CEU Department of Public Policy | CENTRAL EUROPEAN UNIVERSITY

Renewable Energy in the South Caucasus: Legislative, Technological, and Economic Challenges

By Davit Geladze

Central European University

Department of Public Policy

In partial fulfillment of the requirements for the degree of Master of Public Policy

Supervisor: Nick Sitter

Vienna, Austria

2025

Acknowledgments

I would like to thank to my family for their empowerment during my studies. I am also deeply thankful to my supervisor, Nick, for his invaluable guidance and support.

Author's declaration

I, the undersigned, **Davit Geladze**, candidate for **Master of Public Policy**, declare herewith that the present thesis is exclusively my own work, based on my research.

All sources have been properly credited in the text, notes, and the bibliography. I declare that no unidentified and illegitimate use was made of the work of others, and no part of the thesis infringes on any person's or institution's copyright. Furthermore, I declare that no part of this thesis has been generated using artificial intelligence (ChatGPT).

I also declare that no part of the thesis has been submitted in this form as coursework for credits or to another institution of higher education for an academic degree.

Date: 03.06.2025

Name: Davit Geladze

Table of Contents

Abstract

This thesis investigates the legislative, technological, and economic challenges impeding renewable energy development in the South Caucasus, focusing on Georgia, Armenia, and Azerbaijan. Employing a qualitative, comparative case study approach informed by the Multi-Level Perspective (MLP) framework, the study analyzes official documents and reports to understand how these barriers shape energy transition outcomes. Findings confirm that renewable energy growth is hindered by a complex interplay of factors: Georgia faces institutional fragmentation despite strong legal alignment; Armenia relies heavily on donor support due to economic fragility; and Azerbaijan's fossil-fuel wealth fosters regime inertia, delaying diversification. The research reveals that these challenges are mutually reinforcing and deeply embedded in each country's unique political economy and geopolitical orientation. It underscores the necessity of tailored policy solutions and highlights how external pressures alone are insufficient to destabilize entrenched socio-technical regimes without robust internal reform.

Chapter 1. Introduction

1.1 Background and Regional Context

Climate change and energy security have been some of the most discussed issues in the world in recent times (Ang et al. 2022). The shift from fossil fuels to renewable energy is getting more important, because, renewable energy is vital for global climate goals and energy security (Ang et al. 2022). Renewable energy, sourced from naturally replenishing resources such as solar, wind, hydropower, geothermal and more (Ang et al. 2022). It stands as a reliable alternative and solution to gas emissions, environmental problems and depletion of fossil fuels (Ang et al. 2022). As part of the worldwide response to climate change, countries are under pressure to decarbonize the energy sector. But this shift is not only because of climate change, it has as well as a geopolitical dimension (IRENA 2023).

The South Caucasus region, which includes Armenia, Azerbaijan, and Georgia, has significant renewable energy potential: solar, wind, and hydropower (Keohg, Bayramov, and German 2021). However, the region remains dependent on fossil fuels, especially Azerbaijan, which is the main exporter from the region of gas and oil (Mustafayev, Kulawczuk, and Orobello 2022). Georgia and Armenia are less endowed with fossil fuel resources and thus more reliant on fossil fuel imports (Gugushvili et al. 2021; IEA 2020). At the same time, they are seeking alternative energy resources, especially solar and hydropower energy given their geographical and climatic conditions (Gugushvili et al. 2021; IRENA 2025).

Global and regional initiatives emphasize the importance of diversifying energy resources and enhancing energy resilience. One of the most important players in this region, the European Union, has recently become more interested in the South Caucasus' renewable energy as a potential contributor to its decarbonization strategy, especially through projects such as the EU–Caspian Green Energy Corridor (Bayramov 2024). Even so, the energy infrastructure in

the South Caucasus is insufficiently developed. In this context, political instability, regulatory fragmentation and a lack of strategic coordination between countries hinder energy reform on a broader scale (Austrian National Defence Academy 2016). Accordingly, the transformation of the South Caucasus energy sector is not only a technological issue, but also a political and economic one. Therefore, identification of the barriers which hinders the development of renewable energy is important as for the sustainability of the region and at the same time for broader international energy interests (World Bank 2023).

1.2 Problem Statement and Study Significance

This study has academic and practical significance in understanding the barriers to harnessing the renewable energy potential of one of the world's most strategically important regions, the South Caucasus. While energy is increasingly emerging as a critical component of security amid global tensions, the South Caucasus region is located at the crossroads of Europe, Russia, the Middle East, and Asia, where its energy resources are receiving increasing attention. While the transition to green energy is becoming increasingly popular, the global literature remains largely focused on developing countries and regions with stable political and economic environments (Sovacool 2016; Markard, Raven, and Truffer 2012). Consequently, there has been less academic attention to Georgia, Armenia, and Azerbaijan, despite the fact that the resources available in the region should be of interest to stakeholders concerned with climate change and energy security. The literature is fragmentary and lacks a unified, comprehensive study that addresses the barriers hindering the development of renewable energies in the region and how these barriers are interconnected doesn't exists This study aims to fill this academic gap and offers a comparative and policy-relevant analysis of the key legislative, technological, and economic barriers to renewable energy development. Through analysis of national strategy

documents, legal texts, and reports from both governments and international organizationsthe study identifies both common patterns and national differences in energy governance and transition planning.

This research holds practical relevance for policymakers, international organizations (e.g., the EU), development agencies (e.g., USAID), technical assistance providers (e.g., UNDP), and regional financial institutions. By highlighting where support is most needed, it can help shape targeted capacity-building efforts, guide investment strategies, and inform bilateral cooperation frameworks aimed at accelerating the renewable energy transition.

The research is very relevant in the contemporary geostrategic context. The European Union is focused on decreasing its energy dependency on Russia. In this context, alternative routes have great significance, especially the South Caucasus, which is important not only for traditional energy but also for renewable sources of energy. Thus, examining the structural and institutional barriers in the region in the context of the study can help to assess its readiness to contribute to regional and global sustainability goals.

1.3 Research Questions and Hypothesis

The South Caucasus is a complex and strategically important region, where energy development is deeply intertwined with political alignments, infrastructure legacies, and economic capacity (Keogh, Bayramov, and German 2021). This study is guided by the following main research question: What are the legislative, technological, and economic challenges facing the development of renewable energy in the South Caucasus region?

To answer this question, the research is organized around the following objectives**:**

1. To identify and analyze the existing legal and institutional frameworks in Georgia, Armenia, and Azerbaijan that relate to renewable energy, with a focus on how these frameworks either promote or inhibit the transition to sustainable energy systems.
2. To examine the state of technological infrastructure and readiness in each country, including grid capacity, digital energy systems, and the technical ability to integrate intermittent renewable sources.
3. To assess the economic and financial environment for renewable energy in the region, including domestic investment capacity, foreign donor involvement, and market-based incentives or barriers.

These objectives will be addressed through a secondary data analysis approach, combining document analysis of government energy strategies, legislative texts, and industry and donor reports with comparative case studies of Georgia, Armenia, and Azerbaijan.

Drawing on preliminary research and theoretical grounding in the Multi-Level Perspective (MLP), this study proposes the following hypothesis**:**

The development of renewable energy in the South Caucasus is significantly impeded by a combination of legislative, technological, and economic challenges, each interacting to exacerbate the region's struggle to transition from traditional fuels to renewable energy resources.

The hypothesis is derived from existing literature that highlights institutional misalignment, infrastructural limitations, and financial shortfalls as recurring themes in post-Soviet energy systems (Markard, Raven, and Truffer 2012; Sovacool 2016). It reflects the view that the transition is not just a technical issue, or any other issue in isolation, but should be considered in a broader context and linked to economic and political issues, among others.

Chapter 2. Literature Review

2.1 General Overview of the South Caucasus Region: Political and Economic Context

The South Caucasus, comprising Georgia, Armenia, and Azerbaijan, straddles the European, Russian and Middle Eastern political interests (Toal 2017). Following the collapse of the Soviet Union, the region has undergone a phase of political and economic turmoil, protracted warfare, conflicting foreign policies, and uneven institutional evolution (Toal 2017). These countries also differ in terms of democratization, integration into the global market, and economic modernization (Delcour and Kostanyan 2020).

Georgia is considered as the most democratic nation among the South Caucasus Countries. The Country received 58 score in the 2024 "Freedom House" report (Freedom House 2024). This report reflects as well limited media freedom and challenging judicial independence. After signing the Association Agreement in 2014, Georgia is aligning its institutional structures with the EU's legal framework, primarily the trade, governance, energy (Delcour 2015). At the same time, Georgia has experience of participation in partnership programs with NATO (Cornell 2017). However, it is important to note that recently—particularly after the parliamentary elections of October 26, 2024—Georgia has shown signs of democratic backsliding, including concerns over election integrity, violence against peaceful demonstrators and journalists, and problems related to fair trials (European Parliament 2025).

Contrary to Georgia, Armenia is a member of the Russia-led Eurasian Economic Union (EAEU) and the Collective Security Treaty Organization (CSTO). Through a 'complementarity' of relations, country has maintained good ties with Russia while at the same time developing relations with the EU. The European Union-Armenia Comprehensive and

Enhanced Partnership Agreement (CEPA) which was signed in 2017 between the European Union and Armenia, is an ambitious agreement, which aims reforms in Armenia in the fields of public administration, judiciary, energy and other sectors (Giragosian 2020). Despite the "velvet revolution" of 2018 having sparked hopes for change, corruption and problems in the judicial system still exists (Freedom House 2023; Delcour and Kostanyan 2020). The Country received 58 score in the 2024 "Freedom House" report (Freedom House 2024).

Azerbaijan, has an authoritarian regime with a strong executive authority. In 2024, Freedom House rated it 7 out of 100 and labelled it "Not Free" due to its tightly controlled media, lack of political competition and suppression of opposition (Freedom House 2024). The country has a multi-vector foreign policy that maintains a balance of relations with Russia, the EU, and Turkey (Guliyev 2020). While oil and gas revenues contribute to the economic development of Azerbaijan and the regional power, they also contribute to the entrenchment of autocratic rule (Cornell 2017).

As noted, the region is characterized by instability and conflict, two prominent reasons for this is the Nagorno-Karabakh conflict between Armenia and Azerbaijan — which escalated in 2020 and 2023, resulted thousands of refugees (Bayramov 2024). The second important reason is the conflict between Georgia and Russia, most recently expressed in the August 2008 "Russian-Georgian War", where Russia declared two Georgian regions, Abkhazia and South Ossetia, as independent states (Toal 2017). These unresolved territorial disputes undermine investor confidence, disrupt regional cooperation, and limit infrastructure connectivity (Delcour and Kostanyan 2020).

