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CURRENT STATUS-QUO OF AZERBAIJAN RENEWABLE ENERGY AND POSSIBLE COOPERATION WITH EU

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ABSTRACT

The article aims to provide information regarding current situation and future potential of renewable energy sources in Azerbaijan. Moreover, it proposes measures for the more convenient and efficient utilization of alternative and renewable energy sources to address the pollution of the natural environment resulting from recent significant climate changes on our planet. It extensively covers various aspects of alternative energy sources, including their development history, types, operational principles, and structures. Additionally, the factors influencing these energy sources are elucidated, along with an overview of state programs aimed at their development, tasks, and implementation, as well as European Union cooperation initiatives. The research also delves into the utilization of alternative renewable energy sources, ongoing projects, and the efficient utilization of natural resources. In modern times, the use of renewable energy sources present a promising avenue, offering the potential to safeguard environmental balance, restore equilibrium, and maintain ecosystem dynamics. The accelerating disruption of this balance underscores the urgency of expanding development and utilization efforts in this area. This article investigates current and possible future cooperation between European Union and Azerbaijan in renewable energy industry.
Keywords: energy sources, European Union, Azerbaijan, resource, consumption, economy
JEL codes: O13, P18, Q42, N54, N55

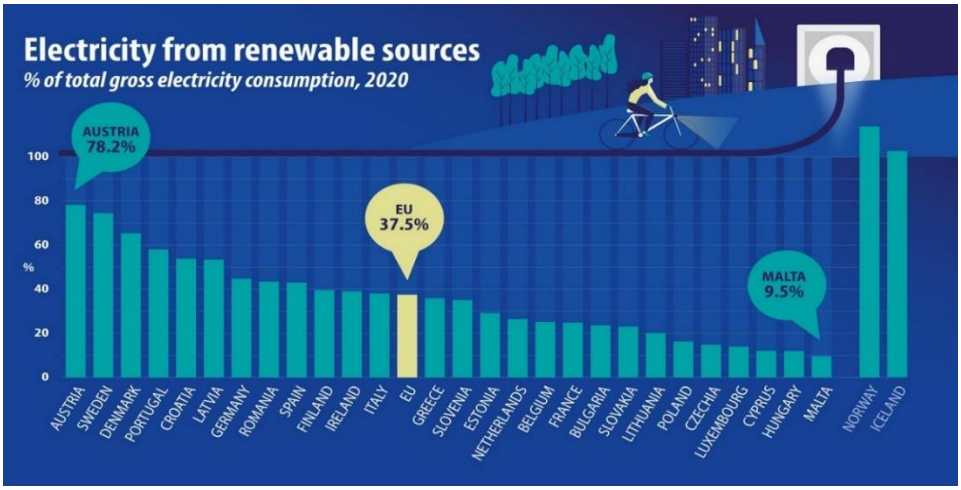
INTRODUCTION

In recent years, renewable energy sources have grown to comprise 39 percent of the total electricity production in European Union (EU) countries (*Figure 1*) (*Eurostat*, 2022). Renewable energy is a key factor in achieving our energy independence. This increase is due to a 28 percent rise in solar energy production and a 7 percent rise in wind energy production.

Azerbaijan holds significant potential for the development of renewable energy. The country boasts excellent wind and solar resources, as well as promising opportunities for biomass, geothermal, and hydropower (*Figure 2*). To harness this potential, the government has set a target to add 420 MW of renewable energy capacity by 2020 (*Mustafayev et al.*, 2022). To achieve this, Azerbaijan has initiated projects using engineering, procurement, and construction contracts. However, the actual implementation has been limited compared to the available resources and long-term objectives. Increasing the share of renewable energy in the energy mix offers numerous benefits beyond economic

