

Energy transition in Algeria (green hydrogen is the ideal choice



Noureddine Saadoun

University of Setif 2 , n.saadoun@univ-setif2.dz

Received date: 04/09/2024

Accepted date: 26/12/2024

Publication date: 01/01/2025

Abstract:

Algeria is among the countries with promising potential in the field of green hydrogen production. It possesses the qualifications, material resources, and human capabilities to produce this type of clean fuel, which has become a real alternative to fossil fuels worldwide. Given Algeria's vast reserves of renewable energy sources, such as solar energy, and the abundance of natural gas, investing in this field represents a qualitative leap towards diversifying income sources and contributing to the prosperity of the national economy beyond hydrocarbons.

Keywords: *Green hydrogen; Energy alternative; Algerian economy; Revenue sources; national economy.*

* Saadoun Noureddine, n.saadoun@univ-setif2.dz

Introduction:

As the world grapples with the impending peak of the fossil fuel era, countries heavily reliant on hydrocarbons, such as Algeria, are facing a critical juncture. For nearly half a century, these nations have depended on petroleum as their primary economic resource. However, the devastating environmental consequences of excessive fossil fuel consumption, including climate change and global warming, have prompted urgent calls for a transition to cleaner energy sources.

The COVID-19 pandemic further exacerbated the vulnerabilities of oil-dependent economies. Global lockdowns led to a sharp decline in oil demand, causing economic recession and a drastic fall in oil prices. These interconnected crises have compelled oil-producing nations to diversify their economies and seek alternative revenue streams.

A new era is dawning as these converging challenges have spurred oil-exporting countries to explore beyond traditional energy sources. Algeria, like many of its counterparts, has experienced severe economic hardship due to the volatility of oil prices. Consequently, the nation has been compelled to seek non-oil-based revenue streams, particularly focusing on diversifying its energy production.

A beacon of hope has emerged in the form of green hydrogen. The global demand for this clean and sustainable energy source, particularly in regions like the Middle East and North Africa, has grown significantly. Experts predict that green hydrogen will revolutionize the global energy landscape, ushering in a post-fossil fuel era.

This transition is driven by the recognition that green hydrogen is not only a clean and environmentally friendly energy source but also a promising avenue for economic diversification. As countries worldwide embark on projects to facilitate this energy transition, Algeria, with its abundant natural resources and strategic location, is well-positioned to become a major player in the global green hydrogen market.

Research problem:

The problem statement is as follows: What are Algeria's natural and technological capabilities that qualify it to invest in this clean energy source to achieve an energy transition? And can Algeria truly rely on green hydrogen production to diversify its revenue sources beyond the hydrocarbon sector?

The hypotheses:

The more natural resources and technical capabilities Algeria possesses, the greater the likelihood of successful investment in green hydrogen production.

The more Algeria diversifies its income sources beyond hydrocarbons, the more it will contribute to the stability and prosperity of its economy."

1. Green Hydrogen as a Global Option:

The global consensus is increasingly leaning towards green hydrogen as the optimal choice for clean energy. This is largely due to its superior efficiency and versatility compared to other energy sources. Green hydrogen can be easily transported and converted, and it is highly efficient as a fuel for machines and vehicles. Moreover, it has the remarkable capacity to produce high-concentration energy with absolutely zero carbon emissions.

In the following sections, we will delve into the definition of green hydrogen, differentiate between its various types, and highlight its key characteristics and advantages.

1.1 Definition of Green Hydrogen:

Green hydrogen is a fuel produced using renewable energy sources such as solar or wind power. This process involves electrolysis, where electrical energy is employed to split water into its constituent elements: hydrogen and oxygen. (Ibrahim, 2013. P 40)

Given that green hydrogen is generated using renewable energy, it is carbon-free, meaning it does not produce any greenhouse gas emissions.

