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Feasibility Study of Using Renewable Energy in the Management of Sports Venues in the Water and Electricity Industry of East Azerbaijan Province and its Prioritization with D-number Theory

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Abstract

In this paper, the prioritization and weighting of different methods of using renewable energy, as well as the feasibility of using renewable energy in the management of sports venues in the water and electricity industry of east Azerbaijan province, have been discussed. The D-number theory method has been used to prioritize different renewable energy methods. The information gathered from experts in this field shows that solar energy weighing 0.5345 is the best method for producing electrical energy in sports and welfare venues. Wind energy, with a weight of 0.5183, and water energy, with a weight of 0.5126, are in the next ranks. The indicators used in ranking factors include total costs, energy efficiency, and compatibility with environmental conditions. Based on the results of the feasibility study and the available findings, it can be seen that the total cost of using renewable energy in the sports and welfare venues of East Azerbaijan province is equal to 10093.4 million Rials. Also, the interest return rate of the investment is equal to 19.43%. Therefore, using solar energy as a source of electricity production has technical and economic justification.

Keywords: Feasibility, Renewable energy, Sport venues, Economic justification, Technical justification, D-number theory.

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1 | Introduction

Natural resources in the not-too-distant past had very little value, making it possible for people to use them for free or for very little money. But nowadays, due to the increasing population growth and the consequent reduction of natural resources due to unprincipled use, not only is the value of these resources not insignificant, but their use is made possible by paying high costs. Since one of the world's main issues today is the energy supply from natural resources, it is no longer possible to use these resources without planning. Because exploiting nature without considering its limitations will soon stop the development and production process and put human lives at risk, with the increase in population and consumption, the available reserves will decrease, and the best solution is to use the available resources optimally. What should be done if these resources are exhausted one day [1]? What is the role of government companies, particularly companies that have the task of producing, transmitting, and distributing energy, and what is the mission of these companies to provide clean and reliable energy?

The pattern of energy consumption in Iran is completely different due to the cheap sources of energy in comparison with world prices, and therefore, in the design and supply of energy in public places, the use of non-renewable energies is still a priority [2]. The application of energy management and using existing solutions in optimization, as well as reducing energy consumption, can save costs and make better use of equipment, and it can also increase the existing efficiency without spending investment expenses for consumers [3]. The world's energy needs are growing. Using non-renewable energy is a moral must and a fundamental solution to meet human needs [4]. Due to the great effect of consumption management on the amount of energy consumption of buildings, finding the factors that reduce energy consumption and using them in the design of buildings, which leads to a significant reduction of energy consumption in buildings, consumption management and the optimal consumption of heating, cooling, lighting and electrical energy needed by electrical appliances, has a great fit with the economic, cultural and social conditions in Iran and it is very successful in execution. According to the way ahead in the withdrawal of subsidies or the reduction of the share of government subsidies in energy carriers, the economic management and saving of these energies will have an important place in families' monthly expenses [1]. Currently, energy plays a decisive role in the global economy and politics. For the coming years, energy will be one of the main axes of technological development, so in the future, we will have to use alternative energies that are inexhaustible and have no adverse effects on the environment. It seems that renewable energies can be a suitable substitute for fossil energies or at least contribute to the diversification of the country's energy portfolio along with these energies. Although Iran has good sources of fossil energy, the excessive consumption of energy shows that in the not-too-distant future, Iran will face energy problems with its current and growing consumption, especially the export of oil and gas. It is vital for Iran, considering its heavy dependence on oil revenues [5].

Considering the structure of sports venues in East Azerbaijan province and considering the climatic situation of this province from the point of view of the possibility of using renewable energies, it seems that if the environmental potential is combined with the ability to manage the consumption of sports venues, it is possible to use renewable energies in the management of sports venues, depending on the type of climate and the location used.

Therefore, considering that the use of renewable energies, in addition to helping to lower the costs of energy carriers and reducing the cost of energy consumption and more economically justifying the use of sports venues, can meet the needs of cooling, heating, and electricity of sports venues, it also can play a role in the structural and cultural development of sports venues and energy management of the discussed venues and financial management, as the most important component [6].

Feeling the need to pay attention to the role of renewable energies in providing energy carriers, this research aims to measure the feasibility of using renewable energies in the management of sports venues of the Ministry of Energy and as a pilot of the sports venues of the Azerbaijan Regional Electricity Company, to examine the possibility of energy consumption management and financial management, investigate the contribution of the

Electricity Company's sports venues in providing clean energy and investigate the participation of the Power Company's sports venues in energy saving and providing solutions to increase the share of clean energy use. It is implemented through the management of structural engineering in electric companies so that the necessary economic and technical feasibility study for it is also determined, in addition to identifying the possibility of using new energies in sports venues. The results of this research can be applied in addition to the practical results in the appropriate design of the sports structures of the electricity company, considering the lighting and ventilation, use of new energies, and expanding the general culture of consumption management and saving in consumption, as well as encouraging the public to use renewable energies in providing clean energy carriers.

According to the Fifth Development Program of the country, all executive bodies and non-governmental organizations are required to apply policies for the optimal consumption of basic resources and the environment to reduce the government's expenditure credits for the implementation of the green management program, including the management of energy consumption, water, raw materials, and equipment, reducing solid waste and recycling according to the regulations of the Environmental Protection Organization. Therefore, considering the economic and environmental benefits and the Islamic Republic of Iran's government's emphasis on directing energy supply through renewable energies, it seems that renewable energies can be used in the management of sports venues, especially financial and environmental management and also, energy consumption management can be used to a significant extent [7]. The use of this type of energy to provide lighting and heating for sports venues and water facilities has been neglected.

