepresented in the MLP framework. As noted by Coenen et al. (2012), incorporating spatial dimensions into socio-technical transitions is essential for understanding the uneven geographical dynamics of such processes. EEG further provides tools to analyze the interplay of actors, institutions, and structural constraints within a specific regional or national context, which is particularly relevant for the post-Soviet environment of Azerbaijan.

Additionally, this project adopts a more granular focus on the roles of diverse actors, including state, non-state, and intermediary agents, along with the concepts of agency and capacity. By integrating multiple perspectives, this approach captures the complexity of sustainability transitions, especially amid regional and institutional shifts

In addition to its empirical contributions, this project seeks to advance the conceptual development of MLP framework. By integrating and discussing theoretical foundations that underpin the MLP, the study highlights its interconnections with other theories utilized in this research. Specifically, it examines the relationships between the MLP framework, the "alternative" perspective on post-communist transformation, as elaborated in Chapters 3 and 4. These theoretical explorations are essential for connecting the geographical and historical dimensions of this research, providing a deeper understanding of how institutional structures, historical legacies, and regional dynamics shape the socio-economic and political evolution of post-communist societies.

The concept of path dependence, which emphasizes that the development of regions and institutions is shaped by their historical trajectories and is deeply influenced by past decisions (Arthur, 1994), serves as a crucial analytical tool in understanding post-communist

transformations. This approach has been particularly valuable in explaining changes in Central and Eastern Europe (CEE), as demonstrated by scholars such as Domanski and Gwosdz (2009), Meurs and Begg (1998), Niewiadomski (2016), and Williams and Balaz (2002). Path dependence has also gained prominence in evolutionary economic geography (EEG) as scholars increasingly focus on the historical evolution of economic landscapes.

By synthesizing insights from the alternative perspective on post-communist transformations and the EEG framework, this project provides a detailed and nuanced understanding of post-communist change. It emphasizes the significance of these transitions for fostering sustainable development and promoting regional collaboration, offering "a meaningful addition to the ongoing dialogue surrounding the socio-economic evolution in post-Soviet spaces.

Over the past decade, energy systems have been examined using various frameworks rooted in sustainability transitions and socio-technical system theories. Among these, MLP has taken on a prominent role within the literature on energy system transformations. However, recent analyses of MLP applications highlight the need for integrating additional elements to generate meaningful insights into the specific processes occurring within energy systems. Researchers have particularly emphasized the importance of contextual factors, focusing on the distinctive institutional settings and the multi-level dynamics that are intricately tied to local conditions (see Luque-Ayala et al., 2018). To this end, combining various transition frameworks offers a promising approach to better comprehend energy systems and effectively advance the shift towards sustainable energy solutions.

From a methodological perspective, this dissertation predominantly utilizes qualitative research methods. Centered on semi-structured interviews and documentary analysis, the study focuses on Azerbaijan’s case. Azerbaijan as the topical case is purposefully grounded in its distinctive geopolitical and economic context, characterized by abundant energy resources and the dynamic interaction between entrenched power structures and emerging sustainable development efforts. This focus enables a detailed examination of transitional processes within a relatively underexplored but geopolitically significant region of the Caucasus, offering a departure from the Eurocentric emphasis commonly found in transition studies. By investigating Azerbaijan, the research adopts an innovative lens to analyze the tension between traditional and emerging systems, revealing unique challenges and opportunities for sustainability transitions in a post-communist framework. This approach not only enriches the empirical landscape of transition studies but also enhances understanding of regional dynamics influencing sustainability efforts, highlighting Azerbaijan's relevance to broader theories of transition.

1.4 The structure of the thesis

Excluding the introductory chapter, which defines the study's scope and objectives, and the concluding chapter, which presents the key findings and their implications, the dissertation is structured into seven main chapters. Chapters 2 and 3 are dedicated to constructing the theoretical framework of the research. The methodological approach is thoroughly outlined in Chapter 4, with the empirical results and their interpretation distributed across Chapters 5 and 6. Each chapter addressing theoretical perspectives examines a specific body of literature that forms the underpinning of the research.

Chapter 2 leads a thorough examination of theories related to sustainability transitions, emphasizing the unique challenges within the post-communist context of Azerbaijan. This chapter critically evaluates various theoretical models, offering insights into the complexities of understanding and advancing sustainability transitions. It also explores the historical background and fundamental principles of the multi-level perspective (MLP). While Chapter 2 takes a broad approach, the subsequent two chapters focus on key thematic aspects of the study. Chapter 3 specifically clarifies post-communist transformation. From a geographical standpoint, Chapter 3 investigates different theoretical approaches to understanding the transformations that have occurred in Central and Eastern Europe since the end of communism.

The methodology of the project, presented in Chapter 4, is consolidated into a single chapter that delves into the philosophical underpinnings of the research. This chapter outlines the research design, elaborates on the data collection methods, and presents the analytical framework applied to interpret the results. It further addresses critical aspects such as power relations, researcher positionality, and ethical issues encountered during the research process.

Chapters 5 and 6 constitute the empirical foundation of the dissertation. Chapter 5 provides a detailed assessment of Azerbaijan’s energy landscape, laying the groundwork for further analysis of the country’s renewable energy transition. It evaluates the present state and prospective development of renewable energy sources, including hydropower, wind, solar, and biomass. This chapter emphasizes significant governmental efforts driving this transformation and evaluates the challenges and opportunities involved. These include aspects such as policy frameworks, regulatory systems, institutional capacity, financial constraints, and technical considerations. The chapter offers an in-depth exploration of Azerbaijan’s move toward sustainable energy, aiming to clarify the multifaceted nature of this transition. It highlights notable achievements as well as

existing obstacles, offering critical insight into the current dynamics and long-term potential of renewable energy in the country.

Chapter 6 examines Azerbaijan's energy transition with a particular focus on developments following the USSR's dissolution in 1991. It contextualizes the energy sector within the Soviet era, analyzing how historical legacies have shaped post-Soviet energy policies and practices. The chapter investigates the drivers behind the accelerated shift to renewable energy after USSR collapsed, highlighting the influence of Soviet-era characteristics such as centralized management, the predominance of fossil fuel industries, institutional weaknesses, and informal governance practices. These factors collectively influenced Azerbaijan's distinctive approach to its energy transition. By critically assessing the historical and contemporary dynamics, the chapter provides valuable insights into how past legacies continue to inform current energy strategies and the shift towards renewable energy in Azerbaijan. Chapter 7 offers a clear summary of the study's main findings and theoretical contributions. It integrates the empirical results with the underlying theoretical framework, delivering a cohesive overview of the research's overall significance. It highlights the main conclusions, discusses their implications, and reflects on how the study advances knowledge in the field. Chapter 8 lists and covers New Scientific results.

In essence, this dissertation delivers an innovative and in-depth exploration of sustainability transition theories, focusing particularly on the post-communist landscape of Azerbaijan and the wider CEE region. It addresses critical gaps in the academic conversation, significantly advancing the understanding of sustainability transitions within urban environments and energy systems. By delving into the complex dynamics of post-communist shifts across the CEE region and analyzing Azerbaijan's specific challenges and opportunities in transitioning to alternative energy, this work makes a distinctive addition to the disciplines of economic geography, sustainability transition studies, and post-Soviet research. Through its rigorous examination of theoretical frameworks, historical developments, and empirical findings, the dissertation offers valuable perspectives on the global dissemination of sustainability practices in the CEE region and beyond, enriching both the theoretical foundations and empirical.

CHAPTER 2: LITERATURE REVIEW: THEORETICAL INSIGHTS INTO SUSTAINABILITY TRANSITIONS

2.1 Introduction

As the initial theoretical chapter, this section establishes the key perspectives necessary for understanding sustainability transitions. It focuses on constructing and critically assessing the theoretical and conceptual foundation that supports the study. To achieve this, the chapter delves into the debates surrounding sustainability transitions, examines various theoretical approaches to analyzing these transitions, and integrates concepts from evolutionary economic geography. This is accomplished through a review of existing sustainability transitions literature and an exploration of theoretical themes particularly relevant to the Azerbaijan case study.

This study adopts the Multi-Level Perspective (MLP) as its analytical and theoretical lens for examining transitions within socio-technical systems—such as those related to energy, transport, or healthcare which are shaped by the interplay of technologies, institutional structures, societal practices, and market forces. The MLP has become a cornerstone in sustainability studies and transition research, offering insight into the processes enabling systemic change. Multi-Level Perspective indeed gave a robust framework through which one can understand socio-technical transition. The structured approach that MLP adopts in its analysis of multi-dimensional processes gives an important clue for the researcher and policymaker who seek to foster sustainable systemic change (Kern, 2012). Thus, I argue that MLP is the most appropriate framework for examining the phenomenon under study and examining how sustainability transitions unfold in the Azerbaijani context.

While this framework offers significant advantages, it also has certain criticisms and limitations that must be addressed to effectively accomplish the study's primary goals. To overcome the limitations of the Multi-Level Perspective (MLP), the analysis integrates key ideas from economic geography, including path dependence and lock-in. These concepts are essential for understanding the persistent obstacles encountered in sustainability transitions. They refer to the self-reinforcing mechanisms that stabilize existing socio-technical regimes and hinder systemic change. Foundational studies, such as those by David (1985) on economic lock-in and Arthur (1989) on increasing returns, provide a theoretical basis for these phenomena. Additionally, Geels (2002) and Unruh (2000) offer insights into how these mechanisms operate within socio-technical systems, particularly in the context of sustainability.

In addition to addressing the shortcomings of the MLP, this chapter highlights the ways and areas in which this project contributes to the framework's further development. Furthermore, it presents various theoretical foundations underlying the MLP, illustrating its interconnectedness with other theories that have informed this research. Specifically, the chapter examines the links between the MLP and the "alternative" approach to post-communist transformation.

To establish the context, chapter 2.2 offers an examination of sustainability transitions, emphasizing their significance in addressing global challenges. Building upon this foundation, Section 2.3 presents a critical evaluation of various theoretical frameworks used to analyze sustainability transitions. Within this analytical framework, Subsection 2.3.1 delves into MLP, highlighting its value in illustrating how transitions unfold across different levels of society. In contrast, Subsection 2.3.2 examines the influence of various actors and institutions in shaping the direction of sustainability transitions. Following this, Section 2.4 introduces the Evolutionary Economic Geography (EEG) approach, highlighting core concepts like path dependence and lock-in, which are explored further in Subsection 2.4.1. The chapter concludes with Section 2.5, which provides a summary of the key themes addressed

2.2 Sustainability transitions

It is a fact that environmental problems such as climate change, loss of biodiversity, and overconsumption of resources became pressing concerns in the international policy arena during the late 1990s and escalated significantly in the early years of the 21st century (UNEP, 2019). The challenges now being faced by humanity transcend the realm of environmental issues into basic areas like energy security, water management, public health, transportation, and agriculture. These complex challenges have stimulated increasing scholarly attention to sustainability transitions in the past twenty year. Researchers maintain that solving these problems cannot be done with simple, incremental improvements; rather, they need transformative changes along socio-technical systems (Smith et al., 2010; Loorbach, 2007). Key systems, such as energy, transportation, and water, are deeply rooted in socio-technical frameworks characterized by strong lock-ins, path dependencies, and institutional resistance (Hughes, 1983; Sovacool and Hess, 2017). Sustainability transitions, by their very nature, are complex and long-term processes; this is because they call for far-reaching changes not only in technologies and institutions but also in societal values, consumer behaviors, and governance structures (Elzen et al., 2004).

A socio-technical transition is defined as an overarching process that leads to the reconfiguration of socio-technical systems to achieve sustainability goals (Geels and Schot, 2007). Different from

the technocratic transitions of pure technological innovation with a narrow focus on just technical advancement, socio-technical transitions entail complex changes along the technological, organizational, political, economic, and cultural dimensions (Smith et al., 2005; Raven et al., 2010).

Considering that this project primarily investigates energy transitions, it is essential to distinguish between the concepts of sustainability transitions and energy transitions to ensure clarity and depth of understanding. While both are interrelated within the broader context of environmental and socio-technical studies, they are distinct in focus and scope. Sustainability transitions encompass large-scale shifts aimed at achieving more sustainable, equitable, and resilient socio-technical systems, incorporating environmental, economic, and social transformations (Loorbach et al., 2017). In contrast, energy transitions are specifically concerned with the systemic transformation of energy infrastructures, shifting from fossil fuel dependency to renewable and cleaner energy sources to mitigate climate change (Bridge et al., 2013).

Despite their differences, both concepts often employ common analytical frameworks like the MLP due to their emphasis on complex, multi-dimensional systemic changes (Rotmans et al., 2001). Understanding the distinction between these transitions allows for a more nuanced appreciation of their respective contexts, particularly concerning the roles of stakeholders, the dynamics of power, and the historical pathways that influence each type of change. Highlighting these differences not only enriches the theoretical frameworks used but also informs the development of practical and context-specific strategies to facilitate effective transitions (Köhler et al., 2019).

The sustainability transitions framework serves as the foundation and key academic audience for this research because:

- Comprehensive Theoretical Insights: It provides a wealth of theories and concepts that allow researchers to examine transitions through systemic, multi-actor, and long-term perspectives, facilitating deeper engagement with the dynamics of socio-technical change (Markard et al., 2012; Köhler et al., 2019).
- Contextual Understanding of Niches: The framework offers rich debates on the emergence and development of niches within transitions. This includes discussions on spatial and sectoral dynamics, with a significant focus on urban transitions and the role of cities as critical arenas for sustainability efforts (Bridge et al., 2013; Bulkeley et al., 2011; Rutherford & Coutard, 2014).

- Methodological Contributions: It provides robust methodologies for identifying, analyzing, and fostering innovative strategies that disrupt entrenched systems. These approaches are instrumental in studying how innovations challenge existing paradigms and drive system-wide transformations (Loorbach et al., 2017; Schot & Steinmueller, 2018).

The study of sustainability transitions encompasses a variety of theoretical frameworks aimed at understanding and facilitating transformative changes. Among the most influential approaches within this field are:

Strategic Niche Management (SNM): This framework emphasizes the creation and nurturing of protected spaces where innovative technologies or practices can mature and eventually scale up to challenge incumbent systems (Kemp et al., 1998; Smith & Raven, 2012). Although SNM approach offers valuable insights, I deemed it less relevant for this research due to its primary focus on fostering niche development in open, collaborative, and technology-driven settings. This orientation often contrasts with contexts characterized by entrenched historical legacies and significant government control, where the dynamics and pathways of transitions may diverge from the assumptions underpinning the SNM framework.

Technological Innovation Systems (TIS): This approach focuses on the structural and functional dynamics of innovation within specific technological domains, analyzing how actors, networks, and institutions coalesce to support technological diffusion and market creation (Hekkert et al., 2007; Bergek et al., 2008). TIS framework is often criticized for its tendency to oversimplify the complex interactions that occur across different levels of governance. Additionally, it fails to adequately account for the significant systemic rigidities and constraints commonly encountered by transitional countries. Due to these limitations, I chose not to adopt the TIS approach for this project.

Transition Management: This framework advocates for structured, long-term processes involving iterative governance, stakeholder collaboration, and adaptive strategies to drive sustainability transitions effectively (Loorbach, 2010; Rotmans et al., 2001). Transition management emerges as an important frame in the domain of transition research, both in handling generation of knowledge-related challenges and in governing transitions. This is because it can be able to define clear long-term vision and interim goals, and thus establish the interconnection of policy-making within multiple time scales, which could allow implementing strategic experiments in order to govern transitions. Despite these strengths, the TM framework has not been adopted in this project. The reason for this decision is that the project focused on specific historical, political, and institutional complexities that distinguish transitions within particular contexts. These specific complexities

required a more tailored and context-sensitive approach than the generally broader, process-oriented methodology typically promoted by Transition Management.

The MLP: This model examines transitions as multi-dimensional phenomena occurring through interactions among three levels—niches, regimes, and landscapes—illustrating how systemic shifts arise from these dynamics (Geels, 2002; Geels & Schot, 2007).

This research therefore uses the MLP as an analytical framework since it allows a multi-faceted approach toward investigating such complex transition processes, taking into consideration the particular challenges and opportunities accompanying the post-communist experience of Azerbaijan. Unlike straightforward transitions that might be analyzed on a single level, the transformation of Azerbaijan is a result of complex interactions between legacies, rapid economic changes, and socio-political dynamics in emergentia. The attention that the MLP pays to the interaction between niches, regimes, and landscapes provides an insight into these elements in more detail and, for that reason, is considered one of the most apt frameworks while describing and unpacking the various complexities in the transition of Azerbaijan from its traditional framework to what it is today. The former approach shall help to track the key drivers of change, as well as the diffused innovations within a context-theory that is not conceived within conventional transition models when trying to conceptualize deeply embedded systemic interconnections along with the disruptive potential of niche innovations within the existing regime.

2.2.1 Sustainability Transitions tendencies

Transitions toward sustainability represent a systemic change in socio-technical regimes that integrate innovation, institutional reform, and behavioral changes in pursuit of ecological resilience. Drawing from Geels (2002), these transitions are analyzed along three dimensions:

Niche innovations: Experimental technologies and practices, including technologies like solar PV and wind turbines, which initially emerged within sheltered environments.

Socio-Technical Regimes: Dominant systems of production and consumption ruled by incumbent actors and infrastructures.

Landscape Pressures: Exogenous factors, such as climate change, economic crises, and public opinion changes, which provide windows of opportunity for regime disruption.

The transition to renewable energy resources from carbon-intensive ones constitutes one of the critical facets of global sustainability. Its political dimension is defined by three interconnected domains: the struggle over power, the making of policy, and social equity.

Energy transitions are often marked by a struggle between incumbent actors, such as fossil fuel companies, and challengers, such as renewable energy innovators. Incumbents wield their economic and political power in an effort to delay change by lobbying against strict regulations or offering carbon capture as a compromise solution. Meanwhile, emergent actors leverage technological advances and grassroots movements in an effort to push for system-wide change.

For instance, fossil fuel interests have invested heavily in political campaigns to influence policy decisions and slow the implementation of renewable portfolio standards in the United States. Conversely, coalitions of German civil society groups and renewable energy firms have successfully championed policies promoting transformation, such as the Energiewende (Jacobsson & Bergek, 2004).

The governance of energy transitions involves the interplay of international commitments, national policies, and local implementation. Although agreements like the Paris Accord set global benchmarks, their fulfillment is contingent upon domestic governance and administrative capabilities.

Feed-in tariffs (FiTs) in countries like Denmark and Germany have been instrumental in scaling up wind and solar power, while renewable portfolio standards (RPS) in the United States create state-level targets for renewable energy deployment (IRENA, 2021).

However, governance faces challenges. Developing countries often encounter institutional and financial obstacles in transitioning their energy systems. The political economy of international aid and technology transfer frequently disadvantages these nations, raising questions about equity in global energy transitions (Newell & Mulvaney, 2013).

Energy transitions must address issues of equity and justice to ensure inclusive benefits. The concept of "just transition" emphasizes protecting vulnerable populations from adverse structural changes. For instance, coal-dependent communities, such as those in Appalachia (U.S.) or Germany's Ruhr Valley, require policies that mitigate job losses and economic dislocation (Heffron & McCauley, 2018).

Similarly, disparities in energy access remain a critical concern. While affluent nations invest in advanced technologies for renewable resources, millions in poorer regions of the world lack basic

electricity. Targeted investments and policies focusing on access rather than mere technological innovation are needed to address such inequities (Sovacool et al., 2019).

- Germany's Energiewende: Germany has taken a leading role in driving its energy transition, setting bold goals for expanding renewable energy and cutting greenhouse gas emissions. Key to its success has been a robust policy framework, including FiTs, extensive stakeholder engagement, and sustained public support. However, rising electricity costs and delays in phasing out coal reveal the complexities of balancing environmental and economic goals (BMWi, 2021).
- India's Solar Revolution: Through the National Solar Mission, India has become a key player in advancing solar energy deployment. Investments in large solar parks and decentralized solutions highlight the potential of renewables to address developmental challenges. Yet, policy inconsistencies and financial constraints reveal the fragility of such transitions in emerging economies (IRENA, 2021).

While progress in energy transitions is evident, challenges persist:

- Path Dependence: Large historical investments in fossil fuel infrastructure create inertia, hindering the switch to renewables.
- Geopolitical Dynamics: Renewables shift resource geopolitics, with rare earth minerals and technology supply chains emerging as new areas of competition.
- Climate Financing: Mobilizing financial resources for renewable energy projects in low-income countries remains a major hurdle.

Addressing these challenges requires international cooperation, innovative financing mechanisms, and adaptive policies that reflect diverse socio-political contexts.

The political dimensions of sustainability transitions especially within the energy sector highlight the complex relationship between technological advancement, governance structures, and social equity. While pathways to transition are contentious and uneven, they offer opportunities to reshape socio-technical systems for a sustainable and just future. Lessons from energy transitions provide critical insights for broader sustainability efforts as nations tackle environmental sustainability and social justice imperatives.

This section concludes by highlighting established actors, policymakers, and grassroots initiatives in advancing sustainable energy transitions. It emphasizes the political nature of these processes, shaped by power dynamics, stakeholder opposition, and collaboration, stressing the importance of

understanding these interactions to effectively navigate and manage transitions. This lays the groundwork for the subsequent discussion on the geographical dynamics of sustainability transitions, focusing on how spatial and locational factors interact with political and economic influences.

2.2.2 The Spatial Dynamics of Sustainability Transitions

Research on socio-technical transitions and sustainability transitions has gained important momentum during the last two decades. Until now, the dominant perspective focused on studying transitions mainly at national levels, frequently targeting well-defined sectoral systems such as energy, transportation, food systems, or urban infrastructure. This approach assumes, as noted by Meadowcroft (2009) and Grin et al. (2010), that national boundaries are the proper scale to analyze sector-specific dynamics. However, an expanding field of scholarship has emphasized the importance of spatial factors, both in analyzing and driving sustainability transitions. Key works by Hodson and Marvin (2010), Hansen and Truffer (2020), and Bridge et al. (2020) argue that geographical perspectives are vital in contextualizing the distinct emergence and trajectory of transitions, as they reveal the unique features of local contexts where these processes occur. Hodson and Marvin (2010, p. 481) emphasize that this focus shifts away from the earlier assumption that transitions occur uniformly across geographies, exploring instead how governance, innovation networks, and resource distribution shape transition dynamics. This "spatial turn" in sustainability transitions research highlights how location-specific socio-technical configurations, resource flows, and institutional landscapes serve as crucial factors in enabling or hindering sustainable change (Hansen and Truffer, 2020). Consequently, the concept of the "spatiality of transitions" has emerged as a key lens to study these processes.

Within the growing body of work examining the spatial dimensions of sustainability transitions, particular attention is given to how localized conditions shape transitions while also being shaped by them. This approach underscores that sustainability transitions are inherently contextual and embedded in the unique spaces where they occur, as noted by Raven et al. (2012) and Coenen et al. (2015). Geographical locations are seen not merely as physical territories but as dynamic configurations of socio-technical networks and interactions (Lawhon and Murphy, 2012). For instance, urban centers are often described as "transition hubs," where diverse stakeholders and resources converge to drive sustainability innovations (Hodson et al., 2012). Additionally, places are viewed as outcomes of interactions between internal dynamics—such as technological specializations, institutional arrangements, and social practices—and external influences like

global knowledge flows and resource interdependencies (Binz et al., 2016). This perspective has led scholars to theorize transitions as "place-shaping" processes, where actors redefine the meaning, functionality, and future trajectory of specific locations.

Recent studies have begun exploring the material and spatial features of local environments, such as urban density, resource accessibility, and infrastructure, and their impact on transition pathways (Pfluger et al., 2021; van den Bosch and Rotmans, 2008). This perspective recognizes that physical attributes, alongside social and institutional factors, play a crucial role in shaping the speed and trajectory of transitions by shaping innovation processes, stakeholder collaboration, and resource mobilization.

Despite advancements in understanding spatial factors, there remains a need to explore deeper interdependencies across scales and the contextual nuances influencing transitions. Comparative and multi-scalar analyses have addressed these gaps. For instance, Raven et al. (2012) examined how transitions unfold across urban contexts by analyzing interactions between global innovation networks and local practices. Similarly, Wieczorek et al. (2020) investigated transitions in emerging economies, highlighting challenges in applying existing frameworks to resource-constrained settings. Binz and Truffer (2017) extended the analysis to explore the interaction between transnational knowledge flows and local socio-technical systems, offering insights into the global-local interplay in transitions. These studies underscore the value of integrating multi-scalar and cross-disciplinary perspectives to capture the complexities of sustainability transitions, enabling the creation of more comprehensive and inclusive frameworks.

The "spatiality of transitions" provides deeper insight into the context-specific processes underlying sustainability transitions. This perspective enriches the discourse by emphasizing the balance between local and global dynamics, mediated through spatial factors such as governance structures, socio-economic networks, and built environments. Subsequent analyses, such as those employing the multi-level perspective (Geels, 2004), further highlight how actors, institutions, and geographic scales interconnect within the broader transition landscape.

2.3 Theoretical Models for Examining Sustainability Transitions

2.3.1 The multi-level perspective

Within transition studies, the MLP has gained considerable recognition as a leading theoretical approach. What sets the MLP apart from other frameworks is its broad perspective, which extends beyond the analysis of individual technologies like biofuels, wind turbines, or electric vehicles.

Instead, it examines energy systems as intricate socio-technical systems. These systems are made up of an array of interconnected elements, including technical infrastructure, technologies, materials, political institutions.

The MLP framework posits that socio-technical systems evolve through three interrelated and dynamic processes. The first is the stability of dominant regimes, which represent the established systems deeply embedded in society and are defined by fixed rules, practices, and norms. The second process involves the emergence of niche innovations—small-scale experiments or pioneering efforts that challenge the prevailing regime. Lastly, the MLP considers the broader landscape, encompassing external factors and overarching conditions that exert influence on both regimes and niches. Together, these processes illustrate the dynamic interplay that drives transformations in socio-technical systems.

Niche social activities and community energy initiatives have emerged as pivotal areas of focus within the sustainability transitions literature. While these activities were traditionally regarded as too marginal or fragmented to significantly influence regime shifts, their role as catalysts for systemic transitions is gaining wider recognition. Recent studies have increasingly explored themes such as the interactions between niches and regimes, strategies for empowering local actors (e.g., Smith & Stirling, 2018; Geels et al., 2017), and the impact of grassroots movements on transformative change (e.g., Seyfang & Haxeltine, 2012; Geels, 2014).

The socio-technical regime is often described as a "deep structure" characterized by the stability and persistence of the current system (Rip & Kemp, 1998; Geels, 2004). This stability arises from entrenched institutional, material, and social interconnections, leading to path-dependent and incremental realignments. Changes at the regime level are not limited to technological advancements but also encompass cultural, political, market, and scientific dimensions. Innovations typically diffuse gradually through minor adjustments rather than radical shifts. Niches must navigate and overcome this entrenched structure to disrupt the prevailing regime and trigger transformative transitions.

Given that transitions are conceptualized as shifts between regimes, the regime level is intricate to the MLP. However, its definition of remains debated. Geels (2002) emphasizes rules and routines as core elements of the regime, excluding specific actors or technologies. Conversely, authors like Raven (2007) and Smith et al. (2005) argue that tangible elements, such as artefacts and infrastructure, should also be considered integral to regimes. Markard and Truffer (2008) further critique Geels's definition for conflating regimes with systems, suggesting that regimes should be delineated more distinctly. Similarly, Berkhout et al. (2004) propose defining regimes at the

sectoral or sub-sectoral levels, rather than broadly. Moreover, Smith et al. (2005) highlight a lack of clarity in the empirical delineation of regimes, complicating their application across sectors.

In summary, the concept of a regime is frequently defined in relation to the specific context, research aims, and sectoral focus of a given study. This flexible interpretation reflects the intricate and diverse nature of socio-technical systems.

Among several merits, the MLP deserves consideration in the current study of sustainability transition for various reasons: First, being able to learn nonlinear complex relations of data, it provides quite an exact modeling of multi-faceted interaction typical for many tasks that involve the issues of sustainability, such as resource management, energy optimization, and ecological impact evaluation. Its architecture offers the possibility to tailor-make the solutions based on requirements and complexities because there are many layer adjustments in this neural network with varying numbers of nodes. The strong generalization capability provided by techniques such as dropout and regularization prevents overfitting and gives reliable predictions for long-term planning. These attributes, together with the adaptability of MLP to various sustainability metrics and datasets, further underline its major part in the advancement of data-driven strategies for sustainable transition.

Although the MLP framework is very powerful, its critique has been on the meager attention given to cases outside Western contexts. While issues such as energy poverty, energy justice, and improvement of livelihoods started to get some traction, there was a great void in how power dynamics, political influence, and contextual nuances shape transitions in underrepresented areas. In addition, few attempts at applying niche theories and MLP have been made up until today; thus, their contribution adds significantly to filling a key shortcoming identified in the current body of literature on this subject. Such theoretically supported methods can bring additional profound understanding related to the difficulties found during energy transition in general but, more significantly, diversified socio-economic and political frameworks.

This observation constitutes the important opportunity to expand the theoretical lens of MLP studies. In extending research to non-Western contexts, scholars could identify challenges and opportunities particular to these regions. This would enrich the diversity and inclusivity of MLP-informed scholarship, offering a more globally relevant understanding of transition dynamics. This thus implies a very strong need for further and broader scholarly investigations using the MLP framework in diverse geographical and cultural settings.

To address the limitations of the MLP in accounting for the influence of stakeholders and their capacity to act during transition processes, recent scholarship has introduced the multi-actor

perspective (MAP). For instance, Schot and Kanger (2018) emphasize the importance of understanding how diverse actors contribute to transitions. The MAP offers a structured approach to differentiate and analyze actors at various levels, including both individuals and organizations, thereby enhancing clarity and improving the analytical robustness of transition studies.

This framework has been instrumental in the thesis as it effectively distinguishes the roles of various actors and their respective sectors, providing a comprehensible way to addressing the diversity of stakeholders. However, despite its strengths, the framework has been critiqued for oversimplifying the intricate relationships and dynamic interactions between actors, as its structure tends to be overly rigid. Therefore, it is essential to explore the actors and their agencies in greater depth.

2.3.2 Characteristics of Agency

The understanding of sustainability transitions has evolved through the development of dominant concepts and frameworks that offer a systemic view. However, the role of actors remains underexplored (Geels, 2011). Addressing this gap, some scholars have adopted a multi-level approach that emphasizes the interplay of actors across scales (Schot and Kanger, 2018). This framework categorizes actors into three types: state actors, non-state actors, and intermediaries, each playing a distinctive role in driving sustainability transitions.

Adopting a multi-scalar perspective is essential for comprehending the hierarchical relationships among local, regional, and national governments and their roles in transitions (Coenen et al., 2012). This perspective highlights the interactions between political scales and the dynamics of governance structures. For instance, the involvement of local governments in sustainability initiatives is a growing area of research. Bulkeley and Betsill (2013) identified key governance strategies employed by municipalities, such as experimenting with new policies, providing direct services, and acting as enablers for private and community initiatives.

Empirical studies on national-level actors are limited but reveal significant insights. Sovacool et al. (2019) explored national energy policies and highlighted how central governments shape the direction and pace of transitions through funding priorities and regulatory frameworks. National policies often dictate the feasibility of local initiatives, as demonstrated by Sovacool and Geels (2020) in their analysis of energy transitions in the UK, which revealed tensions between national priorities and local government ambitions. Similarly, Swilling et al. (2016) examined the complex relationship between national energy strategies and municipal-level implementation, emphasizing the need for coordination across scales to achieve low-carbon transitions.

Non-state actors encompass a broad spectrum of entities that play vital roles in sustainability transitions. At the grassroots level, households and community organizations are crucial for initiating and implementing innovative sustainability practices. Seyfang and Haxeltine (2012) highlighted the importance of grassroots innovations in fostering community engagement and building alternative pathways for sustainability.

In addition to grassroots entities, non-governmental organizations (NGOs) and third-sector actors play a transformative role. For example, Bäckstrand et al. (2010) demonstrated how NGOs influence policy and public behavior in climate governance through advocacy and education. Their work underscores the potential of third-sector actors to connect the policy frameworks and societal needs.

The private sector is another critical non-state actor group, especially in energy transitions. The role of private enterprises in driving innovation and scaling renewable energy solutions has been widely documented (Wüstenhagen et al., 2007). In emerging economies, such as Brazil, Castellani et al. (2018) examined the impact of private investments in renewable energy infrastructure, showcasing how market liberalization creates opportunities for private actors to accelerate sustainability transitions.

Intermediary actors play a pivotal role in sustainability transitions by linking stakeholders, fostering collaboration, and building networks (Hargreaves et al., 2013). Intermediary actors are organizations, institutions, or individuals that act as bridges between various stakeholders, facilitating communication, collaboration, and knowledge sharing. By engaging at both local and national levels and across different sectors, they support innovation and contribute to transformative change. These actors operate across levels, creating synergies between local, regional, and national initiatives. For example, Hodson et al. (2020) highlighted the contributions of intermediaries in facilitating knowledge transfer and policy alignment in the European Union's energy transition initiatives.

Raven et al. (2016) provided evidence of intermediaries fostering collaborations between local authorities and private actors in the Netherlands, resulting in successful transitions to low-carbon systems. These actors also contribute to broader systemic change by promoting institutional learning and enabling the diffusion of innovations (van der Schoor and Scholtens, 2015).

This chapter has delved into the multifaceted roles of state, non-state, and intermediary actors in sustainability transitions. By examining the hierarchical and cross-scale interactions among these

actors, it becomes evident that their capacities and agencies are crucial for effecting sustainable change. These actor dynamics underscore the necessity of integrated and participatory governance in transition processes. Subsequent discussions will explore how historical economic patterns, analyzed through the lens of evolutionary economic geography (EEG), influence these transition processes

2.4. Evolutionary economic geography (EEG)

Evolutionary Economic Geography, or EEG, is such a revolutionary theoretical framework that reconciles the principles of evolutionary economics with a spatial focus on how economic activities, innovations, and institutions grow and change in particular geographic areas. The foundational contributions to EEG come from Ron Boschma, who underlined related variety and regional branching, and Richard Nelson and Sidney Winter, whose evolutionary theories underpin the conceptual bedrock for economic adaptation and innovation. In contrast to traditional approaches that often consider economic landscapes as static or deterministic, EEG underlines the dynamic, path-dependent, and historically contingent nature of economic processes. It seeks to comprehend how the evolution of localized practices, institutional frameworks, and technological trajectories shapes the economic fortunes of regions and places.

EEG draws heavily on the core principles of evolutionary economics, which emphasize variation, selection, and retention as central processes in economic systems. When integrated with geographic analysis, these principles translate into spatially sensitive inquiries.

These processes are underpinned by key concepts like path dependence, lock-in, and regional branching. EEG posits that regions develop along historically specific pathways that constrain and enable future possibilities, often resulting in unique economic geographies.

Path dependence suggests that the economic trajectories of regions are strongly influenced by their historical developments. For example, the Ruhr region in Germany illustrates this concept, as its early focus on coal and steel industries created a path-dependent trajectory that influenced its economic structure for decades, making it challenging to diversify into new sectors. Lock-in occurs when a region’s economic activities become entrenched, making it difficult to shift to alternative paths. This concept explains why certain regions may struggle to transition from declining industries to emerging sectors.

