

CHINA'S ROLE IN EGYPT'S LOW- CARBON ENERGY TRANSITION: From Renewable Energy to Green Hydrogen



Commissioned by



Policy Brief Series on China
and Africa's Energy Transition

Policy Brief 02

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The International Institute of Green Finance (IIGF) of Central University of Finance and Economics (CUFE) is an independent and non-profit think tank established in Beijing, China. It conducts research within a range of areas of green finance such as credit, bonds, insurance, carbon-trading, information disclosure, as well as risk assessment. The IIGF works with numerous stakeholders in green finance both within and outside China.

Authors

Wei Shen is a senior research fellow at IIGF.

Han Chen is a research fellow at IIGF.

Acknowledgements

This report was commissioned by the African Climate Foundation (ACF) which we gratefully acknowledge. It was produced independently by IIGF and the contents represent the views of IIGF and its researchers and not necessarily that of the ACF.

This policy brief is the second of the series of two. Our first policy brief in the series is *Chinese Investments Amid the Energy Crises and Mineral Treasures in Zimbabwe*.

In this second policy brief on China's involvement in African countries' national energy transition pathways, we focus on Chinese renewable energy production and green hydrogen activities in Egypt. Like many countries in the region, Egypt is facing an urgent task of transitioning out of a fossil fuel dominated economy amid other developmental challenges, such as water scarcity, air pollution, and an crave for the continuous industrialisation of its economy. Unlike many African countries, however, Egypt is a relatively popular investment destination, particularly for the green technology and infrastructure. The attractiveness of the Egyptian green tech market imposes notable challenges for the Chinese investors in competing with investors from the EU, Japan, and others in the MENA region.

We will also examine the integration between renewable energy power generation and green hydrogen production, which is the core component of Egypt's national strategy for its low carbon development. Green hydrogen generated through wind and solar parks can be used in multiple industries critical for Egypt's industrialisation, such as steel and cement or used as a clean fuel for vehicles and ships. It can also be exported to European or Arab nations (Kamel, 2022). We would focus on China's competitiveness in providing technological and financial support for Egypt to achieve the ambitious goal of becoming a regional hub for green electricity and hydrogen production in the region.

Egypt's energy transition in a nutshell

Egypt is one of the early movers in the Africa and MENA region in promoting renewable energy capacities to transit out of its current fossil fuel-dominated energy system. It adopted the Integrated Sustainable Energy Strategy to 2035 (ISES 2035) in 2014, which envisages 42% of all electricity to be generated from renewable energy sources by 2035 (IRENA, 2018). It is estimated that reaching such ambitious targets would require a total of 61 GW of installed capacity from renewables including 32 GW from PV solar power, 12 GW from concentrated solar power, and 18 GW from wind power (Tanchum, 2022). These ambitious targets have also been formally enshrined in its National Determined Contributions (NDC) under the Paris Agreement of UNFCCC. Yet dramatic transformation is needed given renewables including hydropower capacities only take up 10% of total installed capacity by 2021 (EEHC, 2022).

