Egypt's Green Hydrogen Policy

Navigating the Trade-off Between Exports and the Domestic Energy Transition

Mohamed Younes

December 2025

EGYPTIAN INITIATIVE FOR PERSONAL RIGHTS
المبادرة المصرية للحقوق الشخصية
tni
transnationalinstitute

Authored by: Mohamed Younes

Reviewed by: Wael Jammal, Mohamed Ramadan, Hamza Hamouchene, and Saber Ammar

Proofread by: Amr Khairy

Editing : Ashley Inglis

Design: shfra.co studios in collaboration with Reina Hasbini & Karim Farah

Produced by the Egyptian Initiative for Personal Rights (EIPR) in partnership with the Transnational Institute (TNI)

This report was published with the support of Terre Solidaire Association (CCFD)

Executive Summary

This study offers a comprehensive analytical account of the evolution of the green hydrogen sector in Egypt, conceptualising it as a domain that is situated at the intersection of energy transition and climate justice. The prominence of green hydrogen on Egypt's national energy agenda has emerged primarily as part of an export-oriented industrial strategy that is shaped by European geopolitical realignments following the outbreak of the Russia–Ukraine war, and by the European Union's pursuit of diversified, renewable, and cost-effective energy sources that are consistent with green certification standards.

Within this framework, Egypt has undertaken rapid action to establish an enabling environment for investment in the green hydrogen sector, including establishing related legislative and regulatory measures – most notably Law No. 2 of 2024, which provides substantial investment incentives – and creating the National Council for Green Hydrogen and its Derivatives (NCGH), which is mandated to coordinate planning processes, regulatory approvals, and technical standards for the sector. These initiatives reflect Egypt's strategy of attracting foreign direct investment and enhancing foreign exchange inflows in the context of mounting macroeconomic pressures.

Egypt's key planning document in this area is the National Low-Carbon Hydrogen Strategy, which delineates a three-stage plan for the period up to 2040. Under the strategy, production is primarily oriented towards European markets. To date, approximately 30 memoranda of understanding (MoUs) and 12 binding framework agreements have been signed with international investors. These are predominantly concentrated in the Suez Canal Economic Zone. The production capacities specified in some of these agreements exceed the short-term targets set out in the strategy; however, on-the-ground implementation is likely to be constrained by overlapping challenges, including the availability of additional renewable capacity that meets European standards, securing long-term offtake agreements, compliance with green financing requirements, and the high cost of capital in the domestic market.

To understand Egypt's options with regard to hydrogen it is necessary to understand the fragility of Egypt›s energy system. Fossil fuels still account for approximately 95% of the country's energy supplies, with natural gas dominating electricity generation. Domestic production – particularly from the Zohr gas field – has declined significantly in recent years, transforming Egypt from a net exporter to a net importer of gas, leading to frequent power outages.

Achieving the objectives of the national energy strategy and the National Low-Carbon Hydrogen Strategy will require the addition of substantial wind and solar capacity, with current projections of required capacity ranging from 46 to 68 gigawatts (GW) by 2030 (the hydrogen strategy's ambitious 'green' scenario puts the figure much higher, at 90 GW), and potentially reaching 120–170 GW by 2040, to satisfy both domestic demand and export commitments. This will necessitate considerable investment (estimated at billions of dollars) to enhance the electricity transmission grid so as to facilitate the integration of additional renewable energy capacity.

The potential competition between the hydrogen industry and the local energy system over resources such as land and transportation networks presents a physical constraint on potential expansion. While large areas of land have already been allocated to renewable energy projects, hydrogen production remains concentrated in a relatively small area within the Suez Canal Economic Zone, near Egypt's ports, which positions it to serve ammonia and methanol export chains. While this area also benefits from excellent wind power conditions, it is constrained by a lack of available space, suggesting a potential competition in the Gulf of Suez area between wind farms dedicated to exports and those supplying local electricity.

In regard to the electricity grid, the concept of a dedicated 'Green Energy Corridor' for hydrogen projects has been proposed as a way to meet the 'additionality' and temporal and geographical consistency requirements under European standards. However, while this model may provide investors with greater regulatory certainty, it carries the risk of establishing isolated networks devoted to serving exports, without regard to the national system and local demand needs. This division could undermine efforts to reduce the overall system-level carbon footprint and could increase the national grid's reliance on fossil fuels, particularly if the most productive renewable sites are depleted to serve export corridors, instead of enhancing domestic electricity supply.

Egypt's energy policies are clearly influenced by European market conditions. Pursuing alignment with European green certification requirements, 'additionality' regulations, and monitoring, reporting, and verification (MRV) systems, Egypt is in the process of adopting an energy sector model in which wind and solar sites are directly connected to electrolysis units in Egypt's Free Economic Zones with preferential contracts and tariffs. As indicated in the preceding paragraph, this institutional arrangement leads to the creation of energy 'enclaves' or 'oases', i.e. projects that are tailored to meeting European compliance standards and minimising investment risks but are only very weakly integrated into the national energy system. This pattern will remain in place unless operational and legal frameworks are introduced to ensure grid connectivity and the allocation of defined local consumption quotas for industrial use and for the national electricity system.

In terms of the applications of hydrogen in Egypt, it can be stated that it offers a complement to direct electrification, rather than being a substitute for it. For this reason, its use should be prioritised in sectors that are hard to electrify, such as maritime shipping and fertiliser production. Hydrogen has high potential as a fuel for maritime transport, and this is the most commercially viable short-term use case for Egyptian hydrogen, given Egypt's strategic location along the Suez Canal corridor. By contrast, blue hydrogen pathways are less compatible with Egypt's context due to the country's limited natural gas resources and the high cost of carbon capture and storage. It is thus recommended to adopt a transitional approach which entails blending limited amounts of hydrogen into natural gas networks and enabling conventional power plants to operate on hydrogen when feasible, in order to create local demand and absorb early production.

Turning to the issues of sustainability, equity, and benefit-sharing, the current prioritisation of an export-oriented approach to hydrogen risks reproducing existing imbalances in the distribution of land and water resources, and could exacerbate the risk of environmental degradation, unless binding mechanisms to ensure local value-sharing are established. Better still, priorities should be reoriented: moving from an export-led model towards one centred on domestic transformation.

Also linked to sustainability and equity concerns is the fact that the export-oriented hydrogen model currently being pursued will direct the output of Egypt's most productive wind and solar sites towards export routes. This will intensify competition over high-quality land and diminish the overall carbon reduction impact if the national grid continues to rely on fossil fuels to meet domestic demand. Against this backdrop, sustainability assessments relating to the country's hydrogen strategy should extend beyond individual projects and account for cumulative national impacts. It is also necessary to ensure transparency and public access to data on emissions, water, and land use – which are key conditions for social acceptance and the long-term continuity of investments.

Based on the study's analysis, it is recommended to adopt an approach that ensures complementarity between the local energy production and exporting systems , rather than isolating them at the local level. This requires a clear sequencing of priorities, beginning with electrification and increasing energy efficiency in order to reduce reliance on gas, alongside the accelerated strengthening of the national grid – which should be treated as shared infrastructure that should not face competition from isolated parallel systems – so that exports can serve as a supportive element within a broader domestic energy transition, rather than creating additional competition for resources.

Furthermore, there is a need for a more comprehensive vision of Egypt's energy transition: one that is grounded in the principles of climate justice. This includes negotiating compliance rules, financing arrangements, and green certification standards with European partners to ensure equitable burden-sharing and commitments that are aligned with the capacity of the local economy. A further ambition should be to build mutual understanding and practical coordination among North African countries on these issues, with the aim of enhancing their collective negotiation power, harmonising green compliance standards within a regional framework, preventing a race to the bottom in offering incentives, and opening shared pathways for infrastructure, manufacturing, and value-chain development in hydrogen and its derivatives.

Table of Contents

Executive Summary **3**

1. Introduction **8**

2. Hydrogen in Egypt **9**

3. Projects **12**

4. Overview of Egypt's Energy Situation **14**
4.1. Natural gas 14
4.2. The electricity sector 15

5. The Impact of Hydrogen Policies on Egypt's Energy System **18**

6. Areas of Competition **20**
6.1. Land productivity 20
6.2 Challenges of, and competition over, electricity transmission 22
6.2.1 Development cost 23
6.2.2 The electricity transmission model 24

7. Expected Uses of Hydrogen **26**
7.1. Export as fuel / intermediate material (ammonia) 26
7.2. Use for local industries 26
7.3. Use of hydrogen for electricity generation 28
7.4. Fuel for maritime shipping (green methanol) 30
7.5. Sustainable aviation fuel 31

8. Policy and Legal Framework for the Egyptian Hydrogen Sector **33**

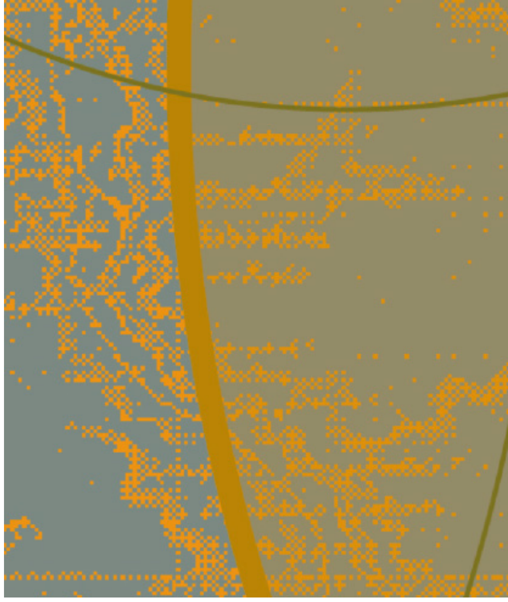
9. Sustainability and a Just Energy Transition in Egypt's Hydrogen Model **35**
9.1. Local impacts of export policies 35
9.2. Land 36
9.3. Water 36
9.4. Transportation 37
9.5. Cost 37
9.6. Societal acceptance 38
9.7. Justice 38

10. Discussion and Recommendations **40**

Endnotes **42**

Abbreviations

CBAM	Carbon Border Adjustment Mechanism
EBRD	European Bank for Reconstruction and Development
ECHEM	Egyptian Petrochemicals Holding Company
EETC	Egyptian Electricity Transmission Company
EU	European Union
GW	Gigawatt
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
LNG	Liquefied natural gas
m/s	Metres per second
MOERE	Ministry of Electricity and Renewable Energy
MOIC	Ministry of International Cooperation
MOPCO	Misr Fertilizers Production Company
MoU	Memorandum of understanding
MRV	Measurement, reporting, and verification
NREA	New and Renewable Energy Authority
MW	Megawatt
NWFE	Nexus of Water, Food and Energy
OECD	Organisation for Economic Co-operation and Development
SAF	Sustainable aviation fuel
TSFE	Sovereign Fund of Egypt
UAE	United Arab Emirates
UNFCCC	United Nations Framework Convention on Climate Change



1. Introduction

Views of green hydrogen have rapidly evolved in recent years: once regarded as a mere technical option for reducing carbon emissions and ensuring energy security, it is now assuming a more pivotal role within global energy transition agendas. This rapid rise of green hydrogen has been propelled by the changing energy market landscape in Europe following the outbreak of the Russian-Ukrainian war, as major European economies have sought to compensate for the loss of Russian gas supplies and to diversify their energy sources. Momentum around hydrogen started to build at the United Nations Climate Change Conference (COP26) in Glasgow in 2021, during which 32 countries and the European Union (EU) launched an initiative to accelerate the deployment of renewable hydrogen and make it globally available at competitive prices by the next decade.[1] The EU has since established the REPowerEU plan, which aims to produce 10 million tonnes of renewable hydrogen domestically, and to import a similar amount, by 2030.

To further the REPowerEU agenda, the EU has initiated broad partnerships with Global South countries that possess sufficient natural resources and large land areas for solar and wind power generation, and the potential to produce green hydrogen, including countries in North Africa and the Middle East. Geographical location and low production costs are a key consideration in these partnerships, given that these countries offer high-quality land for renewable energy projects and are geographically close to Europe. These partnerships have prompted candidate countries to formulate national hydrogen strategies and establish regulatory and legislative incentives that provide financial support and sovereign guarantees to investors in order to secure a share of the emerging international market for hydrogen and its derivatives.

Within this context, Egypt, which is a potential production partner for the EU, has swiftly adopted policies to support and regulate the development of green hydrogen. In 2021, the country began formulating its National Low-Carbon Hydrogen Strategy (officially unveiled in 2024). Around the same time, it launched several pilot hydrogen projects, in collaboration with international investors. Under the national hydrogen strategy, the Egyptian Government aims to capture a share of the emerging global hydrogen market, seeking both to secure additional sources of hard currency in the short term and to diversify its energy mix over the medium and long term. However, these efforts are taking place amid complex economic and energy challenges, including rising external debt, a persistent trade deficit, a decline in the production of natural gas – the dominant fuel in Egypt's energy portfolio – and recurrent supply disruptions.

Against this backdrop, this study draws on a broad range of official sources, international reports, sectoral statistics, and market assessments to examine the status of green hydrogen in Egypt, within the broader context of the global energy transition. In doing so it seeks to provide a descriptive and analytical account of the factors underlying the emergence of Egypt's green hydrogen sector and its interplay with global and regional dynamics. Ultimately, it is hoped that the study will increase understanding of green hydrogen in Egypt, which is an issue that sits at the intersection of economics, politics, the environment and development.

2. Hydrogen in Egypt

It was in 2021 that momentum for hydrogen development in Egypt began to pick up. In January of that year, the former Minister of Electricity and Renewable Energy signed a letter of intent with the CEO of Siemens regarding initiating discussions and feasibility studies for a pilot green hydrogen production project in Egypt, laying the groundwork for future expansion and potential exports.[2] In the same year, Egypt began preparing a national hydrogen strategy.[3] At the COP27 conference in November 2022, the initial framework of the National Low-Carbon Hydrogen Strategy, developed in collaboration with international partners such as the European Bank for Reconstruction and Development (EBRD) and the consulting firm Advisian, was unveiled. The strategy was formally adopted during a meeting of the National Green Hydrogen Council in November 2023, chaired by the Prime Minister, and was officially launched by the government in August 2024.[4]

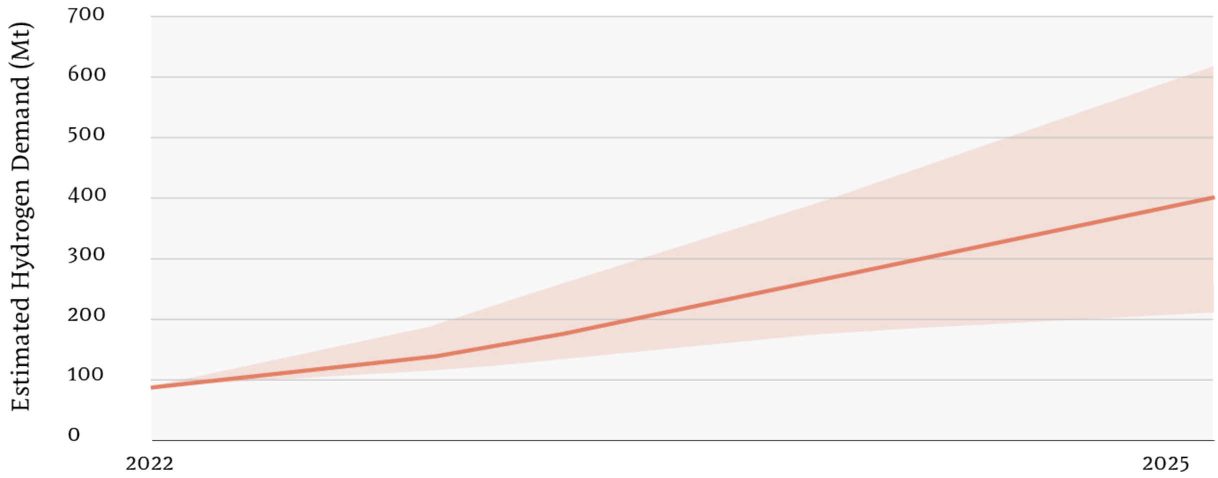
The National Low-Carbon Hydrogen Strategy, which outlines a three-phase roadmap extending to 2040, has the dual objectives of integrating low-carbon hydrogen into the Egyptian economy and positioning Egypt as a regional exporter of hydrogen and its derivatives. According to the strategy, projections indicate that global demand for hydrogen will increase from approximately 100 million tonnes in 2022 to between 200 and 600 million tonnes by 2050, with an annual average of 400 million tonnes.[5] These projections are conservative compared to the estimates of the International Energy Agency (IEA), which anticipates demand rising from approximately 100 million tonnes per year in 2020 to between 500 and 800 million tonnes by 2050, with hydrogen potentially accounting for 12–22% of total global energy consumption, depending on climate scenarios and decarbonisation targets.[6]

Under the strategy, Egypt aims to produce 6–10 million tonnes of low-carbon hydrogen per year by 2040, with the majority intended for export markets, particularly in Europe. This production volume would represent approximately 5–8% of the projected global green hydrogen market in 2040 and will require estimated investments nearing $60 billion by the same year. The strategy argues that developing the sector will reduce carbon emissions by 40 million tonnes annually, create 100,000 jobs, and contribute $10–18 billion to Egypt's gross domestic product (GDP) by 2040, based on the strategy's estimated hydrogen price of $1.8 per kilogram. (It is important to note that these figures are only indicative: the eventual price, and thus the contribution to GDP, could well differ from this estimate due to uncertainties related to technology costs, energy input prices, financing costs, and the evolution of global hydrogen demand.)

In the strategy's 'central scenario', projects under the strategy will produce approximately 1.5 million tonnes of green hydrogen and its derivatives per year by 2030. The majority of this output – around 1.4 million tonnes – will be dedicated for export, while domestic consumption will remain limited to roughly 0.1 million tonnes. This means that over 90% of hydrogen produced in 2030 is intended to serve foreign markets, particularly in the form of derivatives, such as green ammonia. By 2040, total production is expected to rise to about 5.8 million tonnes per year according to the central scenario, with approximately 3.8 million tonnes exported (around 5% of the projected global low-carbon hydrogen market) and 2.0 million tonnes consumed domestically. Consequently, domestic consumption would account for roughly 35% of total hydrogen production by 2040 in this scenario.

On the other hand, in the highly ambitious 'green scenario', the strategy envisions even more rapid acceleration in the coming decade. According to this scenario, by 2030, production could reach approximately 3.2 million tonnes per year, with the goal of capturing a larger share of the global market. The majority of this volume – 2.8 million tonnes – would be directed towards exports, compared with 0.4 million tonnes for domestic consumption. By 2040,

Figure 1: Projected global demand for hydrogen fuel and derivatives (2022–2050)



Source: Egypt's National Low-Carbon Hydrogen Strategy (Advisian, 2024)

the green scenario targets production of around 9.2 million tonnes per year of low-carbon hydrogen, with 5.6 million tonnes exported (about 8% of the global tradable market) and 3.6 million tonnes allocated for domestic use. While exports still dominate in this scenario, domestic consumption rises to roughly 39% in 2040, which is 4% higher than in the central scenario, reflecting increased efforts to replace fossil fuels with green hydrogen in the domestic market. Achieving these targets will require greater investment and infrastructure, including an electrolysis capacity of 76 GW by 2040, compared with 48 GW in the central scenario.

In short, under the strategy's two scenarios, exports will continue to outweigh demand in both 2030 and 2040, but the share of domestic use will increase (more so under the green scenario) as the market and technologies mature.

The National Low-Carbon Hydrogen Strategy roadmap follows a gradual, three-stage approach, as follows:

1. **Pilot projects phase (2020s):** This initial phase focuses on laying the foundations of the hydrogen economy, including through the following: establishing governance structures and legislation; ensuring essential infrastructure and facilities are in place; forming a national committee dedicated to hydrogen project development; and introducing project incentives to encourage expansion and attract investment. This phase also involves implementing pilot and experimental projects for hydrogen and its derivatives, and building national expertise. At the time of writing, all the necessary preliminary elements for this stage had already been implemented.
2. **Expansion and deployment phase (2030s):** This phase aims to increase production capacities to the gigawatt scale in electrolysis and green ammonia units, alongside the development of hydrogen transport and storage infrastructure. During this period, Egypt will work to establish an integrated hydrogen value chain, including large-scale commercial production at strategic locations (such as the Suez Canal Economic Zone), development of export ports, and linking production to domestic industrial use. The ultimate goal of this phase is to position Egypt as a major supplier of hydrogen to European and Asian markets.
3. **Integration and sustainable development phase (2040s)**: In this phase, Egypt's hydrogen economy reaches full maturity and becomes fully integrated into the national economy. The focus is on large-scale domestic deployment of hydrogen to support the decarbonisation of key sectors, including industry, transportation, and power generation.