Regional branching emphasizes that new economic activities often emerge from pre-existing industries or knowledge bases within a region. For instance, the transition from shipbuilding to offshore wind energy in regions like Northern Germany showcases how related industries can drive economic evolution, as detailed in studies by Boschma and others on related variety. These actor dynamics underscore the necessity of integrated and participatory governance in transition processes.

EEG offers a valuable perspective for examining the intricate and evolving relationship between economic processes and their spatial contexts.. Recent studies, such as Boschma (2015) on regional innovation systems and Martin and Sunley (2010) on path dependence in economic geography, highlight its impact and relevance in contemporary research. Its emphasis on evolution, history, and spatial specificity provides a nuanced perspective that is highly relevant in a rapidly changing global economy. Future research could focus on integrating EEG with emerging fields like sustainability transitions, digital economies, and global production networks.

2.4.1 Path dependence and lock-in

Path dependence offers a powerful lens to analyze the progression of socio-political-economic systems, emphasizing how historical decisions and trajectories can shape and limit future pathways (Arthur, 1989). Rooted in the seminal works of North (1990) and Page (2006), this concept asserts that a system's evolution is intrinsically tied to its historical context, where prior events and choices significantly influence current conditions. As Mahoney (2000, p. 514) observes, "Path dependence arises when early events or decisions establish trajectories that prove difficult to reverse, thereby constraining the range of future possibilities."

Economic geographers have elaborated on this by examining how historical patterns influence regional development. For instance, Maskell and Malmberg (1999) discuss how regional innovation systems evolve through path-dependent processes, where previous investments, local knowledge bases, and institutional structures interact to sustain certain trajectories. Similarly, Martin and Simmie (2008) identify how dependence on particular resources, entrenched institutional frameworks, and technological norms can anchor systems to specific paths, making deviation increasingly costly and improbable.

The transformative potential of path dependence lies in its ability to highlight how existing systems can evolve by recombining and redefining current assets. As highlighted by Grabher (1993), the rigidity of path-dependent systems can be disrupted through processes of creative destruction, leading to the reconfiguration of socio-economic structures. Furthermore, institutions play a

pivotal role in this transformation, as Pierson (2000) asserts that institutional arrangements can either reinforce path dependency or enable shifts through adaptive governance.

Complementing path dependence is the concept of lock-in, which explores how systems become entrenched in specific patterns of activity due to historical commitments and investments. Frenken and Boschma (2007) describe lock-in as a state where inertia stemming from established routines, sunk costs, and institutional frameworks limits the capacity for change. Initially, such lock-ins can promote stability and efficiency, as noted by Cowan and Hultén (1996), but over time, they can stifle innovation and adaptation.

Technological lock-in, as highlighted by Unruh (2000), emerges when large-scale systems and infrastructures, burdened by significant sunk costs, resist transitions to alternative technologies. For example, carbon-intensive industries face technological lock-in, where the high costs of adopting renewable technologies deter investment in sustainable solutions (Foxon et al., 2009). Such resistance is compounded by increasing returns to scale and network externalities, further solidifying reliance on existing systems (Arthur, 1994).

Institutional lock-in represents another critical dimension, where entrenched policies, regulations, and social norms reinforce the status quo, as described by Geels (2002). This form of lock-in is particularly evident in sustainability transitions, where the interplay of political power, economic interests, and cultural norms creates barriers to systemic innovation (Klitkou et al., 2015). The persistent resistance to change highlights the profound challenges of overcoming institutional inertia, which Geels and Schot (2007) argue necessitates multi-level governance strategies to foster transformative innovation.`

Recognizing and addressing these entrenched dynamics is essential for promoting sustainable development. By understanding the mechanisms of path dependence and lock-in, policymakers and stakeholders can design interventions that disrupt rigid patterns, enabling socio-economic systems to adapt to emerging global challenges. As Walker et al. (2004) emphasize, fostering resilience in socio-economic systems requires proactive strategies that balance stability with adaptability, ensuring systems remain robust and capable of transformation in the face of uncertainty.

2.5 Conclusion

This chapter delves deeply into the theoretical frameworks surrounding sustainability transitions, emphasizing their importance in understanding and managing such changes. By examining these perspectives critically, it highlights the intricate nature of sustainability transitions and the challenges involved. The MLP emerges as a particularly effective framework for analyzing the

dynamics specific to Azerbaijan. Its core advantage is in examining the relationships between multiple stakeholders and scales, alongside the effects of international dynamics. This perspective is vital for examining the diverse geographical patterns and historical legacies unique to Azerbaijan. However, the MLP is not without its shortcomings, particularly its limited focus on economic factors and geographical considerations. To address these gaps, the chapter advocates for integrating insights from EEG, which emphasizes concepts like path dependence and lock-in.

Incorporating EEG principles is especially significant in the context of Azerbaijan's historical and geographical distinctiveness. First, this integration enriches the MLP framework by emphasizing the temporal dimensions of agency and the influence of historical legacy—critical aspects in navigating sustainability transitions in a post-communist environment. Second, it enhances understanding of how historical movements and spatial relationships have shaped the current economic structure and the prospects for future sustainable development. Third, EEG's emphasis on path-dependent processes underscores the critical role of historical contingencies, highlighting the potential benefits and difficulties associated with the shift from a post-communist context.

Moreover, this chapter highlights the value of adopting a multi-actor lens to better understand how various stakeholders, including governmental, non-governmental, and intermediary entities, contribute to transition dynamics. This approach highlights the intricate interactions between different levels of political authority and explores the potential for both conflict and collaboration in driving sustainable change.

Importantly, the chapter also identifies limitations in existing theoretical frameworks, particularly in addressing the unique challenges faced by post-communist countries such as Azerbaijan. It points out a significant gap in the literature, as sustainability transition studies often overlook non-Western contexts. There is a growing demand for regionally grounded studies that reflect the specific political, economic, and societal characteristics of these countries.

In conclusion, the section provides a solid conceptual framework for understanding sustainability transitions in a post-communist setting, with a particular focus on Azerbaijan. It stresses the necessity of adopting a holistic way that combines diverse theoretical perspectives while considering the historical, geographical, and socio-political particularities of the region. This framework lays the groundwork for empirical studies on sustainability transitions in Azerbaijan.

CHAPTER 3: LITERATURE REVIEW: AZERBAIJAN AND POST-COMMUNIST TRANSFORMATIONS

3.1 Introduction

A thorough understanding is essential to grasp how historical decisions, institutional frameworks, and regional contexts shape the socioeconomic and political dynamics of these countries. This section sets out to suggest a nuanced perspective on the intricate and multifaceted processes of post-communist transformations by integrating an alternative approach to these changes with insights from EEG, emphasizing their significance for sustainable development and regional collaboration.

3.2 Transition process

Following the collapse of USSR in 1991 and the end of communist regimes in CEE in 1989, the region experienced a significant ideological and structural shift. The communist bloc fragmented into independent states, with many adopting the term “post-communism” to describe this new era of political, social, and economic transformation. Stark (1992) characterized post-communism as a transient "non-system," arising from the rejection of centralized socialism, while Goldstone (2001) coined the term "refolution" to capture the blend of reform and revolution driving the change. Scholars such as Csaba (1995) and Smith et al. (1998) observed that these countries embarked on a dual transition: politically, moving toward liberal democracy and civic society, and economically, pivoting to market-driven economies. This process involved sweeping reforms, including dismantling central planning, fostering foreign investment, privatising state assets, and cultivating entrepreneurial frameworks (Bradshaw and Stenning, 2004; Kolodko, 2000; Pickles, 2016; Sokol, 2001). Ultimately, the goal was rapid integration into the global market while redefining political and social structures to align with democratic and capitalist norms.

The economic transition in post-communist states was underpinned by a widespread belief that rapid and comprehensive neoliberal reforms would foster swift economic growth and help close the economic gap with Western economies (Fischer and Gelb, 1991; Murrell, 1992). Neoliberalism, as described by Thorsen and Lie (2007), emphasizes enhancing individual entrepreneurial freedoms within a framework that prioritizes private property, deregulated markets, and open trade. Central to this ideology is the notion that dismantling the old system entirely is a prerequisite for successful reform (Roland, 2000). Proponents like Lipton and Sachs (1990) advocated for an immediate and total overhaul, envisioning a transition characterized by what they called "shock therapy." Neoliberal reformers urged post-communist governments to abandon previous structures entirely, embracing a new market-oriented order. Drawing on this

framework, scholars such as Kornai (2000) highlighted the four critical elements of economic restructuring: price liberalization, inflation control, privatization of production assets, and integration into the global economy, all seen as essential for a seamless transition to a competitive market system.

Building on the perspectives of Sachs (1995), the implementation of rapid economic reform in CEE mirrored structural adjustment policies observed in other global regions undergoing similar transformations. This alignment implies that the experiences of advanced economies in navigating capitalist frameworks could offer valuable guidance for CEE's transition. Furthermore, perspectives from Stark and Bruszt's (1998) research underscore the influence of Western economic paradigms in shaping the reconstruction strategies within CEE.

The diverging results of shock therapy across countries underline the role of prior economic contexts and historical developments. For example, Poland and Czechia had some experience with market economies before communism; this historical legacy helped their adjustment to the new economy. The previous exposure to market mechanisms and entrepreneurial practices rendered the conceptual foundation for these countries' reintegration into the international economy easier. It was such a pre-communist market tradition that played a critical difference in determining a better adaptation to the imperatives of a capitalistic system and, therefore, it shows how specific historical context determines economic policy success (Ekiert & Hanson, 2003; Roland, 2004).

The economic challenges were just as severe and alarming. National industries faced widespread collapse, and production levels dropped sharply, resulting in soaring unemployment and heightened economic inequality. This overall instability was compounded by substantial surges in prices.

3.3 A Different Perspective on Post-Communist Transformations

The collapse of state socialism in CEE marked a turning point, ushering in a period of profound socio-economic and political transformation. Initially, neoliberal frameworks dominated discussions on transition, emphasizing rapid market liberalization and minimal state intervention (North, 1990; Sokol, 2001). However, the shortcomings of these strategies became evident, sparking debates about alternative approaches that consider the complex legacies of communism (Smith & Timar, 2010). This chapter delves into the institutionalist perspectives that emerged as a response, focusing on embeddedness and path dependence as key concepts for understanding the multifaceted nature of post-communist transformations.

Neoliberalism, characterized by market liberalization, privatization, and fiscal discipline, was widely implemented in post-communist countries (North, 1990). Advocates believed this approach would lead to efficient markets and rapid economic growth. However, the application of neoliberalism often ignored historical and institutional legacies. Shock therapy, a rapid transition strategy, faced criticism for exacerbating economic inequality, political instability, and social fragmentation (Sokol, 2001). Proponents argued for the complete dismantling of communist structures, while critics highlighted its failure to account for pre-existing social networks and institutional frameworks, leading to uneven outcomes across the region (Smith & Timar, 2010).

In contrast, institutionalist perspectives emphasize the role of institutions in shaping economic behavior and outcomes, viewing the economy as embedded in social relations and broader societal processes (North, 1990; Smith & Timar, 2010). Institutionalism prioritizes the concepts of embeddedness—the integration of economic activities into social and cultural contexts—and path dependence, which underscores the influence of historical legacies on current trajectories. Recognizing that new systems are built "from the ruins of communism," institutionalist perspectives stress the importance of adapting pre-existing resources, organizational forms, and cultural norms to new socio-economic realities (Sokol, 2001).

The concept of embeddedness originates from economic sociology, emphasizing the integration of economic activities into broader social frameworks (North, 1990). Geographers have expanded the concept to include spatial dimensions, illustrating how local institutions and networks influence regional development. For example, regional development agencies in Southeast Poland and informal networks in Ukraine played critical roles in facilitating transitions (Smith & Timar, 2010; Sokol, 2001). Embeddedness brings a lens for comprehending how social and institutional concept form economic activities, highlighting the interplay between local traditions and global influences.

Path dependence, on the other hand, denotes that past decisions and institutional trajectories heavily influence present and future developments (North, 1990). While historical legacies can act as constraints, they also serve as resources for innovation and adaptation. Organizational forms and cultural practices from the communist era have been reconfigured to support new economic systems (Sokol, 2001). The spatial aspects of path dependence reveal how place-specific histories shape regional disparities. For instance, Ukraine's struggles with kleptocracy and passive social norms illustrate the challenges of leveraging historical legacies for development (Smith & Timar, 2010).

Together, these concepts challenge the notion of linear, universal transitions to capitalism, offering a more nuanced understanding of the varied trajectories observed in post-communist regions (North, 1990; Sokol, 2001).

Post-communist transitions involve the reconfiguration rather than replacement of existing systems. This process reflects the "bricolage" approach, where old and new elements are combined to create unique developmental pathways (Smith & Timar, 2010). Contrary to neoliberal expectations, some countries experienced "vicious circles," where political and economic transformations undermined each other. Outcomes ranged from "bandit capitalism" to hybrid systems (Sokol, 2001).

Actors in post-communist transitions have employed innovative strategies to navigate constraints, demonstrating the potential for agency in shaping new trajectories (North, 1990). These adaptive strategies highlight the dynamic nature of transitions, emphasizing the importance of context-sensitive approaches (Smith & Timar, 2010).

Mechanisms such as foreign direct investment (FDI), trade, and financial flows have profoundly influenced post-communist transitions. However, these mechanisms often exacerbated regional inequalities. Western-led initiatives often imposed conditionalities that favored wealthier regions, deepening the East-West divide (Sokol, 2001). For instance, FDI flows concentrated in politically stable countries like Poland and Hungary, leaving others behind (North, 1990). The distribution of resources and opportunities underscores the limitations of neoliberal strategies in addressing regional disparities (Smith & Timar, 2010).

Moreover, the influence of international institutions, driven by neoliberal ideals, played a pivotal role in promoting free-market ideology in former Soviet countries. Their interventions often perpetuated regional imbalances, shaping the economic and social landscape of post-communist states (Sokol, 2001).

Three decades after the collapse of state socialism, post-socialist studies remain vital for understanding the enduring impact of communist legacies on contemporary systems (Smith & Timar, 2010). State-socialist legacies continue to shape economic geography, labor markets, and social dynamics in CEE countries. For instance, industrial location patterns and urban development frameworks rooted in the communist era still influence economic activities (Sokol, 2001).

New approaches emphasize the integration of historical and geographical contexts, offering insights into the diverse trajectories of post-communist societies. By acknowledging the

complexities of these transitions, scholars can better understand the interplay of historical legacies and contemporary global influences (North, 1990; Smith & Timar, 2010).

The limitations of neoliberal approaches to post-communist transitions underscore the need for alternative frameworks that consider historical, institutional, and socio-cultural legacies. Institutionalism, with its emphasis on embeddedness and path dependence, offers a detailed insight into the multifaceted nature of transition processes. By integrating these perspectives, this chapter highlights the importance of context-sensitive strategies for fostering equitable and sustainable development in post-communist regions (Sokol, 2001; North, 1990).

3.4 Evolutionary Economic Geography

Post-communist transformations have led to uneven development both between and within countries. A geographical approach, such as EEG, offers valuable insights into these varied trajectories. EEG emphasizes the importance of historical legacies and spatial contexts, focusing on the interplay between institutional frameworks, proximity, and socio-economic dynamics. This chapter explores how EEG can deepen our understanding of post-communist transitions, with a particular focus on sustainability transitions in regions marked by path dependence and historical legacies (Hensen & Coenen, 2015).

Post-communist regions, such as CEE and the former Soviet republics, illustrate how transitions are shaped by historical events and spatial relationships. EEG integrates the concept of path dependence to examine how institutional legacies influence current trajectories. Similarly, it emphasizes proximity—both spatial and non-spatial—to explain how regional development is affected by external connections and cultural ties. This narrative underscores the adaptability of EEG as a framework for understanding regional transformations. I found the implementation of EEG in research on sustainability transitions in the former Soviet context useful due to these particular regions' strong path dependence and observable traces of the past.

Path dependence is a cornerstone of EEG, reflecting how historical events and institutional legacies shape future trajectories. As Stark and Bruszt (2001) argue, the exploitation of institutionalized resources during transitions highlights the paradox of transformation even radical change is marked by historical continuity. Pierson (2000) reinforces this by demonstrating how early events and institutional developments create deterministic pathways, profoundly influencing political and economic landscapes. Mahoney (2000) builds on this by showing how critical junctures, such as the fall of communism, leave enduring impacts on institutional frameworks.

These insights align with EEG's focus on sustainability transitions, which capture the interconnectedness of regional development processes. Bouzarovski (2009) frames energy

transitions in CEE and Central Asia as the liberalization of the energy sector, marked by shifts in ownership structures and competition dynamics. Xiao et al. (2016) complement this view, arguing that these transitions follow a more related pathway compared to the knowledge-intensive transitions observed in Western Europe. Leveraging existing institutional resources has proven more effective than radical restructuring, demonstrating the path-dependent nature of these changes.

EEG emphasizes the role of both spatial and non-spatial proximity in shaping regional development trajectories. Spatial proximity fosters network formation and knowledge transfer, facilitating transformation processes (Asheim et al., 2011). For instance, Berkhout et al. (2009) argue that the better economic and political performance of CEE countries compared to former Soviet republics can be attributed to their proximity to Western Europe, which enables network production and donor intervention. McCauley and Stephens (2012) highlight that collaborative innovation projects—a key driver of transformation—have successfully been transferred to CEE countries due to their geographical and cultural closeness to Western Europe.

Non-spatial proximity, such as cognitive and cultural resemblance, further influences transitions by fostering shared norms and institutional learning. These proximities enable the diffusion of resources, norms, and institutions necessary for political and economic transformation. It underscores the significance of both geographical and relational dynamics in shaping developmental outcomes.

EEG provides a comprehensive lens for analyzing post-communist transformations, integrating historical and spatial dimensions to explain regional development patterns. While alternative approaches to post-communist transformations emphasize the socio-economic legacies of communism, EEG's broader orientation incorporates spatial dynamics, making it adaptable to various regional contexts. For example, the compatibility between EEG and institutionalist perspectives enhances our comprehension of sustainability shifts by emphasizing the influence of geographic and institutional settings in shaping transformation.

Applications of EEG range from energy transitions to knowledge transfer and regional development trajectories. By examining these processes through the lens of path dependence and proximity, EEG elucidates the complex interactions that shape post-communist regions' evolution. It demonstrates that transformation is not solely dictated by historical constraints but also influenced by regional networks and external connections.

EEG offers a robust framework for understanding post-communist transformations, emphasizing the importance of spatial and historical contexts. By integrating path dependence and proximity,

EEG provides nuanced insights into sustainability transitions and regional development trajectories in post-communist regions. This perspective complements alternative approaches, offering a comprehensive lens for analyzing the complexities of political and economic change. EEG's emphasis on the interplay between spatial dynamics and institutional legacies makes it a valuable tool for understanding the uneven development patterns that characterize post-communist transformations.

3.5 Conclusions

This section provided a critical assessment of the post-communist transitions undergone by former Soviet states after the dissolution of USSR, focusing particularly on the spatial and economic dimensions of these changes. The primary goal was to assess how neoliberal reforms and gradualist strategies have differently influenced the socio-economic landscapes of these countries, shaped by their historical contexts and institutional structures.

The chapter begins by examining the "shock therapy" model, advocated by neoliberal proponents as a rapid means to achieve economic prosperity and narrow the disparities between Eastern and Western European regions. Although this approach yielded economic growth and integration for some nations, such as Poland and Hungary, it frequently intensified disparities and heightened economic inequalities both across and within countries.

Alternatively, the chapter advocates for a more nuanced approach to post-communist transitions in former Soviet states, grounded in institutional theory. This viewpoint emphasizes how historical legacies shape the pace, scope, and trajectory of economic and social change. By acknowledging the intricate nature of post-communist changes and the importance of pre-existing social relations and institutional frameworks, this alternative approach offers a deeper understanding of the sustainability paths followed by post-Soviet nations.

Additionally, the chapter underscores the relevance of EEG in studying post-communist transformations. The EEG framework emphasizes the significance of historical trajectories and spatial dynamics, suggesting that contemporary regional disparities and economic inequalities in CEE are deeply rooted in historical developments rather than solely recent policy decisions. Furthermore, its focus on innovation and the evolution of economic clusters sheds light on why some regions have adapted more successfully to the new economic landscape, while others have struggled. As such, EEG provides a valuable theoretical tool for understanding the varied sustainability pathways across these countries.

In conclusion, this chapter establishes a foundational framework for analyzing post-communist transitions. The next chapter will build upon this by exploring thematic concerns, particularly the

critical role of urban environments in shaping sustainability transitions in post-communist societies.

CHAPTER 4: MATERIALS AND METHODS: EXAMINING THE SHIFT TO SUSTAINABLE ENERGY IN AZERBAIJAN'S THE POST-COMMUNIST ERA

4.1. Introduction

This chapter transitions from theoretical discussion to a detailed exploration of the research methodology and strategy. It begins by establishing the research context, outlining the chosen research strategy while addressing its advantages, limitations, and methodological considerations. Given the post-communist backdrop of Azerbaijan, the section examines the unique obstacles encountered during the research process, shaped both by the subject matter and the socio-political dynamics of the country.

Azerbaijan's fluid and complex socio-political environment necessitated a nuanced approach, balancing depth and breadth. To comprehensively understand the country's energy transition pathway, the research incorporated diverse factors, including economic, political, institutional, and socio-cultural spheres, as well as the roles of various actors within the energy landscape. The study was deeply influenced by the intricate political and socio-economic realities of Azerbaijan's post-communist context. Recognizing these complexities, the research leveraged a wide range of data sources and perspectives to construct a cohesive narrative. Consequently, this chapter highlights the multi-dimensional and adaptive face of the research strategy.

The chapter is structured as follows: Section 4.2 establishes the philosophical and methodological underpinnings of the study. Section 4.3 presents the overall research strategy, with particular emphasis on the case study approach and the rationale for selecting Azerbaijan. Section 4.4 reviews the data collection techniques employed, such as interviews and document analysis, while Section 4.5 explains the procedures used for data analysis. The chapter concludes with Section 4.6, which offers a summary of the key points discussed.

4.2 Research Context

Sustainability transitions research has evolved into a highly interdisciplinary field, with significant empirical contributions emerging from various academic disciplines, including anthropology (e.g., Smith and Stirling, 2018), environmental science (e.g., Leach et al., 2012), urban planning (e.g., Evans et al., 2016), innovation studies (e.g., Geels et al., 2017), and behavioral economics (e.g., Shove, 2014). This interdisciplinarity enriches the field by offering diverse perspectives and fostering a more integrated understanding of sustainability transitions. However, it also introduces

methodological complexity, as scholars employ distinct discipline-specific methods and frameworks. These approaches inherently reflect varying ontological and epistemological assumptions, thereby necessitating a careful consideration of methodological congruence and integration.

To address these challenges, the 'transition research onion' has been proposed as a guiding framework. This model provides a systematic approach by delineating a transition research philosophy—comprising layers such as research questions and paradigms—from a transition research design, which includes elements such as theoretical frameworks, methodological choices, data collection strategies, and temporal perspectives. The transition research onion aids in structuring interdisciplinary studies by aligning philosophical foundations with methodological decisions. In the subsequent chapter, the paradigms and conceptual frameworks underpinning this study are examined, offering clarity on the methodological and philosophical choices made in this study.

4.2.1 Epistemological and Ontological positions

A paradigm refers to a coherent set of assumptions, values, and practices that guide researchers in how they perceive and study reality. It serves as a foundational framework for research by aligning beliefs about the nature of reality (ontology) and the nature of knowledge (epistemology) with specific methodological choices. Among the most widely recognized paradigms are positivism, which prioritizes objective and quantifiable observations; interpretivism, which centers on subjective meanings and social contexts; and critical theory, which challenges power structures and advocates for transformative social change. Paradigms shape the formulation of research questions, data collection strategies, and the interpretation of findings.

Epistemological and ontological positions form the foundational pillars of philosophical inquiry and academic research, shaping how knowledge is perceived and studied. Ontology concerns itself with the nature of reality, addressing questions about what exists and the fundamental structures of being (Guba & Lincoln, 1994). It explores whether social phenomena are objective entities independent of human perception or socially constructed and shaped by interactions (Crotty, 1998). On the other hand, epistemology focuses on the nature and scope of knowledge, asking how we come to know what we know, the reliability of knowledge claims, and the criteria for truth (Creswell, 2014). Together, these positions influence research methodologies, determining whether studies adopt a positivist stance, emphasizing objective, measurable truths, or an interpretivist approach, prioritizing subjective experiences and meaning (Bryman, 2012).

Understanding these positions is crucial, as they guide researchers in aligning their methods and interpretations with their philosophical worldview.

This study's primary aim is to analyze pre-existing structures and emerging agencies through a historically situated lens, making it closely aligned with critical realism. Critical realism, developed as an alternative to positivism and pragmatism, seeks to explain surface-level events by examining causal mechanisms and underlying structures (Geels, 2022). Positivist proponents view transitions as consisting of observable and measurable facts, asserting that reality is objective and independent of researchers' cognition (Saunders et al., 2015). While this perspective contributes to understanding transitions, it falls short in addressing agency, context-specific dynamics, and the complex causalities inherent in socio-technical transitions. Conversely, pragmatists interpret transitions as the practical outcomes of ideas and knowledge, emphasizing their utility in enabling actionable solutions to identified problems. Unlike positivists, pragmatists regard "theories, concepts, ideas, hypotheses, and research findings in terms of the roles they play as instruments of thought and action" (Saunders et al., 2018). Although the pragmatist approach facilitates investigation into specific issues using quantitative methods, it struggles to fully encompass the complexity and phenomenological dimensions of socio-technical transitions. Therefore, critical realism offers a particularly apt philosophical foundation for research on socio-technical transitions due to its emphasis on structures, actors, and causal mechanisms.

At its foundation, critical realism is built on several fundamental principles: Ontological Realism: Critical realism suggests a layered reality divided into three distinct domains: the real, the actual, and the empirical. The 'real' consists of the deep structures and causal mechanisms inherent in entities—be they physical, social, or relational. These mechanisms possess causal powers regardless of whether they are currently active or observed. The 'actual' represents events triggered by these causal powers, which may or may not be visible. Finally, the 'empirical' refers to events that are directly experienced or observed, emphasizing a clear distinction between existence and observation (Lawani, 2021).

Epistemological Relativism and Judgmental Rationality: Critical realism recognizes that human understanding is shaped by subjective perspectives and conceptual frameworks, making it inherently fallible. However, it also maintains that objective knowledge of the world is attainable. This perspective underscores the importance of subjecting knowledge claims to critical evaluation and accepting that they may evolve with new evidence or stronger arguments (Bogna et al., 2020).

Methodological Pluralism: Critical realism advocates for employing diverse research methods to investigate and explain the intricate nature of social phenomena. It values both qualitative and

quantitative approaches, emphasizing methodologies capable of uncovering the underlying causal mechanisms driving observed phenomena (Vincent and Mahoney, 2018).

Critical realism asserts that social phenomena arise from underlying mechanisms that are continuously evolving, driven by human actions and interactions. This perspective calls for social scientific methods capable of uncovering these mechanisms while acknowledging human reflexivity and the potential for transformation. As a philosophical approach, critical realism supports a deeper exploration of social complexity by directing attention to the hidden structures and forces driving observable events.

Critical realism highlights the need to understand structures, agents, and causal mechanisms, requiring a clear distinction between different types of causation. Outcomes are understood as the result of agent actions, endowed with causal powers, operating within and mediated by structural mechanisms. Two main forms of causality are commonly identified. The first, linear causality, addresses simple, straightforward cause-and-effect relationships, often characterized by a direct sequence of events (Blaikie, 2007). The second encompasses complex causalities, which can be further categorized into conjunctural, configurational, and event-chain causality.

Configurational causality, also referred to as "co-evolution," examines how the convergence and interaction of multiple causal factors generate outcomes. Falleti and Lynch (2009) describe this form of causality as a mode of analysis that explores how diverse factors combine to create larger causal configurations or systems. While this framework is especially valuable in analyzing transformations within heterogeneous systems, it struggles to account for the intricacies of social phenomena such as socio-technical transitions, which involve interconnected and multifaceted causal processes rather than a singular, integrated system.

Event-chain causality, in contrast, focuses on the sequential connections and causal linkages between events, providing insight into how processes develop over time. Abbott (2001) emphasizes the importance of examining how each event's position within a sequence shapes its effects, particularly in historical and social contexts. However, while event-chain analysis is helpful for identifying causal patterns and developmental trajectories, it remains limited in addressing the broader complexity of phenomena like socio-technical transitions, which demand a more integrative approach to understand their interconnected dynamics and components (Sayer, 2010).

In summary, critical realism follows up particularly with the epistemological underpinnings of transition research, which increasingly emphasize a process-oriented approach to causality and explanation. Specifically, the agentic-processual variant of critical realism proves particularly

well-suited for analyzing socio-technical transitions. Its framework enables the exploration of long-term transformative changes within complex and heterogeneous systems by focusing on the interplay of events and processes over time.

4.2.2 Conceptual Framework

Critical realism is characterized by its realist ontology and relativist epistemology, implying that it regards theories as heuristic tools for explaining concrete phenomena through diverse concepts such as actors, activities, structures, and causal mechanisms (Bhaskar, 1975; Sayer, 1992). This approach underscores the value of theoretical frameworks in guiding researchers to focus on specific theories and concepts, thereby enabling them to address distinct research problems (Easton, 2010). For instance, Köhler et al. (2019) describe theoretical frameworks as methodological constructs, conceptual tools, and heuristic devices that facilitate the study of transitions in complex systems.

To address intricate causalities and account for temporal dynamics, scholars advocate for the application of multiple theoretical frameworks that capture diverse causal mechanisms and processes (Pettigrew, 1997; Ragin, 2008; Mahoney, 2012). As Pettigrew (1997, p. 338) notes, "Complex phenomena necessitate the deployment of pluralistic frameworks to illuminate their multidimensionality and nuanced processes."

Given the multi-actor, wide nature of socio-technical transitions, this study integrates the MLP and TIS frameworks, as previously elaborated. The MLP framework, with its core concepts of niche, regime, and landscape, is particularly suited for analyzing the dynamics of low-carbon transitions (Geels, 2002; Smith et al., 2005). Additionally, combining insights from evolutionary economics, institutional theory, and innovation studies, this approach provides a robust middle-range framework for understanding socio-technical change (Hekkert et al., 2007).

To examine Azerbaijan's energy transition, the study employs the TIS approach alongside the MLP. The TIS framework's focus on system functions, institutional alignment, and resource mobilization helps highlight the dynamics driving or impeding transition processes in practice (Wieczorek & Hekkert, 2012). This conceptual framework, which incorporates both MLP and TIS perspectives, forms the foundation of the research strategy. By aligning theoretical underpinnings with the methods and objectives, this integrated approach ensures coherence and depth in addressing the research questions. The subsequent sections will elaborate on how the conceptual framework has directly informed and structured the research methodology.

4.3 Case Study Strategy

Case studies have become a cornerstone of qualitative research, offering a unique pathway to explore complex phenomena in their real-world settings. They are particularly valued for their ability to provide rich, context-specific insights that other methodologies often fail to capture. As Silverman (2013) observes, the strength of case studies lies in their ability to deeply investigate specific issues, uncovering layers of meaning that illuminate broader patterns. Despite this, case studies have often been overlooked or misunderstood in the methodological discourse. Hammersley and Gomm (2000) argue that research literature frequently misrepresents case studies, conflating them with other forms of inquiry, while Simons (2009) notes that attempts to define the method have often resulted in greater confusion due to the diversity of interpretations.

When the aim of research is to address "how" and "why" questions, the case study emerges as an indispensable tool. Yin (2014) explains that case studies are particularly effective when researchers aim to explore contemporary phenomena within their natural contexts, especially in scenarios where external control is limited. In this project, the focus on Azerbaijan's energy transition aligns seamlessly with this methodology. By examining the interplay between citizens, entrenched incumbents, and evolving political frameworks, the study aspires to reveal the nuanced dynamics shaping the country's trajectory.

Stake (1995) captures the essence of the case study by emphasizing its ability to delve into human affairs in a way that feels grounded and relatable. This feature makes the method particularly apt for exploring phenomena that unfold within unique social and political contexts. Azerbaijan, with its rich natural resources and a politically regulated environment, presents a compelling case for this kind of detailed investigation.

One of the most notable strengths of case studies is their versatility. They can take on various forms depending on the research objectives. Fisher and Ziviani (2004) outline three primary types: exploratory, descriptive, and explanatory case studies. Exploratory studies are used to investigate situations with uncertain outcomes, descriptive studies aim to document processes or interventions, and explanatory studies seek to uncover causal relationships. For this project, an explanatory approach is the most fitting, as the research seeks to understand how historical, political, and economic factors have influenced Azerbaijan's energy transition.

Despite their widespread use, case studies are not without their detractors. Critics often point to their perceived lack of objectivity, precision, and generalizability (Starman, 2013). Yin (1994) acknowledges these concerns but reframes them by emphasizing the case study's strength in providing deep, contextualized insights rather than broad, statistical generalizations. Stake (1995)

further supports this view, arguing that the purpose of a case study is not to represent the world but to illuminate the intricacies of the specific case. Starman (2013) concurs, advocating for analytical induction over statistical generalization as the primary goal of case study research.

Selecting the right case and participants is a critical step in any case study. Brown (2008) identifies two levels of sampling in case studies: selecting the case itself and choosing participants within the case. While the selection process may be guided by the research problem, participant selection often involves purposeful techniques such as snowball, network, or theoretical sampling (Bradshaw & Stratford, 2010). Mesec (1998) advises that researchers begin by identifying a practical problem of interest and then select a case where this problem is evident.

There is some debate among scholars about whether to focus on typical cases or unusual ones. Bradshaw and Stratford (2010) emphasize the value of disconfirming cases, which challenge existing assumptions and provoke deeper reflection. Conversely, Yin (2009) advocates for the study of typical cases, arguing that they can reveal new hypotheses and overlooked dynamics. The appropriateness of a case hinges on its relevance to the research goals and its potential to yield rich analytical insights.

For this study, Azerbaijan was chosen as the focus due to both theoretical and practical considerations. Its abundant energy resources, strong incumbent actors, and unique position within the post-communist Caucasus region make it an ideal site for exploring the dynamics of energy transitions. Unlike many other post-communist nations, Azerbaijan faces significant resistance to transition from entrenched players, creating a compelling dichotomy between old systems and emerging alternatives.

Practical factors also support this choice. Being familiar with the language and local context of Azerbaijan allows the researcher to obtain richer data and grasp the intricacies of its sociopolitical environment. Starman (2013) argues that prior knowledge of a case often enhances the research design, enabling the development of a more robust theoretical foundation.

Critics of case study research often raise concerns about subjective case selection and potential bias (George & Bennett, 2005). However, Starman (2013) counters that selecting a case based on prior knowledge can lead to more meaningful insights. Cases chosen for their unique characteristics or relevance to the research problem are particularly valuable in advancing theoretical understanding and ensuring rigorous analysis.

The case study strategy offers an invaluable framework for investigating complex phenomena in real-world contexts. While critiques of objectivity and generalizability persist, scholars such as

Yin (2014) and Stake (1995) have highlighted the unique insights that case studies can provide. For this project, Azerbaijan is a well-suited case for this study, as it provides a valuable context for exploring the tensions between established energy structures and emerging renewable alternatives within the country's transition process.

