

Review of Promoting Energy Sustainability In Iraq: A Comprehensive Vision For The Application and Development of Renewable Energy

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Abstract:

The importance of using and investing in renewable energy (green energy or clean energy) as alternative energy or supplement to non-renewable energy, such as fossil fuel, is accelerating at present. Renewable energy is considered one of the main axes towards the transition to a sustainable energy system, confronting the growing global demand for energy and filling the economic crisis in addition to the prominent role in preserving the environment, reducing harmful emissions, and adapting to the effects of climate change. The wide spread of renewable energy applications also resulted in a noticeable decrease in the cost of electrical energy produced, especially from the two energy sources (solar and wind energy, while Its use in the areas of heat production, heating) or in the transportation sector is still much less. In this research, the issue of renewable energy was reviewed in Iraq, which is considered one of the countries that deal with alternative energy sources timidly despite the availability of sources such as sun, wind and water, illustrating the importance of investing in renewable energy in Iraq. Iraq needs a specific and clear strategy to deal with energy and to set goals and plans to achieve maximum benefit from it and invest it optimally, also determine the main challenges that affecting renewable energy sources. We also review the alternative energy sources available in Iraq to find out whether it is feasible to rely on them entirely or if there is a need to rely on non-renewable fuels at the same time to meet Iraq's needs in various areas of production for energy. Additionally, this research focuses on the prospects of different renewable resources and energy in Iraq to enhance its economic recovery, whether in the production or consumption sectors.

Keywords: Renewable energy, Green energy, Solar energy, Environmentally friendly energy, Wind energy, Hydropower, Sustainable development.

مراجعة تعزيز استدامة الطاقة في العراق: رؤية شاملة لتطبيق وتطوير الطاقة المتجددة

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الخلاصة:

تسارع في الوقت الحاضر أهمية استخدام الطاقة المتجددة والاستثمار فيها (الطاقة الخضراء أو الطاقة النظيفة) كطاقة بديلة أو مكملة للطاقة غير المتجددة مثل الوقود الأحفوري. وتعد الطاقة المتجددة أحد المحاور الرئيسية نحو التحول إلى نظام الطاقة المستدامة ومواجهة الطلب العالمي المتزايد على الطاقة وسد الأزمة الاقتصادية. فضلاً عن دورها البارز في الحفاظ على البيئة وتقليل الانبعاثات الضارة والتكيف مع تأثيرات التغير المناخي. و أدى الانتشار الواسع لتطبيقات الطاقة المتجددة إلى انخفاض ملحوظ في تكلفة الطاقة الكهربائية المنتجة، خاصة من مصدري الطاقة: (الطاقة الشمسية وطاقة الرياح، في حين استخدامها في مجالات إنتاج الحرارة والتدفئة) أو في وسائل النقل. و في هذا البحث استعراض موضوع الطاقة المتجددة في العراق الذي يعد من الدول التي تتعامل مع مصادر الطاقة البديلة على استحياء رغم توفر مصادرها كالشمس والرياح والماء؛ مما يوضح أهمية الاستثمار في الطاقة المتجددة في العراق ، إذ يحتاج العراق إلى استراتيجية محددة وواضحة للتعامل مع الطاقة ووضع أهداف وخطط لتحقيق أقصى استفادة منها واستثمارها بالشكل الأمثل، كما تحدد أهم التحديات التي تؤثر على مصادر الطاقة المتجددة. كما نستعرض مصادر الطاقة البديلة المتوفرة في العراق وهل يمكن الاعتماد عليها بشكل كامل أم أن هناك حاجة للاعتماد على الوقود غير المتجدد في الوقت نفسه لتلبية احتياجات العراق في مختلف مجالات إنتاج الطاقة. كما يركز هذا البحث على مستقبل مصادر الطاقة المتجددة المختلفة في العراق ويضمن الانتعاش الاقتصادي سواء في قطاع الإنتاج أو الاستهلاك.