Table 1: Targets under Egypt's hydrogen strategy scenarios

	2030 target (central scenario)	2040 target (central scenario)	2030 target (green scenario)	2040 target (green scenario)
Total green hydrogen production (million tonnes per year)	1.5	5.75	3.2	9.2
Domestic consumption (million tonnes per year)	0.1	2.0	0.4	3.6
Exports	1.4 (93.3%)	3.75 (65.2%)	2.8 (87.5%)	5.6 (60.9%)
Electrolyser capacity (GW)	13	48	27	76
Renewable energy required for hydrogen (GW)	19	72	41	114
Investments required (for electrolysers only)	$10 billion	$24 billion	$22 billion	$30 billion

3. Projects

According to official statistics from the Suez Canal Economic Zone, as at early 2025, approximately 30 MoUs had been signed with international investors on developing hydrogen-related projects in the zone. Of these, 14 have been converted into active agreements and 12 into binding framework agreements, representing a total investment of $64 billion. These projects target production capacity of up to 18 million tonnes per year of green hydrogen, either directly or through derivatives such as ammonia and methanol, once operations commence.[7,8]

Including projects referred to in other sources, a total of 36 hydrogen projects have been announced in Egypt so far. These have a combined green hydrogen production capacity of about 5.7 million tonnes per year and a green ammonia production capacity of about 16.7 million tonnes per year, alongside a production capacity of 340,000 tonnes of methanol and 120,000 tonnes of clean jet fuel per year. Total investments under these projects exceeds $113 billion.

Most of these projects are concentrated in Ain Soukhna and East Port Said, within the Suez Canal Economic Zone, with a few new initiatives located on the north-western coast (the Port of Gergoub), the Nile Delta coast (Damietta), and Ras Shukheir (Red Sea). They range from small-scale pilot projects, such as the 100 MW 'Egypt Green' project, which launched trial operations in 2022, to large-scale complexes designed to produce hundreds of thousands of tonnes per year of green hydrogen or ammonia. The majority of these projects are at an early stage of development (i.e., with only MoUs or framework agreements in place).

Overall, the planned production volume of the announced projects surpasses the official targets for 2030 under the National Low-Carbon Hydrogen Strategy's different scenarios. However, near-term implementation is likely to be slower than initially announced, and production is likely to be lower, due to several challenges, including the limited availability of renewable energy capacity to meet the needs of hydrogen plants and ammonia facilities, difficulties in securing long-term purchase agreements with international consumers, and potential financing constraints. Furthermore, as indicated above, many of the announced projects are currently either in the pilot phase or at the stage of MoUs or non-binding agreements, and may very well never be realised. Nevertheless, these initiatives are laying the foundation for Egypt's emerging hydrogen model.[9]

Table 2: Sample of planned hydrogen projects

Project name	Location	Production capacity	Investors/developers	Expected start date
Egypt Green Hydrogen Project (Scatec/ Fertiglobe Alliance)	Ain Soukhna (Suez Canal Economic Zone)	100 MW of electricity and 15,000 tonnes of green hydrogen/year, to produce 90,000 tonnes of green ammonia/year (pilot phase)	Scatec (Norway), Fertiglobe/OCI (UAE/Egypt), Orascom Construction, Sovereign Fund of Egypt (TSFE)	November 2022
Globeleq Green Ammonia Project (Phase 1)	Ain Soukhna (Suez Canal Economic Zone)	100,000 tonnes of green ammonia/year (using a 100 MW electrolyser in the first phase)	Globeleq (UK), in partnership with: Suez Canal Economic Zone Authority, TSFE, New and Renewable Energy Authority (NREA), Egyptian Electricity Transmission Company	2026/2027 (initial Phase 1 operation)
Alfanar Green Hydrogen Project	Ain Soukhna (Suez Canal Economic Zone)	100,000 tonnes of green hydrogen/year converted to produce 500,000 tonnes of green ammonia/year	Alfanar Company (Saudi Arabia)	2027 (first phase)
ReNew Power Green Ammonia Project	Ain Soukhna (Suez Canal Economic Zone)	1 million tonnes of green ammonia/year (planned in phases; Phase 1 = 100,000 tonnes/year by 2025)	ReNew Power (India), in partnership with the Suez Canal Economic Zone Authority	2025 (first phase)
OCIOR Hydrogen/Ammonia Project (Phase 1)	Ain Soukhna (Suez Canal Economic Zone)	1 million tonnes of green ammonia/year (first phase; subsequent expansions possible)	OCIOR Energy (India)	2030
Kemet Project	Ain Soukhna + other locations in Egypt	4 GW of electrolysis capacity; production of 2.3 million tonnes of green ammonia/year (with an initial focus on marine methanol fuel)	Masdar (UAE), Infinity Power and Hassan Allam (Egypt), BP (UK)	2026 (first phase for methanol)
Ra Green Ammonia Project	East Port Said (Suez Canal Economic Zone)	2 million tonnes of green ammonia/year	DAI Infrastruktur (Germany), in alliance with the Suez Canal Economic Zone Authority, and TSFE Fund	2028
Voltalia-TAQA Hydrogen Cluster Project	Ain Soukhna (Suez Canal Economic Zone)	130,000 tonnes of green hydrogen/year (using 1 GW of electricity from wind/solar energy)	Voltalia (France), Arab Energy (Egypt)	2025–2026 (expected)
EDF-Zero Waste Green Ammonia Project	Ras Shukeir, Red Sea coast	1 million tonnes of green ammonia/year	EDF Renewable Energy (France), Zero-Waste company (UAE/Egypt)	2028 (expected)
Hyport 'West Matrouh' Green Ammonia Project	Gargoub Port (west of Marsa Matrouh)	320,000 tonnes of green ammonia/year (first phase trial; potential subsequent expansions)	DEME Group (Belgium), in partnership with local Egyptian parties	2026 (first phase)
Damietta Green Ammonia Project	Damietta Port, Nile Delta	150,000 tonnes of green ammonia/year + 26,000 tonnes of hydrogen/year (first phase)	Misr Fertilizers Production Company (MOPCO), Egyptian Petrochemicals Holding Company (ECHEM) (Egyptian state-owned companies), Scatec (Norway)	2025–2026 (first phase)
Maersk Green Methanol Project (C2X)	Suez Canal Economic Zone	300,000 tonnes of green methanol/year (as fuel for ships in the Suez Canal)	Maersk (Denmark) and Hassan Allam Group (Egypt)	2025–2026 (first phase)

4. Overview of Egypt's Energy Situation

Fossil fuels (oil and gas) currently dominate Egypt's total energy supply mix (95%) and account for 87% of its electricity generation (2023 data, Figure 2).[10] Since the beginning of the century, following the discovery of large natural gas reserves in the Mediterranean Sea and the commissioning of several production fields, dependence on natural gas has gradually increased, particularly for fuel supplies for the electricity sector. This trend has been accompanied by the export of surplus production in the form of liquefied natural gas (LNG) and by the expansion of infrastructure in terms of pipelines and liquefaction plants. Despite efforts to diversify energy sources and promote renewable energy to ensure a stable energy supply, the abundance of natural gas discovered at the start of the century, combined with Egypt's strong export ambitions, has led to excessive reliance on natural gas.

4.1. Natural gas

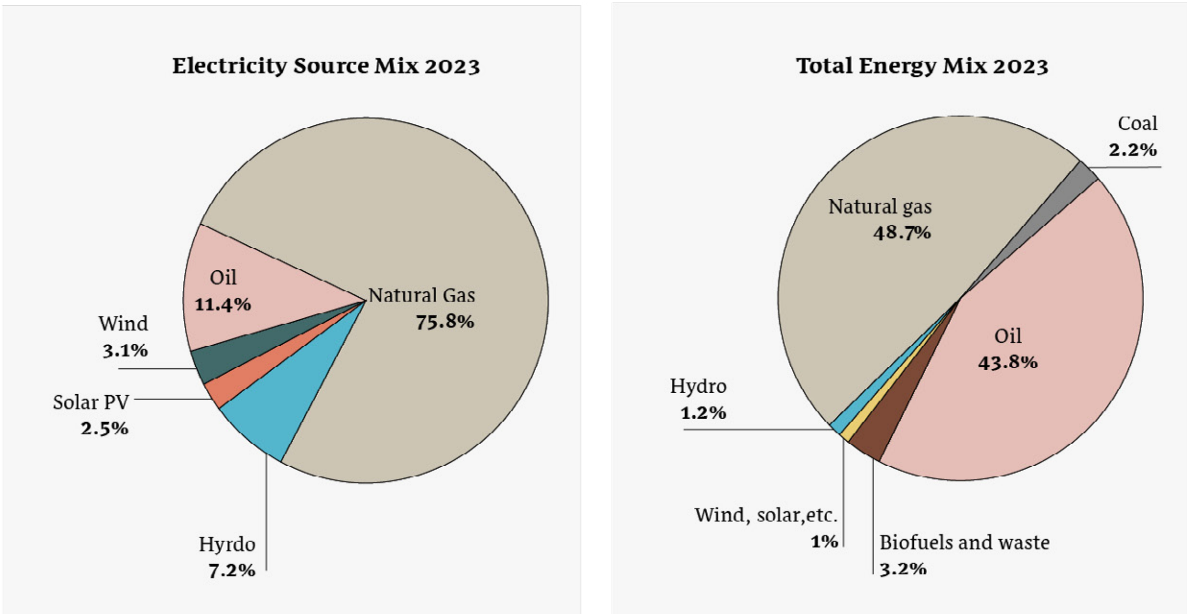
Excessive reliance on natural gas makes Egypt's energy system fragile in the face of production shortfalls. Furthermore, with rising domestic demand, particularly in the electricity sector and energy-intensive industries, a vicious cycle has begun to take shape whereby short-term oil exploration aimed at quickly boosting production (rather than longer-term exploration planned within a broader energy transition strategy) further reinforces dependence on gas.

An additional dimension of fragility arises because Egypt does not possess its own technology for fossil fuel exploration and drilling, depending instead on major international oil companies, which are engaged under contracts denominated in foreign currencies. This leads to delayed payments of dollar-denominated dues to exploration and production firms, which disrupts the continuity and regularity of production.

Egypt began producing natural gas for domestic consumption in the mid-1970s and achieved self-sufficiency during that period. By 2004, production surpluses enabled the country to become a net exporter of natural gas, a status it maintained for nearly a decade. However, Egypt reverted to being a net importer in 2014, primarily due to insufficient investment in the sector and the accumulation of government arrears owed to oil and gas companies during the years of political instability following the 2011 revolution. The downward trend in production was temporarily reversed in 2017 with the commissioning of the Zohr gas field, which was at that time the largest natural gas field in the Mediterranean region (Figure 3).[11] This led to Egypt once again being a net exporter of LNG, with exports of roughly 10 billion cubic metres (m^3) in 2021 and 2022.

However, Egypt is now facing a shortage of natural gas supplies, with domestic production declining by nearly one-third in recent years, from 70.4 billion m^3 in 2021 to 49.4 billion m^3 in 2024. As a result, Egypt has yet again returned to being a net importer of gas, projected to purchase over 6 billion m^3 in 2025 (Figure 4).[12] Analysts estimate that the continued accumulation of arrears owed to foreign companies in relation to these imports, coupled with reduced investment in exploration, is likely to result in Egypt becoming still more dependent on gas imports in the short term, unless financing challenges and regulatory barriers are effectively addressed.[13]

Figure 2: Sources of energy and electricity in Egypt



Source: International Energy Agency, 2025

A key source of fragility in Egypt's gas supply system is its heavy reliance on the Zohr field, which accounted for nearly 40% of the country's total annual production in 2021.[14] The field saw an early decline in productivity in 2022, despite initial expectations that it would continue to produce until 2045. The primary cause of this decline was a sharp drop in reservoir pressure, with associated water infiltration, which led the operator to shut down wells with high water output at the end of 2023 and to expand water treatment facilities – used to process the gas-water mixture – in an effort to handle the unexpectedly high water volumes. These developments reduced the Zohr field's estimated ultimately recoverable reserves (EUR) by about 10 trillion cubic feet. As a result, it fell from being considered the largest gas field in the Mediterranean to being considered the third largest, behind Israel's Leviathan and Tamar fields.[15]

In response to these developments, the government is now relying on the faster development of Cypriot gas fields in the Eastern Mediterranean, such as Aphrodite and Kronos, to supply the liquefaction plants in Damietta and Idku, as part of efforts to restore balance in the gas market and to generate a new export surplus by 2027.[16] At the same time, Egypt currently depends on gas imports from Israel via pipeline, which amounted to approximately 2.2 billion m^3 per year in 2020, rose to 4.2 billion m^3 in 2022, and reached 10.1 billion m^3 in 2024 – equivalent to 16% of domestic demand of 62 billion m^3.[17] This growing dependence underscores the fragility of Egypt's energy security, given its reliance on volatile regional supply arrangements. Indeed, this vulnerability materialised when Israeli gas exports to Egypt were temporarily halted in June 2025, just two months before the signing of an agreement to extend the 2018 long-term gas supply deal, valued at around $35 billion through to 2040 for the delivery of approximately 130 billion m^3. Then, only weeks after the agreement was announced, reports in September 2025 indicated that the $35 billion deal had been suspended amid escalating political tensions between Egypt and Israel, as a result of Israel's genocide in the Gaza Strip.[18]

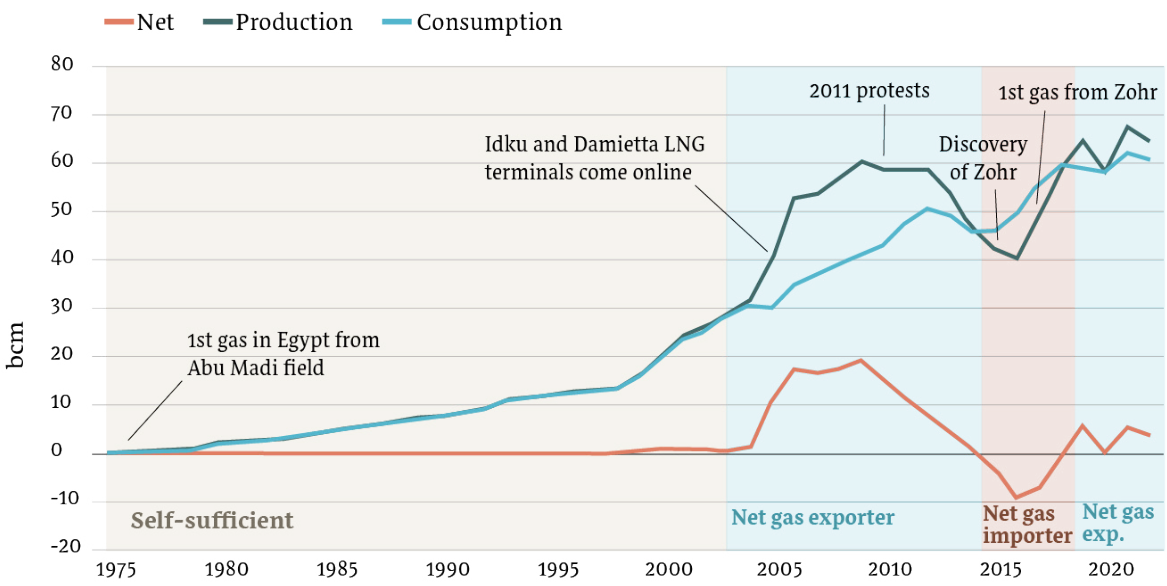
4.2. The electricity sector

Energy supply in Egypt's electricity sector relies predominantly on fossil fuels, which account for 87% of total generation, comprising natural gas (75.8%) and oil (11.4%). Hydropower contributes 7.2%, while wind and solar energy provide 3.1% and 2.5%, respectively, according to 2023 data (Figure 2). [19]The electricity sector consumes approximately 57% of Egypt's total natural gas supply.[20]

This heavy reliance on fossil fuels exposes the sector to significant vulnerability, due to the unsustainability of fuel supplies to power plants. One symptom of this vulnerability is electricity outages. For example, a decline in natural gas production in 2013–2014, alongside reduced oil and gas sector investments and ageing power plants, led to a shortage in available capacity and emergency power cuts due to the grid's inability to meet demand (Figure 5).[21]

The situation was similar in 2023 and 2024, when the decline in production at the Zohr field (discussed above)

Figure 3: Evolution of gas supply and consumption in Egypt



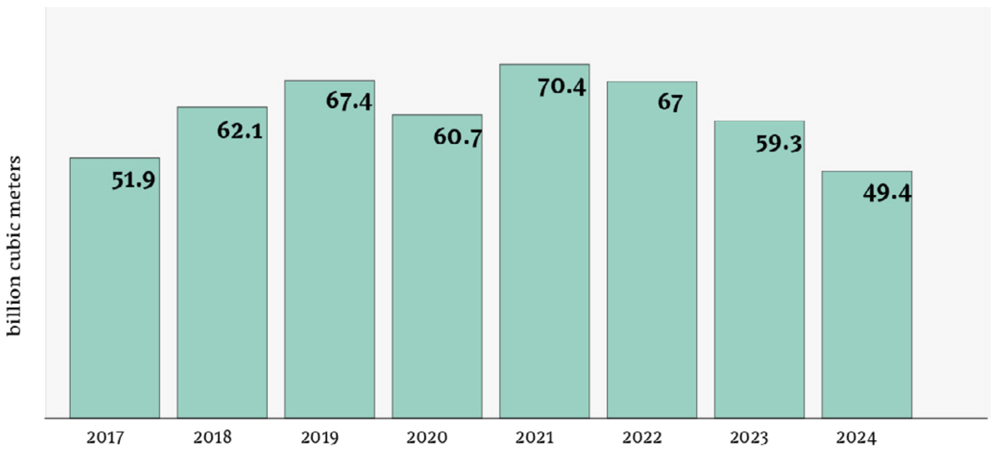
Source: Energy Institute, via EqualOcean, 2024

led to electricity rationing. For example, in June 2024, the government imposed scheduled outages of up to three hours per day due to increased demand during the summer heat waves and declining gas supplies.[22]

Nevertheless, in the last decade, Egypt has taken some steps towards achieving a more diversified energy mix. In 2014, prompted by the gas supply crisis, it launched two feed-in tariff programmes that guaranteed a fixed purchase price per kilowatt-hour for investors throughout the life of their projects. This initiative led to the development of the 1,465 MW Benban solar power plant in Aswan.[23] However, thereafter, several factors – including the discovery of the Zohr gas field, requests from funders and investors that the dues of international renewable energy companies be paid in foreign currency, and Egypt's implementation of an economic reform programme under the auspices of the World Bank – prompted the government to prioritise investment in non-renewable power plants, to avoid exacerbating the burden of its foreign currency obligations.

