



AFRICAN NARRATIVES

Green Hydrogen as a Tool for Energy Interconnection Between Africa and Europe: An Analysis of African Supply Sources



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Abstract

This study examines the pathway of energy inter-connection between Africa and Europe by evaluating potential green hydrogen suppliers for France amid the global transition toward clean energy. The study highlights Africa's growing role as a region with a competitive advantage in green hydrogen production, driven by abundant renewable resources such as solar and wind energy, as well as lower production costs compared with Europe. It also explores opportunities for

ation between the two continents to secure sustainable energy supplies for Europe, with a focus on technical and economic feasibility, infrastructure, and supply chains. The study sheds light on several prospective African supplier countries, including Morocco, Egypt, Algeria, Tunisia, South Africa, and Namibia, as potential hubs for exporting green hydrogen to the European market, particularly France.

Main Ideas

1. Africa's Competitive Advantage in Green Hydrogen Production

African countries possess vast natural resources in solar and wind energy, giving them strong potential to produce green hydrogen at lower costs than Europe. Countries such as Morocco, Egypt, Algeria, South Africa, and Namibia stand out as promising hubs for clean energy production and export.

2. The Importance of Energy Cooperation Between Africa and Europe

Energy interconnection represents a strategic opportunity to strengthen European energy security and support carbon neutrality goals,

while simultaneously fostering economic development in Africa through investment, technology transfer, and job creation, thereby promoting a mutually beneficial partnership.

3. Challenges Related to Transport Infrastructure, Governance, and Stability

Despite its strong potential, the interconnection project faces challenges related to infrastructure costs, cross-border hydrogen transportation, storage, geopolitical risks, and the need for regulatory frameworks and international agreements to ensure supply sustainability and equitable distribution of benefits.

Introduction

Hydrogen is rapidly emerging as one of the transformative solutions in the global energy transition, playing a pivotal role in decarbonizing industrial sectors, transportation, and power generation. Traditionally, hydrogen has been widely used in oil refineries and industrial applications, where it is produced through various methods, including thermochemical, biological, and electrochemical processes. Hydrogen production is often classified using a color-coded system, with green hydrogen (GH₂) recognized as the most environmentally sustainable form. Among these types, green hydrogen stands out as a clean and sustainable alternative to fossil fuels. As nations strive to achieve net-zero emissions, green hydrogen is increasingly viewed as a key enabler of a low-carbon economy due to the energy security, economic resilience, and environmental benefits it offers. It can be produced through a variety of

renewable energy-based methods, including electrical, thermal, biochemical, photonic, and hybrid processes.

These production methods rely on energy sources such as solar, wind, hydropower, nuclear energy, and energy recovery technologies, making green hydrogen adaptable to diverse regional energy landscapes. Despite its promising potential, green hydrogen production remains in its early stages and faces significant challenges related to high costs, energy losses, and inadequate infrastructure. Various production methods have been explored to improve efficiency and reduce costs, including biomass-based hydrogen production using agricultural and forestry waste, as well as photocatalytic water splitting. Nevertheless, high production costs remain a major barrier due to the reliance on expensive materials and the high energy consumption of

electrolysis processes. Consequently, enhancing the commercial viability of green hydrogen requires substantial investment and continuous technological advancement.

There are differing perspectives regarding the primary role of green hydrogen (GH_2) in the energy transition. Some researchers emphasize its role as an energy carrier, enabling the storage, transportation, and distribution of renewable energy. Green hydrogen can serve as an intermediary to help balance electricity grids, particularly in regions reliant on intermittent renewable sources such as solar and wind power. Current estimates suggest that green hydrogen could reduce carbon dioxide emissions by more than 800 million tonnes by replacing hydrogen derived from fossil fuels. Others consider green hydrogen a clean fuel for the transportation sector, helping mitigate climate change and air pollution. Its use in fuel cell vehicles and electric mobility solutions enhances energy security and contributes to fuel price stability by reducing dependence on fossil fuels. However, public acceptance of hydrogen-powered vehicles remains a critical factor in their widespread adoption, as studies indicate low awareness of hydrogen technologies in some regions.

Although green hydrogen is widely recognized as a major driver of global decarbonization, large-scale deployment requires overcoming technical, economic, and regulatory barriers. Safety concerns, including flammability and explosion risks, remain among the most significant challenges, especially in refueling stations and storage facilities. Additionally, hydrogen storage and transport require high-pressure systems and specialized infrastructure, increasing both opera-

tional and capital costs.