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الكلمات المفتاحية: الطاقة المتجددة، الطاقة الخضراء، الطاقة الشمسية، الطاقة الصديقة للبيئة، طاقة الرياح، الطاقة الكهرومائية، التنمية المستدامة

1. Introduction

The demand for energy and associated services is increasing to support human growth in society, the economy, social services, health and various other services. All societies need energy services to meet basic human requirements. Securing energy supplies and reducing the role of energy in climate change are two of the most pressing concerns facing the energy industry on the path to a sustainable future. Many individuals still do not have access to electrical energy, especially those who live in rural areas. As a result, several rural communities rely on the traditional use of biomass [1]. Therefore, there has become a significant trend towards strongly relying on renewable energy, that is, investing in renewable natural resources with high efficiency and using them as a basis for energy, as these sources are considered inexhaustible. Relying on these is regarded as a cornerstone for confronting significant climate changes and reducing the environmental degradation that occurs as a result of emissions of greenhouse gases. Generated by fossil fuel sources [2] In addition to reducing dependence on non-renewable resources, which are considered limited, achieving energy independence provides job opportunities for many workers. Thus, this achieves economic recovery in various fields [3]. Despite the importance of renewable energy or clean energy now, there are many challenges facing this field, such as constant weather and climate fluctuations, especially in countries where the winter season is relatively long, and the importance of storing surplus energy and dealing with it economically and fruitfully. Also, fully securing energy requirements and the ability to meet the need for energy, political interventions and the relations of countries among them can also affect the production of renewable energy, the need to spread awareness among members of society of the importance of renewable energy, enhancing energy production from renewable

sources, especially in oil-based countries. There is a strong reliance on oil in energy production, in addition to many obstacles that may face the consumer, especially if the country does not have special laws for investing in environmentally friendly renewable energy. Renewable energy sources and sustainability [2,3,4].

2. Forms of renewable energy sources in Iraq.

Iraq covers large areas of land and water, such as the desert plateau, the northern highlands, the transitional highlands region between the northern highlands and the desert plateau, and the alluvial plain region that includes the delta of both the Tigris and Euphrates rivers. Therefore, Iraq, due to its different terrain, enjoys a great diversity of renewable natural energy sources, such as [5]:

2.1 Solar energy

Solar energy is considered one of the most important types of renewable energy because all living organisms depend on it, as it is considered an essential factor in the nutrition of plants, and it is also considered a major source of light and heat. The total amount of energy that the Earth receives is considered a small fraction of the amount of energy consumed in the world if it were used perfectly. Solar energy is continuous energy that does not cause pollution and is renewable. The hours during which Iraq is exposed to solar radiation are relatively long, especially in central and southern Iraq, where the intensity of solar radiation in Iraq is greater than in other countries [5,6]. Solar energy is derived from the sun's radiation. On solar panels, sunlight is transformed into electricity via the photovoltaic effect, which is the conversion of photons to electrons, which subsequently flow through electrical circuits. Solar energy may be utilized to generate electricity for home and commercial purposes, as well as to power solar water heaters and appliances [7]. Figure 1 shows the Global Horizontal irradiation in Iraq [8].

