

# Economic Evaluation of “Green Energy” Potential in Nagorno-Karabakh and Neighboring Regions

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Received: July 1, 2020

Accepted: May 20, 2021

Online Published: May 28, 2021

doi:10.5539/mas.v15n3p71

URL: <https://doi.org/10.5539/mas.v15n3p71>

## Abstract

The paper focuses on the economic opportunities of renewable energy resources (RES) in Azerbaijan's liberated territories. Armenia illegally exploited energy and other natural resources in Nagorno-Karabakh and its surrounding areas during its 30-year occupation. As a result, it is not surprising that the establishment of a "green energy" zone in the territories has been given high priority in the post-liberation period. Traditional energy sources are currently the most common source of electricity generation in the world. In this regard, the world's ever-increasing energy demand accelerates nation-states' gradual transition to green energy. Electricity generation from renewable energy sources is increasing in many countries, including the United States. In Nagorno-Karabakh and seven neighboring regions, the state is focusing on the production and effective use of renewable energy resources. As a result, ensuring harmony in the gradual use of renewable and traditional energy resources will be essential to the country's socioeconomic development, environmental sustainability, and energy security. The economic analysis of renewable energy potential and the establishment of a "green energy" industry are conducted in the article.

**Keywords:** Azerbaijan, energy security, green energy, Nagorno-Karabakh, post-liberation period, renewable energy resources

## 1. Introduction

The reduction in oil and gas reserves, as well as production decline in Azerbaijan in the future, compels Azerbaijan to draw attention to renewable energy resources, in addition to, undertake an appropriate action plan developed and implemented in this area. As a result, one of the essential aspects of the energy security strategy for achieving socio-economic stability in the country is the stability and efficacy of energy resources. In this regard, Azerbaijan should therefore make efficient use of its existing or conventional energy resources while also fostering the development of renewable energy resources (RES). One of the most pressing issues confronting Armenia today is the country's inability to meet its energy demands. The liberated countries' power resources were instrumental in meeting the energy needs of Armenia. The loss of most of these resources creates further energy needs glitches leading to higher energy imports and increased domestic energy prices. As a result, household electricity prices have risen since February 1, 2021. The rise in prices is worsening Armenia's economic and social situation. Furthermore, Armenia's inability to pursue an independent energy policy makes the energy sector vulnerable to external shocks, exacerbating the situation in the Armenian energy sector. (Center of Analysis of International Relations, 2021)

On December 5, 2019, order No 1673 "on measures to implement pilot projects in the use of renewable energy sources" was signed in Azerbaijan. As a result, it should be noted that Azerbaijan has launched a new large-scale campaign in the field of renewable energy since 2019. (President of the Republic of Azerbaijan, 2019) The fact that the country's electricity sector will gain more power and kilowatts in the coming years eliminates any doubt that it will meet the country's growing demand for electricity on the one hand while increasing exports on the other. The country's goal is to increase the share of renewable energy sources in electricity production to 30%. (IRENA, 2019) A favorable investment climate has been created in Azerbaijan as a result of the decrees, as in

other areas of energy, in the use of renewable energy sources, consistent measures are being taken to attract private investment and implement large-scale projects. According to the Ministries of Economy and Energy, discussions are currently underway with investors to attract private investment in the use of renewable energy sources to create a "green energy" zone following the liberation of these lands. Moreover, international organizations have positively assessed calls for the establishment of a "green energy" zone in Nagorno-Karabakh and surrounding areas, and interest in cooperation in this region has also been expressed. (Ministry of Energy of the Republic of Azerbaijan, 2021) Hence, Azerbaijan's liberated territories would become "green energy" zones, with new opportunities for the sustainable development of these regions.

