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CLEAN ENERGY TRANSITION DILEMMA: FUTURE VALUE OF GREEN INVESTMENT IN AZERBAIJAN

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Abstract

Shifting to cleaner and greener energy sources is a hot-debated issue that requires determination and resolution to solve global warming. One of the natural resources-rich countries, Azerbaijan, has adopted the green agenda to reach alternative energy production, 30% in the energy mix, by 2030. To that end, this paper aims to identify hydrogen production perspectives, examine the future value of a green investment as a case study, the relationship between population growth and electricity production, and, lastly, the Azerbaijani people's opinions towards green transition. The statistical, comparison, correlation (Pearson and Spearman), financial management methods, regression (simple linear), and survey methods have been utilized. The survey was carried out among the people of Azerbaijan, and people courageously demonstrated their support for the transition to clean energy sources. Via correlation methods, the relationship between population growth and electricity production was revealed; one unit increase in the former bolsters the latter, 6.98 units. Financial examination of a 100 MW solar farm proved that investing in renewable energy sources in the country is a lucrative business, and the payback period for invested money is 4.8 years. The foreign exchange rate is stable, and the sensitivity to initial investment is 15%, which means only a 15% chance can overturn the investment. All these findings and results can attract investors to pour money into the green energy sector of Azerbaijan, where both sides will be in a win-win situation.

Keywords: Hydrogen, investment, green energy, solar, wind

Introduction

The world we live in has gone through several significant changes and revolutions. Today, in the XXI century, all world governments agree to transform the way of life that is present into a cleaner and greener one. After coal, oil, and natural gas, the modern world is experiencing the fourth energy revolution, which, to a certain extent, can be called the green revolution. In the car industry, internal combustion leaves and is replaced by battery-powered vehicles. Utilization of coal, oil, and even natural gas is supposed to be substituted by renewable energy sources, such as wind and solar power. Recent research revealed that energy production through wind and solar power would not be carbon-free. According to the study, wind power emits 16 g of carbon emissions (CO_2), while solar power emits 40 g per kilowatt-hour production of electricity (DW Planet A 2021, DW Planet A 2023).

The elements necessary for wind and solar devices are common materials (aluminum, chromium, copper, silicon, etc.), critical metals (gold, molybdenum, titanium, etc.), and rare earth elements (dysprosium, neodymium) (Tleubergenova, 2023). Once these devices reach the end of their life-cycle, a huge amount of precious metals is going to be wasted. At this point, reuse and recycling issues arise, necessitating significant financial resources that exceed the cost of production. One of the precious elements of batteries is lithium which enables possible huge carbon emission in the extraction phase.

The list of publications can be downloaded on the following website: https://www.ijhsdr.com/

As to solar panels and their probable efficiency issues, Dinneen's study (2024), which brings this matter to the center stage, proved that the total efficiency of simple solar panel can reach only in laboratory settings to 27%. There is also an opportunity to add extra layers to cells, which is known as "tandem", to increase these panels' efficiency. However, this option also cannot increase the efficiency figure in a favorable way. The other option is to use perovskite on silicon cells, and tandem cells can increase the efficiency to 43%. Nevertheless, implementation of this process results in higher and higher production costs.

One of the most hot-debated issues in the transition to clean energy forms is related to hydrogen. In this respect, many scholars and scientists have explored the forms of hydrogen usage. Di Lullo et al. (2021) discussed the hydrogen economy and, in this respect, adding H2 increases transportation emissions as well as upstream emissions. Steam methane reforming (SMR) projects should be approved at a time when there were carbon capture, utilization and storage (CCUS) systems. Ahn et al. (2023) consider CCUS systems a bridging technology and note that 30-40% of natural gas is utilized in blue hydrogen production to dilute CO2, and the rest is concentrated with H2. Massarweh et al. (2023) explored hydrogen types and their respective CO2 emissions. Blue hydrogen is able to cause 4.02 kg CO2/kg fuel, while gray hydrogen can stand at 11.24 kg CO2/kg fuel.