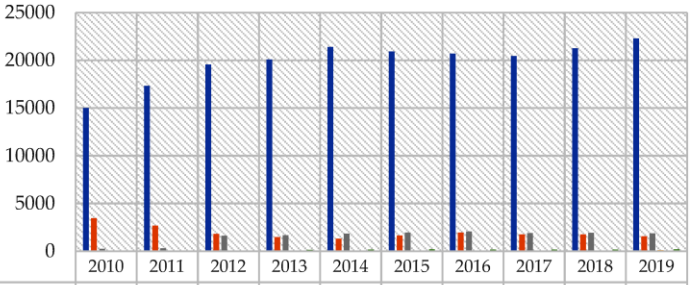
diversification. It can serve as a catalyst for new employment opportunities, particularly in a nation traditionally reliant on oil and gas, by fostering technological innovation and developing new sectors that contribute to economic growth and GDP. Furthermore, the accelerated adoption of renewable energy, coupled with ongoing improvements in energy efficiency, can reduce the country's oil and gas consumption. (*Masud et al.*, 2019).

Figure 1. Renewable energy on the rise: 39% of EU's electricity



Source: *Eurostat*, 2022

Figure 2. Power generation and types of resources used in Azerbaijan (million kWh)



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TPP and PPs working with fuel	15003	17317	19537	20066	21401	20905	20699	20445	21243	22290
Hydro Power Plants	3446	2676	1821	1489	1300	1638	1959	1746	1768	1565
Autonomous producers (working with fuel)	260	301	1630	1664	1848	1955	2062	1900	1934	1873
Wind Power Plants	1	0	0	1	2	5	23	22	83	105
Solar (photovoltaic) Power Plants	0	0	0	1	3	5	35	37	39	44
Electricity generated from waste incineration	0	0	0	134	174	182	175	170	162	196

Source: *Mustafayev et al., 2022*

The share of renewable energy needs to increase from about 18% of total final energy consumption in 2015 to roughly two-thirds by 2050. During this period, the share of renewables in the power sector should rise from about one-quarter to 85%, primarily driven by the expansion of solar and wind power generation. The energy intensity of the global economy must decrease by approximately two-thirds, reducing energy demand in 2050 to just below 2015 levels. Despite significant population and economic growth, this can be achieved through major improvements in energy efficiency, according to the report. (*IRENA*, 2018)

Azerbaijan has significant potential for renewable energy development, with abundant wind and solar resources, as well as promising opportunities for biomass, geothermal, and hydropower. The government aims to add 420 MW of renewable energy capacity by 2020 and has initiated projects using engineering, procurement, and construction contracts to achieve this. However, actual implementation has fallen short of the available resources and long-term goals. Increasing the share of renewable energy in the energy mix can provide numerous benefits beyond economic diversification, such as creating new jobs in sectors outside of oil and gas, fostering technological innovation, and boosting GDP growth. Moreover, accelerating the adoption of renewable energy and improving energy efficiency can reduce the country's dependence on oil and gas. (*IRENA*, 2015).

MATERIALS AND METHODS

Our motivation for selecting this topic stems from the pressing issues related to energy and climate change. We aim to provide insights into the current situation and future potential of renewable energy sources in Azerbaijan. Another goal is to explore how EU countries are attempting to shift their current energy policies with key partners. Additionally, we thoroughly examine the potential renewable energy sources in Azerbaijan. The widespread use of conventional energy resources in today's production sectors significantly contributes to climate change, which has hazardous and detrimental effects on our environment, leading to continuous pollution. Currently, many countries around the world are striving to modify and enhance their energy policies to address this global challenge.

This study is based on desktop research utilizing secondary data and statistics. Initially, the research theme was established, followed by the collection of relevant data regarding the Azerbaijan's alternative energy sector from various sources to support objective conclusions. Data was gathered from official databases such as Stat which is Azerbaijan's official statistical database. Subsequently, the data was analysed to reflect current EU trends and the consequences of their policies. Based on this analysis, we will determine the extent to which the EU has succeeded in implementing its renewable energy policies.

RESULTS AND DISCUSSION

Current Energy Policies of Azerbaijan

Azerbaijan is interested in increasing the proportion of renewable energy sources to 30 % of total electricity by 2030 (*WindEurope*, 2024). Government of Azerbaijan has

initiated certain energy policies to achieve this goal. In accordance with the President's Decree No. 1209 dated May 29, 2019 „On Accelerating Reforms in the Energy Sector of the Republic of Azerbaijan", the draft law „On the use of alternative (renewable) energy sources in the production of electricity" has been started.