The South Caucasus' economies have different structures and levels of development. Azerbaijan, which is the richest among the three, relied on oil and gas, which accounted for 88 % of its export revenues and almost 46 % of GDP in 2022 (World Bank 2023; IMF 2022).

Although Georgia has limited fossil fuel reserves, its location makes it an important transit corridor for Caspian hydrocarbons. It hosts both the Baku-Tbilisi-Ceyhan (BTC) oil pipeline and the South Caucasus Gas Pipeline (SCP), which contribute to its geopolitical importance (IEA 2020). Since the early 2000s, Georgia has been implementing liberal economic reforms that improved its international rankings. Despite these efforts, however, country still experience high levels of rural poverty (over 17%), under-employment, and large informal economy (World Bank 2023; Geostat 2023). Armenia is a landlocked country. In 2022, approximately 11% of GDP came from remittances, which underlines its dependents on this source (World Bank 2023). Despite structural weaknesses, it has developed in various sectors including IT, mining, and agriculture. Moreover, it still relies on importing Russian gas and investments.

2.2 The Southern Caucasus Region Energy History

The collapse of the Soviet Union changed the south Caucasus countries energy dynamics. During Soviet time, their systems were integrated into the central soviet energy system (Austrian National Defence Academy 2016). After independence, their energy trajectories were revised based on natural rescourse capacity, geopolitical position and foreign capital (Opitz et al., 2015; Guliyev, 2020).

A unified power infrastructure existed in the South Caucasus under Soviet empire rule. Azerbaijan was an important hub for oil production and by the early 20th century it was producing in excess of half the world's oil. (Yergin, 1991, 54). On the contrary, Georgia was known for the substantial potential of hydropower generation, supplying power to surrounding areas through the Enguri and Vardnili plants (IEA, 2020). As Armenia had not fossil fuel resources, created a dependency on oil and gas imports from Russia (IEA 2020). To reduce this

dependency, the Metsamor nuclear power plant was commissioned in 1976, which supplied around 40 % of the country's electricity until a temporary closure in 1989 (IAEA, 2021).

The collapse of the Soviet Union in 1991 resulted in a major upheaval to the energy supply of the South Caucasus. For Georgia, the collapse was almost swift and severe. Conflict, neglected upkeep, and a scarcity of fuel sources led to a rapid deterioration of its power infrastructure (Gochitashvili and Archvadze 2016). In the early 2000s, Georgia's energy sector was slowly being liberalized, with financial and technical assistance from international players, including the World Bank and USAID (EBRD 2016, 18).

After the Spitak earthquake on 1988, and along with the 1989 shutdown of the Metsamor plant because of safety concerns, Armenia faced an extreme energy shortage. Electricity sometimes was available for only a few hours a day from 1992 to 1995 (IEA 2003, 12). The Metsamor nuclear power plant in Armenia was reactivated with Russian technical specialists in 1995 to support the country's energy independence (IRENA 2025). The power plant supplied roughly 38% of Armenia's electricity as of 2025. Additional energy came from hydroelectric and thermal sources (around 29%) and natural gas-fired plants (roughly 31%) (IRENA 2025).

On contrast, Azerbaijan utilized its oil reserves to draw foreign capital and revive its energy industry. They signed the "Contract of the Century" with BP and other Western companies in 1994, which was a game changer (Cornell and Ismailzade 2005). This deal led to the development of offshore oil fields and key projects like the Baku-Tbilisi-Ceyhan pipeline that opened in 2006, and the South Caucasus Gas Pipeline in 2007 (Cornell and Ismailzade 2005).

Since the 2000s, the shift towards green energy in the South Caucasus was initiated with the growing global climate change awareness, energy security, and economic diversification (Opitz et al. 2015). Armenia, Azerbaijan, and Georgia have significant renewable prospects—hydropower, solar, wind and biomass. However, their advancement has been limited by

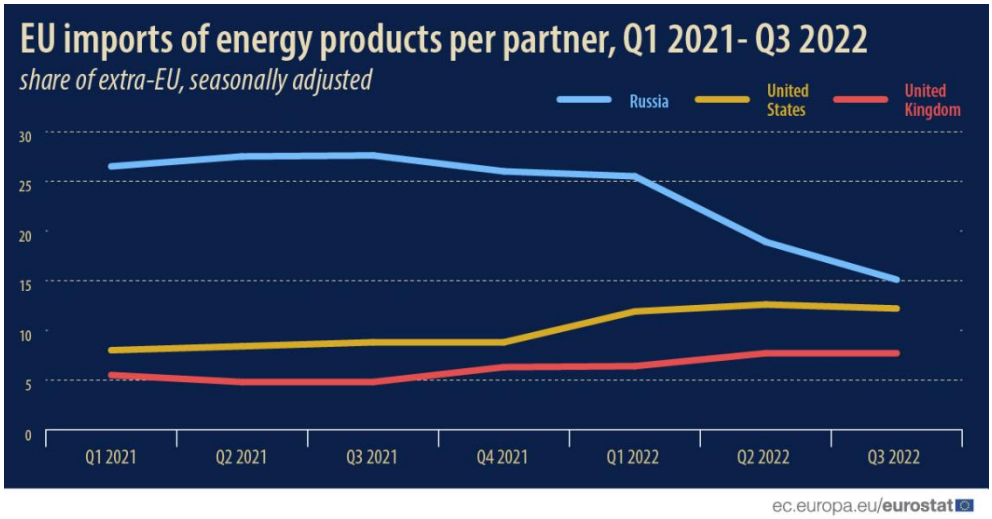
domestic constraints, geopolitical stances and international engagement (IRENA 2025; Opitz et al. 2015).

2.3 EU Energy Policy and Its Connection to the South Caucasus

For a long time, the South Caucasus has long been an area of interest within EU foreign and energy policy due to its geopolitical position between the Black and Caspian Seas, and its role as a transit region for oil and gas pipelines. The Partnership and Cooperation Agreements (PCAs) signed in the early 1990s mark the EU's first engagement with the region. The European Neighbourhood Policy (ENP) was launched in 2004 (Delcour and Wolczuk 2015). The eastern Partnership (EaP) emerged in 2009 and institutionalized energy cooperation under multilateral platforms and bilateral adaction plans. Armenia's energy relationship has grown since 2017, when it signed the Comprehensive and Enhanced Partnership Agreement (CEPA). Georgia has deepened its alignment through its Association Agreement and membership in the Energy Community Treaty (Energy Community 2023). In contrast, by virtue of its position as a fossil fuel exporter on the Southern Gas Corridor, Azerbaijan has pursued a more transactional engagement (European Commission 2022).

Russian invasion of Ukraine in 2022 brought an unprecedented shock to the EU's energy system, highlighting the risks of dependency on politically unstable suppliers (IEA 2023). Before the war, Russia supplied more than 40% of the natural gas to EU. After the sudden interruption, a strategic maneuver was necessary. In response, the European Union initiated "REPowerEU", aiming to reduce Russian gas imports by 2/3 over the year and cut them altogether by 2027, while also accelerating renewable energy deployment (European Commission 2022). At the end of 2023, Russian gas imports dropped to 15% in EU and solar energy surpassed coal in electricity generation for the first time (IRENA 2024). Consequently,

the crisis accelerated previously articulated ideas and bolstered European interest in diversification of energy sector. Before the war, the European Green Deal was launched in 2019, aiming to achieve climate neutrality by 2050 (European Commission 2019).



EU imports of energy products per partner, Q1 2021-Q3 2022 (eurostat 2022).

Today, the South Caucasus is increasingly viewed not only as a transit zone but as a potential source of renewable energy itself. Georgia, Armenia, and Azerbaijan all possess significant potential in hydropower, solar, and wind energy, though their capacity to develop this potential varies (Keogh, Bayramov, and German 2021). EU-supported projects are focused on these asymmetries, for example, by funding infrastructure upgrades, supporting legal harmonization, and encouraging private investment (Gugushvili et al. 2021). In turn, the unstable political environment in the region poses challenges to relations between the European Union and the countries of the region. Meeting EU regulatory frameworks is difficult for Armenia because of membership in Russia's Collective Security Treaty Organisation (CSTO) and the Eurasian Economic Union (EAEU). At the same time, Azerbaijan's rentier-state structure and ongoing fossil fuel prioritization contradict the trend of EU decarbonization (Guliyev 2020). Georgia is the closest to the EU, but domestic governance challenges limit investor confidence in large-scale renewable investments (Kakulia and Lezhava 2021).

Despite these limitations, the mutual benefits of closer energy ties are clear. For the EU, the South Caucasus represents a diversification option that complements its internal energy goals and geopolitical recalibration. For the South Caucasus countries, deeper energy cooperation offers opportunities for technological upgrading, foreign investment, and institutional modernization.

2.4 Transition Theory and the Multi-Level Perspective Framework

The Multi-Level Perspective (MLP) developed by Frank W. Geels (Geels 2002) - has developed as a leading framework for the analysis of transitions towards sustainability. The development process model illustrates how innovations are resisted or supported and eventually replace existing systems. The MLP framework consists of three different levels: niches, regimes and the socio-technical landscape (Geels 2002).

Niches are protected spaces where radical innovations can develop without immediate pressure from mainstream market competition. These are often supported through subsidies, research initiatives, or experimentation.. Within renewable energy, pilot projects such as solar, wind, or off-grid renewable systems are considered niche innovations.

Socio-technical regimes refer to the dominant structures and practices that govern current systems. These are not just technological artifacts, but also cultural norms, established regulations, industry practices, business models and infrastructures (Rip and Kemp, 1998). Regimes tend to be path-dependent, meaning they resist change due to embedded institutions and vested interests.

The landscape level refers to the wider, exogenous environment in which regimes and niches are embedded. This covers political trends, environmental issues like climate change, socio-

cultural values and economic structures. Changes at the landscape level—such as rising climate awareness or geopolitical instability—can place pressure on regimes and create opportunities for niche innovations to scale up (Geels 2011).

The interaction between these three levels explains the dynamics of transitions. Usually, transitions occur when niche innovations are maturing while the existing regime is destabilised by landscape pressures. So, there is a "window of opportunity" for a shift (Smith, Stirling, and Berkhout 2005).

In this sense, the MLP allows scholars and policymakers to analyse how energy transitions emerge, why they are opposed and under what conditions they succeed. The theory enable the analysis of energy system changes where heterogeneous actors are involved that include technologies as well as policies, institutions and user practices (Köhler et al. 2019). Accordingly, the theory provide us a conceptual map to analyze the uneven and political complex transition to renewable energy in the South Caucasus region.