Monetizing the blue hydrogen transition can be trouble in terms of investment. In this context, Santos et al. (2021) noted that surging oil production may pave the way for gaining additional money to finance natural gas resources. De Tommasi and Lyons (2022) investigated global hydrogen perspectives, including in the framework of the European Union. Before jumping and investing in this sector, an appropriate amount of demand should be determined. Besides that, the EU's climate policy and reduction of greenhouse gas emissions were the central topic of the research.

In terms of the viability of hydrogen, Nazir et al. (2020) discussed the best way for it and ended up finding a solution which stressed that steam methane reforming and auto-thermal reforming would be of significant value in the near future for greener life. According to Wallington et al. (2024) improved or enhanced efficiency in e-fuel synthesis, electrolyzers, and other necessary elements of transition might be realized by 2035. They highlighted that hydrogen-powered vehicles are less efficient (roughly 3-8 times) than their battery-powered rivals.

Green hydrogen disregards social and environmental impacts. In this direction, research conducted by Virens (2024) discusses hydrogen justice, energy poverty and includes a multidisciplinary strategy to incorporate both material and human-environmental impacts, thus not leaving out anything. Long-distance delivery of hydrogen can cause a 30% loss, and the regasification process demands a 5% loss (Umbach, 2023).

Table 1. Summary of literature review

№	Study	Time	Country	Result
1	Ahn et al.	(2023)	Republic of Korea	30-40% of natural gas is utilized in blue hydrogen production, and rest is concentrated with H_2
2	De Tommasi and Lyons	2022	Ireland	Initially, hydrogen demand should be determined after that investment assessment is conducted
3	Di Lullo et al.	(2021)	Canada	Transmission lines and in this direct, policy recommendations were prepared
4	Dineen	2024	The United Kingdom	Solar power's efficiency was investigated
5	DW Planet A	2021-2023	Germany	An approximate amount of carbon emissions in electricity production via solar panels and wind turbines noted
6	Humbatova et al.	(2019)	Azerbaijan	According to research, 1% increase in electricity consumption of population diminishes their income by 20.5%
7	Massarweh et al.	(2023)	Qatar	Types of hydrogen and their respective CO_2 emissions were scrutinized
8	Nazir et al.	2020	USA, Spain	Examined which types of production line is viable for hydrogen production
9	Santos et al.	(2021)	Brazil	Increasing oil production in order to finance natural gas resources
10	Tleubergenova et al.	2023	Kazakhstan	Key minerals and elements for manufacturing of solar panels and wind turbines were determined
11	Umbach	2023	Germany	Blue and green hydrogen production costs were touched
12	Virens	2024	New Zealand	Discusses hydrogen justice and energy poverty
13	Wallington et al.	2024	USA	Compared battery- and hydrogen-powered vehicles.

Hydrogen production costs and requirements

Before delving into a comprehensive and detailed analysis, hydrogen types and production sources should be examined (see Table 2).

s seen from the table, blue hydrogen is produced from natural gas, and there is a CCUS system to keep carbon emissions. From this perspective, blue hydrogen can be called emission-free or minimum CO2 emission fuel. However, building CCUS systems increases blue hydrogen production costs. Per kg of blue hydrogen costs 1.50 USD; hence, a ton equals 1500 USD (Tleubergenova et al., 2023). Gray hydrogen is also produced from natural gas, similar to blue. However, the main difference is related to not using CCUS, which causes enormous carbon emissions and releases them into the environment. The green hydrogen production phase involves green energy sources, through which energy enters electrolyzers, and electrolyzers separate hydrogen and oxygen. Brown hydrogen is obtained from coal, which causes, of course, massive amounts of CO2 emissions and cannot be considered the best alternative energy form.