The following section outlines the qualitative methods applied in this research. Expanding on the case study approach, it describes the specific procedures used for data collection, analysis, and interpretation, ensuring methodological rigor while remaining sensitive to the study's contextual setting.

4.4 Data collection methods

In the evolving field of transition studies, selecting an appropriate data collection method is crucial for obtaining insights that reflect the depth and complexity of the subject matter. Research methods are broadly categorized into two main types: quantitative methods, which emphasize the identification of patterns, trends, and defining characteristics within a population (Creswell, 2014), and qualitative methods, which focus on understanding phenomena through the analysis of narratives, perceptions, and contextual meanings. According to Silverman (2020), qualitative research seeks to understand the social world through participants' interpretations, prioritizing depth over numerical data. For this study's explanatory nature, qualitative methods were deemed the most suitable approach.

Within the qualitative research paradigm, various methods can be employed, but their suitability depends on the study's objectives and design. As this research adopts a case study strategy, it is vital to choose a data collection method that aligns with the strategy's focus on depth and context-specific understanding. Interviews with key stakeholders were identified as the most appropriate method, given their utility in case study research. Yin (2018) underscores the role of interviews as a core data collection tool in case studies, enabling researchers to capture nuanced, in-depth information. Similarly, Thomas (2016) notes that interviews provide a flexible platform for exploring individual experiences and perspectives, making them an invaluable resource for examining complex phenomena.

Interviews allow researchers to delve into participants' views and experiences, which is particularly beneficial for studying transitional processes and decision-making dynamics. This method not only facilitates rich qualitative insights but also supports the case study's aim of uncovering context-specific details that may not be accessible through other methods.

A frequent critique of case study research is its limited generalizability, as it often focuses on unique or context-specific examples. To address this limitation, this study incorporates triangulation, a methodological approach that enhances reliability and validity by integrating multiple data sources and methods. According to Denzin and Lincoln (2018), triangulation strengthens research findings by providing multiple perspectives on the same phenomenon, thereby reducing potential biases.

In this study, triangulation is achieved by combining interviews with qualitative documentary analysis. This methodological synergy allows for cross-verification of findings, improving their accuracy and robustness. The integration of diverse methods ensures that the research outcomes are more credible and contextually enriched, addressing concerns about potential limitations of individual approaches.

By leveraging the complementary strengths of interviews and documentary analysis, this study ensures a well-rounded and methodologically sound approach to investigating the complexities of transitions. The detailed implementation of these methods will be elaborated in the subsequent sections, highlighting their respective roles in addressing the study's research questions.

4.4.1 Interviews

Interviews remain a cornerstone of qualitative research, often utilized to explore the intricate details of participants' lived experiences, beliefs, and opinions (Cohen, Manion, & Morrison, 2018). They provide a means to understand complex phenomena through the narratives of individuals, uncovering layers of meaning that other methods may overlook. As Denscombe (2017) argues, interviews offer a unique depth of inquiry, enabling researchers to explore subjective perspectives in a dynamic, interactive manner.

Interviews were used as the main data collection method in this study for two key reasons. First, the social and political complexities of sustainability transitions required a method capable of eliciting detailed explanation into the motivations, perceptions. Second, energy transitions, as a multifaceted subject, demanded a deeper understanding of individual rationales and viewpoints. Interviews, as noted by Gubrium and Holstein (2002), are well-suited to capture the nuances of human behavior, allowing researchers to delve into subjective meanings and relational dynamics.

Interviews also address a gap that quantitative methods often fail to bridge: the ability to examine decision-making processes and stakeholder relationships within complex systems. As Patton (2015) highlights, interviews excel at uncovering rich, contextual data that structured questionnaires or surveys may miss. Additionally, they align well with critical realism

frameworks, as they enable researchers to investigate causal mechanisms and underlying social structures (Fletcher, 2017).

One of the most notable advantages of interviews is their adaptability and openness. Flick (2018) emphasizes that the flexibility of interviews enables researchers to navigate conversations organically, tailoring questions in real-time based on participant responses. This adaptability facilitates a deeper exploration of emergent themes while allowing participants to express themselves freely. However, the unstructured nature of interviews can pose challenges, such as inconsistent data collection and potential biases introduced by the interviewer's influence.

To mitigate these issues, this study adhered to a structured process based on Kvale's (2007) seven-stage model for conducting interviews. These stages defining the purpose, designing the study, conducting the interviews, transcribing, analyzing, validating, and reporting—provided a systematic framework to ensure reliability and consistency in data collection.

The thematising stage, a preparatory phase, focused on defining the purpose of the research and identifying key themes. This stage involved a comprehensive examination of the literature and a preliminary analysis of relevant documents, which informed the conceptual framework, research questions, and overall strategy. As Yin (2018) notes, a robust thematic foundation ensures that the subsequent stages of research are grounded in a clear and focused direction.

The designing stage involved planning the procedures and techniques necessary to meet the research objectives. This included selecting an appropriate interview format, developing an interview guide, determining the sampling method, and outlining a strategy for participant recruitment. Bryman (2016) emphasizes that careful planning at this stage is critical for balancing flexibility with the need for methodological rigor.

This research primarily utilized semi-structured interviews, which provide a balance between the rigidity of structured interviews and the openness of unstructured formats. Semi-structured interviews, as described by Gill, Stewart, Treasure, and Chadwick (2008), involve a predefined set of questions while allowing for flexibility in the order and phrasing of queries. This approach enables researchers to explore unexpected themes and insights while maintaining a consistent line of inquiry across interviews.

Semi-structured interviews were particularly feasible for this research as they allowed for tailored questioning based on participants' expertise while ensuring that all relevant themes were addressed. This flexibility was essential for capturing the diverse perspectives of stakeholders involved in Azerbaijan's energy transition.

The selection of participants was guided by purposive sampling, which focuses on identifying individuals who are best positioned to provide insights relevant to the research objectives (Palinkas et al., 2015). To gain a thorough grasp of the subject matter, participants were drawn from five key groups: state actors, third-sector representatives, business professionals, students, and experts.

Participants were identified through desk research, criterion sampling, and snowball sampling. Criterion sampling was used to select participants who possessed the necessary expertise and viewpoints, whereas snowball sampling allowed for the identification of further participants through recommendations made by those initially interviewed. As noted by Biernacki and Waldorf (1981), snowball sampling is particularly effective in identifying hard-to-reach participants or those with specialized knowledge.

Interviews were conducted primarily online due to logistical constraints, including travel restrictions and limited funding. Participants were offered the choice of 3 languages—Azerbaijani, Turkish, and English—to ensure that language barriers did not hinder the data collection process. Interviews were conducted in a semi-structured format using open-ended questions and typically ranged from 30 to 60 minutes in duration.

At the start of each interview, participants were reintroduced to the research project and their consent for participation and audio recording was reaffirmed. In line with Robson's (2011) guidance, the initial questions served as icebreakers to foster a relaxed atmosphere. The core section of the interview delved into the central research topics, while the closing segment allowed interviewees to raise questions or seek clarification on any discussed issues.

The concept of data saturation was employed to determine the appropriate sample size. Saturation occurs when no new information emerges from additional interviews, signaling that the data collected is sufficient for addressing the research questions (Guest, Bunce, & Johnson, 2006). In total, 41 interviews were conducted, meeting the criteria for saturation while aligning with guidelines for qualitative research.

Interviews were integral to this study, providing rich, contextualized data on the complexities of sustainability transitions and energy dynamics. By employing a structured yet flexible approach, the research ensured that diverse perspectives were captured while maintaining methodological rigor. Through careful planning, recruitment, and execution, the interviews contributed significantly to the study's ability to address its objectives and uncover new insights.

4.4.2 Documentary Analysis

Documentary analysis, as noted by several scholars, serves as a complementary tool to other data collection methods, such as interviews and ethnography (Liamputtong & Ezzy, 2005). It is considered a non-reactive or unobtrusive research method, meaning it extracts social and cultural meanings from pre-existing resources, including written records, audiovisual materials, and physical evidence of human behavior (Liamputtong & Ezzy, 2005). Unlike data collected through interviews, this type of information is not generated by the researcher but rather exists independently, ready to be gathered.

This research employed documentary analysis as a method alongside qualitative interviews to enhance the reliability and validity of the data. Moreover, documentary analysis is particularly valuable when investigating politically sensitive topics or when respondents might be unwilling to answer specific questions due to political constraints. Another benefit is its efficiency, as the required data is often already available, making the method less time- and resource-intensive (Liamputtong & Ezzy, 2005).

The analyzed sources included a range of online materials selected through a systematic content analysis. This approach involved establishing clear criteria to ensure the relevance of the information to Azerbaijan's energy transition, using standardized search terms across multiple news platforms. The study also examined various policy and strategy documents formally produced and published by governmental bodies involved in energy transitions. In addition, documents and blog posts from businesses and third-sector organizations whose representatives were interviewed were collected and analyzed. Other key sources included news articles and academic literature.

Documentary analysis served multiple purposes in this study. In the initial stage, it was employed for contextual analysis to establish a solid foundation before conducting stakeholder interviews. In the subsequent stage, it was used for qualitative comparison, focusing on documents containing the most relevant and significant elements aligned with the research objectives. During this phase, documentary analysis played a crucial role in complementing and validating the data gathered through interviews.

Despite its limitations, documentary analysis was instrumental in this study, offering historical and real-time insights that were essential for identifying long-term trends and patterns in Azerbaijan’s energy landscape, additional perspectives that interviews alone may not have sufficiently revealed.

4.5. Data Analysis

Once data collection was complete, the project entered its final phase: data analysis. This stage spanned four months. While the analysis became more intensive after the data collection concluded, the two processes largely overlapped. This simultaneous approach proved effective, as it allowed data collection and analysis to occur in an iterative cycle. Insights from earlier analyses informed subsequent observations, creating a dynamic and responsive process. The data analysis itself was conducted in three major steps: transcription, analysis, and verification.

The data analysis process began with transcribing the collected interviews, which involves converting spoken conversations into written text. Although transcription started immediately after the first interview and continued throughout the project, the bulk of the interviews were transcribed only after the interview phase concluded due to time constraints. The researcher, who personally conducted all 41 interviews, transcribed the recordings verbatim. The interviews, exerted in both English and Azeri, were translated into English when necessary by the researcher, who is fluent in both languages. Completed transcripts were shared with interviewees who had expressed a preference to review them prior to their final use. These participants were invited to review the transcripts and offer any corrections or feedback. The final phase of analysis began after the revised transcripts were received from the respondents.

Analyzing the vast amount of data generated by qualitative research can be a demanding task. To address this challenge, three complementary methods were employed. The use of meaning condensation is an effective technique for managing large datasets. This approach involves summarizing participants' responses into concise statements, enabling a comprehensive examination of complex interview texts by distilling them into more manageable forms. The final phase of the analysis focused on meaning interpretation, which facilitated the researcher in drawing conclusions and developing concepts and ideas.

In the data analysis process, coding played a pivotal role. According to Saldaña (2016), coding involves assigning descriptive or conceptual labels to specific segments of text to facilitate later retrieval and organization. Coding can be approached either deductively, through concept-driven coding, or inductively, using data-driven coding. In the former, codes are predetermined based on research objectives, while in the latter, codes emerge during a close reading of the data. This study primarily utilized concept-driven coding, aligning with the pre-defined research questions. Nevertheless, certain codes developed inductively throughout the analysis process, highlighting the flexible and evolving character of qualitative research.

Thematic analysis, widely recognized as a versatile method for qualitative data analysis, was employed in this study. Braun and Clarke (2006) describe thematic analysis as a process of identifying, analyzing, and reporting patterns or themes within a dataset. Unlike other methods, thematic analysis is not bound by rigid procedural frameworks, focusing instead on exploring meaning rather than the frequency of terms. This method typically involves organizing the dataset, familiarizing oneself with the data, generating codes, identifying themes, and finally interpreting and presenting findings (Nowell et al., 2017). Themes were identified in this study by examining patterns such as repetition, metaphors, and analogies, as suggested by Ryan and Bernard (2003). These themes served as the bedrock for constructing the narrative indicated in the findings chapter.

To facilitate the analysis, qualitative data was processed using NVivo, a specialized software for qualitative research. NVivo enabled efficient annotation, coding, text organization, and keyword searches (Bazeley & Jackson, 2013). While NVivo streamlined the organization of the data, the interpretive aspects of the analysis were conducted manually by the researcher. Coding began with identifying primary themes, which were subsequently refined into sub-themes to enhance the analytical depth. Examples of these sub-themes include governance structures, barriers to transition, and historical influences, ensuring the analysis was tightly aligned with the research objectives.

Following the analysis, the next steps—verification and reporting—were conducted to ensure the integrity and clarity of the research. Morse (2015) defines verification as the process of validating the consistency and accuracy of research results. This involved cross-checking codes and themes against the data to ensure they were a faithful representation of participants' perspectives. The final stage, reporting involved integrating the identified themes into a structured narrative that aligned with the research aims and was tailored to the target audience.

Document analysis was conducted in parallel with the interview data, following the same coding and thematic analysis processes using NVivo. Data from various sources were integrated to identify overarching themes and develop thematic networks, which linked findings to the study's conceptual framework and relevant literature (Eckersley, 2018; Loorbach et al., 2017). This theoretical grounding ensured that emerging patterns were contextualized within broader academic discussions. Ethical considerations remained central for this study, particularly given the qualitative nature of data collection and analysis. To complement and support the qualitative analysis, quantitative time series analysis was conducted too, using a univariate ARIMA (Autoregressive Integrated Moving Average).

4.6. Conclusions

This section has detailed the research strategy used in this study to effectively address the research questions. It began by outlining the study's research philosophy, which is grounded in the critical realism approach. To build a robust theoretical foundation, the study integrated various frameworks, themes, and key concepts drawn from the extensive body of literature on sustainability transitions. This comprehensive approach was instrumental in analyzing the complex dynamics of energy transitions in Azerbaijan. By aligning these theoretical elements with the research questions, the study provided a structured and nuanced framework for exploring these transitions in depth. This theoretical grounding not only enhanced the understanding of the subject matter but also positioned the research within a broader, relevant context, ensuring a thorough investigation of energy transitions in a post-communist setting.

The research adopted a case study methodology, which was identified as the most relevant style for this project. Azerbaijan was chosen as the focal case, offering a valuable opportunity to examine energy transitions in a post-communist environment. This selection enabled the generation of rich, detailed findings and supported the practical aspects of conducting fieldwork.

The chapter also addressed the methodological challenges encountered during the research. These challenges included managing the intricacies of interview processes, obtaining critical insights, and conducting the study amidst an evolving global and political context, such as the disruptions caused by the COVID-19 pandemic. Despite these difficulties, the research achieved its objectives through rigorous empirical investigations, resulting in comprehensive and insightful findings. These findings are presented in detail in Chapters 5, 6, and 7.

CHAPTER 5: ANALYSIS AND RESULTS: THE STATUS OF THE ENERGY TRANSITION IN AZERBAIJAN

5.1 Introduction

Chapter 5 serves as the initial empirical section of this dissertation, setting the groundwork for the historical analysis of Azerbaijan's energy transition that follows in Chapter 6. It examines the present dynamics of the country's energy transition, with particular attention to the prospects for renewable energy expansion, the involvement of governmental actors, and the main opportunities and obstacles shaping the renewable energy landscape in Azerbaijan.

This chapter argues that Azerbaijan's shift toward renewable energy is still in its infancy, primarily due to the longstanding reliance on fossil fuels within the nation's energy mix. Factors such as low production costs, energy security derived from abundant fossil fuel resources, and significant investments in the oil and gas sector have perpetuated this dependency, leaving alternative energy sources underutilized. Additional barriers, including an underdeveloped legal framework, limited institutional capacity, high financial demands for renewable energy projects, and inadequate technological advancements, additionally constrain progress in diversifying the energy sector. Nevertheless, external pressures—such as fluctuations in oil prices and international climate obligations—alongside internal drivers like the depletion of fossil fuel reserves and abundant renewable energy potential, have spurred greater governmental interest in renewables. This growing attention is evident in several large-scale renewable energy initiatives already launched in collaboration with international partners, as well as plans for future projects.

By integrating the principles of EEG with MLP on socio-technical transitions, this chapter provides a nuanced analysis of Azerbaijan's energy transition. The MLP framework is particularly valuable for understanding how the energy sector is interwoven with broader socio-political and economic dynamics while also responding to global environmental imperatives. Within this context, the chapter examines government-led initiatives and emerging renewable energy projects as potential catalysts for reshaping the country's energy landscape. Concurrently, insights from EEG highlight how historical energy practices and infrastructural legacies shape the ongoing transition, revealing both the challenges and opportunities of shifting towards renewables in a fossil fuel-centric system.

Divided into six sections, the chapter begins in 5.2 with a general overview of Azerbaijan's energy sector. Section 5.3 then explores the progress and potential of specific renewable sources, including hydropower, solar, wind, and biomass. Section 5.4 explores notable government projects

and initiatives supporting the renewable energy sector's growth. Section 5.5 identifies and categorizes the key factors influencing the energy transition into four domains: policy and regulatory, institutional, financial, and technical. Finally, Section 5.6 summarizes the chapter's key findings.

5.2 Azerbaijan's Energy Sector

Situated in the South Caucasus region, Azerbaijan shares borders with Turkey, Iran, Russia, Georgia, and Armenia, and spans a territory of approximately 86,600 square kilometers. As of 2018, the country's GDP per capita stood at 8,247 USD (SSCRA 2020a). Its advantageous location along the Caspian Sea provides significant access to oil and gas reserves. Azerbaijan functions as a key oil-exporting nation, characterized by fertile agricultural land and a highly educated labor force. Additionally, it serves as a vital transportation link between Europe and Central Asia.

Analyzing the trends and developments within Azerbaijan's energy sector is essential for formulating a viable renewable energy strategy that aligns with the country's current energy landscape. A comprehensive assessment of the entire energy sector will provide insights into Azerbaijan's capacity to adopt and integrate renewable energy sources. Accordingly, the following section will examine key aspects of the national energy sector, including energy efficiency and energy intensity indicators.

Azerbaijan's substantial energy resources significantly influence the structure of its economy. In the first half of 2019, the country's economic growth—measured at an annual rate of 2.2%—was primarily driven by increased natural gas output alongside steady development in non-energy sectors. During this period, non-energy industries grew by 3.5% year-on-year, mainly due to advancements in agriculture, manufacturing, and services, while the construction industry continued to decline. Favorable trade conditions during early 2019 enabled Azerbaijan to achieve a trade surplus equivalent to 12% of its GDP. This economic strength allowed the government to maintain a stable exchange rate at 1.7 manats per US dollar, avoiding further devaluation—unlike in 2015 when the economy suffered two major currency devaluations triggered by a sharp drop in global oil prices, given Azerbaijan's heavy reliance on hydrocarbons. By the end of 2019, the Central Bank held $6.3 billion in foreign reserves, while the State Oil Fund of Azerbaijan (SOFAZ) had assets amounting to 90% of GDP, totaling $43.3 billion. Despite this, Azerbaijan's dependence on oil and gas exposes it to external vulnerabilities, including global economic slowdowns and geopolitical instability in the Middle East. Low global growth leads to decreased demand for

Azerbaijani exports, and fluctuations in oil prices have a pronounced effect on the national economy (MPO 2020).

A sharp rise in oil output led to a surge in GDP growth in 2006 and 2007, with annual growth reaching 29.8%, following more modest growth rates of around 10% in the early 2000s. The economy's susceptibility to fluctuations in oil production became apparent in 2011 and 2012, when GDP growth fell drastically to 0.1% and 0.2%, respectively, due to declining oil output. As illustrated in Figure 1 below, the relationship between GDP and the oil-gas sector—as well as the sector's share in total GDP—can be clearly observed (CPS, 2014).

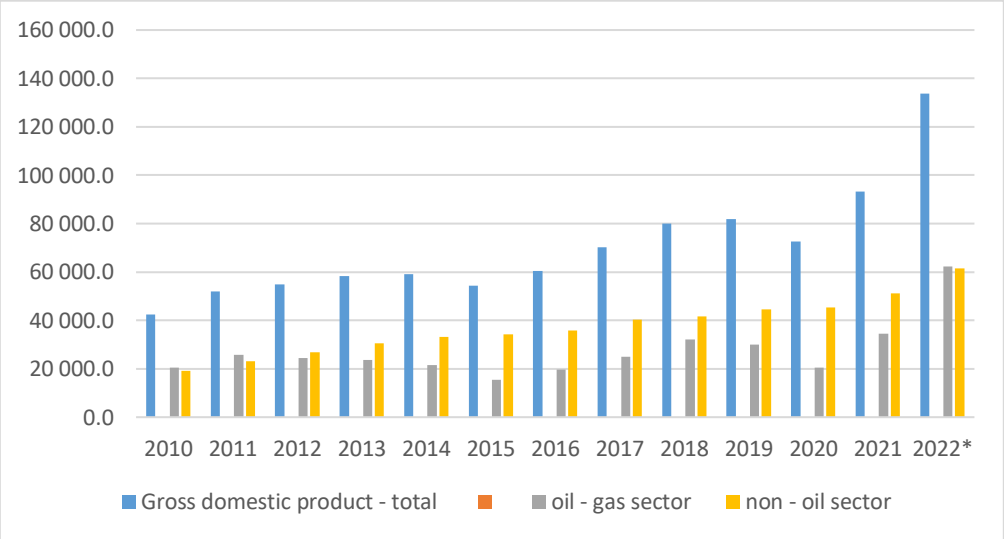

Figure 1. GDP production in the section of oil and non-oil, at current prices, million manats (AZN)

Source: Own construction by Azerbaijan Statistics, 2023.

In terms of assorting final energy consumption with sector as in Figure 2, it is significant to examine the chart below which indicates final sector-wise energy consumption. In 2014, the residential sector accounted for the highest share of total final energy consumption, surpassing all other sectors. It was followed by the transport sector and then the industrial sector in terms of energy usage. Non-energy sector recorded smallest share, while commercial sector was slightly higher than that. In the meantime, the graph below also indicates how the proportion of each sector has changed within four years.

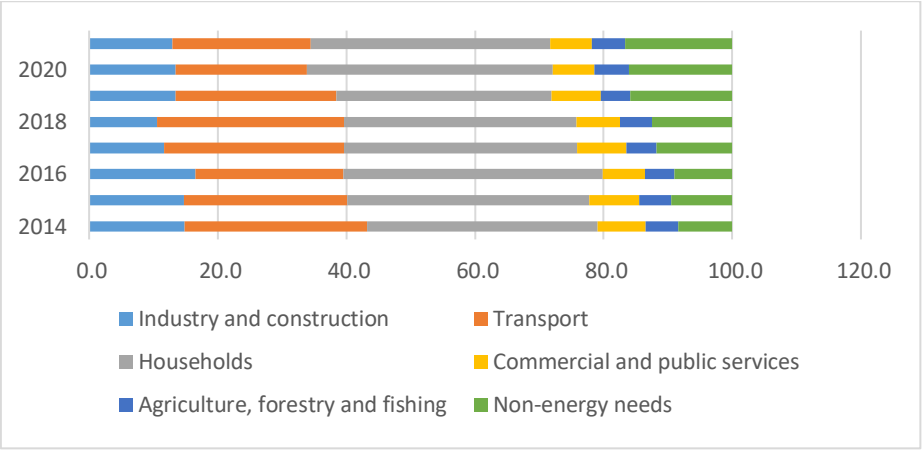

Figure 2. Final energy consumption by sectors of the economy in Azerbaijan, (%)

Source: Retrieved from Azerbaijan Statistics, 2023.

An analysis of Azerbaijan's primary energy sources reveals that three key resources dominate the energy mix: crude oil (including gas condensate), natural gas, and renewable energy.

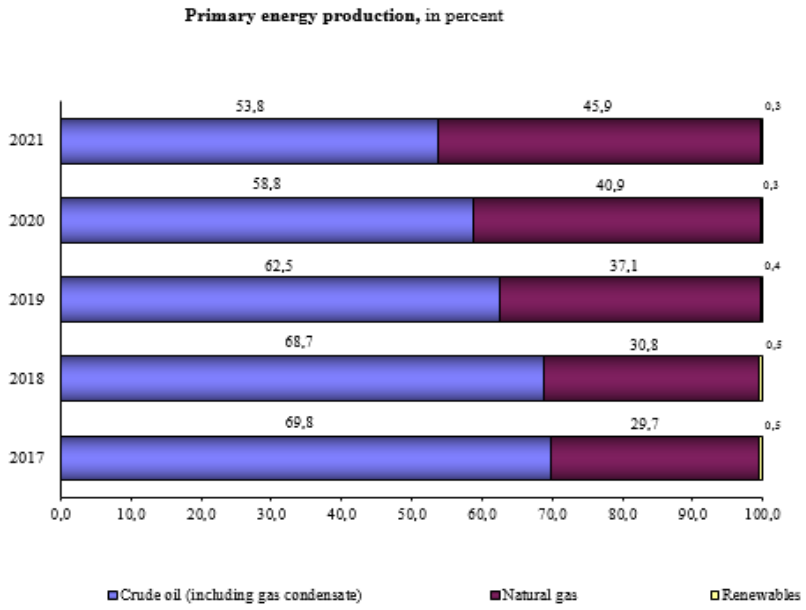

Figure 3. Primary energy production in Azerbaijan, in percent

Source: Retrieved from Azerbaijan Statistics 2023.

As illustrated in Figure 3, which presents data from 2014 to 2018, crude oil consistently maintained its position as the leading energy source, surpassing all other energy carriers throughout the observed period, however, the proportion of crude oil keeps declining while natural gas

experiences a consistent rise in share of primary energy production, in meantime renewables stays on holding same proportion with 0.5 percent.

Having gained independence from Soviet Union in 1991, to become modern and powerful state, former president, Heydar Aliyev implemented new oil projects, which paved the way for appealing foreign investors in the progress of the oil fields of Azerbaijan, expansion of transportation routes of crude oil and efficient management of oil revenues. One milestone agreement in the history of 20th-century Azerbaijan was signed in September 20, 1994, named as "the Contract of the Century". It created a chance for Azerbaijan to discover new prospects for the country and rendered it to become one of the major worldwide energy providers (President.az 2020)[1].

The Contract of the Century reflected the involvement of thirteen companies (Amoco, BP, McDermott, Unocal, SOCAR, LukOil, Statoil, Exxon, TPAO, Pennzoil, Itochu, Ramco, Delta) from eight states (Azerbaijan, USA, Great Britain, Russia, Turkey, Norway, Japan, Saudi Arabia) once signing it on September 20, 1994. Having implemented this contract, Azerbaijan experienced a great development by using revenues coming from oil (AAY 2020)[2].

Oil and Gas Journal stated that Azerbaijan was proved to own approximately 7 billion barrels crude oil reserves in late 2017 (EIA 2019). After independence, oil production in Azerbaijan declined sharply between 1992-1997, hitting the low point of 9.1 million tons in 1997. Production reached 14 million tons in 2000, later it reached at 22.4 million tons in 2005 and 44.3 million tons in 2008. Oil production exceeded 50 million tons for the first time in the history of the country in 2009, with a 14 percent increase in 2008. 83.3% of Azerbaijan's total oil production in this period was provided by high ACG with average of 847,500b / d. For the first time in 2009, oil production had an average of 1.02 million barrels (b/d) per day. Domestic crude oil usage has experienced a significant decline from 12 million tons in 1991 to 4.2 million tons in 2007 following the dissolution of the Sovet Union (Ciarreta, Nasirov 2011**)**.

The Contract of Century created a condition for the country to get through considerable development process and turned the country into main worldwide energy supplier which sets the new energy map of Europe. Basically, this contract encompassed three core oil fields of Azerbaijan in Caspian Sea, namely, Azeri, Chirag and Deepwater Guneshli which is run by BP. Furthermore, this agreement underwent to some changes and signed again for the development of Azeri-Chirag-Guneshli on September 24, 2017 so that co-exploitation of this oilfield is expected to be applied

[1] President.az (2020): *Oil and Gas Projects*. On internet: https://en.president.az/azerbaijan/contract . Accessed: March 10, 2022.

[2] AAY (2020): *Contract of Century*. On internet: http://www.aayda.gov.az/en/pages/244 . Accessed: March 10, 2022.

by 2050. Apart from that, allocation of the profit coming from hydrocarbons is presented as following: 75% for Azerbaijan and 25% for the contractors (MERA 2020a)[3].

The significance of the 1994 agreement was widely recognized by most respondents, including an energy expert.

> "It is clear that reflecting on the period before the new oil era highlights Azerbaijan's remarkable economic growth since 1994. The country's oil and gas resources have unlocked exceptional financial, technological, and collaborative opportunities. These advancements position Azerbaijan to navigate the energy transition with greater success" – (I1- Energy expert, the governmental entity)

Thanks to its significant crude oil and natural gas production, Azerbaijan ranks among the countries with the highest levels of energy self-sufficiency worldwide. Despite the fact that renewable energy field was not invested sufficiently, the government is currently willing to attract and direct some investment in order to speed up the installation of renewables. The government is also preparing a new energy plan which will pave the foundations for more policy changes (IEA 2018)[4].

Oil and Gas Journal reported that Azerbaijan has approximately 30 trillion cubic feet proven gas resources, and it is anticipated to find possible 100 and 200 trillion cubic per feet. Azerbaijan gets most of its natural gas from offshore fields. It is noteworthy that gas production experienced a consistent decline, dropping from eight billion cubic meters in 1991 to 4.5 billion cubic meters by 2005. Due to gas shortage in the country, Azerbaijan imported gas from Russia until 2007. However, after increasing gas production, Azerbaijan did not any longer rely on Russia for the satisfaction of domestic demand and became a gas exporter in the region. The production of gas rose to 23.3 billion cubic meters and there is an expectation that this number would reach to 28.5 billion cubic meters. 66 % of this gas was used to satisfy domestic demand while the remaining amount is exported to Russia, Georgia and Turkey (Ciarreta, Nasirov 2011).

Foreign enterprises have undertaken the development of several Azerbaijani gas fields, including Shah Deniz, Shafaq Deniz, Asiman, Umid, Nakhchivan, Absheron, Dan Ulduzu, and Ashrafi. Among these, the Shah Deniz field is particularly notable for its substantial gas reserves.

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[3] Ministry of Energy of Azerbaijan Republic (2020a): *Contract of Century*. On internet: http://minenergy.gov.az/az/neft/esrin-muqavilesi . Accessed: March 11, 2022.

[4] IEA (2018): *Azerbaijan*. On internet: https://www.iea.org/countries/Azerbaijan . Accessed: March 13, 2020.

Azerbaijan owns Shah Deniz natural gas and condensate field which is one of the biggest in the globe and it was discovered in 1999. It gives a way to provide Europe's South Gas Corridor (SGC). It possesses majority of Azerbaijan's gas reserves. Besides, it will supply Europe with gas via Baku-Tbilisi-Erzurum (BTE). Azerbaijan has started playing a vital role by means of SGC. Not only does it capture great importance due to being shipped to Europe, it also makes up around two-thirds of total energy consumption domestically, which is mainly exploited in power generation (EIA 2019). Drilling operations at the Shah Deniz Stage 1 gas field commenced in 2006. The field has an annual production capacity of approximately 10 billion cubic meters of natural gas and around 50,000 barrels of condensate per day. According to the record in 2017, this field generated 10.2 billion cubic meters of gas. Up to todays, production of the field reached at 89.5 billion standard cubic meters of gas and approximately 22.2 million tonnes of condensate (MERA 2020b)[5].

Based on the figures provided by the State Statistical Committee of the Republic of Azerbaijan, the Figure 4 below sheds a light on natural gas production of Azerbaijan over a period. It presents the fact that the highest amount of production within this period of time was observed at 43,867 million cubic meters in 2021, hence consistent rise in the amount of natural gas.

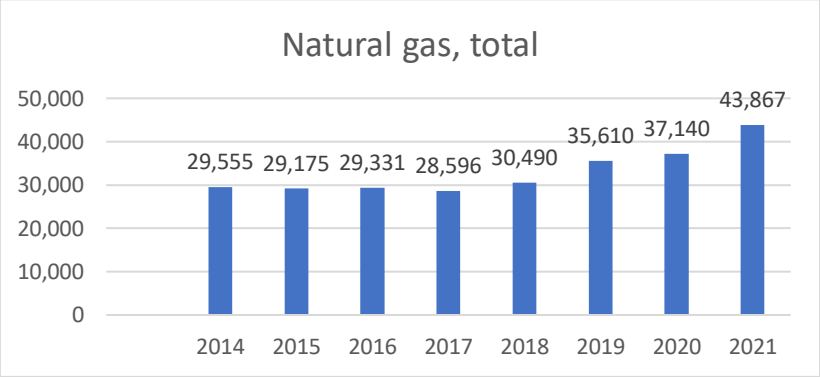

Figure 4. Azerbaijan's natural gas production in million cubic meters
Source: Own construction by Azerbaijan Statistics, 2023

"Azerbaijan's gas production continues to grow steadily, as evidenced by strategies facilitating the transportation of its gas through Turkey to Europe. The country is already tapping into relatively new gas fields with substantial remaining life cycles. As a result, it is highly likely that Azerbaijan will persist in producing natural gas and utilizing it for

[5] Ministry of Energy of Azerbaijan Republic (2020b): Shah Deniz Field. On internet: http://minenergy.gov.az/az/qaz/sahdeniz-yatagi . Accessed: March 12, 2020

electricity generation in the foreseeable future." – (I10- Energy officer, the governmental entity).

In addition, Azerbaijan's hydrocarbon sector develops second major project which involves the development of the Shah Deniz 2 gas field and establishment and progress of gas shipping pipelines to Europe. In late December of 2013, an agreement was made between SOCAR and BP regarding second phase of progressing Shah Deniz gas field.

Azerbaijan anticipates Umid-Babek project to be very successful during installation. Both deposits have a capacity of 600 billion cubic meters of gas and 120 million tonnes of gas condensate. There has been gas production in the Umid deposit for some years. In spring 2018, there were a Risk Service Agreement and other agreements between SOCAR and the UK Company, Nobel Upstream in order to develop, assess and search further the deposits on the shore. The exploration and production company established by the two project contractors is interested in attracting additional foreign partners (AHK, GTAI 2019).

As per the statement of vice president of state energy company SOCAR country is expecting to produce less oil because of already existing reserves while it would increase gas production. Yashar Latifov, Vice President of SOCAR for Field Development, told Reuters, "*Our task is to ensure stable oil production in the coming four to five years, and then a controlled decline, which will be managed by the planned expansion of exploration work at new and existing fields*," (Bagirova, Antidze 2020)[6].

In 1996, Azerbaijan made an agreement with Russia to be able to construct the Baku-Novorossiysk pipeline which ships the Azerbaijani oil from Baku to Novorossiysk port of Russia at coast of Black Sea. The pipeline was launched to transport the oil on October in 1996, which amounts to carrying 105,000 barrels each day with the length of 1,330 km and 231 km with Azerbaijani part (SOCAR 2020)[7].