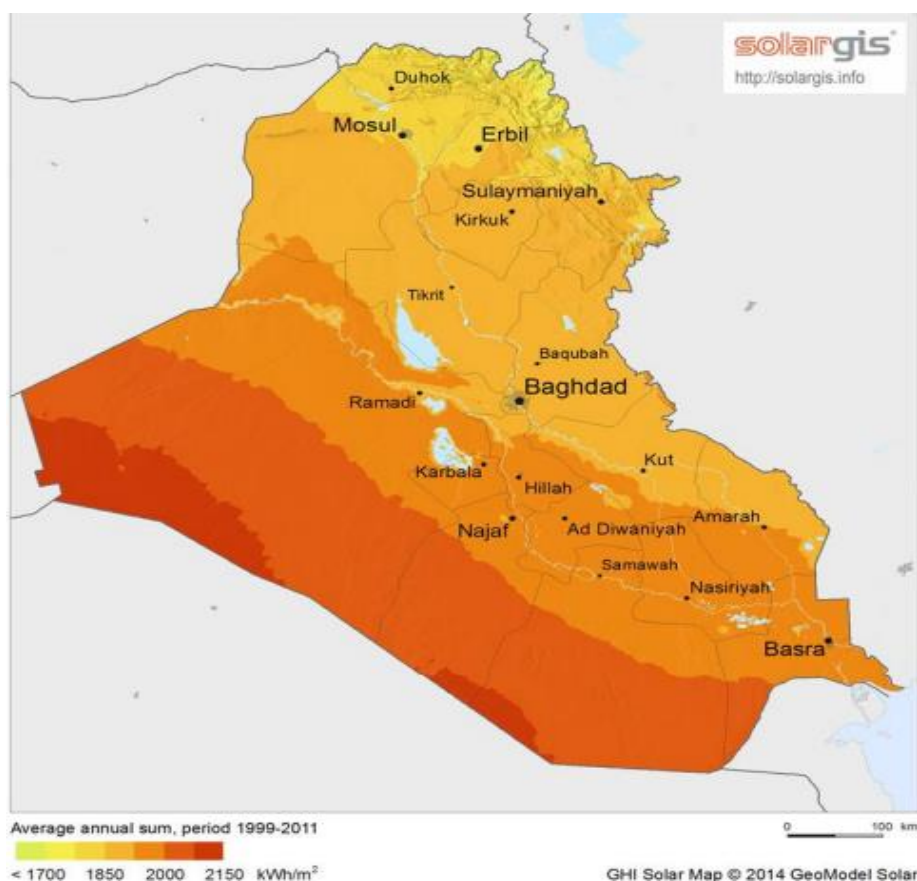


Figure (1): Global Horizontal irradiation in Iraq [8].

2.2 Wind energy

It is one of the most important renewable energy sources and can be classified as a type of energy Electromechanical, which is characterized by abundance, cleanliness, and ease of use. Wind energy is preferable to be used in particular in wide and open areas, as opposed to narrow and closed areas, which are not considered suitable for this type of alternative energy. This energy is affected by the type and design of the turbines used, according to the height of the place where it will be installed, as well as the speed and direction of the wind. Wind energy emerges as a result of the varying degrees of heating of the atmosphere by the sun [9]. The average wind speed in Iraq is considered relatively low on an annual basis [10].

Table(1) : The wind velocities different territories in iraq [5].

Territories	Distance	Wind Velocity
1	48% of Iraq	2–3 m/s
2	35% of Iraq	3.1 to 4.9 m/s
3	8% of Iraq	more than 5 m/s

2.3 Hydropower

This energy is produced from the flow or fall of water at water dams and water tanks, thus moving the turbine blades connected to special generators to produce and generate electrical energy. Hydroelectric energy has many benefits, including that it is considered an environmentally friendly fuel source; in addition to the associated benefits such as flood control, drought reduction, water supply

and irrigation methods, Hydroelectric stations are among the cleanest types of electrical stations and the most efficient in producing electrical energy compared to steam and gas stations, as their efficiency ranges between 80% - 90% depending on the type of turbine used in the station. In Iraq, hydroelectric energy has been invested since 1971, as the Samarra station is the first hydropower station that entered production in 1972; hydroelectric

stations contribute 6% of Iraq's total electrical energy production. Iraq owns ten hydroelectric stations, two of which are in the Kurdistan region, due to its geographical capabilities that allowed it to exploit this important resource, in

Table (2) : The most important source of water in different locations in Iraq [9].

