Green Energy Cooperation and Political Security Issues for a Broader South Caucasus Region

Fuad Humbatov [1]

[1] *The Academy of Public Administration under the President of the Republic of Azerbaijan*
74 Lermontov Street, Baku, AZ 1001, Azerbaijan

DOI: 10.22178/pos.120-30

LCC Subject Category: L7-991

Received 27.06.2025
Accepted 27.07.2025
Published online 31.07.2025

Corresponding Author:
Fuad Humbatov

Abstract. The paper is devoted to the study of positive political and regional security impacts of the regional green energy production and export projects being implemented in the South Caucasus, such as "green energy zone" projects in the Republic of Azerbaijan, as well as the Black Sea Submarine Cable (BSSC), which are important transregional energy connectivity platform between EU and South Caucasus. The main conclusion of the paper is that green energy cooperation is highly important both in addressing the negative impacts of global climate change and for mitigating political and regional security risks. Moreover, the paper focuses on the green energy potential of each country in the region. It provides an analysis of the geopolitical, environmental, and energy security perspectives of such projects in the South Caucasus, which has been plagued by ethnic conflicts orchestrated by geopolitical players for over 30 years since the dissolution of the Soviet Union in 1991.

Keywords: environmental security; regional security; sustainable development; renewable energy sources (RES); climate change.

INTRODUCTION

The 21st century has seen unprecedented global change in search of affordable and scalable solutions to reduce the dependency on fossil fuels, bearing serious consequences for the environment and climate. Globally, oil-gas rich economies are facing pressure to reduce their carbon footprint and develop low-emission pathways, despite the emergence of new global economic challenges largely driven by geopolitical processes.

Moreover, among the other global risks, climate change is going to be the most challenging and necessitate broader international cooperation. In this regard, the Intergovernmental Panel on Climate Change (IPCC), which serves as a scientific platform responsible for promoting the UN science base in the relevant field, predicted that global climate change would lead to a global disaster if global warming exceeded 1.5° C per year. At the same time, the WMO confirmed that 2024 was the warmest year on record at about 1.55 °C above the pre-industrial level [1]. Besides that, the past ten years have all been in the Top Ten, in an extraordinary streak of record-breaking temperatures. Generally, let's look at the situation with the progress of SDGs implementation, according to the UN's latest Sustainable Development Goals Report. Only 17% of the Sustainable Development Goals (SDGs) are currently on track, nearly half have made very little or moderate progress, and more than a third have stalled or gone into reverse [2]. The significant "contribution" to being substantially out of track with the SDG implementation has been made by global warming. The extreme events of climate change and environmental pollution are affecting the survival and development of almost all countries, particularly those that are highly sensitive to the negative impacts of climate change. In the last 50 years, the number of recorded climate disasters has increased fivefold, and economic losses have increased sevenfold [3].

RESULTS AND DISCUSSION

In this regard, the Republic of Azerbaijan, as COP29 host country in 2024, has outlined strategic development plans, goals and COP initiatives on green energy transition as a substantial contribution to combat global climate change and addressing other SGD challenges. For instance, the COP29 initiative on "Green Energy Zones and Corridors" announced by Azerbaijan aims to connect

green energy sources with communities in need by developing interconnected power grids [4]. Moreover, the initiative is a part of the wider Green Energy Pledge that focuses on promoting investment, stimulating economic growth, and fostering regional cooperation. With a significant contribution to reducing greenhouse gas emissions, the green energy zones, particularly the energy corridors projects, can foster broader socio-economic cooperation among regional countries. This, in turn, enables the mitigation of political security risks and conflict vulnerability, generating a new, conducive geopolitical momentum for resilient and permanent peace.

It should be noted that a broader South Caucasus format, i.e., the "3+3 format," emerged with the end of the Second Karabakh War in 2020 to establish a regional cooperation framework involving three countries of the South Caucasus - Armenia, Azerbaijan, and Georgia, alongside the neighbouring powers – Iran, Russia, and Türkiye. While the issue generated much debate and looked both relevant and controversial, particularly in 2021-2022, such a framework was also offered in the past and other variations. The comprehensive information on this cooperation format can be found in [5]. At the same time, the format has recently gained popularity, with many considering it as a potential solution to the power vacuum arising from the West's distance from the South Caucasus. Though the "3+3 format" is embraced by all countries, except for Georgia, and is regarded as a certain mini-summit system for the local players to discuss, there are nevertheless differing views on the efficacy of the initiative [5]. The format of the "3+3 initiative" achieves what Moscow has long been striving for – the exclusion of non-regional powers from the South Caucasus. To achieve this goal, Russia's understanding with both Türkiye and Iran is advantageous, since these two Middle Eastern powers likewise pursue reducing the influence of other countries, particularly the US influence in the region.