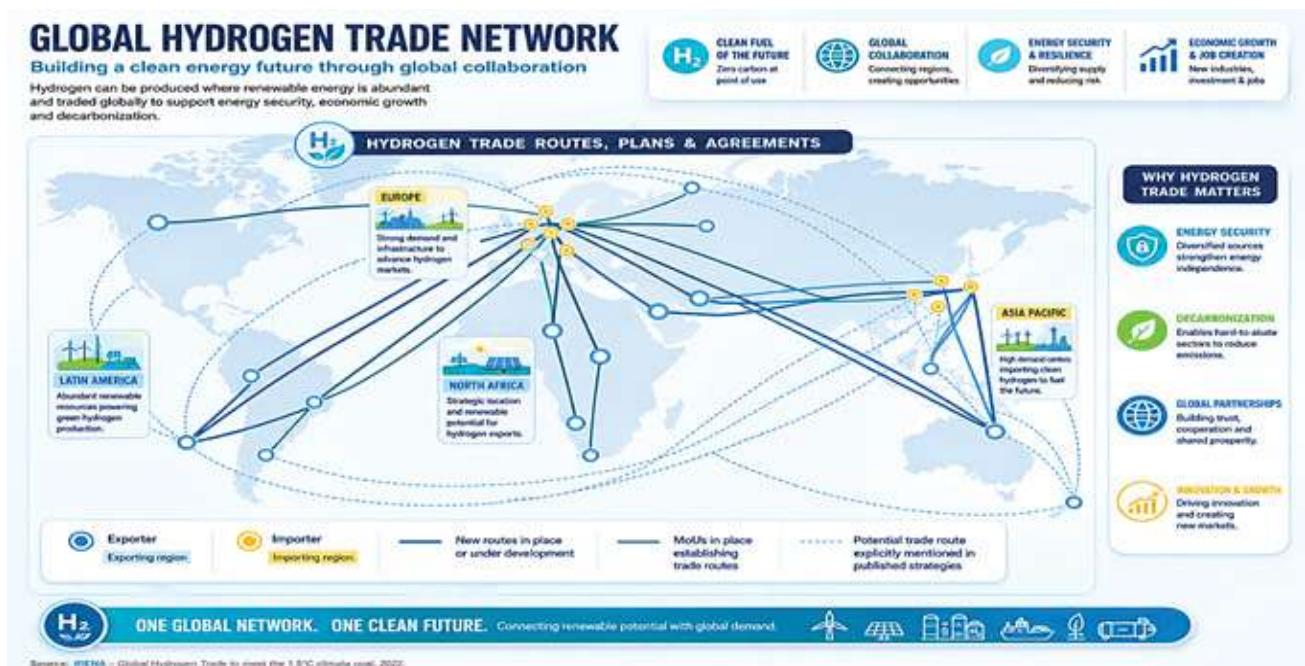
At the international trade level, interest in cross-border green hydrogen trade is growing rapidly. Countries rich in renewable resources, such as Australia, the Middle East, North Africa, and Latin America, are positioning themselves as major hydrogen export hubs. Meanwhile, energy-importing regions such as Europe, Japan, and South Korea are seeking secure hydrogen supplies to accelerate their decarbonization efforts. This global trade not only diversifies energy sources but also strengthens international partnerships and fosters a more interconnected and resilient energy network. However, long-distance hydrogen transport presents substantial technical and economic challenges due to hydrogen's low energy density, which necessitates conversion into liquefied hydrogen, ammonia, or methanol for efficient shipping. Moreover, scaling the global hydrogen economy requires policy harmonization, increased investment in large-scale production facilities, and the establishment of supportive international trade agreements.

This research paper examines the dynamics of green hydrogen production and trade across countries and regions, focusing on techno-economic feasibility, infrastructure requirements, regulatory frameworks, and policy considerations. The study also provides insights into opportunities and challenges associated with green hydrogen exports by analyzing key trade corridors, emerging hydrogen hubs, and market drivers. As a case study, the paper explores the energy interconnection corridor between Africa and Europe.