City	Hamrine	Samarra	Derbinderkhan	Dokan	Haditha	Musol
Source of water	Diyala	Tigris	Diyala	lake	Euphrates	Tigris
Generated energy	50 MW	84 MW	249 MW	400 MW	660MW	1050 MW

2.4 Geothermal energy

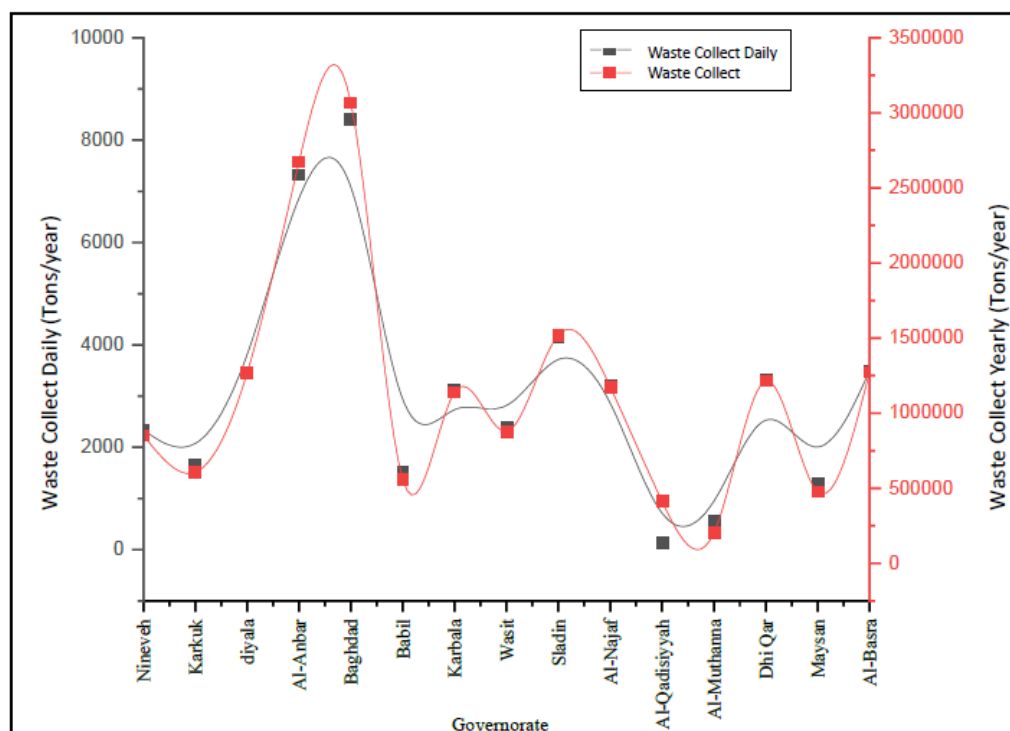
It is a renewable source of clean, sustainable, and environmental energy that can generate electrical energy for cooling and heating purposes and many agricultural and industrial applications. Two approaches are employed in producing geothermal energy: the first is called power plants, and the second is called a heat pump [12]. The temperature gradient in Iraq is divided into two parts: the first in northern Iraq and the second in southern Iraq. It is considered a geothermal-poor region with no significant hotspots throughout the country. However, for low-temperature applications, it can be exploited using depleted oil wells [13]. It may be inferred that there is great potential for utilizing geothermal energy resources using binary power cycles, particularly in the W region of the Rutba subzone. Temperatures of up to 280°C are projected in certain disposal regions. To attain this temperature point, the actual drilling depth should be between 4000 and 4500 meters. These temperatures are high enough to support a binary power plant. However, the initial cost of digging such deep wells and establishing the power plant is relatively high. Furthermore, borehole drilling into that depth is difficult due to exceptionally hard rock strata. Because such plants do not require fuel to operate, cost savings may be obtained over

addition to its possession of two rivers running from north to south [9,11]. Table 2 illustrates the most crucial water source in different Iraq locations[8]

time, in addition to the environmental friendliness of this technology [12,13].