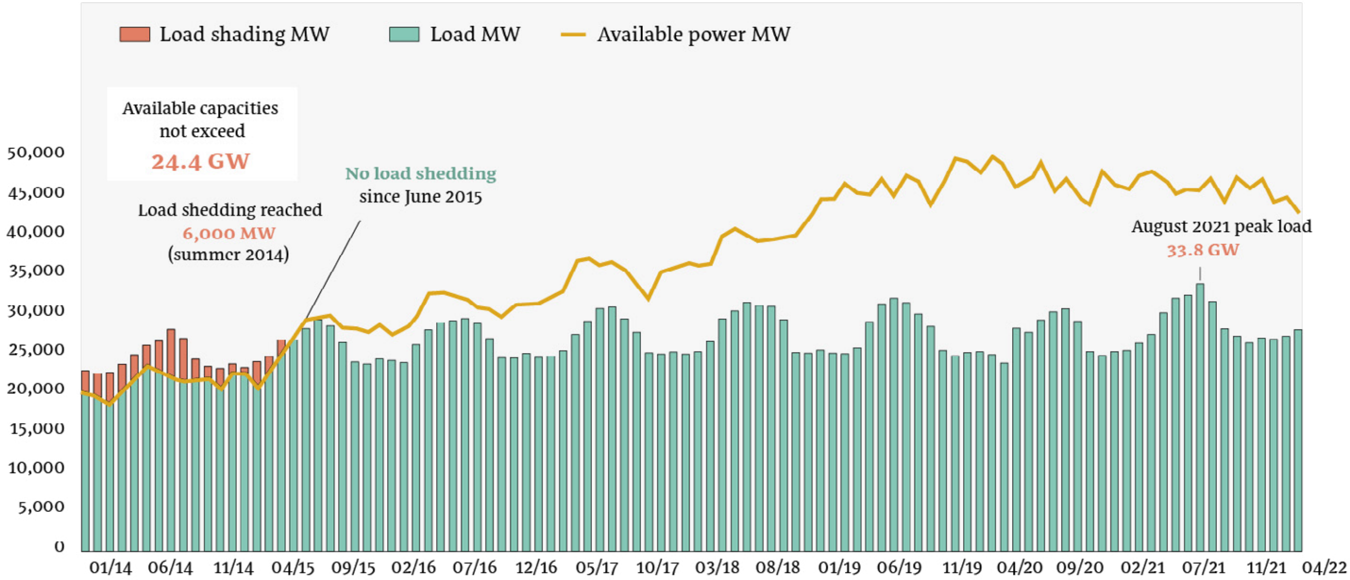
It is important to point out here that one of the paradoxes of Egypt's electricity sector is that it has more power plants than it needs to meet current demand, even as it continues to face a shortfall in fuel to operate them. The country's reserve capacity (the positive difference between the total combined capacity of power plants and the country's demand for electricity) is 42%: total installed capacity across all plants is 59.4 GW, while maximum demand is only 34.2 GW. Importantly, this refers only to the capacity of power plants, in a situation in which they have sufficient fuel to operate, which, as the preceding paragraphs have shown, has not always been the case. This inflated reserve of conventional capacity began to accumulate in the aftermath of the 2014 gas supply crisis, as additional fossil fuel power plants were built and their efficiency progressively improved up until 2021. This reflects the lack of a clear strategic vision and incoherent long-term planning: Egypt has over-invested

Figure 4: Evolution of gas production in Egypt



Source: Oxford Energy & APS, American University in Cairo (AUC)

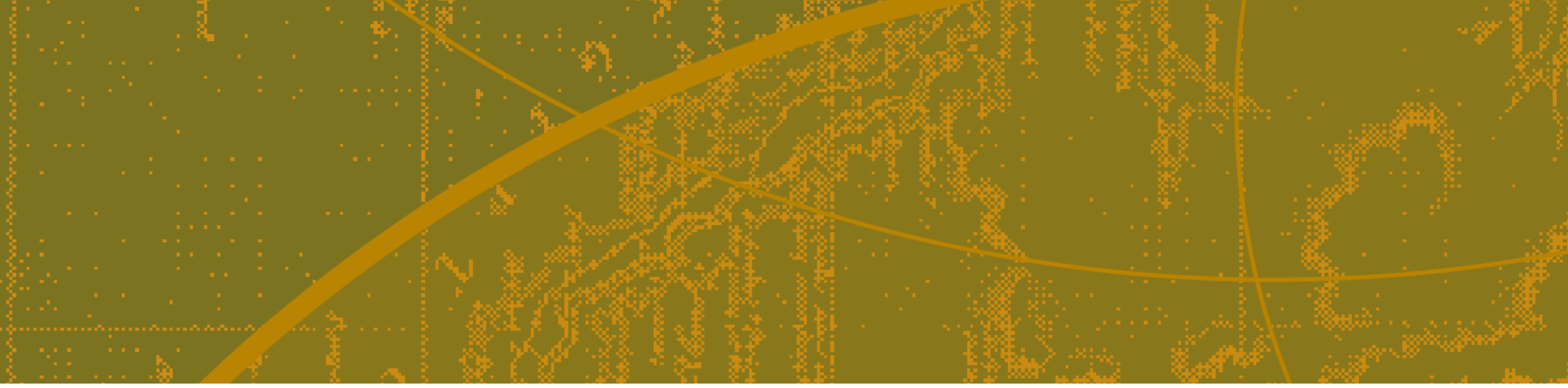
Figure 5: Comparison between demand (maximum load) and generation capacities 2011–2022



Source: Egyptian Ministry of Electricity and Renewable Energy

in plants that rely on oil and gas, which now face the risk of being decommissioned due to the lack of fuel to operate them and the pursuit of a greater share of renewable energy in the country's energy mix.

In sum, Egypt's current energy situation is unsustainable, due to its heavy reliance on fossil fuels, which leaves the country's energy security highly vulnerable to unexpected disruptions. At the same time, strategic planning in the sector is largely influenced by forecasts by EU experts, rather than emerging from a comprehensive, locally grounded Egyptian perspective. As a result, Egypt's energy strategy prioritises participation in regional energy trade over securing domestic energy needs in the short term and achieving self-sufficiency in the long term, and over investing in energy technology development and transfer.



5. The Impact of Hydrogen Policies on Egypt's Energy System

The current situation in Egypt mirrors that in many other countries in the Global South that likewise face the dual challenges of transitioning to renewable energy while also implementing electrification policies. These challenges stem from these countries' limited access to clean technologies and their weak capacity to finance large-scale infrastructure projects. It is in this overall context that the surge of interest in hydrogen in these countries is taking place, even as they have not yet completed full electrification. Importantly, this surge is being driven primarily by global demand for exports and these countries' desire to generate hard currency, rather than being based on their local energy needs. The adoption of green hydrogen thus risks being both a burden and a source of distraction for Global South countries like Egypt, forcing a trade-off between countries' green transition. Simultaneously, it can lead to higher costs for investments in renewable energy for the domestic market in these countries, because projects for domestic markets carry higher financial and operational risks than those for export markets.

Egypt's National Low-Carbon Hydrogen Strategy fits this scenario: it is not grounded in a thorough assessment of Egypt's local energy situation and domestic energy context, including factors such as demand growth, system management, financing challenges, green hydrogen standards, and the resulting implications for emission standards for primary energy sources in electricity supply. Rather, it is designed primarily around the perceived economic opportunity of securing a share of the international market, within the European vision of creating external hydrogen markets.

The strategy's approach relies heavily on certain geographical and natural factors, such as Egypt's high solar radiation, strong wind speeds in the Gulf of Suez and western Nile regions, and the availability of land, as well as on existing Egyptian expertise in the fertiliser and petrochemical industries, which currently depend on grey hydrogen in their production processes.

In Egypt, achieving the strategic objectives for both the hydrogen sector and the domestic energy transition will require increased reliance on renewable energy sources – primarily wind and solar – while treating natural gas as a transitional fuel, given that it is the least polluting fossil fuel and can be blended with green hydrogen. The achievement of Egypt's energy visions and plans, including the development of a hydrogen economy and the ability to meet domestic energy needs, therefore depends on a massive expansion in the construction of renewable electricity plants, including solar and wind power stations. To this end, at the national level, the Integrated Sustainable Energy Strategy (ISES2016) – Egypt's national energy plan prior to the hydrogen ambition – originally targeted 42% of electricity generation from renewable sources by 2035. This deadline was brought forward to 2030 in the second update to Egypt's Nationally Determined Contribution (NDC),[24] following an agreement with the United States and Germany at the COP27 climate conference in late 2022 (under the Nexus of Water, Food and Energy (NWFE)) programme, to phase out 5 GW of conventional thermal power plants by 2025 and to build 10 GW of solar and wind capacity by 2028.[25] It was envisaged that this would free up additional natural gas for export. The agreement also came on the heels of Egypt signing a trilateral MoU with the EU and

Israel in June 2022 to facilitate the export of liquefied gas from Idku and Damietta to Europe, as part of the EU's strategy to compensate for reductions in Russian gas supplies.[26]

However, recent statements on this target of achieving 42% of electricity generation from renewables by 2030 have been contradictory. The Minister of Petroleum announced a reduction in the target to 40% by 2040, emphasising continued reliance on natural gas,[27] while the Minister of Electricity indicated a 65% renewable energy target.[28] Meanwhile, press reports suggest that 11.5 GW of fossil fuel capacity (out of the current 53 GW) will be phased out under the Egyptian-European agreement, as a condition for green financing for renewable energy projects. [29]

These targets are highly ambitious in the short and medium terms. Importantly, they do not account for renewable energy requirements for hydrogen production. Under the National Low-Carbon Hydrogen Strategy's central scenario (the least ambitious), 19 GW of renewable energy will be needed by 2030 and 72 GW by 2040. The more ambitious green scenario calls for 41 GW of renewable energy in 2030 and 114 GW in 2040.

Assuming no new thermal power plants are constructed, 5 GW of capacity is phased out in line with green financing conditions, coal plant projects are cancelled, and the 42% renewable energy target in the electricity mix is pursued solely through renewable power plants,[30] Egypt will therefore need to reach a total installed capacity from renewable power plants of about 35 GW by 2030, up from the current 7.7 GW.[31] The country currently plans to add over 46 GW of renewable capacity by 2030: 27.3 GW under the national energy strategy (35 minus 7.7) and 19 GW under the central scenario of the hydrogen strategy. This will require an installation rate of roughly 9 GW per year. Under the more ambitious green hydrogen scenario, total renewable additions by 2030 would be higher still, reaching around 68 GW.

Looking further ahead: meeting the hydrogen strategy's central scenario target for 2040 will require 72 GW of renewable energy capacity. Combined with the 55 GW required to achieve a 58% renewable share, and assuming that 40 GW of the current 53 GW of thermal capacity remains operational (after plant ageing or decommissioning), Egypt would need to add around 120 GW to reach a total installed capacity of approximately 127 GW by 2040. This implies an average annual installation of over 8 GW. Under the green scenario, total capacity requirements are set to increase further, to 169 GW by 2040.

Achieving this massive renewable capacity increase will require exceptional financing and extensive infrastructure, including the development of vast areas of land for renewable energy projects (such as solar and wind energy), and the expansion of electricity transmission lines. Given the lack of complementarity between export-oriented visions and participation in international green energy trade, on the one hand, and meeting domestic demand, on the other (as well as the resulting need to set public spending priorities), conflicts and competition are likely to arise between the domestic strategy aimed at ensuring energy supply and meeting local consumption growth, and the export-focused hydrogen strategy. The next section discusses two key areas where competition is likely to take place: over land and over electricity transmission.

6. Areas of Competition

Egypt has allocated vast land to NREA for renewable energy development, totalling 32,000 km². This is reserved for solar and wind power plants that have a combined potential capacity of about 174 GW. In addition, 11,000 km² is currently earmarked for allocation, with a further 60,000 km² under consideration, bringing the total potential area to around 102,000 km², equivalent to roughly 10% of Egypt's total land area.[32]

In theory, the total land area allocated so far for renewable energy plants covers the needs of both domestic energy projects, under the Energy Strategy 2035, and export-oriented projects under the National Low-Carbon Hydrogen Strategy. However, questions remain regarding the readiness and suitability of these lands in terms of their potential productivity and quality for energy generation, as well as whether the area allocated adequately accounts for the space required to construct electricity transmission lines or connect to the national grid. In practice, competition is expected to emerge over high-quality, ready-to-develop sites. To date, there is no official Egyptian document that addresses the issue of site allocation, or that differentiates between land designated for domestic energy production and land dedicated for the production of energy for export.

Table 3: Land area to be used for renewable energy

Land	Already allocated	Already allocated	Already allocated	Total
Area (km²)	31,700	10,847	59,050	101,597
Solar power capacity	83.3	70	420	573.3
Wind power capacity	91	37.4	199.4	327.8
Total capacity in GW	174.3	107.4	619.4	901.1

6.1. Land productivity

Renewable energy production is inherently dependent on the availability of natural resources: specifically, wind speed and solar radiation. The productivity of land for renewable energy generation varies based on climatic and geographical conditions. Locations with stronger and more consistent winds or higher/more intense solar radiation offer greater energy generation potential. This can translate into varying costs per unit of energy produced (kilowatt-hours (kWh)) and varying rates of return on capital.

For instance, the operational efficiency of wind turbines is predominantly determined by wind speed, owing to the cubic relationship between wind velocity and energy output. The theoretical power available in the wind can be expressed as follows: power = 0.5 × air density × blade-swept area × (wind speed).³ This cubic relationship implies that even modest increases in wind speed yield disproportionately larger gains in energy production.[33]

To demonstrate this effect, Table 4 presents the relative gains from incremental increases in wind speed. The relative operating capacity (energy production) is calculated for each specific wind speed. Using a wind speed of 5 metres per second (m/s) as the baseline (relative capacity = 1), the results show that energy production increases markedly with higher wind speeds.

As indicated in this table, a site with an average wind speed of 10 m/s can theoretically produce eight times more energy than a site with a wind speed of 5 m/s, assuming all other factors (such as turbine size, efficiency, and air density) remain constant. This cubic (exponential) relationship underscores the strategic importance of high wind-speed locations for maximising energy output.

The substantial increase in energy production resulting from relatively small wind speed gains has significant implications for the economic viability of wind energy projects. Sites with higher average wind speeds substantially enhance project profitability and accelerate returns on investment. Consequently, strategic site selection – prioritising areas with high wind quality and consistency – is the primary driver of most national wind energy development strategies.

In Egypt, all state-owned wind farms are concentrated in the Gulf of Suez region. These include Zafarana, Gabal El-Zayt, Gulf of Suez, and Red Sea 1. These farms have a combined installed capacity of approximately 1,700 MW, out of 2,192 MW of total implemented wind projects that are currently active.[34] This concentration is understandable because the Gulf of Suez region represents the highest-quality wind resource area in the country (Figure 6), with average wind speeds exceeding 10 m/s at a height of 150 metres, outperforming other potential sites for wind farm development. [35]It also makes sense because many of the end uses for the generated energy from wind farms in the area are expected to be concentrated near the Suez Canal, including supplying ships with green fuel and producing green fertilisers for export.

Table 4: Relative operating capacity at variable wind speeds (at a hub height of 150 metres)

Wind speed (m/s)	Relative wind speed (vs. 5 m/s)	Relative energy production (V3) (vs. 5 m/s)
5	1.00	1.00
8	1.60	4.10
10	2.00	8.00
12	2.40	13.82

At the same time, most hydrogen projects for which agreements have recently been made are located in the same region, within the Gulf of Suez Economic Zone. This presents a problem, because the Gulf of Suez region has a relatively limited area available for renewable energy: approximately 2,793 km², representing 6.5% of the total 42,000 km² allocated for renewable energy projects nationwide. In regard to wind, this area is estimated to be sufficient for developing only 20 GW of wind capacity,[36] with most of the available land already utilised and the capacity to accommodate only an additional 400 MW through the use of advanced turbine technologies (Figure 7).[37]

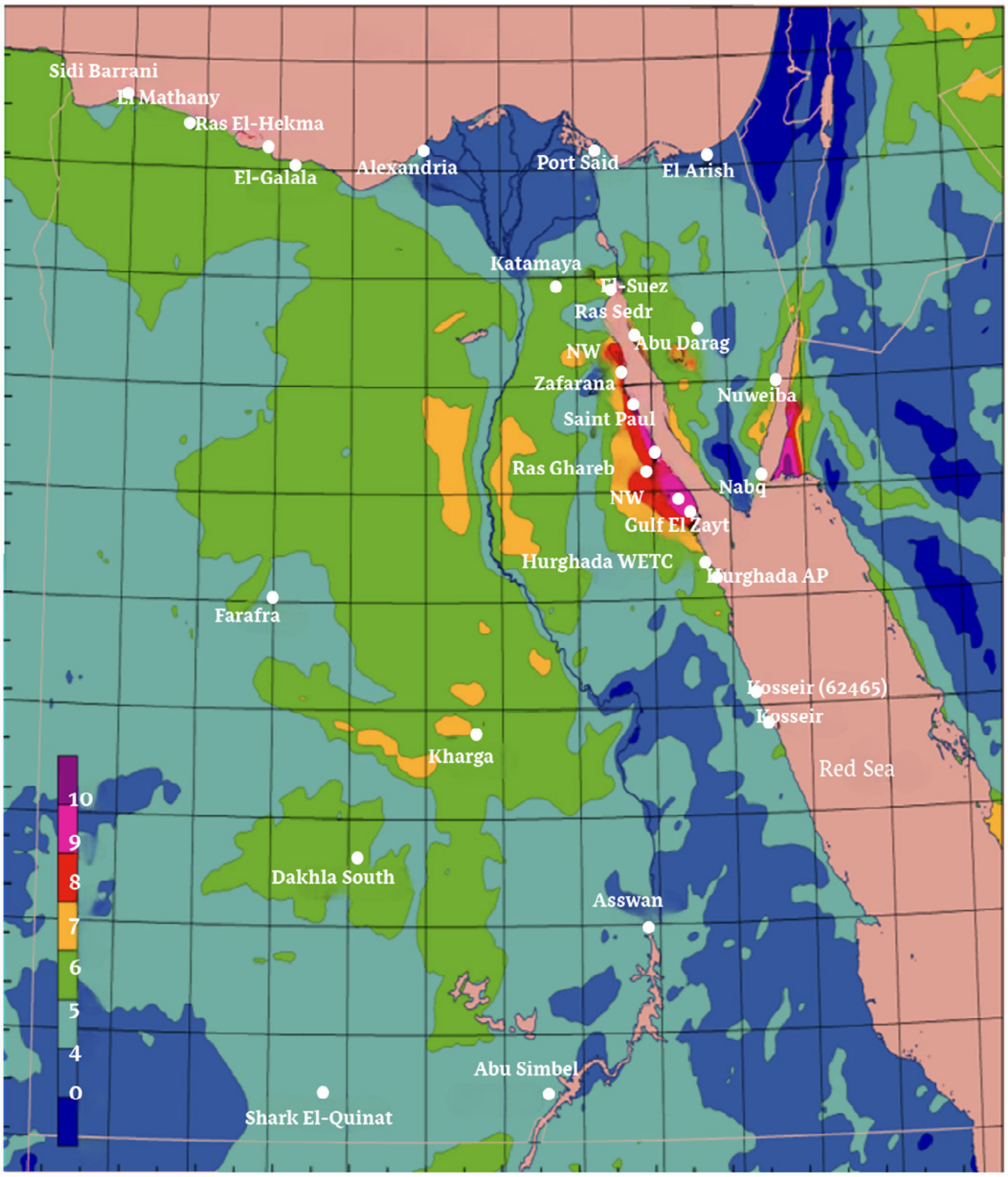
Given all of these factors, the Gulf of Suez region is likely to experience intense competition for available land among investors: for wind farms, for supplying the local grid, and for hydrogen production facilities. Since the most productive areas of the Gulf of Suez are already fully utilised, opportunities for local energy use may be limited.

The competitive environment in regard to the land available for renewable energy has already prompted Egypt to privatise some of its oldest state-owned wind farms in the Gulf of Suez region. In 2023, the government included the Gabal al-Zayt and Zafarana plants among 32 state assets offered to investors.[38] A few months later, the British company Actis reached a preliminary agreement to acquire the 580 MW Gabal El-Zait plant for approximately $350 million.[39] In October 2023, Maersk signed a preliminary agreement to acquire a 51% stake in the first four phases (1–4) of the Zafarana complex (545 MW), as part of a broader $15 billion strategy to produce green fuels from hydrogen and its derivatives in Ain Soukhna.[40]

The Egyptian Government also initially decided to put phases 5 to 8 of Zafarana up for competitive tender in the second half of 2024, requiring that candidate investors have a green hydrogen project that would utilise the site's electricity.[41] However, the sale was subsequently postponed as the government chose to focus instead on redeveloping the site to make it more attractive for future investors. MOERE then signed a non-binding MoU with a consortium of France's Voltalia and Taqa Arabia to transform the entire site into a 3 GW hybrid complex (1.1 GW wind + 2.1 GW solar), with initial operations expected to begin by 2028.[42]

The government's strategy in the Gulf of Suez region reflects a clear preference for exporting energy in the form of hydrogen derivatives and leveraging the area's highest-quality sites to attract wind energy investments. This represents a short-term policy response to recent economic pressures, rather than a plan that can

Figure 6: Egypt wind atlas



Source: New and Renewable Energy Authority (NREA)

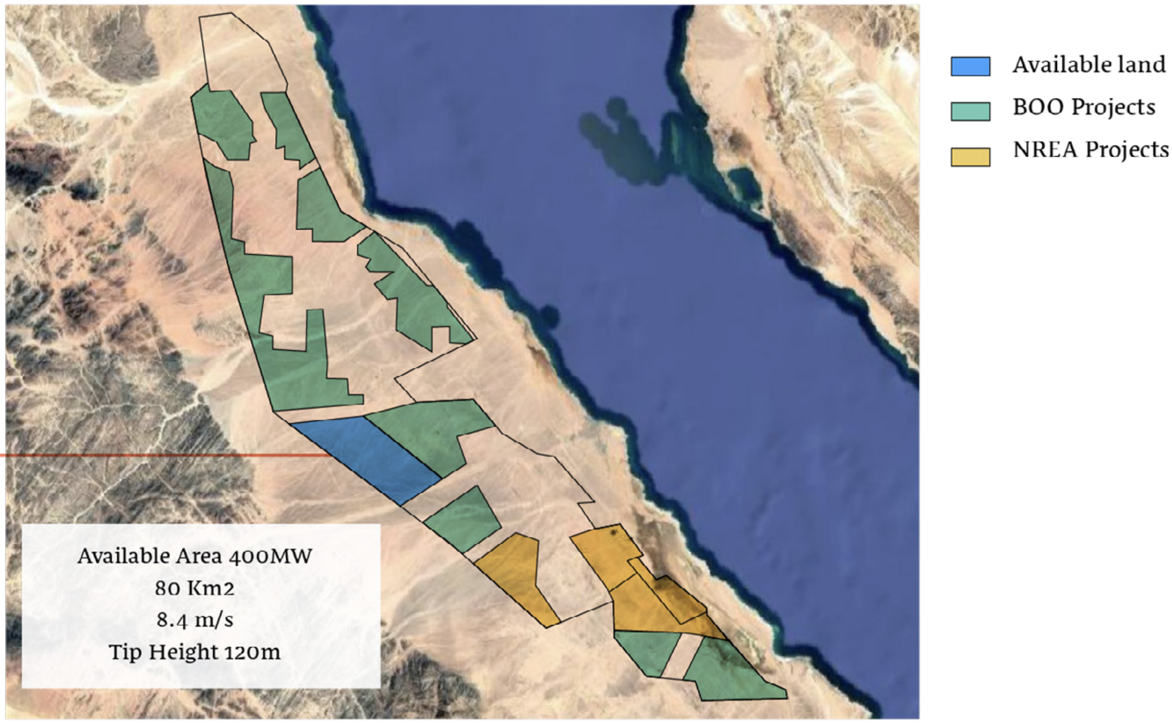
meet domestic energy transition needs amid current energy challenges and also serve more long-term climate goals. As such, it risks undermining the long-term sustainability of Egypt's domestic energy supply.