Chapter 3. Methodology

3.1 Research Design and Rationale

This thesis adopts a qualitative, comparative case study approach. This method seeks to investigate the complexity of energy transitions across three different but regionally interconnected political systems: Georgia, Armenia and Azerbaijan. A case study design is a suitable approach for the type of research where the aim is to understand country-specific barriers (Yin 2018). The study is based on Transition Theory, developed by Geels (Geels 2002). Based on the theory, sociotechnical transitions emerge from interactions between landscape pressures, regime structures and niche innovations.

3.2 Case Selection

In the South Caucasus exists three country - Georgia, Armenia, and Azerbaijan, therefore they were chosen based on their geographical proximity (Austrian National Defence Academy 2016). Because of Soviet legacy, they were connected to each other and share energy infrastructure. They differ politically and and at the same time, there energy profiles are different. Despite their regional similarities, the countries differ significantly in their degree of alignment with European Union energy norms, fossil fuel dependencies, and economic development trajectories (Austrian National Defence Academy 2016). These differences make them well suited for a comparative analysis that aims to explain the variation in renewable energy development.

- Georgia is the most pro-European in the sense of political orientation, energy market liberalization, and integration with EU energy directives (Gugushvili et al. 2021; Kakulia and Lezhava 2021).

- Armenia, although landlocked and resource-scarce, has shown progress in grid diversification and policy efforts aligned with international partners such as the European Union and donor agencies, but still closely connected to Russia-aligned organizations (Delcour and Wolczuk 2015; IRENA 2024).
- Azerbaijan economy majorly dependent on fossil fuelds and hydrocarbon resource. However, in recent times, the country has taken some steps toward diversifying its energy mix with solar and wind projects. (Azerbaijan Ministry of Energy 2023).

Through the analysis of these three cases, this thesis seeks to uncover the underlying legislative, technological, and economic dynamics that facilitate or hinder renewable energy development.

3.3 Data Collection

The study relies exclusively on secondary data sources, which is reliable and relevant to study Objectives. This includes:

- Legislative documents: National energy laws, renewable energy strategies, energy efficiency frameworks, and implementation roadmaps.
- Governmental reports: Official statistics from Ministries of Economy, Energy, and Environment in each country.
- International organizations: Reports and policy assessments from the International Renewable Energy Agency (IRENA), the European Bank for Reconstruction and Development (EBRD), the World Bank, USAID, UNDP, and other key actors involved in regional energy transition support.
- Donor-funded project evaluations: Documentation from EU4Energy, KfW, GIZ, and similar programs supporting grid modernization, technical feasibility studies, and financial instruments in the renewable sector.

- Think tank and consultancy outputs: Reports by regional think tanks and technical experts (e.g., Caucasus Energy Research Centre).

The data were obtained from official websites, international databases as well as policy repositories during the period of April-may 2025.

3.4 Analytical Framework and Techniques

The empirical analysis is set out in three pillars, integrating with the research question.

- Legislative - analysis of national legislation relevant to renewable energy, including compliance with EU directives, regulatory clarity, administrative burden and institutional coordination.
- Technological - assessment potential of a countries in terms of renewable energy resources (wind, solar and hydro), existing infrastructures like grid capacity, smart grid deployment, cross border transmission, technological readiness and so on. Using data estimates of technical potential, the information was classified in infrastructure-type reports and grid maps.
- Economic - Analysis of macroeconomic conditions affecting renewable energy development, e.g. government budget deficits/fiscal issues, foreign direct investment trend (FDI), GDP per capita. Analysis of financial constraints and dependency of donors as well.

The main method of analysis is a qualitative content analysis of official and policy documents.This approach enables the identification of major themes, policy priorities, and institutional patterns across the legislative, technological, and economic spheres (Bowen

2009). The analysis relies on close reading of documents to find relevant information, interpret gaps or inconsistencies, and compare approaches across countries.

3.5 Limitations

This study has several methodological limitations. First, as the study rely upon secondary sources, the analysis depends on the availability, transparency and quality of official reporting. In Azerbaijan, the politicization of energy sector data creates considerable empirical gaps or data limitations (Guliyev 2020)**.** Second, the absence of interviews or fieldwork in the study limits its ability to capture informal institutional barriers, as well as political resistance. Third, differences in legal terminology and administrative organization make cross-country comparison complex, requiring explicit contextualization for each case.

Despite these limitations, the structured comparative approach and reliance on official sources provide a reliable foundation to assess the systemic challenges of the renewable energy sector in the South Caucasus.

3.6 Ethical Considerations

As the study involves no human subjects or primary data collection, it does not require formal ethical clearance. In line with academic honesty, we have made sure to cite, interpret and critique all secondary sources properly and appropriately. It is acknowledged that government or donor-produced reports can be biased and are cross-checked with other sources.

3.7 Summary

This methodology chapter has outlined the rationale, design, and analytical tools used to examine the legislative, technological, and economic challenges to renewable energy development in Georgia, Armenia, and Azerbaijan. By combining Transition Theory with a structured comparative analysis based on secondary content, this study provides a strong framework for assessment of the renewable energy transitions in the South Caucasus Region.

Chapter 4. Case Study of Georgia

Georgia's strong pro-European orientation, liberalized energy market and substantial renewable energy potential – especially in hydropower – have positioned it as a key player in the South Caucasus energy scene (Energy Community 2023). Although the country is moving towards a green energy model, there are still various legislative, technological and economic obstacles.

4.1 Legislative and Political Challenges

Georgia remains committed to European energy standards, having signed the EU-Georgia Association Agreement in 2014 and joined the Energy Community in 2017 (European Union and Georgia 2014). This formal membership obliges Georgia to align its national legislation with EU regulations on electricity markets, renewable energy, and energy efficiency (Energy Community 2023). In 2020, Georgia adopted the Law on Energy and Water Supply, which is a major step towards the liberalisation of the country's electricity market and non-discriminatory access to the grid (FAOLEX 2019).

However, despite progress, several legislative challenges persist. One critical issue is the lack of a robust legal mechanism to support renewable energy auctions and power purchase agreements (PPAs). While Georgia introduced a competitive scheme for renewables auction in 2022, its rollout has been delayed due to procedural ambiguities and investor hesitancy (World Bank 2023). Therefore, the instability of long-term policy and regulatory environment, deters private sector investment and limits renewable projects' scalability.

Another challenge connected to the legislation is institutional fragmentation. Three governmental organization shares overlapping responsibilities regarding energy policy implementation: the Ministry of Economy, the Georgian Energy Development Fund (GEDF) and the Georgian National Energy and Water Supply Regulatory Commission (GNERC)

(Government of Georgia 2021). As a result, this fragmentation creates inefficiencies and delays in policy coordination, licensing, and grid access processes (CAREC Program 2023).

Moreover, Georgia's political connection to the EU puts it in a sensitive geopolitical situation given its proximity to Russia and import dependence on energy during the winter season (Dzebisashvili 2024). The energy dynamics of the region, especially Russian influence in occupied territories, creates a security-related uncertainty that indirectly undermines investment confidence in infrastructure and diversifying energy (Dzebisashvili 2024).

4.2 Technological Challenges

Georgia has many different renewable energy resources, especially hydropower, which makes up nearly 80% of the country's electricity generation capacity (IRENA 2025). As per estimates, the technical potential of hydropower is around 15 000 MW, of which presently only about 30% is harnessed. The country also has huge untapped potential for solar and wind. According to the International Renewable Energy Agency (IRENA), an annual solar potential - 1200 to 1800 kWh/m² exists in different regions of Georgia, especially the eastern and southern parts. At the same time, wind energy potential stands at about 4000 MW around the city Gori and Ksani valleys (IRENA 2025a).

Despite Georgia is highly reputed for its wind and solar energy potential, country's grid is old and has seasonal instability (IRENA 2025). During the winter months, when water in rivers falls and consequently hydropower generation also falls, the country is highly dependent on electricity imports, especially from Azerbaijan and Russia (IEA 2023). Significant investments have recently been made in improving cross-border interconnectivity such as with the Black Sea Transmission Line in Turkey (European Investment Bank 2015).

The Black Sea Transmission Line (BSTN) is a quite important project for Georgia's energy export potential (European Investment Bank 2015). It is a high voltage electricity line that was completed in 2013. The BSTN enables the flow of electricity from Georgia to Turkey and beyond. The line operates at 500 kV in Georgia and 400 kV in Turkey. Its backbone consists of two 350 MW back-to-back high-voltage direct current (HVDC) converter stations located at the Akhaltsikhe substation, giving it a total transmission capacity of 700 MW (EBRD 2013). The full length of the transmission line is about 283 km, with operation and maintenance by Energotrans, a subsidiary of Georgia's State Electrosystem (GSE). The BSTN has enabled Georgia to export its excess hydropower, particularly during the summer months, while also contributing to grid stability and energy security in the region (European Investment Bank 2015). Nonetheless, the internal electricity grid remains outdated, limiting the ability to incorporate large-scale intermittent renewables, such as wind and solar, despite these cross-border enhancement (IRENA 2025).

Following the BSTN's success, Georgia is positioning itself to serve as a hub for a more ambitious project in the region: the Black Sea Submarine Cable Project, which is also known, the Green Energy Corridor. This planned 1,195 km undersea HVDC cable would connect Azerbaijan, Georgia, Romania and Hungary and enable the export of renewables, mainly wind and solar, from the Caspian to the EU. The cable is expected to have a transmission potential of 1,000 MW, with an estimated cost of €2.5 billion and is currently under a feasibility study co-financed by the European Commission (European Commission 2023). As per the project plan, the cable will be laid under the Black Sea, and Georgia will become an energy bridge between Asia and Europe (European Commission 2023). The extension could diversify the EU's energy supply, while promoting Georgia's domestic market and renewable energy infrastructure.

Another important challenge is the lack of smart grid technologies and energy storage system that stabilize supply and manage peak load in a renewable-based energy mix. In addition, connection rules for renewable producers are still lacking development. Technical developments standarts have already been introduced by the Georgian National Energy and Water Supply Regulatory Commission (GNERC), but implementation has been delayed and this process faces lacks transparency (Energy Community 2023b)

At the same time, Georgia's technical and vocational education system does not provide sufficient knowledge for development of renewable energy. The unavailability of local expertise in renewable system design, maintenance, and digital architecture is an additional barrier to technology diffusion (UNDP Georgia 2021).

4.3 Economic Challenges

Georgia’s macroeconomic environment poses a serious challenge to renewable energy investment. The country’s GDP per capita is $9,090 USD by 2024 but with a low fiscal space (World Bank 2024). Governmental investment in infrastructure competes with the priority areas like healthcare, education, and regional development, leaving governments with limited capacity to co-finance renewable projects (UNDP 2022).