Azerbaijan was striving to put up alternative route to be able to ship its oil to the customers. Although Russia wanted northern pipeline to be an only viable route for export of Azerbaijani oil and it was going to be operated by Transneft, Azerbaijan International Operating Company

[6] Bagirova, N. - Antidze, M. (2020): *Azerbaijan plans to produce less oil, more gas in 2020 - state energy firm, Reuters.* On internet: https://www.reuters.com/article/energy-azerbaijan/azerbaijan-plans-to-produce-less-oil-more-gas-in-2020-state-energy-firm-idUKL8N2A90H6 . Accessed: March 15, 2023

[7] SOCAR (2020): *Transportation, Baku Novorossiysk pipeline.* On internet: http://www.socar.az/socar/en/activities/transportation/baku-novorossiysk-oil-pipeline . Accessed: March 17, 2023.

imagined this to be not feasible in term of disadvantages which might arise and there was security issue due to sparkling military operation in Chechnya (Terence, Gregory 1995)[8].

Head of Foreign Relations Department of the Azerbaijani Presidential Administration in 2013, Novruz Mammadov has stated in his interview to 1news.az that the Baku-Novorossiysk pipeline does not bring enough benefit to carry on shipping oil by means of this line. Obviously, it is not viable option in terms of economic and commercial feasibility. He pointed out that this issue was discoursed during the negotiations (CESD 2013)[9].

This pipeline starts from Sangachal terminal in the vicinity of Baku and lies across Azerbaijan and Georgia to Supsa terminal in Georgia. It has 829 km length and Opening ceremony of this pipeline was on 17 April 1999. It achieved to export 3,751,300 tonnes of crude oil in 2018 which is 36,600 less than amount in 2017(Abbasova 2019)[10].

What is more, one of the most important oil pipelines is Baku-Tbilisi-Ceyhan (BTC) which crosses Azerbaijan, Georgia and Turkey by transporting the oil extracted from Azeri-Chirag-Deepwater Gunashli (ACG) field and condensate from Shah Deniz. It connects Sangachal terminal on the coast of Caspian Sea to Ceyhan terminal on Turkish Mediterranean coast. Apart from that, Turkmenistan's crude oil also remains being shipped by means of this pipeline. From October 2013, Kazakhstan's Tengiz crude oil has continued to be transported to some extent via BTC (BP 2019)[11].

Based on its records, On 11 August 2014, BTC celebrated the event of shipping two billionth barrel of oil at Ceyhan port in Turkey. Since that time, it has transported 3.2 billion barrels of crude oil which was placed on 4,234 containers and released to world markets (BP 2019).

As regards the transportation of Azerbaijani gas, it is quite essential to emphasize Baku-Tbilisi-Erzurum (South Caucasus Pipeline – SCP) pipeline which reaches Azerbaijani gas to Georgia and Turkey from Shah Deniz field in Azerbaijani side of Caspian Sea. It lies around 980 km with ability to ship the volume of 20 billion cubic meters a year. The volume of gas that this pipeline is capable of transporting a day is 32 million cubic meters gas from Shah Deniz field, while it is

[8] Terence A., Gregory R. (1995): *Great Power Politics and the Azerbaijan Oil Pipeline*. On internet: https://www.washingtoninstitute.org/policy-analysis/view/great-power-politics-and-the-azerbaijan-oil-pipeline . Accessed: March 17, 2023.

[9] CESD (2013): *Transportation of Oil Via the Baku-Novorossiysk Pipeline Is Not Profitable*. Center for Economic and Social Development On internet: http://cesd.az/new/?p=6670 . Accessed: March 18, 2023.

[10] Abbasova, G. (2019): *Baku-Supsa pipeline exported 3.75 mln tonnes of oil last year*. Reports News Agency. On internet: https://report.az/en/energy/baku-supsa-pipeline-exported-3-75-mln-tonnes-of-oil-last-year/ . Accessed: March 18, 2023.

[11] BP (2019): *Baku-Tbilisi-Ceyhan pipeline.* On internet: *https://www.bp.com/en_az/azerbaijan/home/who-we-are/operationsprojects/pipelines/btc.html* . Accessed: March 18, 20203

reported that total volume of gas processing and exporting is mainly 50 million cubic meters a day which also encompasses extraction of associated gas with ACG (Huseynli 2018)[12].

Another up-to-date statistic which was given by the State Statistics Committee brings up the fact that this pipeline route carried 32.4 % of natural gas with seven months of 2018. This derives high importance this pipeline for Azerbaijan and respective neighboring countries, thus by examining the table of pipelines route below (Table 1), we could formulate basic opinion of how those pipelines evolved and endured throughout the time period which has passed by (Huseynli 2018).

Table 1. Azerbaijan's oil and gas export pipelines

Facility	Status	Capacity, 1000 barrels/day	Total length (miles)	Origin	Destination	Details
Baku–Tbilisi–Ceyhan (BTC) - oil	Operated by BP	1,200	1,100	Sangachal terminal, near Baku, Azerbaijan	Ceyhan terminal, on Turkey's Mediterranean coast	First tanker loaded at Ceyhan in June 2006
Baku–Novorossiysk (Northern Route Export Pipeline) - oil	Operated by SOCAR and Transneft	105	825	Sangachal terminal, near Baku, Azerbaijan	Novorossiysk, on Russia's Black Sea coast	Started operation in 1996
Baku–Supsa (Western Route Export Pipeline) - oil	Operated by BP	100	515	Sangachal terminal, near Baku, Azerbaijan	Supsa, on Georgia's Black Sea coast	First tanker loaded at Supsa in April 1999
South Caucasus Pipeline (SCP) - BTE	Operating	310	430	Shah Deniz field, Azerbaijan	Georgia and Turkey	First deliveries to Turkey in 2007, follows the route of the BTC oil pipeline from Azerbaijan through Georgia, and connects to Turkey's domestic transmission pipeline system

Source: Own construction by U.S. Energy Information Administration.

According to the data of USA Energy Information Administration, in 2017, crude oil export of Azerbaijan was recorded to be 700 b/d which is displayed via the figure below. Apart from that, the pie chart throws a light on the proportion that Azerbaijan's crude oil export partners capture in Azerbaijan's crude oil export. Delving into the figure below reveals the fact that the largest proportion of crude oil exports is received by OECD Europe with 66 percent, which is followed by Asia and Oceania with 19 percent, meanwhile Americas takes hold of 19 percent outpacing Non-OECD Europe and Eurasia with seven percent. To illustrate it further, the figure 5 is to be

[12] Huseynli, N. (2018): *Over 4.3B cubic meters of gas transferred through BTE*. On internet: https://www.azernews.az/oil_and_gas/136313.html . AzerNews. Accessed: March 18, 2023.

interpreted from countries' perspectives, thus it grants the right to point out Italy due to holding a lion's share in Azerbaijan's crude oil exports by hitting the significant figure at 32 percent. The other European countries such as Germany, Czech Republic, Portugal, France amounts to very little proportion, former two with seven percent, yet latter two with five percent. In the meantime, Other OECD Europe and Non-OECD Europe and Eurasia make up ten percent and seven percent, respectively, whereas Canada accounting for seven percent dominates the other respective countries such as Taiwan, China, United States and other Asia & Oceania countries.

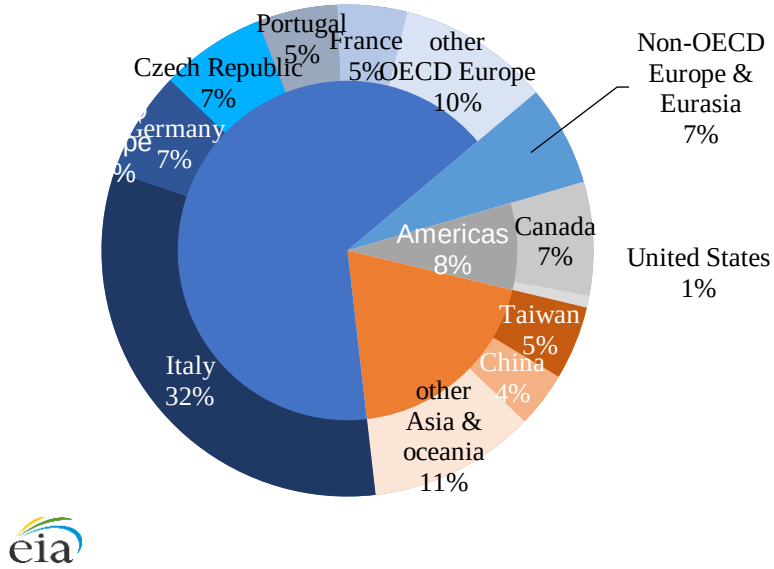

Figure 5. Azerbaijan crude oil exports by destination, 2017
Source: Retrieved from U.S. Energy Information Administration, based on Azerbaijani partner country import statistics, Global Trade Tracker

First and second phases of Shah Deniz Field Development (SD1and SD2) stands for the implemented progress of Shah Deniz natural gas and condensate field. Thus, in second phase of Shah Deniz field 16 bcma of gas will be combined to 9-10 bcma from Shah Deniz stage 1. Around six bcma generated from second phase will be carried to Turkey and ten bcma to Europe. Based on the framework of Final Investment Decision (FID), the shareholders decided to develop Shah Deniz Field into third phase of its field development (AERA 2018).

The South Caucasus Pipeline Expansion (SCPX) represents the extension of the original South Caucasus Pipeline, designed to accommodate increased volumes of natural gas. This expanded pipeline is intended to transport gas from the Shah Deniz field to the Georgian-Turkish border, where it will be delivered to Turkish consumers through the TANAP pipeline by 2018, and further to Southern Europe via the TAP pipeline by 2020. The total transmission capacity of the SCPX is projected to reach 23.4 billion cubic meters annually (AERA, 2018)

Trans Anatolian Pipeline (TANAP) takes hold of the route which starts from Georgia-Turkish border crossing through Turkey until its border with Greece. In the beginning, it was considered to transport 16 bcma which could be enlarged to 31bcma (AERA 2018).

Trans Adriatic Pipeline (TAP) is ending line of SGC which aims at getting natural gas extracted by second phase progress of Shah Deniz field to European markets. This pipeline begins at the border o Greece and Turkey and ends in Italy by going through Greece, Albania and Adriatic Sea. It starts from its connection with TANAP and at the end, it joins to natural gas provider in Italy, Snam Rete Gas (SRG). The pipeline is considered to have availability of shipping 10 bcma natural gas. The SGC holds great importance on the face of playing vital role in Eastern Partnership (EaP) as it is essential for regional cooperation, too, and Georgia participates in the process of executing the projects as well (AERA 2018).

If we scrutinize the table 2 below which depicts the route of Azeri Gas Export Pipelines, we are able to comprehend complete route and capacity of these pipelines. As mentioned above, not only TANAP and TAP carry the natural gas of Caspian basin countries, it also helps the country integrate European market and being able to take part in Eastern partnership too. From the beginning to the end it was named as Southern Gas Corridor.

Table 2. Azerbaijan Gas Export Pipelines

		Gas Export Pipelines				
		Name of the pipeline	From (Supply country)	Through (country)	To (Markets)	Capacity (bcma)
Azerbaijan	Existing	SCP	Azerbaijan	Az-Geo	Turkey	8
		Gazi-Magomed-Mozdok	Azerbaijan	Az-Rus	Russia	1
		Baku-Astara	Azerbaijan	Az-Iran	Nakchcivan	0.5
	Future	Scpx	Azerbaijan	Az-Geo	Turkey-Eu	16
		Tanap	Azerbaijan	TR	Turkey-Eu	16
		Tap	Azerbaijan	GR-IT	Italy	10

Source: Own construction by Azerbaijan Gas Export Potential & Related Infrastructure for EU & TR Energy Security Issues (UP TO 2050)

While these infrastructures play a vital role in driving capital inflows to the country, they also hinder progress toward diversification and energy transition by creating a condition of infrastructural lock-in. This issue will be researched in depth in Section 6.

Azerbaijan's oil and gas sector, while supported by substantial resources and advanced infrastructure, encounters a range of challenges both domestically and internationally. These include the depletion of reserves, geopolitical uncertainties, environmental issues, and fluctuations

in market dynamics. Recent analyses indicate that Azerbaijan's reserves-to-production (R/P) ratio stands at approximately 24 years for oil and 117 years for gas (Mustafayev et al., 2022). An energy expert has corroborated these findings, stating:

> "Based on exploration data, the reserves in the Absheron field are not as substantial as initially anticipated. The exploration efforts in the Shafaq-Asiman area have also yet to produce favorable outcomes. To advance exploration and enhance production at the Umid-Babek site, geologists and technologists must overcome significant technical challenges." - (I10- Energy Officer, the governmental Entity)

This section provided an in-depth examination of Azerbaijan's energy sector, offering key insights into the nation's current energy framework and its strategic importance for future planning. By tracing the historical development, current conditions, and anticipated trends within the oil and gas industries, it laid a comprehensive groundwork for understanding Azerbaijan's ongoing energy transition. The analysis emphasized the challenges of an economy heavily reliant on fossil fuels, setting the stage for Chapter 6, which delves into the effects of post-communist developments since 1991 on the country's efforts to diversify and pursue sustainable energy sources. This historical lens is essential for grasping the distinct dynamics of Azerbaijan's energy shift, revealing how legacy policies continue to shape both obstacles and opportunities in its path toward a more sustainable energy future.

5.3 The Influence of the Ukraine War on Energy Dynamics in the Post-Soviet Region

The conflict in Ukraine, initiated by Russia in February 2022, has significantly affected the geopolitical, economic, and energy sectors across the post-Soviet region. This region, which has traditionally depended on its abundant natural resource reserves, especially fossil fuels for economic stability and geopolitical leverage, has experienced significant disturbances in its energy trade dynamics. These disruptions have exposed vulnerabilities and triggered a reassessment of energy security and geopolitical strategies among post-Soviet states (Vinogradova, 2024).

For decades, Russia has dominated energy production and supply in the region. Nevertheless, the war in Ukraine has highlighted and exacerbated the vulnerabilities associated with this reliance. Ukraine, a critical transit route for Russian natural gas to Europe, has witnessed frequent disruptions in gas flow, with major pipelines like Nord Stream being affected by sanctions or targeted attacks (Sezer, 2024). Countries such as Moldova, Armenia, and the Baltic states have struggled to secure stable energy supplies under these circumstances (Makarychev & Dufy, 2024).

In response, nations like Azerbaijan and Kazakhstan have made concerted efforts to diversify energy supply chains. Azerbaijan has increased gas exports to Europe through the Southern Gas Corridor, while Kazakhstan has pursued partnerships with China and the European Union to develop new transit routes that bypass Russia (Pepe, 2024).

The conflict has also highlighted the vulnerability of critical energy infrastructure, with power plants, pipelines, and refineries in Ukraine frequently targeted. This has prompted neighboring countries to reevaluate their strategies for protecting energy infrastructure (Malerius, 2024).

The economic impact of the war has been pronounced, particularly through its effects on energy markets and inflation across the post-Soviet region. Global energy prices surged following the conflict's outbreak, placing considerable strain on energy-importing nations like Moldova and Georgia. While energy-exporting countries such as Kazakhstan and Azerbaijan initially benefitted from higher prices, their heavy reliance on volatile energy markets introduced additional risks (Sezer, 2024).

The inflationary pressures have been severe, with countries like Armenia and Kyrgyzstan experiencing significant economic challenges as rising energy costs have affected transportation, industrial production, and food systems (Makarychev & Dufy, 2024). Meanwhile, resource-rich nations such as Turkmenistan and Uzbekistan have faced disruptions in traditional energy trade routes due to sanctions on Russia, forcing costly adjustments in their export strategies (Vinogradova, 2024).

The war has prompted substantial changes in the post-Soviet region's energy alliances and strategies. Russia’s strained relations with its neighbors have driven many countries to reduce their dependence on Moscow. For instance, Kazakhstan has strengthened its ties with China and the EU, while Azerbaijan has positioned itself as a key energy supplier to Europe amidst the crisis (Pepe, 2024).

The Eurasian Economic Union (EAEU), led by Russia, has faced challenges in fostering energy cooperation as member states reassess the risks of deeper integration with a sanctioned Russia. Some member countries, such as Armenia and Belarus, have expressed growing dissatisfaction with the limitations of the union (Sezer, 2024).

Furthermore, the conflict has accelerated the region's shift toward renewable energy sources. Countries like Uzbekistan and Kazakhstan have unveiled ambitious plans to expand solar and wind

energy capacity to reduce reliance on fossil fuels and enhance energy security (Makarychev & Dufy, 2024).

Beyond immediate concerns, the war has influenced long-term energy policy and economic decisions in the post-Soviet region. The interdependence of energy and food security has become more apparent, with disruptions in natural gas supplies—critical for fertilizer production—aggravating food insecurity in countries like Armenia and Georgia (Malerius, 2024).

The conflict has also reshaped global energy markets, as Europe seeks alternatives to Russian gas and the United States increases liquefied natural gas (LNG) exports. These shifts have created both challenges and opportunities for energy-exporting post-Soviet states (Pepe, 2024).

- Ukraine**:** As a battleground and key transit country, Ukraine has endured severe consequences, including the destruction of energy infrastructure and reduced export revenues. However, the war has accelerated its shift toward renewable energy and deeper integration with Europe (Makarychev & Dufy, 2024).
- Kazakhstan**:** By capitalizing on its abundant oil and gas reserves, Kazakhstan has positioned itself as a key actor in the regional energy landscape, enhancing its partnerships with both China and the European Union through a diversified energy strategy (Pepe, 2024).
- Azerbaijan**:** Azerbaijan has expanded its role as a primary gas supplier to Europe, while simultaneously investing in renewable energy to enhance its long-term energy security (Malerius, 2024).

The conflict in Ukraine has significantly reshaped the energy landscape across the post-Soviet region. It has exposed the vulnerabilities of traditional energy dependencies, catalyzed diversification efforts, and accelerated the transition to renewable energy. While the conflict presents significant challenges, it has also driven innovation and strategic shifts in energy policy. The future of the region’s energy security will hinge on its ability to adapt to the evolving global energy landscape (Vinogradova, 2024; Sezer, 2024)

5.4 Azerbaijan Renewable Energy Status

Alongside its rich oil and gas reserves, Azerbaijan also holds considerable potential for the development of renewable energy. This section offers an in-depth overview of the country's renewable energy sector, concentrating on wind, solar, biomass, and hydropower sources. It underscores the largely underutilized nature of these resources and the gradual shift toward cleaner

energy pathways that began in 2019. By outlining these developments, the section illustrates the importance of forward-looking energy policies in supporting the country's long-term sustainable growth.

According to estimates by the Ministry of Energy, Azerbaijan's renewable energy potential that is both economically and technically viable totals around 27,000 MW. This includes approximately 3,000 MW from wind, 23,000 MW from solar, 380 MW from bioenergy, and 520 MW from mountain river hydropower. Nevertheless, despite this substantial capacity, the share of renewables in the country's overall energy production and consumption remains limited.

Azerbaijan aims to raise the share of renewable energy in its total electricity generation to 30% by 2030 (WindEurope, 2024). To support this objective, the Azerbaijani government has implemented a series of energy policy measures. In line with Presidential Decree No. 1209, issued on May 29, 2019, titled "On Accelerating Reforms in the Energy Sector of the Republic of Azerbaijan".

Meanwhile, electricity generated from renewables accounted for 7.2% of total electricity output (Figure 6). These figures highlight Azerbaijan's significant reliance on fossil fuels and underscore the urgent necessity to enhance the contribution of renewable energy sources.

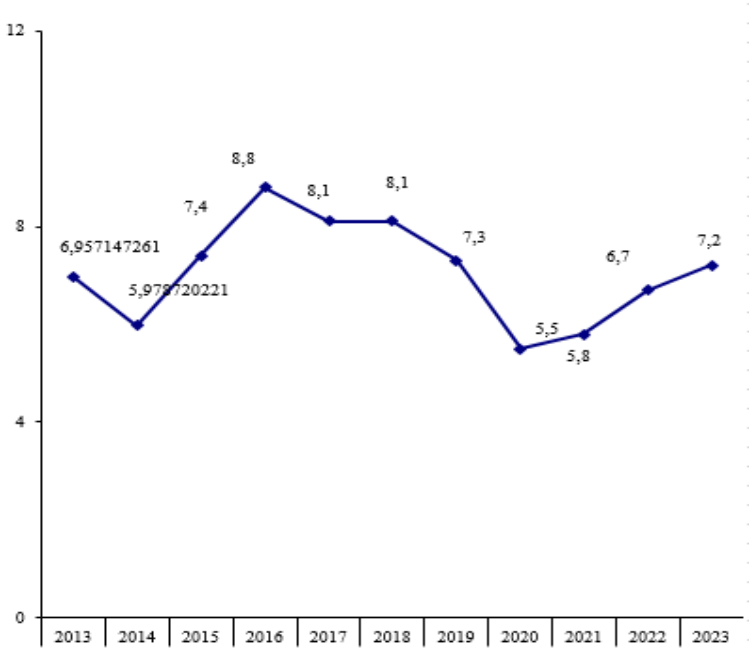

Figure 6. Share of electricity generated from renewable sources in total production of electricity in percent

Source : SSCRA, 2023

Azerbaijan aims to increase the share of renewable energy sources (RES) in total electricity generation as part of its strategy to diversify the energy sector. This would enable the country to allocate a larger portion of its natural gas for export to European markets after meeting domestic needs. The upcoming figure illustrates the projected capacities of renewable energy sources as outlined in Azerbaijan's Strategic Road Map through 2030 (Aydin, 2019). Table 3 provides a detailed breakdown of the expected growth across various renewable energy types by 2030. According to these projections, the capacity of all renewable energy plants is expected to rise steadily—except for hydropower—ultimately resulting in renewables accounting for approximately 35–40% of total installed power capacity.

Table 3. Power installation up to 2030

	2025	2030
Wind PP	440 MW	465 MW
Solar PP	150 MW	190 MW
Hydro PP	220 MW	220 MW
Bioenergy PP	30 MW	50 MW
Total (MW)	840 MW	925 MW
Total (RES%)	25-30%	35-40 %

Source: Own construction based on Overview of the renewable energy developments in Azerbaijan by The State Agency on Alternative and Renewable Energy Sources of the Republic of Azerbaijan.

5.4.1 Hydropower

From the perspective of renewable energy utilization, hydropower stands out as the most widely used source in Azerbaijan. Since 1990, electricity generation from hydropower has shown a consistent upward trend. Currently, hydroelectric power accounts for 17.8% of the country's total electricity generation capacity. Due to the abundance of rivers across Azerbaijan, there is significant potential for constructing small hydropower plants, which also aid in managing river floodwaters (UNECE, 2019). Hydropower has been an integral part of Azerbaijan's energy mix since the Soviet era. The country's hydroelectric potential is estimated at 40 billion kWh, of which 16 billion kWh is considered economically viable, including 5 billion kWh from small hydropower facilities. However, a key challenge lies in the outdated condition of many small and mini hydropower plants, as a substantial portion—around 35%—has been operating beyond their intended lifespan of over 30 years, with outdated technology that no longer meets current standards. The government has expressed a commitment to revitalizing the hydropower sector and increasing the number of installations. According to a statement by the Ministry of Industry and

Energy published in *Azernews* in September 2013, plans were underway to build 34 small hydropower plants with a combined capacity of 239.9 megawatts (Safarov, 2015).

In addition, a state program was launched to promote the expansion of small hydropower plants, which ultimately led to the privatization of several facilities, including "Guba," "Gusar," "Sheki," "Chichakli," "Mughan," "Zaykhur," "Nugandy," "Balakan," and "Chinarli." Renovation efforts on the small hydropower plant located on the Kish River in Sheki increased its annual electricity output from 720 kWh to 1.2 MW. Furthermore, the United Nations Development Programme (UNDP) office in Azerbaijan supported the refurbishment of another small hydropower plant in Sheki with a generation capacity of 580 kWh. Over the past ten years, Azerbaijan has also seen the commissioning of multiple modern power stations, incorporating advanced technologies and contributing to a total electricity generation capacity of 7,149 MW (Vidadili et al., 2017).

The overall installed electricity generation capacity in Azerbaijan stands at 8,320.8 megawatts. Out of this, renewable energy sources—including large hydropower facilities—contribute 1,687.8 megawatts, making up approximately 20.3% of the total capacity (Ministry of Energy of Azerbaijan, 2024). Table 4 below outlines the country's existing large and small hydropower plants.

Table 4. Hydropower Plants of Azerbaijan

Hydropower Plants	**Small Hydropower Plants (SHP)**
Mingachevir HP – 424 MW	Goychay SHP – 3.1 MW
Shemkir HP – 380 MW	Ismailli – 1 SHP – 1.6 MW
Yenikend HP – 150 MW	Ismailli – 2 SHP – 1.6 MW
Fuzuli HP – 25 MW	Balakan – 1 SHP – 1.5 MW
Tahtakopru HP – 25 MW	Kusar SHP – 1.0 MW
Shemkirchay HP – 25 MW	Astara – 1 SHP – 1.7 MW
Varvara HP – 18 MW	
Nakhichevan AR	
Aras HP – 22 MW	Vayhir SHP – 5 MW
Aras HP – 22 MW	
Arpacay – 1 HP – 20,5 MW	
Arpacay – 2 HP – 1.4 MW	
Ordubad HP – 36 MW	

Source: Own construction by Azerenerji ASC

Table 7 indicates that the Mingachevir Hydropower Plant, with a capacity of 424 MW, is the largest in Azerbaijan in terms of electricity generation, followed by the Shemkir Hydropower Plant, which has a capacity of 380 MW.

An energy expert highlighted the significant role of hydropower in meeting domestic energy consumption needs:

"I can't recall the exact amount of electricity, but I know it makes a significant contribution to domestic consumption." – (I13-Renewable energy expert, a local private company).

5.4.2 Wind energy

When comparing wind energy to other forms of renewable energy, it stands out as the most practical option due to the favorable conditions for establishing wind power infrastructure. Azerbaijan's geographical features significantly contribute to its wind energy potential, offering an estimated 800 MW of annual capacity. If this potential is efficiently harnessed, it could generate approximately 2.4 billion kWh of electricity annually, reducing the need for around one million tons of fossil fuels and preventing substantial emissions of greenhouse gases (Vidadili et al., 2017). The country has several promising areas for wind energy development, including the Absheron Peninsula, the Caspian Sea coast and nearby islands, the Ganja-Dashkesan area in western Azerbaijan, and the Sharur-Julfa region within the Nakhchivan Autonomous Republic. In terms of development efforts, a partnership was established in 1999 between Japan's Tomen Corporation and Azerbaijan's Scientific Research Institute of Power Engineering and Energy to install two wind measurement towers, 30 and 40 meters tall, in Absheron. These recorded average annual wind speeds ranging from 7.9 to 8.1 meters per second. Additionally, a separate feasibility study has been conducted for the installation of wind turbines with a combined capacity of 30 MW in the Qobustan region (UNECE, 2019).

According to data from the Global Wind Atlas, a tool developed by the World Bank, the Absheron Peninsula and its surrounding areas exhibit favorable wind conditions, with average wind speeds of 8 meters per second and a power density of 810 watts per square meter measured at 50 meters height. These figures increase at higher altitudes, reaching 9.1 m/s and 1,026 W/m² at 100 meters. Importantly, wind energy potential is not limited to the Absheron region. Western Azerbaijan, particularly the mountainous zones of Lachin and Kalbajar, also demonstrates considerable potential, with estimated wind energy capacity reaching around 2,000 MW as illustrated in Figure 7.

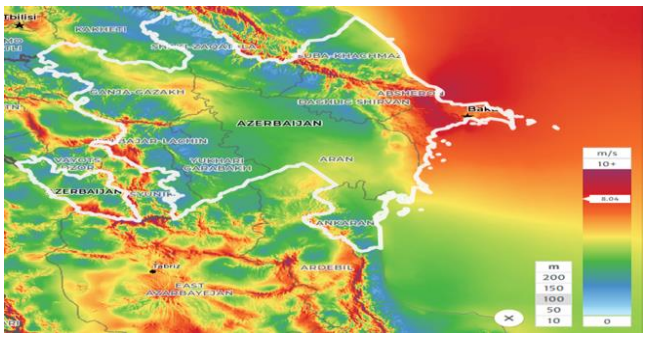

Figure 7. Mean wind speed at 100-m altitude

Source: The World Bank Global Wind Atlas

Most interviewees recognized the significant wind energy potential in Azerbaijan. As one senior researcher noted:

"As highlighted in various reports and statistics, including the latest publication by Azerbaijan's Ministry of Energy, our country possesses substantial renewable energy potential, particularly in solar and wind power. This includes a significant capacity for offshore wind energy development." - (I9-Researcher, a higher education institute in Baku)

A notable recent advancement in Azerbaijan's wind energy sector involves attracting foreign investment to the country's renewable energy landscape. Azerbaijan has entered into two major agreements totaling USD 400 million aimed at expanding solar and wind energy capacities. One of these agreements was signed with ACWA Power, a company based in Saudi Arabia, for the development of a 240 MW wind power project in the Khizi and Absheron regions along the Caspian Sea coast. Details of the second agreement, which pertains to solar energy, will be addressed in the following section (O'Byrne 2020)[13].

At the policy level, Azerbaijan has set clear targets to boost wind energy development. The *Strategic Road Map for the Development of Utilities*, approved by Presidential Decree No. 1138 on December 6, 2016, outlines goals to reach 440 MW of installed wind power capacity by 2025 and 465 MW by 2030.

At present, Azerbaijan has seven active wind farms, including two hybrid facilities that integrate wind energy with other power sources. Additionally, several new projects are underway. For

[13] O'Byrne, D. (2020): *Azerbaijan looks to renewables to meet growing power demand*. On internet: https://eurasianet.org/azerbaijan-looks-to-renewables-to-meet-growing-power-demand . Accessed: March 20, 2020.

example, construction began on the 240 MW "Khizi-Absheron" wind power plant in 2022 (AREA, 2022)[14].

Given the high wind power density, all existing wind power plants are currently situated in the Absheron, Khizi, and Gobustan regions. However, in October 2021, a new 300 kW wind power plant was commissioned in the Julfa region, located in the southeast of the country. Moreover, there are plans to develop additional wind power plants in Azerbaijan's liberated territories as part of the "Green Energy Zone" initiative.

5.4.3 Solar energy

In simple terms, Azerbaijan has substantial potential for harnessing solar energy, with annual sunshine ranging between 2,400 and 3,200 hours. Despite this, the country has not yet fully capitalized on this resource. One of the primary challenges in expanding solar photovoltaic (PV) energy lies in the relatively high cost of electricity generation from PV systems, which currently cannot compete with Azerbaijan’s low domestic electricity tariffs. Nevertheless, the government has taken meaningful steps to strengthen the development of solar energy. An example of such efforts is the commissioning of the Surakhani solar power plant, operated by 'AzAlternativEnerji' LLC under SAARES, which was inaugurated in a ceremony attended by the President of Azerbaijan. To ensure the long-term growth of the sector, the introduction of strong financial incentives will be crucial to attract private investment in PV projects (Safarov, 2015).

In addition, Azguntech LLC has implemented various solar panel projects in educational and healthcare institutions, aligning with the *State Program on the Use of Alternative and Renewable Energy Sources* and the *Renewable Energy Development Plan for 2011–2013*. These initiatives aim to provide clean energy and support environmental sustainability across Azerbaijan. As part of these efforts, solar panels and heat pumps were installed in ten schools across various districts of Baku. Moreover, solar systems were deployed in the Beylagan and Masalli regions, with capacities of 50 kWh and 76 kWh, respectively. A solar power plant capable of producing 35 kWh and heat pumps with a 60 kWh capacity were also installed in a pediatric healthcare facility in Baku's Hovsan district. The expansion of solar power installations in Azerbaijan remains ongoing (Vidadili et al., 2017).

As previously mentioned in the section on wind energy, the second major agreement Azerbaijan signed was with Masdar, a renewable energy company based in Abu Dhabi. This deal involves the

[14] AREA. (2022). New priorities for SGC and renewable energy cooperation were discussed with EBRD President. Available at: News | Azerbaijan Renewable Energy Agency under the Ministry of Energy of the Republic of Azerbaijan (area.gov.az)

development of a 200 MW solar power plant in the Alat region. Together, the two large-scale renewable energy projects have a combined investment value of USD 400 million (O'Byrne, 2020).

Despite its significant potential, Azerbaijan's current solar energy capacity is relatively modest at 45.9 MW. In 2021, solar energy production amounted to just 55.2 million kWh, a small portion compared to the 26.2 billion kWh generated from fossil fuels. Nevertheless, the government has set ambitious goals to expand solar electricity generation, aiming for 150 MW by 2025 and 190 MW by 2030. A senior academic confirmed this ambition, stating:

> "Significant projects are underway, such as a 240 MW solar initiative. By 2030, it is anticipated that approximately 30% of electricity could be generated from solar energy." - (I26-Senior Officer, governmental entity)

In summary, while technical and financial challenges persist, Azerbaijan's solar energy sector possesses significant untapped potential. With the planned projects and initiatives, the industry is well-positioned for substantial growth in the years ahead.

5.4.4 Biomass energy

Exploring the potential of biomass energy in Azerbaijan reveals that the country possesses a variety of biomass sources. These include industrial residues, forestry and wood processing by-products, municipal and household waste, pollutants from oil and petroleum products, as well as agricultural crops and organic waste materials. These biomass resources can be converted into gaseous, liquid, or solid forms of energy. Two million tons of solid and industrial wastes are dumped to the areas named as neutralization zone in Azerbaijan annually, which is more or less considered to foster heating public buildings in Baku and some other big industrial regions (UNECE 2019). Besides, Safarov (2015) asserts that based on feasibility studies by independent energy analysts, Azerbaijan has adequate capability of generating biomass energies in country sides of Azerbaijan, however, there is high price of benzene and diesel which gets in the way of launching respective biogas generation, the production of green maze and other crops for obtaining biogas is inclined to exhaust so much fuel. In 2012, a major development occurred with the launch of a large waste-to-energy plant in Baku, built by the French company CNIM—considered the largest of its kind among post-Soviet countries. Owing to this plant, Azerbaijan evades wasting 60 million m^3 for production of electricity by annual generation of 231,500 MWh, which supplies electricity to over 100,000 households with electricity (Safarov 2015). As one senior official expert confirmed:

“Our nation holds immense potential for renewable energy development, particularly in wind, solar, and biomass resources. Currently, we have an estimated biomass capacity of around 400 megawatts.” - (I2-Senior official, an energy company)

Having researched the unexploited potential of biomass energy, the government has undertaken initiatives to harness this resource effectively. A key initiative in this area is the creation of the Baku Waste-to-Energy Plant, which was implemented as part of the Comprehensive Action Plan for Improving the Environmental Situation in the Republic of Azerbaijan for 2006–2010. Located in the Balakhani area, this facility boasts an annual power generation capacity of 213.5 GWh (IRENA, 2019). As one renewable energy expert stated:

"We utilized hazel nutshells as a biomass resource to heat the school. Biomass is a practical and cost-effective option." - (I18-Senior Officer, an international company in Baku)

Another expert shared the following:

"The third initiative focused on biomass. We utilized the biomass potential of cotton residues to produce pellets, which were then used to heat buildings such as schools and kindergartens." - I5-Senior academic, a higher education institute in Baku)

Azerbaijan currently operates two bioenergy plants, including one hybrid facility: “Tamiz Shahar” OJSC with a capacity of 37 MW and Gobustan HPP Bio with 0.7 MW (AREA, 2023). Additionally, the "Strategic Road Map for the Development of Utilities in the Republic of Azerbaijan" outlines plans to establish seven new bioenergy plants with a capacity of 20 MW in table 5. The government also aims to expand bioenergy power generation to 50 MW by 2030.