2.5 Biomass energy

Biomass energy refers to the energy that can be extracted from biological organic matter, whether plant or animal or from organic waste. These organic materials are converted into thermal or electrical energy or fuel. Sources of biomass may be plants, where various types of plants such as wood, straw, and grasses can be used as a source of biomass, or food waste and organic waste. Organic materials can be burned to generate direct heat, and this heat is used to heat buildings or generate steam to operate kinetic energy engines. Organic materials can also be converted by bacteria into biogas, which can be used as a gaseous fuel to generate electricity. A common application of this energy is the use of biomass energy to generate electricity in biopower plants. This energy also contributes to environmental sustainability, reduces dependence on fossil fuels, and limits carbon dioxide emissions. Food waste and organic waste can be used to generate energy instead of their final disposal. The use of biomass is an important source of renewable energy, as it can contribute to environmental sustainability and provide a clean, renewable energy source [14,15]. Figure 2 illustrates The amount of solid waste collected through Iraqi governorates.



Figure(2): that illustrate The amount of solid waste collected through Iraqi governorates [15].

Table 3 bellow illustrate different types of renewable energy with their feasibility of using it with its drawbacks

Table (3): Feasibility and drawbacks of renewable energy in Iraq.

The type of energy	Feasibility	Drawbacks
Solar Energy [16]	<ul style="list-style-type: none"> ▪ Environmental sustainability: Solar energy is clean and does not produce greenhouse gas emissions during operation. ▪ Local availability of energy: Solar energy can be generated at the place of consumption, reducing energy loss during its transmission. 	<ul style="list-style-type: none"> ▪ Dependency on weather conditions: The efficiency of solar energy depends on weather conditions and geographical timing, and solar energy may be ineffective at night or on cloudy days. ▪ Initial investment cost: Solar systems require a high cost of installation and operation in the initial stage.
Wind Energy[17]	<ul style="list-style-type: none"> ▪ Environmental sustainability: Wind energy is clean and reduces reliance on traditional sources of electricity generation. ▪ Effective in windy areas: High efficiency can be achieved in areas with strong winds. 	<ul style="list-style-type: none"> ▪ Visual and audio impact: Some people may find the lights and sound generated by wind generators to be annoying. ▪ Impact on Wildlife: The presence of wind towers may impact wildlife and the migratory routes of birds.
Hydropower energy [9,11]	<ul style="list-style-type: none"> ▪ Hydroelectric power generation: Providing a sustainable source of electricity generation, which contributes to 	<ul style="list-style-type: none"> ▪ Environmental Impact: The construction of dams and reservoirs can lead to changes in

	<p>meeting Iraq's energy needs.</p> <ul style="list-style-type: none"> ▪ Flood Control: The ability to control torrents and floods by regulating the flow of water. ▪ Improving agricultural irrigation: Using dams and hydroelectric stations to improve agricultural irrigation operations and provide water for agriculture. ▪ Enhancing environmental sustainability: Reducing carbon emissions associated with electricity production compared to some other sources. 	<p>the local environment and loss of biodiversity.</p> <ul style="list-style-type: none"> ▪ Social Impact: Dam construction may cause displacement of local communities and loss of agricultural land or historical sites. ▪ Sediment buildup: Sediment buildup in reservoirs may reduce long-term storage capacity and hydroelectric efficiency. ▪ Infrastructure cost: The structure of dams and hydroelectric plants can be expensive to construct and maintain.
Geothermal Energy[18]	<ul style="list-style-type: none"> ▪ Performance forecasts: Predictions of geothermal efficiency are more difficult than those for solar and wind. ▪ Cost: The cost of constructing geothermal plants can be high. 	<ul style="list-style-type: none"> ▪ Sustainability: Geothermal energy depends on the heat generated from the ground and does not depend on weather conditions. ▪ Long-term sustainability: It can provide heat for a long time
Biomass Energy[19]	<ul style="list-style-type: none"> ▪ Waste Management: it can be used to dispose of organic waste and convert it into an energy source. ▪ Local sustainability: it can provide a local source of energy. 	<ul style="list-style-type: none"> ▪ Emissions: Biomass burning operations may produce greenhouse gas emissions and air pollutants. ▪ Resource Use: Bioenergy production may require the use of significant land and water resources.