The energy sector of Georgia has been significantly shaped by foreign direct investment (FDI), especially through collaborations with foreign development institutions, notably the EBRD, KfW, USAID (EBRD 2021). Foreign direct investment (FDI) in the energy sector falling sharply during COVID-19 and recovering only partially in 2022 (Geostat 2023). A key factor discouraging investors is the lack of a predictable tariff structure as well as weak guarantees for project bankable in the solar and wind energy segment.

The Georgian Energy Development Fund (GEDF) is a fund created by the government to support project development in the country (GEDF 2023). However, the capacity of the fund is limited . By 2024, only a few small hydropower and solar feasibility studies were supported by the GEDF, with little advancement to the commercial scale (GEDF 2023).

The electricity pricing model is another challenge. The country has a partially liberalized market, but subsidies for certain consumer categories distort pricing signals and undermine the viability of renewable energy producers. In the absence of carbon pricing or other incentives, fossil-based electricity can often be cheaper, making it harder for renewables to compete without state support (World Bank 2022).

Ultimately, for infrastructure upgrades and policy reform Georgia relies heavily on donor assistance. While this support has enabled pilot projects and legal reforms, it also means that the renewable energy transition is vulnerable to shifts in donor priorities and international funding cycles (USAID 2023).

4.4 Summary

Georgia transition shows a mixed performance in renewable energy. On the one hand, the country has shown political commitment and harmonization with EU standards and has immense renewable energy potential, primarily in hydropower (Energy Community 2023). On the other side, the implementation of legislation remains sluggish and inconsistent (Energy Community 2023). Additionally, infrastructure is outdated and the prevailing economic conditions offer little hope for stability and scaled-up investment (World Bank 2022). These legislative, technological and economic challenges are interacting to limit Georgia's ability to move beyond pilot projects and to a large-scale transformation (Kakulia and Lezhava 2021).

Chapter 5 – Case study of Armenia

Armenia is a dynamic but constrained player in the renewable energy transition in the South Caucasus. Unlike its neighbors, Armenia has a less fossil fuel resources, what made forced to pursue energy diversification and energy security strategies very carefully (IEA 2022). Despite, Armenia is more connected politically with the Eurasian Economic Union than, the European Union, the country, has taken steady legislative and infrastructural steps toward renewable energy development (IEA 2022). At the same time, its green energy transformation continues to be impeded by systemic limitations in legal, technical and financial capacities (EBRD 2024).

5.1 Legislative and Political Challenges

Armenia is primarily motivated for transition to renewable energy, for national security reasons as 80% of gas for Armenia comes from Russia (World Bank 2023). The country updated its Energy Sector Development Strategic Program 2021–2040, which sets out specific targets for the share of renewables in electricity generation (excluding large hydropower) to 30% by 2030 (Ministry of Territorial Administration and Infrastructure 2021). This vision aligns with its revised Nationally Determined Contributions (NDCs) under the Paris Agreement.

Armenia has adopted critical legislation to facilitate this transition, which includes the Energy Law adopted in 1997 (with regular amendments), and the Law on Renewable Energy and Energy Efficiency (FAOLEX 2004). These laws set out fundamental principles associated with access to the market, licensing and tariffication. However, they need comprehensive updates to reflect more advanced practices like grid access for small producers, power purchase agreements (PPAs), and auction-based procurement mechanisms (IRENA 2019).

The Public Services Regulatory Commission (PSRC) is a key player in Armenia's regulatory regime, overseeing tariff structures, licensing, and consumer protection matters (USAID 2023).

Over the years, the PSRC has become more open in the electricity sector, but regulatory updates have not kept pace with technology (USAID 2023). One political constraint is the slow pace of legislation aligned with the EU energy acquis due to Armenia's membership of the Eurasian Economic Union and balancing between Russia and the West (Delcour and Kostanyan 2020). Given its geopolitical position, Armenia is unable to enjoy all the benefits of integration programs and infrastructure funding tools, such as EU4Energy (IEA 2023).

The Ministry of Territorial Administration and Infrastructure is charged with overall energy strategy but is severely constrained by budget limitations and delays in administrative processes. The war in 2020 for Nagorno-Karabakh led to political instability as well as temporary setbacks in energy sector reforms. However, most programs resumed in 2022 (UNDP Armenia 2022).

5.2 Technological Challenges

Most of Armenia's energy mix comes from nuclear power, natural gas and hydro. The electricity generation of the Metsamor nuclear power plant is around 30–35% of the total electricity consumption of the country (IRENA 2024). Further, 25–30% of the electricity is through hydropower depending on seasonality (IEA 2021). Though solar and wind form of renewable energy is underdeveloped. Installed solar capacity in 2023 was approximately 310 MW, while installed wind capacity is negligible (IRENA 2024; EBRD 2023).

Armenia's solar energy technical potential is estimated at 8,000 MW due to the high level of solar irradiance, from 1,700 to 2,000 kWh/m2 annually, in Vayots Dzor, Syunik and Gegharkunik (IEA 2022). The wind energy capacity of Armenia is fairly limited. The technical potential is estimated at around 500 MW and located in Qarahunj and Bazum high uplands (USAID 2010).

Armenia's energy infrastructure contains many technological barriers. The national grid of the country is quite outdated and is lacking in important grid flexibility mechanisms like smart meters and real-time balancing (IRENA 2024). It limits the use of intermittent renewable sources, especially solar energy (BM.ge 2024).

Although Armenia joined the regional Black Sea Transmission Network upgrade program**,** its cross-border electricity exchange remains limited, especially with Turkey and Azerbaijan due to political tensions (Energy Charter Secretariat 2015). According to the World Bank, Armenia's largest energy trade partner is Georgia. Armenia does import some electricity from Iran as well. Nonetheless, this exchange is not significant, and it also lacks modern synchronization (World Bank 2023).

Another limitation of the technology is the limited development of energy storage systems. Armenia may experience an imbalance in the supply of renewable energy and its demand as solar energy penetration grows (World Bank 2023). In the meantime, pilot projects have started, particularly donor-supported feasibility studies on battery storage by KfW and UNDP (World Bank 2023).

In addition, Armenia has no national policy to develop a technical workforce in renewable energy. Lack of vocational training centers and universities that train "green energy engineering specialists" limit the local experts capable of scaling up operations and maintenance of renewables (UNDP Armenia 2022).

5.3 Economic Challenges

Armenia's economic situation limits investments in renewable energy. Armenia's GDP per capita is about USD $8,500.6 as of 2024 (World Bank 2024). It is vulnerable to external shocks and has limited public capital investment. Despite having limited fiscal abundance, the

government has focused on subsidised electricity tariffs for the low-income families, which limits its space for renewable subsidies or feed-in tariff schemes (CivilNet 2023).

The foreign aid and concessional financing are significant contributors to the country's renewable energy projects. The Scaling-up Renewable Energy Program (SREP) under the Climate Investment Funds, the Green Climate Fund and bilateral donors such as the EU, KfW and USAID, have provided financial and technical support for pilot solar plants and feasibility studies (CIF 2021; KfW 2023).

Despite efforts, attracting private sector investment remains a challenge. Investor interest is curbed as they see persistent regulatory risk and lack of transparency in procurement mechanisms and long-term pricing models (IEA 2022). Despite the government implementing net metering in 2017 and gradually increasing the cap for small producers, the market remains too fragmented to drive investments on a commercial scale (IEA 2022).

In fact, the banking sector of Armenia does not offer financial products tailored to renewable energy projects. Because interest rates are high with short loan durations, it becomes unattractive for households and SMEs to finance capital-intensive renewables installations (USAID 2023). Less than 10% of investments in renewable energy came from domestic financial institutions as of 2023 (USAID 2023).

Energy poverty remains another issue challenge in Armenia. Households in Armenia spend an average of 16% of their income on energy, and rural households up to 20% (World Bank 2023a). This level of expenditure increases vulnerability to external shocks (World Bank 2023a). It also limits the affordability of small-scale renewable investments for many households (World Bank 2023a). While donor programs like EU4Energy are active in the country, including pilot solar initiatives, these efforts remain fragmented and not yet scalable (IRENA 2023).

5.4 Summary

Despite lacking fossil resources and having strong solar potential, Armenia has not been able to develop its renewable energy sources sufficiently owing to obsolete infrastructure, limited investment flows, and delayed legislative modernization (IEA 2022; World Bank 2024). The conflict occurring in the region and the balancing act between East and West make energy cooperation and access to external support even more complex (CivilNet 2023). The independent regulator (PSRC), rising interest from donors, and an ongoing commitment to policy could provide a platform for gradual change (IEA 2022).

Chapter 6. Case study of Azerbaijan

Since the independence of Azerbaijan, oil and gas resources have determined the energy strategy and economic model of the country (IEA 2023). Azerbaijan's national agenda is gradually becoming more engaging to renewable energy development as a result of international climate obligations, domestic diversification and falling global reliance on fossil fuel (IRENA 2019). Azerbaijan government wants to raise the share of renewable electricity generation to 33% by 2027 (Ministry of Energy of Azerbaijan 2021). However, the influence of the fossil fuel industry, as well as legislative, economic, and technological factors, hinders the rapid development of renewable energy (Mammadli 2024).

6.1 Legislative and Political Challenges

The Azerbaijani energy sector is heavily centralized and state dominated. Most energy is produced and supplied by the State Oil Company of the Azerbaijan Republic (SOCAR) and Azerenerji (IEA 2023). There is also strong state ownership of energy infrastructure and transmission. The fossil fuel industry has long dominated the energy sector, resulting in the neglect of alternative energy (Mammadli 2024). While there has been a clear political signal for diversification, the legislative environment for renewables remains underdeveloped (Boell Foundation 2024).

In 2021, the country passed the Law on the Use of Renewable Energy Sources in Electricity Production, which legally codified legal arrangements for renewable energy projects (Ministry of Energy of the Republic of Azerbaijan 2021). The law includes clauses on grid access, connection rights and auction-based possible support among other things in the law. The law is still vague in implementation procedures, investment security, long-term pricing guarantees which affects investor confidence (Dentons 2021).

Azerbaijan is more likely to join bilateral partnerships and regional alliances than the European Union. Although the country is part of the EU's Eastern Partnership programme, the legislative approximation with EU energy law is low (European Commission 2025). The consequences of failing to align with European energy frameworks, notably that of the Energy Community, is limited access to regional energy markets and financial instruments for green infrastructure (IEA 2022).

The Ministry of Energy oversees energy reforms at the institutional level, while the State Agency for Renewable Energy Sources, established in 2020, carries out the reforms (IEA 2020). Still, their coordination with these bodies and the state monopolies is weak (Mammadli 2024). In addition, there are limited opportunities for public scrutiny and stakeholder engagement due to the low transparency of decision-making and the limited role of civil society (OECD 2024).