As a green energy component of the "3+3 initiative", strengthening cooperation between the mentioned countries of the region, the paper focusses on positive political security impacts of such green energy cooperation in the broader South Caucasus, taking into account a huge green energy potential of the region, as well as new very conducive political landmark emerged after restoration of the territorial integrity of Azerbaijan in 2023 and current more balanced political courses of Georgia and Armenia.

Let's first consider the socio-economic situation and the green transition activities of the Republic of Azerbaijan, a state commonly acknowledged as a regional leader of the South Caucasus, as well as a green transition driver and regional risks mitigator of the region.

Thus, regarding SDGs, the Sustainable Development Goals hold particular importance for Azerbaijan from the beginning of its participation in the process, as reflected in [6]. The country is among 12 countries around the globe. It is the first in the South Caucasus, which has submitted its third Voluntary National Review Report on the implementation of the 2030 Agenda [7]. Scoring 72.4 out of 100 points possible on the SDG achievement index, Azerbaijan ranks 55th out of 165 countries in the 2021 Sustainable Development Report, with the best result in the region. Voluntary National Review Reports highlight Azerbaijan's progress in areas such as poverty reduction, healthcare, nutrition, women's labour force participation, clean water and sanitation, access to energy, internet usage, threatened species survival, as well as improving population welfare and sustainable development of cities and communities. Azerbaijan, along with crude oil and natural gas, recently became an exporter of electric energy. Today, the country exports electric energy to 4 neighbouring countries. The most remarkable indicator of Azerbaijan's inclusive, sustainable development in 2024 was the non-oil economy's 6.2% growth, up from 3.7% in 2023, as reported by the European Bank for Reconstruction and Development [8].

The new macroeconomic policy framework towards macroeconomic stability in Azerbaijan includes a change in the medium and long-term "driving forces" of the economy toward sustainability and diversification. The reintegration of territories occupied by Armenia and destroyed during the war into the country's overall economy creates advantages. The opportunities provided by new international and cross-regional transport and logistics corridors give a new momentum and great impetus to Azerbaijan's development. In this context, the establishment of a robust security system, stability, prosperity, and mutually beneficial cooperation in the region, as well as the development of economic and trade relations among regional states, will further strengthen Azerbaijan's role in the South Caucasus and beyond.

As mentioned above, one of the main pillars of sustainable development for each country is

environmental security. Azerbaijan attaches great importance to this issue on all international platforms, striving to create a conducive environment that enhances the resilience of the national ecosystem, conserves biodiversity, and reduces greenhouse gas emissions. The "greening" activities of the country align with its relevant commitments under the UNFCCC and Paris Agreement, as reflected in [9-13].

To meet the national commitments to the United Nations' 2030 Agenda for Sustainable Development, as well as the Paris Climate Agreement, a new strategic framework is outlined in the "Azerbaijan 2030: National Priorities for Socio-Economic Development" document approved by the relevant Order of the President of the Republic of Azerbaijan issued on February 2, 2021. The mentioned strategic framework supports implementation of emerging priorities of particular importance: 1) sustainably growing competitive economy; 2) society based on dynamic, inclusive and social justice; 3) competitive human capital and modern innovations space; 4) great return to the liberated territories; and 5) clean environment and "green growth" country [14].

Within the framework of the implementation of the last but not least, 4th and 5th priorities of the "Azerbaijan 2030: National Priorities for Socio-Economic Development" document, "great return to the liberated territories" and "clean environment and "green growth" country" Azerbaijan realises restoration and reconstruction of the mentioned territories as an opportunity to strengthen regional cooperation. In this regard, the initiative of the President of Azerbaijan, Ilham Aliyev, to turn the mentioned territories into a "green energy" zone should be especially noted. This unique initiative places special emphasis on the application of "green" technologies, effective and "smart" systems and paves the way for regional energy architecture. Moreover, at the COP26 meeting in Glasgow, Azerbaijan announced its plan to transform the de-occupied territories (Karabakh and Eastern Zangezur economic regions) into a "net-zero" zone. The relevant full-scale measures towards the green zone are underway, having strategic importance for the sustainable development of the whole region.

Generally, Azerbaijan is one of the countries with a huge potential for RES in the South Caucasus. The country's renewable energy potential exceeds 27 gigawatts of wind and solar power onshore and 157 gigawatts of wind power in the Azerbaijani sector of the Caspian Sea [15]. Additionally, the Biomass and waste energy potential is over 900 MW, and the potential of small rivers is more than 650 MW [16]. Together with the "Masdar" company (UAE), Azerbaijan plans to implement 3 gigawatts of wind and 1 gigawatt of solar power by 2027, 80 per cent of which will be exported. By 2037, the country plans to create an additional capacity of at least 6 gigawatts. Moreover, on December 15 2022, the Ministry of Energy of the Republic of Azerbaijan and Fortescue Future Industries (FFI) (Australia) signed a Framework Agreement to collaborate on studying and developing potential green hydrogen and renewable energy projects in Azerbaijan. Aimed at further strengthening the close relationship between Azerbaijan and Fortescue, the Agreement will explore up to 12GW of potential projects from renewable energy sources and green hydrogen production in Azerbaijan [17].

