The Egyptian Cabinet
Information and Decision Support Center

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Policy Perspective

Egyptian Path of Investments in Green Hydrogen

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A non-periodic publication issued by Cabinet's Information and Decision Support Center (IDSC). It covers the most prominent topics in the scene from all aspects to present a comprehensive vision regarding such topics relying on experts' perspectives.

IDSC's Commentary

Due to the pressing climate catastrophes countries all over the world currently witness, green transformation has gained real momentum. It essentially relies on the global energy system's shift from dependence on fossil fuels to renewable and clean energy sources. This shall reduce carbon emissions in order to reach carbon neutrality to prevent more climate catastrophes.

Since countries bear their responsibility to combat climate change, several ambitious strategies have been developed over the past few years. They aim at accelerating green transformation and localizing renewable energy sources, most importantly green hydrogen as a clean alternative to fossil fuels.

In this regard, Egypt approved the Integrated and Sustainable Energy Strategy to 2035. It shall expand the use of renewable energy sources, increase electricity supplies generated by renewable sources to 42% by 2035, and provide wind energy by 14%, hydropower by 2%, and solar energy by 25% by 2035.

Moreover, the Integrated and Sustainable Energy Strategy to 2035 targets promoting Egypt's efforts to benefit from the growing momentum in the production of natural gas and build on it to develop the renewable energy sector. Green hydrogen and its derivatives have emerged as viable options in light of the current global status regarding reducing carbon emissions as part of countries' plans for green transformation. Hence, global demand for low-carbon fuels shall grow in the foreseeable future. In addition, Egypt shall have an opportunity to promote its regional leadership in producing and exporting green hydrogen.

Worthy of mentioning, Egypt has a plethora of main qualities that pave the way for implementing green hydrogen projects given the political support and will towards green transformation. Furthermore, Egypt's unique location nearby Europe —one of the most prominent markets importing renewable energy products— facilitates the implementation of green hydrogen. Also, the infrastructure necessary to transport green hydrogen to European countries is available, relying on the network of exporting natural gas.

That being said, the new issue of the Policy Perspective series, published by the Information and Decision Support Center (IDSC), sheds light on the current challenges facing the global energy sector due to the Russia-Ukraine crisis. It also tackles the definition of green hydrogen as a clean alternative to fossil fuels and the Egyptian efforts to localize green hydrogen projects. Finally, the issue reviews Egypt's measures to boost its green hydrogen exports and regional and international partnerships in this regard.

Egyptian Path of Investments in Green Hydrogen

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Recent global developments proved that energy security necessitates the diversification of energy resources, with a focus on green energy and minimizing dependency. This study illustrates the efforts the Government of Egypt (GoE) put forward to diversify its basket of energy resources over recent years, paving the way for investments in the production and export of green hydrogen, which is considered a promising field to overcome various challenges.

Global Challenges in Energy Security Sector

The most recent challenge in the energy security sector is the Russia-Ukraine war, which broke out in February 2022 and caused global energy market shock waves. Price volatility, supply shortages, security issues, and economic uncertainty led to global infringement of energy security, opening the door to shifting strategies and changing policies.

The repercussions on the global economy brought on by the Russia-Ukraine crisis led to skyrocketing gas prices in Europe soaring by 450%. Such crises accelerated the demand of the European Union (EU) for green hydrogen. They forced it to become partially independent of Russian energy resources, which supply 45% of the EU's imported gas and 40% of its total gas consumption.

The EU focused on a range of alternatives, including green hydrogen, to speed the process of gaining independence from Russia in order to fulfil its energy needs. Earlier, the EU developed its Hydrogen Strategy in July 2020; it set out an ambitious framework and roadmap for hydrogen development. The strategy was Supported by and aligned with the EU's Member States' strategies. The EU policy emphasizes importing hydrogen from Southern and Eastern Neighborhood partners. Southern neighborhood states are Egypt, Israel, Jordan, Lebanon, Palestine, Syria, Algeria, Libya, Morocco, and Tunisia; Eastern neighborhood states are Azerbaijan, Armenia, Ukraine, Belarus, Georgia, and Moldova.