According to the stated content and the importance of using renewable energy instead of fossil fuel in organizations and companies, in this article, the feasibility of using renewable energy in the management of sports venues in the Water and Electricity Industry of East Azerbaijan province has been investigated. Due to different methods of renewable energy with various functions, this article discusses the prioritization and weighting of different renewable energy methods with the theory of D-numbers. This method ranks factors using experts' opinions based on specified indicators, including total cost, energy efficiency, and compatibility with environmental conditions. As a result, based on the best method obtained, technical and economic feasibility studies are examined, and the desired analyses are performed.

Hamledar et al. [8], in an article entitled "utilize the potential of the water and wastewater industry for distributed generation of clean energy," came to the conclusion that the limited use of fossil energy sources, increased environmental concerns due to excessive consumption of fossil fuels, increased population and energy consumption, power grid losses, low efficiency of thermal power plants, are the topics that show the importance of energy efficiency improvement and the use of renewable energies. In this article, it is pointed out that the water and sewage industry has the potential for renewable energy due to having facilities such as water transmission lines and underground tanks.

This industry has not only made it possible to build renewable power plants and recover these energies, but it has also made it a suitable alternative for fossil fuels to generate electricity, for reasons such as the inexhaustibility of renewable energies, the low cost, the use of the minimum water potential, less social and environmental problems to reduce the production of greenhouse gases. On the other hand, waste in electricity distribution networks is one of the key parameters in energy efficiency, showing the importance of the water and sewage industry as a great potential for producing various types of renewable energy sources. In this article, the potentials in the water and sewerage industry for the dispersed production of clean energy have been investigated, emphasizing the economic advantages and feasibility of this industry for Tehran [8].

Tavana et al. [9], in a study entitled "a review of uncertain decision-making methods in energy management using text mining and data analytics," concluded that despite the constant flow of rivers, renewable hydropower is always available in mountainous regions. Due to the alignment of water molecules, the production efficiency of hydropower plants is higher than that of wind power plants. Also, despite the energy loss in transmission to distant areas, hydropower plants have played a good role. In this research, it seems that from a technical point of view, by making changes in the existing elements such as height, pressure, inlet, and outlet flow of water, this type of turbine can be used in fish breeding ponds, agricultural areas, gardens, pools, and grounds, because the height is zero and pressure pumps create the water load. The feasibility study of this research has shown that the implementation of this plan is economically feasible and is affordable, and will be effective in managing electricity consumption and related costs [9], [10].

Sadeghi et al. [11], in an article entitled "renewable energy, economic growth and quality of the environment in Iran (1980-2012)," have declared that positive shock in renewable energy consumption affects changes in economic growth with a positive coefficient. Since energy is a driving force in economic growth and development, such a positive relationship is expected to be established. However, contrary to expectations, it was observed that the positive shock of renewable energy consumption has a positive effect on CO_2 emissions, and we can see that the use of renewable energies in Iran's economy has not caused a reduction in CO_2 emissions. It is also recommended that increasing the share of renewable energies in the country's total energy production should be taken into consideration by the politicians because, despite the high initial cost of renewable energy production, the jump in Gross Domestic Product (GDP) can compensate the initial cost and bring more stable and reliable economic growth. Fluctuations in the price of non-renewable resources in oil-dependent economies directly affect the society's economy. Therefore, it seems possible to reduce the intensity of economic volatility and create more stable economic growth by paying more attention to renewable energies [11]. Energy is an essential parameter for economic-social development and the quality of life. Sustainable energy is necessary for any economic growth. New options for energy production and the use of technologies for its production have been presented. So, the choice of technology is very important [12]. According to Iran's electricity industry reforms and privatization, "funding sources" have been introduced as the most important obstacle in increasing electricity production through renewable energies [13].

Arab [14], in an article entitled "energy performance targeting for an administrative building through energy baseline and energy performance indicator concepts," points to the fact that the agricultural sector is one of the high energy consumption sections, and the examination of data extracted from the south Kerman Electricity Distribution Company shows that the agricultural sector has the highest energy consumption. New demands for diesel wells in the region, the effect of agricultural subscribers on electricity networks, and the high waters due to the network's length force the electricity company to build substations at a high cost, leading to greater consumption of non-renewable energy sources. This issue prompts the electricity company to improve the consumption pattern of such subscribers by thinking of solutions and applying management strategies, attracting capital, and attracting the cooperation of governmental and non-governmental institutions. Research findings show that the use of renewable energies, especially wind turbines in the agricultural sector, despite the high initial cost, has high technical and executive capabilities and can meet the agricultural sector's needs and economic feasibility.