Table 2. Hydrogen and its types (Massarweh et al., 2023)

Hydrogen type	Source	CO2 emissions
Blue hydrogen	Fossil fuels (primarily from natural gas)	Carbon capture and storage is utilized
Green hydrogen	From renewable energy sources	Minimum or zero emissions
Gray hydrogen	Fossil fuels (primarily from natural gas)	Carbon capture and storage is not utilized and thus causes CO_2 emissions
Brown hydrogen	Fossil fuels (coal)	Causes enormous CO_2 emissions
Purple hydrogen	Nuclear energy	Minimum or zero CO_2

The green hydrogen production phase involves green energy sources, through which energy enters electrolyzers, and electrolyzers separate hydrogen and oxygen. Brown hydrogen is obtained from coal, which causes, of course, massive amounts of CO2 emissions and cannot be considered the best alternative energy form. Dissimilar brown, purple hydrogen is produced through nuclear energy and generates zero or minimal CO2. Nevertheless, nuclear energy production itself and its side effects can be considered somewhat problematic.

Tleubergenova et al., (2023) highlighted that two million (mln) tonnes of green hydrogen require 30 gigawatts of power, while five mln 75 gigawatts and ten mln 150 gigawatts of power. When it comes to infrastructure-building expenses for wind and solar power, it should be stressed that 1 MW of solar power comes to a total of 1 mln USD, while wind power is 4.34 mln USD. It is already crystal clear that two mln tonnes of green H2 are going to demand 30 bln USD, while five and ten mln tonnes will require 75 and 150 bln USD, respectively. Blue and green hydrogen production costs are illustrated comprehensively in Table 3.

Table 3. Blue and green hydrogen production costs (EBRD, 2023)

Azerbaijan				The European Union	
Blue hydrogen		Green hydrogen		Green hydrogen	
Tone	Euro	Tone	Euro	Tone	Euro
1	4620	1	2920	1	3670
2 mln	9.24 bln	2 mln	5.8 bln	2 mln	7.34 bln
5 mln	23.1 bln	5 mln	14.6 bln	5 mln	18.35 bln
10 mln	46.2 bln	10 mln	29.2 bln	10 mln	36.7 bln
H_2 costs in Azerbaijan = Blue H_2 > Green H_2					
Cost of H_2 = Azerbaijan green H_2 < The European Union H_2					

Table 3 explicitly shows the production expenditures of blue and green H2. As a case study, 2, 5, and 10 mln tonnes of hydrogen production costs are compared. In every corner, green H2 outpaced its blue rival with respect to expenses; nonetheless, taking into account the CCUS building facility, the figure (blue hydrogen) will definitely increase because carbon capture transport and storage stands at 79 USD per ton of CO2 for hydrogen (Casey, 2023). Regarding hydrogen production in Azerbaijan, it should be emphasized that calculations in this respect show the average cost per ton of green hydrogen production is 2.92 euros while blue is much higher, 4.62 euros. In the European Union, the green H2 production cost per ton stands at 3.67 euros, much higher than that of Azerbaijan. Azerbaijan won the competition for green H2 production expenses and, therefore, can be a green exporter country for the EU. However, there are advantages and disadvantages to the production of H2 in Azerbaijan. Firstly, we must look at the advantages:

Taking into consideration the country's natural gas reserves (2.6 trillion cubic meters), blue hydrogen production is promising;

Having the integrated pipeline system called the Southern Gas Corridor may enable Azerbaijan to export hydrogen via this road;

Low-cost production might encourage all sides (Azerbaijan and the EU) to concentrate on hydrogen production and exportation issues in the near future.

The disadvantages are the following:

The length of the pipeline starting from Azerbaijan and ending in Italy might increase the export price of hydrogen;

Hydrogen production is also dependent on the water resources of the countries. Water scarcity is one of the critical challenges that our world has faced. Unfortunately, Azerbaijan also has water scarcity;

Blue hydrogen export depends on natural gas export, and production depends on CCUS systems;

The exportation of hydrogen requires repurposing of the pipeline, and it demands commercial discussions with all stakeholders and shareholders.