6.2 Challenges of, and competition over, electricity transmission

All of the land currently proposed for renewable energy plants is located in more remote areas, far from the existing national grid, which essentially follows the Nile River and the Mediterranean coast. This means that developing these projects will require not just connecting them to the national grid, but also developing the infrastructure needed for the projects themselves. This will require strategic regional planning, including a vision for building urban communities outside the Nile Valley. Currently, grid development policies, their scope, and construction timelines are a key factor in efforts to increase renewable capacity, whether to meet domestic electricity demand or to support hydrogen exports.

Accordingly, two fundamental questions emerge when defining the model for renewable capacity development and the hydrogen industry. First, the cost of development: who will bear the investment cost required to integrate tens of gigawatts of renewable capacity amid the ongoing economic crisis? Second, the electricity transmission model: should there be separate grids (one for local use and another for export) or an integrated system connecting all production capacities, especially considering that renewable energy production varies, with solar output peaking and dropping within a single day, and wind output changing across seasons? These

Figure 7: Map of land available for wind energy in the Gulf of Suez region in 2022



Zone Name	Name of Area	Land Space Available for Generation (Km²)	Max. Capacity that can be generated (MW)	Wind Speed m/s	Tip Height (meter)
Suez Gulf	1	80 Km²	400 MW	8.4 m/s	120 m

Source: Egyptian Ministry of Electricity and Renewable Energy

issues are dealt with in turn below.

6.2.1 Development cost

The issue of development costs is particularly pressing in light of the National Low-Carbon Hydrogen Strategy's focus on exports, the urgent domestic renewable energy needs, the government's policy of removing energy subsidies, and the broader economic crisis affecting the country, which all add significant financial pressure to an already challenging situation.

Investors generally expect governments to cover the costs of long-term infrastructure and site preparation. Under the government's current energy strategy, this effectively means that local populations will have to bear the burden of infrastructure that is built primarily for export purposes. Indeed, while the Egyptian Government is expected to borrow billions to expand and enhance the efficiency of the national grid, as things stand this will not bring any benefit locally in the foreseeable future. This implies a model that is largely disconnected from the task of meeting domestic energy needs.

At the same time, Egypt is facing a fundamental financial challenge in developing its electricity grid, given the difficulty of covering investment costs amid the current economic crisis and the anticipated scale of the grid (both in terms of length and capacity). Grid capacity was a major factor in the 2014 energy crisis, and between 2014 and 2021 $6.4 billion was spent on grid development, in order to double the capacity and the extent of the high-voltage network, accommodating approximately 30 GW of new generation during that period. Notably, most of this added capacity came from conventional power plants located in, or near, urban areas. By contrast, MOERE estimates that integrating 10 GW of renewable energy into the grid would cost $2.043 billion.[43] This implies that fully integrating the expected renewable capacity by 2030, projected to exceed 40 GW, would require at least $8 billion.

The Benban Solar Park in Aswan represented Egypt's first significant attempt to integrate substantial renewable energy capacity into the national grid. The grid connection, originally planned for 2018, was delayed until four dedicated substations for the site were completed,[44] with full integration into the national grid achieved in late 2019.[45] The electricity transmission company opted to share the costs of infrastructure and grid connection with investors, linking the charges to the output of each plant. However, costs for investors increased repeatedly due to price rises driven by the devaluation of the Egyptian pound and overall cost inflation, leading to disputes between investors and the government, which were eventually resolved through a settlement.[46]

It is against this backdrop that MOERE has developed a plan to increase the grid's capacity to accommodate 20 GW of renewable energy.[47] In December 2024, the EETC secured a €170 million sovereign loan from the EBRD to fund a grid reinforcement programme under the NWFE initiative. This includes upgrading a substation and constructing a 200 km high-voltage line, which will enable the integration of approximately 2.1 GW of wind power from the Gulf of Suez into the national grid. This project marks the first phase of a $2 billion grid investment programme.[48]

At the organisational level, the EETC is also collaborating with the EBRD to develop a regulatory framework that will enable direct power purchase agreements (peer-to-peer) between private producers and consumers,[49] considering that under the new Electricity Law No. 87 of 2015,[50] the EETC operates as an independent transmission system operator. According to the Electricity Regulatory Authority's regulations, investors using the national transmission network are required to pay a wheeling charge.[51] An Organisation for Economic Co-operation and Development (OECD) report on legislation relating to green hydrogen incentives also indicates that the EETC currently imposes a wheeling fee equivalent to 7% of the revenue generated from transmitted electricity. This has raised concerns among developers about the cost of producing green hydrogen.[52] Once the fee structure is stabilised, the introduction of these mechanisms in the private procurement market is expected to facilitate the launch of green hydrogen projects.

6.2.2 The electricity transmission model

Electricity grids are typically centralised, though in some cases they may be decentralised for specific production purposes, with no national interconnection, so as to reduce costs, conserve resources, and minimise environmental impacts. However, when electricity is produced for export or to establish a regional energy trading hub, extending national grids to borders, or even beyond them, is necessary to enable regional interconnection. In Egypt, a centralised grid model is currently in place, with regional extensions linking to neighbouring countries, such as Jordan and Libya. These interconnections are part of a broader plan to export electricity generated from renewable energy sources to Greece and Cyprus.[53]

Contrary to the expected pattern of cumulative, centralised development that involves expanding the length and capacity of the existing electricity grid, a new proposal has been developed to establish what is known as the Green Energy Corridor, a dedicated network designed to directly connect renewable energy sources with hydrogen projects, desalination plants, and regional interconnections.[54] This was announced in May 2022, by the former Minister of Electricity and Renewable Energy, who stated that the corridor would link all renewable energy plants across Egypt, with a target capacity of 70 GW.[55] The creation of a dedicated green electricity grid also remains an option, following a proposal by India's Sterlite Power in March 2025 to invest between $5 billion and $6 billion in high-voltage transmission lines specifically designed to transport wind power directly to green hydrogen parks. [56]

These proposals appear to be driven by investors' desire to mitigate the risks associated with relying on the national grid – particularly the potential diversion of electricity for domestic consumption during internal energy crises. Furthermore, investors have expressed concerns about the regulatory framework for electricity transmission tariffs and cost-sharing, similar to the challenges faced during the connection of the Benban Solar Park to the grid, amid the lack of guarantees regarding the reliability of the existing national grid, as compared to a new dedicated network[57] – notwithstanding recent reforms and the ongoing liberalisation of the electricity market.[58]

Another factor relates to the regulation of the expected green hydrogen market, namely the 'additionality criterion' adopted by the EU for renewable hydrogen. According to the delegated regulation supplementing the Renewable Energy Directive (RED II), hydrogen cannot be recognised as a 'renewable fuel' unless the electrolysis process is powered by new plants (commissioned no more than 36 months before the electrolyser begins operating) that have not received any investment or operating support, and unless a direct connection or a power purchase agreement (PPA) has been concluded for an amount of electricity equivalent to that required for hydrogen production.[59]

It is also required that electricity generation and consumption maintain temporal and geographical consistency, as monitored by the electrolyser. This requirement applies on a monthly basis until 31 December

2029, after which it shifts to hourly consistency, starting 1 January 2030 — provided that both the generation plant and the electrolysis site are located within the same specified connected area.[60] These criteria apply to any fuel recognised as renewable energy within the European market, irrespective of its place of production. According to the European Commission's official Q&A document, the purpose of these conditions is to ensure that only 'new' renewable capacity is used to meet the additional electricity demand from electrolysers, and to prevent the diversion of 'existing' green electricity — which is intended to reduce local grid emissions — towards hydrogen production. If existing renewable capacity were redirected to hydrogen production, the local grid would need to increase fossil fuel generation to compensate, thereby jeopardising emissions reduction targets.[61]

As they currently stand, these standards are impractical because they require harmonising the production model for hydrogen manufacturing across all countries, independent of existing electricity transmission infrastructure and without accounting for the diverse characteristics of the energy systems in candidate exporting countries. Meeting these requirements would also entail significant additional costs to establish a new, isolated system that complies with the standards. A study by Cornell University on the European energy system has estimated that enforcing additionality and temporal and geographical compliance requirements would increase system costs by approximately €82 billion between 2024 and 2048, with the additionality requirement being the largest driver of these costs.[62]

In the case of Egypt, while the government has proposed creating a dedicated Green Energy Corridor for the exclusive transmission of electricity from renewable energy projects only, the goals of additionality and temporal consistency are most effectively achieved when electrolysers are connected to a diversified grid with multiple renewable sources and precise temporal balancing mechanisms. A dedicated, isolated system, such as the proposed green corridor, risks adding costly infrastructure without delivering equivalent environmental benefits. Moreover, constructing a dedicated hydrogen network entails the risk of low utilisation, leaving assets vulnerable to underperformance or failure if there is a gap between projected ambitions and actual demand.[63]

The EU's 'additionality' criterion also conflicts with the EU's policy objectives of supporting and incentivising partner countries — such as Egypt — to expand renewable energy deployment. The requirement that projects must not receive any investment or operational support is also inconsistent with existing measures applied by the Egyptian Government, such as tax exemptions and providing low-cost land access through usufruct rights. This inconsistency could lead to non-compliance with current EU criteria and prevent Europe from recognising or benefiting from renewable hydrogen projects developed in Egypt, potentially driving developers to seek alternative export markets. In practical terms, reliance on Egypt's existing electricity grid, which is still dominated by fossil fuel-based generation, with renewable plants like Benban operating under tariff support schemes, would not satisfy the additionality requirement.

The electricity transmission model most likely to be adopted in Egypt involves the creation of a semi-separate grid that supplies electricity directly to electrolysers and sells any excess, with no purchase of power from the national grid. In this model, wind and solar plants would supply hydrogen electrolysers directly through dedicated lines that do not draw electricity from the national grid, thereby maintaining the European principle of additionality. However, these systems would remain connected either to the national grid or to a parallel renewable grid, such as the proposed Green Energy Corridor, to discharge surplus electricity during peak generation hours. Current proposals focus on preliminary interconnection methods in the Gulf of Suez region, based on a 2024 OECD study that models three potential routes for transferring renewable capacity from Ras Gharib to the Suez Canal Economic Zone for hydrogen production. The OECD study indicates that in these models, all proposed scenarios assume the sale of part of the surplus electricity to other buyers, as this approach is less costly than long-term storage or curtailment of excess generation — making a complete disconnection from the grid practically unfeasible.[64]

The uncertainty surrounding the final model for electricity transmission, i.e. whether the connection will occur through the traditional grid or the Green Energy Corridor, could lead to a new competitive situation, rather than a complementary one that is capable of bringing about immediate improvements in the local grid. Separation of the two grids would also create a situation in which renewable capacity expands primarily to support hydrogen exports, largely isolated from local electricity demand. This effect would be reinforced by the privileged position of the hydrogen industry within the Suez Canal Economic Zone, where transactions are conducted in hard currency, reducing the incentive to develop renewable projects aimed at meeting domestic demand, especially when electricity is priced in local currency. Under such circumstances, it is essential that the Egyptian Government reserves at least the most promising and economically viable sites for meeting domestic electricity needs, or, alternatively, that it adopts new national policies that include additionality criteria to ensure a balanced outcome, preventing a structural bias in favour of renewable energy production for hydrogen exports over local consumption.

7. Expected Uses of Hydrogen

The National Low-Carbon Hydrogen Strategy's prioritisation of hydrogen applications is based on several key factors: the extent to which each application depends on hydrogen for emissions reduction (i.e. checking whether viable alternatives exist); the economic gap between green hydrogen and conventional fuels or other options; and the technological readiness expected by 2030. Overall, the strategy's primary focus in the 2020s and early 2030s is exporting hydrogen to meet rising global demand – particularly in Europe and in hard-to-decarbonise sectors that cannot easily be electrified.

On the latter point, it is important to note that the current shift towards hydrogen stems from its capacity to reduce emissions in hard-to-abate sectors, where direct decarbonisation is challenging. These sectors include heavy industries, such as steel and petrochemicals (notably ammonia and methanol), as well as heavy transport, including large trucks and long-distance maritime and air freight, for which direct electrification remains impractical or insufficient. Beyond its role as a final fuel, hydrogen is also expected to function as an energy carrier/storage medium, enhancing the flexibility and stability of electricity systems that are increasingly reliant on variable renewable sources, such as wind and solar. In this context, hydrogen offers long-term energy storage solutions that complement conventional batteries and help balance electricity supply and demand over extended timeframes.

The hydrogen projects announced to date in Egypt can be classified according to several basic functions with regard to the planned uses for hydrogen and its derivatives: (1) export as fuel or as an intermediate material for industry; (2) inputs for local industries (fertilisers, petrochemicals, iron); (3) production of hydrogen derivatives for electricity generation; (4) fuel for vessels (maritime shipping); and (5) sustainable aviation fuel (SAF). Each of these uses, and related planned projects, are discussed in turn below.

7.1. Export as fuel / intermediate material (ammonia)

Export is regarded as the most important and prominent objective of almost all proposed new hydrogen projects in Egypt. Most agreements focus on the production of green ammonia for export to Europe and Asia (Table 2). Many of these projects are described as either hydrogen projects or ammonia/methanol projects, since hydrogen is often not marketed as a final gaseous product but is instead converted into an easily transportable liquid derivative. This is due to the current inefficiency and immaturity of hydrogen transport technologies. These projects will primarily export ammonia as a hydrogen carrier, which can either be broken down into hydrogen at its destination or used directly in fertiliser and chemical industries, for electricity generation, or for transportation.

Egypt is also participating in the German H2Global mechanism,[65] through the Egypt Green Project, under which Norway's Scatec signed a 20-year purchase agreement with Fertiglobe, benefiting from the H2Global support mechanism to ensure the export of green hydrogen produced in Egypt to international markets. In October 2024, Fertiglobe shipped its first batch of green ammonia produced in Egypt.[66]

7.2. Use for local industries

Several projects aim to supply domestic industries with green hydrogen instead of fossil fuels, while promoting the export of products as end-use commodities rather than mere feedstock. Green hydrogen can also be used locally in cases where natural gas is unavailable as fuel or feedstock, helping to fill the gap. These industries include nitrogen fertiliser production (ammonia and urea), petrochemicals (such as methanol and industrial fuels), and steel and iron production through direct reduction (DRI) (steel and iron are among Egypt's key export commodities). It should be noted that 'local use' here refers to using hydrogen as an input for local industry, not for direct export.

Currently, these sectors rely heavily on hydrogen produced from natural gas (grey hydrogen), whether in ammonia units for fertiliser production, in oil refinery units for hydrotreating and hydrodesulfurisation processes, or in DRI plants that use natural gas as a reducing gas (or reductant). The adoption of clean hydrogen can significantly reduce carbon emissions from these industries, enhancing their global competitiveness as carbon footprint regulations on products become increasingly stringent. Moreover, green hydrogen can serve as a high-quality thermal fuel in industrial processes that are difficult to electrify, offering a clean alternative to gas or coal while maintaining the high temperatures required for such operations.

Fertilisers sector: The Egyptian fertilisers sector currently consumes around 1 million tonnes of grey hydrogen per year as a feedstock for ammonia production. The National Low-Carbon Hydrogen Strategy gives priority to green ammonia as there is no practical alternative to green hydrogen for low-carbon ammonia production, and the economic gap between green and grey hydrogen is considered relatively small, especially in the export market. Green ammonia can be integrated into existing fertiliser plants without major modifications thanks to the availability of the necessary technology. Consequently, this application represents a key starting point for hydrogen projects in Egypt.[67]

The fertilisers sector is one of the most important industrial sectors in the Egyptian economy due to its role in meeting local agricultural demand and generating significant export revenues. According to the Egyptian Ministry of Petroleum, Egypt ranks sixth globally in urea production, with an annual output of 6.5–7 million tonnes, representing approximately 4% of global production, which is estimated to be around 170 million tonnes per year. The country is also the fourth largest exporter of urea in the world, exporting 4.5 million tonnes per year, equivalent to 9% of global trade in the product.[68] In 2023, Egypt exported approximately 3.47 million tonnes of urea, valued at $1.73 billion.[69]

A number of Egyptian fertiliser companies have already begun incorporating green hydrogen into their industrial processes, due to two main factors. First, the shortfall in Egypt's natural gas supply due to the decline in production in recent years, combined with the rise in domestic demand. Second, the fact that fertiliser companies are seeking to maintain their global market share, especially under new carbon regulations such as the EU's Carbon Border Adjustment Mechanism (CBAM). One case that demonstrates the impact of these two factors is that of Abu Qir Fertilizer. In May 2025 this company saw a production decrease of nearly 30% due to severe shortages of natural gas, and the temporary shutdown of some factories during peak periods, especially due to the increase in electricity consumption during the summer and the fact that domestic gas production had fallen to its lowest levels in years.[70] At the same time, Abu Qir Fertilizers had already begun adopting green hydrogen as a partial substitute for natural gas in its production processes, as part of a project to replace some of the natural gas used in ammonia factories with green hydrogen produced from renewable electricity. In doing so, it sought to reduce dependence on traditional energy sources, ensure continuity of operations, and contribute to emission reductions, while achieving a sustainable transformation in the industry. [71]

Another fertiliser company that is seeking to increase its integration of green hydrogen is MOPCO, which plans to build a green hydrogen production unit and increase its urea capacity by 2027 as part of its plant expansion in Damietta.[72] Furthermore, negotiations have already begun on restarting the old electrolysis units at the 40 MW Kima-Aswan fertiliser plant (which had been shut down) to generate green hydrogen to be used alongside hydrogen produced from natural gas at the modern Kima 2 plant.[73]

Iron and steel sector: Iron and steel projects are given a medium priority in the National Low-Carbon Hydrogen Strategy. This sector relies to some extent on hydrogen to achieve deep decarbonisation, with possible partial substitutes through electricity or carbon capture and storage technologies. The strategy estimates that there is a medium-level economic gap between green hydrogen and conventional fuels, given the need for large capital investments, such as new furnaces using green hydrogen. The technology is currently under development and is expected to become available around 2030. This use case is therefore seen as a medium-term priority, i.e. after green ammonia projects prove successful and possibly concurrent with market expansion.