Due to its complete absence of greenhouse gas emissions, green hydrogen presents a promising alternative to fossil fuels. It can be utilized in a wide range of applications, including transportation, industry, and energy. This is precisely what the term "green hydrogen" signifies. However, in this context, what do the different colors associated with hydrogen denote?

As energy experts confirm, hydrogen can be produced through various methods. However, all other methods result in hydrogen with different color designations, indicating the presence of carbon emissions. These methods include steam methane reforming, gasification, and electrolysis. (Sarah, 2023)

1.2 Advantages and Disadvantages of Different Hydrogen Production Technologies:

Several methods are employed to produce hydrogen on a large scale. These methods include steam reforming, electrolysis, direct solar water splitting, and biological processes. (Sarah, 2023)

Hydrogen produced through steam methane reforming and thermal cracking is often termed "gray hydrogen," as it results in significant carbon dioxide emissions. While these carbon dioxide emissions can be captured and stored in secure locations, hydrogen produced from natural gas or biogas is referred to as "blue hydrogen." In this case, the generated carbon dioxide is not captured but released into the atmosphere. (Sarah, 2023)

Compared to gray hydrogen, blue hydrogen produced from natural gas can significantly reduce carbon dioxide emissions through carbon capture and utilization (CCU). Both gray and blue hydrogen production processes generate

carbon dioxide as a byproduct. However, green hydrogen production technologies, such as electrolysis using renewable energy, do not produce any carbon emissions.

1.4 Properties of Green Hydrogen

Green hydrogen possesses several notable properties: (Asma ,2023)

Carbon-free: Green hydrogen produces no greenhouse gas emissions, making it an environmentally friendly fuel.

Versatile energy source: Green hydrogen can be used in a wide range of applications, including transportation, industry, and energy.

Renewable energy source: Green hydrogen can be produced from renewable energy sources such as solar and wind power.

However, green hydrogen is still a relatively new technology, and there are several challenges that must be overcome before it becomes a widely used fuel. One of the primary challenges is the high cost of producing green hydrogen. One way to reduce the cost of producing green hydrogen is to increase the efficiency of the electrolysis process.

There is also a need to develop infrastructure to support the use of green hydrogen, such as hydrogen refueling stations and a hydrogen distribution network.

Despite these challenges, green hydrogen is seen as a promising alternative to fossil fuels. As technology continues to develop and costs decrease, green hydrogen is expected to become a more common fuel in the future.

2. Green Hydrogen: Algeria's Clean Energy Alternative Beyond Hydrocarbons

Reports and studies in the field of renewable energy indicate that Algeria possesses immense potential in this sector, benefiting from several factors and qualifications that enable it to compete in this promising market and potentially take a leading position.

2.1 Algeria's Qualifications for Green Hydrogen Production:

Algeria has promising capabilities for producing green hydrogen through:

a. Natural Resources

According to the type of raw materials used to produce green hydrogen, Algeria is considered one of the countries with enormous potential for this clean resource. The largest solar field in the world is located in the Algerian Sahara, capable of generating vast amounts of electricity. Additionally, the country possesses abundant wind resources and groundwater reserves, which can be used for electrolysis to produce green hydrogen.(Omar,2004 ,p2)

Green hydrogen production also allows for the production of high-purity oxygen, which is used for medical and scientific purposes, as demand for oxygen in hospitals and households increased significantly during the COVID-19 pandemic.

Furthermore, Algeria's vast groundwater reserves represent another natural resource that encourages the production of this vital substance. The country also benefits from active research centers and universities, a growing industrial sector, and highly competitive hydrogen production costs.

As previously mentioned, hydrogen in general, and green hydrogen in particular, is a clean fuel. It can be used for heat production in a mixture with methane, as well as in vehicle engines and electricity generation. It can also be transported through gas pipelines with some necessary modifications.