A significant contribution to increasing the share of RES in the total energy capacity can be made by the relevant activities in the liberated territories (Karabakh and Eastern Zangazur), establishing them as a "green energy" zone. These territories of Azerbaijan have the proven potential of 7200 megawatts of solar energy and 2000 megawatts of wind energy. It proves that the solar energy potential is approximately equal to the country's overall electric energy production capacity. The relevant Decree of the President of Azerbaijan approved the order on "measures to establish a green energy zone in these territories of the Republic of Azerbaijan [18]. " Moreover, it should be noted that 25 % of the country's water resources are located in the mentioned regions, which means 2.47-2.56 billion cubic meters of reserves per year. In this regard, Tartar, Bazarchay, Hakari and their tributaries, as the most abundant rivers, have great potential for the construction of a network of hydropower plants.

Taking into account these circumstances, in recent years, strategically important steps have been taken by the government, hand-in-hand with international energy companies, to create large-scale production capacities for renewable energy and green energy export in Azerbaijan. As a result, the country, along with transforming into a green energy country, is expected to become an important and reliable partner for the EU and other regions, supplying renewable energy and hydrogen. All these steps enable promotion of green energy transmission from the South Caucasus region, that was reflected in the "Agreement on a

strategic partnership in the field of green energy development and transmission between the Governments of the Republic of Azerbaijan, Georgia, Romania and Hungary" (the Black Sea Submarine Cable-BSSC) that was signed on 17.12.22 in Bucharest [16]. The Agreement supported by EU focuses to integrate a growing share of RES, stronger electricity interconnections between Romania, Georgia, and Azerbaijan, i.e. electric cable will connect countries on both sides of the Black Sea and further towards the Caspian sea region and will help reinforce regional countries security of supply by bringing electricity from renewable sources to the European Union via Romania and through Hungary. This ambitious project will directly link the South Caucasus and the EU via a 1,155 km high-voltage direct current (HVDC) cable, transmitting renewable electricity from Azerbaijan and Georgia to Romania and Hungary. Therefore, the BSSC will not only strengthen Europe's energy security but also enable the enlargement of the regional cooperation in green energy production in a broader South Caucasus, as well as in the Central Asia countries through the Caspian Green Energy Corridor. This incredible initiative was launched after by the Memorandum of Understanding between the Ministry of Energy of the Republic of Azerbaijan, the Ministry of Energy of the Republic of Kazakhstan, the Ministry of Energy of the Republic of Uzbekistan and the Asian Development Bank, the Asian Infrastructure Investment Bank within Southern Gas Corridor Advisory Council 11th Ministerial Meeting and Green Energy Advisory Council 3rd Ministerial Meeting in Baku on 04.04.25 [19]. On the same day, the European Union (EU) launched a package of 12 billion euros (US$13.2 billion) for the Central Asian region under its Global Gateway investment program during the historic Central Asia-EU Summit in Samarkand (Uzbekistan) [20]. All these green energy initiatives will strengthen green energy cooperation among the states of the two key regions and their strategic partners, the multilateral development banks. They will certainly reshape the geopolitical security landscape of Eurasia, including the broader South Caucasus region. By the way, according to research by energy transportation experts, the Southern Gas Corridor, a pivotal regional natural gas export infrastructure as broadly analysed in [21], could be easily repurposed as a green hydrogen export infrastructure shortly.

Thus, considering the vast green energy potential of the broader South Caucasus, the mentioned projects may strengthen regional green energy diplomacy, as well as create unprecedented momentum for regional cooperation, political stability, and environmental security of the broader South Caucasus region. In this regard, let's consider the potential of renewable energy sources (RES) in other countries of the broader South Caucasus and find common targets for increasing the RES share in the energy sector and its transmission perspectives.

Thus, one of the key geopolitical players in the region, Russia, possesses a remarkable potential for renewable energy sources, even though in recent years, Russia's role as the main conflict mediator and security provider in the South Caucasus has diminished. Despite this, Russia retains its leading position in the region, which could be augmented if Russia achieves military or diplomatic success on the Ukraine front.

The government of Russia aims to increase the share of RES 10 times over 20 years, raising its share in the total installed capacity to 10% by 2040. Even with these investments, the total amount of one trillion Russian Rubles will be allocated to renewables by 2035. In 2020 alone, around 1 GW of solar and wind energy facilities were installed, which made up 60% of new installed capacities. While solar and wind power plants have seen exponential growth, other RES-based power plants form a minor share. The target share of renewable energy in the country's electricity generation, set earlier by the Russian government as 4.5% by 2024, will not be achieved due to the delays caused by the country's economic problems in 2014-2016 and the time required for local equipment manufacturing [22].