Imports will meet a substantial share of Europe's future green hydrogen requirements. In this sense, the Eastern Mediterranean region is a potential center for exporting low-carbon hydrogen to Europe thanks to its large renewable energy capability. Over the previous years, cooperation was only limited to developing natural gas production, but today cooperation can extend to developing hydrogen production for both exports and domestic decarbonization.

The most recent challenge in the energy security sector is the Russia-Ukraine war, which broke out in February 2022 and has caused shock waves in the global energy markets. Price volatility, supply shortages, security issues, and economic uncertainty led to global energy insecurity.

Non-EU countries of the Eastern Mediterranean region have not been early movers when it comes to green hydrogen. However, to varying

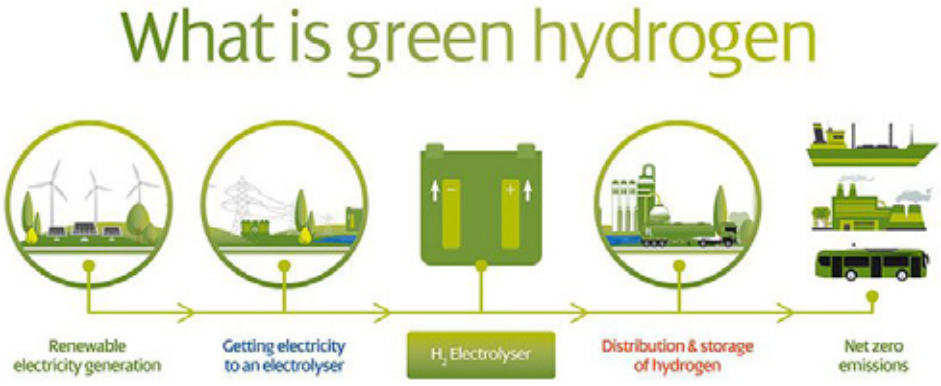
degrees, they have begun to note the potential opportunities it presents. For Eastern Mediterranean countries, green hydrogen is an optimal solution for the need to diversifying sources. It also represents a significant shift towards greener and cleaner energy sources to reduce emissions and alleviate climate change impact, helping to decarbonize certain key sectors such as transportation, shipping, aviation, and manufacturing. Moreover, it leverages the opportunity to export for economic gains, as it can be stored or exported using H2-Industries' Liquid Organic Hydrogen Carrier (LOHC). In addition, natural gas pipelines could be acclimatized to transfer 100% hydrogen to European markets by putting on fundamental new compression capacities or constructing new pipelines from the beginning with specifications. These specifications would permit Europe to relocate hydrogen, with comparatively modest cost implications.

In light of global developments, there is a pertinent need to mitigate climate change and address its root causes. Analysts believe that in addition to the dire outcome of the Russia-Ukraine crisis, there are other reasons to believe this is the "moment of green hydrogen". **Firstly,** there is a global worry due to climate change and interest in reaching a net zero future. Green hydrogen has suddenly emerged as a viable and lucrative substitute; it has drawn interest from governments and private players, who are making substantial strides to bring the alternative energy source into the mainstream. **Secondly,** the industry has long been held back by high costs, but this is expected to change. Green hydrogen is produced using a process known as electrolysis, where H_2O (water) is separated into H (hydrogen) and O (oxygen), enabling hydrogen to be extracted. Only 0.1% of the world's hydrogen supply is actually green; this is mainly because the process is more expensive than its non-green equivalent. Now, by virtue of soaring gas prices, green hydrogen has become a more cost-effective option. Moreover, carbon prices are rising in the EU; they have nearly doubled over the past year, making the green version even less expensive by comparison. **Thirdly,** the demand is available.

The EU is looking into signing the Mediterranean Green Hydrogen Partnership, about which little is known. It is similar to the “East Mediterranean Gas Forum”, but for green hydrogen.