Table 5. Planned bioenergy plants

Bioenergy plants	Power, MW
Agjabedi	8
Siazan	3
Howsan Aviation	3
Barda	2
Samukh ARC	2
Absheron	1
Yalama	1

Source: AREA, 2023

Despite these positive advancements, several challenges must be addressed to ensure the sector's sustainable growth. Key obstacles include the economic feasibility of large-scale biomass energy production, the need to improve waste management systems, and the environmental implications of biomass extraction and utilization.

In summary, while biomass currently represents a modest share of Azerbaijan's energy mix, the increasing interest from both government and private stakeholders highlights its potential. Through effective strategic planning and the adoption of sustainable methods, biomass and solid waste-based energy have the potential to become more significant contributors to Azerbaijan's renewable energy sector in the coming years.

5.5 Azerbaijan Renewable Energy Initiatives

The primary source of financing for renewable energy development in Azerbaijan has been the state budget. Based on data from ABOEMDA, a total of approximately USD 579.1 million (987.4 million AZN) was allocated between 2010 and 2022 to support a range of renewable energy technologies, including waste-to-energy, biomass, wind, small hydropower, solar PV, and heat pump systems. Of this amount, the state contributed around USD 480.9 million (820 million AZN), representing 83% of the total funding. Despite this substantial public investment, the high cost of borrowing has hindered private sector involvement, as elevated interest rates have reduced the appeal of financing renewable energy and energy efficiency projects. In particular, the Central Bank of Azerbaijan raised the key interest rate from 4% at the start of 2019 to 14% by year-end.

A thorough analysis of the Azerbaijani government's energy transition strategy is essential for gaining insight into the defining features of the country's energy regime. Such an analysis not only highlights the regime's defining features but also facilitates an exploration of its influence on the development—or obstruction—of emerging energy niches in Azerbaijan. While endowed with substantial oil and gas resources, Azerbaijan has begun transitioning toward renewable energy sources. This strategic transition stems from a combination of external and internal factors, including diminishing oil revenues, rising electricity demand, and aging energy infrastructure. Despite economic challenges posed by declining oil income and the aftermath of the 2020 conflict with Armenia, the government remains steadfast in its efforts to advance the renewable energy sector. An energy expert noted:

"As we know, Azerbaijan, despite being a relatively young country, began exporting its energy resources on a large scale early on. The opening of the Baku-Tbilisi-Ceyhan pipeline marked a significant milestone, leading to peak oil production in 2010. However, since then, oil production

has been on a steady decline. On the other hand, gas production has seen growth, particularly after 2016, following the launch of new gas pipelines to Europe to meet increasing demand. For the first time in history, revenues from oil and gas are nearly equal. Yet, both resources are finite—oil production is already declining, and gas production is expected to peak within the next 10 to 15 years before it begins to decrease as well. Recognizing the challenges posed by limited reserves, a growing population, and rising energy demand, the government has acknowledged the importance of developing the renewable energy sector." – (I10-Energy officer, the government entity)

Since 2014, the European Investment Bank (EIB) has been actively engaged in Azerbaijan under the scope of the European Neighbourhood Policy, the Eastern Partnership initiative, and other EU-related agreements. To date, the EIB has provided over €96 million in financial support to the country, including €25 million directed toward more than 120 small and medium-sized enterprises through collaborations with local financial institutions. The Bank's involvement aims to assist Azerbaijan in broadening its economic base, with particular emphasis on renewable energy, enhancing energy efficiency, and fostering inclusive economic growth, especially in rural regions. These efforts are part of the EU4Business initiative and are aimed at strengthening growth, healthcare, digitalization, and climate action, especially in light of the COVID-19 pandemic (EIB, 2024).

According to an executive agreement between Azerbaijan's Ministry of Energy and Saudi Arabia's ACWA Power, construction of the 240 MW Khizi-Absheron Wind Power Plant officially began on January 13, 2022, backed by an investment of $300 million. The President of Azerbaijan has outlined an ambitious goal to raise the share of renewables in the country's total energy capacity to 30% by 2030 (ACWA Power, 2020). A study by the German firm VPC suggests that achieving this target will require the addition of 1,500 MW in new renewable energy installations by 2030. This expansion is planned in three stages: 440 MW between 2020–2022, 460 MW from 2023–2025, and 600 MW between 2026–2030 (IEA, 2021). Initial assessments conducted across 16 regions have pinpointed 20 viable locations for solar power plants, covering 9,218 hectares and offering a combined capacity of 4,609 MW. These sites are expected to generate approximately 6.1 billion kWh of electricity annually (IEA, 2021).

ACWA Power has played a substantial role in Azerbaijan's renewable energy sector through its landmark 240 MW wind farm project, which is anticipated to generate one billion kilowatt-hours of electricity annually (ACWA Power, 2023). This initiative highlights the company's strong commitment to supporting Azerbaijan's transition to sustainable energy infrastructure. The project received formal approval through an investment agreement endorsed by President Ilham Aliyev's

administration, affirming ACWA Power's involvement in advancing renewable energy technologies in the country. In collaboration with key partners such as Masdar and SOCAR, ACWA Power is actively working to develop 500 MW of renewable energy capacity, with a significant share—286 million USD—allocated specifically for the ongoing 240 MW wind power facility. These strategic investments underscore the company's long-term dedication to fostering Azerbaijan's sustainable development and reinforce its influential role in shaping the country's renewable energy landscape (Abdul, 2024).

According to insights from expert interviews, the government has increasingly acknowledged the significance of private capital in recent years:

"We are making every effort to engage the private sector in these projects, with many of the current initiatives structured as Public-Private Partnerships (PPPs). The government focuses on establishing the regulatory framework, while the private sector provides the investment. In this way, both the government and private entities collaborate closely." - (I17-Senior officer, an international company)

"When it comes to the energy transition, the Azerbaijani government is not acting alone. They are actively working to attract foreign direct investment and private capital to drive growth in the renewable energy sector." - (I6-Project manager, a regional organisation)

Azerbaijan has initiated its first competitive renewable energy auction for a 100 MW solar power facility in the Garadagh region, marking a major step toward the country's objective of generating at least 30% of its electricity from renewable sources by 2030. The Ministry of Energy, in cooperation with the European Bank for Reconstruction and Development (EBRD), has opened the application process via its official website. Developers interested in participating can access the qualification documents starting April 30, with final submissions due by June 14. This auction supports Azerbaijan's green energy strategy and is designed to attract private sector investment in utility-scale renewable projects. The EBRD has been instrumental in shaping Azerbaijan's legal and regulatory framework for renewable energy, aiding in the development of new legislation and competitive procurement mechanisms. It has also provided financial support for major green projects, including the Garadagh solar plant and the Absheron-Khizi wind farm (Bitsadze, 2024).

In recognition of the private sector's critical role in advancing renewable energy, the Azerbaijani government has implemented specific incentives to encourage greater private sector involvement in this domain. As one expert interviewee noted:

"The government stimulates private sector involvement by signing 20-year power purchase agreements. Additionally, they offer investment promotion certificates that provide tax and customs reductions for private companies for up to seven years. Certain technologies have also been exempted from customs border fees to further support the sector." – (I18-Senior officer, an international company).

In light of growing environmental concerns, Azerbaijan presented its Intended Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) on December 12, 2015. Through this submission, the country pledged to cut its greenhouse gas emissions by 35% by the year 2030, using 1990 as the baseline year for comparison (Niftiyev, 2020).

BP and Nobel Energy have made notable contributions to the development of Azerbaijan's renewable energy sector through various strategic projects. In partnership with the Ministry of Education, BP allocated $2 million to support the launch of a new master's degree program in renewable energy at a local academic institution (BP, 2021). At the same time, Nobel Energy is progressing with the construction of a 100 MW solar power plant in Jabrayil, a project expected to reduce carbon emissions by approximately 1.17 million tons over a 25-year period. Furthermore, the company has entered into an agreement with the Ministry of Energy to build an additional 400 MW of solar energy capacity in the Nakhchivan region (Nobel Energy, 2018).

The support mechanisms for investors is outlined in various government documents, are summarized as follows: Tax and Duty Exemptions: For a duration of seven years, entrepreneurs and eligible companies are free from value-added tax (VAT) on technical facilities, as well as customs duties; Tax Relief: Entrepreneurs and qualifying companies are exempt from property and land taxes, along with a 50% reduction in income tax obligations; Government Guarantees: The government extends specific guarantees and payment commitments to foreign investors. Additionally, Azerenerji OJSC undertakes to purchase the generated energy; Support for Renewable Energy Projects: Investors in renewable energy sources (RES) benefit from guaranteed energy offtake, assured grid connection, priority in energy transmission and distribution, and access to long-term land leases ; Exemptions for Wind Energy Equipment: Since 2007, imports of equipment for wind energy generation have been exempt from VAT; VAT Relief for Renewable Energy Products: In 2014, VAT exemptions were granted for 81 types of products used in the field of alternative and renewable energy (MERA, 2022).

The enactment of the Law on Energy represented a major milestone in advancing the role of renewable energy in Azerbaijan. The Electro Energetics Law defined the primary stakeholders in the electricity sector, such as the state-owned electricity corporation, independent power producers, distribution companies, and end-users. Likewise, the ETPP Law acknowledged the

essential role of private sector involvement in the energy market, reinforcing the broader legal framework that supports market liberalization and renewable energy development.

A pivotal milestone for the renewable energy sector was the May 2021 law, which was the first legislation dedicated exclusively to renewable energy. This law introduced critical support mechanisms for the sector's growth, such as guaranteed tariffs, incentives for foreign investment, scientific research initiatives, and measures to encourage active consumer participation (IEA, 2022).

By contrast, the legislation enacted in July 2021 emphasized energy efficiency and the conservation of energy resources. Notably, this was the first legal framework to address energy efficiency, as no such regulations existed previously. The significance of these laws was highlighted by a renewable energy expert as following:

"We have set ambitious goals for green growth, aiming for 2030, and progress has been strong. Notably, in May 2021, the government enacted the Renewable Energy Law, followed by the Energy Efficiency Law in June 2021. Together, these two laws form the cornerstone of the country's energy transition." - (V8-Senior officer, an international company)

Global energy companies are increasingly turning to renewable energy solutions to lower carbon emissions and address climate change. Achieving meaningful progress in this area requires substantial investment in technologies such as carbon capture and storage, hydropower, solar and wind energy, and green hydrogen production. These efforts not only help meet environmental standards but also aim to set a foundation for a cleaner and more reliable energy future.

In this context, SOCAR has recently made notable advancements in the renewable energy sector. The company's Supervisory Board approved the establishment of SOCAR Green LLC, an entity dedicated to managing renewable energy projects and fostering collaborations with international partners. SOCAR Green LLC's mandate includes reducing the carbon footprint of oil and gas operations through measures such as green hydrogen development and carbon capture and storage. It is also responsible for formulating strategic plans aligned with Azerbaijan's national priorities, drawing on global best practices to support emission reduction goals (Zeynalova, 2023).

Recognizing the challenges within the developing renewable energy sector, Azerbaijan has begun engaging in consultations and partnerships with various international organizations and institutions to advance its clean energy objectives. An energy Officer emphasized:

"They are cooperating with the EU and other entities to establish the legal foundation for renewable energy and to support energy efficiency initiatives. They also engage with the Asian Development Bank and several other organizations." - (I6-Project manager, a regional organisation)

SOCAR has announced the development of a new facility in Azerbaijan in collaboration with Baker Hughes. This initiative is part of a broader set of strategic projects being pursued in partnership with key international players such as Energy China, Masdar, and BP. As illustrated in Figure 8, several leading companies are actively contributing to Azerbaijan's renewable energy landscape. Notable examples include a 1 GW wind and solar power project with Masdar and a 240 MW solar plant in Jabrayil being implemented in cooperation with BP. Future plans also involve expanding renewable energy efforts in the Nakhchivan Autonomous Republic through joint ventures with partners like Masdar and ACWA Power. Additionally, SOCAR and Baker Hughes have established a local facility dedicated to the assembly and maintenance of electric submersible pumps (ESPs). With the help of SOCAR's Azneft Production Union and Baker Hughes Services International, this partnership will first supply 50 ESP kits to Azerbaijan with the goal of improving production efficiency through cutting-edge technology and strategic cooperation (Yevgrashina, 2024).

Figure 8. Azerbaijan Renewable Energy Top Companies

Source: Mordor Intelligence, 2024

The development of smart cities and villages marks a significant advancement in Azerbaijan's efforts to transition toward sustainable energy. A notable example is Aghali, a model "smart village" in southern Azerbaijan, which reflects the government's broader initiative to reconstruct the Karabakh region following the 2020 conflict (Civillini, 2024). Aghali incorporates various renewable energy solutions, including residential solar panels, a modern hydropower plant, and innovative smart agriculture systems, all aimed at achieving net-zero emissions. As the first of approximately thirty planned smart villages, Aghali serves as a blueprint for similar projects throughout Karabakh. Additionally, the Azerbaijani government has designated Eastern Zangezur and Karabakh as "green energy zones" and plans to implement major renewable energy projects in these areas, including a 500 MW solar power plant in Nakhchivan (Azertag, 2024a).

As shown in Figure 9, Azerbaijan's renewable energy sector is projected to grow from an estimated capacity of 8.17 gigawatts in 2024 to 9.66 gigawatts by 2029, reflecting a compound annual growth

rate (CAGR) of 3.40%. The COVID-19 pandemic temporarily disrupted both ongoing and planned projects, negatively affecting market momentum, though the sector has now recovered to pre-pandemic performance levels.

According to the *Strategic Road Map on National Economic Perspectives*, one of the main drivers of growth in the renewable energy sector is Azerbaijan's broader goal to diversify its economy and reduce reliance on oil and gas. Expanding the energy mix is also expected to bring additional benefits such as enhanced energy security and job creation.

Nonetheless, the sector faces challenges. Delays in project implementation and limited foreign investment could hinder further development. Currently, the oil sector accounts for roughly one-third of Azerbaijan's GDP, with crude oil exports playing a dominant role. Moving forward, the government aims to reduce domestic consumption of oil and gas to increase export revenue. This change is probably going to result in a higher proportion of renewable energy in the energy mix, which will open up new opportunities for market players in the near future (Mordor Intelligence, 2024).

Figure 9. Renewable Energy in Azerbaijan Market Size

Source: Mordor Intelligence, 2024

Under the pilot project "Knowledge Sharing and Technical Support for the Advancement of Floating Solar Panel Systems", supported by the World Bank, plans have been outlined to install a photovoltaic system with a capacity of up to 150 kW. The initiative also aims to develop innovative business models to attract private sector investment in solar energy projects and strengthen national capabilities through targeted training programs and knowledge-building workshops (World Bank, 2023). In addition to public sector collaboration, Azerbaijan engages actively with private enterprises and industry stakeholders to foster growth in the renewable energy sector. An expert interviewee stated:

"Azerbaijan is increasingly tapping into its renewable energy potential year after year, with significant advancements made over the past four years. The country currently boasts a renewable energy capacity of 1304 MW. In February 2021, Azerbaijan introduced a law prioritizing a green environment and sustainable growth, highlighting green energy as a core strategic focus. In liberated areas, innovative 'smart village' projects aim to power homes using solar and wind energy." - (I18-Senior officer, an international company)

Azerbaijan works in close partnership with international institutions like the European Bank for Reconstruction and Development (EBRD) to conduct renewable energy auctions and promote smaller-scale initiatives, such as rooftop solar systems. Additionally, the Asian Development Bank is assisting with the installation of floating wind turbines in the Caspian Sea, while IFS supports offshore wind projects. Recent developments include partnerships with UAE's Aqua Company for wind turbine installations, Masdar for a 230 MW solar power plant, and BP for a 240 MW solar energy station in the Jabrayil region."

Hosting COP29 in November 2024 presents a valuable opportunity for Azerbaijan to highlight its renewable energy potential and green energy export ambitions. One of the key topics expected to take center stage is the Caspian-Black Sea-European Green Energy Corridor, which underscores Azerbaijan's dedication to energy security and international climate cooperation. This project aligns with the country's broader strategy to support Europe's decarbonization efforts and accelerate its own energy transition. The summit will allow Azerbaijan to demonstrate its leadership in renewable energy and outline its green export objectives to a global audience.

As the host of COP29, Azerbaijan has announced plans to raise the share of renewables in its energy sector to approximately one-third. The government intends to invest $2 billion in green energy, with Energy Minister Parviz Shahbazov stating that around 2 GW of renewable energy capacity will be added by 2027. This expansion is expected to bring the renewable share of total installed capacity to 33%, up from the current level of 20.86%. While fossil fuel investment is declining globally and future demand remains uncertain, Shahbazov affirmed that Azerbaijan will continue fulfilling its natural gas supply commitments to international partners (WEF, 2024).

Nevertheless, despite the advancements achieved, certain areas require further development to fully unlock Azerbaijan's renewable energy potential. These include setting clear, measurable targets for renewable energy production, enhancing feed-in tariffs, and implementing legislative reforms to align more closely with international best practices. Those prospects will be explored in the following sections.

5.6 Primary Challenges for Transition towards Renewable Energy

Nowadays, the Azerbaijani government has increasingly prioritized the advancement of its renewable energy sector, despite the country's abundant fossil fuel resources. This strategic shift is underscored by several key measures. For instance, Azerbaijan approved the Renewable Energy Development Program in 2005 as a foundational step toward diversifying its energy portfolio. In 2010, the nation strengthened its commitment by becoming a member of the Global Renewable Energy Council and establishing the Ministry of Energy's Renewable Energy Division to oversee the sector's growth (Aliyev & Hasanov, 2019). Additionally, tax incentives were introduced in 2015, offering exemptions on customs duties and VAT for imported technologies and infrastructure supporting renewable energy projects (Huseynov et al., 2021).

Nevertheless, the renewable energy sector continues to be eclipsed by the conventional energy industry. By 2021, renewable energy sources contributed just 6.1% of Azerbaijan's total electricity output, highlighting a stark contrast with fossil fuel-based production. This disparity stems from a complex interplay of economic, political, and technological factors, as well as social and cultural influences that can either hinder or support the transition to cleaner energy alternatives.

The following sections will analyze this transition in greater detail, focusing on key areas such as policy frameworks, institutional structures, financial mechanisms, and technological developments. Each of these components brings forth unique challenges and opportunities for advancing Azerbaijan's renewable energy agenda.

5.6.1 Regulatory Frameworks

Despite the government's commitment to advancing the deployment of renewable energy sources (RES), several obstacles hinder meaningful progress in the sector. A primary issue lies in the absence of a comprehensive legal and regulatory framework governing the use and production of RES. While much of the investment currently comes from the state and international institutions, the lack of clear technical, legal, and institutional structures discourages private sector involvement. As a result, the investment climate for RES remains underdeveloped. Additionally, the full value chain—encompassing generation, transmission, distribution, and delivery—requires better coordination and structure (Aydin, 2019). The government is actively working on drafting legislation to provide proper regulation for the industry, although discussions around the proposed bill are still underway. Until a stable regulatory environment is established, sustained investment in the renewable energy sector will likely continue to rely heavily on public and international funding (Hamidova et al., 2022). As one expert in the field noted:

“We are currently in the early stages of the transition, focusing on establishing legislation to support it. Azerbaijan's energy framework has traditionally been centered on conventional energy sources, rather than renewable or clean energy." - (I13-Renewable energy expert, a local private company)

The legal and regulatory framework has evolved to drive a more competitive power market as can be seen in Figure 10.

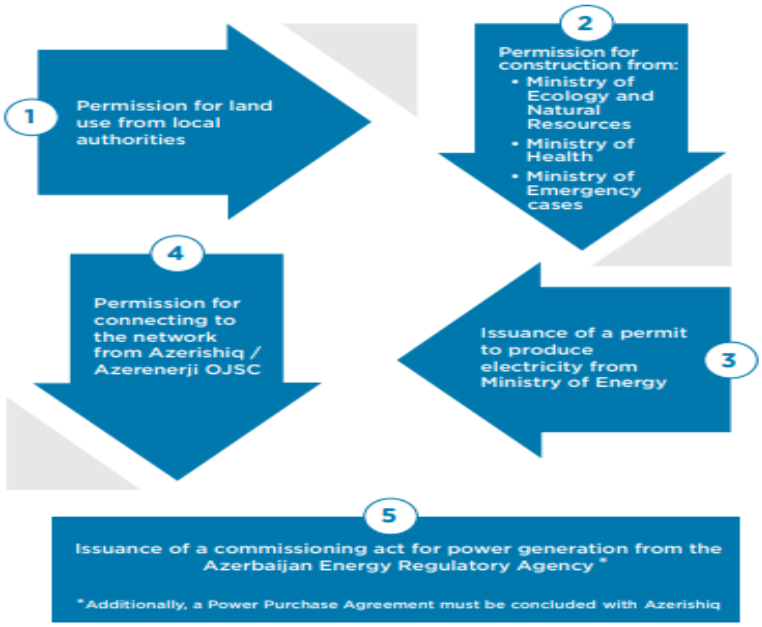

Figure 10. Overview of existing renewable energy permitting procedures

Source: IRENA, 2019

The energy sector in Azerbaijan is primarily overseen by the Ministry of Energy, which governs as the central governing authority. This centralized bureaucratic structure often poses difficulties in effectively implementing regulatory frameworks. For instance, although legal provisions exist to encourage greater participation from private enterprises, the Azerbaijani energy market remains largely state-dominated, with limited private sector engagement (Aliyev & Mammadov, 2021). An expert in energy highlighted:

"The government needs to take more decisive action and adopt a more proactive approach to achieve stronger results. While steps are being taken, the implementation by governmental bodies often falls short. To address this, a robust monitoring system is essential." - (I10-Energy officer, the government entity)

The legal framework is still vague, with unclear targets, strategies, and overly broad requirements, which adds further challenges to the implementation process. Environmental expert highlighted:

“While the legislation exists, it is overly broad and lacks clarity, failing to address specific issues in a precise and detailed manner.” - (I24-Senior officer, the governmental entity)

Despite significant policy and regulatory challenges hindering Azerbaijan's energy transition, recent initiatives present valuable opportunities for reform and innovation. The dynamic between these challenges and opportunities, along with the lessons learned, will be detailed in the subsequent sections.

5.6.2 Institutional Challenges

Institutional aspects, including organizational capacity, interagency collaboration, and governance mechanisms, are critical in determining the success or delay of Azerbaijan's energy transition. These elements provide the necessary framework for policy implementation, shaping how renewable energy initiatives are envisioned, structured, and carried out. Since renewable energy is a relatively new priority in Azerbaijan, systemic-level institutional challenges have emerged, slowing the adoption of clean energy technologies. Notable obstacles include the limited authority and capacity of local governments, overlapping responsibilities among various agencies, the complexity of regulatory frameworks and procedures governing the renewable energy sector, as well as insufficient infrastructure and a shortage of skilled professionals to support the sector’s expansion (Hasanov et al., 2021).

Despite multiple waves of restructuring following the Soviet Union's collapse, the country's institutional framework remains deeply entrenched in its Soviet-era centralized and unstable characteristics, as elaborated in Chapter 6. This persistence can be pertinent, in part, to the state's tendency to prioritize frequent personnel changes and reshuffling over implementing meaningful reforms. Such practices hinder the development of institutional capacity necessary for advancing the renewable energy sector. These combined factors undermine the formal institutional foundation of energy management in Azerbaijan.

The establishment of a robust regulatory framework for the renewable sector has progressed slowly, primarily due to the complexity of existing institutional structures, which complicates the process. For instance, there are currently no dedicated institutional mechanisms or formal arrangements to oversee and coordinate renewable energy development. Moreover, limited or inconsistent collaboration and coordination between relevant entities further impede the sector's growth (I1 – Energy expert, governmental entity; I11 – Junior manager, local private company; I6

– Project manager, regional organization; I2 – Senior official, energy company; I24 – Senior officer, governmental entity). As an expert emphasized:

> "There seems to be an issue stemming from a lack of expertise, coordination, and an effective monitoring system. While we often have well-designed projects that consider all necessary aspects during the initiation phase, challenges arise during implementation and monitoring, which ultimately reduce their overall effectiveness." - (I4-Renewable energy expert, a local private company)

Although these challenges persist, there are growing opportunities to enhance institutional capacity. According to an energy expert:

> "Significant progress has been made since 2012, particularly in terms of political commitment and the development of institutional and legal frameworks." - (I6-Project manager, a regional organisation)

To conclude, although institutional challenges present substantial obstacles to Azerbaijan's energy transition, recent advancements—such as the state's approach to renewable energy, international collaboration, and regional partnerships—offer a solid foundation for continued progress toward a sustainable energy future. The interplay between institutional dynamics and policy and regulatory frameworks, as discussed earlier, enhances the overall understanding of Azerbaijan's path to energy transition.

5.6.3 Financial challenges

Azerbaijan's electricity sector has historically been dominated by oil and natural gas, resulting in greater expertise in conventional energy technologies compared to renewable energy. The renewable sector faces significant constraints, including limited financial resources and high interest rates, which hamper investment and development (Hamidova et al., 2022). The decline in global oil prices in mid-2014 had a profound negative impact on the Azerbaijani economy, with ripple effects that extended to the renewable energy sector as well.

To encourage the adoption of renewable energy sources (RES), the Azerbaijani government has introduced various tax incentives. Under this policy, legal entities and individual entrepreneurs who obtain investment promotion certificates—issued by a designated executive authority—are exempt from customs duties and value-added tax (VAT) on imported technical equipment for a period of seven years from the date of issuance. Additionally, these entities receive a 50% reduction on income and profit taxes, along with exemptions from property and land taxes. These

fiscal measures have supported the development and deployment of renewable technologies across the country. For instance, Sumgait Technology Park now hosts the Azguntex Solar Panel Plant, which has a production capacity of 50 MW, along with a solar collector manufacturing facility.

Despite substantial public investment in renewable infrastructure, the overall capacity and contribution of RES to total electricity generation remain below expectations. This situation mirrors a global trend in which private sector actors hesitate to commit to long-term investments in renewables. Aydin (2019), referencing Yoshino, Taghizadeh-Hesary, and Nakahigashi (2019), notes that private investors often perceive such ventures as high-risk with limited returns, thereby deterring their involvement in RES development.

As discussed in previous chapters, Azerbaijan has access to great potential of renewable energy sources, but the decline of oil prices restricted the availability of the investments to RES and it also revealed the crucial evidence that the development of RES by only the state fund and investments does not arrive at successful deed, therefore major involvement of private funds must be realized by building up the status for private investors act under competitive market rules.

An energy expert stated: “Prior to 2015, Azerbaijan experienced significant levels of investment, largely supported by high oil and gas prices, which provided the necessary funding for various initiatives. However, following the decline in oil prices in 2015, the country faced a severe economic crisis, which hindered its ability to sustain these efforts and continue the process effectively.” - (I13-Renewable energy expert, a local private company)

A government official emphasized:

“Investment in this sector also declined following the Second Karabakh War. Moreover, the financial demands of rebuilding the liberated regions in Karabakh have placed additional strain on the government, diverting attention and resources away from environmental concerns.” – (I30-Researcher, higher education institute).

In summary, although financial obstacles—such as restricted funding, substantial upfront costs, and fossil fuel subsidies—present major hurdles to Azerbaijan's energy transition, new opportunities offer pathways to address these challenges. Growing interest from private investors, the utilization of climate finance, and the mobilization of domestic resources, along with innovative financing strategies, can foster a conducive financial environment for advancing the energy transition. This would enable Azerbaijan to fully utilize its renewable energy resources and contribute significantly to international sustainability efforts.

5.6.4 Technical challenges

Due to the high cost associated with renewable energy technologies, Azerbaijan faces considerable technical challenges in acquiring and transferring these technologies. This represents a key obstacle in the development of the sector. As most of the required technologies are imported, there is a pressing need to streamline technical processes to facilitate their effective integration and use within the country.

The primary challenge in the advancement of the renewable energy sector lies in the expenses associated with energy production and the essential technologies. In industrialized nations, advancements in technology and the declining costs of renewable energy solutions have made them increasingly viable for both residential and industrial applications (Kumar et al., 2022). Conversely, in many developing countries, insufficient scientific progress, minimal innovation, and substantial import expenses hinder access to renewable technologies. Azerbaijan faces similar obstacles, as its technological requirements significantly surpass its current capabilities.

An environmental expert elaborates:

> “The primary reason, in my view, is associated with the expenses required for implementing renewable energy and the limited availability of advanced technology in Azerbaijan.”- (I29-Senior officer, an international company in Baku)

This shortage of technology is exacerbated by Azerbaijan's insufficient scientific and research capabilities, which are crucial for driving technological progress. As noted by a senior researcher:

> "Our universities do not meet the required standards, and our engineering and technology fields are significantly lagging behind." - (I3-Researcher, a higher education institute)

The scarcity of domestically produced renewable energy technologies has led to a significant dependence on imports, driving up the costs of implementing renewable energy projects in

Azerbaijan (Hasanov, 2022). This challenge is particularly evident in the case of solar photovoltaic (PV) systems and wind turbines, where the lack of a robust local supply chain hampers the expansion of the renewable energy sector and exacerbates reliance on international suppliers (World Bank, 2020). As noted by an energy expert:

"We will have to depend on imported technologies since we do not manufacture our own solar panels. This creates challenges, as these technologies are currently quite costly." – (I3-Researcher, a higher education institute)

Incorporating renewable energy into existing energy systems remains a complex task, even for highly developed economies. For instance, the International Energy Agency (IEA) collaborates with G20 nations to formulate strategies, programs, and actionable frameworks to facilitate the seamless integration of renewable energy sources into their established energy infrastructure (IEA, 2020). Successfully achieving this integration requires careful consideration of multiple factors, including grid stability, storage capacity, and energy demand management (Smith, 2016).

A significant technical obstacle in Azerbaijan's shift toward renewable energy is the intermittent nature of sources like solar and wind power (World Bank, 2021). The fluctuation in these energy supplies presents difficulties in maintaining grid stability and reliability, particularly because the current electricity infrastructure was originally designed to support conventional power generation systems (Rahman et al., 2023). Although renewable energy, especially wind power, has demonstrated its potential, integrating it into Azerbaijan's existing grid remains a substantial challenge due to infrastructural and operational limitations. An Energy expert stated:

“However, when it comes to electricity, challenges may arise. Delivering electricity to the grid requires a well-developed infrastructure, and without such systems in place, the process becomes significantly difficult.” - (I2-Senior official, an energy company)

Although Azerbaijan's energy sector infrastructure is relatively more developed compared to other strategic sectors, its electricity grid experiences higher transmission and distribution losses, recorded at 9.7%, compared to 7.3% in neighboring Georgia (ADB, 2021). This highlights the need for modernization of Azerbaijan’s ageing and inefficient grid system to ensure it can effectively support the integration of renewable energy sources (Hasanov & Karimov, 2023). As argued by a senior academic:

“The electricity grid still relies on infrastructure inherited from the Soviet era, which highlights the urgent need for modernization.” - (I5-Senior academic, a higher education institute)

Successfully incorporating a significant proportion of renewable energy into the energy mix demands major investments in grid modernization and the deployment of advanced energy storage systems—challenges that pose particular difficulties for Azerbaijan.

Over the past decade, Azerbaijan has developed new power plants equipped with advanced technologies, increasing the country's electricity generation capacity to 7542.2 MW. A senior officer stated:

"Like many other countries, our nation is experiencing challenges in transitioning to new energy systems due to the complexity of upgrading the entire grid and addressing storage issues. These grid and storage difficulties are significant for us as well. However, substantial efforts are underway in this area, and we are collaborating with international organizations to enhance and modernize our grid." - (I8-Senior officer, an international company).

To promote the use of advanced renewable energy technologies, the Azerbaijani government is engaging in active cooperation with several international firms, such as BP and KBR from the UK, Masdar from the UAE, and Norway's Equinor. These collaborations aim to identify and develop green energy initiatives through the application of innovative technologies (MERA, 2023).

In conclusion, Azerbaijan encounters significant technical and technological barriers in its shift toward renewable energy, such as the intermittent nature of renewable sources and the absence of local manufacturing capabilities. Nevertheless, the country's considerable renewable energy potential, advancements in clean energy technologies, and increasing governmental commitment to the sector present meaningful opportunities to overcome these challenges and move toward a more sustainable and diversified energy landscape.

5.7 Conclusion

This chapter undertook a comprehensive examination of Azerbaijan's progress toward renewable energy, navigating the intricate interplay of historical dependencies, policy developments, and technological advancements. It highlighted a transformative shift in Azerbaijan's energy sector, driven by a mix of domestic priorities and international pressures. The analysis revealed a notable inertia in the country's energy transition, despite its vast renewable energy potential, while also underscoring significant changes in political commitment and policy direction since 2015. These shifts, alongside ongoing barriers, reflect both opportunities and obstacles in the shift to a sustainable energy future.

The findings indicate that Azerbaijan's transition to renewable energy has been gradual, which is particularly striking given its considerable untapped renewable resources. This sluggish progress stems from a combination of entrenched infrastructure, institutional inertia, and public perceptions, illustrating the complex and multifaceted nature of systemic change within the energy sector.

A clear political and institutional shift toward renewable energy is reflected in several major developments. The approval of the National Strategy on the Use of Alternative and Renewable Energy Sources (2015–2020) in 2014 and the creation of the Azerbaijan Renewable Energy Agency in 2019 represent important milestones. These actions, along with the government's growing emphasis on large-scale renewable energy projects and ongoing legal reforms, indicate the beginning of a significant transformation in Azerbaijan's energy pathway.

Despite these positive developments, this chapter identifies persistent barriers that hinder progress. These include the dominance of the extractive sector, high costs of renewable energy technologies, inadequate domestic technological capabilities, and limited institutional capacity. Addressing these obstacles will require coherent policies, greater investment, and inclusive stakeholder engagement. By examining these challenges, the chapter provides a roadmap for actionable pathways to advance the energy transition.

Azerbaijan's efforts to embrace renewable energy carry broader implications for global energy transitions. Azerbaijan's experience provides important insights into navigating the transition from reliance on fossil fuels toward a cleaner and more sustainable energy system. This chapter, therefore, contributes a critical perspective on how policy, technology, and market forces intersect to shape energy transition dynamics.

In conclusion, this chapter not only traces Azerbaijan's evolving energy landscape but also emphasizes the urgency of action, recognizes the progress made, and critically evaluates the challenges that persist. To realize its renewable energy potential, Azerbaijan must continue to enact supportive policies, attract investments, and strategically address existing barriers. The insights provided here lay the foundation for a deeper understanding of Azerbaijan's energy transition while setting the stage for the historical analysis in Chapter 7. The following chapter explores Azerbaijan's post-communist past to examine how it has shaped both current and emerging energy policies, providing deeper insight into the underlying factors influencing the nation's energy trajectory

CHAPTER 6. ANALYSIS AND RESULTS: THE IMPACTS OF POST-COMMUNIST TRANSFORMATIONS ON AZERBAIJAN'S ENERGY TRANSITION

6.1 Introduction

Chapter 6 builds upon the foundation established in Chapter 5, which explored the early stages of Azerbaijan's energy transition. This chapter shifts focus to the historical contexts that have influenced the current energy landscape, specifically examining how post-communist transformations have both facilitated and hindered progress toward renewable energy adoption. In doing so, it provides an in-depth examination of the key forces influencing Azerbaijan's energy transition in the post-Soviet context. Central to this discussion is the second research question introduced earlier in this thesis: How does Azerbaijan's past prior to the independence influence its transition to renewable energy? To address this, the chapter frames evolution as a path-dependent process, wherein inherited characteristics from the previous regime shape development patterns and institutional routines. The analysis begins with the post-communist transformations that unfolded in Azerbaijan following its independence in 1991.