The year 2022 witnessed significant developments in Azerbaijan's energy sector, marking historic milestones. Energy security emerged as a paramount concern on the global agenda during this period. Particularly noteworthy was Azerbaijan's energy collaboration with the European Union (EU), which gained increased significance. The signing of the „Memorandum of Understanding on Strategic Partnership in the field of energy between the Republic of Azerbaijan and the European Union, represented by the European Commission," on July 18 in Baku, marked the inception of a broader and new phase of cooperation in this domain. Energy cooperation has perennially held a prominent position on the agenda, yielding significant accomplishments over time. Presently, its importance has escalated further. The signing of the aforementioned agreement was necessitated by the prevailing circumstances. (*IRENA*, 2019).

President Ilham Aliyev and the President of the European Commission Mrs. Ursula von der Leyen emphasized this while making a statement to the press about the signing. The head of state said in his statement: „Our active cooperation in the field of energy has a history of more than fifteen years. Today's memorandum is not the first document signed between us. We signed the memorandum of understanding in 2006 and the joint declaration on the „Southern Gas Corridor" in 2011. in short, we have a good history and achievements. The energy projects initiated by Azerbaijan and supported by the European Union, including our partners, are completely changing the energy map of Europe. We started with oil production. We built the oil pipeline connecting the Caspian Sea with the Black Sea and the Mediterranean Sea." Reflecting on past years, let's remember that following the establishment of the Baku-Tbilisi-Ceyhan main export oil pipeline named after Heydar Aliyev, the Baku-Tbilisi-Erzurum pipeline, transporting „Shah Deniz" gas, was put into operation. This pipeline facilitated the delivery of natural gas extracted from the Azerbaijani sector of the Caspian Sea to Georgia in 2006 and to Turkey in 2007, solidifying Azerbaijan's status as a gas exporter on the global stage. Subsequently, the realization of the 3,500-kilometer „Southern Gas Corridor" megaproject further diversified the export routes for Azerbaijani gas.

The project unfolded in four successive phases. Under the second phase of the „Shahdeniz" initiative, production commenced. SCPK (South Caucasian Pipeline), traversing Azerbaijan and Georgia, was expanded to deliver gas to the Turkish border. TANAP (Trans-Anatolian Gas Pipeline) was laid across Turkey, covering a distance of 1,850 kilometers. The final leg of the corridor, TAP (Trans-Adriatic Gas Pipeline), transported our natural gas through Greece, Albania, and the Adriatic Sea to Europe. TAP has been delivering Azerbaijani gas to Italy for the past two years. (*IEA*, 2016)

The inauguration of the Greece-Bulgaria Interconnector (IGB) in the summer of 2022 signalled the onset of forthcoming projects aimed at expanding the „Southern Gas Corridor" in the years ahead. This underscores the growing significance of

energy security as a top priority on the global agenda. Consequently, collaborative global initiatives spearheaded by Azerbaijan alongside its partners and backed by the European Union assume critical importance. These initiatives have substantially reshaped Europe's energy landscape. Notably, President of the European Commission, Mrs. Ursula von der Leyen, highlighted three key aspects of the signed Memorandum of Understanding. Firstly, she pledged to double the volume of gas supplied from Azerbaijan to the European Union, affirming the document's commitment to expanding the „Southern Gas Corridor" as a vital supply route for the EU. Secondly, she emphasized renewable energy, citing Azerbaijan's considerable potential in this field, particularly in offshore wind energy and „green hydrogen." She underscored the establishment of a robust foundation for cooperation in this domain through the signed Memorandum of Understanding.