Green Hydrogen for Export

Green hydrogen (GH₂) is increasingly viewed as a transformative energy carrier with the potential to reshape global energy systems. Regions endowed with abundant renewable energy resources are expected to become major exporters of this valuable resource, while also expanding its use across industrial sectors, transportation systems, and national economies. Academic literature has shown growing interest in developing the infrastructure necessary for hydrogen export. Studies also outline potential pathways for integrating green hydrogen into existing energy systems and infrastructure. Research indicates that regions such as the United Kingdom, the United States, Spain, India, China, Asia, and Europe are making rapid progress in

hydrogen research and practical deployment. The International Renewable Energy Agency (IRENA) has developed a forward-looking map of hydrogen trade routes, plans, and agreements, illustrating the involvement of all continents in the future supply chain of this resource. Several studies have also identified countries with strong potential for green hydrogen production, including the European Union, Australia, China, South Korea, Japan, India, Russia, South Africa, North African countries, Canada, and the United States. Within the European Union, data show that out of 109 regions associated with hydrogen production, 88 regions possess a potential surplus in renewable electricity generation that exceeds



annual electricity demand across all sectors, including the energy required for hydrogen production .

Australia has significant potential in solar energy, particularly in its northern states as well as the central and southern mainland regions. Owing to its vast land area and high-quality renewable energy resources, Australia is considered well

positioned to play a leading role in the future hydrogen industry. Japan also plans to import hydrogen from Australia by 2050, and it is estimated that producing the required quantities by 2030 would consume less than 1% of the water currently used by Australia's mining sector .

In Russia, hydrogen production based on nuclear energy and renewable energy sources holds particular importance, with nuclear power playing a central role in this field. The United States, meanwhile, possesses enormous technical potential for electricity generation from wind energy, estimated at approximately 38,000 TWh per year, equivalent to a theoretical hydrogen production capacity of around 700 million tonnes annually. Its technical solar energy potential is estimated at approximately 262,000 TWh per year, corresponding to a theoretical annual hydrogen output of 5,100 million tonnes. South Korea also has substantial solar energy potential, enabling the production of green hydrogen through water electrolysis

The transportation of green hydrogen remains a complex challenge, despite several promising solutions, including leveraging existing natural gas infrastructure. For example, studies on converting long-distance gas networks in Germany and

Europe for hydrogen use indicate that green hydrogen has transport efficiency comparable to natural gas and can be distributed through existing pipelines at significantly lower cost than building entirely new infrastructure. Life-cycle assessments of hydrogen delivery pathways also show that transporting compressed hydrogen via pipelines is the most environmentally sustainable option .

Despite these promising pathways, literature consistently highlights that international hydrogen transport still faces major obstacles. These challenges are not limited to storage and handling requirements but also include difficulties related to market development, political and social alignment, regulatory harmonization, and investment risks. Such barriers underscore the urgent need for coordinated innovation across technology, policy, and economic frameworks to develop scalable hydrogen transport solutions aligned with the goals of the Paris Climate Agreement.

Africa and the Hydrogen Economy

Green hydrogen projects have the potential to generate substantial economic benefits by creating jobs, driving industrial growth, and expanding access to energy in underserved regions. These projects can also stimulate GDP growth, attract foreign investment, and support the diversification of local economies away from dependence on fossil fuels. According to a recent 2024 study by the Hydrogen Council and McKinsey & Company, the adoption of green hydrogen could increase Africa's exports by approximately \$15

billion, while creating nearly 13 million new jobs by 2050 .

Another study, supported by the European Investment Bank, estimated that Africa could produce up to 50 million tonnes of green hydrogen annually by 2035, requiring investments of approximately €1 trillion. This potential is largely driven by the continent's vast land area and abundant natural resources, particularly solar and wind energy.