Since the collapse of USSR, Azerbaijan has undergone considerable economic, social, and political transformations, including changes to its energy policy. This chapter contends that despite these shifts, the energy policies established during the Soviet era remain highly relevant and continue to exercise a strong impact on the country's current energy and environmental strategies. The impact of post-communist transformations on Azerbaijan's energy transition has been both positive and negative. On one hand, the collapse of the Soviet regime and subsequent restructuring fostered openness to the West, enabling collaboration and knowledge exchange with Western nations. This increased flow of information played a crucial role in promoting clean energy policies by raising awareness and reshaping attitudes toward environmental issues at both governmental and public levels. On the other hand, the severe economic decline experienced during the post-communist period reinforced reliance on Soviet-era industrialization, characterized by heavy industry and unchecked exploitation of natural resources. Therefore, gaining insight into Azerbaijan's communist-era history is crucial for examining the enduring influences that continue to impact its current energy transition.

This analysis is grounded in transition theory, with a special attention on the MLP on socio-technical transitions. By exploring the interactions among landscape pressures (macro-level influences), regime stability (established energy policies and infrastructures), and niche innovations (emerging clean energy solutions), it unpacks the intricate dynamics of Azerbaijan's energy transition. Furthermore, the EEG framework, including its key concept of path dependency,

is employed to examine how historical choices and developmental trajectories continue to shape the scale and trajectory of energy policy changes in the post-communist period.

The chapter is organized as follows: Section 6.2 provides a historical background of Azerbaijan's energy transition leading up to the dissolution of the Soviet Union, laying the groundwork for the subsequent analysis. Section 6.3 explores the country's energy transition after 1991, focusing on the factors that influenced the shift in its energy agenda during the post-communist restructuring. Section 6.4 delves into the various aspects of Azerbaijan's post-communist legacy that continue to shape its current energy transition strategy. This section is organized into four sub-sections that explore major factors influencing the energy transition, such as centralized governance, the prevailing role of fossil fuel industries, institutional structures, and levels of public engagement. The chapter concludes with a summary of key insights in Section 6.5.

6.2 Energy transition in Azerbaijan prior to the dissolution of the Soviet Union

As discussed in earlier chapters, Azerbaijan's renewable energy adoption remains relatively low, and the country lags behind developed nations despite possessing significant renewable energy potential. A common misconception is that Azerbaijan's energy transition is slow because it began only recently. In fact, initiatives aimed at broadening the energy mix and decreasing dependence on fossil fuels were underway even before Azerbaijan gained independence in 1991. While modest in scale and largely focused on the incremental substitution of fossil fuels, these early efforts have significantly influenced the direction of Azerbaijan's present-day energy transition.

During the Soviet era, the focus on achieving rapid industrial expansion often led to the neglect of environmental concerns, as the government prioritized the consistent growth of industrial output (Smith and Johnson, 2015). The scarcity of reliable data on the Soviet Union's energy profile has made it challenging to ascertain the exact proportion of renewable energy in the overall energy mix. Nonetheless, the evidence available suggests that renewables, with the exception of hydropower, contributed minimally—nearly zero—until the mid-1980s, as outlined in Table 6 below.

Table 6. Electricity generation by primary energy sources in per cent

Fuel Type	1970	1980	1985
Coal	41.4	32.1	24.7
Fuel oil	17.8	28	16.1
Natural gas	19.3	19.3	34
Peat, wood, etc.	2.5	0.8	-
Nuclear	0.5	4.5	10.8
Hydro	18.5	15.3	14.4
Total	**100**	**100**	**100**

Source : Sinyak, 1991, p. 798

While modest in scale and largely focused on the incremental substitution of fossil fuels, these early efforts have significantly influenced the direction of Azerbaijan's present-day energy transition. The dominance of Marxist principles, alongside abundant natural resources, led the Soviet leadership to prioritize extensive resource exploitation with limited focus on conservation (Petrov and Ivanov, 2014). From the period following the October Revolution of 1917, the Soviet economy increasingly depended on oil and gas exports, which accounted for approximately half of the nation's total revenue (Brown et al., 1987). The core strategy of the Soviet regime revolved around maximizing oil extraction and prioritizing its sale to the greatest extent possible (I7-Interview with a researcher from a higher education institution)

Since the 1917 Revolution, environmental management in the Soviet Union has evolved through three clearly defined phases. During the Leninist period (1917-1924), efforts were made to limit environmental degradation, particularly in areas such as land management, wildlife conservation, and forest preservation. However, these environmental policies were largely symbolic and rarely enforced effectively (Anderson et al., 1984). The Stalinist phase, often referred to as the "maximum growth phase" (1925-1960), prioritized aggressive resource exploitation to achieve immediate economic goals, with little to no regard for environmental sustainability. In the neo-Leninist period (1961-1975), there was a growing recognition of environmental challenges, leading to the implementation of new protective measures. Legislation during this time emphasized conservation, sustainable resource use, and pollution control (Roberts, 1992).

Azerbaijan, as a key petroleum hub of the Soviet Union contributing approximately 70% of Soviet oil production, witnessed a significant rise in environmental pollution from the 1920s onward. Although industrial pollution began in Baku during the 1870s with the early stages of oil extraction, the Soviet era amplified the problem due to the heavy industrialization concentrated in the region (Aliyev, 2019). The polluted landscapes around Baku, particularly from petroleum

activities, were largely ignored by Soviet authorities, whose priorities were shaped by Lenin's vision of "Soviet power plus electrification" and the policy of national self-reliance (Petrov et al., 2015). The current challenge for Azerbaijani officials lies not in addressing contemporary emissions alone but in managing the extensive legacy of past contamination (World Bank, 2007).

As noted by an energy sector official, "The Soviet government exploited Azerbaijani oil but neglected environmental remediation. Most of the pollution we face today stems from that era, and efforts are underway to clean it up" (Interview, May 2022). While comprehensive data on the Soviet energy landscape remains scarce, particularly in peripheral regions like Azerbaijan, studies and interviews suggest minimal attention was paid to environmental protection or energy transition in the region during Soviet times. More broadly, the Soviet Union made little effort to tackle sustainable development issues across its territories (Kuznetsov and Ivanova, 2009).

The mid-20th century saw significant economic growth in the Soviet Union, largely fueled by the expansion of oil and gas exports. However, during this time, little to no attention was given to developing a forward-looking energy strategy or implementing conservation measures (Smith and Taylor, 1985). A governmental officer states:

> "The Soviet Union, with its vast expanse and diverse resources, operated under the belief of endless abundance, showing little regard for resource conservation or environmental sustainability." - (I24-Junior officer, the governmental entity).

At the 26th Party Congress of the Communist Party, held from February 23 to March 3, 1981, General Secretary Leonid Brezhnev (who served from 1964 to 1982) emphasized that energy priorities would remain unchanged for at least the next decade. Brezhnev's remarks indicate that, by the 1980s, renewable energy had not been introduced into the energy mix, and fossil fuel-based, unsustainable production systems continued to dominate. The Soviet leadership acknowledged that transitioning from one energy type to another was not only costly and time-consuming but also posed the risk of power shortages, particularly in the European regions of the USSR. This conservative approach and reluctance to diversify the energy mix reinforced dependence on fossil fuels and postponed the integration of renewable energy sources, highlighting the regime's prioritization of energy security over long-term sustainability.

In the early 20th century, Soviet leaders, concerned about the potential for conflict with Europe and shortages in essential energy supplies within the European regions of the USSR, began to explore natural resources in peripheral areas such as Siberia and the South Caucasus. Rising domestic and international energy demands provided further impetus for oil exploration and

development in these remote territories. However, many of these resource-abundant areas were located far from major consumption hubs and suffered from a lack of fundamental local and regional energy infrastructure. Soviet authorities recognized the significant challenges associated with resource extraction in these distant locations, particularly the high costs involved in establishing necessary infrastructure.

During this period, Baku's energy infrastructure experienced substantial modernization and upgrades, largely thanks to the efforts of British and German engineers. These advancements positioned Baku as a focal point for fossil fuel extraction (Smith, 2020). The city's proximity to European USSR regions and the availability of advanced infrastructure contributed to its emergence as a key player in energy production. At the time, the oil production and refining industry was overwhelmingly concentrated in the Baku region, which accounted for over 97% of the former Russian Empire's oil output (Jones, 2021).

During the Soviet era, Baku rose to prominence as a key hub for the oil industry (V25 - Interview with a Senior Official from an Environmental Organisation). Azerbaijan's energy system underwent significant transformations. In the 1920s, the Azerbaijani oil industry was nationalized and consolidated under a single state-run organization, "Azneft," which oversaw the sector's operations under centralized Soviet control until the 1980s. Concerned about declining oil production in regions like Grozny, Azneft significantly boosted output in Baku to compensate for the shortfall (Karimov, 2021).

From the 1950s onward, the industrial settlement of Neft Dashlari, a pioneering collection of offshore oil platforms in the Caspian Sea and regarded as the first of its kind globally, became a critical production site. Over a span of six decades, approximately 170 million tons of oil and 15 billion cubic meters of natural gas were extracted from this offshore complex (Petrov, 2012). However, these developments, combined with the country's limited engagement with the outside world, further impeded efforts to modernize and transition the energy sector.

The isolation from global technological and informational advancements during the Soviet era left Azerbaijan reliant on outdated and inefficient technologies. The Soviet economy’s high energy intensity—primarily the result of inefficient machinery—led to growing concern among Soviet officials, motivating efforts to import Western technologies as a means of modernizing industrial operations. To fund these imports, the Soviet Union resorted to its historical practice of exporting oil, particularly from the Caucasus region. Consequently, Azerbaijan did not undergo any significant shift toward renewable energy sources. This dependency on fossil fuel exports, coupled

with centralized Soviet control, stifled innovation and hindered the development of alternative, sustainable energy options.

By the late 1960s and early 1970s, a shift in attitudes toward energy and environmental issues began to emerge among Soviet leaders. As noted by Rutland (1982), the primary concern within the Soviet energy system at the time was an overreliance on oil and the absence of diversified energy resources. By the mid-1970s, recognizing the limitations of oil exploration and the potential for resource scarcity, Soviet policymakers started to explore alternative energy sources. Over the following decades, the USSR adopted various strategies to reduce dependence on oil, turning to fuels such as natural gas, brown coal, and nuclear power (Thane and Roberts, 1985). However, efforts to incorporate cleaner energy sources remained absent. By 1988, as highlighted by Kovalenko (1990), the Soviet Union still lacked a comprehensive energy program addressing environmental concerns.

The Soviet regime's lack of engagement with environmental issues has often been attributed to the absence of grassroots advocacy and limited public pressure. This lack of societal activism stemmed from low levels of environmental awareness among the population and the restrictions imposed by a politically repressive system (Petrov and Smith, 2011). However, the mid-20th century marked a turning point. Beginning in the 1950s, public interest in environmental issues surged as people became increasingly aware of the consequences of ecological damage. This growing environmental consciousness spurred grassroots movements and niche social activities across the Soviet Union, including in Azerbaijan (Ivanov and Kuznetsova, 2014).

By the 1970s, mounting social pressure led to significant political shifts toward environmental advocacy. For the first time, environmental rights were enshrined in the Soviet constitution, marking a historic development. A policy focused on sustainable growth was also introduced during this period (Johnson et al., 2015). During the perestroika era of the 1980s—a time of political and economic reform aimed at restructuring the Soviet system—environmental protection was formally established as a national priority. However, actions taken during this period were largely restricted to conservation efforts, pollution control, and resource management, with little progress toward broader environmental reforms.

The first formal acknowledgment of renewable energy sources in Soviet energy policy appeared in the 1982 Energy Program, which outlined the long-term development goals and strategic directions for the Soviet energy system through 2010 (Ivanov, 1992). The program projected that clean energy sources, including hydropower, would only begin to play a significant role after the

year 2000. However, their contribution to the primary energy mix was expected to remain limited, accounting for no more than 8-9% of total production.

Scenarios modeled based on this energy program indicated that the role of renewables would continue to be negligible within the Soviet Union's energy framework through 2030. This marginal share reflected the regime's prioritization of traditional energy sources such as oil, coal, and natural gas over a transition to sustainable alternatives (Petrov, 1993).

The preceding analysis clearly indicates that renewable energy held only a minimal position within the Soviet energy system. This was largely due to factors such as adherence to Marxist principles and a disregard for environmental concerns. As a resource-rich area within the Soviet Union, Azerbaijan followed a similar fossil-fuel-centric energy policy.

6.3 Energy transition in Azerbaijan after the independence.

Following the collapse of the Soviet Union, the newly independent states underwent diverse economic and political transformations, often aimed at achieving liberalization, privatization, macroeconomic stability, and integration into the global economy. While the pathways from a centrally planned economy to a market-based system varied significantly among these nations, most adopted policies influenced by neoliberal principles (Smith and Brown, 2010).

Some countries opted for a "shock therapy" strategy, implementing rapid and sweeping reforms, whereas others chose a "gradualist" approach, introducing changes incrementally over time (Johnson, 2003). Azerbaijan, however, does not align neatly with either of these categories. As noted by Clark et al. (2005), Azerbaijan is often classified as a "late reformer," reflecting its slower and more cautious approach to economic and institutional reforms.

Like many other post-communist states, Azerbaijan encountered considerable economic, political, social, and energy governance challenges following the collapse of USSR. To address its economic decline, the country increased its reliance on oil and gas exports. Azerbaijan’s economic transition did not conform strictly to the "shock therapy" or "gradualist" reform models; instead, its approach was rooted in elements of a neoclassical framework, with a focus on physical investments and infrastructure development. Efforts were made to attract foreign investment through institutional and market liberalization measures aimed at enhancing the country's investment climate (Peterson and Ivanov, 2012).

While these reforms succeeded in drawing substantial foreign investment into Azerbaijan's fossil fuel sector, the government struggled to diversify both the economy and its energy portfolio. As a result, the nation's energy system remained heavily reliant on fossil fuels. Environmental sustainability challenges persisted and, in some respects, intensified after the end of communism. This was partly due to the entrenched interests of fossil fuel incumbents and the influence of rent-seeking networks, which prioritize economic gains over societal or environmental benefits. Rent-seeking, in this context, refers to the exploitation of resources and power by individuals or groups to secure financial advantages without contributing to productive or value-added activities (Baker and Williams, 2014)

It would be inaccurate to claim that no advancements have been achieved during the three decades of independence. Following the establishment of relative political and economic stability, Azerbaijan initiated numerous environmental initiatives by strengthening partnerships with international organizations and major corporations. This collaborative approach exemplifies a multi-stakeholder framework aimed at fostering sustainable development. Beginning in the late 1990s and extending into the early 2000s, significant legal and regulatory frameworks were introduced in the energy sector, marking a transition in the governance of energy production and usage (Smith & Jones, 2019). Broadly, the surge in international collaboration after the collapse of the Soviet Union reflects a transformative period that has encouraged dialogue around energy and environmental issues. Furthermore, the emphasis on modernizing infrastructure and adopting environmentally conscious policies has catalyzed niche innovations, driving Azerbaijan's energy transition in the post-Soviet era.

The economic and political liberalization that followed the collapse of USSR created new avenues for international collaboration, significantly contributing to Azerbaijan's energy transition. The networks, partnerships, and cooperative projects established after this period facilitated the transfer of European environmental policies and standards into the country. Consequently, from the mid-1990s onward, European influence became a pivotal factor shaping Azerbaijan's energy and environmental agenda. The proximity to Europe and the inclusion of Azerbaijan in the EU's Neighbourhood Policy further supported the alignment of its policies with EU environmental standards, reducing ecological challenges and promoting the adoption of sustainable practices (Doe & Smith, 2010). This external pressure, combined with financial, technical, and institutional support from Europe, elevated environmental protection and sustainability to key priorities within Azerbaijan's governance framework (Brown & Green, 2005).

Notably, the constitutional recognition of citizens' rights to a healthy environment in 1995 marked a foundational step in defining the nation's energy and environmental policies. This was followed by a landmark move in 1998 with Azerbaijan's ratification of the European Energy Charter, solidifying its commitment to energy transition (Taylor, 2019). These developments underscore the interplay between international influences and domestic policy evolution in shaping Azerbaijan's environmental and energy strategies.

Following the dissolution of the USSR, Azerbaijan was required to align with international climate policies, which became a significant factor shaping the nation's energy and environmental strategies. Historically, as discussed earlier, the Soviet Union and Azerbaijan had often displayed a skeptical attitude toward climate change, characterized by denialist rhetoric and resistance to climate-related initiatives. However, the combined influence of global pressures and Azerbaijan's strategic goal of enhancing its economic and geopolitical standing in the global marketplace drove the country to adopt more progressive energy and environmental policies.

"The primary motivations, in my view, stem from the interactions between governments and international organizations. These entities encourage governments to sign international treaties as a means of gaining acceptance on the global stage. In response, governments comply, driven by a desire to integrate into the modern world." - (I10-Energy officer, the government entity).

Azerbaijan underwent a notable policy shift, demonstrating its dedication to aligning with international environmental frameworks. This transformation is evident through its ratification of key global climate agreements. The country officially joined the Kyoto Protocol in 2000, followed by its adoption of the Doha Amendment in 2015, and later affirmed its commitment to the Paris Agreement in 2017 (World Bank, 2021). To fulfill its obligations under the Paris Agreement's nationally determined contributions (NDCs), the State Oil Company of Azerbaijan (SOCAR) outlined its mitigation strategies within the framework of the "Nationally Appropriate Mitigation Actions" document, showcasing a proactive stance in addressing climate change (SOCAR, 2019). A senior official from the government entity confirmed the statement:

"SOCAR has implemented a zero-emission strategy aimed at achieving net-zero emissions across all its operations, including oil and gas fields, production, processing, and transportation, as previously mentioned." - (I12-Senior officer, the governmental entity)

It can thus be concluded that, after the dissolution of USSR, the influence of global pressures and the adoption of international environmental agreements have prompted a more pragmatic and constructive discourse on environmental and sustainability issues.

Global organizations and multinational corporations have played a crucial role in Azerbaijan's energy transition by not only offering financial assistance but also fostering institutional improvements, promoting adherence to the rule of law, and encouraging transparency and sound governance practices (OECD, 2019). As highlighted by Smith and Johnson (2010), large energy companies often exert a substantial influence on energy policy development in the areas where they operate, shaping the regulatory environment and advancing sustainable practices. An expert interviewee stated:

> "If a developer or organization seeks funding from institutions like the EBRD or the World Bank, they are required to adhere to specific guidelines. For instance, when installing wind turbines, they must address issues such as noise pollution and ensure compliance with the established limits. Failure to meet these standards will result in the denial of financial support from these banks." - (I4-Renewable energy expert, a local private company).

Deficiencies in the Soviet education system resulted in a widespread lack of skilled labor across various sectors, with the hydrocarbon industry being a notable exception. During the Soviet era, workforce training in Azerbaijan was heavily concentrated on the fossil fuel industry, resulting in limited capacity to meet the demands of a developing renewable energy sector. (I7-Researcher, a higher education institute).

The limitations of the Soviet education system resulted in a severe shortage of skilled labor in nearly all industries, except for hydrocarbons. Under Soviet rule, Azerbaijan's workforce was predominantly trained for the fossil fuel sector, leaving it ill-prepared to support the growth and development of the renewable energy industry.

Under Soviet governance, environmental challenges were often obscured, with restrictions placed on scientific research, communication, and access to external information (Brown, 2006). This approach exemplified a regime that stifled innovation and shielded the socio-technical system from external influences. After the dissolution of the USSR, public participation in environmental efforts remained low, primarily due to limited awareness and understanding of ecological concerns. However, the post-communist era, characterized by open borders and exposure to international media, fostered a natural growth in environmental consciousness. This shift in public awareness marked the beginning of a transformation in the socio-technical regime, paving the way for the emergence of niche innovations and sustainable practices.

After the dissolution of the USSR, Azerbaijan gained access to advanced Western climate science, characterized by modern computational tools and precise modelling techniques, which stood in

stark contrast to the Soviet-era natural sciences. This newfound exposure allowed Azerbaijan to break free from the unrealistic projections and resource estimates of the Soviet narrative, particularly regarding the Caspian shelf's reserves. Recognizing the finite nature of fossil fuel resources and the potential risks of depletion, the nation began to shift its energy strategy. Furthermore, rising domestic electricity demand, anticipated to grow steadily through 2025 (Jones & Associates, 2015), has intensified pressure on the government to expedite the energy transition and diversify its energy portfolio.

In response, Azerbaijan has prioritized renewable energy development as a strategic imperative. To support this shift, the government has implemented a range of incentives, including tax benefits, guaranteed tariffs, investment in scientific research, long-term land leases for renewable energy projects, and other measures aimed at fostering growth in the sector (Global Energy Policy Reports, 2021).

The remnants of Soviet-era infrastructure in Azerbaijan's oil and gas sector are often viewed as obstacles to the country's energy transition. However, this infrastructure can occasionally serve as a catalyst for progress, highlighting the intricate relationship between regime stability and opportunities for niche innovations within the broader socio-technical framework. Historically, Azerbaijan's electricity and gas networks, along with power plants inherited from the Soviet period, were marked by inefficiency and significant transmission losses—an outcome of the regime's reliance on outdated infrastructure. (I4- Renewable energy expert, a local private company). The inefficiency of this outdated infrastructure has not only driven a political push toward energy transitions but also exposed the regime's susceptibility to systemic weaknesses.

The economic inefficiency reflected in the disparity between energy consumption per capita and GDP output, largely a consequence of aging and inefficient Soviet-era infrastructure, has driven Azerbaijan to implement new energy efficiency policies. This strategic approach aims to modernize the energy sector and catalyze a transformation within the existing regime (Aliyev, 2020). The significant financial resources required to upgrade outdated infrastructure have heightened the government's interest in renewable energy, framing it as a strategic development area with the potential to disrupt the traditional energy system. This transition reflects an effort to break free from the constraints of entrenched technologies and practices, steering towards a more sustainable socio-technical framework. Additionally, by prioritizing renewable energy for domestic use, the government can reallocate heavily subsidized and unprofitable internal oil and gas consumption toward more profitable exports, while simultaneously advancing its climate

policy goals (I5-Senior academic, a higher education institute in Baku). An expert on renewables, confirmed the statement:

> "Oil and gas are finite resources, and extracting them is becoming increasingly difficult and expensive. As a result, our focus is on maximizing the value of what has already been extracted. Moving forward, our goal is to reserve fossil fuels for external use while relying on renewable energy for domestic consumption." - (I10-Energy officer, the government entity)

Considering these factors, Azerbaijan's shift to renewable energy represents both a strategic departure from its dependence on hydrocarbons and a broader dedication to sustainable development and global climate commitments. This ongoing transition is motivated by a combination of external pressures, increasing internal demand for cleaner energy solutions, and the imperative to strengthen energy security. Through its active investment in renewable energy, Azerbaijan is establishing the foundation for a more diversified and sustainable energy system. These efforts are particularly noteworthy given the historical challenges inherited from the Soviet period, which will be explored in the next section.

6.4 The Impact of Soviet Legacy on Azerbaijan's Shift to Renewable Energy

Azerbaijan's transition to renewable energy is deeply intertwined with its Soviet heritage, which has profoundly shaped the nation's energy framework. Four key aspects of this legacy continue to impact its energy policies: a centralized energy governance structure, a strong reliance on fossil fuels, entrenched institutional norms, and widespread public support for hydrocarbons. This section explores these elements, analyzing their role in shaping Azerbaijan's energy transition while highlighting the challenges and opportunities they present.

6.4.1 Centralized governance

Beginning in the late 1990s and early 2000s, Azerbaijan developed key regulatory frameworks and legislative instruments for its energy sector (Huseynov et al., 2019). The inclusion of the right to a healthy and clean environment in the 1995 Constitution of Azerbaijan provided a foundational basis for the country's energy and environmental strategies (UNDP, 2006). A major advancement in energy reform was achieved with Azerbaijan's endorsement of the European Energy Charter in 1998, signaling a commitment to aligning with international energy standards (Karimov, 2021). In May 2021, the law "On the Promotion of Renewable Energy Sources in Electricity Generation" was enacted, representing a landmark development by focusing exclusively on renewable energy. This legislation introduced mechanisms such as guaranteed tariffs, incentives for foreign investment, promotion of active consumers, and support for scientific research in renewables

(Official Legal Bulletin, 2021). Additionally, the passage of the law “On Energy Resource Efficiency and Rational Energy Use” in July 2021 emphasized optimizing energy resource usage and enhancing energy efficiency across sectors (Azerbaijan Parliamentary Records, 2021).

Collectively, these legislative measures recognize renewable energy as a viable substitute for traditional fossil fuels. They also emphasize the importance of private sector involvement in the energy market and reflect the government's dedication to implementing targeted policies that facilitate the advancement of the renewable energy sector. As a result, discussions surrounding environmental and sustainability issues have started to take on a more pragmatic and optimistic tone, influenced in part by external pressures and the geographical proximity to the European Union, as explored extensively in Chapter 5. Nevertheless, despite these recent strides, deeply ingrained bureaucratic frameworks continue to present significant obstacles to the effective implementation of these regulations.

As noted by Kovacs (1997, p. 18), "The dissolution of the Soviet Union left its former republics grappling with significant challenges, including economic dependency on specialized sectors, outdated infrastructure, extensive environmental damage, reliance on inter-republic trade, and entrenched systems of state-controlled enterprises and governance." Although Azerbaijan announced its shift from a centrally planned economy to a market-oriented system in 1991, it faced significant challenges in quickly breaking away from its Soviet legacy and implementing a fully modernized model of governance. While the country has implemented substantial reforms and restructuring since gaining independence, its energy sector still bears many hallmarks of the Soviet era. The persistence of a vertically integrated governance structure and limited market competition highlights the path-dependent nature of Azerbaijan’s energy system (Mammadova & Aliyev, 2010). An environmental expert elaborated:

"The Azerbaijani energy market is completely monopolised. Basically, there is one company for each sector, for example, one for oil, one for gas, one for heat and one for water. So, there is basically no competition when it comes to utilities." - (I6-Project manager, a regional organisation)

The government holds a dominant position in the energy sector, exerting substantial authority, primarily through its state-owned enterprises (Kamalov et al., 2023). Each segment of the energy industry is managed by distinct state-owned entities, yet all operate under the overarching supervision and strategic direction of the state (Hasanov, 2022). This centralized oversight is a hallmark of the existing energy governance framework, where the Ministry of Energy, the Council

of Ministers, and the Head of State have direct control over activities within the sector and the state-owned enterprises involved. The Ministry of Energy plays a pivotal role, not only in coordinating and implementing energy projects but also in overseeing and regulating state-owned entities such as Azerenerji OJSC, Azerishiq OJSC, Azeristiliktechizat OJSC, Azeriqaz PU, and SOCAR (Hasanov, 2022).

Azerenerji OJSC manages electricity production, transmission, and operational activities, while Azerishiq OJSC oversees electricity distribution. Azeriqaz PU is accountable for the distribution and transmission of natural gas across the nation (Executive Directive No. 2017 on Azerishiq, 2016). SOCAR (State Oil Company of the Republic of Azerbaijan) stands as a cornerstone of the energy framework, commanding Azeriqaz and over 20 additional entities involved in oil and gas exploration, production, transportation, and processing, all under the implicit direction of the Azerbaijani government's integrated energy strategy (SOCAR, 2023). Despite the establishment of legal frameworks for renewable energy, challenges such as centralized decision-making, a monopolized market structure, and limited competition hinder both the energy transition and broader economic progress.

Shifting toward renewable energy has the potential to act as a driving force for liberalizing Azerbaijan's energy sector. Expanding the energy portfolio and decreasing reliance on fossil fuels could open the door to broader economic reforms and greater market openness. The sharp decline in oil prices in 2015 acted as a significant external pressure, diminishing oil revenues and prompting the government to consider alternatives to fossil fuel reliance. This shift in strategy led to the introduction of the National Strategy on the Development of Alternative and Renewable Energy Sources in Azerbaijan in 2015, underscoring the vital role of private sector involvement in renewable energy initiatives. Unlike the traditional energy sector, where state-owned enterprises dominate, this strategy reflects a commitment to fostering partnerships with private entities to advance renewable energy projects (Ismayilov, 2020).

The lasting influence of Soviet-era practices, including bureaucracy, intricate procedures, centralized governance, and limited private sector participation, remains a key factor shaping Azerbaijan's current energy regime. Centralized management plays a pivotal role, providing the framework within which decisions are made and the energy sector is organized. This governance approach continues to favor the dominance of fossil fuel industries, often prioritizing their interests over those of the renewable energy sector—a dynamic that will be detailed further in the next section.

6.4.2 Dominance of conventional energy industries

The dissolution of the USSR led to significant macroeconomic turmoil and a substantial fiscal deficit in Azerbaijan between 1992 and 1994. During this period, the country's key sources of income, including taxes, revenues from state-owned enterprises, and customs fees, dropped sharply from 51% of GDP to 34% of GDP (Sadigov, 2010). Faced with ongoing fiscal pressures, the Azerbaijani government was driven to continue the Soviet-era model of intensive resource exploitation, even though it was environmentally and economically unsustainable. Even today, Azerbaijan's economy remains heavily reliant on oil revenues, which contribute approximately 40% of GDP and make up 90% of its exports (World Bank, 2021). This entrenched dependence on the hydrocarbon sector, coupled with institutional inertia, has created a strong lock-in to the country's efforts toward an energy transition. A researche pinpointed the following:

> "The enduring influence of Soviet legacies remains significant even decades after the Soviet Union's collapse. For instance, the Mingachevir power plant serves as a clear testament to Soviet-era infrastructure and industrial contributions, continuing to benefit the nation 30 years later. Similarly, Azerbaijan's oil industry owes much to the geophysical research conducted during the Soviet period. Even as recently as 2019, offshore oil discoveries relied on data from that era. Thus, the oil produced in Azerbaijan today stands as a tangible outcome of the Soviet Union's industrial and scientific heritage." - (I3-Researcher, a higher education institute)

Azerbaijan's reliance on fossil fuels cannot be solely attributed to its Soviet legacy, yet the enduring influence of Soviet-era infrastructure and the expertise developed during that period has made the country's plentiful fossil resources increasingly appealing to policymakers today. Nonetheless, this reliance does not overshadow Azerbaijan's significant potential and growing commitment to renewable energy development. As outlined in Chapter 5, there are clear efforts underway to diversify energy sources and decrease dependence on hydrocarbons. This evolving landscape highlights a complex interplay of opportunities and challenges, capturing Azerbaijan's multifaceted transition toward a more sustainable energy future.

The majority of Azerbaijan's oil and gas reserves are located in the Baku region (Aliyev, 2015). As a result, extensive investments have been directed toward developing the necessary infrastructure to facilitate the extraction and export of these resources, benefiting both the local and national economy (Khan and Liu, 2019). This focus on fossil fuels has contributed to what can be described as an "energy-society nexus," where societal systems, economic frameworks, and daily life are deeply intertwined with energy infrastructure and the natural resources it depends upon (Petrov, 2021). Furthermore, the significant investments in energy infrastructure have created

an infrastructural dependency, lock-in making it increasingly challenging for Azerbaijan to pivot toward alternative energy sources and pursue energy transition strategies. An academic expert elaborated:

"The existing legacy infrastructure presents a significant challenge, as the electricity system is already established and represents a substantial investment. Building new power plants or overhauling the current system is expensive and complex. Achieving such a transformative shift requires a powerful and sustained impetus to overcome these barriers." - (I5-Senior academic, a higher education institute)

Azerbaijan's reliance on fossil fuels, while posing significant challenges, is part of a broader context defined by both progress and obstacles in the country's energy sector. This complex reality reflects the interplay of historical legacies, economic factors, and political dynamics, all of which shape the pace and direction of the reforms needed for an energy transition. The central role of the fossil fuel sector in Azerbaijan's economy, political landscape, and national identity underscores the complexities involved in shifting toward a more diversified energy mix. The prevailing dominance of fossil fuels tends to perpetuate centralized governance structures, posing challenges to diversification. Nevertheless, it is also essential to recognize the institutional developments and progressive measures that are shaping a more sustainable energy future, reflecting a nuanced and evolving path toward long-term sustainability.

In assessing the barriers to energy diversification in Azerbaijan, it is important to consider the dual character of the country's institutional framework. On one side, the continued dominance of the fossil fuel sector is sustained by both formal structures and informal systems, such as patronage networks and corruption. Conversely, a series of emerging reforms and policy initiatives reflect an increasing recognition of the need to confront these systemic challenges. Although still in the early phases, these measures indicate a shift toward embracing a more diversified and sustainable energy landscape. The next section will explore these institutional dynamics in greater depth.

6.4.3 Institutional practices

After the USSR's dissolution, the Azerbaijani government made considerable efforts to strengthen institutional capacity, placing particular focus on the development and reform of the energy sector. An energy expert underscored this progress, noting:

"Notably, since 2012, there has been tangible progress in terms of political commitment as well as the development of institutional and legal infrastructure." - (I7-Researcher, a higher education institute)

In alignment with its commitment to advancing the energy sector, Azerbaijan introduced a comprehensive development framework titled *"Azerbaijan 2020: Vision for the Future"*. This strategic eight-year roadmap not only articulates the government's long-term vision for renewable energy development but also holds significant legal authority. Established through Presidential Decree No. 800 in 2012, the framework emphasizes renewable energy initiatives, including creating an independent regulatory body and designing a supportive legal environment for renewable energy advancement (Presidential Decree No. 800, 2012). Furthermore, Azerbaijan has fostered collaborations with international and regional organizations to enhance its institutional energy sector capacity. For example, as a participant in the Eastern Partnership, Azerbaijan has benefited from initiatives like the EU4Energy program, which offers policy guidance, technical expertise, and support for energy market development and sustainability in the region (EU Neighbours East, 2021). Such collaborations represent a vital step toward transforming Azerbaijan's institutional structure and energy landscape.

Despite these efforts, Azerbaijan has yet to fully achieve its ambitious renewable energy targets. Previous initiatives—such as the *National Programme on Environmentally Sustainable Socio-Economic Development* (2003–2010) and the *State Action Plan for the Preservation and Sustainable Use of Biodiversity* (2006–2009)—along with expanded international cooperation in the post-Soviet period, have thus far fallen short of producing the intended results. These shortcomings are primarily attributed to the existing political regime and the lingering institutional legacies of Soviet governance. These historical legacies shape current policies and foster instability within formal institutions, perpetuating informal practices that hinder the transition to renewable energy. Consequently, while international collaborations and policy programs are promising, entrenched institutional challenges rooted in Azerbaijan's historical framework significantly obstruct progress toward achieving its energy transition goals.