In addition to its role as a fuel provider, Azerbaijan is poised to emerge as a significant and dependable supplier of renewable energy to the European Union. It's imperative that our gas cooperation aligns with our climate responsibilities, such as addressing methane gas emissions. Our memorandum includes a pledge to reduce methane gas emissions across the entire gas supply chain, among other commitments. Furthermore, a comprehensive energy dialogue has been initiated, underscoring the European Union's recognition of Azerbaijan's substantial potential in renewable energy production (*Zhang et al.*, 2016). The process of investing in wind and solar energy has already been commenced. Azerbaijan's renewable energy potential has been assessed on a preliminary level. Our territories on Garabagh district were declared a „green energy" zone shortly in the recent years. So, the potential of solar and wind energy here is 4500 megawatts. (*Ministry of Energy of Azerbaijan*, 2020)

On 1st of March in 2024, Azerbaijan Renewable Energy Agency has signed a Memorandum of Understanding (MoU) with WindEurope for developing wind energy industry in Azerbaijan and possible export of this energy to EU through Caspian-EU Green Energy Corridor. Azerbaijan has already signed cooperation agreements with Georgia, Romania and Hungary to launch this corridor. In December of 2022, Black Sea Energy Project was launched among these countries which involves laying a 1-GW underwater cable (*Mammadov*, 2024) Additionally, each new built wind turbine generates 13 million EUR revenue per year which creates new economic possibilities for Azerbaijan. Furthermore, each party will exchange their best practices in order to make this cooperation more fruitful (*WindEurope*, 2024).

Furthermore, Azerbaijan has signed another Memorandum of Understanding (MoU) with Kazakhstan and Uzbekistan in May of 2024 in Tashkent, Uzbekistan. The main purpose is to produce green energy and deliver to Europe through Trans-Caspian and Middle Corridors. These countries are already working on the development of deep sea cables in the bottom of Caspian Sea such as Trans Caspian Fibre Optic (TCFO) which will help to connect Chinese, Central Asian energy markets to Azerbaijan and Europe (*Mammadov*, 2024).

Renewable Energy Sources in Azerbaijan

Presently, renewable energy sources do not play a notable role in Azerbaijan's overall final energy consumption, despite several energy policies on ameliorating renewable energy industry. This proportion peaked at 3.1% in 2010 but declined to 1.7% by 2022. One contributing factor to this variance is the fluctuation in hydroelectric power production, which amounted to 3,446 million kWh in 2010 and dropped to 1,746 million kWh in 2022. The percentage of renewable energy sources utilized in non-energy applications remains consistently low, accounting for 0.4% of the total final energy consumption in 2022 (*Table 1, Table 2 and Table 3*). (*Mustafayev et al.*, 2022).

Market reforms seek to leverage competitive market dynamics to establish energy carrier prices that accurately reflect their true costs, ultimately enhancing economic efficiency nationwide. International development partners have provided support for the realization of six out of these ten strategic objectives (*Table 4*) (*IRENA*, 2019).

Table 1: Installed electricity generation capacity, MW, 2022

State electricity producers /autonomous electricity producers /independent electricity producers	Power plants					
	General	Heat	Water	Sun	Wind	Boycott
„Azerenergy" JSC	6 935	5 881	1 055	-	-	-
Nakhchivan State Energy Agency	237	147	68	22	-	-
Self-producers of electricity (BP, SOCAR, Azersun Holding)	722	722	-	-	-	-
„Clean City" OJSC	37	-	-	-	-	37
„Azerishiq" JSC	52	-	-	-	52	-
„Azalternativenerji" LLC	16	-	-	13	3	1
Private wind and hydropower plants	17	-	9	-	8	-
Total, MV	8 017	6 750	1 132	35	62	38
Share, %	100	84.2	14.1	0.4	0.8	0.5

Source: *IRENA*, 2019

Table 2: Potential of renewable energy sources

Renewable energy sources	Technical Potential, MVT
The wind	3000
Sun	23 040
Bio/Waste	380
Small SES	520

Source: *IRENA*, 2019

Table 3. Ten priority directions for the energy sector

Preparation of the country's energy sector development strategy for the next 25-30 years.
Development of a 15-20-year state program on efficient use of energy resources, improvement of energy efficiency of end consumers and use of alternative energy sources.
Development of a 5-year state program for the development of the energy sector (the 1st five-year Strategic Development Plan).
Preparation of the draft law on the regulation of the domestic electricity market.
Preparation of the draft law on the regulation of the domestic natural gas market.
Preparation of the draft law „On the Network Code" in the field of electric energy.
Drafting a draft law on an independent energy regulator to regulate domestic energy (electricity and gas) markets.
Draft law on „Network Code" for natural gas.
Restructuring of energy system structures (Azerenergy, Azerishik) on the basis of new market entities provided for in the legislation.
Creation of a flexible tariff system based on the cost of goods and services that reflect and supply the interests of end consumers and other market participants (X-Factor).