However, Azerbaijan has recently taken more visible steps to signal political commitment to renewable energy. Participation in the Green Energy Corridor aligns with its aim to reposition itself as a regional energy leader. Hosting the COP29 climate summit in Baku in November 2024 further underscored this shift, as the government used the event to present itself as a credible actor in the global energy transition (World Economic Forum 2024). During the summit, Azerbaijan announced plans to raise the share of renewables in its electricity generation to 33% by 2027, supported by $2 billion in green energy investments (World Economic Forum 2024). The summit also introduced the COP29 Green Energy Pledge, which outlined the creation of regional green energy zones and corridors to boost cross-border cooperation and infrastructure (COP29 Azerbaijan 2024). However, as noted, Azerbaijan has a number of steps to take to demonstrate to the international community its commitment to

these solutions. The strong traditional energy lobby poses a significant challenge, including at the political level.

6.2 Technological Challenges

Although Azerbaijan is the Hydrocarbon-rich country, it has potential in renewable energy that remains untapped (IEA 2023). International Renewable Energy Agency (IRENA) claims the country has solar energy potential of about 23,000 MW. Energy potential of Jabrayil, Nakhchivan and Kur-Araz lowlands makes up for 1,600-2,000 kWh/m² (IRENA 2023). The technical wind potential exceeds 3,000 MW, especially along the Absheron Peninsula, Caspian Sea coastline, and the Khizi-Gobustan corridor, where average winds are 7–8 m/s (IEA 2023).

The government has started a number of pilot projects with international actors. Azerbaijan signed implementation agreements in 2021 with Masdar (UAE) for a 230 MW solar project and ACWA Power (Saudi Arabia) for a 240 MW wind project (Ministry of Energy of Azerbaijan 2022). These projects are the first major attempts to use the country's renewable resources.

Azerbaijan’s grid infrastructure is aging and centralized, primarily set up for distribution of fossil-based power. Integration of variable renewable energy sources faces hurdles (IEA 2022). The country has insufficient smart grid systems as well as grid-scale battery storage and demand-side management technologies to handle the intermittency of wind and solar (IEA 2022).

Around 8% of total generation cost is due to transmission losses which hamper the economic feasibility of renewables located at far-away locations and remote regions (World Bank 2022). In addition, unlike Georgia or Armenia, there are no full-fledged cross-border interconnectors

between Azerbaijan, Turkey and the EU, which also hinders its capacity to export green electricity to regional markets (IEA 2022).

There are also deficiencies in technical education and training. Azerbaijani universities or technical colleges do not have specialized programs training for renewable energy system design, engineering or maintenance (UNDP 2023). As a result, key decisions on large-scale projects are made by foreign contractors and technical staff. This results in higher costs and limits the building up of domestic capacity (UNDP 2023).

6.3 Economic Challenges

Azerbaijan's economy is structurally dependent on fossil fuels, oil and gas contributing to almost 90% of export revenues and more than 50% of government income (IEA 2023). While it provides financial stability, it reduces urgency to diversify the energy mix. The low price of fossil energy is a disincentive to market-based renewable development – especially in the absence of a carbon price or green tax (World Bank 2025).

Azerbaijan aims to turn Karabakh into a Green Energy Zon which aims to reconstruct all the infrastructures around renewable energy principles (Ministry of Energy of Azerbaijan 2022). By the year 2030, the region is expected to see the installation of wind and solar projects which shall total over 1,000 MW (Ministry of Energy of Azerbaijan 2022). However, significant economic and political risks stemming from post-conflict reconstruction, land demining, and infrastructure financing limit the implementation progress which is slow (WSJ 2024).

It remains challenging to attract private investment into the renewable energy sector. The government has signed many agreements with foreign companies, but the overall investment climate is hampered by the lack of judicial independence, transparency in procurement but

predictable regulatory enforcement (OECD 2024). International financial institutions often point to these difficulties as major obstacles to boosting investment.

The national tariff system also poses a challenge. Electricity prices are state-regulated and do not reflect actual full market costs (World Bank 2023). The ability of renewable energy producers to recover investment is hampered by state subsidized prices to households and state-owned enterprises without guaranteed off-take and/or premium tariffs (World Bank 2024).

Moreover, local banks do not have customized financial products for renewable energy yet. There are few project finance options, but interest rates are generally high and loans are rarely available for longer maturities (EBRD 2025). Donor financing from international agencies, such as the World Bank and ADB, plays a critical function, though local co-financing mechanisms remain underdeveloped (UNDP Azerbaijan 2023).

6.4 Summary

The renewable energy sector in Azerbaijan is at an early transition stage (IEA 2023). Although there is growing political interest in diversification and large scale pilots are being put in place, the inertia of fossil fuels, underdeveloped legal frameworks and outdated infrastructure continue to hold back progress (OECD 2024). The energy governance in the country is state-centric, and legislative alignment with European standards is very limited (European Commission 2025). Moreover, these two phenomena limit the scope for international engagement and market integration (IEA 2022). However, the Green Energy Zone and collaboration with Gulf investors are the potential developments that can give a new strategy (WSJ 2024). Unlike Georgia and Armenia which have taken steps towards regulatory alignment and external integration, Azerbaijan's pathway is characterized by economic inertia and state control (World Bank 2023).

Chapter 7. Cross-Country Comparison of Renewable Energy Challenges in the South Caucasus

Despite being neighbours and sharing a common Soviet history, the South Caucasus nations have adopted sharply divergent paths of renewable energy transition (Keogh, Bayramov, and German 2021). To understand this divergence, it is not enough to look at each country individually. An appropriate comparative approach demonstrates the existence of a broad set of structural constraints that exists in the region, as well as the existence of deeper variation given political alignments, institutional choices, and state capacity (Austrian National Defence Academy 2016; Markard, Raven, and Truffer 2012). At the legislation level, every country formally recognizes the importance of renewable energy, but this acknowledgment becomes operationalized in a fundamentally different way (IRENA 2020; World Bank 2023).

The legal frameworks of all three nations refer to renewable energy, but their actual functionality is uneven in practice (Energy Community 2022). Georgia is taking the most overt steps to legally converge with European norms. The Association Agreement with the EU in 2014 and membership of the Energy Community has driven very significant reforms, especially the Law on Energy and Water Supply (Energy Community 2023; European Union and Georgia 2014). But here, as in the other two states, formal alignment should not be mistaken for institutional capacity. The existence of a legislation does not lead to good governance (Delcour and Wolczuk 2015). Georgia's legislation sound promising on paper but it is undermined by an absence of coherence and fragmentation (Energy Community 2023). Armenia and Azerbaijan, both countries—are behind when compared to any expectations, not just in legislative modernization but also in credibly and consistently implementing the legislation (IRENA 2022). Although Armenia has modified strategic plans and passed enabling legislation, it is still without modern provisions, such auction-based procurement and competitive PPAs (World Bank 2023). Azerbaijan only rolled out its Renewable Energy Law

in 2021. This is vague, unfriendly to investors, and offers scarce pricing guarantees and legal protection (World Bank 2022).

The country's differentials cannot be reduced to a scale of "more democratic" or "more pro-European." They respond to different national logics (Toal 2017). Georgia aligns with the EU, not only to pursue preference, but to survive. It uses the EU framework to derive legitimacy and investment, amongst other things (World Bank 2023; Kakulia and Lezhava 2021). Armenia's legislative ambiguity stems from its geopolitical balancing act as it is committed to Russia through CSTO and EAEU while also practically engaging with the EU via CEPA (Giragosian 2020; Delcour 2015). Azerbaijan's weakness is more deliberate; its fossil-fuel wealth reduces the urgency of reform, and a strong executive has no incentive to open decision-making processes to scrutiny (Guliyev 2020; Freedom House 2024). These aren't merely administrative conditions, they are political realities that determine what kind of legal systems are conceivable (Bayramov 2024).

Technological capacity follows a similar pattern. While the three countries face issues with Soviet centralized infrastructure, they all vary in respect to adapting or investing in modernization (Keogh, Bayramov, and German 2021). Overall, the region has an abundance of renewable potential – Georgia for hydro, Armenia for solar, Azerbaijan for wind and solar – but serious limitations on the capacity to convert potential into reality (IRENA 2024). Regionally, instability on the grid, poor storage capacity and a lack of real-time balancing mechanism are common (World Bank 2023). Yet here again, differences emerge. Georgia has been making progress in cross-border integration, namely with Turkey. Also, the country has secured donor support for grid modernization (Ministry of Economy and Sustainable Development of Georgia 2023). Armenia has the highest solar irradiance levels in the region, but its geographic isolation and weak grid infrastructure nuances its supply (Ministry of Environment of the Republic of Armenia 2022). Azerbaijan is rich in technical potential. Its

grid, however, is designed to accommodate fossil-based generation. As a result, demand-side management and energy storage isn't sufficient (IEA 2022**).**

What is interesting — and what is made clear by this comparison — the technology gap is not just a money issue. Armenia has no fiscal space, Azerbaijan has it in abundance. Fiscal capacity alone could not drive infrastructure change. What matters more is how far a particular government institutionalizes renewable energy not as a donor-driven checkbox or a PR tool, but as a long-term national strategy (World Bank 2023). In Georgia, the growing narrative around renewable energy is not just environmental, but also geopolitical (Kakulia and Lezhava 2021). In Armenia, there's a vision — but it's patchy, and imposed (UNDP Armenia 2022). In Azerbaijan, the narrative has just started to take shape, and it often coexists uneasily with a state identity built around hydrocarbon dominance (COP29 Azerbaijan 2024**;** Guliyev 2020).

The relationship between what's written in laws regarding technologies and what the government is allowed or able or wants to build is at the core of why transition remains so elusive in the South Caucasus. It also begins to show why niche innovations, central to the Transition Theory, have not scaled up meaningfully (Geels 2002). Legislative uncertainty delays investment. Grid fragility discourages integration. Without each other, neither technical innovation nor legal clarity can succeed. It does not involve fixing isolated problems but recognizing how they interact with each other systemically and differently in each country.

In the South Caucasus, the role of economic conditions in the energy transition takes one of the center stage (World Bank 2023). Instead of acting as simple barriers, these conditions are active players that shape the kind of energy future that is possible—or thinkable (Mustafayev, Kulawczuk, and Orobello 2022). Utilizing this lens to compare Georgia, Armenia and Azerbaijan reveals differences that are more than just income or investment, but rather how economic logics interact with governance and infrastructure priorities (IRENA 2020). These

interactions, are not accidental but structurally embedded, and they explain why some countries stall at the pilot stage while others do not even start (Keogh, Bayramov, and German 2021).