Iron and steel production is currently the second-largest consumer of hydrogen among Egyptian industrial sectors, after fertilisers, but it relies primarily on grey hydrogen produced from natural gas. Local steel companies are expected to begin studies and experiments on mixing increasing proportions of green hydrogen with natural gas in reduction units (removing oxygen from iron oxides using hydrogen), to reduce emissions. Egypt has a technological advantage here, as all of its current sponge iron production (at Ezzsteel, Beshay Steel, and Suez Steel) relies on natural gas, meaning that this gas can be partially or fully replaced with green hydrogen relatively easily, as compared to steel industries that rely on coal-fired blast furnaces.[74]

However, there has been no explicit news so far about local companies upgrading their facilities or adopting green hydrogen, either as fuel or in manufacturing processes. Nevertheless, the iron and steel industry is included in the vision of the German energy company Siemens, which signed an MoU with the Egyptian Electricity Holding Company to develop Egypt's green hydrogen industry and to provide the necessary infrastructure, including developing experiments for green hydrogen reduction in existing factories.[75]

On the other hand, there are reports of investors seeking to integrate green hydrogen into the iron and steel industry, with several projects already in progress or at the planning stage. For example, the Italian Danieli Group has a proposed project to establish an integrated industrial complex for green steel production in Egypt, with an investment of $4 billion. The project includes units for the production of sponge iron (direct reduction), seamless steel pipes, and flat products, and aims to direct a large part of the production for export to Europe.[76]

India's Jindal Steel & Power Group (JSPL) has also signed an MoU on studying the establishment of a green steel plant in the Suez Canal Economic Zone that relies on hydrogen, initially with a small trial capacity. The agreement refers to the aim of establishing an iron and steel complex in the Ain Soukhna area with an annual production capacity of 5 million tonnes for export. The project is planned to be implemented in two phases across an area of 5–7 million square metres. It will include facilities for green steel production, green energy generation, and the production of clean hydrogen needed for the industrial process.[77]

7.3. Use of hydrogen for electricity generation

Egypt's strategic approach to hydrogen includes using it to decarbonise the electricity sector, particularly through co-firing with natural gas in existing combined-cycle power plants. The National Low-Carbon Hydrogen Strategy estimates that the use of hydrogen in electricity generation will be a medium- to long-term application, due to technical and economic challenges related to fuel costs and the limited returns compared to other applications, such as ammonia production for export. However, green hydrogen can be integrated into power plants as a step towards reducing emissions and enhancing the flexibility of the electricity grid, especially given the significant surplus in currently installed capacity, which exceeds actual demand by 25 GW.[78]

Siemens plants in Egypt (Burullus, Beni Suef, and the New Capital) are candidates for this type of project. Pilot projects have already begun to demonstrate the operation of gas turbines in Egypt using a mixture of gas and hydrogen. In October 2024, MOERE announced a project at the Burullus gas plant to operate two gas units using a fuel mixture containing 30% green hydrogen and 70% natural gas. The project includes the construction of an electrolysis unit to produce hydrogen on site using desalinated seawater.[79] Mixing 30% hydrogen is expected to reduce carbon dioxide emissions by approximately 10–15% per gas unit.[80] A similar pilot project is also being considered at the Beni Suef power plant. This has become more relevant in light of the recent announcement of plans to sell a significant portion of the plant to a foreign investor. However, the German banks that financed Siemens' power projects in Egypt objected to the sale. This situation has strengthened the case for upgrading the plant's technology and market value by adding low-carbon systems.[81]

Siemens aims to strengthen its position in the hydrogen dual-fuel market by leveraging the capabilities of its eight SGT5-8000H turbines, which are used in major power plants in Burullus, Beni Suef, and the Administrative Capital.[82] These turbines enable the operation of power plants with a fuel mixture of up to 30% green hydrogen, giving Siemens a competitive advantage in emerging markets such as Egypt.[83] This effort forms part of a broader commitment by members of the European Union Turbines (EUTurbines) consortium, which pledged in January 2019 to develop gas turbines capable of operating 100% on hydrogen by 2030. This commitment enables Siemens to accelerate the implementation of dual-fuel projects in Egypt as part of a wider strategy to transition the energy infrastructure toward low-carbon sources.[84]

Another application of green hydrogen in the Egyptian electricity sector is to increase the efficiency of, and avoid waste in, electricity production. As stated earlier, the Egyptian electricity system currently produces a significant surplus in thermal (conventional) power plant capacity.[85] To respond to this situation, MOERE has begun studying using the periodic surplus that exists during low-demand periods to operate electrolysers to produce hydrogen. This hydrogen can then be stored for later use during peak periods, converting surplus electrical energy into clean, usable fuel. This will indirectly enhance grid flexibility and facilitate the integration of renewable energy.

It should be explained here that the significance of hydrogen as an alternative fuel lies in its potential to be blended with natural gas, thereby reducing overall dependence on it. The inclusion of a proportion of green hydrogen in the fuel mix enables power plants to generate part of their energy without consuming an equivalent amount of gas. This reduces pressure on gas resources, particularly during times of crisis or high prices. This approach is especially important for electricity generation in Egypt, where natural gas makes up 85–88% of the fuel mix used in power plants.[86]

Another incentive for moving to green hydrogen in electricity production relates to the privatisation of assets and the consequent need to attract investors; since 2019, the Egyptian Government has been considering selling shares in Siemens power plants as part of its IPO and privatisation programme. The implementation of this programme began in 2023 with the sale of 70% of the Beni Suef plant to an international company, amid interest from firms such as Britain's Actis and Malaysia's Edra.[87] If power plants are operated with cleaner fuels, such as hydrogen, this can enhance their investment attractiveness as it highlights their capacity to adapt to the requirements of the global energy transition.

There are also monetary policy incentives for using green hydrogen in electricity production, given Egypt's shortage of hard currency. A portion of hydrogen production can be directed to the domestic market through contracts denominated in Egyptian pounds. This approach will encourage local investors and reduce the government's foreign currency commitments. To this end, Egyptian institutions such as the Suez Canal Economic Zone, TSFE, and several companies linked to the ministries responsible for energy have already signed multiple MoUs with international firms on establishing green hydrogen projects for export, under which there is the possibility of allocating part of production for domestic use once the quotas for government companies are determined.

Blue hydrogen: The National Low-Carbon Hydrogen Strategy defines blue hydrogen as hydrogen produced from fossil fuels – typically natural gas – using steam methane reforming (SMR) technology, accompanied by carbon dioxide capture and storage systems to reduce emissions. The strategy emphasises low-carbon hydrogen from both green and blue sources due to the availability of natural gas resources in Egypt, the existing infrastructure in factories and oil refineries, and the potential for carbon dioxide storage in geological cavities within depleted oil and gas fields. Blue hydrogen is considered a viable option, provided that the regulatory framework and carbon capture and storage technologies are adequately supported. The hydrogen strategy anticipates that five to 10 years will be required for the maturation and development of sufficient capacity for carbon capture and storage technologies.[88]

Despite Egypt's substantial fossil fuel infrastructure, which includes significant gas reserves, established pipeline networks, grey hydrogen plants serving energy-intensive industries, and extensive sector expertise, it is unlikely that blue hydrogen will be widely adopted in the country amid the current energy supply crisis. This ongoing situation has caused Egypt to transition from being an occasional LNG exporter to a net LNG importer. Consequently, Egypt is not expected to undergo a transitional phase involving the deployment of carbon capture and storage technologies, which would require a development timeline comparable to that for renewable energy and green hydrogen capacities.

As at 2025, no integrated blue hydrogen project for export has been announced in Egypt. However, some preliminary studies and initiatives are underway. The most notable example is the 2021 MoU between the Egyptian Natural Gas Holding Company (EGAS) and Italy's Eni on exploring blue hydrogen production using gas sourced from the Meleiha field in the Western Desert, with carbon dioxide reinjection into nearby geological formations.[89] The first practical steps began in May 2022, when Egypt's Minister of Petroleum and Mineral Resources signed an agreement with Eni to launch a $25 million pilot carbon capture and storage project at the Meleiha oil field. The project aims to inject approximately 30,000 tonnes of CO_2 annually into geological reservoirs, reducing the field's emissions by around 63,000 tonnes per year.[90]

7.4. Fuel for maritime shipping (green methanol)

The global shipping sector is increasingly targeting green ammonia and green methanol as alternative fuels. In Egypt, the current domestic demand for hydrogen used in methanol production is estimated at approximately 0.27 million tonnes per year, as the current methanol industry uses natural gas as the primary source for hydrogen supply. The National Low-Carbon Hydrogen Strategy identifies the economic gap between green hydrogen and conventional fuels for green methanol in maritime shipping as being of a medium level, and assigns it a high priority among proposed applications for green hydrogen. The technology for green methanol production – combining low-carbon hydrogen with carbon dioxide – is already available, and limited commercial-scale implementation is feasible before 2030. This makes green methanol a particularly attractive investment opportunity, especially for the production of marine fuel.[91]

Egypt is well-positioned to become a supplier of marine fuels due to its strategic geographic location on the Red Sea and the Mediterranean Sea, with the Suez Canal serving as a key global shipping corridor. The country also benefits from a long-established petrochemical sector, which produces petroleum-derived fuels from crude oil. Notably, the world's first green methanol bunkering of a container ship (i.e. refuelling the ship's fuel containers) occurred at Egypt's East Port Said on 17 August 2023. The vessel was fuelled with bio-methanol, produced from biogas derived from organic waste through a process that converts the biogas into bio-methanol and then into green methanol.[92] In support of this transition, the Egyptian Government has launched the 'Green Fuel Alliance' initiative, in a collaboration between the Ministry of Transport and MOERE. This initiative aims to produce green ammonia at a competitive cost for use as an alternative marine fuel.[93]

While there is currently little to no use of hydrogen in the shipping sector, either in Egypt or at the global level, maritime shipping nevertheless is among the most feasible applications of hydrogen in Egypt in the short term. This is largely due to the fact that hydrogen can be produced and stored on site, close to maritime activity – particularly if production facilities are located in the Gulf of Suez area. Additionally, Egypt already possesses the necessary expertise in hydrogen production, through its petrochemical and fertiliser industries, which can support this development. Future demand for hydrogen in shipping is expected to rise, driven by the International Maritime Organization's target to achieve net-zero greenhouse gas emissions in international shipping by 2050. Interim milestones include reducing emissions by at least 20% by 2030 and by at least 70% by 2040 compared to 2008 levels.[94] In response, shipping companies are actively competing to establish bunkering stations to secure a share of the emerging hydrogen market.

In this context, several green hydrogen-related projects in the maritime sector have already been contracted in Egypt, including the following:

- **Maersk Project**: A framework agreement has been signed with Maersk's subsidiary, C2X, to develop a plant producing 300,000 tonnes of green methanol per year in its first phase. The facility, located in the Suez Canal area, entails an estimated investment of $3 billion and is expected to be operational in 2027 or 2028.[95]

- **Scatec Port Said Project:** During COP28 in December 2023, the Suez Canal Economic Zone Authority signed an MoU with the Norwegian company Scatec relating to supplying ships with green fuel at East Port Said port. The project, valued at approximately $1.1 billion, includes constructing a plant to produce 100,000 tonnes of green methanol annually by 2027, powered by a 190-megawatt electrolyser using 317 MW of wind energy and 140 MW of solar energy.[96]

- **Scatec Damietta Project:** In May 2023, the Alexandria National Refining and Petrochemical Company (ANRPC), together with Scatec and in partnership with the Egyptian Bioethanol Company, agreed to jointly develop a green methanol production facility at Damietta Port, with an investment of $450 million. The project is designed to produce 40,000 tonnes of green methanol annually, with the potential to scale up production to 200,000 tonnes per year. It involves the installation of renewable energy capacity comprising at least 40 MW of solar power and 120 MW of wind power, along with a 60 MW green hydrogen electrolyser, a seawater desalination plant, and infrastructure for the production and storage of green methanol. Additionally, the project includes the construction of Egypt's first green biofuel bunkering station for vessels.[97]

- **EDF and Zero Waste Project:** A €7 billion framework agreement has been signed between the Egyptian Government and two companies, EDF of France and Zero Waste of the UAE, to establish a green hydrogen production facility in Ras Shukheir on the Red Sea. The project aims to produce 1 million tonnes of green ammonia annually to supply clean fuel for ships.[98]

7.5. Sustainable aviation fuel

The National Low-Carbon Hydrogen Strategy identifies hydrogen-based sustainable aviation fuel (SAF) as the primary pathway for reducing emissions in the aviation sector. While hydrogen and its derivatives are not currently used in aviation in Egypt, demand is expected to emerge shortly before 2030, driven by the development of sustainable hydrogen-derived fuels such as ethanol and synthetic kerosene. The strategy highlights the fact that hydrogen as the only viable low-carbon alternative for long-haul flights, despite its high cost, and therefore assigns it high strategic importance for aviation in the long term. This aligns with global airline commitments to decarbonise with the goal of reaching 2% SAF in the global aviation fuel mix by 2025, rising to 70% by 2050.[99] Egypt has taken initial steps towards this transition through conducting a feasibility study in partnership with Honeywell and the EBRD that explores the use of advanced hydrotreating technologies to convert used oils into sustainable jet fuel.

The aviation fuel sector is expected to play a significant role in the second phase of Egypt's hydrogen economy. Egypt sees the sector as offering economic opportunities and has the broader vision of becoming a regional hub for clean aviation fuel in Africa and the Middle East.[100]

In support of this objective, Egypt has established the Egypt Sustainable Aviation Fuel Company (ESAF), which will support efforts to reduce aviation-related carbon emissions. The company is 85% owned by Egyptian oil and gas companies, with the remaining 15% held by private sector entities. It operates under the supervision of ECHEM. ESAF plans to utilise used cooking oil as a feedstock to produce approximately 120,000 tonnes of jet fuel annually, with projected investments of around $530 million. Production is expected to begin within the next few years near the El Dekheila port in Alexandria.[101] Furthermore, discussions are underway with the Italian firm Technip Energies to explore opportunities for producing green hydrogen-based aviation fuel in Egypt.[102]

As the previous discussion has made clear, Egypt's National Low-Carbon Hydrogen Strategy has been developed as a sectoral industrial strategy that is strongly export-oriented. High-potential avenues for domestic use of hydrogen – such as ammonia and methanol for the fertiliser and maritime shipping industries – are not primarily directed towards serving local demand, but are framed mainly as export-oriented projects. The explanation for this export focus is not hard to find: in a period in which investment and financing costs are rising sharply, the government is seeking a strong push into the hydrogen economy in the hope of attracting new financial flows. It is to this end that it is providing generous allocations of high-quality land, establishing supportive legislation and offering tax incentives to support the development of the hydrogen sector.

One example of these inducements is Law No. 2 of 2024, issued in January 2024, which offers a comprehensive package of investment incentives for projects that sign agreements within five years of the law's enactment. Notably, it provides a cash incentive – known as the 'green hydrogen incentive' – that ranges from 33% to 55% of the project's income tax liability, payable after the commencement of commercial operations. The law also grants customs and tax exemptions on the import of essential equipment and machinery, reduces port usage fees by 30%, lowers land use fees for projects by 25%, and cuts port storage licence fees by 20%. Moreover, under the law, hydrogen projects are designated as strategic projects, making them eligible for a golden licence, which enables fast-track approval through a decision by the Council of Ministers.

Another relevant policy development is Decree No. 3445, issued in September 2023, which established the National Council for Green Hydrogen and Derivatives (NCGH). The NCGH is tasked with overseeing the implementation of Egypt's National Low-Carbon Hydrogen Strategy and with facilitating coordination among the various stakeholders. Its mandate is to unify state efforts to attract investment in the green hydrogen sector, in line with sustainable development goals, to enhance Egypt's regional and international competitiveness, and to remove obstacles to investment.[103]

Looking at the policy framework more broadly, the National Low-Carbon Hydrogen Strategy aligns with Egypt's long-standing ambition to become a regional hub for energy trade. The foundations of this ambition were laid with the discovery of natural gas fields in the Eastern Mediterranean and the opportunity to export this gas to Europe via Egypt. This vision has been supported by the EU, which recognises Egypt's potential role as a regional oil and gas hub in the Mediterranean.[104] It was in this context that the trilateral MoU between the EU, Egypt, and Israel referred to earlier was signed in 2022 to facilitate the export of LNG through Egypt's Idku and Damietta.[105] Egypt made partial progress toward this goal during the period of the COVID-19 pandemic and the onset of the Russian invasion of Ukraine, when energy markets were under pressure. However, the country has since struggled to maintain momentum due to a decline in gas production and reserves, particularly in the Zohr field, which has impacted its ability to sustain exports.

It is important to note here that Egyptian-European governmental cooperation has played a leading role in shaping the country's energy policy over the past decade. For example, Egypt's Integrated Sustainable Energy Strategy (ISES) 2035, announced in 2016, was developed under the EU-funded Technical Assistance to Reform the Energy Sector (TARES) initiative, which aimed to enhance energy efficiency in Egypt.[106] Moreover, the recent push on renewable energy came about after Egypt's agreement with the United States and Germany during the COP27 climate conference in late 2022, as part of the NWFE programme, which aims to finance the decommissioning of 5 GW of conventional thermal power plants by 2025 and the development of 10 GW of solar and wind power by 2028.[107]

Egyptian-European cooperation extends to the hydrogen sector: a framework agreement for a European-Egyptian partnership on renewable hydrogen was signed during the COP27 summit in November 2022. The partnership seeks to support the development of Egypt's green hydrogen industry and its required infrastructure, to promote European investment, and to establish a pathway for the export of hydrogen and its derivatives from Egypt to Europe.[108] In parallel, Egypt and Germany signed two Declarations of Intent on strengthening cooperation in the fields of natural gas and green hydrogen, particularly with a focus on building Egypt's production and technological capacity in green hydrogen.[109] This cooperation was further reinforced with the launch of the Egyptian-German Green Hydrogen Partnership in 2023, under the framework of the Joint Committee of Renewable Energy and Energy Efficiency (JCEE). The partnership is funded by the German Ministry for Economic Affairs and implemented by the German Agency for International Cooperation.[110]

These direct agreements in the energy sector are part of broader long-term partnerships and frameworks. One of these agreements is the Euro-Mediterranean Partnership Agreement, signed between Egypt and the EU in the late 1990s, which established the foundational principles that continue to govern clean energy cooperation between Egypt and the EU today, as confirmed by official statements from the Egyptian Government and the country's president. [111]

More recent initiatives also play a significant role, such

8. Policy and Legal Framework for the Egyptian Hydrogen Sector

as the EU's Global Gateway programme, launched in 2021, which aims to achieve €300 billion of international infrastructure investment worldwide by 2027. This programme prioritises renewable energy and green hydrogen development.[112] Through the Global Gateway, Egypt benefits from a framework for cooperation and financing that supports clean energy projects, including electrical interconnection with Europe via the GREGY project, which seeks to export 3 GW of renewable energy from Egypt to Greece. Additionally, Global Gateway supports methanol production, green fuel projects for maritime transport, and industrial emission reduction initiatives, all within the scope of the European Investment Plan for the Southern Neighbourhood.[113]

It is important to note here that the EU's agreements with Egypt parallel similar agreements signed with other countries in the Global South that are identified as candidates for hosting green hydrogen projects, including in North Africa. These agreements aim to foster a competitive market among potential exporting countries, which primarily benefits the largest energy consumers by incentivising candidate countries to vie for support mechanisms and risk mitigation means, in the race to export green hydrogen. This approach is characterised by the central role of the EU (made up of the wealthiest consuming countries), engaging with a fragmented group of producers from developing economies. The producers compete intensely to export their resources and shoulder the responsibility of emissions reductions and decarbonisation efforts on behalf of the core countries. Importantly, this export-driven competitive approach does not seek to foster integration or open communication channels between exporting countries themselves. As a result, it does not encourage the formation of a producers' association that could collectively negotiate with the EU or the Global North – for example, to rationalise resource consumption or to negotiate social benefits such as soft financing and technology transfer – that would facilitate these exporting countries' transition to green energy.

A final key point to note, when looking at the policy framework for Egypt's hydrogen sector, is that the benefits that developing countries like Egypt receive from internationally funded initiatives and grants in the energy sector simultaneously enable the funders to gain access to information about, and to influence public policy within, the sector. In Egypt's case, nearly all aid programmes and regulatory initiatives in the energy sector have had a significant impact on shaping strategic policies. For instance, as noted above, the European TARES programme was the foundation for launching Egypt's Energy Strategy 2035. Similarly, the National Low-Carbon Hydrogen Strategy was developed with the support of the EBRD.