Beygzadeh et al. [15], in a work titled "energy analysis of the west Azerbaijan gas company sport and cultural complex and swimming pool," considering network losses and wind potential, have concluded that measuring the potential of using wind energy in an area requires accuracy and sensitivity in data collection. In this regard, an effort has been made to find the optimal location of the wind farm by estimating the wind potential in different areas of Regan, Kerman province and considering the daily load of subscribers. Therefore, it was found that in the case of using wind power plants and proper location and compliance with standards, the income from energy production and improvement of losses is obtained, which has a high economic benefit. Technically, according to the information obtained from the anemometer tower and the wind speed atlas, implementing wind turbines is possible and has high efficiency. Shafiezadeh and Falakdoost [7], in an article entitled "management the energy consumption of computers in offices and organization with an approach to changing attitude and human resources behavior," concluded that Iran is a very vulnerable country due to its special geographical and climatic conditions. To reduce the effects of global warming, the widespread use of renewable energy and the reduction of fossil fuels can save Iran from this pervasive and destructive crisis. Therefore, some parts of Iran, such as the Loot desert in the eastern south of Iran, are suitable for constructing a solar power plant because they receive maximum sunlight yearly. This research shows that the power plant can supply electricity throughout Iran. With technical analysis and simulation results, it has been concluded that this system has reduced environmental pollution and supplied the energy the consumer needs. Also, it is technically practical and feasible because it can be implemented in a telecommunication station. Makkiabadi et al. [16], in a study entitled "performance evaluation of solar power plants: a review and a case study," achieved the result that controlling and using a huge source of energy and optimal design of solar systems requires knowledge and awareness of the quantity and nature of solar energy. The obtained values show that the average received solar energy is (17.48) megajoules per square meter per day, and the value of the sky filter coefficient was calculated for all days of the year, which, on average, shows that 60% of the days, Tabriz has a clear sky and 40% of the days, the sky of this city is cloudy or partly cloudy, and also the average air clarity throughout the year is (0.6). According to the amount of received energy, cloud factor, sky transparency factor, and air transparency, it was determined that in Tabriz, it is possible to use solar energy in all technical and operational fields in the field of electricity generation and the creation of a solar power plant for private sector investment. Park and Kwon [17], in a study entitled "renewable energy systems for sports complexes: a case study," concluded that for one of the greatest stadiums in Busan, South Korea, an electricity supply system was proposed through combined renewable sources. The simulations were investigated using a combined optimization of multiple energy sources (Homer). The proposed optimized system includes a photovoltaic array, wind turbine, battery, and a converter. Considering an interest rate of 3 percent, generating electricity costs 0.585 dollars per kilowatt hour. 100% of electricity production is from renewable energy. As a result of this research, it was found that in this case, Busan Stadium has been identified as one of the most economical, environmentally friendly stadiums in South Korea, and this can be technically and operationally as a way to better understand the planning potential for renewable energy programs. Lucas et al. [18], in a study entitled "Sustainability Performance in Sports Venues Management," concluded that sports venues have a great impact on the environment because of a very impressive public view, social responsibility to the public, large venues such as football stadiums, use of resources such as energy, water, and materials during different periods. The need for transportation and many other environmental, social, and economic effects force sports managers to be more sensitive to the reduction of energy consumption, water consumption, and waste production, and in this way, the use of renewable energy is the best way to reduce costs and manage consumption in football stadiums. Javani and Davarn Hagh [19] confirmed using a hybrid system to meet the electricity demand in a considered stadium, based on data from Northeast Iran with average wind speed and daily solar radiation. Furthermore, the feasibility of adding renewable energy sources to gain an economical and environmental power supply to secure the electricity demand of the considered area was discussed. The results showed that if the proposed hybrid systems supply the required energy, they will have low costs, help significantly increase the use of renewable energy systems, and provide clean and economical energy systems. Elnour et al. [20] presented the first review article addressing the research gap in building operation management and optimization for SFs compared to other types of buildings and SFs located in hot climatic zones compared to cold ones. The topic's significance is highlighted with emphasis on the climatic zone and the characteristics of SFs. Abbasi et al. [21] improved a previous optimization approach to achieve an enhanced Total Cost of Electricity (TCE). Based on integrating many energy deposits to support the primary Renewable Green Energy Source (RGES), the whole system is modeled and improved, which contributes to achieving a more comprehensive write-up of the studied formulation problem. The results of the optimization display that savings in TCE is 14,792 $ compared to the calculation process without using the VCS algorithm. McQueen et al. [22] intended a theory-based aerodynamic model developed and applied to electrified powertrain configurations to analyze the feasibility of implementing fully electric and serial hybrid electric propulsion in light-sport aircraft. Kameya et al. [23] proposed a light rail system that runs on 100% renewable energy named the "Solar Light Rail" has been. Experiments using a prototype model have been carried out to demonstrate the availability of the rechargeable power supply method using supercapacitors. Rahimi et al. [24] compared the impact of renewable and non-renewable energy consumption on the economic welfare of Iran's provinces from 1379 to 1398. In this research, the Panel Data model was used. The results show that the consumption of renewable energy has a positive and significant impact, and the consumption of non-renewable energy has a negative and significant impact on welfare. Also, the variables of unemployment rate, inflation rate, and inequality of income distribution (Gini coefficient) have a negative and significant effect, and the variables of population growth rate, GDP, and labor productivity have a positive and significant effect on the economy. Pratihar et al. [25] introduced a new uncertainty control method called fuzzy neutrosophic to solve the transportation problem. Pratihar et al. [26] used Modified Vogel's Approximation method to solve the transportation problem in a two-level supply chain. They also investigated two numerical examples to check the effectiveness of the proposed method.

The literature review generally shows that an economic, technical, and feasibility study justifies using solar energy, water, and wind in the public and private sectors and different parts of Iran. However, the general and long-term view of the use of renewable energy has been neglected and has not been seriously included in macro politics. The present study seeks to answer whether using renewable energy, water, wind, and solar in managing the Azerbaijan Regional Electricity Company sports venues will be economically and technically feasible.