Georgia has shown strong political will and legal reform but his fiscal capacity is insufficient to scale renewables, without external support (World Bank 2022). Armenia's economic fragility and energy poverty mean its development is completely dependent on donor assistance because it has no financial system able to fund any long-term sustainable investments (UNDP Armenia 2022). Azerbaijan has resources but not enough incentive and real actions to switch: its fossil-fuel wealth allows an energy model resistant to diversification (COP29 Azerbaijan 2024**;** Guliyev 2020). Azerbaijan is stagnant because of its abundance of resources and the insulation of its regime. In contrast, Georgia and Armenia are struggling in scarcity and instability.

This comparative economic picture reinforces a critical insight: financial constraints are not only about how much money a country has, but about how it chooses to use and structure that money. The liberal framework of Georgia has given way for reform efforts (Kakulia and Lezhava 2021). However, it does not possess enough depth or stability to consolidate these reforms. Armenia faces a cycle of dependency on donors (World Bank 2023). Reforms that take place in Armenia are fragile and conditional (EBRD 2024). Azerbaijan can lead, but the political economy of hydrocarbons limits effective diversification (Mustafayev, Kulawczuk, and Orobello 2022). What these countries share is not identical conditions, but an underlying vulnerability: none has a fully functioning economic ecosystem that is adapted to the long-term needs of renewable energy (IRENA 2024). The energy transition remains marginal and not mainstream as this vulnerability, whether due to scarcity, fragmentation or over-centralization.

This lens of Transition Theory makes this dynamic particularly revealing. Through geopolitics, donor expectations, climate urgency – the pressures on landscapes in Georgia and Armenia are

visible, indeed intense (IEA 2023; UNDP 2022). But the regimes are only partially open to transformation. Institutions are too weak or fragmented to absorb these forces and channel them into fundamental change (Keogh, Bayramov, and German 2021). Small, solar projects and donor funded feasibility studies a are examples of niche innovation (IRENA 2024). These innovations exist but they are not integrated or scaled as the broader regime is not favourable for this (IEA 2023; IRENA 2025). The pressure produced by landscape in Azerbaijan is weaker and more abstract while regime is more entrenched (Toal 2017). Here, fossil wealth acts as a buffer against change and not just a resource. This confirms what Transition Theory predicts: without regime destabilization or strategic alignment, even strong niche innovations or external pressures will fail to reshape the system (Geels 2002; Markard 2018).

Crucially, these findings confirm the central proposition of Transition Theory: that sustainability transitions are non-linear, politically contested, and highly sensitive to regime-level dynamics (Geels 2011). The Multi-Level Perspective provides an effective framework for interpreting why countries with favourable geographical conditions or climatic conditions struggle to make energy transitions (UNDP 2022; IRENA 2020). Centralised governance in Azerbaijan, fragmented institutional mandates in Georgia, and fiscal dependency in Armenia underlie the deeply entrenched socio-technical regimes in the South Caucasus (World Bank 2023). Political and social logs are the reason why resistance to change happens in these regimes rather then technical or economic logics (IRENA 2020; Rip and Kemp 1998).

At the same time, the landscape pressures identified by Transition Theory are undeniably present. Each country's energy policy space is influenced by climate change imperatives in addition to donor expectations, shifts in EU energy policies and even regional instability (European Commission 2022; UNDP 2023). Nonetheless, these pressures alone are not enough to destabilise entrenched regimes, unless there is an internal momentum and institutional

capacity to harness them. The South Caucasus countries are falling short in this aspect (World Bank 2023). Niche innovations are being created, such as Armenia's rooftop solar pilots, Georgia's small wind farms, or Azerbaijan's bilateral solar deals, and are growing, but they peripheral (IRENA 2024; IEA 2022). Alignment between niches, regime openness, and landscape pressure is rare and fragile (IRENA 2025).

What also becomes apparent in the comparison is that divergence in renewable energy performance is not simply a matter of "political will" or "technical capacity". It also reflects broader historical trajectories and geopolitical choices (Toal 2017). Georgia has made limited progress due to its consistent orientation towards the west and willingness to adopt EU-specific regulatory frameworks (European Union and Georgia 2014). The market, donor partners and liberalized legal framework have provided a more fertile ground for reforms, even as practical implementation still lags behind (World Bank 2022). Armenia's mixed path reflects its balancing act between Russia and the EU, causing legislative dualism, donor dependence, and delayed modernization (Delcour 2015). On the other hand, Azerbaijan have fossil wealth, which suggests that the country operates in a structurally different paradigm (Mustafayev, Kulawczuk, and Orobello 2022). The existence of a rentier model in Azerbaijan is not only a matter of economy. It is a regime feature which shapes the energy priorities and governance architecture of the regime (Guliyev 2020).

Thus, while the hypothesis—that renewable energy development is hindered by a combination of legislative, technological, and economic challenges—is strongly supported, it must be further refined. The barriers are not only cumulative but also mutually reinforcing (UNDP 2022). Weak legislation undermines economic incentives; poor infrastructure complicates legal implementation; and economic constraints prevent the upgrading of infrastructure (World Bank 2023). These feedback loops trap each country in a different form of energy transition

stagnation (IRENA 2024). The comparison therefore reveals a typology of obstacles rather than a simple spectrum of progress: Georgia illustrates a case of partial alignment constrained by capacity; Armenia exemplifies a donor-driven transition hampered by fiscal and geopolitical limits; and Azerbaijan demonstrates how resource wealth can delay diversification and reinforce regime inertia.

This comparison exercise highlights the importance of sequencing, coherence and political alignment in the energy transition process. According to Transition Theory, radical change needs more than a technical or isolated innovation (Geels 2011). It requires a transformation in the rules, roles, and routines of the dominant regime. Such transformation in the South Caucasus is possible, but it depends on the convergence of external incentives and internal reform. For Georgia, this could entail increased integration with the EU and greater access to its markets (World Bank 2023). In the case of Armenia, strategic planning that connects donor assistance to capacity development will be required. Azerbaijan has to do a political rethink of its hydrocarbon-based economic model. This is admittedly an ambitious but ultimately necessary prospect.

In conclusion, the comparative analysis of the South Caucasus reveals that while all three countries face serious challenges for renewable energy development, these challenges stem from deeper structural factors rather than mere policy deficiencies (IEA 2023). The hypothesis has been affirmed. Legislative, technological and economic barriers are real and interactive, shaped by institutional trajectory and geopolitical strategy.

Chapter 8. Conclusion

This thesis set out to examine the legislative, technological, and economic barriers to renewable energy development in the South Caucasus, focusing on the comparative cases of Georgia, Armenia, and Azerbaijan. The research was guided by the question: What are the legislative, technological, and economic challenges facing the development of renewable energy in the South Caucasus region? The study seeks to uncover how legislative, technological, and economic challenges shape energy transition outcomes in the South Caucasus by analyzing official policy documents, infrastructure data, and donor reports (World Bank 2023).

The findings strongly support the hypothesis that the development of renewable energy in the region is not hindered by a single factor, but rather by the interplay of legislative fragmentation, outdated technological infrastructure, and economic constraints (IRENA 2020). Georgia's laws are aligned with European Union requirements, but institutional fragmentation and weak financial capacity hinder the country (Energy Community 2023; World Bank 2024). Armenia is committed through strategic planning and donor collaboration, but is not able to leverage its internal resources and institutional stability to go beyond pilot projects (USAID 2023; World Bank 2023). Azerbaijan, on the other hand, can afford to spend heavily on renewable energy. However, its rentier economy and centralized system reduces the incentive to leave hydrocarbons (IMF 2023; Guliyev 2020).

These patterns align closely with the expectations of Transition Theory and the Multi-Level Perspective (MLP) framework (Geels 2002). In each country, the socio-technical regime (legal framework, pricing structures, utility governance, etc.) continues to dominate and resist change. Despite the visible landscape pressures from climate change, international donor influence and EU policy ambitions, these regimes have not yet been destabilized enough to enable scaling of niche innovations (IRENA 2024). There is some evidence of regime adaptation in Georgia and Armenia, primarily due to external funding or geopolitical

orientation, however, it is partial (UNDP 2022). In Azerbaijan, the regime is highly stable thanks to fossil fuel income. The policy logic currently followed is to maintain state control, not long-term diversification (Markard 2018; Geels 2002).

The practical relevance of this research is twofold. Essentially, the research shows that policy solutions must be designed according to regime-specific constraints. In Georgia, boosting regulatory clarity and investor protections would help mobilize more private sector involvement. Specific capacity-building on finance and vocational education will benefit Armenia. Azerbaijan's current governance model strengthens fossil fuel socio-economic dominance and meaningful progress will likely necessitate reforms to this model. Further, the analysis offers insights for international organizations like the EU, UNDP and USAID whose funding choices and policy conversations are key determinants of the energy landscape.

Future research could build on this thesis by incorporating fieldwork, stakeholder interviews, or quantitative modeling to assess investment risk and public support for renewable energy. While the findings here are based on secondary data, they reveal clear patterns that merit further investigation.

In the end, the energy future of the South Caucasus will depend not only on solar radiation or wind speeds but also on political will, institutional reform, and economic transformation. Countries can move from energy stagnation to energy transition only through addressing persistent structural issues.

Bibliography

Ang, Tze-Zhang, Mohamed Salem, Mohamad Kamarol, Himadry Shekhar Das, Mohammad Alhuyi Nazari, and Natarajan Prabaharan. 2022. "A Comprehensive Study of Renewable Energy Sources: Classifications, Challenges and Suggestions." *Energy Strategy Reviews* 43: 100940. https://doi.org/10.1016/j.esr.2022.100940

Austrian National Defence Academy. 2016. *The South Caucasus: Leveraging Political Change in a Context of Strategic Volatility*. Vienna: National Defence Academy, Institute for Peace Support and Conflict Management. https://www.bmlv.gv.at/pdf_pool/publikationen/19_2016_sgi_13_rssc_web.pdf

Bayramov, Agha. 2024. "The EU–Caspian Green Energy Corridor: A New Era of Energy Cooperation." *Caucasus Watch*, January 12, 2024. https://caucasuswatch.de/news/green-energy-corridor-eu-caspian.html

Bayramov, Agha. 2024. "The Green Energy Corridor between the EU and the Caspian Sea: Potential and Challenges." *Caucasus Strategic Perspectives* 5 (1): 81–96. https://cspjournal.az/uploads/files/CSP%20Summer%202024/7%20Agha%20Bayramov.pdf

BM.ge. 2024. "Armenia's Power Grid: 60% of Infrastructure Requires Modernization." https://bm.ge/en/news/armenias-power-grid-60-of-infrastructure-requires-modernization

Boell Foundation. 2024. "Azerbaijan Greenwashes Authoritarianism at COP29." *Heinrich Böll Stiftung*. https://www.boell.de/en/2024/11/20/azerbaijan-greenwashes-authoritarianism-cop29

Bowen, Glenn A. 2009. "Document Analysis as a Qualitative Research Method." *Qualitative Research Journal* 9(2): 27–40. https://doi.org/10.3316/QRJ0902027

CAREC Program. 2023. *Overview of Energy Policy and Investment Opportunities in Georgia*. https://energy.carecprogram.org/wp-content/uploads/2023/11/Overview-of-Energy-Policy-and-Investment-Opportunities-in-Georgia.pdf

CivilNet. 2023. "Armenia's Energy Dependence: A Complex Web of Challenges." *CivilNet*. https://www.civilnet.am/en/news/804409/a-roadmap-for-armenias-energy-dependencies-and-challenges/

CIF (Climate Investment Funds). 2021. "Energy Access in Armenia: Incentivizing the Move to Clean Power Among SMEs." https://www.cif.org/news/energy-access-armenia-incentivizing-move-clean-power-among-smes

Cornell, Svante E. 2017. *Azerbaijan Since Independence*. London: Routledge.