3. The importance of investing in renewable energy in Iraq

Despite advances in the use of renewable energy internationally, global energy consumption is growing, with production currently reaching 222 gigawatts. Oil demand will increase and rise further as global oil supplies run out. In Iraq, renewable energy has several important aspects, including:

- Investing in renewable energy in Iraq will provide a portion of oil production for domestic consumption, which can then be exported and generate additional funds [20,21].
- Iraq is considered one of the countries rich in renewable energy, especially solar energy. Therefore, attention and investment must be paid to this energy in a way that benefits Iraq today and in the future [22].
- Many of the countries of the Organization of Petroleum Exporting Countries (OPEC) have resorted to using renewable energies, which are considered a non-depleting source of

energy that strengthens their national economies.

- Protects the environment, reduces pollution, and improves public health.
- Renewable energy technologies offer new job prospects for the unemployed and new graduates due to their simplicity and ease of learning [20,21].

4. Challenges affecting renewable energy sources.

There are several challenges affecting the development and adoption of renewable energy sources in Iraq. Some of these challenges include:

- **Security challenges:** Security unrest and conflicts in some regions pose a major challenge to the implementation of renewable energy projects and their impact on investments, especially in the Western Plateau.
- **Weak infrastructure:** Iraq's weak infrastructure can be a challenge, as there can be difficulties in effectively

transmitting and distributing renewable energy.

- **Financial challenges:** Financial challenges may be an obstacle, as developing and building renewable energy projects requires large investments, and these investments may sometimes not be sufficiently available.
- **The economy's dependence on oil:** The Iraqi economy's heavy reliance on oil exports could be a challenging factor for diversifying energy sources and shifting them toward renewables.
- **Legislation and Policies:** Iraq may need to update energy-related legislation and policies to provide a better investment environment for renewable energy projects.
- **Lack of Awareness and education:** There may be a need to increase awareness and education about the benefits and importance of renewable energy, whether among the public sector, the private sector, or the local community.
- **Technological transformation challenges:** New technology and equipment upgrades can have a cost, and Iraq may need to take advantage of modern technologies to increase efficiency and improve performance [23,24,25,26].

5. Future of renewable energy in Iraq

5.1 Future of Solar energy

Iraq has an abundance of solar resources, with long periods of sunshine throughout the year. As a result, solar energy can be a viable choice for generating power and fulfilling future energy demands. Technological advancements, as well as government and private sector backing for renewable energy projects, can all help to promote solar energy adoption. Furthermore, government measures aimed at encouraging sustainability and strengthening the country's energy infrastructure may aid the growth of the solar energy sector. International initiatives and foreign funding can help to accelerate the development of solar installations in Iraq. The government must take steps to upgrade infrastructure and create a legal and economic environment that encourages investment in solar energy. Solar energy has the potential to play a key role in producing power and enhancing energy sustainability in Iraq, provided that technology advancement continues and the government and private sector work together positively.

Iraq's reliance on solar energy may expand in the future [24, 27].

5.2 Future of Wind energy

Like solar energy, wind energy holds great potential in Iraq due to the availability of suitable geographical locations for generating electricity through wind plants. Here are some factors that may affect the future of wind energy in Iraq:

1. **Wind resources:** Iraq is considered a region with good potential for generating energy from wind. Some areas in Iraq have high wind speeds and a suitable climate for operating wind plants.
2. **Investment and financing:** Wind energy projects require large investments, but once sufficient financing is available, more plants can be developed. Cooperation with international companies or international funding bodies can play a role in supporting the implementation of these projects.
3. **Infrastructure:** Infrastructure must be developed and improved to support wind energy generation, such as electricity networks and power transmission. This can help improve the effectiveness of transporting electricity from wind sources to areas that need it.
4. **Government policies:** Government support plays an important role in promoting the development of renewable energy. The government can adopt policies that encourage investment in wind projects and provide incentives to companies involved.
5. **Technology:** Advances in wind farm technology can make them more effective and economical. With technological advances, the performance of wind plants can be improved and maintenance costs reduced [8, 9, 18, 28, 29].