3 Driving Continental Energy Integration through CEPA and ENGAGE, September 2025, <https://short-url.cc/1s2T6>

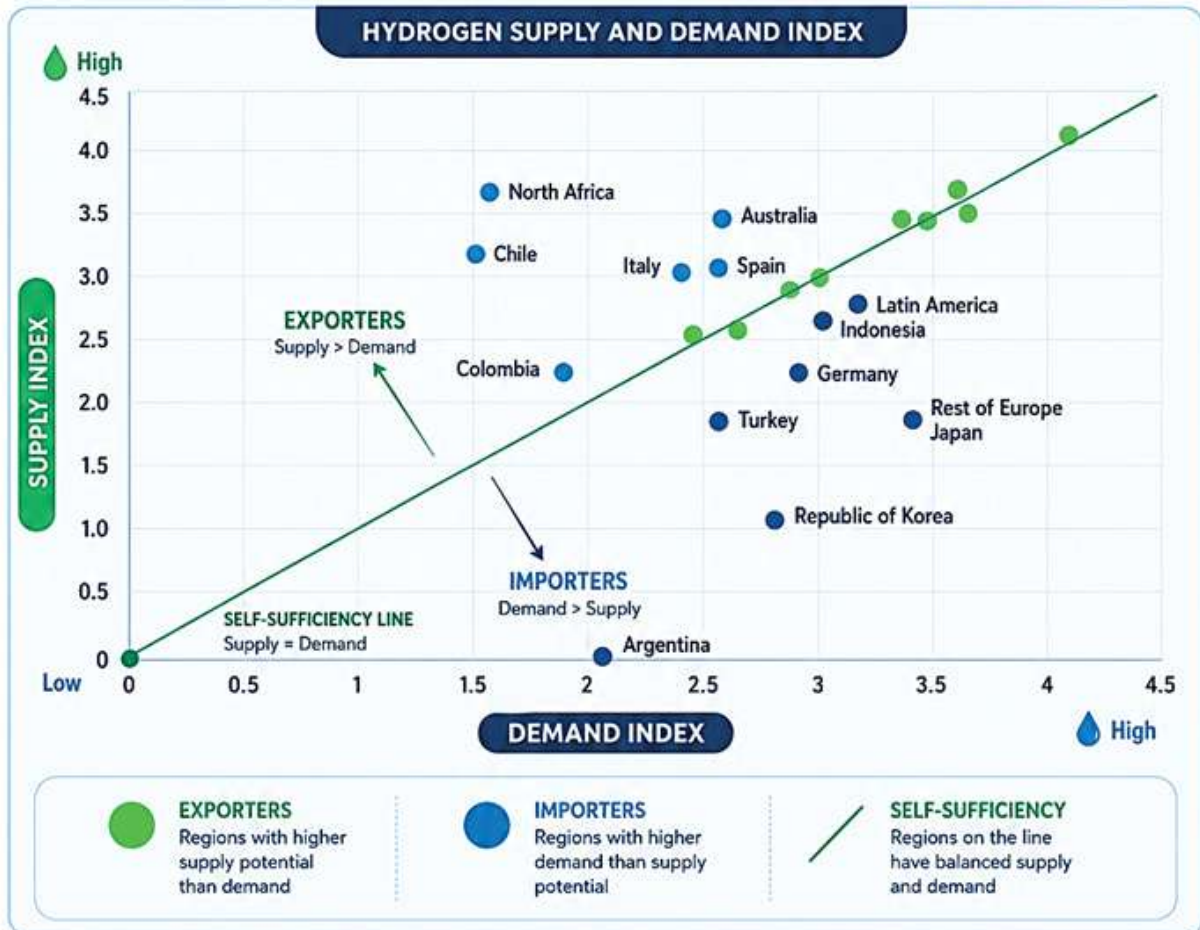
4 Laury Haytayan, EU-North Africa Energy Partnerships: Is a Win-Win Formula Possible?, 29 January 2025, <https://short-url.cc/1s2UE>

5 Michael Tanchum, RENEWABLE ENERGY AND ELECTRICITY INTERCONNECTION MEGAPROJECTS IN NORTH AFRICA: PROSPECTS FOR EURO-NORTH AFRICA COOPERATION, June 2024, <https://short-url.cc/1s2UY>

HYDROGEN FUTURE 2050

SUPPLY vs DEMAND AROUND THE WORLD

This chart compares hydrogen supply potential with demand needs for regions worldwide under optimistic technology assumptions in 2050.



KEY INSIGHTS

- Strong Export Potential**
North Africa, Chile, Australia, and Spain show high supply potential and are well-positioned to export hydrogen.
- High Demand Hubs**
Europe, Japan, Korea, and Turkey are among the regions with high demand and lower domestic supply potential.
- Balanced Regions**
Some regions like Italy and parts of Latin America are close to self-sufficiency.

TOP EXPORTERS BY SUPPLY INDEX

Rank	Region	Supply Index
1	North Africa	3.6
2	Australia	3.3
3	Chile	3.1
4	Spain	2.9
5	Italy	3.0



WHY HYDROGEN MATTERS

Hydrogen can power industry, transport, and homes with clean energy—supporting a net-zero future.