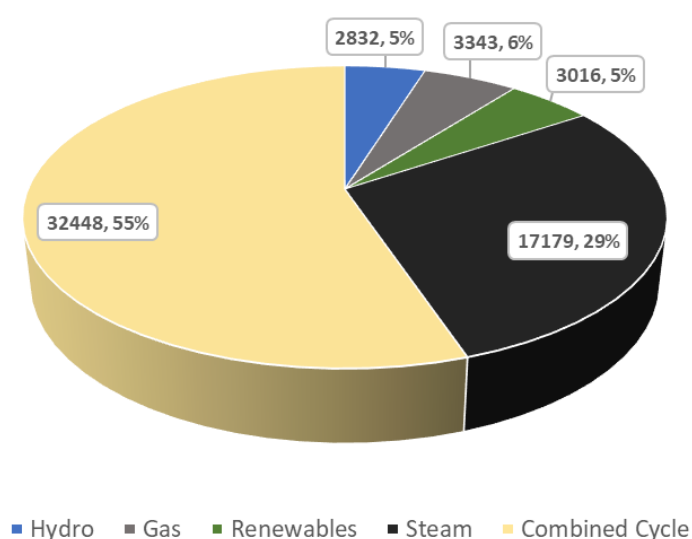


Figure 1. Installed power generation capacity (in MW) in Egypt by 2021

Source: Egyptian Electricity Holding Company

The current energy system is based on Egypt's energy endowment as being one of the major oil and gas producers in the region. Egypt holds over 3.3 billion barrels of oil reserves by 2020, and it is the third-largest natural gas producer in Africa, only after Algeria and Nigeria (EIA, 2022). However, Egypt's steady economic and industrial growth in the past two decades has been accompanied by rising energy demand, making the country a net energy importer since 2018. Egypt is by far the largest consumer of oil and natural gas in Africa while representing 22% of petroleum and other liquids of the continent's total consumption and 37% of its dry natural gas consumption (EIA, 2022). Although the Egyptian government has been largely managing to meet the domestic energy demand by encouraging both explorations and production in the past few years, it is increasingly clear that relying purely on oil and gas resources to power the entire economy is no longer feasible. A diversification strategy, particularly via increasingly cost-effective renewable energy options such as wind and solar resources, emerged as an important pillar to achieving long-term energy security in Egypt.

Besides growing concerns about national energy security, environmental impacts such as ambient (outdoor) air pollution, mainly caused by industrial and transportation activities powered by fossil fuels, are also urging the Egypt government to take action. The air quality in the Greater Cairo area is far more polluted than the WHO standards, which is a major cause of rising respiratory diseases and premature deaths (Abbass et al, 2021). Therefore, promoting low carbon energy transition would provide notable health-related co-benefits.

Renewable energy deployment in Egypt

Egypt is endowed with abundant renewable energy resources. As a ‘solar belt’ country, the average daily sunshine in Egypt is between 9 to 11 hours per day, with direct radiation intensity of about 2 000–3 200 kilowatt hours per square meter (kWh/m²) per year (IRENA, 2018). In addition, Egypt enjoys vast wind resources, which are mainly located on the coast of the Red Sea, along the southwest Nile banks, and in the south of the Western Desert. In these three areas, the average annual wind speed is between 6 and 10 meters per second, which is sufficient to be tapped comfortably for wind power generation (IRENA, 2018). Land availability is another geographic advantage for Egypt, particularly when considering developing utility-scale renewable energy infrastructure. About 95% of the country’s 101 million people (2021) live along the banks of the Nile and in the Nile Delta, whereas the vast unpopulated areas are ideal for developing large solar parks.

Since 2014, the Egyptian government has established a comprehensive regulatory framework to support the deployment of its rich renewable energy resources. New policies were announced, including the Renewable Energy Law (No. 203/2014), the new Electricity Law (No. 87/2015), and the Investment Law (No.72/2017), plus several implementational decrees from the Minister of Electricity and Renewable Energy (MoERE) and the Prime Minister office. Based on the institutional framework, a mix of policy instruments and schemes was also established, including a combination of feed-in-tariffs (FITs) schemes and various competitive tender programs for the solar and wind energy EPCs or IPPs. Under these supportive policies, the cost of solar PV and onshore/offshore wind generation has been decreasing significantly (from USD 0.0840/kWh to USD 0.025/kWh for solar PV and from USD 0.0585/kWh to USD 0.03/kWh for the onshore wind) (NREA, 2021).