Additionally, the Azerbaijani government's heavy dependence on fossil fuel revenues and the lack of robust modern policy instruments have constrained the effective regulation of the energy sector. This dependence has led to an over-centralized regulatory approach, with overlapping roles and unclear responsibilities, ultimately undermining accountability (Franke et al., 2009). For instance, before 1989, the Soviet Union lacked a centralized environmental authority, leading to the adoption of a fragmented responsibility model. This "shared responsibility" approach, characterized by competing mandates among various governmental entities, persists in Azerbaijan, further complicating energy sector governance (Bektashi and Cherp, 2002).

Despite ongoing challenges, recent reforms and initiatives reflect Azerbaijan's increasing acknowledgment of the need for a more sustainable and diversified energy mix. These efforts, while still in their early stages, reflect a gradual shift toward addressing historical barriers and aligning with contemporary energy goals.

The institutional challenges faced by Azerbaijan have been profoundly shaped by its Soviet legacy. This historical influence has also contributed to the broader instability within the country's institutions. From the 1950s until the Soviet Union's dissolution, Azerbaijan's energy sector underwent multiple phases of restructuring and reorganization (Ivanov, 1993). Following independence, these patterns persisted, with little substantive change. The energy sector in Azerbaijan today is marked by institutional instability and hysteresis, a phenomenon where historical structures and decisions continue to influence the present. The frequent establishment and dissolution of government agencies, along with the adoption of numerous strategic frameworks, have only exacerbated this instability and hindered consistent policy development. As a senior academic highlights:

"They have developed numerous roadmaps, so many that I've lost track. But the real question is, how many of these plans have been implemented? Is anyone monitoring their progress, comparing the set targets to where we actually stand today?" - (I5-Senior academic, a higher education institute)

The creation of the State Agency for Alternative and Renewable Energy Sources in 2009, initially operating under the Ministry of Energy, reflects Azerbaijan's broader efforts toward institutional reform in the energy sector. In 2013, the agency was granted independent status but was later dissolved in 2019 through a presidential decree (Aliyev, 2014; Smith, 2019). It was subsequently re-established in 2020 as the Azerbaijan Renewable Energy Agency, once again placed under the Ministry of Energy (Presidential Decree No. 1159, 2020).

The economic, social, and political upheaval following the Soviet Union's collapse left Azerbaijan with limited institutional capacity to address energy and environmental challenges (Petrov and Kharitonova, 2009). The current legal and institutional frameworks remain deeply rooted in outdated Soviet-era legislation, which often conflicts with the country's evolving needs and priorities. While technological advancements have rendered many regulations from the 1960s and 1970s obsolete, these outdated standards persist alongside newer rules. Transitioning from Soviet-era regulations to modern, internationally aligned frameworks is both costly and time-intensive (World Energy Report, 2006).

This reliance on Soviet institutional practices has slowed the development of effective governance structures for Azerbaijan's energy sector. The resulting stagnation not only hinders policy implementation but also fosters informal practices. Weaknesses in formal institutions create gaps that stakeholders often exploit, perpetuating inefficiencies and undermining reforms in the energy governance landscape.

Post-Soviet Azerbaijan inherited not only the formal institutional structures of the Soviet system but also a range of informal institutional practices, such as neo-patrimonial governance, patron-client networks, and, in extreme cases, corruption (Aliyev, 2021; Guliyev, 2003; Karimov, 2018). A patron-client network is characterized by a relationship where a powerful patron offers resources or protection to a client in exchange for loyalty or support (Scott, 1972). These networks, along with the entrenched power dynamics inherited from the Soviet era, became deeply embedded during the challenging early years of Azerbaijan's independence (Mammadov, 2019).

The shift to a market economy without an adequate regulatory framework, coupled with persistent macroeconomic instability and significant revenue from fossil fuels, further entrenched these informal practices. Key players in the energy sector, for example, have often utilized oil revenues to consolidate power, leading to widespread corruption. Transparency International ranked Azerbaijan 129th out of 180 countries in its 2020 Corruption Perceptions Index, a decline from 126th in 2019, illustrating the persistence of governance challenges (Transparency International, 2020).An academic expert stressed:

"We often discuss Azerbaijan as a modern, post-Soviet state, yet many Soviet-era practices remain deeply ingrained. Working within a state agency, I see firsthand how much of the Soviet bureaucratic legacy persists, from outdated management systems to inefficient processes. These legacies are still evident across various state institutions. Furthermore, issues like corruption and the mismanagement of public funds remain pressing concerns, with weak oversight mechanisms exacerbating the problem. A great deal needs to change before we can genuinely create the conditions necessary for a transformative shift, such as an energy transition." - (I5-Senior academic, a higher education institute)

After the dissolution off USSR, many former elites retained their influential positions in society, largely sustained by revenue from fossil fuels. This continuity allowed them to preserve Soviet-era attitudes toward the environment and perpetuate institutional inertia. In Azerbaijan, certain officials have also inherited a legacy of Soviet-era climate skepticism, fostering resistance to the adoption of climate initiatives and activities. A renewable energy expert emphasized:

"It’s not easy to fully move on from the Soviet past—it’s deeply rooted in the mindset. I recall that many individuals in the Ministry of Energy still come from Soviet backgrounds and remain skeptical about renewable energy. It’s particularly striking with our national grid operators, who are highly resistant to embracing renewables. They continue to believe that expanding gas-powered power plants is the only viable solution." - (I4-Renewable energy expert, a local private company)

Although Azerbaijan's energy landscape is dominated by a highly centralized governance system and the prevalence of fossil fuels, institutional practices remain a crucial lens through which to understand the country's energy trajectory. Influenced by a combination of historical legacies and modern developments, these practices expose the complex challenges and dynamics shaping the sector, making them vital for a thorough analysis of Azerbaijan's energy framework in this research.

6.4.4 Public Endorsement

Public support in the energy transition context refers to the general population's acceptance and endorsement of moving from conventional energy sources, like hydrocarbons, to renewable and sustainable alternatives (Steg et al., 2015). This support is pivotal as it influences policy-making, shapes consumer behaviors, and drives market trends. In Azerbaijan, where the economy and societal identity are closely tied to hydrocarbon resources, gauging and cultivating public support for renewable energy is particularly important. The nation's strong dependence on fossil fuels presents unique challenges to fostering a cultural and economic shift towards sustainability (Aliyev, 2020b).

Azerbaijan’s approach to energy transition is deeply influenced by its Soviet-era legacy and its long history of oil extraction, both of which have significantly shaped the country’s environmental perspective. This historical backdrop has contributed to the limited development of grassroots movements and hindered the emergence of innovative energy niches. Nevertheless, there is growing potential for change. As societal awareness increases and attitudes shift, opportunities for bottom-up initiatives and novel energy solutions are emerging. This shifting landscape highlights the ongoing tension between historical dependence and contemporary innovation, signaling Azerbaijan’s gradual move toward a more diversified and sustainable energy future.

Looking ahead, it is crucial to confront the ongoing challenges and structural barriers that hinder the energy transition. The following discussion will explore these issues in detail, offering insights

into how they influence Azerbaijan's pursuit of energy diversification and environmental sustainability.

Azerbaijan's deep-seated oil legacy is also embedded in public sentiment, with many viewing it as a cornerstone of national identity. Oil is widely regarded as a driving force behind the country's independence, global recognition, and relative economic and social prosperity. This perspective is not only upheld by government officials but also resonates strongly with the general public. Highlighting the importance of this legacy, an expert observed:

"Imagine Saudi Arabia or Russia without their oil and gas resources—they would lose much of their political influence. Similarly, Azerbaijan has established a significant portion of its geopolitical clout on the foundation of its oil and gas wealth." - (I1-Energy expert, the governmental entity)

The deeply entrenched hydrocarbon culture in Azerbaijan, which views oil as a symbol of the nation's status as an energy superpower and a guarantor of its independence, poses significant challenges to the transition toward renewable energy. Moreover, heavily subsidized fossil fuel-based electricity comprising of over 90% of the country's energy generation has fostered a unique dependency on hydrocarbons among the public. With electricity priced at just $0.047 per kilowatt-hour (kWh), significantly lower than in other post-Soviet countries like Armenia ($0.108), Georgia ($0.075), Belarus ($0.092), and Russia ($0.055), Azerbaijanis have grown accustomed to low energy costs. As a result, many citizens believe prices should be even lower, reinforcing the challenge of shifting away from this entrenched reliance on fossil fuels (V10-Energy officer, the government entity). Subsidized energy prices present a significant cultural and political obstacle to Azerbaijan's energy transition. Given the potential for public backlash against rising energy costs, fostering a constructive discourse around renewable energy will be crucial in shaping future political decisions (I8-Senior officer, an international company). A senior official confirmed the argument:

"The government remains cautious, driven by concerns about whether electricity generated from renewable sources will be affordable for the general population." - (I2-Senior official, an energy company)

Given these challenges, Azerbaijan, as a newly independent or reestablished nation, has struggled to prioritize environmental initiatives amidst pressing economic and social issues. A senior researcher emphasized:

"Another significant barrier, in my view, is economic and social hardship. Many Azerbaijanis express sentiments like, 'I'm struggling to survive and make ends meet, and you expect me to focus on environmental issues?' - (I9-Researcher, a higher education institute in Baku)

Given the state's unusually dominant role, a regime-level shift is essential to securing public support for Azerbaijan's energy transition. Once the state takes the lead, the private sector and the public are likely to follow suit. (I26-Senior officer, a third sector organisation). As another respondent stated:

"In Azerbaijan, as in many post-Soviet countries, there is a deep reliance on the government, which exerts control over nearly every aspect of life. For instance, if a project lacks government involvement, people tend to view it with skepticism. However, when the government is involved, there is greater trust and even active participation. The prevailing mindset in Azerbaijan seems to be, 'No government, no project." - (I9-Researcher, a higher education institute)

A private-sector renewable energy expert echoes this sentiment, stating:

"For any project or initiative to succeed, it's crucial that the explanation comes directly from the government. If I, for example, talk about the benefits of renewable energy or its environmental advantages, people might dismiss it or not take it seriously. But if influential government figures present the case, explaining that this approach is better for the country, it builds trust. Essentially, for such a project to gain traction, the government's involvement is necessary to persuade the public." - (I13- Renewable energy expert, a local private company)

It can be concluded that, despite privatization efforts and the growing influence of grassroots advocacy, a state-centered approach will remain pivotal in advancing renewable energy in Azerbaijan. The country's deeply ingrained hydrocarbon culture, rooted in its Soviet heritage, presents a formidable obstacle to the energy transition. Subsidized energy prices further entrench this dependency, shaping public attitudes toward fossil fuels, while economic and social challenges reinforce support for the hydrocarbon sector. Nevertheless, due to the state's dominant position within Azerbaijani society, the effectiveness of the energy transition is largely contingent upon strong governmental leadership. Decisive actions by the regime have the potential to significantly shift public perception, fostering broader acceptance of renewable energy initiatives in Azerbaijan.

6.5 Contemporary Governance: Institutional Shifts in Azerbaijan's Renewable Energy Transition

Over the past three decades of independence, Azerbaijan has experienced significant institutional evolution. While historical legacies remain influential, the country has increasingly demonstrated its capacity to modernize governance structures and embrace progressive energy policies. This chapter compares the Soviet-era centralized bureaucracy with the post-independence institutional architecture, highlighting both the enduring structural influences and the positive transformations that support Azerbaijan's renewable energy transition (North, 1990; Pierson, 2000).

Under the Soviet regime, Azerbaijan's energy sector operated within a rigid command-and-control structure dictated by central planning authorities in Moscow. Regional autonomy was minimal, and decisions related to production, distribution, and infrastructure were made far from local realities (Kalinina, 2019).

Since gaining independence, Azerbaijan has made substantial efforts to reclaim policy autonomy and reconfigure its governance model. The country has introduced constitutional and legislative reforms that grant greater authority to national institutions, with an emphasis on national planning and strategic development. Though central coordination remains important, the establishment of dedicated ministries and agencies focused on renewable energy demonstrates an evolving administrative landscape capable of long-term strategic planning and responsiveness to global energy trends (Ismayilov, 2020).

The Soviet governance structure featured vertically organized institutions with rigid mandates, offering little space for horizontal coordination. Today, Azerbaijan is increasingly adopting a more dynamic, collaborative approach to energy governance (Hanson, 2003). The Ministry of Energy and SARES operate with improved clarity of function and growing inter-agency cooperation.

Institutional streamlining and ongoing reforms reflect a broader commitment to aligning with international governance standards. Azerbaijan's energy institutions have also begun embracing digital tools and project-based management structures, improving efficiency and policy coordination. This shift represents a meaningful break from the legacy of inflexible hierarchies, supporting a more agile governance culture suited to managing complex energy transitions (ADB, 2020).

While the Soviet system often relied on informal networks and opaque decision-making, Azerbaijan has shown a growing commitment to transparency and institutional integrity since

independence (Ledeneva, 2006). Legal and administrative frameworks for public procurement, investor relations, and public sector accountability have been steadily enhanced.

The adoption of electronic government systems such as ASAN Service has simplified administrative procedures and improved transparency. In the energy sector, investment regulations have been clarified, and public-private partnerships are increasingly formalized. These improvements not only help reduce uncertainty but also position Azerbaijan as a more attractive environment for sustainable energy investments (Transparency International, 2022).

During the Soviet era, industrial development was prioritized over environmental protection, resulting in ecological degradation across many regions. Post-independence Azerbaijan has taken steps to reverse this trend by committing to sustainable development goals and expanding environmental oversight (Aliyev, 2018).

The ratification of major international environmental treaties and the incorporation of environmental planning into national strategies illustrate Azerbaijan's evolving priorities. Although enforcement mechanisms are still evolving, the establishment of environmental institutions and the integration of ecological criteria into energy procurement processes reflect an increasing acknowledgment of environmental sustainability as a core element of national policy.

Azerbaijan has made meaningful developments in modernizing its governance framework and aligning its energy policy with international standards. These improvements reflect a strategic recognition of the importance of energy diversification, environmental protection, and global economic integration (EBRD, 2021).

The establishment of entities such as SAARES and the enactment of the 2021 Law on the Use of Renewable Energy Sources for Electricity Generation mark important milestones in the progression of Azerbaijan's renewable energy policy framework. Competitive auctions, power purchase guarantees, and clearer regulatory frameworks have improved investor confidence and facilitated the expansion of renewables (Ministry of Energy of Azerbaijan, 2021).

Since the early 2000s, Azerbaijan has built strong relationships with international organizations such as the EBRD, IRENA, and ADB. These partnerships have enabled access to technical expertise and funding, accelerating the country's transition to cleaner energy (IRENA, 2022). Major renewable projects backed by foreign investors highlight the success of these collaborative efforts.

Azerbaijan's "2030 National Priorities" reflect a strategic commitment to green growth. Investments in renewable energy zones, free economic zones, and infrastructure modernization underscore the country's long-term planning capacity and its proactive stance in anticipating energy transitions (President of Azerbaijan, 2021).

Civil society has become an increasingly visible and constructive actor in energy discourse. NGOs, universities, and youth organizations contribute to public dialogue on sustainability and environmental protection. The government has shown openness to stakeholder input, which represents a significant departure from past governance models (Hajiyev, 2019).

In addition to sector-specific developments, Azerbaijan's public administration reforms have created a more transparent and efficient state apparatus. The digitalization of services, improved rule of law, and human capital development have strengthened institutional resilience. These broader improvements create enabling conditions for sustainable energy governance.

Furthermore, Azerbaijan's openness to global institutions and multilateral cooperation has enhanced its ability to absorb international best practices and adapt them to domestic needs. Education reforms and workforce development in STEM fields support long-term capacity building for renewable energy leadership.

Azerbaijan's energy governance has undergone a significant transformation since independence. While the legacy of Soviet administrative structures remains visible, the country has made marked progress in regulatory reform, institutional innovation, and global integration. By integrating its historical legacy with contemporary governance strategies, Azerbaijan is steadily laying the groundwork for a more resilient and sustainable energy system. Acknowledging both the progress made and the ongoing obstacles provides meaningful insight into the broader patterns of post-Soviet energy transitions.

6.6 Conclusion

This section has provided a comprehensive exploration of Azerbaijan's energy transition, delving into its intricate connections with post-communist transformations. It has examined how the lingering influence of Azerbaijan's Soviet heritage continues to shape its current energy and environmental policies, influencing the shift toward renewable energy. By tracing historical overvew of the country's energy landscape, from its Soviet-era reliance on fossil fuels to its growing focus on renewables—this analysis highlights the significant impacts of historical legacies, institutional frameworks, and societal attitudes on Azerbaijan's energy trajectory.

Azerbaijan’s progress in developing renewable energy is influenced by a multifaceted combination of political, economic, and social factors, many of which stem from its communist-era legacy. While the country’s reliance on oil predates Soviet rule, it was significantly reinforced during the communist era. The Soviet regime's focus on maximizing resource exploitation with minimal conservation left Azerbaijan with limited institutional capacity to facilitate an energy transition. As a result, the current state of Azerbaijan's energy transition reflects not only contemporary energy policies but also the enduring institutional, economic, political, and social legacies of the Soviet era. By critically analyzing these Soviet influences, this chapter has illuminated both the scale of the challenges and the potential opportunities for transformative change.

Azerbaijan’s energy transition has been profoundly influenced by four key Soviet legacies that continue to shape its energy landscape: A highly centralized energy governance system, the dominance of fossil fuels, Institutional practices, and Public attitudes and perceptions.

The nation's energy policies are marked by entrenched path dependencies derived from historical and institutional legacies. Although Azerbaijan has launched multiple initiatives to promote the transition to renewable energy, the country has not fully met its ambitious goals. For example, the National Strategy on the Use of Alternative and Renewable Energy Sources (2015–2020) set targets of generating 20% of electricity and covering 9.7% of total energy consumption from renewables by 2020—objectives that remain largely unmet.. However, these targets were not achieved, largely due to enduring Soviet-era influences.

The centralized management structure, a legacy of the Soviet bureaucratic system, has led to inefficiencies and misalignments, hindering the flexibility required for renewable energy integration. This centralization has reinforced the dominance of the fossil fuel sector, creating significant barriers to diversification. Furthermore, institutional instability and informal practices—such as corruption and patronage—have deepened this dependency. Frequent restructuring of state agencies and the proliferation of strategic roadmaps have perpetuated institutional inertia, limiting the country's capacity for reform and adaptability.

The prominence of the fossil fuel industry extends beyond economic considerations; it carries substantial social and political implications. The institutional structures carried over from the Soviet period have produced a "lock-in" effect, hindering efforts to transition away from conventional energy sources. Moreover, the socio-economic turbulence following the Soviet Union’s collapse entrenched these patterns further, deprioritizing energy and environmental reforms in favor of short-term stability.

Post-independence Azerbaijan not only retained the formal practices of the Soviet system but also sustained informal mechanisms such as neo-patrimonial governance and patronage networks. These systems re-established themselves during the tumultuous early years of independence, allowing former Soviet elites to maintain their influence, primarily through revenues from fossil fuels. This continuity of Soviet-era practices has perpetuated institutional stagnation, further constraining the country's energy transition efforts.

Public attitudes, deeply rooted in Soviet-era environmental skepticism and an ingrained hydrocarbon culture, have also posed challenges. Fossil fuels are viewed as a symbol of national identity, associated with Azerbaijan's independence, economic progress, and diplomatic achievements. The provision of heavily subsidized, low-cost electricity has strengthened public reliance on hydrocarbons, creating resistance to change. This entrenched mindset presents a significant obstacle to fostering environmental awareness and public support for renewable energy initiatives.

Despite the significant challenges posed by its historical legacy, Azerbaijan has started to make measurable progress toward a more sustainable energy future. Ongoing efforts to diversify the energy sector and incorporate renewable sources indicate a slow but important shift in both institutional frameworks and societal perceptions. A critical analysis of the relationship between inherited constraints and contemporary reforms reveals that the country stands at a pivotal moment of transition. While the road ahead is complex, the changing dynamics of the energy sector offer promising opportunities to reshape Azerbaijan's energy landscape.

The journey towards renewable energy in Azerbaijan underscores the importance of resilience and adaptability. Overcoming these entrenched legacies requires sustained reform, innovation, and collaboration. By leveraging the lessons of its past, Azerbaijan can build a more sustainable future, offering a model for other post-communist societies facing similar challenges.

Chapter 7: SUMMARY AND CONCLUSION

7.1 Introduction

The primary goal of this study was to explore the energy transition in post-communist Azerbaijan. It examined a wide range of economic, political, institutional, and socio-cultural factors that either facilitate or hinder the country's progress towards energy transformation. Special focus was given to the historical influences, particularly Azerbaijan's Soviet heritage, and their impact on shaping the development and current dynamics of the nation's energy system.

This thesis adopts an economic geography perspective, employing MLP as its core analytical framework. By applying the MLP across various levels and scales, the research addresses the limitations of conventional governance and policy models, which often fail to account for the intricate interplay of systemic factors. This approach enables a holistic analysis that transcends localized considerations and avoids reducing transitions to a narrow political viewpoint. Rather, it adopts a more comprehensive perspective on the political and economic context, analyzing it through a multi-level framework.

This research also explores how path dependence and contextual factors influence transition processes, either facilitating or hindering progress. To examine historical influences, the study incorporates core concepts from evolutionary economic geography, including path dependence and institutional lock-in. These themes are critical for understanding the dynamics of change, emphasizing the urgency of decision-making and the ways in which historical contexts shape current and future efforts toward sustainability.

To investigate sustainability transitions within a post-communist context, the study focuses on the following research questions:

- What is the current state of the energy transition in Azerbaijan?
    - How do public perceptions and levels of civic engagement influence the development and implementation of renewable energy policies in Azerbaijan?
    - What technological barriers and infrastructural limitations are currently constraining the growth of renewable energy deployment in Azerbaijan?
- How has Azerbaijan's communist heritage influenced its shift toward renewable energy?

- In what ways have Soviet-era public governance practices and institutional cultures affected societal attitudes toward energy reform and decentralization?
- How have technological legacies from the Soviet period contributed to lock-in effects that impede the adoption of renewable energy systems in Azerbaijan today?

This chapter seeks to synthesize the main findings of the thesis, outline its theoretical and methodological contributions, explore the policy implications, and suggest avenues for future research. In alignment with the research questions, Section 7.2 focuses on presenting the central arguments and empirical findings related to sustainability transitions in transition economies. Section 7.3 outlines the theoretical and methodological advancements introduced by this study. Building on the conclusions, Section 7.4 explores how these insights can be applied in practice, offering recommendations for policymakers and industry stakeholders. Lastly, Section 7.5 outlines the thesis's limitations and points to possible directions for future research, setting the stage for continued progress in the field.

7.2 Summary of Main Findings

This research sought to explore the energy transition within a post-communist context, focusing on the influence of historical factors. As outlined earlier, the study aimed to address two primary research questions. Data was collected through 41 interviews and the analysis of various documents, providing a robust foundation to answer each question. The findings are detailed in Chapters 6–7 and summarized below.

Research Question 1: What is the current status of the energy transition in Azerbaijan?

- How do public perceptions and levels of civic engagement influence the development and implementation of renewable energy policies in Azerbaijan?
- What technological barriers and infrastructural limitations are currently constraining the growth of renewable energy deployment in Azerbaijan?

The oil and gas industries have traditionally played a central role in Azerbaijan’s energy sector, serving as the backbone of the country's economy for decades. With a legacy of exploiting its abundant oil reserves since the late 19th century, Azerbaijan’s economy has been deeply intertwined with these hydrocarbons. However, this heavy reliance is increasingly regarded as unsustainable due to concerns over resource depletion and environmental impacts. This context

highlights the pressing need for Azerbaijan to diversify its energy portfolio and transition toward more sustainable energy sources.

Renewable energy presents a promising alternative for Azerbaijan, a country endowed with considerable potential in this sector. Azerbaijan's geographical and climatic conditions are favorable for multiple types of renewable energy, including wind energy along the Caspian coast, solar power in its dry regions, hydropower in the mountainous terrain, and biomass from agricultural residues. However, despite this abundant potential, the current utilization of renewable energy remains minimal, leaving a vast resource untapped.

Initial observations suggest that Azerbaijan’s transition to renewable energy has been notably gradual. This slow progress is striking, given the country's substantial renewable energy potential, which remains largely unexploited. The slow progress can be explained by a range of factors, such as established infrastructure, existing institutional structures, and prevailing societal mindsets. This inertia highlights the multifaceted challenges inherent in systemic transitions, particularly within a critical and complex sector like energy.

The research identifies a notable turning point in Azerbaijan’s energy policy starting in 2015, characterized by a strategic governmental shift toward renewable energy. This policy transition seems to be influenced by a combination of domestic and international drivers. The sharp decline in oil prices in 2015, depleting oil reserves accompanied by rising exploration costs, growing recognition of the climate crisis, and mounting global pressures have all played a role in shaping this policy change. Moreover, this shift reflects the influence of broader, international dynamics on Azerbaijan's energy decisions, emphasizing the interconnected challenges facing the energy sector globally.

This strategic pivot has been accompanied by the adoption of various policies and legislative measures aimed at fostering renewable energy development. Notably, in 2014, Azerbaijan introduced the National Strategy on the Use of Alternative and Renewable Energy Sources for the period 2015–2020. Further demonstrating its commitment, the Azerbaijan Renewable Energy Agency was established in 2019. These initiatives underline the government’s dedication to building a sustainable energy framework, representing a critical milestone in the nation’s energy transition journey.

Despite these positive strides, the analysis reveals several enduring challenges to Azerbaijan’s energy transition. An underdeveloped legal and regulatory framework continues to hinder the efficient execution of renewable energy initiatives. Additionally, the sector’s institutional capacity

requires significant strengthening to improve the management and execution of renewable energy projects. Financial constraints pose another hurdle, particularly in attracting investments for large-scale renewable ventures. Technological obstacles persist, largely due to reliance on imported equipment and the limited availability of domestic expertise in renewable energy technologies.

Addressing these obstacles demands a comprehensive and integrated approach. This should involve a combination of policy reforms, institutional enhancements, technological advancements, and skill development initiatives. Opportunities to advance renewable energy lie in Azerbaijan's commitments to international climate agreements and the growing demand for domestic energy. The country's plentiful renewable energy resources provide a solid foundation for progress. International collaboration and investment will be essential in overcoming these barriers and unlocking Azerbaijan's renewable energy potential.

The findings present a nuanced view of Azerbaijan's renewable energy landscape, highlighting a combination of slow progress, notable policy changes, and persistent obstacles. Despite these challenges, Azerbaijan is steadily prioritizing renewable energy through governmental initiatives and strategic policies. Azerbaijan's abundant renewable energy resources offer a strong basis for advancement. Overcoming existing challenges and fully realizing this potential will require sustained international cooperation and investment. Addressing the critical legal, financial, and technological barriers will be essential for advancing this transition. Azerbaijan's path to sustainable energy development depends on the strategic use of its domestic resources and the strengthening of international partnerships, aiming to establish renewable energy as a core component of the national energy strategy rather than a secondary option.

Research Question 2: How does Azerbaijan's communist history influence its transition to renewable energy?

- In what ways have Soviet-era public governance practices and institutional cultures affected societal attitudes toward energy reform and decentralization?
- How have technological legacies from the Soviet period contributed to lock-in effects that impede the adoption of renewable energy systems in Azerbaijan today?

The study reveals that political, economic, and societal factors rooted in Azerbaijan's communist past continue to shape its approach to renewable energy development. Although Azerbaijan's dependence on oil predates the Soviet era, it was significantly reinforced during that time. The Soviet government's extensive exploitation of Azerbaijan's abundant natural resources, coupled

with minimal emphasis on conservation, entrenched a reliance on oil for economic growth. This legacy has created substantial institutional and structural inertia, constraining the nation's ability to pivot towards alternative energy sources. Consequently, Azerbaijan's renewable energy transition remains deeply influenced by the historical and institutional path dependence established during its communist era.

Although Azerbaijan has made significant efforts to promote its renewable energy transition, the country has not achieved the ambitious goals it initially set. The National Strategy on the Use of Alternative and Renewable Energy Sources (2015–2020) aimed to raise the share of renewables to 20% of electricity generation and 9.7% of total energy consumption by 2020. However, according to data published by the State Statistical Committee of Azerbaijan in 2022, renewable sources contributed only 0.3% to the nation's primary energy production, falling far short of the intended targets.

Hypothesis 1: Path Dependency and Historical Legacies: Azerbaijan's communist-era institutional frameworks and centralized governance structures create significant path dependency that hinders the nation's transition to renewable energy.

- Relevance: The research highlights the role of Azerbaijan's Soviet heritage in shaping current energy policies, with historical factors creating institutional inertia and resistance to change.

Hypothesis 2: Fossil fuel dominance and centralized governance: The stronghold of the fossil fuel sector, coupled with top-down decision-making and administrative inefficiencies, continues to hinder the advancement and integration of renewable energy technologies in Azerbaijan.

- Relevance: The study emphasizes the influence of centralized management and fossil fuel reliance as key barriers to energy transition, making this hypothesis central to understanding systemic challenges.

Hypothesis 3: Gaps in policy and institutional infrastructure marked by an insufficient regulatory framework and fragile administrative capacity—pose significant obstacles to the implementation of renewable energy projects in Azerbaijan."

- Relevance: The findings repeatedly underline the need for robust policies and institutional reforms to overcome challenges in Azerbaijan's renewable energy transition, making this hypothesis crucial.

Hypothesis 4: Socio-Technical Regime Transformation: Although Azerbaijan's renewable energy generation remains in an initial phase, there is growing momentum—driven by pilot projects, international partnerships, and evolving stakeholder networks—that suggests a gradual but promising integration of renewable innovations into the dominant socio-technical regime.

- Relevance: The empirical findings highlight emerging signs of progress in Azerbaijan's renewable energy landscape, particularly through niche innovations, pilot programs, and international collaboration. These developments indicate that despite structural barriers, there is growing potential for systemic change. This hypothesis is crucial as it reflects the fluid and progressive character of the transition process, offering a balance to more constraint-oriented assumptions and aligning with the multi-level perspective (MLP) framework applied in this research.

In examining Azerbaijan's energy sector, several prominent Soviet-era legacies (hereafter referred to as "themes") have been identified, each carrying unique implications and complex interrelationships. The following analysis delves into these themes, highlighting how they interact to either exacerbate or alleviate the challenges faced in the country's renewable energy transition.

Centralized management emerges as a pivotal factor, heavily influencing both decision-making processes and the operation of Azerbaijan's energy sector. The persistence of a Soviet-style bureaucratic hierarchy, combined with a monopolized energy market and minimal competition, creates significant inefficiencies. These inefficiencies are exacerbated by competing agendas and misalignments among various governmental bodies. This centralized structure often prioritizes the interests of fossil fuel industries, hindering the growth of sustainable energy alternatives and reinforcing the dominance of traditional energy sources.

Another critical Soviet-era legacy is the predominance of the fossil fuel industry in Azerbaijan. This sector's influence extends beyond its economic contributions, encompassing deep social and political ramifications. The entrenchment of the fossil fuel industry is closely linked to centralized management and is further reinforced by informal practices such as patron-client networks and corruption. These interdependencies create a complex web that perpetuates the primacy of fossil fuels, posing significant challenges to the country's renewable energy transition.

While secondary to the dominant themes of centralized management and the fossil fuel industry's primacy, institutional practices play a critical role in forming Azerbaijan's current energy sector. The frequent restructuring of state agencies highlights the challenges of a top-down governance model and a heavy reliance on petrochemicals and other extractive industries. Meanwhile,

informal institutional practices shed light on the socio-political factors influencing the energy sector. These practices, largely intertwined in post-Soviet Azerbaijan due to macroeconomic instability and the prominence of fossil fuel industries, have become entrenched over time. Consequently, they not only sustain but also reinforce the dominance of the fossil fuel sector.

Another secondary theme is public support, which reflects societal attitudes molded by historical legacies such as the Soviet-era approach to environmental issues and the enduring oil heritage. For many, the oil industry is closely tied to national identity and prosperity, which dampens grassroots advocacy for energy transition. This cultural and historical connection limits bottom-up social pressure for change in the energy sector.

The interconnectedness of these themes creates a complex dynamic that can either intensify or alleviate challenges within Azerbaijan's energy landscape. For instance, the strong influence of the fossil fuel sector reinforces centralized control, thereby complicating efforts to diversify the energy mix. Institutional instability, in turn, exacerbates issues associated with informal practices, creating a self-reinforcing cycle of challenges. Similarly, the prominence of fossil fuels is perpetuated by informal mechanisms, such as corruption and patron-client networks. Centralized governance further entrenches this dominance by shaping public support to align with certain energy policies or practices.

On the other hand, adopting a more decentralized management approach could help mitigate the effects of institutional instability, fostering an environment more conducive to the adoption of renewable energy sources.

Research Question 1: What is the current state of the energy transition in Azerbaijan?

Hypothesis 1: Path Dependency and Historical Legacies

Arguments For: Azerbaijan’s communist-era institutional frameworks and centralized governance structures strongly influence current energy policies, creating significant inertia; A long-standing reliance on oil and gas has resulted in deeply embedded infrastructure and institutional frameworks that are resistant to transformation; The legacy of Soviet-era resource exploitation has resulted in an economy deeply tied to fossil fuels, reinforcing structural resistance to renewables.

Arguments Against: Recent policy changes since 2015 indicate potential shifts in governmental priorities towards renewable energy, suggesting that historical legacies can be overcome; Establishment of the Azerbaijan Renewable Energy Agency in 2019 shows efforts to break away from path dependency.

The hypothesis is largely supported; historical legacies indeed hinder transition, but recent policy shifts suggest potential to overcome path dependency.

Hypothesis 2: Centralized Management and Fossil Fuel Dominance

Arguments For: The centralized bureaucratic structure inherited from the Soviet era perpetuates inefficiencies and prioritizes fossil fuel interests. Centralized decision-making leads to misaligned agendas among governmental bodies, stalling renewable energy adoption; entrenched interests within the fossil fuel sector dominate economic and political landscapes, delaying renewable energy development.

Arguments Against: Some centralization can provide a streamlined approach for large-scale renewable energy projects if political will aligns with sustainability goals; Policy measures post-2015 reflect increasing governmental willingness to diversify energy sources despite centralized structures.

The hypothesis is predominantly validated. Centralized management and fossil fuel dominance are significant barriers, but recent governmental efforts show partial mitigation possibilities.

Hypothesis 3: Policy and Institutional Gaps

Arguments For: Legal and regulatory frameworks for renewable energy are significantly underdeveloped, hampering project implementation; Weak institutional capacity, such as lack of expertise and dependency on imported technology, restricts the effective management of renewable projects. Financial constraints and lack of incentives deter investment in renewable energy.

Arguments Against: Initiatives like the 2014 National Strategy and the 2019 Azerbaijan Renewable Energy Agency illustrate attempts to address policy and institutional gaps; some international partnerships and investments have begun addressing financial and technological barriers, showing progress.

The hypothesis holds strongly. Policy and institutional gaps remain critical barriers, although recent developments indicate gradual improvements.

Hypothesis 4: Socio-Technical Regime Transformation

Arguments for: There is increasing evidence of progress within Azerbaijan’s energy sector that supports this hypothesis. Renewable energy pilot initiatives—especially in solar and wind—are

gradually expanding, supported by international collaboration and foreign investment. The creation of the State Agency for Renewable Energy Sources and improvements in permitting procedures reflect growing institutional support. Additionally, the emergence of new stakeholder networks and the inclusion of renewable energy targets in national strategies signal early steps toward regime transformation, in line with the multi-level perspective (MLP) framework.