- INDUSTRY**
Clean processes
- TRANSPORT**
Zero-emission fuel
- POWER**
Reliable energy
- PLANET**
Lower emissions

Source: Fig. 2. Volumes of hydrogen supply and demand for regions around the world in 2050 with optimistic technology assumptions [38].

Studies by the International Renewable Energy Agency indicate that Africa—particularly North Africa—is well positioned to become one of the world’s major hydrogen exporters by 2050. The principal production capacities for green hydrogen are concentrated in North, East, and Southern Africa, regions that could derive substantial benefits from low-carbon hydrogen deployment. For example, both Morocco and Egypt host large fertilizer industries that currently depend on ammonia derived from fossil fuels; however, both countries are actively pursuing a transition toward green ammonia to reduce emissions and strengthen sustainability. International demand for green hydrogen is also expected to expand significantly, positioning Africa as a strategic supplier in the global energy market.

The German Society for International Cooperation (GIZ) estimates that the green hydrogen economy could create around one million jobs by 2030 across several African countries, including Morocco, Namibia, Tunisia, South Africa, Kenya, and Egypt. This figure is projected to rise to 2.5 million jobs by 2040 and between 3.5 and 4.5 million jobs by 2050. In South Africa alone, the hydrogen economy could generate approximately 360,000 jobs by mid-century. Economically, green hydrogen projects could accelerate sustainable industrialization across Africa and raise GDP by an estimated 6% to 12% in six key countries .

From a social perspective, developing green hydrogen supply chains could improve access to clean and reliable energy, support rural electrification, enhance educational opportunities, and stimulate local business growth. Community-based ownership and engagement initiatives may further strengthen social cohesion and resilience. Nevertheless, important challenges remain regarding equity and inclusiveness, including land displacement risks, competition over water resources, and unequal benefit-sharing

with local communities—particularly if export priorities to Europe outweigh domestic energy needs. Given the broad benefits of green hydrogen production and distribution, several African countries have already launched large-scale projects leveraging abundant renewable resources and critical raw materials required for electrolyzers and fuel cells. Supporting this momentum, international alliances focused on capacity building, financing mechanisms, and regulatory development have emerged, most notably the Africa Green Hydrogen Alliance (AGHA), established in 2022 with founding members including Egypt, Kenya, Mauritania, Morocco, Namibia, and South Africa.

In this study, nine African countries were selected based on their renewable energy potential, the level of actual project development, openness to global markets, and current natural gas production. These countries are: Morocco, Tunisia, Algeria, South Africa, Nigeria, Ghana, Namibia, Egypt, and Kenya.

1) Morocco:

Morocco, located in northwestern Africa on the Atlantic Ocean, benefits from a strong combination of solar photovoltaic (PV) and wind power generation capacities. The country possesses significant renewable energy potential, particularly due to strong and stable coastal winds in regions such as Tarfaya and Dakhla, alongside high solar irradiation averaging around 5 kWh/m²/day. This combination creates ideal conditions for deploying hybrid solar-wind systems, making Morocco highly suitable for large-scale green hydrogen production. Morocco ranks ninth globally in solar energy capacity and thirty-first in wind energy capacity, with substantial potential for expanding both onshore and offshore infrastructure.



Several locations in Morocco have been considered for green hydrogen production projects, particularly coastal areas that can benefit from desalination plants used to cool electrolyzers during production, including Dakhla, Laayoune, Tarfaya, Tangier, and Jorf Lasfar. However, priority has been given to Dakhla and Laayoune in the southern provinces due to their relatively low production costs, estimated at approximately \$2.54/kgH₂ and \$2.56/kgH₂ respectively.

Morocco also benefits from its strategic location near the Strait of Gibraltar, granting direct access to European markets through the Mediterranean. One major development reinforcing this role is the Nigeria–Morocco Gas Pipeline, first agreed upon in 2016 between the Nigerian National Petroleum Corporation and Morocco’s National Office of Hydrocarbons and Mines. The project aims to build a 5,660 km onshore and offshore pipeline along the West African coast, crossing 13 countries: Benin, Togo, Ghana, Côte d’Ivoire, Liberia, Sierra Leone, Guinea, Guinea-Bissau, Gambia, Senegal, Mauritania, and finally Morocco.

2) Tunisia:

Tunisia, located in North Africa on the Mediterranean Sea, also has significant potential for green hydrogen production through solar PV and wind

power. The country has experienced delays in renewable energy development due to administrative, regulatory, and financing challenges. However, progress has been partially achieved through cooperation with international private companies and institutional support, including assistance from Italy’s Ministry for Environment and Energy Security, aimed at accelerating project execution and strengthening cross-border energy cooperation.