## 2. Materials and Methods

It is no coincidence that Azerbaijan places a high value on the establishment of a "green energy" zone, particularly in Nagorno-Karabakh and its surrounding districts. Thus, on 3 May 2021, Azerbaijan's President, Ilham Aliyev, signed an order establishing a "green energy" zone after the liberation of these territories from Armenian occupation during the Second Karabakh War. The Energy Ministry of Azerbaijan and the Japanese TEPSCO company signed an agreement to establish a "green energy" zone in the country's liberated territories. According to the project, it is planned to develop energy-efficient technologies based on modern energy management approaches to effectively use renewable energy potential such as wind, solar, hydro, geothermal, and bio-energy in Azerbaijan's liberated territories. The project also envisions researching international experience, regional energy demand, and power supply, as well as network integration of renewable energy resources. (Ministry of Energy of the Republic of Azerbaijan, 2021) The company founded in 1960, has completed projects in over 90 countries, and has international experience in the field of "green energy", providing "green solutions" as part of "smart city" projects in Japan, Vietnam, Malaysia, Indonesia, Brazil, and Thailand. In addition, the company has also been involved in the implementation of a number of projects in Azerbaijan, including consulting services in the project for the construction of the "Shimal-1" and "Shimal-2" power plants, field analysis of the energy sector, and others in Azerbaijan. (Azernews, 2021)

Although traditional energy sources are currently the world's dominant source of electricity generation, electricity generation from renewable energy sources is increasing in many countries. The production of this type of energy is also a hot topic in the country. The creation of a green zone or "green space" concept in Nagorno-Karabakh and its surrounding regions, which will cover the use of renewable energy sources, energy efficiency, environmentally friendly technologies, including the use of vehicles, and other issues, is currently underway. Discussions with the International Renewable Energy Agency in this direction have been in the spotlight. According to the International Energy Agency, global renewable energy production will increase by 50% by 2024 compared to 2018. (International Energy Agency, Renewables, 2019) Azerbaijan also has a great potential for using renewable energy. Taking into account the potential of the country's renewable energy sources, the goal is to increase renewable energy's share of total investment capacity to 30% by 2030. (IRENA, 2019)

The availability of renewable energy potential is a crucial element of green energy zones. Karabakh and its environs are abundant in solar and wind energy. More than 4,000 megawatts of solar energy potential and around 500 megawatts of wind energy potential are estimated to be available in the territories. Small hydropower plant inventories have also begun. Around 20 such stations have become inoperable during the occupation, according to preliminary data. In addition, clear-cut measures are already being taken to begin the process of identifying renewable energy sources and sites in all other liberated lands, in parallel with the construction of hydropower plants. As a result, the liberated lands will be designated as a "green energy" zone in the coming future. Wind energy has broad potential in the Kalbajar and Lachin regions, and solar power in Zangilan and Jabrayil. There are large areas in Karabakh's mountainous region with an average annual wind speed of 7-8 meters per second at an altitude of 100 meters. The average annual wind speed in the Kalbajar and Lachin regions, bordering Armenia, exceeds 10 meters per second. The southern part of the Karabakh plain - Fuzuli, Jabrayil, and Zangilan regions - ranks second after the territory of Nakhchivan AR in terms of solar radiation falling on the earth's surface. The solar radiation falling on a horizontal surface of one square meter here constitutes 1600-1700 kWh per year. (Ministry of Energy of the Republic of Azerbaijan, 2020)

Furthermore, Karabakh accounts for 25% of Azerbaijan's local water resources, the prospects of using the rivers namely Tartar, Bazarchay, Hakari, and their creeks for electricity generation are being considered. Along with this, the Kalbajar region has 3,093 m<sup>3</sup> / day thermal water reserves and Shusha has 412 m<sup>3</sup> / day thermal water reserves. Following the liberation of those areas, the possibility of using thermal sources for energy is also being investigated. Coal reserves are also present in the Karabakh region. Thus, the Chardagli village of the Tartar region possesses 8.5 million tons of coal reserves. (Ministry of Energy of the Republic of Azerbaijan, 2020)

In a nutshell, Azerbaijan tries to catch the global trend of transitioning to a "green" economy on the fly. Despite the country's continued reliance on the oil factor for state revenues, the country is content to steer its future economic and energy policy in a "green" direction. Therefore, improving energy security, developing decentralized power grids, reducing the share of power outages, and diversifying energy sources provide and accelerate access to energy for Azerbaijani residents and remote locations in these territories.