According to the above, the research gap can be summarized in the following cases:

- *Feasibility study or renewable energy use in water and electricity industry sports venues.*
- *Prioritizing the construction of a renewable power plant for energy supply by D-number theory.*
- *Analysis of construction costs of renewable energy power plants for sports venues.*

2 | Research Methodology

The present research method is applied in terms of its purpose and descriptive-analytical in terms of data use. The statistical population of the current research includes the sports venues of the Ministry of Energy and, as a case study, the cultural, sports, and welfare complex of Azerbaijan Electricity, which is affiliated with the Azerbaijan Regional Electricity Company and also includes indoor sports halls, large and small swimming pools, men's and women's gyms, aerobics hall, chess and the administrative part of sports venues, and the entire sports complex has been considered as a statistical sample and has been evaluated. Information about sports venues has been completed through the sports system of the Secretariat of the Ministry of Energy, and the officials have completed the specification form for sports venues and equipment of the water and electricity industry companies of East Azerbaijan Province.

Information about the potential of using renewable energies has been obtained through the organization of Renewable Energy and electricity productivity, specialized units implementing new energy projects, the executives of the consumption optimization plans of the mentioned companies, and the executives of the provincial water and electricity industry consumption management group and finally, supplementary information related to water, wind, and sun of East Azerbaijan province been obtained through the renewable energy organization and the energy efficiency from the Ministry of Energy. Radiation sensors were installed in the relevant places to measure the feasibility of using renewable energies in the sports venues of the water and electricity industry in the Azerbaijan region. Then, data monitoring and estimation of the amount of energy produced by the power plant was done considering the geographical and structural conditions of the places. Finally, the data was analyzed and presented using PYSYS software.

To monitor the data of the wind energy sector, the amount of energy produced by small wind power plants was estimated by taking into account the geographical and structural conditions and the wind of the region at the desired height, in terms of advantages and disadvantages and the obtained information was analyzed by siren software. Temperature and humidity sensors were used in the output data for both subjects above. In the end, the inflow or outflow of sports venues, especially swimming pools and water facilities, was analyzed to estimate the amount of energy produced by a small hydroelectric power plant. Therefore, before examining the feasibility of using renewable energy in managing the Azerbaijan Regional Electricity Company sports venues, their prioritization has been done using the D-number theory.

Evidence theory is a branch of mathematical science related to the empirical evidence in the mind and thoughts of every human being to create a coherent picture of facts. This theory, designed to deal with unexpected empirical reasons, offers new and fresh possibilities against existing evidence. The theory of evidence was first proposed by Dempster and later by Schaffer; hence, this theory is called the Demcepter-Schaefer theory, or D_S for short. Dempster-Schaefer's theory is based on the belief derived from evidence, so the belief structure of evidence theory is related to the classical probability model [27]. Dempster-Schaffer theory or evidence theory is used to deal with uncertain information. This theory requires weaker conditions than Bayesian theory; hence, it is often called a form of Bayesian theory. In the mathematical framework of Dempster-Schaefer's theory, the Basis of Probability Allocation (BPA) has been used in the diagnostic framework to express uncertainty. However, this theory has some limitations for displaying some information. One limitation is the need for elements to be unique in the detection framework. For example, linguistic variables are often used in evaluating an object. With "very bad" and "bad", "relatively good", "good", and "very good" such as paying attention to evaluations based on human judgment, the monopoly hypothesis is not exactly guaranteed, as the application of Dempster-Schaefer theory for such situations is questionable [28].

The D-number method works efficiently and effectively in dealing with various uncertainties, including ambiguity and information deficiencies. Therefore, in many other fields, such as crisis management, decision analysis, risk assessment, etc., a new presentation can be used to model unreliable information in D-numbers are long-term decisions that have been introduced to overcome the shortcomings of Dempster-Schaefer theory and are defined as follows.

If Ω the finite set is non-empty, then the mapping of D-numbers is shown as *Eq.(1)*:

$$\sum_{B\subseteq\Omega} D(B) \leq 1 \quad \text{and} \quad D(\phi) = 0, \tag{1}$$

ϕ is an empty set, and B a subset of Ω [29].

Based on the D-number evaluation, the elements are not mutually exclusive, and given the principle of incomplete information, the sum of the probabilities may be less than 1, which $\sum_{B\subseteq\Omega} D(B) = 1$ means that the information is complete and $\sum_{B\subseteq\Omega} D(B) < 1$ represents incomplete information.

For a discrete set $\Omega = \{b_1, b_2, \dots, b_i, \dots, b_n\}$ such that $b_i \in R$ and $b_i \neq b_j$ if $i \neq j$ a particular form of numbers is expressed as follows:

$$\begin{aligned} &D(\{b_1\}) = \upsilon_1, \\ &D(\{b_2\}) = \upsilon_2, \\ &D(\{b_i\}) = \upsilon_i, \\ &D(\{b_n\}) = \upsilon_n. \end{aligned} \tag{2}$$

Or more simply $D = \{(b_1, \upsilon_1), (b_2, \upsilon_2), \dots, (b_i, \upsilon_i), \dots, (b_n, \upsilon_n)\}$ so that $\upsilon_i > 0$ and $\sum_{i=1}^{n} \upsilon_i \leq 1$. If there are two numbers, D as a $D_1$and D_2 and as a *Relation (4)*.

$$\begin{aligned} &D_1 = \left\{(b_1^1, \upsilon_1^1), \dots, \left(b_i^1, \upsilon_i^1\right), \dots, (b_n^1, \upsilon_n^1)\right\}, \\ &D_2 = \left\{(b_1^2, \upsilon_1^2), \dots, \left(b_i^2, \upsilon_i^2\right), \dots, (b_m^2, \upsilon_m^2)\right\}. \end{aligned} \tag{3}$$