Tunisia hosts two major wind farms in the north, located in Sidi Daoud (45 MW) and Bizerte, both contributing significantly to the national electricity grid. The Tunisian Solar Plan aims to achieve 3.8 GW of renewable energy capacity by 2025, with several solar projects underway in regions such as Gafsa, Tataouine, Tozeur, Sidi Bouzid, and Kairouan. Southern regions like Kebili enjoy particularly high solar irradiation, reaching 5.8 kWh/m²/day, making them highly suitable for large-scale solar installations. Strategic partnerships with Italy and Algeria are crucial for future green hydrogen distribution. The proposed GALSI pipeline connecting Algeria to Italy via Sardinia has also been discussed as a potential route for transporting natural gas and hydrogen to European markets, although it remains in the planning stage.

⁷ North Africa's power play gains momentum as Europe eyes new energy lifeline, 23/03/2026, <https://short-url.cc/1s2YV>

H₂

3) Algeria:

Algeria is located in North Africa between Morocco and Tunisia along the Mediterranean Sea. It is Africa's largest country, with most of its population concentrated along the coastline, while much of its territory is covered by the Sahara Desert, making vast inland areas sparsely populated. These extensive desert lands present major opportunities for renewable energy and green hydrogen production. Algeria relies primarily on solar power, in addition to wind energy.

Adrar is among the most promising regions for wind-based hydrogen production, with estimated production capacity averaging 46,262 tonnes/km²/year, translating into a total hydrogen potential of approximately 1.066 gigatonnes annually across 730,719 km². Despite this potential, wind energy remains underutilized, whereas solar PV is the dominant renewable source due to Algeria's exceptionally high solar irradiation, exceeding 13.9 TWh annually.

4) South Africa:

South Africa lies at the southern tip of the African continent and is considered one of the most promising future suppliers of green hydrogen. Its hydrogen roadmap includes deploying 10 GW of electrolysis capacity in the Northern Cape region and producing at least 500,000 tonnes of hydrogen annually by 2030, increasing to 15 GW by 2040, positioning South Africa as a key player in the global green hydrogen economy.

The country enjoys strong natural advantages, including approximately 2,500 sunshine hours annually and solar radiation ranging from 4.5 to 6.6 kWh/m², placing it among the top three countries globally in solar potential. Wind energy potential is estimated at 67,000 GW, comparable to its solar potential. The Upington region in the Northern Cape is particularly suitable for solar production and electrolysis deployment.

5) Nigeria:

Nigeria is Africa's most populous country, with over 237 million inhabitants in 2025. Located in West Africa on the Gulf of Guinea, Nigeria possesses a significant renewable energy mix, mainly hydropower and ocean energy, alongside solar and wind resources. However, the country's energy system still relies heavily on fossil fuels and hydropower, with around 78% of electricity generated from natural gas.

Nigeria's diverse climate—dry in the north, tropical in central regions, and humid equatorial in the south—creates favorable conditions for multiple renewable technologies. GIS-based studies in southeastern Nigeria identified 61 out of 95 municipalities as suitable for green hydrogen projects based on factors such as elevation, slope, surface temperature, energy demand, and proximity to infrastructure.

6) Ghana:

Ghana, located in West Africa, benefits from geographic diversity between northern dry zones and the Gulf of Guinea in the south. The country possesses significant technical potential for green hydrogen production but requires further investment to improve technology and reduce costs. Studies suggest that around 85% of Ghana's land is suitable for green hydrogen projects, with potential production reaching approximately 14,196 million tonnes annually from solar and 10,123 million tonnes from wind energy.

However, grid connectivity remains a challenge. Northern regions offer excellent solar resources but suffer from limited infrastructure due to low population density, while wind projects are concentrated in southern coastal areas where wind conditions are more stable.

7) Namibia:

Namibia, located in southern Africa, borders Angola, Zambia, Zimbabwe, Botswana, and South Africa, with the Atlantic Ocean to the west. Namibia possesses exceptional renewable energy resources, with solar irradiation ranging from 2,200 to 2,400 kWh/m² annually—among the highest globally. It also has substantial wind energy potential, particularly in southern and coastal regions, where wind speeds exceed 7 m/s and capacity factors can reach 50%.