Cornell, Svante E., and Fariz Ismailzade. 2005. "The Baku-Tbilisi-Ceyhan Pipeline: Implications for Azerbaijan." *Insight Turkey* 7(1): 87–97.

COP29 Azerbaijan. 2024. "COP29 Green Energy Pledge: Green Energy Zones and Corridors." https://cop29.az/en/pages/cop29-green-energy-pledge-green-energy-zones-and-corridors

Delcour, Laure. 2015. *The EU and Armenia: Between Conditionality and Engagement*. London: Routledge.

Delcour, Laure, and Hrant Kostanyan. 2014. "Towards a Fragmented Neighbourhood: Policies of the EU and Russia and Their Consequences for the Area That Lies in Between." *CEPS Essay* No. 17. https://aei.pitt.edu/56061/

Delcour, Laure, and Kataryna Wolczuk. 2015. *The EU's Policy towards the Eastern Neighbours: The Role of Association Agreements*. London: Routledge.

Dentons. 2021. "On the New Law on the Use of Renewable Energy Sources in the Production of Electricity." https://www.dentons.com/en/insights/alerts/2021/july/23/on-the-new-law-on-the-use-of-renewable-energy-sources-in-the-production-of-electricity

Dzebisashvili, Shalva. 2024. "National Security Planning and Energy Sector – Systemic Challenges." *Georgian Institute of Politics*. https://gip.ge/publication-post/national-security-planning-and-energy-sector-systemic-challenges/

EBRD (European Bank for Reconstruction and Development). 2013. "EBRD Finances the Modernisation of Energy Infrastructure in Georgia." https://www.ebrd.com/news/2013/ebrd-finances-the-modernisation-of-energy-infrastructure-in-georgia.html

EBRD. 2016. *Strategy for Georgia*. https://www.ebrd.com/georgia-strategy.pdf

EBRD. 2021. *Georgia Country Strategy 2021–2026*. https://www.ebrd.com/content/dam/ebrd_dxp/assets/pdfs/country-strategies/georgia/EBRD-Latest-Georgia-Strategy-English.pdf

EBRD. 2023. *Transition Report 2023–24: Country Assessments*. https://www.ebrd.com/publications/transition-report-202324-eastern-europe-and-the-caucasus

EBRD. 2024. *Armenia Country Strategy 2025–2030*. https://www.ebrd.com/content/dam/ebrd_dxp/assets/pdfs/country-strategies/armenia/country-strategy-armenia-2025-30.pdf

European Bank for Reconstruction and Development (EBRD). 2025. *Azerbaijan Country Strategy 2025–2030*. London: EBRD. https://www.ebrd.com/azerbaijan-strategy-2025-2030.pdf

European Parliament. 2025. "Further Deterioration of the Political Situation in Georgia." Resolution, March 13, 2025. https://www.europarl.europa.eu/doceo/document/TA-10-2025-0019_EN.html

Eurostat. "Russian Energy Imports Fell by €6.1 Billion." *Eurostat News*, November 22, 2022. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20221122-3.

Energy Charter Secretariat. 2015. *Electricity in the South Caucasus: The Role of Georgia*. Brussels: Energy Charter Secretariat. https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/Electricity_in_South_Caucasus.pdf

Energy Community. 2022. *Annual Implementation Report 2022*. https://www.energy-community.org/dam/jcr%3A3706068e-9a3d-47d5-ae22-f7af0bbd1097/EnC_IR2022.pdf

Energy Community. 2023. "Status Quo of DSO New Roles Implementation and Regulations in Georgia." https://www.energy-community.org/dam/jcr:018ec306-54a5-4d91-bab7-1e1f35eabd72/EU4Energy_Georgia.pdf

European Commission. 2019. "The European Green Deal." COM(2019) 640 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52019DC0640

European Commission. 2022. "REPowerEU Plan." COM(2022) 230 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0230

European Commission. 2023. "EU Strategic Approach Black Sea Strategy." https://enlargement.ec.europa.eu/document/download/170d9b3a-d45f-4169-80fa-9adb753c0921_en?filename=EU+Strategic+Approach+Black+Sea+Strategy.pdf

European Commission. 2025. "Azerbaijan." *European Neighbourhood Policy and Enlargement Negotiations.* https://enlargement.ec.europa.eu/european-neighbourhood-policy/countries-region/azerbaijan_en

European Union and Georgia. 2014. *Association Agreement between the European Union and Georgia*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A22014A0830%2801%29

FAOLEX. 2004. "Law on Energy Saving and Renewable Energy." *Food and Agriculture Organization of the United Nations.* https://www.fao.org/faolex/results/details/en/c/LEX-FAOC075645/

FAOLEX. 2019. "Law of Georgia on Energy and Water Supply (No. 5646-RS of 2019)." *Food and Agriculture Organization of the United Nations.* https://www.fao.org/faolex/results/details/en/c/LEX-FAOC193147/

Freedom House. 2024a. "Freedom in the World 2024: Armenia." https://freedomhouse.org/country/armenia/freedom-world/2024

Freedom House. 2024b. "Freedom in the World 2024: Georgia." https://freedomhouse.org/country/georgia/freedom-world/2024

Freedom House. 2024c. "Freedom in the World 2024: Azerbaijan." https://freedomhouse.org/country/azerbaijan/freedom-world/2024

Geels, Frank W. 2002. "Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case Study." *Research Policy* 31(8–9): 1257–1274. https://doi.org/10.1016/S0048-7333(02)00062-8

Geels, Frank W. 2011. "The Multi-Level Perspective on Sustainability Transitions: Responses to Seven Criticisms." *Environmental Innovation and Societal Transitions* 1(1): 24–40. https://doi.org/10.1016/j.eist.2011.02.002

Geostat. 2023. "Foreign Direct Investments." *National Statistics Office of Georgia.* https://www.geostat.ge/en/modules/categories/191/foreign-direct-investments

Geostat. 2023. "Indicator of Poverty and Gini Coefficients – 2023." *National Statistics Office of Georgia.* https://www.geostat.ge/media/62702/Indicator-of-Poverty-and-Gini-Coefficients---2023.pdf

GEDF (Georgian Energy Development Fund). 2023. "Partnership Agreement on the Development of the Wind Power Plant with 45 MW Installed Capacity." GEDF. https://gedf.ge/en/n/news/sapartnioro_shetankhmeba_45_megavati_dadgmuli_simdzlavris_karis_elektrosadguris_ganvitarebis_shesakheb

Gochitashvili, Lasha, and George Archvadze. 2016. "Energy Policy of Georgia: Challenges and Perspectives." *International Journal of Energy Economics and Policy* 6(4): 763–772.

Government of Georgia. 2021. *Georgia's 2030 Climate Change Strategy (Mitigation).* https://faolex.fao.org/docs/pdf/geo209870.pdf

Gugushvili, Alexi, et al. 2021. "Renewable Energy Potential in the South Caucasus: Opportunities and Challenges." *Energy Policy* 149: 112–119.

Guliyev, Farid. 2005. "Post-Soviet Azerbaijan: Transition to Sultanistic Semiauthoritarianism? An Attempt at Conceptualization." *Demokratizatsiya* 13(3): 393–436. https://www.researchgate.net/publication/228159868_Post-Soviet_Azerbaijan_Transition_to_Sultanistic_Semiauthoritarianism_An_Attempt_at_Conceptualization

Guliyev, Farid. 2020. "Formal-Informal Relations in Azerbaijan." *Caucasus Analytical Digest* No. 114: 7–10. https://www.ssoar.info/ssoar/bitstream/document/87257/1/ssoar-caucasusad-2020-114-guliyev-Formal-Informal_Relations_in_Azerbaijan.pdf

IAEA (International Atomic Energy Agency). 2021. "Armenia – Country Nuclear Power Profiles." https://cnpp.iaea.org/public/country-profiles/Armenia/Armenia.htm

IEA (International Energy Agency). 2003. *Energy Policies of IEA Countries: Armenia 2003 Review.* Paris: IEA.

IEA. 2020. *Energy Policy Review: Georgia.* Paris: International Energy Agency. https://www.iea.org/reports/georgia-2020

IEA. 2022. "Armenia Energy Profile." *International Energy Agency.* https://www.iea.org/reports/armenia-energy-profile

IEA. 2023. "Azerbaijan Energy Profile." *International Energy Agency.* https://www.iea.org/reports/azerbaijan-energy-profile

IEA. 2023. "EU4Energy Programme." *International Energy Agency.* https://www.iea.org/programmes/eu4energy

IEA. 2023. *Georgia Energy Profile. International Energy Agency.* https://www.iea.org/reports/georgia-energy-profile

IEA. 2022. *Energy Efficiency Policy in Azerbaijan: A Roadmap.* Paris: *IEA.* https://www.iea.org/reports/energy-efficiency-policy-in-azerbaijan-a-roadmap

IMF (International Monetary Fund). 2022. "Azerbaijan: Staff Concluding Statement of the 2022 Article IV Mission." https://www.imf.org/en/News/Articles/2022/07/06/azerbaijan-staff-concluding-statement-of-the-2022-article-iv-mission

IMF. 2024. *Republic of Azerbaijan: 2023 Article IV Consultation – Press Release; and Staff Report.* https://www.imf.org/en/Publications/CR/Issues/2024/02/07/Republic-of-Azerbaijan-2023-Article-IV-Consultation-Press-Release-and-Staff-Report-544481

International Renewable Energy Agency (IRENA). 2019. *Renewables Readiness Assessment: Republic of Azerbaijan.* Abu Dhabi: *IRENA.* https://www.irena.org/Publications/2019/Dec/RRA-Republic-of-Azerbaijan

IRENA. 2019. *Renewable Energy Auctions: Status and Trends Beyond Price.* Abu Dhabi: *International Renewable Energy Agency.* https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Dec/IRENA_RE-Auctions_Status-and-trends_2019.pdf

IRENA. 2020. *Global Renewables Outlook: Energy Transformation 2050.* Abu Dhabi: *IRENA.* https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020

IRENA. 2024. *Renewables 2024: Global Status Report.* Abu Dhabi: *IRENA.*

IRENA. 2024. *Renewable Capacity Statistics 2024.* Abu Dhabi: *International Renewable Energy Agency.* https://www.irena.org/publications/2024/Mar/Renewable-Capacity-Statistics-2024

IRENA. 2025. *Energy Transition Assessment: Georgia.* Abu Dhabi: *IRENA.* https://www.irena.org/Publications/2025/Apr/Energy-transition-assessment-Georgia

IRENA. 2025a. *Investment Opportunities for Utility-Scale Solar and Wind Areas in Georgia.* Abu Dhabi: *IRENA.* https://www.irena.org/Publications/2025/May/Investment-opportunities-for-utility-scale-solar-and-wind-areas-Georgia-zoning-assessment

IRENA. 2025. *Green Hydrogen for Industrial Decarbonisation: Central Asia and the South Caucasus.* Abu Dhabi: *IRENA.*

Kakulia, Irakli, and David Lezhava. 2021. "Investment Climate in Georgia's Energy Sector: Challenges and Opportunities." *Journal of Energy Policy* 156: 112–119.