The combination of D_1 and D_2 is calculated as $D = D_1 \oplus D_2$ as shown below:

$$D(b) = \upsilon. \tag{4}$$

$$b=\frac{b_i^1+b_j^2}{2}. \quad (5)$$

$$\upsilon=\frac{\frac{\upsilon_i^1+\upsilon_j^2}{2}}{C}. \quad (6)$$

$$C=\begin{cases}\sum_{j=1}^{m}\sum_{i=1}^{n}\left(\frac{\upsilon_i^1+\upsilon_j^2}{2}\right), & \sum_{i=1}^{n}\upsilon_i^1=1 \quad \sum_{j=1}^{m}\upsilon_j^1=1,\\ \sum_{j=1}^{m}\sum_{i=1}^{n}\left(\frac{\upsilon_i^1+\upsilon_j^2}{2}\right)+\sum_{j=1}^{m}\left(\frac{\upsilon_c^1+\upsilon_j^2}{2}\right), & \sum_{i=1}^{n}\upsilon_i^1<1 \ \& \ \sum_{j=1}^{m}\upsilon_j^1=1,\\ \sum_{j=1}^{m}\sum_{i=1}^{n}\left(\frac{\upsilon_i^1+\upsilon_j^2}{2}\right)+\sum_{i=1}^{n}\left(\frac{\upsilon_i^1+\upsilon_c^2}{2}\right), & \sum_{i=1}^{n}\upsilon_i^1=1 \ \& \ \sum_{j=1}^{m}\upsilon_j^1<1,\\ \left(\begin{array}{c}\sum_{j=1}^{m}\sum_{i=1}^{n}\left(\frac{\upsilon_i^1+\upsilon_j^2}{2}\right)+\sum_{j=1}^{m}\left(\frac{\upsilon_c^1+\upsilon_j^2}{2}\right)+\\ \sum_{i=1}^{n}\left(\frac{\upsilon_i^1+\upsilon_c^2}{2}\right)+\frac{\upsilon_c^1+\upsilon_c^2}{2}\end{array}\right), & \sum_{i=1}^{n}\upsilon_i^1<1 \ \& \ \sum_{j=1}^{m}\upsilon_j^1<1.\end{cases} \quad (7)$$

So that

$$\upsilon_c^1=1-\sum_{i=1}^{n}\upsilon_i^1 \quad \& \quad \upsilon_c^2=1-\sum_{j=1}^{m}\upsilon_j^2. \quad (8)$$

It is noteworthy that hybrid operations do not maintain a corporate nature so that D-numbers can be combined correctly and efficiently [29], [30].

$$(D_1\oplus D_2)\oplus D_3\neq(D_1\oplus D_3)\oplus D_2\neq(D_2\oplus D_3)\oplus D_1. \quad (9)$$

If $D=\{(b_1,\upsilon_1),(b_2,\upsilon_2),\dots,(b_i,\upsilon_i),\dots,(b_n,\upsilon_n)\}$ is a D-number, the D consensus operator is defined according to *Eq. (11)*.

$$I(D)=\sum_{i=1}^{n}b_i\upsilon_i. \quad (10)$$

3 | Results Analysis

3.1 | D-number Results

Table 1 shows five options for constructing a renewable power plant for energy supply are considered. Therefore, this section uses the number theory method to discuss the ranking and selecting the most appropriate option for using renewable energy. According to *Table 2*, three indicators are considered for each option, and three experts must provide their opinions on each of the indicators and for each option. The indicators (environmental compatibility) and (creating sustainable employment) have a positive evaluation (the more, the better), and the indicators (start-up cost) have a negative assessment (the less, the better). *Table 1* shows the decision matrix for the initial evaluation of the option for each indicator and by each expert.

Table 1. Initial decision matrix for expert decision-making in choosing the type of renewable energy.

Alternatives	Expert 1			Expert 2			Expert 3		
	c_1	c_2	c_3	c_1	c_2	c_3	c_1	c_2	c_3
Water	0.24	0.33	0.43	0.40	0.20	0.40	0.15	0.24	0.61
Solar	0.30	0.35	0.35	0.45	0.18	0.37	0.28	0.16	0.56
Geotermal	0.28	0.33	0.39	0.35	0.25	0.40	0.23	0.44	0.33
Biologocal	0.42	0.26	0.32	0.25	0.40	0.35	0.35	0.20	0.45
Windy	0.25	0.32	0.43	0.30	0.30	0.40	0.44	0.18	0.38

This paper needs to provide each expert's desirability weight for each index, for which the variable correlation method has been used to weight the indicators. *Table 2* shows the weight of the indicators using the variable correlation method.

Table 2. The weight of evaluation indicators in choosing the type of renewable energy.

	c_1	c_2	c_3
Expert 1	0.5082	0.2255	0.2663
Expert 2	0.3658	0.5371	0.0971
Expert 3	0.3479	0.4222	0.2299

Next, the problem of prioritizing options is based on the opinion of experts, for which the method of D-number theory has been used. *Table 3* shows the converted decision matrix in the selection of options. Since the indicators c_1 and c_3 have a positive evaluation (the more, the better), and the index c_2 has a negative evaluation (the less, the better), the operator $(1 - c_2)$ is used to convert the negative indicators so that all the indicators become positive.

Table 3. Converted matrix for expert decision-making when choosing the type of renewable energy.