4Ps of Azerbaijan's green horizon: Policy, potential, projects and perspectives

Achieving green energy production and securing a clean environment and growth are among the five national priorities the fossil-fuel-rich country Azerbaijan targets until 2030. According to International Finance Corporations' calculations, Azerbaijan has 157 gigawatts of wind energy potential in the Caspian Sea. Illustratively, renewable energy projects and potential are depicted in Figure 1.

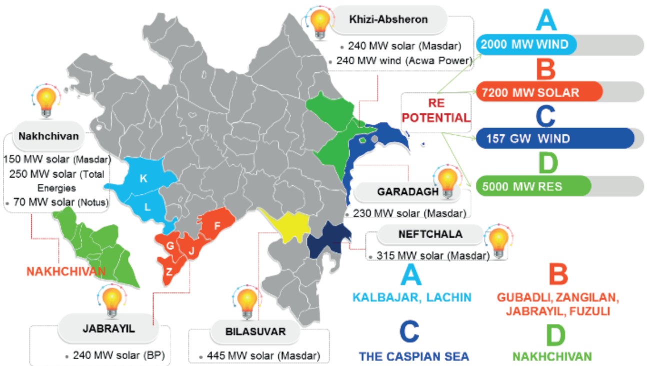

Figure 1. Renewable energy potential and projects (made by the author based on Guliyev, 2024)

Table 4. Companies invested in renewable energy in Azerbaijan (compiled by the author)

Companies	Solar energy	Onshore wind	Offshore wind
Masdar (Portfolio of 10 GW)	150 MW (Nakhchivan)	1 GW	2 GW
	1 GW		
	230 MW Garadagh		
Nobel Energy Management	400 MW (Nakhchivan)		
ACWA Power		1 GW	1.5 GW
TotalEnergies	250 MW (Nakhchivan)	250 MW	
China Gezhouba Group Overseas Investment	2 GW Renewable energy		
Notus	70 MW (Nakhchivan)		
Fortescue Future Industries	12 GW renewable energy and green hydrogen projects		
bp	240 MW (Jabrayil)		
Czech Engineering	Solar energy project		
SOCAR-ACWA Power	Battery storage systems		

It is evident from Figure 1 that Azerbaijan has 2000 MW of wind energy potential in the Kalbajar and Lachin districts, 7200 MW of solar in the Zangilan, Jabrayil, Gubadli, Fuzuli districts (the Eastern Zangezur and Karabakh economic regions). In the Nakhchivan region, it equals 5000 MW of renewable energy. In order to dive into more regarding companies that poured money into the renewable energy sector of the country, we need to look at Table 4.

Table 4 and Figure 1 show that Masdar is the most actively involved company invested in the clean energy field, with a portfolio of 10 GW. Before explaining the figure and table, it should be stressed that the Azerbaijani government is planning to achieve 30% clean energy in the electricity production landscape by 2030. The Nakhchivan, Eastern Zangezur, and Karabakh economic regions were declared "green energy zones" by the Azerbaijani state. Land areas for renewable energy use are exempted from tax by the government's decision; also, the import of electric cars is an exemption from value-added tax.

With the biggest share, Masdar has a leading role in Azerbaijan (Khizi-Absheron solar farm 240 MW, Garadagh solar 230 MW, Bilasivar solar 445 MW, Neftchala solar 315 MW, Nakhchivan solar 150 MW, 1 GW onshore and 2 GW offshore wind), followed by Acwa Power (Khizi -Absheron 240 MW wind farm, 1 GW onshore and 1.5 GW offshore wind farm), BP (Jabrayil district "sunrise" solar farm), Notus (70 MW solar in Nakhchivan), Total Energies (250 MW solar in Nakhchivan and 250 MW onshore wind), China Gezhouba Group Overseas Investment (2GW renewable energy projects), Fortescue Future Industries (12 GW renewable energy and green hydrogen production projects), and Czech Engineering (solar energy).