Keogh, Mary, Agha Bayramov, and Tracey German. 2021. “Renewable Energy in the South Caucasus: Trends and Prospects.” *Caucasus Analytical Digest* 120: 1–16. https://www.research-collection.ethz.ch/handle/20.500.11850/476772

KfW Development Bank. 2024. "Saving Costs and Resources: Renewable Energy in Armenia." *KfW Development Bank.* https://www.kfw-entwicklungsbank.de/Partner-countries/Europe/Project-information-Armenia-Renewable-energy/

Köhler, Jonathan, Frank W. Geels, Florian Kern, Jochen Markard, and Bernhard Truffer. 2019. "An Agenda for Sustainability Transitions Research: State of the Art and Future Directions." *Environmental Innovation and Societal Transitions* 31: 1–32. https://doi.org/10.1016/j.eist.2019.01.004

Markard, Jochen. 2018. "The Next Phase of the Energy Transition and Its Implications for Research and Policy." *Nature Energy* 3(8): 628–633. https://doi.org/10.1038/s41560-018-0171-7

Markard, Jochen, Rob Raven, and Bernhard Truffer. 2012. “Sustainability Transitions: An Emerging Field of Research and Its Prospects.” *Research Policy* 41(6): 955–967. https://doi.org/10.1016/j.respol.2012.02.013

Mammadli, Sabuhi. 2024. “Primary Impediments to Investing in Azerbaijan’s Renewable Energy Projects.” *Regional and Business Studies* 16(2): 57–69. https://doi.org/10.33568/rbs.5922

Ministry of Energy of Azerbaijan. 2024. “Energy Minister Spoke about Azerbaijan's Energy Transition Policy.” https://minenergy.gov.az/en/xeberler-arxivi/00292

Ministry of Energy of the Republic of Azerbaijan. 2022. "The Use of Renewable Energy Resources in Azerbaijan." https://minenergy.gov.az/en/alternativ-ve-berpa-olunan-enerji/azerbaycanda-berpa-olunan-enerji-menbelerinden-istifade

Ministry of Territorial Administration and Infrastructure. 2021. *Energy Sector Development Strategic Program to 2040.* Government of the Republic of Armenia. https://policy.asiapacificenergy.org/sites/default/files/Energy%20Sector%20Development%20Strategic%20Program%20to%202040%20.pdf

Opitz, Petra, Artem Kharazyan, Astghine Pasoyan, Muslum Gurbanov, and Murman Margvelashvili. 2015. *Sustainable Energy Pathways in the South Caucasus: Opportunities for Development and Political Choices.* Tbilisi: South Caucasus Regional Office of the Heinrich Boell Foundation.

Organisation for Economic Co-operation and Development (OECD). 2023. "Governing through Transparency: Corruption, Accountability and the Extractive Industries." https://one.oecd.org/document/DCD%282023%2927/en/pdf

Organisation for Economic Co-operation and Development (OECD). 2024. "OECD Review of the Corporate Governance of Azerbaijan Investment Holding and Its State-Owned Enterprises." https://www.oecd.org/en/publications/oecd-review-of-the-corporate-

governance-of-azerbaijan-investment-holding-and-its-state-owned-enterprises_6764976e-en.html

Osička, Jan, and Filip Černoch. 2022. "European Energy Politics After Ukraine: The Road Ahead." *Energy Research & Social Science* 91: 102757. https://doi.org/10.1016/j.erss.2022.102757

PSRC (Public Services Regulatory Commission of the Republic of Armenia). 2022. *Annual Report 2022.* https://www.psrc.am/en/annual-reports

Rip, Arie, and René Kemp. 1998. "Technological Change." In *Human Choice and Climate Change*, edited by Steve Rayner and Elizabeth L. Malone, Vol. 2, 327–399. Columbus, OH: Battelle Press.

Smith, Adrian, Andy Stirling, and Frans Berkhout. 2005. "The Governance of Sustainable Socio-Technical Transitions." *Research Policy* 34(10): 1491–1510. https://doi.org/10.1016/j.respol.2005.07.005

Sovacool, Benjamin K. 2016. "How Long Will It Take? Conceptualizing the Temporal Dynamics of Energy Transitions." *Energy Research & Social Science* 13: 202–215. https://doi.org/10.1016/j.erss.2015.12.020

Toal, Gerard. 2017. *Near Abroad: Putin, the West and the Contest over Ukraine and the Caucasus.* New York: Oxford University Press.

UNDP Armenia. 2022. *Climate, Environment and Resilience.* https://www.undp.org/armenia/our-focus/climate-environment-and-resilience

UNDP Armenia. 2022. "Ready for Future Today." *United Nations Development Programme Armenia.* https://www.undp.org/armenia/news/ready-future-today

UNDP Georgia. 2021. "Creating Better Life-Long Learning Opportunities through Local Vocational Education and Training." *United Nations Development Programme.* https://www.undp.org/georgia/projects/life-long-learning

UNDP. 2022. *Final NDC Financing Strategy and Investment Plan.* United Nations Development Programme. https://www.undp.org/sites/g/files/zskgke326/files/2022-12/undp-georgia-eu4climate-ndc-financing%20strategy%202022-eng.pdf

UNDP Azerbaijan. 2023. *Highlight Report 2023.* https://www.undp.org/azerbaijan/publications/highlight-report-2023

USAID (United States Agency for International Development). 2010. *Wind Energy in Armenia: Overview of Potential and Development Perspectives.* https://advisory.am/pdf/8_USAID_Wind-Potential-Report_Eng.pdf

USAID. 2021. *Securing Georgia's Energy Future Program.* https://gnerc.org/en/international-projects/projects/completed/amerikis-sheertebuli-shtatebis-saertashoriso-ganvitarebis-saagentos-usaid-energetikis-programa-uep-2018-2021/261

USAID. 2023. "Creating an Open and Secure Electricity Market in Armenia." *United States Agency for International Development.* https://www.tetratech.com/projects/creating-an-open-and-secure-electricity-market-in-armenia/

USAID. 2023. "Energy Security in Georgia." https://pdf.usaid.gov/pdf_docs/PA00X4NZ.pdf

Wall Street Journal (WSJ). 2024. "At COP29, the Host Boasted About Its Renewable-Energy Plans. They Just Happen to Be on Disputed Territory." https://www.wsj.com/articles/at-cop29-the-host-boasted-about-its-renewable-energy-plans-they-just-happen-to-be-on-disputed-territory-62928d38WSJ

World Bank. 2022. "Electric Power Transmission and Distribution Losses (% of Output)." *World Bank Open Data.* https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS

World Bank. 2022. *Georgia Country Economic Memorandum: Charting Georgia's Future.* Washington, DC: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099435012022237049/p17548605921fd062093cb077bd2d45cd13

World Bank. 2022. *Georgia Power Sector: Maximizing Finance for Development.* https://documents1.worldbank.org/curated/en/099730006022222802/pdf/P1682550aaf216050aa5d0b97398b86338.pdf

World Bank. 2023a. *Country Climate and Development Report: Armenia*. Washington, DC: World Bank. https://documents1.worldbank.org/curated/en/099110524115029619/pdf/P18076418d641b0e91954b113281d9a1165.pdf

World Bank. 2023. *Azerbaijan Country Economic Memorandum.* https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099100009222236784/p17532606988e2056084e603c9c48ddc618

World Bank. 2023. *Armenia - Energy Storage Program: Summary of Economic, Financial and Regulatory Analyses of Energy Storage Development in Armenia.* https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099062824091119489/p1746661d32c0b0c1af4e1d0be31ac6b4d

World Bank. 2023. *Country Climate and Development Report: Azerbaijan.* Washington, DC: World Bank. https://documents1.worldbank.org/curated/en/099112723161524095/pdf/P17904806938f5083093a707fa0352e87a5.pdf

World Bank. 2023. *Investments and Policy Reforms Towards Low-Carbon Transition and Resilience Are in Azerbaijan's Economic Interest, Says World Bank.* Press release, November 24, 2023. https://www.worldbank.org/en/news/press-release/2023/11/24/investments-and-policy-reforms-towards-low-carbon-transition-and-resilience-are-in-azerbaijan-s-economic-interest-says-w

World Bank. 2023. *Overview of Support Schemes for Renewable Energy Sources.* https://documents1.worldbank.org/curated/en/099062824091130004/pdf/P174666-4045e9f5-c8d3-4594-b232-f8591c007172.pdf

World Bank. 2024. *Armenia Overview.* https://www.worldbank.org/en/country/armenia/overview

World Bank. 2024. *Carbon Pricing Policy Opportunities in Central Asia and Azerbaijan.* Washington, DC: World Bank. https://www.carecprogram.org/uploads/9-April_Session-7.3.CI-DD2-Carbon-Pricing-Policy-Bishkek-Presentation-April-2025-1.pdf

World Bank. 2024. *Georgia Overview.* https://www.worldbank.org/en/country/georgia/overview

World Bank. 2025. *Azerbaijan Scaling-Up Renewable Energy Project (AZURE) (P505208): Project Appraisal Document.* Washington, DC: World Bank. https://documents1.worldbank.org/curated/en/099050924195559638/pdf/P5052081fd76670a187671c6210da401be.pdf

Yergin, Daniel. 1991. *The Prize: The Epic Quest for Oil, Money & Power.* New York: Simon & Schuster.