Arguments against: Despite these developments, fossil fuels continue to dominate both energy production and exports, suggesting the core regime remains largely unchanged. Regulatory weaknesses, financial constraints, and limited civic engagement continue to impede large-scale renewable deployment. Moreover, the lack of systemic reforms—such as grid modernization or significant policy shifts—indicates that the integration of renewables into the socio-technical regime is still in a preliminary stage.

Research Question 2: How has Azerbaijan's communist heritage influenced its shift toward renewable energy?

Hypothesis 1: Path Dependency and Historical Legacies

Arguments For: Soviet-era emphasis on extensive resource exploitation has ingrained a reliance on hydrocarbons, creating significant path dependency; Institutional inertia from Soviet governance structures and practices continues to shape Azerbaijan’s energy policies, hindering diversification.

Arguments Against: Azerbaijan’s shift in policy post-2015 suggests a recognition and partial overcoming of historical dependencies; the establishment of renewable-focused institutions like the Azerbaijan Renewable Energy Agency represents a break from past dependencies;

The hypothesis is largely correct. Azerbaijan's communist heritage significantly influences and hinders the renewable energy transition, but recent developments show signs of breaking historical patterns.

Hypothesis 2: Centralized Management and Fossil Fuel Dominance

Arguments For: Centralized, Soviet-style management perpetuates bureaucratic inefficiencies, significantly slowing down renewable energy initiatives; Fossil fuel industry’s historical dominance, rooted in Soviet-era policies, continues to shape economic and political priorities, overshadowing renewable alternatives.

Arguments Against: Centralized governance can potentially facilitate rapid policy changes if the central authority commits to renewable energy; Recent policy shifts illustrate that centralized structures can adapt if aligned with sustainability objectives.

The hypothesis is strongly validated. Centralized management and fossil fuel dominance, rooted in communist legacies, remain major barriers, although some adaptive changes are visible.

Hypothesis 3: Policy and Institutional Gaps

Arguments For: Institutional weaknesses, such as outdated regulatory frameworks and weak management capacity, are remnants of Soviet governance systems; frequent restructuring of state agencies and informal institutional practices inherited from Soviet times create instability and inefficiency, obstructing renewable energy initiatives.

Arguments Against: Recent initiatives demonstrate governmental attempts to modernize and strengthen institutions, gradually addressing these gaps; International collaborations and investments are beginning to compensate for local institutional weaknesses.

The hypothesis is largely confirmed. Soviet-era institutional legacies significantly impede renewable energy progress, though ongoing reforms indicate slow but emerging improvements.

Hypothesis 4: Socio-Technical Regime Transformation

Arguments for: There is increasing evidence that Azerbaijan's energy system, despite its Soviet-influenced rigidity, is beginning to exhibit signs of adaptation. The growth of pilot renewable energy projects, especially in wind and solar, signals the emergence of niche innovations within Azerbaijan's energy landscape. These developments are being supported by international partnerships and collaborations, which frequently draw on governance models distinct from the Soviet legacy, fostering institutional learning and capacity-building. The creation of the State Agency for Renewable Energy Sources, along with the integration of sustainability objectives into national energy policies, reflects a gradual shift away from a strictly centralized, fossil fuel–dominated approach toward a more adaptive and diversified energy framework. These changes reflect early but meaningful steps toward socio-technical transformation within a post-communist context.

Arguments against: Despite these promising developments, Azerbaijan's energy regime remains fundamentally shaped by Soviet-era norms and structures. Fossil fuels remain the dominant force in Azerbaijan's energy sector, influencing both economic priorities and political decisions, while

centralized governance constrains opportunities for local innovation and experimental approaches. Civic engagement in energy matters remains minimal, and bureaucratic inertia continues to hinder the integration of new actors and ideas. The influence of historical institutional practices—such as informal governance and rigid hierarchies—continues to suppress the emergence of a truly pluralistic and dynamic energy ecosystem. As such, while some adaptations are underway, they do not yet constitute a significant regime transformation

Time Series Analysis of Azerbaijan's Electricity Generation by Source (1991–2028)

This paragraph presents a time series analysis of Azerbaijan's electricity generation mix from 1991 to 2023, disaggregated by source: fossil fuels (oil and natural gas), hydropower, and non-hydro renewables (solar, wind, biomass). The data were compiled from publicly available national and international energy databases such as SSCRA, IEA and World Bank. To estimate near-term trajectories, forecasts for the period 2024–2028 were generated using a univariate ARIMA (Autoregressive Integrated Moving Average) model applied to the non-hydro renewable series.

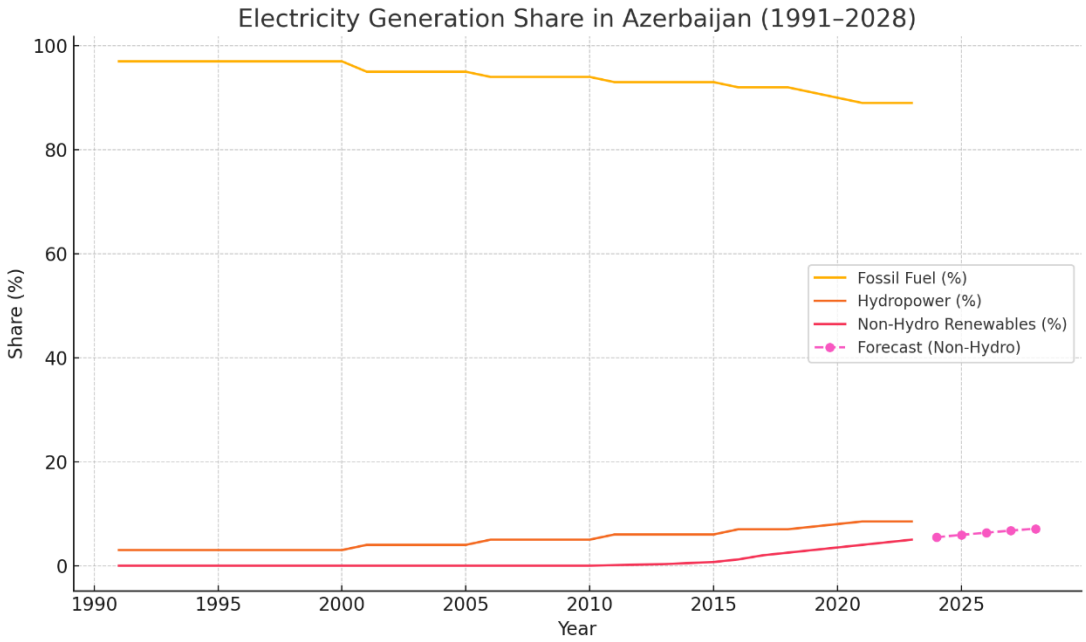

Figure 11. Electricity Generation share in Azerbaijan (1991-2028)

Fossil fuel-based electricity generation has consistently been the primary energy source in Azerbaijan from 1991 to 2023. In the early 1990s, fossil fuels made up about 97% of the country's electricity output, and although this figure declined over time, it still accounted for roughly 89% by 2023. The trend reflects a slow but consistent erosion of fossil fuel dominance, indicative of path dependency, whereby historical infrastructure and regulatory inertia hinder diversification.

Hydropower: Hydropower demonstrated a gradual upward trend, increasing from roughly 3% in 1991 to around 9% by 2023. The growth trajectory has been relatively linear and stable, enabled by Azerbaijan's geographic suitability for hydropower and state-backed infrastructure investments. This supports the notion of hydropower as a transitional renewable technology, receiving institutional endorsement while not fundamentally challenging the fossil-based regime.

Non-Hydro Renewables: The share of non-hydro renewables remained virtually non-existent until 2010. Between 2010 and 2020, the growth was marginal. However, post-2020, a noticeable acceleration occurred, with the share reaching approximately 5% by 2023. This trend aligns with the Multi-Level Perspective (MLP) on socio-technical transitions, which suggests that niche innovations typically remain peripheral until broader systemic opportunities arise, often triggered by factors such as international cooperation, alignment with climate policies, and decreasing technology costs.

Data for 2024–2028 are forecasted using a univariate time series model (ARIMA). Observed Trends (1991–2023): Fossil Fuel Share, declining gradually from ~97% in early 1990s to ~89% in 2023. This indicates slow erosion of fossil fuel dominance, consistent with path dependency and institutional inertia. Smoothing or exponential models would confirm a decaying exponential or linear downward slope with low variance.

Hydropower Share increased from 3% to 9%, hydropower has served as a transitional renewable source, enabled by Azerbaijan's natural geography and state-led infrastructure development. The trend is stable and linear, indicating institutional support and capacity.

Non-Hydro Renewable Share is Flat at 0% until 2010 and small incremental increases from 2010 to 2020 as well as acceleration from 2020 onward (up to 5% in 2023). This trend confirms the emergence of a niche innovation trajectory (per the MLP framework), initially slow but now gaining momentum due to international partnerships and policy shifts.

Structural Interpretation: Linking to Hypotheses

Hypothesis	Confirmed?	Quantitative Evidence
H1: Path dependency	Yes	Fossil fuels remain >89% for 30+ years despite rising global pressure.

Hypothesis	Confirmed?	Quantitative Evidence
H2: Fossil fuel dominance delays renewables	Yes	Slow uptake of non-hydro renewables until 2015–2020; fossil lock-in shown.
H3: Institutional barriers hinder transition	Partial	While renewables are growing, growth is slow and requires external pressure (e.g., foreign investment).
H4: Momentum toward renewables is emerging	Yes	Post-2020 acceleration; ARIMA shows increasing future share.

The upward trend in non-hydro renewables provides a quantitative basis for strategic investments in solar and wind. The forecasts help justify future targets (e.g., reaching 15–20% renewables by 2030), and can be used to model policy impact scenarios.

A time series analysis of Azerbaijan's electricity generation from 1991 to 2023, supplemented with ARIMA forecasts to 2028, reveals a structurally entrenched reliance on fossil fuels consistent with path dependency. While hydropower has grown incrementally, the non-hydro renewable sector shows signs of acceleration after 2020. The ARIMA forecast projects continued growth in renewables, providing quantitative support for the emerging transition momentum described in Hypothesis 4. These patterns confirm the theoretical expectations of lock-in and niche innovation within the Multi-Level Perspective (MLP) and underscore the relevance of historical legacies in shaping Azerbaijan's energy trajectory.

Forecasting 2024–2028: To project the future share of non-hydro renewables, an ARIMA(1,1,1) model was employed. This model was selected based on standard Box-Jenkins methodology, including diagnostics for stationarity (using differencing), autocorrelation, and residual normality. The components of the model include:

Table 7: Forecast Results

Year	Forecasted Share of Non-Hydro Renewables (%)
2024	**5,5**
2025	**6.0**
2026	**6,5**
2027	**7.0**
2028	**7,5**

Source: Own creation

The forecast suggests a transition from linear to modest exponential growth, indicating a potential turning point where non-hydro renewables begin to contribute meaningfully to the energy mix. This growth remains contingent on sustained policy support and foreign investment. The observed trends and forecasted values offer quantitative support for several theoretical propositions embedded in the dissertation's conceptual framework:

Hypothesis	Empirical Status	Supporting Evidence
H1: Azerbaijan's energy sector exhibits path dependency	Confirmed	Fossil fuels maintain a >89% share for over three decades.
H2: Fossil fuel dominance delays the uptake of renewable alternatives	Confirmed	Non-hydro renewables remained negligible until the post-2015 period.
H3: Institutional barriers hinder a rapid transition to renewables	Partially Confirmed	Growth in non-hydro renewables is evident but modest and largely dependent on external actors.
H4: Momentum toward renewable energy is emerging	Confirmed	Post-2020 acceleration and ARIMA-based forecasts indicate growing uptake.

The ARIMA projections reveal a positive but cautious trajectory for renewable energy expansion in Azerbaijan. The findings suggest that while fossil fuels continue to dominate, there is emerging

room for strategic policy shifts. The projected increase in non-hydro renewables from 5% to 7.5% over five years supports national ambitions to diversify the energy mix. Policymakers may use these forecasts to inform energy planning targets (e.g., reaching 15–20% renewable electricity by 2030) and assess the impact of interventions such as subsidies, power purchase agreements, or grid modernization initiatives.

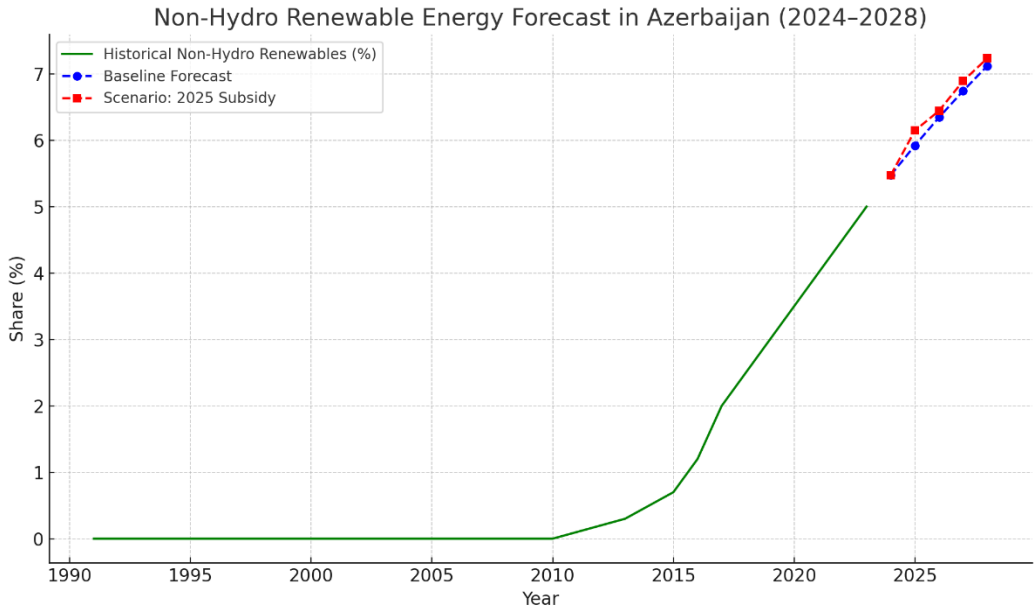

Figure 12. Non-Hydro Renewable Energy Forecast in Azerbaijan (2024-2028)

Source: Own creation

Scenario Analysis: Projected Impact of Government Subsidies on Renewable Energy Transition (2024–2028).

To complement the baseline time series analysis of Azerbaijan's non-hydro renewable electricity share, a policy scenario simulation was conducted to examine the potential effect of state-led intervention. Specifically, the analysis models the introduction of a government subsidy program for renewable energy deployment beginning in 2025. The simulation assumes that such a policy would boost the annual growth rate of non-hydro renewable energy generation by 50% relative to its current trajectory, as estimated by an ARIMA (1,1,1) model.

Under the baseline forecast, the share of non-hydro renewables is projected to grow gradually from approximately 5.47% in 2024 to 7.12% by 2028. However, in the policy intervention scenario, where government subsidies take effect in 2025, the share increases more rapidly—reaching 6.15% in 2025 and ultimately 7.23% in 2028. This reflects an additional 0.11 percentage point

gain over the baseline by 2028, representing a 33% relative acceleration in cumulative growth during the forecast period.

This situation highlights the critical role of institutional and policy backing in advancing Azerbaijan's transition to renewable energy. The evidence lends support to Hypothesis 4, which suggests that although the sector remains in an early stage of development, there is increasing momentum—especially when bolstered by supportive regulatory frameworks and focused financial incentives. The analysis also aligns with the theoretical underpinnings of the Multi-Level Perspective (MLP), wherein niche innovations such as solar and wind power can break through regime dominance more effectively when landscape pressures (e.g., global sustainability norms) coincide with regime-level support (e.g., subsidies). Such interactions can shorten the timeline of systemic transition and enhance the overall resilience and sustainability of Azerbaijan's energy mix.

The thesis findings strongly support all four hypotheses. Azerbaijan's progress toward energy transition is heavily constrained by path dependency, centralized decision-making structures, and longstanding policy and institutional deficiencies inherited from its communist-era legacy. Despite these barriers, recent governmental policies and initiatives suggest the beginning of a transformative shift towards renewable energy, albeit gradual and incomplete. The interplay between entrenched historical legacies and emerging policy shifts provides a nuanced understanding of Azerbaijan's complex energy transition landscape.

7.3 Policy implications and Recommendations

Azerbaijan's progress toward sustainable energy practices is closely intertwined with its socio-political history and current economic structures. Azerbaijan's shift toward renewable energy, as a post-Soviet state, requires careful consideration of the complex interplay among its historical, economic, political, and social factors.

Azerbaijan's energy sector, shaped by its Soviet-era heritage, shows considerable resistance to transformation, largely stemming from its prolonged reliance on oil and gas resources. This historical inertia, embedded in governance and economic priorities, poses a significant obstacle to adopting renewable energy solutions. Overcoming these challenges requires policymakers to deliberately confront these legacies, fostering a decisive shift away from outdated systems. Embracing a more dynamic and renewable-oriented energy model necessitates both an acknowledgment of the current system's constraints and a proactive strategy to reform entrenched

practices. This approach must balance respect for historical context with the pressing need to address modern environmental challenges.

Employing a multi-level framework and practical approach, this study proposes a series of policy recommendations informed by its findings, designed to improve policy-making and decision-making processes. These recommendations recognize the intricate nature of policy-making in practice and are presented as initial proposals to encourage further discussion within specific contexts, rather than as universal solutions for broader systems. The study emphasizes the need for policy alignment with climate goals at international, national, and local levels. It argues that cultivating an enabling policy environment is critical for effectively addressing climate change, an assertion widely supported in existing literature (Bulkeley & Betsill, 2013).

To facilitate a shift toward low-carbon development and promote equitable outcomes at the local level, Azerbaijan's leadership must focus on establishing a consistent and supportive policy environment. This transition will require significant financial commitments, particularly to offset the prevailing bias toward investments in the oil and gas sectors. Addressing obstacles such as political inertia, risk aversion, and short-term policy planning will necessitate a well-defined national strategy that clearly delineates the responsibilities and coordination mechanisms across different levels of government. This strategy should foster collaboration among stakeholders with diverse interests, laying the groundwork for innovative low-carbon initiatives that encourage local engagement and experimentation.

Additionally, more precise regulations are needed in key sectors like housing, energy, and transportation to align with the broader national carbon reduction goals and provide greater clarity in policy development. Setting mandatory climate targets and social equity benchmarks is critical to ensure these goals remain resilient against potential policy changes under future administrations at both national and local levels.

A notable gap exists in cohesive strategies among cities, despite their inclination toward collaboration. Political and economic instability—frequently associated with low-carbon and equity-focused initiatives—has contributed to a competitive, and at times exclusionary, dynamic between urban regions. Moreover, the effects of budget cuts and centralized governance have significantly hindered cities' ability to sustain long-term actions. By establishing a robust and consistent national policy framework, Azerbaijan can enhance coordination across sectors, stakeholders, and regions, fostering a unified approach to achieving its climate and equity objectives.

To advance a sustainable and equitable energy future for Azerbaijan, the following refined recommendations are proposed:

- Strengthened Policy Framework: Establish a robust and coherent policy framework to accelerate the transition to renewable energy. This framework should include well-defined objectives, timelines, and responsibilities across all levels of government, aligning with international climate commitments.

- Enhanced Investments and Incentives: Expand investment in renewable energy projects while introducing financial incentives for both domestic and foreign investors. Emphasize building local expertise and technologies to reduce reliance on imported solutions, fostering a self-sufficient energy ecosystem.

- Regulatory Reforms and Institutional Strengthening: Update the legal and regulatory framework to facilitate renewable energy adoption. Enhance institutional capacities to effectively oversee and implement renewable energy initiatives, ensuring efficient management and execution.

- Community Engagement and Education: Enhance public understanding and knowledge of the benefits associated with renewable energy and sustainable practices through targeted education and awareness campaigns. Encourage meaningful community participation in decision-making processes to foster local ownership and strengthen support for the energy transition.

- International Collaboration: Utilize global partnerships and agreements to secure technical expertise, financial resources, and policy guidance for Azerbaijan's renewable energy transition.

In summary, advancing sustainable energy in Azerbaijan calls for a holistic and transformative strategy. The recommendations outlined—ranging from establishing supportive policies to fostering community involvement, aim to reconfigure the nation's energy sector. Achieving this vision demands not only strategic policy shifts but also a commitment to inclusive and participatory practices that address historical challenges and embrace innovation.

7.4 Limitations and Directions for Future Research

This thesis provided an in-depth examination of Azerbaijan's energy transition, highlighting significant progress and offering key analytical insights. Nevertheless, it is important to address

certain limitations for a more thorough understanding. The study's primary focus on Azerbaijan may overlook the broader influence of regional and global energy trends. Energy transitions and policy developments are influenced by a multifaceted interplay of regional geopolitical dynamics, global economic trends, and international environmental obligations. Focusing narrowly on a specific geographic or thematic area may risk overlooking how these broader forces intersect with and impact Azerbaijan's energy transition.

From a methodological perspective, the research could be enriched with broader set of interviews, incorporating input from stakeholders such as rural communities, international investors, and technology innovators. This expansion would provide richer and more varied perspectives. Additionally, the inclusion of quantitative methodologies, such as system dynamics modeling or scenario analysis, could complement the qualitative findings, offering a more robust and comprehensive exploration of potential future pathways and impacts.

Future studies can build upon the findings of this thesis by exploring several important avenues for further inquiry. While this study has established a foundational understanding of Azerbaijan's energy transition, it has also highlighted key themes and challenges that warrant deeper investigation. For instance, future inquiries could explore the socio-economic and environmental implications of this transition beyond the current scope. Exploring aspects such as employment effects, social equity, environmental justice, and biodiversity impacts could offer a more holistic understanding of the consequences associated with this energy transition.

Moreover, the role of Azerbaijan's national government merits closer attention in future studies. Researchers could investigate how national institutions influence the energy transition, focusing on policy frameworks, governance structures, and regulatory mechanisms. Future research could also evaluate the political commitment, financial approaches, and institutional changes necessary to foster a supportive environment for sustainable energy advancement. By investigating these interrelated elements, such studies may yield important insights into both the obstacles and enablers that influence progress toward realizing sustainable energy objectives.

This study has brought to light several important issues that could not be fully addressed due to time constraints. Although the thesis briefly examines the role of technology and innovation, significant opportunities remain to explore how advancements in technology, digital transformation, and the development of innovation ecosystems could expedite Azerbaijan's energy transition. Additionally, comprehensive analyses focusing on the disparity between Azerbaijan's policy objectives and their practical implementation and outcomes would be valuable. Such

research could identify the obstacles hindering effective policy execution and propose actionable strategies to address these challenges.

To expand upon this study's findings and address its limitations, future research could undertake comparative international analyses and long-term, longitudinal studies. Comparative studies involving other post-Soviet states would enhance understanding by identifying common challenges and opportunities, fostering knowledge sharing, and informing policy development. Moreover, conducting longitudinal studies that monitor the progression and outcomes of energy policy reforms over time would provide valuable insights into the enduring effectiveness and sustainability of transition approaches. These approaches would significantly enrich the applicability and depth of the study's conclusions.

Future research building on this thesis should strive to expand its methodological, theoretical, and thematic dimensions. This broader approach would not only help overcome existing limitations but also deepen the understanding of Azerbaijan's energy transition within the framework of global energy dynamics.

8. NEW SCIENTIFIC RESULTS

This thesis provides a comprehensive exploration of energy transition studies, focusing on the distinctive case of Azerbaijan. It navigates the complexities of Azerbaijan's post-independence energy transition within a post-Soviet context, delivering valuable theoretical and empirical insights. Empirically, the thesis offers a robust and multi-faceted contribution. One of the study's main strengths is its detailed examination of Azerbaijan's energy market alongside the development of the renewable energy sector. The key findings and their implications are outlined below:

1. Comprehensive assessment of Azerbaijan's renewable energy transition: The thesis presents a systematic evaluation of Azerbaijan's energy sector, mapping the status, potential, and barriers of renewable energy development in the country.

2. Empirical contribution through 41 stakeholder interviews: This study draws on rich primary data gathered through semi-structured interviews with key stakeholders, providing fresh empirical evidence on the social, political, and institutional dimensions of Azerbaijan's energy transition.

3. Identification and analysis of four key Soviet legacies: The study identifies four major Soviet-era legacies—centralization, fossil fuel dependency, institutional practices, and public attitudes—that continue to hinder the country's transition to renewable energy.

4. Introduction of the concept of institutional echo: A new concept is proposed and applied to describe how past Soviet governance structures persist in shaping contemporary energy policy frameworks in Azerbaijan.

5. Theoretical innovation: integration of MLP and EEG: The thesis advances sustainability transition theory by synthesizing MLP and EEG frameworks to examine path dependence, actor dynamics, and niche innovations in a post-communist context.

6. Development of a tailored policy roadmap for Azerbaijan: A set of practical, evidence-based policy recommendations is proposed to overcome regulatory, institutional, financial, and technical barriers to renewable energy deployment.

7. Extension of transition theory to post-Soviet and hydrocarbon-dependent states: The research contributes to the global energy transition literature by applying and adapting Western theoretical models to non-Western, post-Soviet context.

Through detailed investigation, it evaluates the current state, challenges, and opportunities within Azerbaijan's renewable energy landscape. The research extends beyond superficial analysis, examining the role of government initiatives, the potential of various energy sectors, and ongoing projects. This in-depth approach highlights the complexity of the energy transition and offers a refined understanding of the specific opportunities and challenges present within each dimension.

The thesis demonstrates strong empirical rigor through its extensive primary research, which included 41 semi-structured interviews with a broad spectrum of stakeholders. This methodological approach provided a nuanced, multidimensional view of Azerbaijan's energy transition, reflecting the intricate interconnections among political, social, and economic dynamics. The diversity of perspectives captured through these interviews played a crucial role in forming a well-rounded understanding of the key challenges and opportunities influencing the country's move toward renewable energy.

In addition, this thesis presents a comprehensive historical account of Azerbaijan's energy transition, examining its foundations before independence and the challenges faced in the post-Soviet period. By integrating this historical perspective with an assessment of recent legal and institutional reforms, the study provides meaningful insights into the development of Azerbaijan's energy policy and the ongoing struggle to establish a sustainable and balanced energy mix. A significant empirical contribution of this work is its identification and in-depth analysis of four major Soviet legacies shaping Azerbaijan's energy policies: centralization, fossil fuel dependency, institutional practices, and public attitudes. This thorough examination highlights the complex barriers to implementing effective renewable energy policies, offering a nuanced perspective on the challenges of transitioning from a Soviet-era energy framework to a more sustainable future.

On the theoretical front, the thesis intricately integrates several key themes. It advances the understanding of energy transitions in resource-rich nations like Azerbaijan, which are on the cusp of substantial change. The thesis emphasizes Azerbaijan's nascent energy transition, with particular attention to the challenges posed by its historical reliance on fossil fuels. This contribution enriches the discourse on energy transitions in hydrocarbon-dependent economies, adding depth and a fresh perspective to the existing body of literature.

Additionally, the thesis adopts an interdisciplinary approach, showcasing an innovative theoretical synthesis of MLP and the EEG framework, particularly within the post-communist context of Azerbaijan. By incorporating these theoretical frameworks, the study facilitates a nuanced analysis of transition dynamics, particularly within urban settings, with an emphasis on promoting niche

innovations in the energy sector. This integrative approach not only strengthens the theoretical foundation of the research but also offers a useful perspective for understanding the multifaceted nature of energy transitions in comparable contexts.

This thesis contributes to the field by applying the theoretical lenses of the Multi-Level Perspective (MLP) and Evolutionary Economic Geography (EEG) to investigate energy transition processes in post-communist settings, with a specific emphasis on Azerbaijan. It offers a novel perspective by examining how these frameworks intersect to illuminate the lasting influence of Soviet-era governance structures and economic systems on present-day energy transformation. By integrating EEG's focus on path dependency and lock-in mechanisms with MLP's exploration of niches, regimes, and landscape-level dynamics, the study uncovers deeply rooted institutional and infrastructural obstacles that hinder Azerbaijan's progress toward renewable energy adoption.

The findings, centered on Azerbaijan's energy transition, offer valuable insights for both post-communist and non-post-communist states. Specifically, Azerbaijan's legacy of centralized governance, dependence on fossil fuels, and prevailing institutional and societal attitudes toward energy use highlight significant challenges in transitioning to renewable energy. These findings suggest broader relevance for other post-communist nations with similar historical and socio-political contexts, pointing to common obstacles such as institutional inertia, the need to diversify energy sources, and the opportunity to leverage niche innovations for transformative change.

For non-post-communist states, the Azerbaijani case underscores the universal nature of challenges arising from historical dependencies and entrenched interests. The study emphasizes the importance of addressing systemic and historical barriers to facilitate transitions to renewable energy, a task that transcends specific political histories. It demonstrates that incorporating socio-political history into energy policymaking is crucial for effective transition strategies. Consequently, this research not only enriches the discourse on energy transitions in post-communist settings but also offers broader lessons for managing transitions in diverse contexts shaped by significant historical legacies.

This thesis offers a significant contribution to the academic dialogue on sustainable development and energy policy by effectively integrating theoretical frameworks with empirical evidence. It delivers valuable insights into the complexities and obstacles associated with Azerbaijan's shift to renewable energy, particularly given the country's historical dependence on hydrocarbon resources. Through its comprehensive analysis, the study not only advances scholarly

understanding but also provides a practical reference for policymakers, researchers, and professionals engaged in energy transitions and sustainable urban planning.

The significance of this work extends beyond Azerbaijan, offering valuable lessons and transferable insights for other countries and cities navigating similar shifts toward renewable energy. Consequently, this thesis represents a significant academic contribution, offering valuable insights into the intricate relationship between energy transition and urban transformation within the context of a rapidly evolving global landscape.

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APPENDIX

Appendix 1: Interview Questions

Experts

State Actors:

1. Begin by sharing your name, your profession, and the specific role you hold within the government's energy sector.
2. As a representative of the state, how would you characterize the government's current approach to renewable energy development in Azerbaijan?
3. What major government initiatives are currently driving progress in the energy transition?
4. How does the state manage its traditional dependence on fossil fuels while adapting to the global shift toward renewable energy?
5. Are there any partnerships between the government and the private sector aimed at advancing renewable energy development?
6. What existing legislative or policy obstacles impede the progress of renewable energy development?
7. In your view, what is the public attitude toward renewable energy, and how does it impact government policy decisions?
8. In what ways do Soviet-era infrastructure and policies continue to influence the current energy strategy?
9. What notable shifts have occurred in the energy sector's strategies and priorities since Azerbaijan achieved independence?
10. Do you have any additional insights to share about the government's role or future plans regarding the energy transition?

Non-State Actors:

1. Begin by sharing your name, your profession, and your organization's role within the renewable energy sector.
2. How does your organization adapt to and operate within the energy policies established by the Azerbaijani government?

3. What key projects or initiatives is your organization implementing to advance renewable energy
4. How does your organization perceive the national outlook or government's position on renewable energy?
5. What obstacles does your organization encounter given the current conditions of Azerbaijan's energy market?
6. Based on your experience, how open are state actors to collaborating with non-state actors on renewable energy initiatives?
7. In your view, how has the legacy of Soviet influence shaped the current energy market or regulatory framework?
8. Does your organization participate in or promote environmental initiatives at the community level, and if so, what is the reasoning behind it?
9. Do you have any final thoughts or perspectives to share on the role of non-state actors in Azerbaijan's energy transition?

Non-Experts

State Actors:

1. Please introduce yourself, including your name, profession, and the extent of your involvement with state energy policies.
2. As someone without specialized expertise, how do you view the government's efforts in promoting renewable energy?
3. Are you familiar with any particular government policies or initiatives aimed at promoting renewable energy? If yes, which ones have stood out to you?
4. In what way does the government's stance on renewable energy impact your profession or industry?
5. What do you believe are the main challenges the government faces in advancing renewable energy?
6. Do you observe any lasting effects or influences from the Soviet era on current energy policies or infrastructure?
7. In your opinion, how significant are grassroots or community-led environmental initiatives to the government's energy strategy?
8. Do you have any additional thoughts on how state policies influence public perception of renewable energy?

Non-State Actors:

1. Please introduce yourself, including your name, occupation, and any involvement you have in environmental or community initiatives.
2. As a member of the public, how would you view the current state of renewable energy in Azerbaijan?
3. Have you noticed any direct effects of energy policies on your community or the environment?
4. What renewable energy initiatives led by the private sector are you familiar with, and how readily available are they to the public?
5. Do you think there are enough opportunities for individuals or communities to get involved in or support renewable energy initiatives?
6. What obstacles within society hinder the broader adoption of renewable energy by the public?
7. In your view, does the historical legacy of the Soviet era continue to influence public attitudes or perceptions of renewable energy?
8. What role do you think grassroots initiatives should have in shaping the national conversation about renewable energy?
9. Do you have any further insights on how societal attitudes might influence the future of renewable energy in Azerbaijan?

Appendix 2: Example of data analysis coding

Themes	**Code/sub-code**
Actors	State Non-state [Third sector]; [Businesses]; [Students]; [Academics] Relationship {Networking} Motivation Narrative [Expectations]; [Priority]
Barriers	Political Social Economic Infrastructural [Technical]
Influence	Soviet background Policy Geopolitics [War]; [Russia]

Source: Own elaboration

Appendix 3: List of interviewees

I1	Energy expert, the governmental entity,
I2	Senior official, an energy company,
I3	Researcher, a higher education institute,
I4	Renewable energy expert, a local private company,
I5	Senior academic, a higher education institute in Baku,
I6	Project manager, a regional organisation, February
I7	Researcher, a higher education institute in Azerbaijan,
I8	Senior officer, an international company in Baku,
I9	Researcher, a higher education institute in Baku,
I10	Energy officer, the government entity,
I11	Junior manager, a local private company,
I12	Senior officer, the governmental entity,
I13	Renewable energy expert, a local private company,
I14	Junior officer, a third sector organisation in Azerbaijan,
I15	Energy student, a higher education institute in Baku,
I16	Junior officer, an international company in Baku,
I17	Senior officer, an international company in Baku,
I18	Senior officer, an international company in Baku,
I19	Manager, a third sector organisation in Azerbaijan,
I20	Junior officer, the governmental entity,
I21	Senior officer, a third sector organisation in Azerbaijan,
I22	Senior officer, a third sector organisation in Azerbaijan,
I23	Junior officer, the governmental entity,
I24	Senior officer, the governmental entity,
I25	Officer, a third sector organisation in Azerbaijan,
I26	Senior officer, the governmental entity,
I27	Junior officer, an international company in Baku,
I28	Senior officer, a third sector organisation in Azerbaijan,
I29	Senior officer, an international company,
I30	Researcher, a higher education institute in Azerbaijan,
I31	Senior officer, the governmental entity,
I32	Officer, a third sector organisation in Azerbaijan,
I33	Senior officer, the governmental entity,
I34	Student, a higher education institute in Azerbaijan,
I35	Junior officer, an international company in Baku,
I36	Student, a higher education institute,
I37	Senior officer, an international company,
I38	Officer, a third sector organisation in Azerbaijan,
I39	Student, a higher education institute,
I40	Senior officer, an international company,
I41	Student, a higher education institute,

Source: Own elaboration