



THE AFTERMATH AND COST OF INVESTING IN CLEAN ENERGY, AN ARTICLE REVIEWING RENEWABLE ENERGY RESOURCES

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Article history:	Abstract:
Received: 6 th September 2023 Accepted: 6 th October 2023 Published: 7 th November 2023	The research aims to uncover the implications of adopting the costs of electricity production and the challenges faced by institutions when investing in clean energy resources for electricity production (sustainability costs) versus avoiding the costs of importing, environmental, social, wastage, and economic costs (unsustainability costs). The research applied the deductive approach as a literature review that addressed the research topic of renewable resources and the costs of electricity production. The most important conclusions indicated the necessity for institutions to focus on employing clean energy (solar energy as a source of electricity generation) and reducing the costs of fossil fuel consumption. Therefore, institutions should rely on proactive plans and feasibility studies to calculate the costs of employing clean energy that mimic the incurred costs and avoidance of clean energy costs.

Keywords: clean energy, renewable resources, costs of investing in clean energy, sustainability costs.

INTRODUCTION:

The article seeks to explain the role and importance of transitioning towards clean energy, but the question remains about the implications and necessity of this transition towards clean energy and the environment, as well as the financial burdens that should be borne by state institutions. Forecasts indicate that by 2050, the demand for clean energy will increase significantly, due to its vital role and importance in the sustainable development process. Iraq relies on fossil energy sources, represented by petroleum and natural gas, producing approximately 4,431,000 barrels of crude oil daily according to statistics from June 4, 2023. It is known that the majority of the electricity needs come from traditional oil resources. Utilizing these resources to generate electricity has negative effects, such as non-clean energy producing water waste from coal, oil, and gas storage facilities.

Sustainability has become a typical approach in the plans of various companies. As it is known, possible energy is clean energy that is created through solar, wind, sea, hydroelectric, biomass, geothermal, and biological contributions, as well as hydrogen. The directions of advanced countries to produce clean energy require investment costs. What are these costs and outlets for expenditure? Considering it is one of the most discussed areas in the twenty-first century for economic and environmental reasons, and the importance of obtaining clean and sustainable energy as a guarantee to ensure the present and safety of the future, we shall review this with the following article:

FIRST, CONCEPTUAL FRAMEWORK OF CLEAN ENERGY

1. The nature of clean (renewable) energy:

The term energy no longer needs further concepts and definitions as much as the term renewable, which refers to a new type of energy that differs from traditional sources in terms of sustainability and its impact on the environment in which different organisms live. The world has turned to explore new alternatives to non-renewable energy sources, which are limited and susceptible to depletion.

2. Definition of clean energy:

It is the energy that can be obtained through recurring and naturally occurring currents, in contrast to non-renewable energies that are mostly found in solid reserves in the earth and cannot be utilized without human intervention. Therefore, renewable energies can be considered as acquired energy from (Ahmed 2012 : 11)nature that constantly renews itself, is non-depleting, It is also defined as Energy Renewable Energy, whose flow in nature is renewed and inexhaustible (Abd al-Wahhab, 2017: 493), which indicates that they are permanent, non-depleted natural sources that are available in nature in a limited or unlimited manner but are constantly renewable, and their use does not result in relative environmental pollution, that is, clean energy (U.S. Energy Information Administration, <http://www.eia.gov>). renewable energy has also been defined as non-depleted, enduring natural sources available in



nature on a limited or unlimited and continuously renewable basis, which are clean and produce relatively <http://www.emarifa.com> /environmental pollution. The energy we acquire through energy currents that are frequently found in nature is automatic and cyclical (Sahel, 2008:203), and is the key to achieving a cleaner environment, comfort, happiness and greater well-being (Mahad, 2009:3).