Alternatives	Expert 1			Expert 2			Expert 3		
	c_1	c_2	c_3	c_1	c_2	c_3	c_1	c_2	c_3
Water	0.24	0.67	0.43	0.40	0.80	0.40	0.15	0.76	0.61
Solar	0.30	0.65	0.35	0.45	0.82	0.37	0.28	0.84	0.56
Geotermal	0.28	0.67	0.39	0.35	0.72	0.40	0.23	0.56	0.33
Biologocal	0.42	0.74	0.32	0.25	0.60	0.35	0.35	0.80	0.45
Windy	0.25	0.68	0.43	0.30	0.70	0.40	0.44	0.82	0.38

In the second step, each option (renewable energy) must be set in a D-number format. For example, the weight applied by the first expert in selecting the first option is (0.5082, 0.2255, 0.2663) and the allocated amount is (0.24, 0.67, 0.43). Accordingly, the number D corresponds to the weights and the amount assigned to the first expert in selecting the first option as $D_{A_1}^{E_1} = \{(0.24,0.5082),(0.67,0.2255),(0.43,0.2633)\}$. Therefore, the same relationships are calculated and obtained for other experts when choosing options. For example, in *Table 4*, the numbers D show experts' opinions regarding selecting the first option.

Table 4. Numbers D provided for hydropower selection.

Hydropower	D-number
Expert 1	$D_{A_1}^{E_1} = \{(0.24,0.5082),(0.67,0.2255),(0.43,0.2633)\}$
Expert 2	$D_{A_1}^{E_2} = \{(0.40,0.3658),(0.67,0.5371),(0.43,0.0971)\}$
Expert 3	$D_{A_1}^{E_3} = \{(0.15,0.3479),(0.67,0.4222),(0.43,0.2299)\}$

In the third step, the total opinions of all experts should be specified in the form of D-numbers. For example, combining the opinions of all experts in choosing the first option is in the form of *Relation (11)*.

$$D_{A_1} = D_{A_1}^{E_1} \oplus D_{A_1}^{E_2} \oplus D_{A_1}^{E_3}. \tag{11}$$

Table 5 shows the consolidated opinions of experts regarding the selection of the first option.

Table 5. Results of the opinions of experts regarding the selection of hydropower.

b	v	b	v
0.2350	0.0660	0.5650	0.0449
0.2825	0.0571	0.5725	0.0425
0.3350	0.0580	0.5875	0.0653
0.3425	0.0556	0.6125	0.0404
0.3825	0.0535	0.6400	0.0663
0.4425	0.0528	0.6475	0.0638
0.6450	0.0529	0.6725	0.0397
0.5125	0.0440	0.6875	0.0618
0.5400	0.0743	0.7475	0.0610

According to the table above, the final score assigned to the first option equals 0.5126. Finally, *Table 6* shows the ranking and points earned for each option.

Table 6. Ranking of renewable energy types according to the total opinions of experts.

Option	Water	Solar	Geotermal	Biologocal	Windly
I(D)	0.5126	0.5345	0.4311	0.5065	0.5183
Rank	3	1	5	4	2

Based on the summary of the D-numbers theory results, it is observed that solar, wind, and hydropower energies with weights of 0.5345, 0.5183, and 0.5126 have been set as the first to third priorities for construction. In the following, the feasibility of each of these priorities is discussed.

3.2 | Feasibility Study of Using Renewable Energies

3.2.1 | Feasibility study of using wind energy

The selected location is in an area with a high density of people, and the nearby structures act as barriers to the wind, reducing its year-round effectiveness. Effective wind hours for capturing energy typically drastically decrease throughout the year. The following prerequisites must be met to use wind energy:

I. The wind turbine must be installed on the top of the building, and every obstacle must be at least 90 meters away from the turbine (adjacent high-rise buildings in all these complexes have distances of less than 90 meters).

II. 2- The wind efficiency hours have decreased due to the improper spacing of the nearby buildings, which significantly reduces the feasibility study and renders the project's implementation unprofitable.

III. 3- The noise pollution from wind turbines disturbs the nearby residents and creates issues, especially at night.

Fig. 1 shows the location of the case study in east Azerbaijan province.

Fig. 1. The location of the case study.

3.2.2 | Feasibility study of using water energy

Initially, using pool water increases the likelihood of using water turbines. The use of this method for energy extraction also lacks a technical and feasibility study due to the following reasons:

I. The water flow in the pools is not constant and is used at specific times of the day to fill the pool. In contrast, one of the requirements for using small water turbines is the presence of water flow with a volume of at least five cubic meters per minute and a duration of at least 16 hours per day.

II. Energy cannot be extracted using this method due to the high water consumption and high repair and maintenance costs.

III. Complementary equipment is significantly more expensive for the final extraction of electricity in this small volume.

3.2.3 | Feasibility study of using solar energy

I. The cultural, sporting, and welfare complex of east Azerbaijan features two parking lots, a hotel, a men's and women's gym, a multipurpose hall, and both large and small swimming pool roofs. The cars of hotel guests and pool visitors are parked roughly 500 square meters on the site's south side. The construction of solar parking offsets the costs of building conventional parking. A solar parking structure can be built on the western side of the property, which has a space of 250 square meters, if necessary.

II. A downward slope can be seen on the pool's roof. Because only 100 square meters of the southern portion of the office building attached to it can be used for 7 KW, the construction cost is not cost-effective in terms of the maintenance structure relative to the number of panels.

III. The roof of the football hall and the administrative department are between the pool and the hotel building. A portion of this section, which covers an area of about 1800 square meters, is impacted by the hotel building's shadow. As a result, 600 square meters is the total amount of usable space unaffected by the hotel building's shadow.

Generally, a power plant with a nominal 100 KW capacity can be built in east Azerbaijan's cultural, sporting, and welfare complex. *Table 7* presents an initial technical and economic analysis of East Azerbaijan Electricity's cultural, sporting, and welfare complex based on the feasibility study given.

Table 7. Initial technical and economic analysis of East Azerbaijan electricity's cultural, sports, and welfare complex.