Another key geopolitical player in the broader South Caucasus region, Türkiye, has seen its renewable capacity grow by 50% over the last five years. Even in 2019, Türkiye had the fifth-highest level of new renewable capacity additions in Europe and the 15th highest in the world. The IEA report notes that the country can achieve even stronger growth in renewables, especially solar, wind and geothermal, given its considerable resource endowment. Its rich potential for expansion of renewables is not limited to electricity generation but is also relevant in the heating sector. Notably, Türkiye uses only an estimated 3% of its solar and 15% of its onshore wind potential. The country has been proven to implement innovative stimulation measures to reduce costs and increase investments in renewables; for example,

auctions play an essential role in this end. The planned commissioning of Türkiye's first nuclear power facility in Akkuyu in 2023, which is being built in close cooperation with Russia despite the political and economic pressure from Western countries, will further diversify the country's low-carbon fuel mix [23].

Concerning Iran, the country is currently the 10th largest CO2 emitter in the world, with its energy sector accounting for 33% of Iran's total CO2 emissions [24]. In this regard, according to Iran's sixth Five-Year Development Plan, the country plans to produce 5000 MW of energy using renewables in the next five years. Moreover, the plan aims to promote renewable energy to reduce the environmental impact of the country's energy sector. Consequently, the main reasons behind Iran's interest in renewable energy development are improving energy security, reducing dependence on fossil fuels and meeting domestic electricity demand. Most of the plants in Iran use fossil fuels, especially natural gas. Therefore, taking into account all of these issues, F-class turbines are expected to replace currently installed E-class turbines, bringing the efficiency of turbines from 37.2% to 58%. Moreover, new conventional power plants are also to be built. So, in the next five years, 26 thousand megawatts (MW) of energy are to be generated by new power plants [25].

Georgia is the only country in the region with a significant share (78%) of RES in electricity production, and it ranks among the top countries in water resources per capita. Notably, 300 out of 26,000 rivers offer excellent opportunities for hydropower production. Now, only 22% of the total hydro-potential is utilised. The country has an effective regulatory framework on RES, consisting of the Law of Georgia on Energy, the Law of Georgia on Promotion of Production and Utilisation of Energy from Renewable Sources, the National Renewable Energy Action Plan (NREAP) of Georgia, etc. The share of energy from renewable sources, calculated following the Law of Georgia on Promotion of Production and Utilisation of Energy from Renewable Sources, in gross final consumption of energy in 2030 is at least its national overall target for the share of energy from renewable sources in that year, which is equal to 35% [26].

Although Georgia's energy consumption per capita is two times lower than the world average, its indicator value is growing very quickly. From 2000 to 2018, both energy demand and electricity consumption per capita multiplied by more than 1.6 times. The energy mix is relatively diverse compared with other countries in the region. In 2019, natural gas was the first fuel in the energy mix (45.4%), followed by oil (27%), renewables (20.4%) and coal (4.7%) [27].

Armenia's energy policy focuses on developing indigenous energy sources, primarily renewables, and extending the lifetime of the nuclear reactor that supplies nearly one-third of the country's electricity. The government pays more attention to energy efficiency issues, and the second National Energy Efficiency Action Plan (NEEAP-2) was developed in 2020. The country does not have a dedicated agency for renewable energy policies, so the Renewable Resources and Energy Efficiency (R2E2) Fund is responsible for implementing renewable energy and energy efficiency projects. In 2014, the government developed the Scaling-Up Renewable Energy Program Investment Plan. It is an update of the Renewable Energy Road Map developed in 2011 and includes comprehensive analyses of renewable energy potential, costs and benefits, and the viability of specific technologies. It also sets targets and objectives for renewables to 2025, including a plan for financing. The investment plan describes the first geothermal and solar PV projects, which are being developed by the government and serve as examples for other investors. Although the existing reactor is old, its service life has been extended to 2026, by which time the government hopes to have secured financing to build a new reactor of 1,000 MW**.** The government's ambitious plan to increase renewables to 28% of the power generation mix by 2036 (from 7% in 2012) includes small hydro, wind, solar PV and geothermal, but excludes biofuels. To reach this target, Armenia will need to have 634 MW of new renewable energy capacity installed by 2036. Estimated projected capacity additions comprise 148 MW of small hydro and 266 MW of large hydro, 150 MW of wind, 30 MW of geothermal, and 40 MW of solar PV [28].

All these data and analyses show once more the huge potential of the RES-related industry, sustainable development of the broader South Caucasus, which has common historical values and traditions. The expansion of green energy projects across the region will make a great contribution to strengthening the energy and environmental security of the broader South Caucasus. At the same time, projects of establishment of "green energy" zones, like it's being done in Azerbaijan (related in

the paper later on), as well as organisation of the joint export of green energy to the western and other countries will create ample opportunities for close cooperation between the countries of the region and, as a result, increasing political stability there. It is no coincidence that the project of exporting green energy, via electric cable connecting countries on both sides of the Black Sea and further towards the Caspian Sea region, is currently considered by international experts to be one of the most promising infrastructure projects in the region. For this purpose, energy and environmental diplomacy activities between countries must be intensified, particularly as all regions of the world are increasingly focused on this direction in light of climate change cooperation.