Secondly, The importance of renewable resources:

the importance of clean energy is reflected in (Nashida and Sharifa, 2013: 4-5)

1. One of the industrial and commercial sectors within a market witnessing tremendous growth worldwide.
2. Supplies industrialized and developing countries with clean and sustainable energy.
3. Present, non-depletable, and characterized by durability and renewal worldwide.
4. Reduces reliance on energy imports and provides a valuable local alternative.
5. Economical in many uses and has a significant economic return.
6. Aligns with the reality of developing remote and rural areas and their needs as a source of local output development.

Thirdly, Clean Energy Sources:

Clean energy sources are characterized by their ability to be utilized without depleting their source. Clean energy includes electricity generated from the sun, wind, biomass, geothermal heat, and water, as well as biofuels and hydrogen extracted from renewable sources periodically and automatically. (Hassan, 2013: 1-2):

1- Solar energy:

It is considered one of the most important sources of thermal energy, which is converted into electrical energy. It provides food and fuel through solar energy by means of photosynthesis in plants. In this way, it is understood that the energy produced by sunlight is equivalent to 10,000 times the total energy consumed worldwide from any fossil fuel. The thermal emission density of sunlight in hot deserts such as the Algerian, Moroccan, and Tunisian deserts is estimated at Wm^{343} . Solar energy can be used in power plants to generate electricity by producing steam that operates electricity turbines. (Renewable Energy Guide, 2007: 32)

Many countries have high hopes for solar energy as an energy source, considering it as an alternative to oil. They are interested in its development and use it in Europe and America for heating water and swimming pools, as well as for heating and cooling purposes. It is also used to power water pumps in arid desert areas in developing countries. Serious attempts are being made to use it in water desalination and electricity production (Ali, 2020: 90).

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Solar energy is used to generate electricity through the operation of turbines to generate water vapour (Renewable Energy Handbook 2022:32).

What solar cooling technology is to use solar energy by cooling processes is to collect solar energy on special panels and convert it into electrical energy that operates the drums responsible for cooling and heating, The trend towards global solar investment has risen to 65% since the beginning of 2022 by a 40% rate in 2017 and emerging from recession following the global financial crisis 2008 representing the available alternative at a rate of \$ 149.6 billion of total investment (Zahraa and Lubna, 2021:44).

Solar uses: (Mustafa, 2019:4):

- Use in agricultural activity: Those interested in agricultural development seek to increase the productivity rate of cultivated plants by utilizing solar energy, using it in the management of water pumping machines, crop drying, chicken hatching, and drying organic chicken manure.
- Water heating: Solar-powered heating systems are used to heat water used in homes and swimming pool technology.
- Heating, cooling, and ventilation: Specialized heating systems are used to store seasonal heat for heating purposes and year-round water heating.
- Water desalination: Over 2 million people in developing countries use solar energy-based water purification processes to treat drinking water.
- Wastewater treatment: It works to remove toxins from water through the process of photo catalysis.

2- Wind energy:



Wind energy has been used since ancient times, derived from the movement of wind and air, both in managing windmills for grinding grains and operating sailing ships, and lifting water from wells. And used to convert wind energy into mechanical energy that is then converted into electrical energy or used directly through generators, Arab countries have started to benefit from wind energy in the form of small units for lifting groundwater on the northern coasts. Today, the concept of this energy is associated with "wind turbines" and power generation stations, and the needy areas are supplied with electrical wires through desert areas. According to estimates by the International Standards Organization, it is possible to generate 20 million megawatts from this source globally, which is equivalent to multiple times the capacity of hydroelectric power (Ka'awan, 2022: 10).