What is Green Hydrogen?

Green Hydrogen is also called renewable hydrogen as mentioned above. It is obtained by the electrolysis of water; thus, water is the raw material. Nevertheless, the most crucial issue is that this process is entirely powered by clean energy. It also generates no polluting emissions into the atmosphere; therefore, it is the cleanest and most imperishable hydrogen. Electrolysis is an electric current that splits water into hydrogen and oxygen. If the electricity is produced by renewable sources, such as solar or wind energy, the resulting hydrogen will be considered renewable as well. It shall also have numerous emissions benefits.



Egypt's Interest in Green Hydrogen

Egypt has recently announced its efforts to produce green hydrogen, aiming at becoming a major exporter. These efforts are part of a global trend towards decarbonization and the transmission of renewable energy sources. Egypt has abundant clean energy resources, including wind and solar energy; thus, it aims at generating 42% of its electricity from renewable sources by 2035. The manufacture of green hydrogen is expected to play quite an essential role in achieving this target. Green hydrogen can help reduce carbon emissions from transportation, industry, and power generation.

Egypt's interest in green hydrogen is picking up steam, and it is principal to underscore the availability of the political will. This was demonstrated by the announcement of Egypt's Green Hydrogen Strategy during COP27, which was developed in collaboration with the European Bank for Reconstruction and Development (EBRD) and the Arab Union for Sustainable Development and Environment (AUSDE). The hydrogen strategy splits the State's goal for the sector into three stages: the experimental stage (starting in 2022 or 2023), green hydrogen expansions by 2030, and full implementation and beyond by 2040. The strategy estimated that the hydrogen economy would rise sevenfold by 2050, giving Egypt a substantial share of the international market, an increase in GDP of USD 10–18 billion, and more than 100,000 jobs. Egypt hopes to capture 5% of the international hydrogen market by 2030 and 8% by 2040 through establishing an international export center for hydrogen and its derivatives to achieve energy security and accomplish the sustainable development goals (SDGs) between 2030 and 2040.

With an eye towards launching an initial phase of projects that could be worth USD 3-4 billion, these ambitions are being supported by tax incentives that would allow companies involved in several key areas —including green ammonia and green hydrogen production, storage, and export— to deduct 30-50% of their investment costs from their tax bills. Egypt's green hydrogen

project plans currently amount to almost 12 GW, equivalent to more than 1.57 million tons of green hydrogen. If such plans were fully implemented, Egypt's capacity would expand to provide one-sixth of the 10 million tons of green hydrogen the EU plans to import by 2030.

Egypt's first green hydrogen facility lies in the economic zone of the Suez Canal. It is also the first integrated green hydrogen plant in Africa. Green Hydrogen will be used for green ammonia production to boost Egyptian exports and advance its decarbonization. Once fully operational, it is expected to save about 130,000 CO_2 emissions annually. This project is owned, built, and operated by Fertiglobe, one of the largest exporters of combined ammonia and urea; Scatec ASA, a Norway-based integrated independent power producer; Orascom Construction, one of the biggest engineering and construction companies in the MENA region; and the Sovereign Fund of Egypt (TSFE), a sovereign wealth fund. It is owned by the Egyptian State and managed through the private sector, positioning itself as the partner of choice in Egypt. The European Bank for Reconstruction and Development's provides financing to acquire and construct a 100-MW electrolyser facility to be powered by renewable energy. Upon being fully developed, the facility will deliver up to 15,000 tons of green hydrogen each year. This, in turn, will be used as a source of green ammonia to be sold on both local and international markets. It is important to know the fact that ammonia production is energy-intensive and responsible for around 1.8 percent of global carbon dioxide (CO_2) emissions despite its essential nature as the building block for nitrogen fertilizers, a critical crop input that provides food to 40% of the world's population. Decreasing the amount of CO_2 produced during the production process is, therefore, a pivotal step in serving the international community to achieve its net zero targets by 2050. Using green hydrogen, brought out by means of clean energy, is seen as the essential step to achieve sustainable development goals (SDGs).