Climate change cooperation is a key driver of RES enlargement. For example, Azerbaijan made certain contributions in its NDC document, setting a GHG reduction target of 35% compared to the 1990 level (base year). Moreover, during the UN Climate Change Conference (26th Session of the Conference of the Parties to the UN Framework Convention on Climate Change (COP26)) that was held in Glasgow, UK from October 31 to November 12 2021, Azerbaijan officially has declared updated its goal of reduction in net emissions reduction from 35% up 40%, as well as taken a conditional target of reducing the GHG emissions, level by 2050 to 40% as a contribution to initiatives to reduce the impact on global climate change. At the same time, for the first time in the country's history, specifically in the 4th National Report, the author of the present paper calculated the projection of mitigation measures across all sectors using mathematical modelling on special application software (LEAP - Low Emissions Analysis Platform [29]). The total effect of policies and measures to reduce greenhouse gas emissions, along with forecasts for 2030, indicates that industries such as the energy sector, agriculture, and waste management are the primary sectors in terms of their GHG emissions share in overall emissions. In this sense, the energy sector remains the most important one in terms of the mitigation policies and measures to reduce greenhouse gas emissions, as noted in [10].

One of the main conclusions of the following research in [9, 10, 13], based on the impact assessment of the relevant mitigation measures to reduce GHG emissions and the analysis of their projections until 2030, was that namely the expansion of the use of alternative and renewable energy sources in the energy sector of Azerbaijan should be considered the most effective policy to mitigate the climate change impacts. Thus, the relevant calculations and mathematical modelling carried out based on modern methodologies proves that in the energy sector of the country (main emitting sector) 63.3 percent of the total reduction (27.8 million tons of CO2 equivalent) of the country's GHG emissions level will be feasible due to the enlargement of use of alternative and renewable energy sources in Azerbaijan. This once again proves the importance of developing a transition to alternative energy sources in the country. At the same time, during the COP26, as well as in its NDC2 document Azerbaijan officially reaffirmed its goal to increase the share of renewable energy in Azerbaijan's total energy production from the current 17% to 30% by 2030, as well as to establish a "net zero emission" zone (coinciding with "green energy" territory) initiative in the mentioned territories.

Some detailed steps of RES enlargement policies are also reflected in the 5th National Priority (clean environment and "green growth country") of the document mentioned above "Azerbaijan 2030: National priorities of socio-economic development". These measures aimed at creating a high-quality ecological environment and a green energy space, along with the efficient use of resources, including energy, the expansion of the use of alternative and renewable energy sources, green technologies, and preference for new sustainable energy sources were emphasised.

In this regard, a huge contribution to the decarbonisation of the country and regional environmental security issues could be made by the renewable energy production in a "green energy" zone in the mentioned territories of Azerbaijan. To this end, the relevant concept was prepared together with the Japanese TEPSCO, a consulting company specialising in this area. Having analysed the mentioned concept, we could notice the preparation of 3 main scenarios determining the energy demand and supply issues there:

Full electrification in the mentioned areas under ***Scenario 1*** (*lack of natural gas supply*);

Scenario 2: Scenario 2A - Availability of natural gas supply in other city/district centres except Lachin and Kalbajar;

Scenario 2B: Availability of natural gas supply in all city/rayon centres, settlements and villages near main gas pipelines, including Lachin and Kalbajar;

Scenario 3: Natural gas supply in all the mentioned areas.

All these scenarios are based on the settlement projection of the mentioned territory. Thus, according to international practice, 215,000 people are expected to settle in the mentioned territories in 2025, 304,000 in 2030, 404,000 in 2035 and 472,000 in 2040.

In this regard, as a result of the calculations, the annual electricity demand in the mentioned territories is projected to be 0.98 billion kWh in 2025, 1.6 billion kWh in 2030, 2.38 billion kWh in 2035 and 3.12 billion kWh in 2040 under Scenario 1. As for peak demand, this figure will be 164 MW in 2025, 266 MW in 2030, 395 MW in 2035 and 518 MW in 2040. In response to the peak capacity requirement, approximately 652 MW (solar, wind, and water) areas are required by 2030, and an additional 826 MW of solar power is to be commissioned between 2031 and 2040.

Moreover, as a result of the calculations, the electricity demand in the mentioned territories is projected to be 0.88 billion kWh in 2025, 1.43 billion kWh in 2030, 2.13 billion kWh in 2035 and 2.78 billion kWh in 2040 under Scenario 2A. As for peak demand, this figure will be 146 MW in 2025, 237 MW in 2030, 353 MW in 2035 and 462 MW in 2040. In response to the peak capacity requirement, approximately 525 MW (solar, wind and water) of the mentioned areas will be commissioned by 2030, and an additional 697 MW of solar and hydropower in 2031-2040.