B .Technical Qualifications

Algeria's recent shift towards exploring alternative resources beyond hydrocarbons and diversifying its national economy has led the Ministry of Energy and Mines to prioritize the development of a hydrogen sector. This decision is based on the country's vast potential in renewable energy, particularly its extensive solar fields, geographic location, and substantial natural resources. Additionally, Algeria possesses a well-developed electricity grid and a network of national and international gas pipelines connecting it to Europe. (Stambouli and others,2024)

By leveraging these capabilities, Algeria aims to achieve several objectives, including diversifying its energy supply, accelerating the energy transition, enhancing energy security in the medium and long term, and reducing its carbon footprint across various sectors. These goals align with the repeated calls of environmental organizations, such as the United Nations, urging countries to reduce greenhouse gas emissions that contribute to climate change and its associated natural disturbances.(Tawhariya,2020 .P335)

Algeria also seeks to reduce domestic consumption of fossil fuels, especially natural gas, and preserve its energy resources by utilizing this clean energy source. Furthermore, the country aims to create a suitable ecosystem for developing renewable and clean hydrogen, including industrial integration, technological control of the entire hydrogen value chain, and human capital development through research, development, training, and the establishment of talent pools and centers of excellence focused on the hydrogen economy.

With the recent government approval of a national strategy for developing this sector, the Ministry of Energy and Mines is tasked with mobilizing all available resources to realize this strategic energy transition. The national strategy aims to gradually establish a domestic hydrogen and its derivatives economy (ammonia, urea, methanol, synthetic fuels, etc.) and create a hydrogen production and export hub. (Sharif,2023)

Algeria also aims to develop both blue and green hydrogen. Blue hydrogen is produced through steam methane reforming (SMR), where carbon dioxide is captured and stored (CCS) or captured and utilized (CCUS). Green hydrogen, on the other hand, is produced through the electrolysis of water using electricity from renewable sources. (Sharif, 2023)

2.2. Production Plan

The national roadmap for developing the hydrogen sector is based on three main phases: (Hawisha, 2023)

. **Phase 1 (2023-2030):** This phase is characterized by the launch of short-term pilot projects.

. **Phase 2 (2030-2040):** During this phase, the sector will be launched on a large scale, and the intensive production of green hydrogen will commence.

. **Phase 3 (2040-2050):** In this phase, large-scale exports of green hydrogen will be undertaken.

2.3 Mobilizing Resources

In addition to the technical capabilities for developing hydrogen, the process also requires the mobilization of numerous factors, including human capital development, technology transfer, financing, and the creation of a transparent and competitive market.

Algeria seeks to launch pilot projects to test various technologies and concepts related to hydrogen production, storage, and distribution. These projects will serve as a foundation for the widespread use of hydrogen in Algeria. Algeria has already initiated some of these pilot projects, such as the fertilizer plant in Arzew (Oran). (Hydrogen development, 2023)

Algeria's geographical proximity to Europe is an advantage that positions it to become a major supplier of clean energy to Europe, thereby facilitating its energy transition.

Energy experts emphasize the need for Algeria to move from the planning to the implementation phase, as competition in green hydrogen production is fierce. Despite Algeria's natural endowments to become a regional and global leader in green hydrogen, the international context necessitates swift action and a transition to implementation. Numerous competitors are vying for the opportunity to supply this energy resource to the heart of Europe.

International demand for Algerian green hydrogen has begun to materialize, particularly from Germany and other European countries. Discussions are currently underway regarding the second Southern Hydrogen Corridor (SouthH2 Corridor). Experts note that this project is not the only one, and there are similar initiatives to transport hydrogen to Europe from various regions, such as Spain, Northern Europe, and Eastern Europe. (Hanou, 2023)

According to international market data, Germany, Europe's largest economy, is interested in hydrogen supplies from Algeria. Given its economic size, Germany is a significant consumer. The arrival of Algerian hydrogen in Germany would mean reaching the heart of Europe, passing through other countries like Italy and Austria. (Hanou, 2023)

Experts suggest that it is in Algeria's interest to quickly attract interested customers, as there are many competitors, and various countries are proposing partnerships with Europe, such as Chile, South Africa, and Australia. The world is on the cusp of a new revolution: the green hydrogen revolution. The faster Algeria can implement green hydrogen projects, the more likely it is to gain the trust of its customers and secure long-term contracts. Developing plans and enacting laws is merely a theoretical roadmap; tangible results can only be achieved through implementation, training, research, and development.