3- Biomass Energy:

Biomass energy is a renewable energy that is represented by organic matter such as agricultural crops, wood, and animal waste, because it converts solar energy into stored energy in plants through the process of photosynthesis. Green plants possess solar energy stored in them. Therefore, we have biomass energy that can be obtained through various methods from these plants. As for biomass resources, they include forest waste and agricultural residues. It is possible to exploit (cut) forest wood in a planned manner, as well as urban waste and crops specifically grown for energy purposes (Al-Zahraa and Lubna, 2021: 12)

4- Hydropower:

The history of relying on water as a source of energy dates back to the 18th century, before the discovery of steam power. At that time, humans used river water to operate some waterwheels. Nowadays, humans have started using water to generate electricity, as we can see in many countries such as Norway, Sweden, Canada, and Brazil. Waves in normal conditions produce energy ranging from 10 to 100 kilowatts per meter of coastline in regions that are moderately distant from the equator (Jaghabala, 2012: 32). Hydropower is considered one of the most important sources of clean energy and has the least cost, as it is a clean and environmentally friendly energy source. Water energy can be obtained from oceans and inland waters and is divided into (Al-Ghazali, 2006: 49-50) (Bakhosh, Battash, 2013: 13):

***Hydropower:** River water has been used to generate mechanical and electrical energy over the past century. It represents approximately 18% of the world's electricity production and is an important part of electricity generation systems due to its flexibility and high reliability in operation. The total exploitable and economically feasible sources amount to 22 million kilowatts and a production capacity of 9.70 billion kilowatts per hour.

***Ocean Thermal Energy:** It is called ocean thermal gradient energy resulting from the temperature difference between ocean water layers, through a very low-efficiency thermodynamic cycle, based on the contrast between surface and deep waters.

***Wave and Tidal Energy:** This energy is produced by the gravitational force of the moon on the Earth's surface directed towards it. The water is affected by this attraction because it is a fluid and easily movable body. The sun also affects the water surface, but its influence is much less than the moon's.

5-Geothermal Energy:

It is the heat that comes out from the Earth's interior through conduction, heat transfer, volcanoes, and hot springs. It is the heat from the Earth's interior used in electricity generation and is based on extracting the energy present in the soil and using it for heating and thermal electricity. The temperature increases vary according to the depth. This heat is mainly produced through the natural radioactive activity of the rocks forming the Earth's crust, and it can only be obtained from the geological components of the Earth's interior

6-Nuclear Energy:

Also known as atomic energy, nuclear energy is the energy generated through the fusion or fission of atomic nuclei. This energy is used in nuclear power plants to heat water and produce steam, which is then used to generate electricity. It is one of the most efficient known forms of energy, and nuclear energy can be divided into two different types: nuclear fission and nuclear fusion) (Reza, Naseem, 2010:72)..(

Fourthly, Characteristics of Clean Energy (Ahmed, 2012:141):

Renewable energies have several characteristics, the most important of which are mentioned below:

- 1- They contribute to meeting a high percentage of energy requirements, as they play an important role in human life, considering them as long-term sources of energy primarily derived from the sun.
- 2- Renewable energy is not a ready-made stock that we can use whenever we want. Renewable energy sources are beyond human control or the ability to determine the quantities available, such as the sun and its intensity of radiation.



- 3- The high initial cost of renewable energy devices is a barrier to their rapid spread, as it requires the use of many devices with large areas and sizes.
- 4- Different forms of renewable energy are available, which requires the use of suitable technology for each type of energy.
- 5- There are two common characteristics between different renewables: regeneration and non-pollution of the environment.

Fifthly, Implications of clean energy orientation and investment costs:

1- The investment in electricity production entails:

After reviewing the main sources of clean energy, it is necessary to consider the economic feasibility and carefully examine the costs of investing in the field of clean energy production. The investor, for the purpose of electricity production, adopts the costs of establishing power stations, site licensing costs (construction), environmental testing costs for these stations, and other incidental costs (Abdelwahab, 2017: 498).

2- Implications of shifting towards the renewable resources sector:

Many countries have shown interest in the world, market, industry, and trade of clean energy, where most of their efforts have focused on harnessing clean energy sources and using them as a source of income, material benefit, and increasing the national output. Despite the high costs of investing, employing, and providing mechanisms, technologies, and infrastructure for electricity production adequately, we notice a significant number of countries preparing to start investment projects in renewable energy while ensuring the formulation of policies for these projects and working on their development and growth.