According to Scenario 2B, these figures are projected to be 0.71 billion kWh in 2025, 1.15 billion kWh in 2030, 1.71 billion kWh in 2035, and 2.24 billion kWh in 2040. As for the peak demand, this figure will be 118 MW in 2025, 191 MW in 2030, 284 MW in 2035 and 372 MW in 2040. In response to the peak capacity requirement, approximately 525 MW (solar, wind and water) by 2030 and an additional 556 MW of solar and hydropower are required in the mentioned areas in 2031-2040.

According to the calculations, the electricity demand in the mentioned territories is projected to be 0.6 billion kWh in 2025, 0.96 billion kWh in 2030, 1.43 billion kWh in 2035 and 1.87 billion kWh in 2040 under Scenario 3. As for peak demand, this figure will be 98 MW in 2025, 159 MW in 2030, 237 MW in 2035 and 310 MW in 2040. In response to the peak capacity requirement, approximately 525 MW (solar, wind and hydro) of the occupied territories will be commissioned by 2030, and an additional 246 MW of solar and hydropower in 2031-2040.

A comparative analysis of the scenarios revealed that Scenario 2B (availability of natural gas supply in all city/district centres and settlements and villages near the main gas pipelines, including Lachin and Kalbajar) is the most viable option in terms of both commercial and "green energy zone" principles.

According to preliminary estimates, there are 45 hydropower plants (two industrial types, including 43 small hydropower plants) in the mentioned areas. At present, 3 HPPs with a total capacity of 15.8 MW ("Gulabird", "Sugovushan-1", "Sugovushan-2") have been restored and put into operation, contributing to the energy supply of the area [30]. Repair and restoration works have been started at "Kalbajar-1" HPP with a capacity of 4.4 MW. In general, the capacity of HPPs (including stations in areas where peacekeepers are temporarily stationed) is estimated at 220 MW. This list does not include Khudaferin and Maiden Tower hydropower plants. It is planned to build "Xudaferin" and "Maiden Tower" HPPs on the Araz River in the Jabrayil region, and the capacity of these HPPs for the Azerbaijani side will be 140 MW. According to the initial plan, the HPPs will be commissioned in 2023-2024. Moreover, an Executive Agreement was signed for the construction of a 240 MW solar power plant in the Jabrayil / Zangilan area. The project is expected to generate approximately 500 million kWh of electricity per year.

A project is planned to build wind power plants with a capacity of up to 100 MW in Lachin and Kalbajar. In the medium term, this project will also contribute to the creation of a "green energy" zone in the area [31].

The potential of geothermal energy and bioenergy will be explored through appropriate analysis and research. Kalbajar and Shusha have geothermal energy potential, and the use of this potential for future thermal energy will be considered [16].

Within the framework of the "green energy" zone project, energy efficiency will be considered a crucial element in buildings and structures, as well as in other areas and activities, and the development of appropriate models and standards in this direction is envisaged [16].

Particular attention will be paid to small-scale renewable energy solutions that can be

decentralised and mobile in the "green energy" zone. It is planned to install solar panels, heat pumps and heat pump-based water heaters in private households located in areas not supplied with natural gas, as well as the application of various "green technologies" in public buildings. The installation of solar panels in individual houses located in areas not supplied with natural gas will eliminate the need to implement a solar energy project with a capacity of about 100 MW in the coming years. Solar collectors can be installed for hot water supply in private houses supplied with natural gas, and these solar collectors will allow for more optimal consumption of natural gas for hot water supply [16].

Accompanying the development of the legislative and regulatory environment, reasonable steps are being considered to ensure effectiveness in the energy production, supply, and demand chain. The improvement of new production capacities to meet contemporary energy system requirements, a decrease in losses in transmission and distribution systems, and the fulfilment of productivity through the refurbishment and modernisation of existing energy production capacity are key steps outlined in [11, 13, 32].

In addition, it should be noted that Azerbaijan is among the countries most sensitive to the effects of climate change. In this regard, appropriate adaptation measures are needed to reduce or minimise losses that may occur at the national, regional, local and community levels across sectors to reduce their sensitivity to climate change. For information, currently the most sensitive sectors to climate change are water resources, agriculture, coastal areas, health and tourism.

The establishment of a "net zero emission" zone in the mentioned territories creates new opportunities for international cooperation between countries of the broader South Caucasus as well. The President of the Republic of Azerbaijan, Mr. Ilham Aliyev, declared at the press conference about the future of the region: *"It is planned to work following the geographical position of each region. The conclusion of contracts with many international companies, driven by investments in project implementation, stems from the region's great interest and the work to be done there. For the first time in the region, experimental projects will be implemented using international experience. The "Green Energy" zone and the "Smart Village" pilot project are among these projects" [16].*

It should be noted that the Smart Village Project has already been launched in the Zangilan region, where greenery has been planted and new sowing areas have been established. The five components of the Smart Village Project - housing, production, social services, "smart agriculture", and alternative energy - will create conditions for the declaration of these areas as a "net zero emission" zone.