5.3 Future of Hydropower energy

The future of renewable hydropower in Iraq could be affected by several factors, including technological developments, government policies, and environmental and economic challenges. Here are some factors that may affect the future of hydropower in Iraq:

1. **Expansion of infrastructure:** If investment is made in building more dams and hydroelectric plants, it can increase hydropower production and meet growing electricity needs.
2. **Technological development:** Continued technological advances in

hydropower can improve the efficiency of power generation and reduce infrastructure impacts on the environment.

3. Environmental and social challenges: Consideration must be given to how to deal with the environmental and social impacts of building water projects, such as their impact on local communities and ecosystems.
4. Climate change: Climate changes may affect water availability, requiring strategies to deal with fluctuations in water resources.
5. Diversification in energy sources: Hydropower's future may be connected to energy source diversification to assure supply stability and progress toward higher sustainability.
6. International cooperation: Cooperation with neighbouring nations and multinational corporations can help to realize huge projects and share technology and experience.
7. It is also important to strike a balance between meeting growing electricity needs and protecting the environment and water resources. Overall, hydropower can have an important role in providing sustainable energy supplies in Iraq, provided it is carefully managed to ensure a balance between economic benefits and environmental sustainability [9,11,30,31].

5.4 Future of Geothermal energy

The use of underground energy in Iraq, such as geothermal energy, may have a promising future as a sustainable means of generating energy. Here are some points that may affect the future of underground energy in Iraq :

1. Resource Exploration: Exploiting geothermal energy requires careful exploration of the resources available in Iraq, including determining ground temperatures and potential source locations.
2. Extraction technology: Development in geothermal extraction technology can contribute to enhancing the efficiency of using this source.
3. Technical Challenges: Technologies associated with geothermal energy may face technical challenges related to extraction and heat transfer.
4. Investment and financing: Financing and investment in underground energy

projects provide vital support for the development of this sector.

5. Legislation and Policies: Establishing policies and legislation supportive of renewable energy, including geothermal energy, can encourage positive steps towards developing this sector.
6. Awareness and Education: Increasing awareness about the environmental and economic benefits of geothermal energy may play a role in enhancing community acceptance of this technology.
7. Integration with the electrical grid: Integration of underground energy systems with the national electrical grid requires appropriate infrastructure and strategic planning.
8. With the advancement of technology and increasing interest in diversifying energy sources, geothermal energy can play an important role in the future of energy sources in Iraq, especially if the focus is placed on overcoming technical and economic challenges [12, 13, 33, 34].

5.5 Biomass energy

A renewable and sustainable resource. Here are some aspects that may affect the future of biomass energy in Iraq :

1. Project and infrastructure development: Iraq could see development in biomass-related projects, including power plants from organic waste and agricultural waste. This requires investment in infrastructure and the development of effective technologies.
2. Use of agricultural waste: The use of agricultural waste, such as grass plants and rice straw, can play an important role in generating bioenergy.
3. Promoting sustainable agriculture: Supporting sustainable agriculture can enhance the provision of sustainable resources for biomass generation.
4. Improving energy conversion efficiency
5. Focusing on improving the efficiency of biomass-to-energy conversion processes can make this type of energy more attractive.
6. Government Policies: Establishing supportive government policies that encourage the use of biomass and providing financial incentives can help promote the development of this sector.
7. International cooperation: Cooperation with other countries and international

companies in the field of biomass energy can contribute to technology transfer and efficiency improvement.

8. Community awareness: Increase community awareness about the benefits of energy from biomass and its role in sustainable development.

As the world moves towards sustainable energy sources, biomass utilization can play an important role in achieving

renewable energy goals and mitigating environmental impacts [9,14,15, 34, 35].

5.6 Comparative overview

A new strategic agreement with the Iraqi government to develop solar energy projects to generate at least 2 GW by 2030 is promoted by an international company called International Renewable Energy and Sustainability in 2022 [36]. The prospects of investments in solar power in Iraq are promising, as shown in Table 4.

Table (4): A comparative view of the energy sources in Iraq [36].