Source: *IRENA*, 2019

Table 4: Technical assistance projects in the renewable energy sector

Objective of the project	Donor	Beneficiary
Supporting the development of Azerbaijan's long-term energy strategy (initial stage).	**European Commission, EU4ENERGY, Energy Charter Secretariat**	Ministry of Energy
Supporting the drafting of the electricity market law in line with the EU's Third Energy Package.	**USAID**	Ministry of Energy
Development of the regulatory and legal framework for the expansion of the Renewable Energy Sources sector.	**European Commission**	Ministry of Energy
Development of the regulatory and legal framework for the expansion of the renewable energy sector.	**SHAME**	Ministry of Energy
Supporting the holding of auctions for renewable energy sources in Azerbaijan.	**SHAME**	Ministry of Energy
A regional TA (Transportation Alternatives) project to improve energy statistics and policy in Eastern Europe, the Caucasus and Central Asia.	**European Commission, BEA**	State Statistics Committee, Ministry of Energy
TA project „Azerbaijan: preparation of the financial recovery plan of the energy sector".	**AIB**	Ministry of Energy, Ministry of Finance
Supporting the creation of an independent energy regulator to regulate domestic energy (electricity and gas) markets and drafting a draft law on „independent energy regulator".	**SHAME**	Ministry of Energy, Energy Regulation Agency
Preparation of the Network Code.	**AIB**	Ministry of Energy

Source: *IRENA*, 2019

Hydropower Energy Sources

In the nation's energy balance, hydropower has long had a dominant role. With a potential of 1,131 MW, hydropower was the most promising renewable energy source in 2017; thermal energy had a potential of 6,750 MW. Resources can be found around irrigation canals, the Caspian Sea, the Araz River, and the Kura River and its tributaries. Together with independent electricity producers in Azerbaijan, the small hydropower sector – which includes the power plants at Sheki, Mugan, Zeykhur, Gusar, Nügadi, Chinarli, Balakan, Guba, and Zurnabad – is also flourishing. These independent energy producers generate electricity for their own use at their own facilities. The 2017 addition of the 1.5 MW Balakan HPP is another attempt to boost output in this tiny hydropower industry. The production of hydropower is influenced by seasonal factors. (*Ministry of Energy of Azerbaijan*, 2024)

Wind Energy

Excellent wind resources are available in Azerbaijan, particularly in the Caspian Sea's coastline districts. ABOEMDA's investigation indicates that the wind potential is approximately 3000 MW. The government's 2020 target of obtaining 350 MW of new power reflects this potential. fell to his share at the end of 2017. Of the 62.4 MW of power generated, 51.7 MW belonged to „Azerishiq" OJSC, 2.7 MW to „Azalternativeenergy" LLC, and 8 MW to the private sector. A number of projects are still in the development stage, such as the recently inaugurated „Yeni Yashma" Wind Power Plant and the „Absheron Wind" project in Azerbaijan. (*Malikov*, 2016)

Solar Power Sources

The potential for solar energy in Azerbaijan is estimated to be 23,040 MW. Between 2400 and 3200 sunshine hours are experienced annually. For the most part of the region, global horizontal radiation ranges from 1,387 kW/m^2 to 1,534 kW/m^2. The majority of the region receives less than 1,387 kW/m^2 of direct normal radiation, which ranges from 1,095 kW/m^2 to 1,534 kW/m^2. Four solar photovoltaic plants with a generating capacity greater than one MW are present. In addition to the 24 MW capacity of the Nakhchivan sun Power Plant, plans call for the building of 5 2.8 MW sun power plants and 1 4 MW solar power plant. 34.6 MW of solar power has been installed nationwide by the end of 2017, including on the roofs of numerous public buildings and social enterprises. The sports complex in Masalli, which has a 70 kW photovoltaic system, is one example of such a project. This system is owned by the „Azalternativenerji" Public Legal Entity, and ABOEMDA is where the pertinent financial and administrative processes are produced. (*IRENA*, 2019)