In the light of the mentioned initiatives, establishment of the "green energy zone" in the mentioned territory of Azerbaijan and its gradual enlargement across the country enabling transition to a circular, green economy on the base of enlargement of alternative energy sources will essentially contribute to achievement of SGDs, as well as the global efforts of the international community towards combat the climate change and upgrading international image of the country.

CONCLUSIONS

On the example of the above projects, cooperation between states of the broader South Caucasus region towards production of green energy, establishment of appropriate "green energy" or "zero-emission" zones, as well as the implementation of joint infrastructure projects for exportation of the green energy resources will hugely contribute to combat the ecological degradation of the region, the global climate change impacts, as well as make a great impulse to ensuring energy security for a rapid transition to green economy in the relevant countries and, most importantly, the political security of the region. Regional cooperation in this field will create new realities and opportunities for the broader South Caucasus, enabling the establishment of a new hub for global green energy production and transmission, thereby strengthening regional stability and environmental security.

REFERENCES

1. World Meteorological Organisation. (2025, January 10). *WMO confirms 2024 as warmest year on record at about 1.55°C above pre-industrial level.* Retrieved from https://wmo.int/news/media-centre/wmo-confirms-2024-warmest-year-record-about-155degc-above-pre-industrial-level

2. UN. (2024, October 14). *World on Track to Achieve Only 17 Per Cent of 2030 Agenda Targets, Speakers Warn, as Second Committee Takes Up Sustainable Development Reports*. Retrieved from https://press.un.org/en/2024/gaef3604.doc.htm#:~:text=With%20only%20six%20years%20remaining,as%20it%20took%20up%20that

3. World Meteorological Organisation. (N. d.). Rising Risk. Retrieved April 30, 2025, from https://wmo.int/about-us/world-meteorological-day/wmd-2022/rising-risks#:~:text=According%20to%20WMO's%20Atlas%20of,by%20a%20factor%20of%20seven

4. The Ministry of Energy of the Republic of Azerbaijan. (2024, November 11). *COP29 energy initiatives were officially announced*. Retrieved from https://minenergy.gov.az/en/xeberler-arxivi/00405#:~:text=As%20part%20of%20COP29%20Green,the%20efficient%20use%20of%20resources

5. Avdaliani, E. (2025, April 5). *3+3 Initiative as a New Order in the South Caucasus*. Retrieved from https://caucasuswatch.de/en/insights/33-initiative-as-a-new-order-in-the-south-caucasus.html

6. Alekperov, U. (2013). *Fundamentals of Sustainable Human Development and Ecological Civilisation*. Baku: Neshriyyat.

7. President of the Republic of Azerbaijan Ilham Aliyev. (2021, September 24). *Speech of President of Azerbaijan Ilham Aliyev in video format was presented at the annual General Debate of the 76th session of the UN General Assembly*. Retrieved from https://president.az/en/articles/view/53197

8. EUNeighboursEast. (2025, February 28). *EBRD: GDP growth in Azerbaijan projected to moderate to 3 per cent in 2025 and 2.5 per cent in 2026*. Retrieved from https://euneighbourseast.eu/news/latest-news/ebrd-gdp-growth-in-azerbaijan-projected-to-moderate-to-3-per-cent-in-2025-and-2-5-per-cent-in-2026/

9. Aliyev, A., & Humbatova, R. (2020). Role of International Cooperation and Transfer of Best Available Technologies in Fulfilment of Paris Agreement. In *İnsan və biosfer (MaB, UNESCO). Azərbaycan milli komitəsinin əsərləri* (pp. 305–314). Baku: Təhsil.

10. Humbatov, F. (2022). *Low emission development outlook and its role in the environmental security system of the Republic of Azerbaijan*. Baku: Tuna.

11. Humbatov, F. (2021). Issues of the Fourth Industrial Revolution and Environmental safety in the context of International Relations. *Journal of Theory and Practice, 3*(75), 159–176.

12. Humbatov, F. (2020, January 25). *On the political and economic significance of President Ilham Aliyev's participation in the World Economic Forum in Davos*. Retrieved from https://az.trend.az/azerbaijan/politics/3183865.html (in Azerbaijani).

13. Humbatov, F. (2020). *Measures to Mitigate the Effects of Climate Change in the Republic of Azerbaijan and Their Assessment*. Baku: Zardabi Neshriyyat.