Some Algerian energy experts believe that the establishment of a specialized hydrogen research center is urgently needed to acquire the necessary knowledge and expertise. Alternatively, one of the existing renewable energy development centers, such as those located in Tipaza (Bou Ismaël), Ghardaïa, and Adrar, could be converted into a branch for hydrogen research and development. These regions are considered ideal locations for establishing hydrogen production plants. Experts also suggest that establishing green hydrogen production plants in northern Algeria, particularly along the coastal strip, would be an optimal choice.

In terms of natural resources, Algeria possesses vast renewable energy potential, including solar and wind energy. The country has one of the largest solar fields in the world and significant wind energy potential of 7,000 gigawatts. These resources can be combined, with solar energy production during the day and wind energy production at night. (Houicha,2023)

As mentioned earlier, a prerequisite for producing carbon-free green hydrogen is that the electricity used for water electrolysis must come from clean and renewable sources.

Given the ambitious program to desalinate seawater by 2030, experts suggest using desalinated water for electrolysis to produce green hydrogen, as the water used must be completely pure. (Houicha,2023)

Considering that the most likely and strategic option is to electrolyze desalinated seawater in plants distributed along the coastal strip, which can also be used to cover the water supply deficit, Algeria plans to transfer electricity from production plants in the south, whether solar or wind-powered, to the north to supply desalination plants and hydrogen production plants.

Research is currently underway to directly electrolyze seawater to obtain green hydrogen, reducing production costs.

Algerian green energy experts emphasize the need to quickly sign long-term sales contracts, starting in 2030, similar to gas contracts. Entities interested in supplying Algerian green hydrogen are known, and signing contracts in advance will ensure immediate investment.

Algerian green hydrogen is expected to be highly competitive in the international market due to its cost-effectiveness, which is driven by the abundant and low-cost electricity generated from solar and wind power.

Experts also believe that green hydrogen is an ambitious project for Algeria and will have positive implications for the country's economy, both in terms of creating added value and generating employment.

Algeria can leverage its expertise in natural gas, liquefied natural gas, and downstream industries to maintain a leading position in the green hydrogen sector.

2.4 Challenges of Green Hydrogen Production in Algeria

Algeria faces several challenges in green hydrogen production, primarily related to renewable energy projects, especially solar power, securing large quantities of water, managing hydrogen transportation technologies through natural gas pipelines, determining costs, and consolidating and valorizing national efforts in hydrogen research initiated in 2005.

Energy experts identify five major challenges for green hydrogen production in Algeria: (Kadry.2023)

- . **Challenge1:** The need to accelerate the completion of renewable energy projects, particularly solar power projects, in the southern regions.

- . **Challenge2:** The need to secure large quantities of water, specifically desalinated freshwater. This poses an additional challenge related to seawater desalination projects. According to global companies interested in investing in hydrogen, global water consumption for hydrogen production is 620 million cubic meters, representing 1.3% of global water consumption in the water sector. This is twice the water consumption for hydrogen production through natural gas gasification, making water availability the most significant challenge in producing green hydrogen.

- . **Challenge3:** The need to master the technologies and techniques for transporting hydrogen through natural gas pipelines, either mixed with natural gas.

- . **Challenge 4:** The need to determine costs, which is crucial for entering the global market and offering competitive prices. According to the Ministry of Energy and Mines, the development of green hydrogen production in Algeria depends on several factors, including:

Decreasing the cost of renewable energy production (photovoltaic solar and wind energy) and strengthening electricity grids to accommodate increased integration of renewable energy.

Reducing the cost of electrolyzes (from \$1000/kW to \$400/kW), which will follow the evolution of electrolysis technologies, and developing storage, transportation, infrastructure, and competitive hydrogen markets.