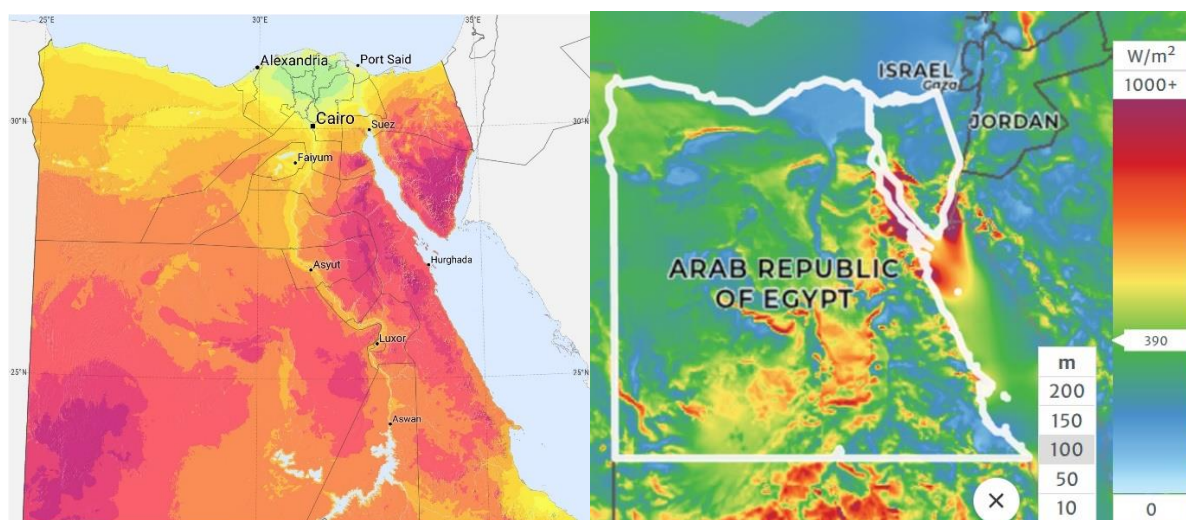


Figure 2. Solar, wind, and land resources in Egypt

Source: Global Solar Atlas, Global Wind Atlas

By 2021, there are altogether four completed wind energy projects in Egypt, with a total capacity of 1635MW, plus another project of 250MW is under construction. In addition, there are 2800MW BOO projects under the initial development stage, mainly in the Gulf of Suez area (NREA, 2021). As for solar energy capacities, 1756MW were installed, including one CSP/thermal project (140MW) and the flagship Benban solar PV park (1465MW). 50MW of PV capacity is under construction, and another 770MW is further in the pipeline of initial project development (NREA, 2021). Additionally, there are 151MW off-grid and roof-top systems being installed.

**Table 1. Wind and solar energy projects in Egypt
(Completed and under construction by 2021)**

Project Name	Capacity (MW)	Energy Resources	Status
Zafarana	545	Wind	Completed
Gulf of El Zayt	580	Wind	Completed
Ras Ghareb	260	Wind	Completed
West Bakr	250	Wind	Completed
Gulf of Suez	250	Wind	Under Construction
Kuraymat	140	Solar CSP	Completed
Benban	1465	Solar PV	Completed
Kom Omp	26	Solar PV	Completed
Off grid/roof top	151	Solar PV	Completed
Zafarana	50	Solar PV	Under Construction
Total	3717		

Source: NREA, 2022 and other resources

Besides wind and solar projects, the Egyptian government is also exploring opportunities in the biomass, nuclear, and geothermal sectors as important complementary resources to decarbonize its energy system (Salah et al, 2021).

At the current stage, most of these utility-scale renewable energy projects are funded mainly through IFIs and DFIs, such as the International Finance Corporation, the European Bank for Reconstruction and Development, the European Investment Bank, Japan Bank for International Cooperation, Japan International Cooperation Agency or the African Development Bank. The Egyptian Electricity Transmission Company (EETC) is the off-taker, and most projects are developed as non-recourse project finance arrangements, but increasingly some lenders would require a sovereign guarantee from the Ministry of Finance or the Central Bank of Egypt for the PPA, plus an international arbitration clause outside Egypt courts (El-Mazghouny, 2022). It is noted that although the current plan for renewable energy deployment looks very ambitious, it is yet insufficient to support the policy goal set out in the ISES and NDC that 42% of the power supply is from renewable energy sources.

Another notable trend of renewable energy development in Egypt is the shift from public investment to private ones, which is in line with the continuous energy sector reforms in the country to enhance the competitiveness and efficiency of the sector. The encouragement of private investment is clearly stated in the 2015 Electricity Law which aims to transform the power sector from state-directed management to regulatory management, which could potentially increase private-sector investment (EIA, 2022). Currently, private investment only takes up a third of total installed wind and solar energy capacities (NREA, 2022). The Covid-19 pandemic and the consequent ongoing economic and geo-political havoc globally have delayed the process of growing private investment in the country, as the projects that are under construction are mostly public ones. However, in the long run, the vast majority of the projects would be IPPs and BOOs.

Egypt is one of the African countries with the potential to nurture a domestic renewable energy supply chain and to create more high-skilled jobs, which is also elaborated in Egypt's Vision 2030. The major policy tool to achieve these green industrial goals is the local content requirement for the tendering programs. MoERE succeeded in reaching 30 percent local content for wind farms in 2018 and aiming to increase the share in future state-funded procurement schemes. However, local content requirements can be a double-edged sword to discourage private investment as it may drive up the cost and the bankability of the IPPs. Other policies in supporting local manufacturing capacities are now in place, particularly around innovative capacities of local solar PV productions through bilateral/multilateral joint research and capacity-building projects. Meanwhile, notable efforts have been made by the Egyptian government to enhance the industrial capabilities, particularly around electric vehicles and green hydrogen sectors as additional pillars to support the energy transition in the country.