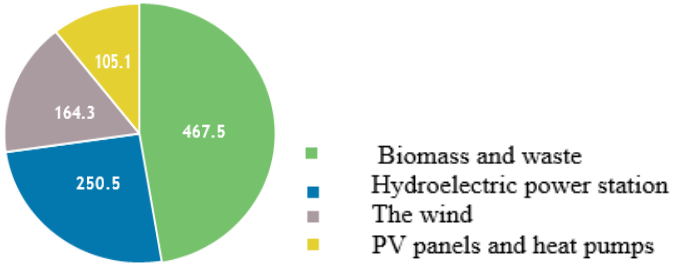
Bio Power Sources

Azerbaijan's capacity to produce electricity from garbage and biomass is estimated to be 380 MW. At the moment, traditional biomass is the primary kind of bioenergy utilized for cooking and heating in rural regions. Additionally, the Baku Solid garbage Plant (Block 4) shows the government's efforts to harness the huge potential for energy production from biodegradable household garbage.

Renewable Energy Economics

The primary funding source for Azerbaijan's development of renewable energy sources is the state budget. ABOEMDA states that US$579.1 million ($987.4 million) will be allotted between 2010 and 2022 to various energy sources, such as waste, biomass, wind, small hydropower, solar photovoltaics, and heat pumps. AZN) was invested, of which the state contributed 480.9 million US dollars (820 million AZN), or 83%. Due to high interest rates, lending for renewable energy and energy efficiency is not advantageous in the current investment environment. The interest rate was raised by the Central Bank of Azerbaijan in 2019 from 4% at the start of the year to 14% at the conclusion.

Figure 6: Investments in renewable energy sources, mln. in AZN



Source: *Malikov*, 2016

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CONCLUSION

To facilitate the shift to the market's operation for renewable energy sources, support measures should be found. In order to facilitate the initial establishment of the national market for renewable energy sources, guaranteed tariffs are necessary. But if the market for renewable energy sources grows, it would be possible to use auctions to buy renewable energy sources through market pricing at a reduced cost. But for this strategy to work, a few things need to be in place, such as a solid legal and regulatory environment and intense market competition.

Azerbaijan has enormous potential for the development of renewable energy sources. The nation boasts abundant solar and wind energy, as well as substantial potential for hydroelectric, geothermal, and biomass power production. The

government has given itself the goal of acquiring 420 MW of renewable energy capacity by 2020 in order to fulfil this potential. Projects on the design, acquisition, and construction of contracts using renewable energy sources have been implemented nationwide in order to achieve this goal. However, in comparison to the scope of the nation's long-term objectives and the amount of available resources, the projects' actual implementation has been quite constrained.

Increasing development in the field of alternative energy in the future:

1. Expanding the contribution of renewable and alternative energy sources to the nation's overall electricity generation and energy security;
2. Boosting energy output and consumption by the use of alternative energy sources, making effective use of additional energy resources, and making sure that environmental harm brought on by human activity is minimized during the energy production process;
3. Making use of alternative energy sources and sending raw materials from oil and gas to the petrochemical sector;
4. Operating space power plants fueled by solar batteries is the most economical way to use solar energy;
5. Widespread use of cutting-edge technology in the sphere of applying alternative energy sources and implementing international best practices;
6. Development of high-tech technical and material foundation for the Republic's use of alternative energy sources;
7. Buying and using biogas energy in regions with advanced animal husbandry;
8. Using AEM to guarantee energy security when utilizing conventional energy sources like gas and oil;
9. In Azerbaijan, widespread usage of alternative energy sources significantly reduces reliance on fossil fuels; this is known as energy diversification.
10. The Republic of Azerbaijan's future utilization of geothermal and wind energy depends on financial resources being invested and state level measures.

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