As a result, Namibia is regarded as a critical contributor to global decarbonization through green hydrogen. The country targets annual hydrogen production of 1–2 million tonnes by 2030 and 5–7 million tonnes by 2040. Studies suggest importing green hydrogen from Namibia to Belgium is economically viable, especially with continued reductions in solar panel and electrolyzer costs.

8) Egypt:

Egypt, like other North African countries, has abundant solar and wind resources, giving it a strong long-term competitive advantage in green hydrogen and green ammonia production. However, limited freshwater access remains a major constraint. Egypt's theoretical renewable capacity reaches approximately 350 GW in wind energy and 650 GW in solar energy.

Egypt hosts Africa's largest solar power plant, the Benban Solar Park, with 1.8 GW capacity across 37 km² near Aswan, alongside major wind farms such as Gabal El-Zeit and Zafarana. Unlike Morocco and Algeria, Egypt currently lacks direct hydrogen pipeline access to Europe, although feasibility studies have examined an 1,800 km pipeline linking Port Said to Calabria in Italy, potentially reducing hydrogen costs to €2.7/kg by 2030 and €2.3/kg in the long term.

9) Kenya:

Kenya is located in East Africa on the Indian Ocean and is the second-largest economy in the region. The Port of Mombasa serves as a major trade gateway for East Africa. Kenya has solar capacity of approximately 15 GW and wind capacity of 4.6 GW. Although its green hydrogen sector remains at an early stage, Kenya is considered a promising future supplier.

The country aims to achieve 100% renewable energy by 2030, while its 2040 energy roadmap targets expanding renewable capacity to 100 GW. Regions south and southeast of Lake Turkana are considered among the most cost-effective production sites for green hydrogen and green ammonia. This region also hosts one of Africa's largest wind farms, the 310 MW Lake Turkana Wind Farm.



Africa-Europe Green Hydrogen Interconnection

Unlike Europe, Africa enjoys a clear comparative advantage in green hydrogen production, particularly due to the abundance and relatively low cost of renewable energy inputs, especially solar and wind power. Several countries, including Egypt, Algeria, Morocco, and South Africa, are making significant progress in developing green hydrogen hubs to meet growing global demand. These regions can produce hydrogen at much lower costs than Europe, positioning Africa as an ideal strategic market for green hydrogen supply.