### 3. Discussion and Results

The oil and gas sector has long dominated Azerbaijan's economy, and this trend is likely to last in the near future. However, new laws and model agreements are now being drafted, which will provide a clear framework for RES in Azerbaijan for the first time. Significant new wind and solar projects are being negotiated with foreign companies, and there are plans to expand RES development as part of a larger infrastructure renewal program. In order to provide socio-economic and energy sustainability in the country, as well as apply the best international experience in Karabakh and its neighboring districts, the development of the concept of a green zone or green space to cover the use of renewable energy sources (RES), energy efficiency, eco-friendly technologies, including the use of vehicles, and other issues has begun.

Table 1. The renewable energy supply of Azerbaijan between 2015-2019, thousand TOE

	2015	2016	2017	2018	2019
Total energy supply	15 569,4	15 393,5	15 471,9	15 556,1	17 041,9
from those:					
Hydropower	140,8	168,5	150,2	152,0	134,6
Share of hydropower in total energy consumption, in percent	0,9	1,1	1,0	1,0	0,8
Biomass and waste	160,7	100,8	102,4	110,7	115,9
Share of biomass and waste in total energy consumption, in percent	1,0	0,7	0,7	0,7	0,7
Wind power	0,4	2,0	1,9	7,1	9,1
Share of wind power in total energy consumption, in percent	0,0	0,0	0,0	0,1	0,1
Solar (photovoltaic) power	0,4	3,0	3,2	3,4	3,8
Share of solar power (photovoltaic) in total energy consumption, in percent	0,0	0,0	0,0	0,0	0,0
Total renewable energy supply	302,3	274,3	257,7	273,2	263,4
Share of total renewable energy supply in total energy consumption, in percent	1,9	1,8	1,7	1,8	1,6

**Source:** State Statistical Committee of the Republic of Azerbaijan. (State Statistical Committee of the Republic of Azerbaijan, 2019)

According to the Dentons publication "Investing in renewable energy projects in Europe", Dentons' Guide 2021, eight territories with high solar potential are being explored by Azerbaijani authorities in the Kalbajar, Lachin, Gubadli, Zangilan, Jabrayil, and Fuzuli regions, with the wind power potential of the first two also being assessed. The Dentons 2021 guide also highlighted that Azerbaijan's Ministry of Energy currently estimates a potential RES capacity of 3,000 MW for wind, 23,040 MW for solar, 380 MW for biomass, and 520 MW for small hydropower. Azerbaijan's strategic priority in the coming years is to rebuild damaged energy infrastructure and significantly increase its wind and solar energy capabilities. (Dentons' Guide, 2021)

### 4. Conclusion

To summarize, the practice, known as "green energy" is common throughout the world and thought to be successful in Azerbaijan. To achieve it, some preparations should be made in the country, such as determining the characteristics of the technical connection of households to electricity networks, developing a mechanism for selling unused energy, and keeping commercial records. Besides, complex preparations are required, such as

determining the characteristics of the technical connection of households to the electricity grid, improving the mechanism of selling unused surplus energy, and maintaining commercial records. Simultaneously, it is necessary to calculate the maximum amount of electricity that each house, residential complex, or social facility can contribute to production.

Transforming Nagorno-Karabakh and seven adjacent regions into a green energy zone will, first and foremost, diversify the country's energy production sources. The transition to inexhaustible energy will also reduce the number of carbon emissions into the atmosphere and ensure environmental sustainability. In addition, it will save natural gas, which is the core source of electricity generation. Saving natural gas will have a positive impact on increasing the country's foreign exchange earnings by expanding export opportunities. Renewable energy sources can also meet the energy needs of areas where natural gas extraction is technically impossible or economically inefficient. Given the high mountainous terrain of the Kalbajar and Lachin districts, the use of renewable energy sources would be more efficient. The establishment of a green energy zone will also help to increase employment. The advancement of renewable energy sources is also essential for the sustainability of Azerbaijan's power system. Thus, the attraction of new investments in liberated territories, as well as the use of renewable energy potential, will play a vital role in Azerbaijan's international recognition as a green energy country.

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