With respect to the green energy perspectives in Azerbaijan, the most remarkable issue is related to the exportation of clean energy to Europe. For this purpose, Azerbaijan, Georgia, Romania, and Hungary signed a declaration in 2022 on a "green energy corridor" stretching from Azerbaijan through the Black Sea and ending on the European Union's soil. 80% of the green electricity generated in the country is going to be delivered in the European direction. Azerbaijan, once called a pan-European gas supplier partner, will transform its name into a green partner.

Future value of green investment in Azerbaijan

Now that we have explored green energy potential and companies invested in this sector, the next phase is going to question why invest in Azerbaijan's renewable energy field. Hence, the main focus areas will be the future value of the green investment, payback period, return on capital employed, internal rate of return of perpetuity, and sensitivity to the initial investment. For the case study, a 100 MW solar project, which generates approximately 208 mln kWh of energy, is taken. The power purchase agreement (PPP) would take the least amount, at 0.1 USD/per kWh. The interest rate in Azerbaijan is 8%, and we will calculate the future value of a 100 mln USD green investment in solar energy by 2030.

Future value of money invested now:

$$F=P(1+r)^n=100\times(1+0.08)^6=100\times1.5868=158.68 \text{ mln USD} \quad (1)$$

Where,

F – future value after n years

P – present or initial value

r – rate of interest

n – number of years

Our result shows a 50% increase in the investment value, increasing from 100 mln to 158.68 mln USD until 2030. Future value is quite positive and, therefore, attractive for investors. If the PPP value is 0.1 USD/per kWh, the annual total amount from a 100 MW solar farm will stand at 20.8 mln USD. That is why we have to analyze the internal rate of return of perpetuity.

Internal rate of return of a perpetuity:

$$\text{IRR a perpetuity}=\frac{\text{Annual Inflow}}{\text{Initial investment}}\times 100\%=\frac{20.8 \text{ mln}}{100 \text{ mln}}\times100\%=20.8\% \quad (2)$$

The calculation reveals that the annual IRR figure will be 20.8%. This is the second reason for investing in renewables in the country. In the next phase, we will cast light on the return on capital employed (ROCE) and, scrap value for a 100 MW solar farm is nearly 4 mln USD and lifecycle is 25 years):

$$\text{Average annual depreciation} = (100\text{-}4)\div25=3.84 \text{ mln USD} \quad (3)$$

$$\text{Average annual profit} = 20.8 - 3.84 =16.96 \text{ mln USD} \quad (4)$$

$$\text{ROCE} =\frac{\text{Average annual profits before interest and tax}}{\text{Initial capital costs}}\times100\% = \frac{16.96}{100}\times100=16.96\% \quad (5)$$

Alternatively (average capital investment (ACI)):

$$\text{ACI} =\frac{\text{Initial investment + scrap value}}{2}=\frac{100+4}{2}=52 \text{ mln USD} \quad (6)$$

$$\text{ROCE} =\frac{\text{Average annual profits before interest and tax}}{\text{Average capital investment}}\times100\% =\frac{16.96 \text{ mln}}{52\text{mln}}\times100\% = 32.61\% \quad (7)$$

The ROCE value is high enough for investing, 16.96%, and, through average capital investment calculation, this figure will be 32.61%. The last calculation is regarding sensitivity to the initial investment (net present value is 15 mln USD):

$$\text{Sensitivity to initial investment} = \frac{\text{Net Present Value}}{\text{Initial investment}}\times100\% = \frac{15}{100}\times100\% = 15\% \quad (8)$$

It means that a 15% increase in the initial investment cost would cause the net present value to fall to zero. However, foreign exchange risk is almost zero in Azerbaijan, which is why we can say the sensitivity formula is optimal. Concerning the payback period of a 100MW solar farm, it is calculated in the following:

$$\text{Payback period} = \frac{\text{Initial investment}}{\text{Annual profit}}=\frac{100}{20.8} = 4.8 \text{ years} \quad (9)$$

It is crystal clear from the formula that 4.8 years will be sufficient for earning an initial investment value for companies that invest in the green energy sector of Azerbaijan.