In the long run, Egypt also aims to be developed into a regional power hub that is capable of exporting surplus electricity to neighbour countries in Europe, the Middle East, and eastern Africa. In December 2019, Egyptian President Abdel Fattah al-Sisi announced that Egypt was prepared to export 20 percent of its surplus electricity to African nations, particularly its southern neighbour Sudan. It is a partner country of the Eight Country Interconnection Project (EIJLLPST) project which involves interconnecting the electrical grids of Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey. In addition, Egypt and Saudi Arabia are also planning to construct cross-border power transmission facilities. Since the Russian-Ukraine crisis, the negotiations between the Egyptian and European governments are accelerating regarding the potential export of clean PV energy from Egypt to Greece and Cyprus via submarine cable.

Chinese involvement in the renewable energy sector

The ambitious and comprehensive vision of the Egyptian government for its transition from a fossil fuel-dominated economy to an energy-independent and sustainable future requires tremendous external technological and financial support. At the current stage, most of the funding and technological support are from Western and MENA regions, China as the major player of infrastructure developers and financiers internationally has been playing a supportive but increasingly active role in the fast-growing but highly competitive market.

Table 2. Chinese renewable energy projects in Egypt

Project name	Capacity	Energy Sources	Developer/EPC	Financiers	Status
Benban	165.5MW	Solar PV	Chint-ACWA	N/A	Completed
Benban	186MW	Solar PV	TBEA	ICBC/AIIB	Completed
North El Gouna	35.7MW	Off-grid Solar	CEEC	N/A	Completed
Suez Gulf	500MW	Wind	PowerChina-AMEA	N/A	Under Development
Attaqa	2400MW	Hydro (pumped storage)	Sinohydro (PowerChina)	China Eximbank	Under Development

Source: compiled by the authors from different open online resources

Chinese players in the Egyptian market include both private companies and large SOEs, who are involved in both wind and solar PV energy sectors, and in utility-scale and distributed systems alike. Leading Chinese solar companies like Chint and TBEA have undertaken two EPC contracts under Egypt's flagship Benban Solar Park in Aswan. The installed capacity of the two projects is 350MW, or nearly a quarter of the total installed capacity (1465MW). It is noted that Chint also acts as a small equity investor together with the leading renewable energy developer in the MENA region, namely ACWA Power from Saudi Arabia. The project was also financed via ICBC and AIB jointly. The same cooperative model can be found in a more recent agreement between Power China and Dubai-based AMEA Power to develop a 500MW wind farm in the Suez Gulf area, whereas Power China will take up the EPC.

In 2018, Sinohydro (a Power China subsidiary) signed a contract with EEHC for a 2400-pumped storage hydropower plant in mount Attaqa under the conventional EPC+Finance arrangement. The project has significant political implications as the conditional agreement was signed during the official visit of the Egyptian President to Beijing. China Eximbank also committed to supporting the financing of 85% of the contract value. However, the specific implementation date is not yet revealed. Another Chinese giant construction SOE, CEEC, is involved in the EPC of a 35.7MW distributed solar energy project in the north El Gouna area, which includes four rooftop systems and four standby mini-grid systems.

As the largest solar PV technology supplier in the world, China is also involved in the efforts to nurture Egypt's solar PV manufacturing capacity. Both governments inaugurated a research laboratory on solar energy and electricity storage in Sohag in 2015. The Chinese partners of this joint lab include a research institute under the China Electronics Technology Group Corporation (CETC) and Tianjin University, whereas the Egyptian partner is the Egyptian Academy of Scientific Research and Technology (ASRT). It is designed to serve as a model for an industrial production line for the manufacturing of silicon solar cells in Egypt. Besides this pioneer government-sponsored project there are privately led efforts too. For example, Chint partnered with an Egyptian SOE EGEMAC in Jan 2017 and established a joint venture to produce Low/Medium voltage switchgear. EGEMAC also established a joint venture with China XD Group for equipment of high voltage substations. Meanwhile, the Egypt-based Enara group also announced its plan to work with Chint to establish local manufacturing capacity from silica-rich sand, with project details unrevealed at the current stage. Other unconfirmed sources also report Chinese firms' interest in developing solar panel parts factories in the country given proper financial support from the Chinese DFIs.