- . **Challenge 5:** The need to update the legal framework for this resource, as green hydrogen is currently not classified as an energy source like oil, gas, and other used energies.

. **Challenge 6:** Energy experts also believe that before focusing on green hydrogen produced through water electrolysis, Algeria should first focus on producing blue hydrogen from natural gas, as the former is more expensive. Blue hydrogen produced from natural gas is less costly than green hydrogen, although it is less pure. However, Algeria should prioritize blue hydrogen production from natural gas before green hydrogen due to lower costs and the fact that blue hydrogen accounts for approximately 75% of global hydrogen production, while green hydrogen accounts for only 2%. Black hydrogen produced from coal accounts for approximately 20% of global hydrogen production. This necessitates Algeria's rapid securing of a position in the international blue hydrogen market.

To achieve its goal of producing both blue and green hydrogen, Algeria must mobilize all its resources to make hydrogen a national asset. Additionally, it is essential to valorize the research conducted by Algerian researchers and experts since 2005 on hydrogen and to facilitate coordination and knowledge exchange between these researchers, the Ministry of Energy Transition and Renewable Energy, and state-owned economic institutions, primarily Sonatrach.

Fortunately for Algeria, global studies and research confirm that the lowest cost of hydrogen production worldwide will be in North Africa, specifically in Algeria. This factor can help accelerate the launch of projects and the initial steps towards producing this energy source, which will be used in various industries in the future.

3. Algeria's Prospects for Green Hydrogen Investment

In an effort to reduce its reliance on oil and gas imports, Algeria has diverse ambitions in the field of hydrogen, ranging from production and investment to partnerships and job creation for local citizens. These ambitions can be summarized as follows:

3.1 Production and Export:

Algeria aims to produce two million tons of green hydrogen between 2030 and 2040, representing 10% of the expected European demand during that decade, according to Algerian energy officials (Hamdawi.2023). This aligns with the global trend towards clean energy sources, which aims to combat climate change, achieve carbon neutrality, and provide Europe with alternative energy sources to Russian gas.

As previously mentioned, the Ministry of Energy and Mines has unveiled a national roadmap (Hamdawi.2023). through which Algeria seeks to become a regional and international leader in the production and marketing of clean hydrogen and its derivatives, aiming to cover 10% of Europe's needs by 2040 with exports reaching \$10 billion annually. (Hawisha.2023)

The ministry's roadmap emphasizes that Algeria's focus on developing the hydrogen sector is primarily driven by three reasons: (Hawisha.2023)

. Increasing exports of clean energy.

- . Seizing domestic economic opportunities.
- . The significant development of renewable energy.

Algeria has set ambitious plans to capture a share of the green hydrogen export market, which it considers the fuel of the future, by allocating significant investments to develop its production and export.

In this context, the Directorate of Studies and Foresight at the Ministry of Energy and Mines revealed that Algeria has allocated a budget of between \$20 and \$25 billion for green hydrogen exploitation.

Algeria's green hydrogen plans coincide with the development and enhancement of hydrocarbon exports (oil and gas), as part of developing the country's resources and maintaining its position as a key player in supplying energy to global markets.

3.2 Investment, Partnerships, and Job Creation

Investment is closely linked to partnerships through a mutual exchange of roles. No promising investment can occur without partnerships and financing for investment projects.

a. Investment

Through its plan to produce 15,000 megawatts of solar energy by 2035, Algeria aims to support its green hydrogen production plans and produce 500 megawatts of clean energy. This is despite the obstacles faced by the "Solar 1000" project. (Portail algérienne.2022) aimed at generating electricity from solar energy in Algeria. This vital project, which aims to produce electricity from solar energy as part of Algeria's national renewable energy program, has faced repeated delays in recent years due to stalled negotiations between Algeria and its German partner.