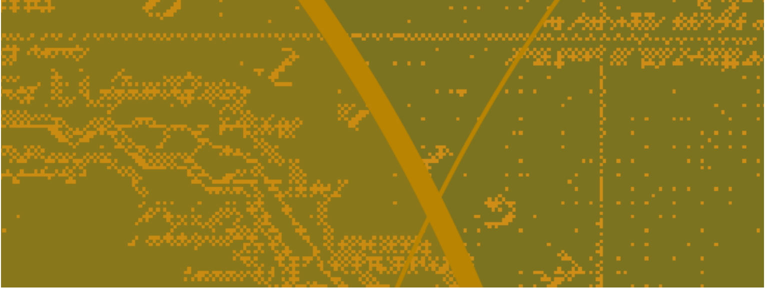
The Egyptian Government and other stakeholders primarily view hydrogen either as a tool for emissions reduction or as an investment opportunity. Limited attention is currently given to the broader, deeper implications of hydrogen for a national energy transition. Egypt's hydrogen economy model is embedded within a wider context of commercial, political, and developmental dynamics, revolving around two main elements: the exchange and trade of advanced renewable energy production technologies; and the allocation of natural resources, such as high-quality land. Within this framework, Egypt's role is that of an exporter of primary energy resources, utilising its natural assets like land and water, and thus it aims to establish an isolated hydrogen production model within the country's free economic zones.

More broadly, Egypt's policy on hydrogen aims to mitigate risks associated with the hydrogen industry while complying with European regulatory standards, supported by financial incentives outlined in the Hydrogen Industry Incentive Law. In return, Egypt expects the hydrogen sector to drive export revenue growth and to foster technology transfer, without imposing significant financial burdens, in accordance with Law No. 2 of 2024, under which projects must start commercial operations within five years of signing agreements, to qualify for incentives. The law also requires that foreign financing covers at least 70% of project costs, local components are used at a minimum rate of 20% where available, contributions are made towards technology transfer and the training of Egyptian workers, and social responsibility plans are implemented.

As stated earlier, current policies for the hydrogen sector are primarily focused on exports to the EU. Meanwhile, domestic industries, such as fertilisers, petrochemicals, and steel, are adjusting to meet the requirements of the European CBAM, which positions the energy transition in the hydrogen and derivatives sector as an extension of the global energy transition first, with the domestic transition as a secondary priority.

This model prioritises exporting hydrogen first, with local consumption of any surplus hydrogen, its derivatives, and renewable electricity inputs coming second. This constitutes a clear shift from Egypt's previous model of primarily exporting energy surpluses.

In contrast to the fossil fuel economy, which consumes land resources vertically, produces intensive emissions and pollution, and primarily serves the domestic market before exports, the hydrogen economy is land- and water-intensive (requiring large horizontal areas), competes with local electrification efforts, and targets international markets first, with the local market placed second. This approach risks undermining both the sustainability of an export-focused hydrogen economy and the development of local energy production, as it depends on competing for limited resources – starting with high-quality land, renewable energy, and water. Moreover, in this approach, Egypt bears significant environmental and social burdens linked to resource use, including the potential impacts from constructing, operating, and decommissioning energy facilities and hydrogen facilities, as well as saline discharge from desalination and chemical usage. Continuing such an export-focused strategy without balanced and fair policies that support both export and domestic transition carries the risk of transforming Egypt into a green 'energy oasis' that exports value but imports environmental and social impact.



9. Sustainability and a Just Energy Transition in Egypt's Hydrogen Model

9.1. Local impacts of export policies

Egypt's prioritisation of natural gas exports over domestic use leads to unaccounted-for environmental and social costs at the local level. In pursuit of maximising foreign currency earnings from LNG exports during 2021–2022 – amid rising global prices due to the Russian-Ukrainian war – electricity generation companies began operating steam units using a fuel mix that includes heavy fuel oil (mazut), in order to free up larger volumes of natural gas for export.[114] Data from December 2021 shows a 620% increase in reliance on fuel oil compared to the same month in 2020.[115] In 2022, fuel oil accounted for 20.95% of total power generation fuel – the highest level recorded since 2017. [116]The Egyptian Government contributed to this trend through a series of regulatory measures, including limiting the operating hours of some industrial facilities and government buildings, launching an electricity rationalisation programme, and temporarily adjusting electricity prices to encourage lower consumption during peak periods.[117] As a result, revenues from gas and LNG exports rose to around $8 billion in fiscal year 2021/2022 and further increased to nearly $8.4 billion in 2022.[118]

However, while these developments increased Egypt's foreign currency earnings, substituting fuel oil for natural gas has had adverse effects on multiple levels. Environmentally, it can be calculated that, based on standard emission factors, carbon dioxide emissions increased by approximately 38% due to the shift from natural gas (56.1 tonnes CO_2/terajoule) to fuel oil (77.4 tonnes CO_2/terajoule).[119] In addition, there has been an increase in local air pollutants – particularly sulphur oxides and fine particulate matter – as recorded by data from the European Environment Agency, placing an added health burden on the population.[120] Operationally, burning fuel oil in steam boilers leads to the formation of deposits that accelerate high-temperature corrosion, requiring more frequent cleaning and maintenance, thus reducing unit availability (Barroso and Barreras, 2004). This is consistent with local operational reports indicating higher maintenance costs when operating on fuel oil compared to natural gas.[121]

Moreover, a field study conducted at the Assiut Thermal Power Plant (El Walidia) found that the ash resulting from heavy fuel oil combustion contains high levels of naturally occurring radioactive materials. The concentration of these materials is more than 10 times higher than that typically found in crude oil, and it exceeds the global average, posing radiation-related health risks to both residents and plant workers.[122] Additionally, one local farmer reported that wastewater from the fuel oil power plant had mixed with Nile irrigation water and polluted his farmland, reducing its productivity and damaging his crops.[123]

These cases illustrate how Egypt's export policy during the 2022 energy crisis may have achieved short-term financial gains, but also resulted in serious environmental, operational, and social burdens. In effect, the country exported value while importing long-term costs. To avoid this dynamic in the hydrogen sector and to ensure a fair and sustainable transition to a green hydrogen economy, export policies must be governed by clear domestic priorities. These priorities should include guaranteeing clean electricity coverage for domestic needs first, establishing minimum quotas for local hydrogen production, and implementing mechanisms that link export activities to reliable indicators of national energy security and air quality.

9.2. Land

As outlined earlier, the implementation of Egypt's National Low-Carbon Hydrogen Strategy will require vast land resources to support the targeted buildout of renewable energy capacity – ranging between 19 GW and 41 GW by 2030, and between 72 GW and 114 GW by 2040, depending on whether the central or green scenario is pursued.[124] As the strategy document does not specify the share of solar versus wind energy, two different assumptions are used for estimating land needs: a 50/50 split between solar photovoltaic (PV) and onshore wind power, or a 70/30 split favouring solar, which would have a smaller land footprint.

Table 5: Comparison of average land requirements for 50/50 & 70/30 scenarios

Scenario	Renewable capacity (GW)	Average area (km²) - 50/50	Average area (km²) - 70/30
Central 2030	19	1,853	1,264
Green 2030	41	3,998	2,727
Central 2040	72	7,020	4,788
Green 2040	114	11,115	7,581

The figures for land needs given below are rough estimates intended as reference points, since actual land requirements can vary widely depending on project location, technological design, and efficiency. For example, onshore wind farms require much larger areas due to the wide spacing between turbines. According to an IEA report,[125] the average land use density for a 50/50 solar-wind mix is about 97.5 km² per GW. In the 70/30 solar-wind scenario, land intensity drops to 66.5 km² per GW, due to the lower spatial demands of solar energy.

The table indicates that shifting the energy mix towards solar power reduces the land area required by approximately 30–35% across all scenarios, representing a potential improvement in land-use efficiency. However, this option carries additional challenges linked to long-distance electricity transmission networks, since high-quality solar sites are concentrated in the south (such as Benban and Kom Ombo), while electrolysis facilities and export ports are located in the Gulf of Suez region. As a result, the overall transmission and distribution costs increase due to the greater need for transmission infrastructure.

According to the latest government reports, the areas allocated by Egypt for renewable energy projects are sufficient, exceeding 40,000 km2 across all hydrogen and derivative production scenarios.[126] Nonetheless, questions can be raised about the fairness of the allocation of land between local and export-oriented uses. So far, the trend has been to prioritise high-quality (and therefore lower-cost) sites for hydrogen projects intended for export, which aligns with the Egyptian Government's current focus, given the challenging economic context. However, the long-term sustainability implications of this approach must be carefully considered. From an environmental standpoint, the isolated and preferential treatment of hydrogen exports could heighten domestic dependence on fossil fuels in the short term, leading to increased emissions and air pollution. From a social standpoint, the potential impact of higher green fertiliser costs on local farmers must be assessed: these higher costs come about because domestic fertiliser plants often prefer to export their 'green' products to cover capital investments, which are often in foreign currency.

The issue of land must also be addressed as a matter of land governance, not just an issue of technical area calculations: questions must be raised about how the state regulates sites shared with remote communities, how export revenues from the energy transition are distributed locally, and how water needs are met. This latter issue is discussed in the next sub-section.

9.3. Water

In Egypt, hydrogen plants must rely on the electrolysis of saline water to generate hydrogen, due to the scarcity of freshwater. Egypt is among the 10 countries worldwide most severely affected by water stress, according to the Water Stress Index published by the World Resources Institute.[127] United Nations data show that water use in the country reaches 141% of renewable freshwater resources, which is considered to constitute 'critical water stress'.[128] There is a persistent gap between available resources of about 60 billion m³ per year and demand of nearly 114 billion m³. The deficit is met by reusing around 21 billion m³ of wastewater and by importing food products equivalent to 33.5 billion m³ of virtual water.[129] The National Low-Carbon Hydrogen Strategy will add new demand for desalinated water. Using a consumption factor of 10.11 litres of water per kilogram of hydrogen,[130] the projected water demand can be summarised as follows:

Table 6: Projected demand for desalinated water as a result of green hydrogen production in Egypt (2030–2040)

Scenario	2030 hydrogen production (million tonnes)	2030 water demand (million m³)	2040 hydrogen production (million tonnes)	2040 water demand (million m³)
Central	1.5	15.2	5.8	58.6
Green	3.2	32.4	9.2	93.0

To secure these quantities, work is underway to establish a joint desalination facility within the Suez Canal Economic Zone: the Ain Sokhna plant, with an initial capacity of 250,000 m^3 per day (91 million m^3 per year), and a planned gradual expansion to 1 million m^3 per day (365 million m^3 per year). The project is financed through a public–private partnership that links each developer's share to their consumption volume.[131] The capacity of the first phase is sufficient for the 2030 green scenario and approaches the projected demand by 2040 shown in the table above.

9.4. Transportation

Official and market evidence indicates that the current Egyptian transportation model for hydrogen focuses on maritime supply chains involving hydrogen derivatives (ammonia and methanol), rather than transportation through trans-Mediterranean pipelines. Most hydrogen and hydrogen-derivative production facilities are concentrated around the Suez Canal area, and most projects aim to export ammonia or use methanol in maritime shipping (separation of uses). This contrasts with the likely model in the Maghreb region (Morocco, Tunisia, and Algeria), where projects will directly link to Europe via pipelines, as part of the Southern Hydrogen Corridor – a pipeline connecting North Africa via Tunisia to Italy, and then to Austria and Germany. There is currently no comparable project to connect Egypt to Europe in the near term.[132]

Maritime transportation of hydrogen derivatives represents the most profitable option for Egypt in the short term, given the readiness of port infrastructure and the strategic location of the Suez Canal area. However, there is a risk that Egypt's competitiveness will decline in the future if direct pipelines from the Maghreb region become operational, which could exert downward pressure on Egypt's maritime export prices – unless a North African hydrogen producers' association is established. To respond to this risk, Egypt should examine the option of blending hydrogen into the national gas network as a medium-term strategic measure to enhance domestic energy security and reduce emissions.

9.5. Cost

In terms of operating costs, most analytical models of the green hydrogen production system indicate that electricity represents the largest cost component in low-carbon hydrogen production – exceeding other capital and operating costs, such as electrolysis or storage units – due to the system's near-total reliance on renewable electricity as its primary input.[133] Egypt provides this input at competitive prices, enabling levelised costs of €2.59 to €3.11 per kilogram of hydrogen produced (based on one production model in Alexandria), and it can become even more cost-effective in locations with higher solar irradiance or stronger wind speeds.[134]

Regarding capital costs, the focus on clean technologies for export means high upfront investment requirements. Egypt's export-oriented strategy may therefore increase the cost and risk of the domestic energy transition compared with the relatively lower-risk export system. Two distinct financing pathways for renewable energy and hydrogen development in Egypt are therefore likely to emerge: an export-oriented pathway concentrated within the Suez Canal Economic Zone, and a domestic energy transition pathway linked to the national grid.

For domestic projects, analysis of hydrogen project data [135]shows that the weighted average cost of capital (WACC) in Egypt is approximately 15.6%, among the highest in developing countries. This figure is derived from an analysis of PtX (Power-to-X) hydrogen project models in general and can serve as an indicator of the cost of capital for renewable energy and hydrogen projects serving the Egyptian market. In contrast, dollar-based pricing and long-term purchase agreements within an isolated or semi-isolated export project in the Suez Canal Economic Zone reduce the WACC to the range of 9–10%, a decline recorded by the IEA[136] and confirmed by the Cost of Capital Observatory in comparable programmes in Kenya and Senegal.[137]

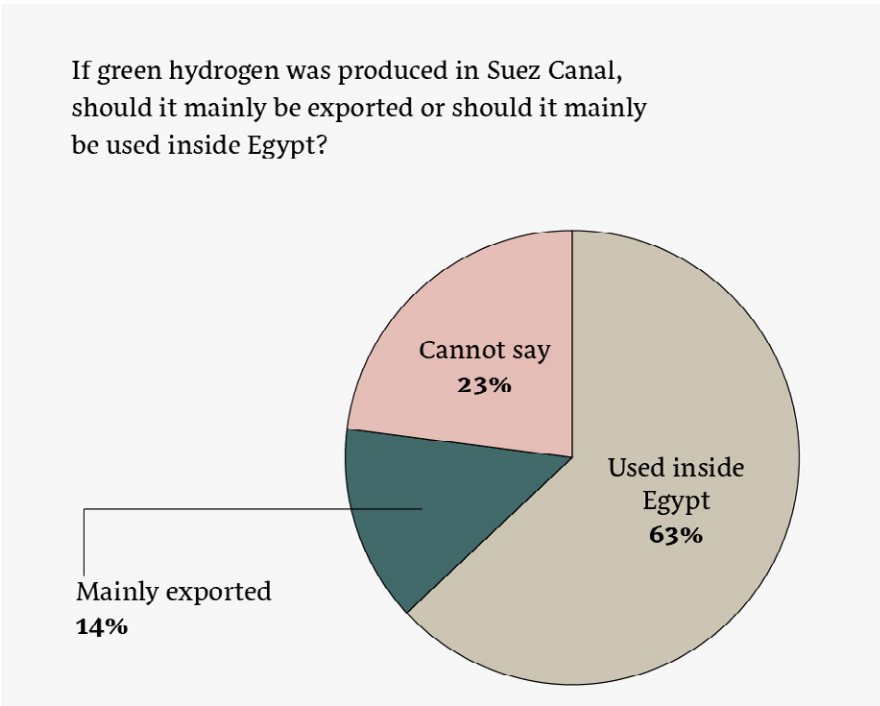
This brief estimate of the cost of capital indicates that the isolated export model appears to be less capital-intensive for investors and more attractive for concessional financing, whereas the domestic electrification scheme will be burdened by high financing costs, in addition to the investment required to expand the electricity grid and desalination infrastructure. This situation would create a preferential financing channel that would see concessional capital directed towards isolated, export-oriented projects, while leaving domestic transformation – that is, the integration of renewables into the grid and the reduction of reliance on domestic fossil fuels – to face higher borrowing costs and greater regulatory risks.

9.6. Societal acceptance

In the export-orientated growth model the Egyptian Government seeks to adopt for the energy sector, the surplus renewable energy will be sold to the national grid, while hydrogen production will primarily serve export markets and only secondarily Egyptian industries. This structure will create the potential for competition over cheaper renewable energy resources, which could increase the financial burden on the local population while offering more competitive prices for exporters. Such an outcome would likely be socially unpopular, which could jeopardise the sustainability of the model.

In 2024 a survey was administered to 505 residents of Suez and Port Said, the two main centres of planned hydrogen projects in the Suez Canal Economic Zone. Data were collected through face-to-face interviews, and the sample was stratified by age and gender to ensure demographic representation. The survey participants were asked: 'If green hydrogen were produced in the Suez Canal region, should it mainly be exported or should it mainly be used inside Egypt?' 63% of respondents preferred local use, 14% supported exports, and 23% did not specify a position. The study found that awareness of increased income and local employment opportunities was the strongest factor explaining the preference for local use, whereas the perceived benefits of export, such as promoting international trade, were less preferred.[138]

Figure 8: Response to survey in Suez and Port Said



Source: Green Hydrogen Cooperation between Egypt and Europe: The Perspective of Locals in Suez and Port Said, 2024

The results of this survey indicate that societal acceptance of hydrogen projects in Egypt depends on the realisation of direct economic benefits for the local population. The provision of tangible local added value is a prerequisite for the sustainable social legitimacy of green hydrogen projects. In the absence of such benefits, the societal legitimacy of any approach focused exclusively on exporting green hydrogen may be weakened. Popular opposition is likely if projects do not generate tangible benefits for surrounding communities – particularly when the lack of benefits coincides with environmental or social harm to those communities.

9.7. Justice

Historically, Egypt has contributed only very marginally to the climate change crisis. According to aggregated data, Egypt's cumulative greenhouse gas emissions represent less than 0.5% of the global total.[139] This limited contribution is reflected in its international commitments, as Egypt was not included in Annex I or Annex II[140] of the United Nations Framework Convention on Climate Change.[141] Consequently, it was not legally bound to reduce emissions under the Kyoto Protocol (1997), which imposed quantitative commitments only on industrialised countries.

Egypt still has comparatively low per capita emissions, at approximately 2.3 tonnes per year in 2022, compared with a global average of about 4.7 tonnes per capita.[142]

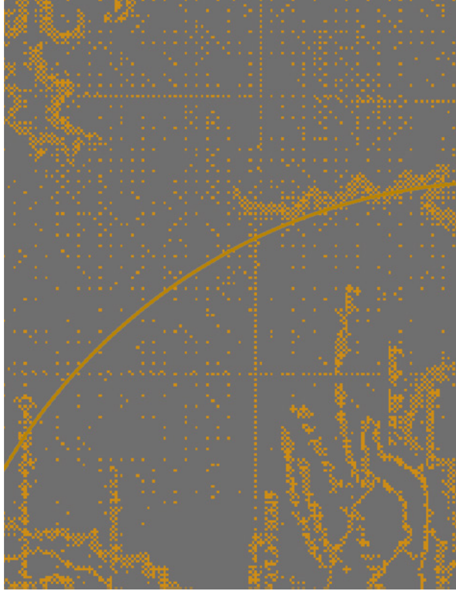
Similarly, per capita primary energy consumption in Egypt in 2022 was around 35 gigajoules per year in 2023, placing it among the top 10 countries with the lowest per capita energy consumption.[143]

Despite this very limited contribution to climate change, Egypt is highly vulnerable to its effects, with rising sea levels threatening coastal cities and the Nile Delta, leading to gradual submersion and the loss of fertile agricultural land. Moreover, a projected temperature increase of 2 to 3°C by mid-century will exacerbate water scarcity and negatively affect food production and energy security.[144]

In this legal and historical context Egypt bears a greater burden in relation to adaptation than it does in relation to mitigation, and it has the moral right to demand climate finance and technology transfer. This is reflected in its prioritisation of climate justice in its national agenda and in climate negotiations. In line with this approach, Egypt has adopted Nationally Determined Contributions (NDCs) under the Paris Agreement and is committed to total emissions elimination, contingent upon receiving international funding to support its energy transition.[145]

However, notwithstanding this justice-focused approach, recent developments suggest that Egypt seeks to serve primarily as a host for projects aimed at mitigating emissions from industrialised countries, and at securing their energy supplies, rather than benefiting from an equitable scenario in which Egypt and other developing countries receive compensation for the burden of adapting to new climatic conditions amid current climate challenges. Under this approach, the harmed parties, including Egypt, bear the burden of mitigating effects that have been caused by those responsible for emissions, even as the Global North remains dominant in financing and technology, enabling it to use climate action to extract further economic benefits, at the expense of peoples in the Global South. This raises important questions about environmental and social justice.