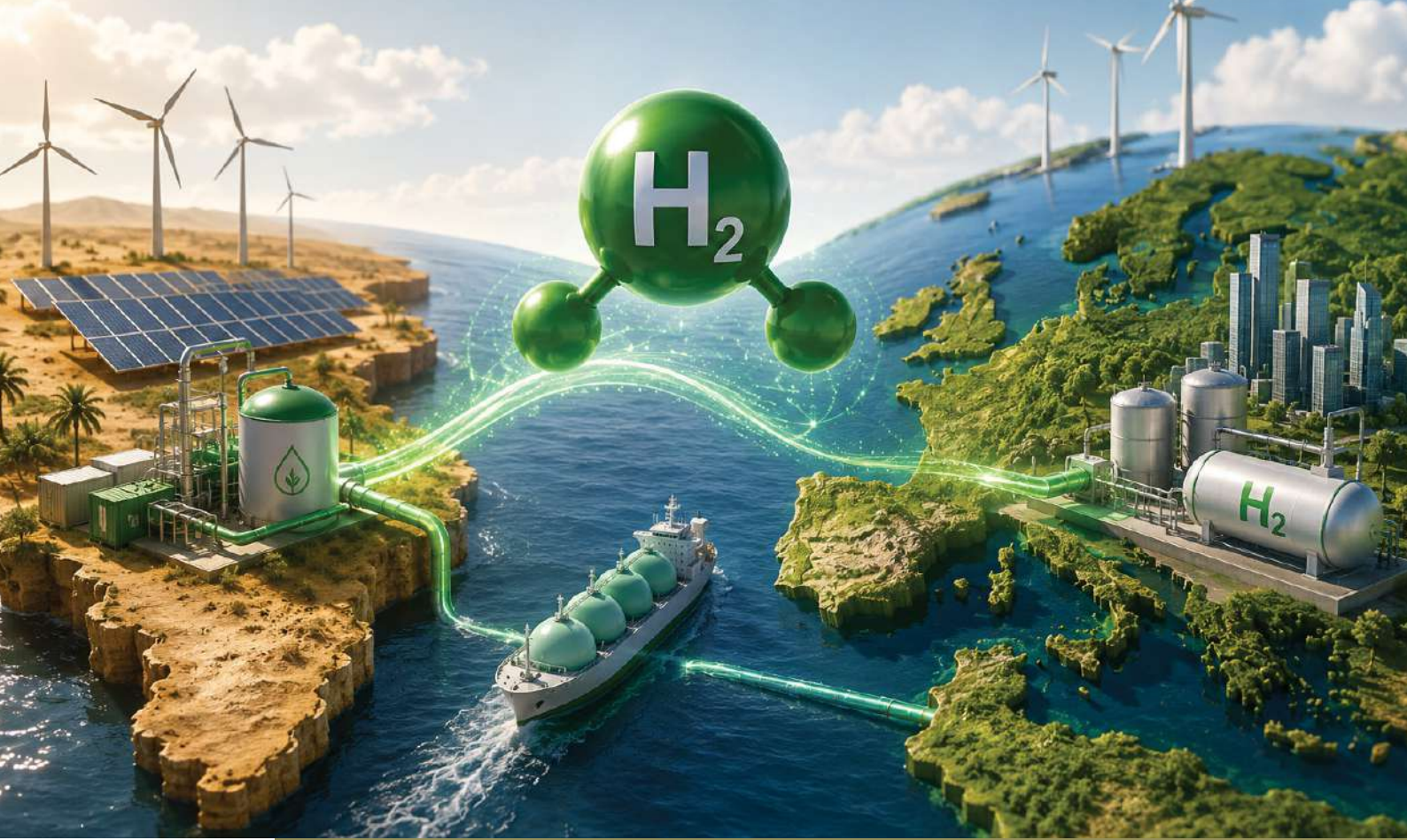
Consequently, Europe could overcome regional constraints related to renewable hydrogen availability by importing it from Africa, thereby supporting its climate objectives. However, this pathway requires addressing several major challenges, foremost among them ensuring stable political relations with producing countries and developing the necessary infrastructure for hydrogen transportation, particularly pipeline networks. European environmental assessments indicate that green hydrogen represents a strategic opportunity for Europe–Africa cooperation, provided that such cooperation is built on mutual benefit: supplying clean energy to Europe while fostering economic development and social stability in African partner countries. Equally important is ensuring fair distribution of benefits to local communities to support sustainable development.

Existing literature suggests that hydrogen cooperation between the two continents could generate mutual gains. Europe would strengthen its energy security and climate transition, while Africa would benefit from economic growth and expanded energy infrastructure. Nevertheless, Europe is not among the most favorable regions

for hydrogen production compared to countries such as China, Australia, and several African nations including Namibia, Morocco, and Tunisia. South Africa, for example, possesses substantial solar energy resources that position it as a major future exporter of green hydrogen. Likewise, North African countries such as Algeria, Tunisia, Libya, Egypt, and Morocco are considered highly promising suppliers to the European Union, with potential export revenues estimated at up to €50 billion annually by 2050. Other large-scale projects, such as the HYPHEN project in Namibia, further demonstrate the continent's growing potential in this sector.

Two main production and export zones emerge in Africa: Southern Africa, particularly South Africa, and North Africa. Currently, approximately 1,800 petajoules of energy are already exported from North Africa to Italy and Spain through pipelines and liquefied natural gas infrastructure. Additional projects aim to connect solar power from Tunisia and Libya to electricity grids in Greece and Italy. Pipeline transmission is considered a cost-competitive option compared with High Voltage Direct Current (HVDC) electricity transmission, given its ability to transport large quantities of energy over long distances with relatively low losses. As fuel cell technologies continue to advance, hydrogen pipelines are expected to become among the most sustainable methods for transporting renewable energy in the future. Maritime hydrogen transport also remains possible under strict technical conditions and represents the primary option through which South Africa seeks to expand its global export markets.





In conclusion

Africa–Europe energy interconnection through green hydrogen represents a dual strategic opportunity. It offers Europe a pathway to enhance energy security and achieve climate goals, while giving Africa with a promising route toward economic growth, infrastructure development, and investment attraction. However, realizing this vision depends on overcoming challenges related to financing, technological readiness, transportation infrastructure, geopolitical stability, and equitable benefit-sharing. Building a balanced energy partnership between the two continents could therefore serve as a global model for transitioning toward a low-carbon economy founded on cooperation and integration rather than competition.