This project constitutes a qualitative step forward in the modernization of the energy sector in Egypt, as it is the first step towards decarbonization of the ammonia sector in Egypt. As such, it will be the main catalyst for future green hydrogen projects and will make Egypt the largest ammonia-producing country in Africa.

Furthermore, the Emirati renewable energy company Masdar will work with Hassan Allam Utilities to establish a facility capable of producing 480k tons of green hydrogen a year. In late August 2022, the Egyptian Government signed a Memorandum of Understanding (MoU) with Globeleq and Actis, two UK-based companies specializing in clean energy, to produce green hydrogen. It is expected that the project will be carried out over three phases, totaling 3.6 GW of electrolysers and around 9 GW generated from wind and solar energy. Additionally, Globeleq intends to produce 2 million tons of green hydrogen each year in Egypt. British Petroleum (BP) has pledged to estimate the commercial and technical feasibility of developing a multiphase green hydrogen production and export hub in Egypt. In this regard, the Egyptian Government and BP announced the deal on December 8, 2022, one day after Cairo had signed another agreement with local energy and utility provider Taqa Arabia. Its French partner, renewable energy producer Voltalia, is to set up, finance, and turn on about a capacity of 150 kilotons/year of green hydrogen manufacturing plant. In addition, similar MoUs with other partners took place last year such as Saudi Arabia's Alfanar company, Australia's Fortescue Future Industries (FFI), and Indian renewable energy firm ACME Group. Furthermore, TSFE signed a number of protocols for investing billions in renewable energy.

Egypt's energy companies are involved in active talks with the private sector —encompassing major European companies— on projects related to green hydrogen. The Italian company Eni, for example, one of the most important foreign companies working with the Egyptian State in energy production —including natural gas and oil— has been working with Egyptian companies

such as state-owned Egyptian Electricity Holding Company (EEHC) and Egyptian Natural Gas Holding Company (EGAS) since 2021 to explore the feasibility of hydrogen production. In addition, Egypt's Ministry of Electricity and Renewable Energy has signed a MoU with Siemens Energy to develop a pilot project for the production of green hydrogen. The project shall be located in Ain Sokhna. It will use renewable energy sources such as wind and solar energy to conduct hydrogen through electrolysis, and it is expected to produce up to 100 tons of green hydrogen per year. The hydrogen produced will be utilized as fuel for transportation, industry, and power generation. These MoUs are in accordance with the State's efforts to attract foreign investments into green hydrogen production so that Egypt becomes a hub for the transit of clean energy to European countries.

Cooperation with China is also taking place regarding the production of green hydrogen. In March 2023, Egypt's Prime Minister declared that China Energy Engineering Corporation would break ground in May on one of the State's first projects on green hydrogen. The move, following the signing of a MoU in November 2022, represents a significant investment with a value of USD 5.1bn. The project will be implemented over two phases, consisting of a solar park, wind farm, and a facility for electrolysing water and synthesising ammonia. When the two phases are complete, the project will produce 140,000 tons of green hydrogen each year. The plant aims at exporting ammonia to European markets.

Egypt's Structural Arrangements to Export Green Hydrogen

The European Union's simpler approach towards importing hydrogen from the Eastern Mediterranean countries would be the use of hydrogen to get low-carbon or zero-carbon ammonia. Egypt is already an important exporter of ammonia; it usually benefits from the existing ports that facilitate the process of exporting. Low-carbon or zero-carbon ammonia exported to Europe could be used to deliver a CBAM-friendly product to the European market for traditional uses. It could also be a turn back into hydrogen at the receiving European ports. Another option is to use it directly as fuel for power generation; this is part of the decarbonization plans in some Asian Countries such as Korea and Japan. This has not yet been widespread in Europe. The main benefit of the ammonia-based export option for Egypt and other Eastern Mediterranean hydrogen is that it would demand a less substantial capital investment profile for infrastructure development; thus, it would be easier to finance over several stages. However, the impediment is that the total logistics costs —including reconversion into hydrogen— would likely be high once the European demand for traditional uses of ammonia is fully met.