In Egypt's case, if its current energy and hydrogen strategies are implemented as planned, there is a strong risk that it will bear the land, water, and environmental costs of energy production without receiving any guarantee of fair compensation. In particular, the focus on green hydrogen in export projects targeting European markets reproduces colonial dynamics, whereby resources are transferred from the South to the North without empowering producing communities or ensuring their right to a share of the produced energy.[146]



10. Discussion and Recommendations

Egypt's hydrogen policies currently revolve around exports to the EU. This extends beyond quantitative production and import targets to encompass specific EU regulatory standards, such as additionality, temporal and geographical matching between renewable electricity and hydrogen production, and MRV systems. These standards are framed as green market conditions and as the rules of the game for entering or integrating with the European market, but in practice they function as tools of external control and influence, predetermining the technical and institutional structure of the supplier country.

In Egypt's case, this has resulted in an electrical interconnection structure that is shaped primarily to serve exports. This includes the concept of a Green Energy Corridor that separates off electricity produced specifically for particular export projects, with only a limited connection to the national grid (in many cases, to be used solely to sell surplus energy, if available). This approach creates energy production enclaves within a system that already faces a supply deficit, meaning that compliance with external market requirements takes precedence over local energy security. In addition to energy production enclaves, economic architecture strengthens structural favouritism by creating separate economic enclaves dedicated to export, such as free economic zones. These enclaves reduce risk by separating the production chain from crises in the local system, and by establishing specific compliance rules (e.g. green electricity standards) and infrastructure (green corridors, high-quality land, customs, and tax facilities). This design, which guarantees investors' rights, reduces risks for foreign buyers and financiers, and is reflected in lower capital costs for export projects compared with domestic electrification projects.

Such an approach has gained political acceptance due to the ongoing economic crisis in Egypt, which is characterised by a high external debt burden and the urgent need to diversify and expand sources of hard currency. In this context, isolated energy enclaves emerge as a rapid economic instrument for attracting dollar inflows. Here, the policies of European partners – particularly in relation to market access compliance standards and financing conditions – converge with domestic objectives, such as achieving quick returns in foreign currency. This approach channels more resources into isolated enclaves to meet external compliance demands, while the broader domestic economy continues along a slower and more costly trajectory. Within this framework, export-oriented enclaves become the preferred model for exporters operating under financing and creditor pressures, thereby narrowing the space for sovereign decision-making in setting national priorities. This situation aligns with the literature on green extractivism and energy colonialism, where the energy transition is shaped as a structure of external compliance that reproduces existing power hierarchies, rather than transforming them.

The analysis set out in this study and summarised above does not oppose trade or exports per se. Rather, it critiques the decision to shape Egypt's hydrogen pathway based on a compliance logic that entrenches resource and policy dependency, thereby perpetuating unequal power relations. The solution is not to reject compliance altogether, but to reconfigure it locally, through the establishment of local green energy standards, and to negotiate it collectively, through a North African bloc, for instance, acting as a regional advocate for those most vulnerable to the impacts of climate change.

As shown in this study, Egypt's domestic energy supply system is structurally fragile, both financially and technically: gas remains dominant in electricity generation and industrial use, domestic production is in decline, energy deficits are re-emerging, fossil fuel companies face mounting arrears, and electricity outages are increasingly the result of supply-side crises.

The potential solutions to these problems – whether increasing the share of renewable energy or expanding fossil fuel use – face both financial and regulatory challenges. On the renewable energy front, domestic electrification requires a high rate of renewable energy integration, along with more flexible transmission networks. However, this trajectory is constrained by limited available financing for the acquisition of production equipment, inadequate funding for grid interconnections to enhance the network's absorption capacity, and the potential for hydrogen to compete over high-quality sites designated for renewable energy projects. On the fossil fuel side, efforts to boost domestic production amid supply shortages are hampered by a growing arrears crisis. The Egyptian Government has been compelled to permit gas and oil companies (such as Shell, Petronas, and Carillon Petroleum) to export part of their production in order to recover outstanding payments. This, in turn, exacerbates the domestic supply deficit.[147] This constitutes the beginning of the formation of export enclaves out of projects whose original purpose – by definition – was to meet domestic consumption.

The Egyptian Government's proposed policies for addressing the energy crisis in the face of the current economic pressures are primarily financial in nature, focusing on the accumulation of hard currency through export activities or the allocation of resources such as land. However, this approach remains tied to investment opportunities in the energy sector, without a comprehensive development policy to tackle long-term structural imbalances, such as the absence of plans for transferring renewable energy and hydrogen production technologies. Relying exclusively on a financial perspective in the emerging hydrogen market risks reproducing the same vicious cycle of crises, further widening the gap between the profitability of export-oriented projects and those aimed at meeting domestic energy needs, while continuing dependence on creditor-driven policies.

By contrast, the emerging hydrogen economy presents an opportunity for countries in the Global South – and Egypt in particular – to address the relocation of pollution-intensive extractive and manufacturing industries from the Global North by cleaning up these industries and reducing their environmental impacts locally and reducing climate-related impacts globally. Moreover, there is a strategic opportunity on the horizon for industrial transformation in these sectors, driven by a combination of accumulated technical expertise and the availability of capital willing to invest in these foundational industries, as demonstrated in the Egyptian context. It is now incumbent upon the governments of the Global South, including Egypt's government, to assume their responsibilities and to prioritise their long-term strategic interests, in line with their national development agendas. This requires sustained diplomatic and scientific engagement to facilitate technology transfer, alongside a holistic developmental approach to the land and water footprints of these extractive and manufacturing industries – rather than addressing them solely from a commercial or investment-driven perspective.

As this study has shown, Egypt's energy sector is currently being viewed narrowly through a financial lens. It is essential to broaden the perspective of the energy transition. This involves moving beyond investment attraction and hard currency generation to incorporate principles such as climate justice, sustainable resource management, and deeper partnerships among Global South countries. National policy frameworks should integrate hydrogen export strategies with domestic energy planning, including grid capacity expansion and the gradual reduction of fossil fuel dependency. Such policies must support a meaningful industrial transition that enables clean production and technology transfer, aligning short-term gains with long-term development goals.

The following are some of the measures that could be taken to achieve these ambitions:

- Abandon the proposal of establishing a Green Energy Corridor designed solely to achieve compliance with the EU's additionality standard, and instead develop local green compliance rules and standards that are tailored to the characteristics of Egypt's domestic energy system. This would involve establishing a national registry for the certification and real-time monitoring of green electricity and hydrogen, in line with the principles of 'additionality', as well as temporal and geographical matching. Under this proposal, the data should be managed by a designated national authority.
- Mandate the integration of renewable energy projects dedicated to hydrogen production into the national electricity grid.
- Map priority locations that illustrate the local market share of high-quality land resources.
- Consider designing a funding scheme that reduces the gap in capital costs between the export option and the domestic electrification option.
- In collaboration with Egyptian universities, support and fund research programmes aimed at developing locally manufactured electrolysers for hydrogen production.
- Establish partnerships with industrial counterparts for the transfer of renewable energy technologies to Egypt.

Endnotes

1 United Nations Framework Convention on Climate Change (UNFCCC) (2021) 'Breakthrough Agenda at COP26', Glasgow: UNFCCC. https://webarchive.nationalarchives.gov.uk/ukgwa/20230311220958/https://ukcop26.org/the-breakthrough-agenda/

2 Cabinet of Egypt (2021) 'Signing a letter of intent between the Ministry of Electricity and Siemens Company for the use of hydrogen' [in Arabic]. https://www.cabinet.gov.eg/News/Details/7437

3 MOERE (2022) 'Egypt Energy Transition'. http://www.moee.gov.eg/english_new/Presentations/EGYPT_Energy_Transition.pdf

4 Baker McKenzie (2023) 'Egypt's National Hydrogen Strategy and Legal Framework: Key Developments'. https://resourcehub.bakermckenzie.com/en/resources/global-hydrogen-resource-hub/africa/egypt/articles/egypts-national-hydrogen-strategy-and-legal-framework-key-developments

5 Advisian (2024) Egypt National Low Carbon Hydrogen Strategy – Short Version. https://ent.news/20241422/8/.pdf

6 IRENA (2022) 'Geopolitics of the Energy Transformation: The Hydrogen Factor'. https://www.irena.org/Digital-Report/Geopolitics-of-the-Energy-Transformation

7 Ahmed, M. and Yasser, M. (2025) 'Egypt's Push for Green Fuels: A New Hub for Sustainable Energy', Egypt Oil & Gas Monthly Report. https://egyptoil-gas.com/reports/egypts-push-for-green-fuels-a-new-hub-for-sustainable-energy/

8 ESG News (2024) 'Suez Canal Economic Zone Attracts $64 Billion in Green Hydrogen Investments'. https://esgnews.com/suez-canal-economic-zone-attracts-64-billion-in-green-hydrogen-investments/

9 AmCham Egypt (2024) 'Proposed Green Hydrogen and Derivative Projects in Egypt', Industry Insight, 77, American Chamber of Commerce in Egypt. https://www.amcham.org.eg/publications/industry-insight/issue/77/proposed-green-hydrogen-and-derivative-projects; IEA (2024) IEA Hydrogen Projects Database – Global Hydrogen Projects Tracker. https://www.iea.org/data-and-statistics/data-product/hydrogen-projects-database; Ammonia Energy (2024) 'US $37 billion in Egyptian ammonia investments announced'. https://ammoniaenergy.org/articles/37-billion-in-egyptian-ammonia-investments/; Ahmed, M. and Yasser, M. (2025) 'Egypt's Push for Green Fuels'.

10 IEA (2025) 'Egypt: Energy Mix'. https://www.iea.org/countries/egypt/energy-mix

11 EqualOcean News (2024) 'Massive Natural Gas Left Untapped? Egypt is Deeply Enveloped in the Power Outage Crisis', 9 October. https://equalocean.com/analysis/2024100921137

12 Bowden (2025) 'East Mediterranean: Cyprus Upstream to Help Stabilise Egypt Gas Balances', Oxford Institute for Energy Studies. https://www.oxfordenergy.org/wpcms/wp-content/uploads/202503//East-Mediterranean-Comment.pdf

13 EqualOcean News (2024) 'Massive Natural Gas Left Untapped?'

14 Bowden (2024) 'East Mediterranean Gas: A Triangle of Interdependencies', Insight 151, Oxford Institute for Energy Studies. https://www.oxfordenergy.org/wpcms/wp-content/uploads/202405//Insight-151-East-Mediterranean-gas-%E293-%80%a-triangle-of-interdependencies.pdf

15 CC Reservoirs (2024) 'The Zohr Field: The Rise and Fall of a Mediterranean Gas Giant'. https://ccreservoirs.com/the-zohr-field-the-rise-and-fall-of-a-mediterranean-gas-giant/

16 Bowden (2025) 'East Mediterranean: Cyprus Upstream to Help Stabilise Egypt Gas Balances'.

17 Bowden (2024) 'East Mediterranean Gas: A Triangle of Interdependencies'; Bowden (2025) 'East Mediterranean: Cyprus Upstream to Help Stabilise Egypt Gas Balances'.

18 Kimani, A.. (2025) 'Middle East Unrest Clouds Future of $35B Israel-Egypt Gas Deal', OilPrice.com. https://oilprice.com/Energy/Natural-Gas/Middle-East-Unrest-Clouds-Future-of-35B-Israel-Egypt-Gas-Deal.html; Enterprise News (2025) 'Israel halts its USD 35 bn gas export agreement with Egypt as Egyptian–Israeli relations grow tense'. https://enterprise.news/egypt/en/news/story/b39482e1-eba0430-f-964f-acf4bb07ad39/israel-halts-its-usd-35-bn-gas-export-agreement-with-egypt-as-egyptian-israeli-relations-grow-tense

19 IEA (2025) 'Egypt: Energy Mix'.

20 Enerdata (2025) 'Egypt Natural Gas Consumption'. https://www.enerdata.net/estore/energy-market/egypt

21 MOERE (2022) 'Egypt Energy Transition'.

22 Reuters (2024) 'Egypt temporarily extends daily power cuts to three hours'. https://www.reuters.com/world/africa/egypt-temporarily-extends-daily-power-cuts-three-hours-202424-06-/

23 MOERE (2022) 'Egypt Energy Transition'.

24 Cabinet of Egypt (2023) 'Egypt announces completion of the second update to its Nationally Determined Contributions plan, targeting 42 % renewables in the electricity mix by 2030' [in Arabic]. https://cabinet.gov.eg/News/Details/63886

25 Ministry of International Cooperation (2022) 'Egypt, Germany and the United States make a joint declaration to support the NWFE energy pillar'. https://moic.gov.eg/news/789; EBRD (2022) 'Egypt's NWFE energy pillar gathers international support'. https://www.ebrd.com/home/news-and-events/news/2022/egypts-nwfe-energy-pillar-gathers-international-support.html

26 European Commission Directorate-General for Energy (2022) Memorandum of Understanding between the EU, Egypt and Israel on cooperation related to trade, transport and export of natural gas to the European Union. https://energy.ec.europa.eu/system/files/202206-/MoU%20EU%20Egypt%20Israel.pdf

27 Reuters (2024) 'Egypt cuts 2040 renewable energy target to 40%, keeps focus on natural gas'. https://www.reuters.com/sustainability/climate-energy/egypt-cuts-2040-renewable-energy-target-40-keeps-focus-natural-gas-202420-10-/

28 Al-Ahram (2025) 'Electricity: The 2040 Energy Strategy includes developing 40 GW of wind and 20 GW of solar capacity' [in Arabic]. https://gate.ahram.org.eg/News/5093972.aspx; State Information Service (2025) 'Minister of Electricity and Renewable Energy participates in a panel discussion on enhancing Egypt's energy future' [in Arabic]. https://www.sis.gov.eg/Story/298361/ وزير-الكهرباء-والطاقة-المتجددة-يشارك-في-حلقة-نقاشية-حول-تعزيز-مستقبل-الطاقة-في-مصر

29 Salem, M. (2024) 'Electricity Ministry halts several conventional power-generation units' [in Arabic], Al Mal News. https://almalnews.com/1876764/الكهرباء-توقف-وحدات-توليد-طاقة-تقلي/

30 MOERE (2022) 'Egypt Energy Transition'

31 NREA (2024) 'Annual Report 2024' [in Arabic]. https://nrea.gov.eg/Content/reports/arabic%202024.pdf

32 NREA (2023) 'Annual Report 2023' [in Arabic]. https://nrea.gov.eg/Content/reports/Annual%20Report%20202320%Ar.pdf

33 Kasper, D. (2023) 'Wind Energy and Power Calculations', in EMS C 470 Applied Sustainability in Contemporary Culture, John A. Dutton e-Education Institute, Pennsylvania State University. https://www.e-education.psu.edu/emsc297/node/649

34 NREA (2024) 'Annual Report 2024'.

35 NREA (2025) Egypt Wind Atlas. https://nrea.gov.eg/test/en/Technology/WindAtlas

36 Ibid.

37 Egyptian Ministry of Electricity and Renewable Energy (2022) 'Egypt Energy Transition'.

38 Kandil, A. M. (2023) '32 Egyptian state companies to be floated on EGX over a year', Egypt Today. https://www.egypttoday.com/Article/332-/122424/Egyptian-state-companies-to-be-floated-on-EGX-over

39 Daily News Egypt (2023) 'Actis to buy Gabal El-Zeit wind farm for $350 m from TSFE'. https://www.dailynewsegypt.com/202314/09//actis-to-buy-gabal-el-zeit-wind-farm-for-350m-from-tsfe/

40 Daily News Egypt (2023) 'Maersk to acquire 51 % of Gabal Al-Zafarana wind power station'. https://www.dailynewsegypt.com/202309/10//maersk-to-acquire-51-of-gabal-al-zafarana-wind-power-station/

41 Daily News Egypt (2024) 'NREA, TSFE set to initiate Zafarana wind farm's second phase in H2 2024'. https://www.dailynewsegypt.com/202416/04//nrea-tsfe-set-to-initiate-zafarana-wind-farms-second-phase-in-h22024-

42 Voltalia (2024) 'New agreement to repower Egypt's Zafarana wind farm with a three-gigawatt wind-and-solar project' [press release], GlobeNewswire. https://www.globenewswire.com/news-release/20240/2981471/14/11//en/New-agreement-to-repower-Egypt-s-Zafarana-wind-farm-with-a-three-gigawatt-wind-and-solar-project.html; Enterprise News (2024) 'Alcazar, TAQA Arabia and Voltalia to develop 5.2 GW of renewable energy projects [in Arabic]. https://enterprise.news/egypt/ar/news/story/73ab87cd-502c-4202-b469-ac0daba1bdbf

43 MOERE (2022) 'Regional Role of Egypt as Renewable Energy hub'. http://www.moee.gov.eg/test_new/DOC/eco.

44 Bellini, E. (2018) 'Developers' alliance helps bring Egypt's 1.8 GW Benban PV complex online', pv magazine. https://www.pv-magazine.com/201803/10//developers-alliance-helps-bring-egypts-18--gw-benban-pv-complex-online

45 MOERE (2022) 'Egypt Energy Transition'.

46 Farag, M. (2019) 'Benban solar investors object to the 25 % hike in grid-connection cost-sharing fees' [in Arabic], AlBorsaNews. https://www.alborsaanews.com/20191180500/23/02/; Enterprise (2020) 'Benban solar developers get a break'. https://enterprise.press/stories/202002/12//benban-solar-developers-get-a-break-25909/

47 MOERE (2022) 'Regional Role of Egypt as Renewable Energy hub'.

48 EBRD (2024) 'NWFE Electricity Grid Reinforcement – Project Summary Document'. https://www.ebrd.com/work-with-us/projects/psd/54716.html

49 Zgheib, N. (2025) 'EBRD supports Egypt with first private-to-private electricity contracts', EBRD. https://www.ebrd.com/home/news-and-events/news/2025/ebrd-supports-egypt-with-first-private-to-private-electricity-co.html

50 Manshurat (2015) Electricity Law No. 87 of 2015. https://manshurat.org/

node/9539?utm_source (In Arabic)

51 CMS (2024) 'Renewable Energy in Egypt – CMS Expert Guide to Renewable Energy', CMS Law. https://cms.law/en/int/expert-guides/cms-expert-guide-to-renewable-energy/egypt

52 OECD (2024) 'Green Hydrogen Incentives Law – Government of Egypt: Case Study'. https://www.oecd.org/content/dam/oecd/en/about/programmes/cefim/green-hydrogen/2024-case-studies/Green-hydrogen-incentives-law-case-study-2024.pdf/_jcr_content/renditions/original./Green-hydrogen-incentives-law-case-study-2024.pdf

53 MOERE (2023) 'Annual Report 2023'. http://www.moee.gov.eg/test_new/PDFReports/AnnualReport2023.pdf

54 MOERE (2022) 'Egypt Energy Transition'.

55 Hafez, T. (2022) 'Egypt Plans to Integrate Renewables into Grid Via Green Corridor', Business Monthly. https://businessmonthlyeg.com/egypt-plans-to-integrate-renewables-into-grid-via-green-corridor/

56 Transformers Magazine (2025) 'Sterlite proposes $6 B plan for green hydrogen power grid in Egypt'. https://transformers-magazine.com/tm-news/sterlite-proposes-6-b-plan-for-green-hydrogen-power-grid-in-egypt

57 Enterprise (2021) 'Investor confidence in Egypt's renewables is rising, but risks remain'. https://enterprise.press/stories/202107/09//investor-confidence-in-egypts-renewables-is-rising-but-risks-remain-52689

58 Enterprise (2025) 'EETC finally splits from EEHC in move to liberalize the Egyptian electricity market'. https://enterprise.news/egypt/en/news/story/e9f1eb4424-c343-f7-992c-8f2471ceb054

59 European Commission (2023) Commission Delegated Regulation (EU) 20231184/ of 10 February 2023 supplementing Directive (EU) 20182001/ by establishing a Union methodology for RFNBOs, Official Journal of the European Union. https://eur-lex.europa.eu/eli/reg_del/20231184/

60 Ibid.

61 European Commission (2023) 'Questions and Answers on the EU Delegated Acts on Renewable Hydrogen'. https://ec.europa.eu/commission/presscorner/api/files/document/print/en/qanda_23_595/QANDA_23_595_EN.pdf

62 Hordvei, E., Hummelen, S. E., Petersen, M., Backe, S., and Crespo del Granado, P. (2024) 'From Policy to Practice: The Cost of Europe's Green Hydrogen Ambitions', arXiv preprint 2406.07149. https://arxiv.org/abs/2406.07149