The Algerian government had planned to finalize the deals for the "Solar 1000" project before the end of last year (2022), but the project was halted due to confusion and debate over the ministry responsible for the project, whether it is the Ministry of Energy and Mines or the Ministry of Environment and Renewable Energy,(Badr.2023) especially after the abolition of the Ministry of Energy Transition and Renewable Energy and its merger with the Ministry of Environment, and due to other reasons related to national sovereignty.

According to official sources, the Algerian government intends to invest between \$25 and \$30 billion in the green hydrogen sector. However, the size of these investments in this sector is primarily linked to "the development of demand in the global market, the development of production capabilities within Algeria, and of course, after acquiring and effectively controlling hydrogen technology, as well as providing a suitable investment climate and conducting studies that will clarify the vision for implementing these projects through Algerian and foreign companies that express a desire to import hydrogen."

Algeria seeks to develop the hydrogen sector through three main phases: (Bouras.2023)

.Start-up and training phase (2023-2030): Aiming to acquire technology and skills and train human resources in preparation for launching hydrogen production.

. Expansion and market creation phase (2030-2040): Based on pilot projects.

. Manufacturing and export phase (2040-2050).

B .Partnerships

Due to its geographical location and regional proximity, the European Union is one of the international blocs that has expressed interest in expanding its partnership with Algeria in the energy sector to include green hydrogen, which Europe sees as an alternative energy source to Russian gas.

In this context, Teodor Constantinescu, the principal adviser to the Energy Directorate of the European Union delegation in Algeria, expressed Europe's interest in expanding its partnership with Algeria to include renewable energy and green hydrogen. This expert believes that opportunities to accelerate green hydrogen production in Algeria are promising through the establishment of production and export projects. (Khato.2023)

Official sources confirm that there are ongoing agreements and consultations with European parties regarding several deals under study and development, related to initial pilot projects to test technologies.

Sonatrach, the Algerian hydrocarbons company, and the German gas company VNG-AG have signed a memorandum of understanding that will allow for the launch of the first pilot project dedicated to producing green hydrogen in Algeria with a capacity of approximately 50 megawatts, aiming to control the technology associated with this field. (Asharq.2023)

Algeria and Italy have also signed an agreement to build a new gas pipeline that can transport hydrogen from Algeria to the Italian island of Sardinia in the Mediterranean, in addition to an agreement between the Italian company Eni and the Algerian company Sonatrach to develop green hydrogen production through a pilot project at the Rhourd el-Mechouk field in southern Algeria, aimed at reducing the carbon footprint of the gas plant in this field.

C .Job Creation

Estimates indicate that by 2030, over 200,000 jobs will be created in solar energy and over 50,000 jobs in wind energy across Arab countries. Egypt is expected to contribute the largest share of jobs created by renewable energy projects at 54%, followed by Algeria at 22%, Morocco at 10%, and Palestine at 5%. (Farag. 2021)

Another study published in 2019 to measure the impact of renewable energy projects on the local economy found that Algeria has two different

scenarios for expanding clean energy. Algeria aims for renewable energy to account for 37% of its total installed electrical capacity by 2030. This would create between 61,400 and 137,000 jobs between 2021 and 2030, with most of these jobs being in the wind energy industry. (Farag. 2021)

Conclusion:

By examining the topic of green hydrogen production as an energy alternative and the global shift towards clean, emissions-free energy, and by assessing Algeria's potential and promising opportunities to produce and export this fuel as a wealth-generating energy source beyond hydrocarbons, we have arrived at the following conclusions:

.There are numerous energy alternatives that can replace fossil fuels, all of which are clean energies. However, green hydrogen is considered the best due to its practical properties, including its potential use in vehicles and most moving machinery.

. Hydrogen production varies depending on the type of electrolysis it undergoes. There are several types, including blue hydrogen produced from natural gas, pink hydrogen extracted from nuclear reactors, gray hydrogen produced from coal, and green hydrogen produced from clean energy sources such as solar and wind power. Green hydrogen is the best due to its lack of pollutants.