Row	Description	Unit	Rate	Explanation
1	Nominal capacity of the roof	Kilowatt	70	_
	Nominal capacity of the southern area		20	
	Nominal capacity of the western area		10	
	Total		100	
2	Start of construction phase	-	-	After concluding the contract
3	Construction time	Month	7-8	-
4	Start of production phase	-	-	After construction
5	Useful life	Year	20	-
6	Exchange rate	Rial	-	-
7	Guaranteed purchase price	Rials per kilowatt/hour	9100	Regardless of transfer services

Selecting the power plant's nominal capacity marks the start of the design process. The number of solar panels is determined based on this capacity. The best installation angle for the panels concerning the horizon is calculated considering the power plant's location and shading analysis is used to estimate the power plant's approximate size. The power plant's required inverter must be chosen based on technical-economic studies.

The final phase of a solar power plant's electrical design involves designing and positioning AC and DC switchboards, figuring out the cross-sectional area, and determining the length of the cables. Technical benefits and economic efficiency are key factors when selecting an inverter. It is significant because AC and DC conversion can significantly increase power plant revenue and decrease maintenance costs. *Table 8* lists the recommended equipment, and *Table 9* lists the fixed investment costs for the cultural, sporting, and welfare complex in east Azerbaijan.

Table 8. Suggested equipment.

Row	Item Description	
1	Panel	SSF:250,320
2	Inverter	Fronius:25,25KW

Table 9. Fixed investment costs of East Azerbaijan electricity's cultural, sports, and welfare complex.

Row	Item Description	Amount (Million Rials)
1	Project engineering and management	400
2	Supply of solar panels	5300
3	Supply of solar inverters	1640
4	Supply of panel structure	2950
5	Supply of boards, low and medium-voltage cables, and ground system	420
6	Installation and commissioning of power equipment	450
Total sum		11660
Total sum including VAT (9%)		12164/4

3.3 | Geothecnical Survey

Geotechnical surveys are primarily carried out to determine the state of the ground, the roof's strength, the layout of the foundations, and the sequence in which the structures were built. An evaluation of the land topology was the foundation for the construction operations and power plant design. Included in geotechnical studies are the following:

I. Soil characteristics: the type two soil in the area.

II. Roof structure resistances: since the shed's plans are not accessible, the roof structure must be able to support a weight of 75 kg per square meter.

III. Water permeability and soil moisture: the cost of building an earth well is directly related to the moisture content of the soil.

IV. Geographic description: the NASA SSE website is where the software gets its meteorological and geographic data. With the help of this software, you can calculate the average monthly radiation, the radiation-hour curve for various months of the year, and the environment's maximum and minimum temperatures for each geographic longitude and latitude.

The complete list of required information is as follows:

I. Total sunlight: a more accurate estimate of production per year.

II. Average monthly average daily temperature: direct correlation with production.

III. The percentage of the average relative humidity.

IV. The number of days with more than 10 millimeters of rain.

V. The number of days with thunderstorms.

VI. The number of days with dust storms.

VII. The strongest wind's direction and speed.

VIII. The number of cloudy days.

The software's database of solar panels, inverters, and electrical apparatus will be updated online. The data can also be manually updated. Government offices are where the power plants' construction took place. Compared to other locations, power plants constructed in government buildings purchase electricity at a lower rate. Additionally, the return on investment is calculated based on 560 rials.

Table 10 presents all the civil and electrical costs regarding the regional and overhead coefficients.

Table 10. Economic principles and assumption.

Row	Description	Unit	Amount	Explanations
1	Nominal capacity of the power plant	KW	100	-
2	Start of construction phase	-	-	After concluding the contract
3	Construction time	Month	7-8	-
4	Start of operation phase	-	-	After completing the construction phase
5	Project useful life	Year	20	-
6	Annual income growth rate	Percentage	5	-
7	financing	-	-	Investor financing
8	Exchange rate	Rial	-	-
9	Guaranteed purchase price	Rial per kilowatt hour	9100	Regardless of transfer service
10	Guaranteed purchase rate	Rial per kilowatt hour	560	-

Depending on the photovoltaic technology used, the efficiency of electricity produced by solar panels after 20 years is 85% of its initial value. Also, the 1% annual production decline over 20 years is taken into account due to the deterioration in the quality of other power plant equipment. The summary of the report on plant construction is shown in *Table 11*.

Table 11. Summary of plant construction report.

Row	Title	Unit	Amount
1	Total capacity of the power plant	Kilowatt	100
2	Operation place	-	East Azerbaijan
3	Project start time	-	After concluding the contract
4	Project implementation period	Month	7-8
5	Electricity sales rate	Rial kilowatt hour	9100
6	Government sales rate	Rial kilowatt hour	560
7	Equivalent electricity produced in the first year	kilowatt hour	164000
8	Total investment cost	Million rials	12164/4
9	How to provide financial resources	Investor financing	
10	Annual operation and maintenance costs	Million rials	-
11	Licensing costs	Rial	-
12	Internal rate of return(IRR) based on rate(560)	Percent	-12.5
13	Internal rate of return(IRR) based on rate 10400 rials	percent	13.17

The cost of constructing the building can be decreased if the site requires covered parking. Based on this, *Table 12* displays the fixed costs of building a power plant without taking the building structure (30 KW).

Table 12. Reviewing the fixed costs of investing in the cultural, sports, and welfare complex of Azerbaijan Electricity.