Strengthening the financial support for Chinese involvement in the Egyptian RE markets

There is a tremendous financial gap for Egypt to reach its 42% of renewable energy share target in the electricity mix by 2035. The current planning, though one of the most ambitious in the region, is still insufficient and Chinese finance, particularly from its leading DFIs can play a crucial role. In particular, as most of the RE projects would be implemented via IPP or BOO arrangement in the future, Chinese DFIs need to develop proper strategy and expertise in response to the investment trend and business model. Meanwhile, besides RE power generation facilities, financial support is also needed for Chinese companies that are willing to develop renewable energy related manufacturing capacities in Egypt, such as solar panels and switchgears. It should be noted that investments in the manufacturing sectors are more likely to be led by private companies, which are traditionally often overlooked by the Chinese DFIs who tend to be keen to serve the SOEs.

Chinese actors also need to establish active cooperation with MENA and European investors and financial institutions in the country, particularly along the supply chain and complex financial package. There are already notable successful pilots in such cooperation. Cases like Chint's strategy to act as a minor equity investor jointly with ACWA in addition to the EPC, ACWA's collaboration with PowerChina in the wind energy sector, and the ICBC/AIIB's support of TEBA's deal in the Benban Project have indicated the promising prospect for such collaborative efforts. China's state-run Silk Road Foundation acquired a 49% stake in ACWA Power Renewable Energy Holding (ACWA Power RenewCo) in 2020, which provided a more institutionalized basis for such collaboration. The organizational and project-level collaboration indicates that Chinese industrial and financial actors are gradually merging into symbiotic local networks from different approaches. However, to what extent these individual efforts can lead to notable scaling of Chinese funding into the RE sector is yet to be assumed. Lastly, Chinese aid and international development projects should be playing a more active role as complementary efforts to support large-scale investment. The joint China-Egypt solar energy lab has demonstrated the value of such development projects to nurture domestic industrial and research capacities, which are critical for the long-term success of the energy transition.

From green electricity to green hydrogen: killing two birds with one stone?

2022 is the year of green hydrogen for Egypt. The global production of low-emission hydrogen could reach 16-24 Mt per year by 2030, with 9-14 Mt based on electrolysis and 7-10 Mt on fossil fuels with CCUS (IEA, 2022). As the host of the upcoming COP27 UN Climate Change Conference, Egypt has been aiming to position itself as a regional hub for hydrogen production. The Egypt government has launched a National Green Hydrogen Strategy at COP27 to support the development of green hydrogen and ammonia production, storage, and export, with support from the European Bank for Reconstruction and Development (EBRD). EU-Egypt Renewable Hydrogen Partnership was also released (EU, 2022). Meanwhile, a dozen of MOUs were signed with foreign companies to build green hydrogen plants in the Suez Canal Economic Zone (SCZone), including AMEA from UAE, Alfanar, and ACWA from Saudi Arabia, EDF and Total Energies from France, Globeleq and BP from the UK, Fortescue Future Industries (FFI) from Australia, Taqa and ReNew Power from India, Dai Global from Germany, and Scatec from Norway. The list is still expanding after the COP.

Egypt’s approximate total use of hydrogen is estimated at 1.8 million tons in 2019. Most of Egypt’s blue hydrogen is used in the production of fertilizers and steel facilities (Figure 5). Egypt plans to install a capacity of 11.62 GW of green hydrogen projects by 2035, making it the most ambitious government in this sector after Australia and Mauritania. Egyptian government prescribed strong supportive mechanisms in supporting the sector, including generous taxation exemption for the investors and a simplified project approval process. However, Egypt’s hydrogen development is significantly constrained by its severe water scarcity. Both freshwater and seawater as the major water source for green hydrogen production have notable limitations in the Egyptian context. Therefore, any project design with optimal water usage techniques would be particularly welcomed. Storage is another concern. The depleted gas and oil reserves in the Nile Delta and the Western Desert are a possibility for hydrogen storage in the gas form yet with significant safety concerns (Easily et al, 2022, Thaysen, & Nicka, 2022).