The analysis of the relationship between population and electricity production

In the aftermath of examining clean energy potential and projects, the question arises: is there any relationship between electricity production and population growth? It is known that Azerbaijan produces most of its electricity through natural gas, approximately 90%. We are already familiar with green energy projects, and the main question that comes to mind for all of us is: Does Azerbaijan need a tremendous amount of energy? For that purpose, correlation analysis was conducted, and the formula is the following: (Coskun, Altunisik, & Yildirim, 2019):

$$r = \frac{\sum (x_i -\bar{x})(y_i- \bar{y})}{\sqrt{\sum (x_i-\bar{x})^2(y_i- \bar{y})^2}} \quad (10)$$

Where,

r = Correlation coefficient

x_i= Values of the x variable

$\bar{x}$ = Mean of the values of x variable

y_i= Values of the y variable

$\bar{y}$ = Mean of the values of y variable

After conducting a correlation analysis, it was revealed that there was a strong correlation between variables, then carried out simple linear regression, and the formula is the following (Coskun et al., 2019):

$$Y_i = \alpha + \beta_i+ \varepsilon_i \quad (11)$$

Where,

Y = y coordinate;

i = observations

α = y intercept;

β = slope;

ε = error terms

[1] Deutsche WindGuard is a German enterprise offering a wide range of wind energy-related services and knowledge. Established in 2000, the organization holds a significant position in the wind energy sector by providing an extensive array of technical and advisory services with the goal of maximising wind energy generation, guaranteeing security, and augmenting operational effectiveness.

To scrutinize well the potential connection between electricity production and population growth, we compiled secondary data from the official statistical committee on generated energy in the country and the number of people between 2010 and 2022. To that end, the Pearson and Spearman correlations were utilized to identify and reveal the current connection between variables (see Tables 4 and 5).

Carrying out the two correlations aims to reduce any side and potential errors that can occur. In these correlations, the independent variable was the number of people in Azerbaijan, and the dependent was electricity generation. The process was conducted with the help of the SPSS 2022 software.

Table 5. The Pearson correlation

		Azerbaijan electricity production	Azerbaijan population
Azerbaijan electricity production	Pearson Correlation	1	.922**
	Sig. (2-tailed)		.000
	N	13	13
Azerbaijan population	Pearson Correlation	.922**	1
	Sig. (2-tailed)	.000	
	N	13	13

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6. The Spearman correlation

			Azerbaijan electricity production	Azerbaijan population
Spearman's rho	Azerbaijan electricity production	Correlation Coefficient	1.000	.956**
		Sig. (2-tailed)	.	.000
		N	13	13
	Azerbaijan population	Correlation Coefficient	.956**	1.000
		Sig. (2-tailed)	.000	.
		N	13	13

**. Correlation is significant at the 0.01 level (2-tailed).

The tables above clearly demonstrate that the correlation between the two variables is strong. As already known, the correlation value ranges from -1 and +1, and our correlation is near 1, precisely 0.922 (the Pearson correlation) and 0.956 (the Spearman correlation). After seeing the vigorous connection, we must conduct regression analysis, and it is the following:

Table 7. The regression analysis

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
(Constant)	-42822.155	8549.675		-5.009	.000
Az population	6.987	.887	.922	7.876	.000

a. Dependent Variable: Azerbaijan electricity production

When Sig. value is less than $p<0.05$ value, it is considered valuable, and in this calculation (Table 7), the value (Sig .000) shows that the interconnection is extremely noteworthy The interpretation of simple linear regression is as follows:

$$Y = -42822.155 + 6.987 \times X + 8549.675 \quad (12)$$

One unit increase in population growth fosters electricity production by 6.98 units. The number of people in Azerbaijan in the coming year is expected to grow. Thus, our research proved that additional energy will be vital for the country, taking into account the population forecast by 2030.