63 Reuters (2025). Green hydrogen retreat poses threat to emissions targets. https://www.reuters.com/sustainability/climate-energy/green-hydrogen-retreat-poses-threat-emissions-targets-202523-07-

64 Lee, M. (2024) 'Low-Carbon Hydrogen Development in Egypt – Scenario Assessment for the Suez Canal Economic Zone', presentation delivered 29 May 2024, OECD. https://www.oecd.org/greenhydrogen/egypt-sczone-scenarios-2024.pdf

65 The German government has launched the H2Global initiative, which is being implemented by the H2Global Stiftung foundation as part of efforts to accelerate the establishment of global markets for green hydrogen and its derivatives. This mechanism is based on a dual bidding model, whereby green hydrogen is purchased from producers through long-term contracts and then resold to European buyers through short-term auctions, with the price difference being offset by government support. H2Global aims to stimulate early investment in low-carbon hydrogen projects and reduce the commercial risks associated with developing this transitional technology. H2Global Stiftung (2025) 'The H2Global mechanism'. https://h2-global.org/the-h2global-instrument/

66 Fertiglobe (2024) 'Fertiglobe Ships World's First ISCC PLUS Certified Renewable Ammonia'. https://fertiglobe.com/fertiglobe-ships-worlds-first-iscc-plus-certified-renewable-ammonia/; Scatec ASA (2024) 'Scatec's Egypt Green Hydrogen project signed 20-year offtake agreement with Fertiglobe based on H2Global award'. https://scatec.com/202411/07//scatecs-egypt-green-hydrogen-project-signed-20-year-offtake-agreement-with-fertiglobe-based-on-h2global-award

67 Advisian (2024) Egypt National Low Carbon Hydrogen Strategy – Short Version, prepared for the EBRD. https://ent.news/20241422/8/.pdf

68 Samir, S. (2022) 'Egypt Ranks Sixth Among World's Largest Urea Fertilizers Producers: El Molla', Egypt Oil & Gas. https://egyptoil-gas.com/news/egypt-ranks-sixth-among-worlds-largest-urea-fertilizers-producers-el-molla

69 WITS/UN Comtrade (2023) 'Egypt, Arab Rep. – Exports of Urea (HS 310210): value and quantity', World Bank – WITS. https://wits.worldbank.org/trade/comtrade/en/country/EGY/year/2023/tradeflow/Exports/partner/ALL/product/310210

70 Fawzy, A. (2025) 'Abu Qir Fertilizers: Declining gas quantities lead to a 30% drop in production', Al Borsa News. https://www.alborsaanews.com/20251889806/21/05/

71 Kapoor, A. (2024) 'Egypt Advances RE with Green Hydrogen in Fertilizer Production', Saur Energy ME. https://www.saurenergy.me/egypt-advances-re-with-green-hydrogen-in-fertilizer-production/

72 Fuel Cells Works (2024) 'Egypt: MOPCO to Complete Green Hydrogen Production Project by 2027'. https://fuelcellsworks.com/202427/11//clean-hydrogen/egypt-mopco-to-complete-green-hydrogen-production-project-by-2027

73 Abd El Galil, H. (2022) 'Chemical Holding Company to Representatives: Egypt is the first to produce green ammonia in Africa', Youm 7. https://www.youm7.com/story/20225660087/القابضة-الكيماوية-للنواب-مصر-أول-من-أنتج-الأمونيا-الخضراء-فى/18/2/

74 FEI/OECD (2024) 'Egypt's Industrial Low Carbon Hydrogen Demand & Landscape', Federation of Egyptian Industries and OECD. https://www.oecd.org/content/dam/oecd/en/events/20245//cefim-egypt-2nd-stakeholder-workshop-29-may/ECO%20Presentation_Egypt%20LCH%20workshop.pdf

75 MOERE (2022) 'Egypt Energy Transition'.

76 Yermolenko, H. (2024) 'Egypt considers Danieli's plan to create a green steel complex', GMK Center. https://gmk.center/en/news/egypt-considers-danielis-plan-to-create-a-green-steel-complex/

77 Zawya (2023) 'Top Indian manufacturers express interest in investing in Egypt', General Authority for the Suez Canal Economic Zone. https://www.zawya.com/en/projects/industry/top-indian-manufacturers-express-interest-in-investing-in-egypt-c7nygn6c

78 Advisian (2024) Egypt National Low Carbon Hydrogen Strategy – Short Version.

79 Daily News Egypt (2024) 'Electricity Minister explores partnership with Siemens Energy for emissions reduction'. https://www.dailynewsegypt.com/202402/10//electricity-minister-explores-partnership-with-siemens-energy-for-emissions-reduction/

80 Siemens Energy (2023) 'Hydrogen co-firing at Constellation Energy's Hillabee plant: Charting the future of clean energy'. https://www.siemens-energy.com/us/en/home/references/constellation-energy-hillabee.html

81 Sarf Today (2024) 'Ministry of Electricity discusses with Germany's Siemens the implementation of hydrogen projects in power plants'. https://sarf-today.com/news/1679; Daily News Egypt (2024) 'Electricity Minister explores partnership with Siemens Energy for emissions reduction).

82 Siemens (2018) 'The Egypt Megaproject: Boosting Egypt's Energy System in Record Time'. https://assets.new.siemens.com/siemens/assets/api/uuid:38ad89c9f4532436a921ed151da1d987a985deec/siemens-egypt-megaproject.pdf

83 Siemens Energy (2025) 'Hydrogen Power with Siemens Gas Turbines: Reliable Carbon-Free Power with Flexibility'. https://www.siemens-energy.com/global/en/news/magazine/2025/hydrogen-power-gas-turbines.html

84 EUTurbines (2019) 'Spotlight on: Turbines and Renewable Gases!', European Association of Gas and Steam Turbine Manufacturers. https://www.euturbines.eu/spotlight-on/spotlight-on-turbines-and-renewable-gases/

85 Younesm M. (2019) 'The Burden of Excess Electricity' [blog post], Egyptian Initiative for Personal Rights (EIPR). https://eipr.org/blog/محمد-يونس/07/2019/عبء-فائض-الكهرباء https://eipr.org/blog/محمد-يونس/07/2019/عبء- فائض-الكهرباء

86 Ammar, A (2024) 'Egypt's power generation mix: gas share at its highest level since 2020 (infographic)', Attaqa Research Unit [in Arabic]. https://attaqa.net/2024/29/05/مزيج-توليد-الكهرباء-في-مصر-حصة-الغاز-ع/

87 Daily News Egypt (2023) 'Egypt in Talks to Sell 70% Stake in Beni Suef Power Plant' https://www.dailynewsegypt.com/202316/09//beni-suef-power-station-to-be-sold-to-foreign-investor/; Daily News Egypt (2023) 'Beni Suef power station to be sold to foreign investor'. https://www.dailynewsegypt.com/202316/09//beni-suef-power-station-to-be-sold-to-foreign-investor

88 Advisian (2024) Egypt National Low Carbon Hydrogen Strategy – Short Version.

89 Eni (2021) 'Egypt and Eni Sign MoU for Green and Blue Hydrogen Development'. https://www.eni.com/en-IT/media/press-release/202107//egypt-and-eni-sign-mou-for-green-and-blue-hydrogen-development.html

90 Energy Capital Power (2022) 'Egypt, Eni Launch $25 Million CCS project to be developed by Egypt and Eni'. https://energycapitalpower.com/ccs-project-egypt-eni-cop27-emissions/

91 Advisian (2024) Egypt National Low Carbon Hydrogen Strategy – Short Version.

92 Hydrogen Insight (2025) 'Egypt Signs Agreement for €7bn Green Hydrogen Project That Will Produce One Million Tonnes of Green Ammonia a Year'. https://www.hydrogeninsight.com/production/egypt-signs-agreement-for-7bn-green-hydrogen-project-that-will-produce-one-million-tonnes-of-green-ammonia-a-year/21789249-1-

93 Safety4Sea (2025) 'Egypt Looks at Alternative Fuel Project Development in Suez'. https://safety4sea.com/egypt-looks-at-alternative-fuel-project-development-in-suez/

94 International Maritime Organization (2025) 'IMO's Work to Cut GHG Emissions from Ships'. https://www.imo.org/en/MediaCentre/HotTopics/Pages/Cutting-GHG-emissions.aspx

95 Hydrogen Insight (2023) 'Hydrogen to Marine Fuel | Maersk-Backed Producer Inks Deal to Develop $3bn Green Methanol Plant in Egypt'. https://www.hydrogeninsight.com/production/hydrogen-to-marine-fuel-maersk-backed-producer-inks-deal-to-develop-3bn-green-methanol-plant-in-egypt/21529593-1-

96 Safety4Sea (2023) 'Suez Canal Aims to Be the New Hotspot for Alternative Fuel Bunkering'. https://safety4sea.com/suez-canal-aims-to-be-the-new-hotspot-for-alternative-fuel-bunkering/

97 Offshore Energy (2023) 'SCZONE, Scatec Ink $1.1 Billion MoU for Green Bunkering in East Port Said'. https://www.offshore-energy.biz/sczone-scatec-ink-11--billion-mou-for-green-bunkering-in-east-port-said

98 Hydrogen Insight (2025) 'Egypt Signs Agreement for €7bn Green Hydrogen Project'.

99 Samir, S. (2024) 'Egypt Launches Sustainable Aviation Fuel Company to Drive Green Energy Transition', Egypt Oil and Gas. https://egyptoil-gas.com/news/egypt-launches-sustainable-aviation-fuel-company-to-drive-green-energy-transition

100 Ahmed and Yasser (2025) 'Egypt's Push for Green Fuels'.

101 Egypt Today (2024) 'Egypt's Ministers Coordinate on Sustainable Aviation Fuel Production'. https://www.egypttoday.com/Article/1139641//Egypt%E299%80%s-Ministers-Coordinate-on-Sustainable-Aviation-Fuel-Production

102 Fuel Cells Works (2025) '"Technip Energies Outlines Plans for SAF, Green Hydrogen in Egypt.' https://fuelcellsworks.com/202521/04//green-hydrogen/technip-energies-outlines-plans-for-saf-green-hydrogen-in-egypt

103 Alborsa News (2023) 'Details of the establishment of the National Council for Green Hydrogen and its Derivatives'. https://www.alborsaanews.com/20231710360/07/09/

104 European Commission (2018) Memorandum of Understanding on a Strategic Partnership on Energy between the European Union and the Arab Republic of Egypt 20182022-. https://energy.ec.europa.eu/system/files/201804-/eu-egypt_mou_0.pdf

105 European Commission Directorate-General for Energy (2022) Memorandum of Understanding between the EU, Egypt and Israel.

106 European Union Delegation to Egypt (2016) 'The EU promotes governance energy efficiency in cooperation with the Ministry of Electricity and Renewable Energy and Ministry of Petroleum and Mineral Resources'. https://eeas.europa.eu/archives/delegations/egypt/press_corner/all_news/news/201620160718/_en.pdf

107 EBRD (2022) 'Egypt's NWFE energy pillar gathers international support'; Ministry of International Cooperation (2022) 'Egypt, Germany and the United States make a joint declaration to support the NWFE energy pillar'.

108 European Commission (2022) 'COP27: EU and Egypt Step Up Cooperation on the Clean Energy Transition'. https://ec.europa.eu/commission/presscorner/api/files/document/print/en/ip_22_6925/IP_22_6925_EN.pdf

109 Baker McKenzie (2023) 'Egypt's National Hydrogen Strategy and Legal Framework: Key Developments'. https://resourcehub.bakermckenzie.com/en/resources/global-hydrogen-resource-hub/africa/egypt/articles/egypts-national-hydrogen-strategy-and-legal-framework-key-developments; State Information Service (2022) 'Egypt, Germany Sign 2 Declarations of Intent in Natural Gas, Green Hydrogen Fields'. https://www.sis.gov.eg/Story/172496/Egypt%2c-Germany-sign-2-declarations-of-intent-in-natural-gas%2c-green-hydrogen-fields

110 Climate and Energy Partnerships (2023) 'Egypt-Germany Energy Partnership and Green Hydrogen Cooperation'. https://climateandenergypartnerships.org/partner/jcee-green-hydrogen-partnership

111 Presidency of the Arab Republic of Egypt (2022) 'COP 27 press release' (see this link to the Arabic text); Mediterranean Green Electrons and Molecules Network (2024) 'Empowering Egypt: Fueling the Future with Green Hydrogen Investments'. https://med-gem.eu/NationalConsultationWorkshop-Egypt

112 European Commission (2021) 'The Global Gateway', [press release]. https://ec.europa.eu/commission/presscorner/detail/en/IP_21_6433.

113 European Commission (2025) 'Global Gateway Southern Neighbourhood Flagship projects'. https://international-partnerships.ec.europa.eu/document/download/84d5ee136-b5f-463b-948f-562742c69284_en

114 Salah, M. (2021) 'Electricity companies start relying on "mazut" as an alternative to natural gas' [in Arabic], Masrawy. https://www.masrawy.com/news/news_egypt/details/2021-/2121031/10/11/الكهرباء-شركات-الإنتاج-تبدأ- الاعتماد-على-المازوت-كبديل-للغاز

الطبيعي

115 Economy Plus (2022) 'Egypt's electricity sector increased reliance on mazut by 620% in December'. https://economyplusme.com/en/85228/

116 Reuters (2022) 'Egypt burns more heavy fuel oil to free gas for export'. https://www.reuters.com/business/energy/egypt-burns-more-heavy-fuel-oil-free-gas-export-202213-12-/

117 Reuters (2022b) 'Egypt to ration electricity to boost gas exports'. https://www.reuters.com/business/energy/egypts-cabinet-approves-plan-ration-electricity-save-gas-export-202211-08-/

118 Reuters (2022c) 'Egypt's 202122/ natural gas and LNG export revenue hits $8 bln'. https://www.reuters.com/business/energy/egypts-202122-natural-gas-lng-export-revenue-hits-8-bln-cabinet-202225-09-/

119 IPCC (2006) 'Chapter 2' in: 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2 – Energy. https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html

120 European Environment Agency (2023) EMEP/EEA Air Pollutant Emission Inventory Guidebook 2023. https://www.eea.europa.eu/en/analysis/publications/emep-eea-guidebook-2023

121 Salah (2021) 'Electricity companies start relying on "mazut" as an alternative to natural gas'.

122 El-Gamal, H., Farid, M.E.A., Abdel Mageed, A.I., Hasab, M., Hassanien, H.M. (2013) 'Considerable hazards produced by heavy fuel oil in operating thermal power plant in Assiut, Egypt', Environmental Science and Pollution Research. https://pubmed.ncbi.nlm.nih.gov/23589256/

123 Mounir, E. (2022) 'Black cloud over Walidiya: the social and environmental toll of polluted electricity', Mnakh (Shbabbek). https://mnakh.shbabbek.com/digitalmedia/polluted-electricity-en/section3/index.html

124 Advisian (2024) Egypt National Low Carbon Hydrogen Strategy – Short Version.

125 International Energy Agency (2023) 'Net-Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach – 2023 Update'. https://iea.blob.core.windows.net/assets/9a698da44-4002-e538-ef3631-d8971bf84/NetZeroRoadmap_AGlobalPathwaytoKeepthe1.5CGoalinReach-2023Update.pdf

126 NREA (2024) 'Annual Report 2024'.

127 World Resources Institute (2023) 'Aqueduct Water Risk Atlas: Country Rankings – Baseline Water Stress'. https://www.wri.org/resources/data-sets/aqueduct-country-rankings

128 United Nations (2024) 'SDG 6 Data Portal – Indicator 6.4.2: Level of water stress'. https://sdg6data.orghttps://sdg6data.org/

129 Ahram Online (2025) 'Egypt adopts "Irrigation 2.0" to address water scarcity'. https://english.ahram.org.eg/News/546230.aspx

130 Oeko-Institut (2024) 'PTX Business Opportunity Analyser (BOA): Data Documentation. Documentation of data sources and data processing, version 2', Oeko-Institut, Freiburg and Berlin, Germany. Commissioned by Agora Energiewende and Agora Industry. https://www.agoraenergiewende.org/fileadmin/Projekte/202201-2022/_INT_PtX-Dialog/Oeko-Institut_2024_PTXBOA_Data_Documentation_v_2.2.pdf

131 IRENA (2025) 'Box 4', in: 'Enabling Green Hydrogen Development: North Africa'. https://cisp.cachefly.net/assets/articles/attachments/95087_irena_tec_enabling_gh2_

north_africa_2025.pdf

132 SoutH2 Corridor Consortium (2025) 'The SoutH2 Corridor – dedicated hydrogen pipeline from North Africa to Central Europe'. https://www.south2corridor.net

133 IEA (2023) 'Cost of Capital Observatory'. https://www.iea.org/reports/cost-of-capital-observatory

134 United Nations Industrial Development Organization (UNIDO) (2023) 'Assessment of Low-Carbon Hydrogen Production, Demand, Business Models and Value Chain in Egypt – Highlights'. https://www.unido.org/sites/default/files/files/202306-/Low-Carbon-Hydrogen-Assessments-in-Egypt-Highlights-UNIDO.pdf

135 Oeko-Institut (2024) 'PTX Business Opportunity Analyser (BOA)'

136 IEA (2023) 'Cost of Capital Observatory'.

137 IEA (2025) 'How a high cost of capital is holding back energy development in Kenya and Senegal'. https://www.iea.org/commentaries/how-a-high-cost-of-capital-is-holding-back-energy-development-in-kenya-and-senegal

138 Ringel, M., Stockigt, G., Shamon, H. and Vögele, S. (2024) 'Green hydrogen cooperation between Egypt and Europe: The perspective of locals in Suez and Port Said', International Journal of Hydrogen Energy, 79, pp. 1501–1510. https://doi.org/10.1016/j.ijhydene.2024.06.2

139 Ritchie, H., Roser, M. and Rosado, P. (2020) 'CO_2 and Greenhouse Gas Emissions, published online at OurWorldinData.org. Retrieved from: 'https://ourworldindata.org/co2-and-greenhouse-gas-emissions'

140 Countries listed in Annex I are considered to hold the greatest historical responsibility for climate change due to their high contribution to emissions, and are required to prepare a periodic national inventory of greenhouse gas emissions. Countries listed in Annex II are legally required to provide financial and technical support to developing and least developed countries, to help them adapt to the effects of climate change and to develop their capacities to reduce emissions.

141 UNFCCC (1992) United Nations Framework Convention on Climate Change. https://unfccc.int/resource/docs/convkp/conveng.pdf

142 Ritchie et al. (2020) 'CO_2 and Greenhouse Gas Emissions'.

143 Energy Institute. (2025). Statistical Review Country Transition Tracker. Statistical Review of World Energy, Energy Institute. https://www.energyinst.org/statistical-review/energy-transition-tracker

144 World Bank (2024) 'Egypt – Vulnerability Overview', Climate Change Knowledge Portal. https://climateknowledgeportal.worldbank.org/country/egypt/vulnerability

145 UNFCCC NDC Registry (2023) Egypt Nationally Determined Contribution. https://unfccc.int/NDCREG

146 Tunn, J., Müller, F., Hennig, J., Simon, J. and Kalt, T. (2025) 'The German scramble for green hydrogen in Namibia: Colonial legacies revisited?', Political Geography 118, p. 103293. https://doi.org/10.1016/j.polgeo.2025.103293; Müller, F. (2024) 'Energy colonialism', Journal of Political Ecology, 31, pp. 699–717. https://journals.librarypublishing.arizona.edu/jpe/article/5659/galley/5708/view/

147 Fikry, A. (2025) 'Egypt allows "Cheiron Petroleum" to export 550,000 barrels of crude oil' [in Arabic] Asharq Business Bloomberg. https://asharqbusiness.com/power/71186/مصر-تسمح-لكايرون-بتروليوم-بتصدير-550-ألف-برميل-نفط-خام/; ; Asharq Business Bloomberg (2025) 'Egypt allows "Shell" and "Petronas" to export two LNG cargoes in September and October' [in Arabic]. https://asharqbusiness.com/power/96351/مصر-تسمح-ل-شل-وبتروناس-بتصدير-شحنتي-غاز-مسال/

The Transnational Institute (TNI) is an international research and advocacy institute committed to building a just, democratic and sustainable planet. For nearly 50 years, TNI has served as a unique nexus between social movements, engaged scholars and policy makers. www.TNI.org

The Egyptian Initiative for Personal Rights is an independent human rights organization that has been working since 2002 to promote and protect fundamental rights and freedoms in Egypt. This is achieved through research, advocacy, legal aid, and litigation in areas including civil liberties, economic and social rights, women's and gender rights, and criminal justice. www.eipr.org