. Algeria's potential for green hydrogen production is diverse and abundant. Natural resources include vast areas and long hours of sunlight, which facilitate the production of electricity, known as solar energy, and the availability of large quantities of groundwater, which also aids in the electrolysis of water to produce green hydrogen. Technical resources include desalination plants and natural gas pipelines that can be used to transport hydrogen once produced.

. Algeria's green hydrogen production plan is divided into three sequential phases: pilot projects, actual production, and export.

. Mobilizing resources requires financial and human resources, as well as control over hydrogen production technology.

. The challenges Algeria faces in the field of green hydrogen are distributed across various areas, including production costs, which are subject to a number of contributing factors, such as the decline in the cost of energy production and the reduction in the cost of water electrolysis, in addition to the legal framework governing the process of exploitation, production, and marketing.

.The prospects for green hydrogen production in Algeria are subject to the size of investments allocated to this sector and the partnerships established between economic partners and their effectiveness. Through this approach, Algeria aims to diversify its sources of income beyond hydrocarbons while maximizing employment to absorb youth unemployment

Bibliography:

1. Journals:

- . Abdelraouf, M. I. A. (2013). Renewable energies. Economic and Legal Research Journal, 54(10), 40.
- . Sharif, O. (2004). Solar energy and its economic impacts in Algeria. Journal of Humanities, University of Mohamed Khider Biskra, 6, 2.
- . Twahria, M. (2020). Climate change and the stakes of the international environment. North African Economics Journal, 16(22), 355.

2. Websites

- . Al-Sayed, A. A. What is green hydrogen and what are its uses and production methods? 01/16/2024. <https://alfasih.com>
- . Albankaldawli.org. (2022, January 6). COVID-19 pandemic slows progress towards universal energy access. Retrieved from <https://albankaldawli.org>
- . Al Jazeera. (2007, March 19). Algeria builds a \$1.3 billion fertilizer plant. <https://aljazeera.net>
- . Asharq News. Algeria is set to embark on a venture into the green hydrogen market, projecting revenues of \$10 billion. <https://asharq.com>
- . Abdel Nasser. H, Implementation of a giant project to develop the Algerian-European hydrogen pipeline, 06/03/2023. <https://tadamsanews>.
- . Bader, A., & Salah, A. R. (2023, January 4). Solar 1000 project in Algeria faces new delay (exclusive). Attaqa.net. <https://attaqa.net>
- . Bouras, J. (2023, August 19). Algeria expects \$10 billion in revenue from green hydrogen exports. Tadamsanews.dz. <https://tadamsanews.dz>
- . Qatishāt, S. A. (2023, August 7). What distinguishes green hydrogen from other colors of hydrogen? Solar Arabic. <https://solarabic.com>
- . Sharif, E. (2023, March 23). Hydrogen in Algeria: Witnessing the first steps towards global leadership. Attaqa.net. <https://attaqa.net>
- . Qadri, D. (2023, August 9). Does green hydrogen production affect water consumption? A new study answers. Attaqa.net. <https://attaqa.net>
- . Hamdaoui, A. (2023, August 19). Algeria enters the green hydrogen market and expects \$10 billion in revenue. Asharq.com. <https://asharq.com>
- . Khatou, A. (2023, August 20). The European Union is moving to create companies in Algeria in the field of renewable energies. Awwras.com. <https://www.awras.com>
- . Elitihadcom.dz. (2023, August 20). Algeria plans to produce 2 million tons of green hydrogen between 2030 and 2040. <https://www.elitihadcom.dz>
- . Faraj, M. (2021, October 19). Hundreds of thousands: Promising job opportunities in the renewable energy industry in Arab countries. Attaqa.net. <https://attaqa.net>
- . Portail algérien. Hydrogen development: Algeria has the potential to become a major regional player. 14/06/2023. <https://portail.cder.dz>
- . Hassan. H. "Green Hydrogen": Algeria's Energy Leadership, 06/20/2023. <https://elrainews>.