The green energy survey among people

The last examination of our study is related to the survey questions conducted among people in Azerbaijan. We surveyed people to determine the people of fossil-fuel rich country thought about green energy transition. The answers of respondents (100 people) are illustrated in Figure 2.

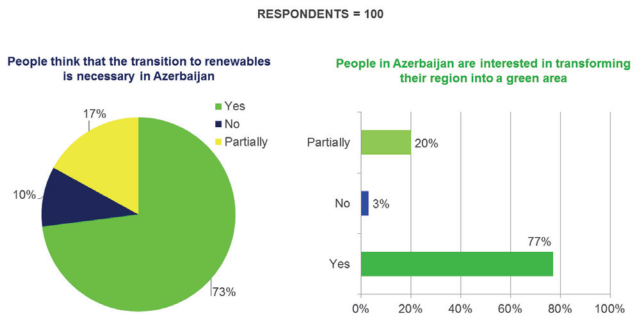

Figure 2. Survey questions regarding the green transition (made by the author)

It seems from Figure 2 that 73% of respondents are in favor of the necessity to shift to clean energy sources in the country. Only 17% of them partially support the ongoing process, and 10% do not accept this notion. Regarding their living areas, people are eagerly backing the idea of transformative changes, such as turning their residential areas or, more broadly, their districts into green spaces. In the survey, 77% of the respondents conformed to the transition process, 20% partially accepted, and only 3% did not support this action.

Conclusion

Analyzing the green transition and investment within the framework of Azerbaijan showcased that the country has massive potential in terms of renewables, particularly wind and solar energies. The potential and projects of green energy have been depicted on the map of Azerbaijan. With respect to hydrogen perspectives, throughout research, the advantages and challenges of hydrogen production have been emphasized. In the perspective period, blue hydrogen production might be achievable, but green hydrogen production is possible. Even the comparison of the production cost of blue and green hydrogen in Azerbaijan and the EU demonstrates that the former is likely to have a lower production than the latter, and this cost-efficiency may push Azerbaijan into a hydrogen-based economy. Our research investigated the companies that invested in the green energy sector in the country, and the listed number of companies was ten, including the local State Oil Company.

Regarding the future value of green investment, our study has taken a 100 MW solar farm as a model. The results of the investigation showed that a 100 mln USD solar farm investment will continuously grow and likely be 158.38 mln USD by 2030. IRR of the perpetuity of our model was 20.8%, the ROCE value was 16.96% (via ACI 32.96%), the sensitivity to the initial investment was 15%, and the payback period was 4.8 years. All these calculations are attractive for any investors making money in a short period of time. The main question for investors may be, 'Where will we forward this electricity?' The green market where Azerbaijan is planning to export clean energy is the EU. On top of that, the growing population, increasing demand for electricity, and, above all, the expanding economy in the country will curb the vast amount of energy in the near future. To illustrate this notion, we conducted the correlation and regression between population growth and electricity production. Our calculations showcased that a unit increase in population growth triggers electricity production by 6.98 units.

Lastly, we targeted to learn the opinions of the people of Azerbaijan on the transition to clean energy sources. A majority of the surveyors (73%) fully supported the green energy transition, initiatives, and projects. The second question was related to transforming their living areas into green ones, and people withstood this idea again, voting yes 77%. These outcomes verify the possibility of the development of the renewable energy sector in Azerbaijan for the years and decades ahead.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

Peer-review

Externally peer-reviewed.

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Conflict of interest

No potential conflict of interest was reported by the author(s).

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