The reports of the International Climate indicate a rise in the percentage of greenhouse gas emissions. This places the responsibility on countries worldwide to provide serious solutions and promote the development and dissemination of clean energy technologies. It signifies a strong global drive to enhance clean energy sources such as solar energy, wind power, and hydropower, among others. Globally, at least 30 countries now possess renewable energy that contributes to over 20% of their clean energy supplies. It is expected that the clean energy markets will continue to grow significantly in the next decade and beyond. In some countries like Iceland and Norway, for example, electricity generation is achieved using 100% renewable energy. Many other countries have set goals to reach 100% clean energy consumption. By 2050, the Danish government has decided to convert the total energy supply for electricity, heating, cooling, and transportation to 100% clean energy.

The report issued by the Clean Energy Institution in 2019 showed that clean energy sources contributed 22.2% of human global energy consumption and 42.7% of electricity generation. Renewable energy consumption in 2019 and 2020 was divided as follows: 11.10% for traditional biomass, 6.2% for thermal energy (modern biomass, geothermal, solar thermal), 5.9% for hydropower, and 4.2% for wind and solar power, geothermal, and biomass (International Renewable Energy Agency, 2021). Global investments in renewable energy technology exceeded \$396 billion in 2020. Countries like the United States and China heavily invested in wind, hydropower, solar energy, and biofuels. Globally, there are approximately 7.7 million jobs related to renewable energy industries (International Renewable Energy Agency, 2020). In the Arab world, there is clear variation among countries in the use of clean resources for energy production, confirming that the situation is still evolving and requires time and a specific culture of utilization and production (Al-Tamimi, 2018: 109-110).

3-The consequences of the shift towards clean energy investment:

The concern for the high costs of non-clean resources and their environmental costs is one of the most important consequences of the shift towards renewable resources. There has been a conflict since the 1970s between the goals and purposes of economic growth and its financial and social objectives, and the preservation of environmental diversity. This economic growth no longer guarantees the desired well-being at the expense of environmental diversity.

There is a recognized and realistic fact that, despite the costs of non-clean resources such as the costs of equipment, techniques, pumps for extracting crude oil and gas, as well as environmental, climate, health, and general harm to humans, there is still an interest in non-clean resources because they provide profits, returns, and extensive expertise in management, control, and wide utilization, but in the short term. However, under non-clean environmental data and laws, this may lead to damages and high costs for non-renewable resources. These issues are related to climate change, ozone layer damage, and environmental pollution problems that have led to the establishment of laws and restrictions for transitioning to environmentally friendly and low-pollution production. In addition to the high cost and depletion of non-clean resources, it is related to issues of climate change, ozone layer depletion, and environmental pollution problems that have led to the enactment of laws and restrictions on transitioning to environmentally friendly



and low-pollution production. In addition, the cost of non-clean resources and their depletion has increased. The issue of environmental costs is now of growing international concern in light of sustainable development goals, including the goal of utilizing clean resources instead of other resources to ensure future generations. Even if we assume that clean resources and accountability for them are one of the most important goals of sustainable development or an important element of the environment or environmental accounting (Al-Tamimi, 2018: 112).

CONCLUSIONS:

- 1- Many studies and research are focusing on the development of renewable energy. The main question for future studies relates to identifying the driving forces for the development of renewable energy and the resulting effects.
- 2- Shedding light on the factors that affect the development of renewable energy, including politics, economy, and technology.
- 3- Most studies have focused on the effects of appropriate policy factors in driving the development of renewable energy, as technological innovation and deployment also play important roles.
- 4- Technological innovation and its market-driven deployment are mechanisms for sustainable development of renewable energy. This topic is important in the development of renewable energy and deserves exploration.
- 5- The development of clean energy should take into account specific goals, technical support, and economic conditions to achieve the goal of transitioning to low-carbon energy with a global focus on renewable energy development.
- 6- Reviewing literature on renewable energy development and the Chinese roadmap, which poses a challenge for sustainability, especially in terms of contextual factors such as resource availability, economic development, and institutional differences.

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