Egypt continues to cooperate with all stakeholders to become a "hub" for developing and exporting green hydrogen. During COP27, the Government of Egypt signed a bilateral MoU with the European Commission (EC) on a strategic partnership on renewable hydrogen.

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Signing the MoU followed the joint statement delivered by the President of the Commission, “Ursula von der Leyen”, and President “Sisi”, highlighting mutual efforts on key energy partnerships for the EU. This would serve as a central element in forging the EU-Mediterranean Renewable Hydrogen Partnership. In addition, a joint statement with the EBRD was delivered, announcing the EC’s contribution of up to EUR 35 million in support of Egypt’s Energy Wealth Initiative.

The Energy Wealth Initiative was launched by the Government of Egypt and EBRD to execute the energy pillar of the Nexus of Water, Food, and Energy Initiative designed to speed up the implementation of the country’s new National Climate Change Strategy (NCCS) 2050, launched in May 2022. The Energy Wealth Initiative targets to shut down 5,000 MW of inefficient gas-based power generation capacity, equivalent to around 5% of Egypt’s total electricity supply and facilitate investments to uphold the insertion of 10,000 MW of new renewable energy capacity. As Egypt is seeking global partners to support grid infrastructure investments, the Commission has announced its intention to provide a grant of EUR 35 million to EBRD under the Economic and Investment Plan (EIP) for the Southern neighbours.

Moreover, Egypt also explores the potential of producing blue hydrogen, which is extracted from converting natural gas into hydrogen, and the emitted carbon is captured and stored. It currently considers methods to implement carbon capture and storage strategies. Although blue hydrogen is not considered a priority to use in Europe, the EU has not explicitly ruled out importing it.

Conclusion

Finally, although green hydrogen currently costs around USD 5-6/kg to produce, the entire industry focuses on reaching the threshold where green hydrogen production falls below USD 2/kg. Such endeavors are related to the price of electricity, the process of developing green hydrogen technology —such as electrolyzers— and the expansion of production capacity, which is currently very low. Nevertheless, the cost of such production should decrease rapidly; the Government of Egypt is currently engaging with stakeholders transparently in this regard.

There is no doubt that Egypt —over the last few years— has introduced several regulations and policies to incentivize investment in renewable energy. Such regulations and policies include announcing the feed-in tariff, offering tax and non-tax incentives for renewable energy projects, guaranteeing access to the grids, allowing long-term power purchase agreements, prioritizing dispatch, allocating lands needed for the projects at a discounted price, guaranteeing the financial obligations of the government off-taker, and gradually lifting government subsidies on traditional fuels.

Meanwhile, there is no clear regulatory framework for licensing and implementing hydrogen in Egypt. Regulations and strategies for hydrogen and hydrogen technology are discussed over time to note that national regulations and codes need to be developed to organize the processes of production, storage, and sequent transport of hydrogen. Accordingly, regulations are put in place for the purpose of competitively pricing the electricity generated by green hydrogen projects the Government is expected to launch, in addition to supplementary incentives to get things off the ground.

Egypt has demonstrated several qualities that could help to achieve its green hydrogen goals and aspirations and fulfill an essential need at a critical moment in the history of energy and climate change. Said qualities range from strategic planning, cooperation with international stakeholders, availability of legislations, the overflow and inexpensive cost of solar and wind power, and strategic location on the Mediterranean and the Red Sea.

Resources

- New and Renewable Energy Authority
- Egyptian Electricity Holding Co.
- Egyptian Electricity Transmission Co.
- Egypt State Information Service
- American Chamber of Commerce in Egypt
- Egyptian Government Web Portal
- International Renewable Energy Agency (IRENA)


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