14. Akram, Kh. (2021, August 05). *Vision 2030: National priorities for robust socio-economic development in Azerbaijan*. Retrieved from https://azertag.az/en/xeber/Vision_2030_National_priorities_for_robust_socio_economic_development_in_Azerbaijan-1846113

15. President of the Republic of Azerbaijan Ilham Aliyev. (2022, December 17). *Ilham Aliyev addressed a plenary meeting on the signing of the Agreement on strategic partnership on green energy was held in Bucharest*. Retrieved from https://president.az/en/articles/view/58221

16. UN. Climate change. (2021, June 23). *Azerbaijan. National Communication (NC). NC 4*. Retrieved from https://unfccc.int/documents/299472

17. Energy Global. (2022, December 29). *Fortescue Future Industries and Ministry of Energy partner to pursue green hydrogen projects in Azerbaijan*. Retrieved from https://www.energyglobal.com/other-renewables/29122022/fortescue-future-industries-and-ministry-of-energy-partner-to-pursue-green-hydrogen-projects-in-azerbaijan/

18. On measures related to the creation of a "green energy" zone in the liberated territories of the Republic of Azerbaijan, 03.05.2021, No 2620. Retrieved from https://e-qanun.az/framework/47397 (in Azerbaijani).

19. The Ministry of Energy of the Republic of Azerbaijan. (2025, April 04). *Azerbaijan, Kazakhstan, Uzbekistan will cooperate with ADB and AIIB on Caspian Green Energy Corridor*. Retrieved from https://minenergy.gov.az/en/xeberler-arxivi/00498

20. The Astana Times. (2025, April 04). *EU Launches US$13.2 Billion Package for Central Asia at Historic Samarkand Summit*. Retrieved from https://astanatimes.com/2025/04/eu-launches-us13-2-billion-package-for-central-asia-at-historic-samarkand-summit/

21. Humbatov, F. (2019). Role of the "Southern Gas Corridor" project in the Sustainable development of the EU and the Caspian Basin Countries. *Journal of Theory and Practice, 4*(61), 43–92.

22. Proskuryakova, L. (2022, March). *Russia's renewable energy sector: Policy recommendations*. Retrieved from https://www.centrumbalticum.org/files/5176/BSR_Policy_Briefing_3_2022.pdf

23. IEA. (2021, March 11). *Turkey's success in renewables is helping diversify its energy mix and increase its energy security*. Retrieved from https://www.iea.org/news/turkey-s-success-in-renewables-is-helping-diversify-its-energy-mix-and-increase-its-energy-security

24. Khatinoglu, D. (2016). *Iran to generate 7% of electricity from renewables, or face fines*. Retrieved from https://www.trend.az/iran/business/2680790.html

25. Akhmetkaliyeva, S. (n. d.). *Renewable Energy Potential of Iran*. Retrieved May 31, 2025, from https://www.eurasian-research.org/publication/renewable-energy-potential-of-iran/

26. Arabidze, M. (2019, October 7). *Renewable Energy in Georgia. Challenges and opportunities*. Retrieved from https://unece.org/fileadmin/DAM/energy/se/pp/gere/GERE.6_Oct.2019/2_RE_Auctions/2_M.Arabidze_Georgia.6th.GERE.pdf

27. IEA. (2023, March). *Georgia Energy Profile*. Retrieved from https://www.iea.org/reports/georgia-energy-profile

28. IEA. (2023, March). *Armenia Energy Profile*. Retrieved from https://iea.blob.core.windows.net/assets/89a4a24d-fe2b-4e04-9ec7-25d3c02dbefd/CountryPages_Armenia_FINAL.pdf

29. SEI. (2025, May 14). LEAP. Retrieved from https://www.sei.org/projects-and-tools/tools/leap-long-range-energy-alternatives-planning-system/

30. The Ministry of Energy of the Republic of Azerbaijan. (2021, December 07). *The liberated territories will become a "Green Energy" zone. Three small HPPs with a total capacity of 15.8 MW (Gulabird, Sugovushan-1, Sugovushan-2) have already been restored and put into operation*. Retrieved from https://minenergy.gov.az/en/maariflendirici-melumat/isgaldan-azad-edilmis-eraziler-yasil-enerji-zonasina-cevrilecekdir-bununla-elaqedar-muvafiq-konsepsiya-hazirlanib-ve-hazirda-razilasdirilma-merhelesindedir-hemcinin-umumi-gucu-158-mvt-olan-3-kicik-ses-gulebird-suqovusan-1-suqovusan-2-berpa-edilerek-istismara-verilib-44-mvt-gucunde-kelbecer-1-kses-de-temir-berpa-isleri-davam-edir

31. Humbatov, F. (2018). *Energy diplomacy in modern international relations*. Baku: Zardabi Neshriyyat.

32. President of the Republic of Azerbaijan Ilham Aliyev. (2022, April 19). *Ilham Aliyev attended the international conference themed "South Caucasus: Development and Cooperation" at ADA University*. Retrieved from https://president.az/en/articles/view/55909