Year	Oil	Natural gas	Hydroelectric	Solar
2017	76%	24%	1.06%	0
2018	72%	28%	1.3%	0.19%
2019	67%	32%	0.91%	0.46%
2020	75%	37%	0.5%	0.1%
2030	92%	66%	1.2%	0.4%

As for wind energy, Iraq is separated into three provinces [37]. The first territory covers 48 per cent of Iraq and has wind speeds ranging from 2 to 3 m/s. The second territory covers 35 per cent of Iraq and has wind speeds ranging from 3.1 to 4.9 m/s. The third territory accounts for 8% of Iraq's land area and has wind speeds of more than 5 m/s. According to these studies, as shown in Table 5, the approximate wind power densities for wind areas are: Al-Emarra has

174 W/m², Al-Nekhaib has 194 W/m², Al-Kout has 337 W/m², Anna has 353 W/m², and Al-Naseria has 378 W/m². Based on the international standards for wind power class shown in Table 6, [38]. These mentioned findings for wind speed and wind power density in some territories in Iraq could be verified to determine the feasibility of investments in wind energy.

Table (5): Findings for wind speed and wind power density in some territories in Iraq [37].

Province	Average Wind Speed (m/s)	Province	Wind Power Density (W/m ²)
First (area 48% of Iraqi area)	2 - 3	Al-Emarra	174
Second (area 35% of Iraqi area)	3.1 - 4.9	Al-Nekhaib	194
Third (area 8% of Iraqi area)	> 5	AlKout	337
-	-	Anna	353
-	-	Al-Naseria	378

Table (6): Standard wind power classification [38].

Wind Class	Wind Speed (m/s)		Power Density W/m ²	
	@ 10m hub height	@ 50m hub height	@ 10m hub height	@ 50m hub height
1 (Poor)	0 – 4.4	0 – 5.4	0 - 100	0 - 200
2 (Marginal)	4.4 – 5.1	5.4 – 6.2	100 - 150	200 - 300

3 (Moderate)	5.1 – 5.6	6.2 – 6.9	150 - 200	300 - 400
4 (Good)	5.6 – 6.0	6.9 – 7.4	200 - 250	400 - 500
5 (Excellent)	6.0 – 6.4	7.4 – 7.8	250 - 300	500 - 600
6 (Excellent)	6.4 – 7.0	7.8 – 8.6	300 - 400	600 - 800
7 (Excellent)	> 7.0	> 8.6	> 400	> 800

It is noticed that the best wind power potential in Iraq is classified as moderate, located in Al-Kout, Anna, and Al-Naseria, where the average wind speed is higher than (5 m/s), and the power density is (378 W/m²). This class of wind power is suitable for small-scale wind turbines.

6. Conclusion

Regarding the issue of renewable energy in Iraq, it can be said that this issue carries significant positive signals for the country's environmental and economic future. Interest in renewable energy is increasing in Iraq due to environmental pressures and the growing need for sustainable energy sources. Iraq is considered one of the countries with huge oil reserves. However, government officials recognize the importance of switching to renewable energy sources to diversify energy sources and reduce dependence on fossil fuels. There are increasing investments in renewable energy projects, such as solar and wind energy, which enhance sustainability and reduce greenhouse gas emissions. Despite the challenges that may face the implementation of renewable energy projects in Iraq, such as financing and infrastructure, continued efforts in this direction reflect commitment to Achieving sustainable development. In addition, Iraq's transition towards renewable energy can contribute to enhancing energy independence and providing job opportunities in the renewable energy sector. In Iraq, the renewable energy transition is emerging as a vital step towards sustainability and economic diversification, as solar energy is characterized by the potential to exploit abundant solar hours, while Wind energy offers opportunities in areas with strong winds. Excess heat can be used to generate electricity, and operating hydraulic stations is one sustainable way. Providing a combination of these technologies contributes to improving sustainability and achieving energy independence, and this requires continued research, development and investments in infrastructure. In conclusion,

Iraq's future in the field of renewable energy stands out as an opportunity for environmental and economic improvement. It requires continued cooperation between the government, the private sector, and the international community to achieve sustainable development goals and improve the quality of life for Iraqi citizens.

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