Row		Item Description	Amount (Million Rials)	
1		Engineering and management of project	400	
2		Supply of solar panels	5300	
3		Supply of solar inverters	1640	
4		Providing panel structure	1050	
5		Supply of boards, low and medium voltage cables and ground system	420	
6		Installation and commission of power plant equipment	450	
7		Total sum	9260	
8		Total sum including VAT (9%)	10093.4	
Row		**Title**	**Unit**	**Amounta**
1	General specification of the design	Total capacity of the power plant	Kilowatt	100
2		Project start time	-	After concluding the contract
3		Operation place	-	East Azerbaijan
4		Electricity sales rate	Rial kilowatt hour	9100
5		Government sales rate	Rial kilowatt hour	560
6		Equivalent electricity produced in the first year	Rial kilowatt rial	164000
7		Total investment cost	Million rials	10093.4
8		How to provide financial resources	Financing	Investor
9	Costs and incomes	Annual operation and maintenance costs	Million rials	-
10		Licensing costs	Rial	-
11		Internal rate of return based on rate(10400)	Percent	19.43
12		Internal rate of return based on rate(560)	percent	9.5

Also, *Table 13* shows the capital return rate for a 100 kW power plant.

Table 13. The rate of return on capital for a 100 kW power plant.

Project Name	Capital Return Rate Free Rate	Capital Return Rate Government Rate	Return on Investment Period (Free Rate)	Return on Investment Period (Governmental Rate)
100 kilowatts, cultural, sports and welfare complex of Azerbaijan	13.7	9.5	73	Capital return is possible during the useful life of the project

In the case of revision, purchasing electricity with a 100 kW solar power plant is guaranteed to be cost-effective. The internal use of grid electricity is a scenario that can be used to determine the return on investment and its duration. *Table 14* displays the cost of the electricity used by the site in various scenarios.

Table 14. The price of electricity consumed by the sports complex in different cases.

Row	Consumption Price	Amount (Rial)
1	Average load	362
2	Peak load	724
3	Low load	181

As can be seen, the cost of electricity has decreased and is comparatively less than the guaranteed purchase rate of electricity from government offices due to the site's cultural and sporting significance. The return on investment will be much longer if we decide that selling electricity to the grid is preferable to using it for domestic consumption. Finally, *Fig. 2* displays the energy output from constructing a 100 kW solar power plant.

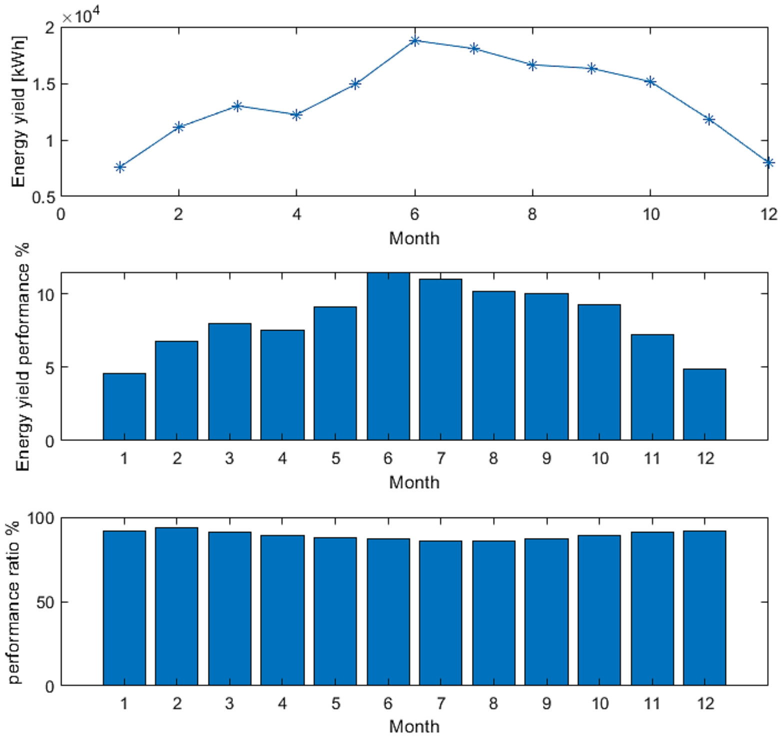

Fig. 2. The energy yield obtained from constructing a 100-kilowatt solar power plant.

4 | Discussion

Based on the findings, it is concluded that using renewable energy results in optimal heating, cooling, lighting, and electricity energy consumption and a significant decrease in the amount of energy used in buildings. Sports facilities must, therefore, be constructed with future energy needs in mind. Additionally, the currently available analysis demonstrates that before switching to renewable energy sources in place of fossil fuels, an economic and technical feasibility study should be conducted, and the costs and revenues that result from it should be carefully calculated.

5 | Conclusion

According to the study's findings, it can be concluded that a small amount of renewable energy can be used to help sports venues with their cooling, heating, and electricity needs. The study's finding that the Ministry of Energy's sports venues have a high potential for using renewable energy is consistent with the study's finding [7]. Since there are numerous ways to use renewable energy, the D-number theory technique was used in this paper to rank and weight them. Based on this, a group of subject-matter experts in this area were identified, and good results were seen by collecting information from them. Based on the summary of the results of the theory of D-numbers, it is observed that the use of solar, wind, and hydropower energies with weights of 0.5345, 0.5183, and 0.5126 has been set as the first to third priority for construction. It is possible to conclude that there is uncertainty in the matter based on the research findings and limitations. Therefore, ranking the factors using the fuzzy and neurosophic sets methods is advised. To cut costs and energy consumption, it is also recommended that these techniques be tested in other public and private organizations and businesses.

Conflicts of Interest

All co-authors have seen and agree with the manuscript's contents, and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

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