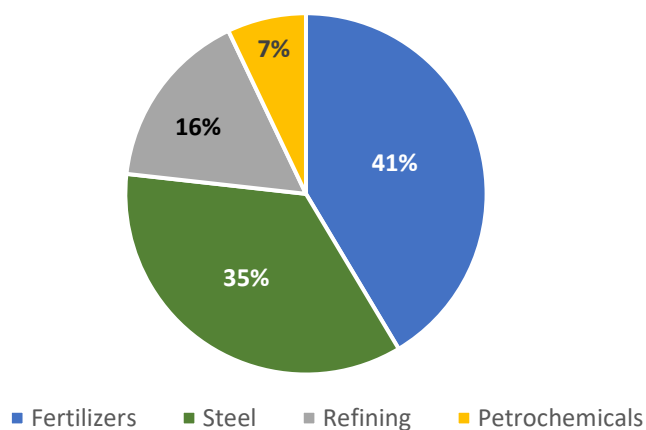


Figure 3. Sectoral breakdown of Egypt’s current hydrogen usage

Source: Adapt from Esily et al, 2022

Chinese involvement in the green hydrogen sector

Chinese involvement in Egypt's hydrogen market is currently limited, and mainly led by large SOEs. In December 2022, China CEEC signed an MOU for China's first green hydrogen project in Egypt. The green project includes a solar and wind-powered power plant, water electrolysis hydrogen generators and ammonia synthesis devices, and supporting storage & processing facilities. Upon completion, it will churn out 140,000 tons of green hydrogen per year. The exemplary deal indicates Chinese SOEs' strong capacity to deliver one-stop solutions for comprehensive infrastructure packages needed for the energy transition strategy in Egypt. Besides distinctive capacity at a corporate level, China also possesses other comparative advantages in the sector. For example, China's heavy-duty fuel-cell vehicle is fast growing. At the end of 2021, China accounted for over 95% of the world's fuel-cell trucks and over 85% of the world's fuel-cell buses (IEA, 2022). China pioneers the manufacturing of electrolyzers used in hydrogen production with the highest electrolyzers capacity in the world (IEA, 2021). The cost of alkaline electrolyzers made in China is up to 80% cheaper than those made in the west (Bloomberg, 2020). China has the greatest number of hydrogen fuel stations of any country worldwide, with a total of 270 in operation by June 2022.

Yet, there are notable challenges in turning this potential competitiveness into real opportunities in the booming Egyptian market. At the outset, China has a fast-growing domestic green hydrogen market, and most of the top Chinese companies are not necessarily focusing on the overseas market when the home market provides sufficient growing space.

Scaling Chinese involvement in the increasingly competitive African markets

Given the unprecedented economic and political uncertainty the world is facing today, the prospect of energy transition among African countries started to polarise in terms of their attractiveness to foreign investors. Egypt is emerging as one of the most popular investment destinations for renewable energy generation and green hydrogen infrastructures. In both sectors, China is playing a supportive but relatively minor role compared to European and MENA investors. As an emerging giant in green technologies, China urgently needs to enhance its profile in the more competitive markets by developing more flexible and collaborative financing and business models. Meanwhile, more supportive policies are needed to push China's rising green-tech companies to leave their comfort zones at the home market to engage with more competitive overseas markets early on.

On the other hand, China's limited involvement also indicates that its previous model in supporting large conventional energy infrastructure projects may no longer be suitable for the new era of transitional energy infrastructures, which are relatively smaller in size, quicker to construct, requires more flexibility in financing, and more integrated with the equally fast-changing down-stream and up-stream sectors, such as energy storage, smart grid, and other related activities. China is the defending champion of building and financing conventional energy infrastructure in Africa, but in this new age of green transitional infrastructure requires some transitional thinking and efforts at home for its exiting institutional systems.

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Appendix: Green hydrogen projects in Egypt by December 2022

#	Location	Product	Announced Size	Egyptian Entity	Foreign Entity	Type of Cooperation	Date Signed	Commissioning Date	Project Cost (million USD)	Status
1	Ain Sokhna port	Ammonia	100 MW electrolyser; 90 kt Ammonia/year using 15 kt Hydrogen/year	Orascom; Egyptian Basic Industries Corporation SAE (EBIC); The Sovereign Fund of Egypt (TSFE)	Norway: Scatec; UAE: Fertiglobe; The Netherlands: OCI N.V.; U.S.: Plug Power Inc	Framework Agreement	Nov 2022	2024	N/A	Initial phase commissioned
2	Ain Sokhna port	Ammonia	700 MW electrolyser, 140 kt Ammonia/year using 25 kt Hydrogen/year	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	France: EDF	Framework Agreement, phase 1	Nov 2022	2026	N/A	Feasibility study
3	Ain Sokhna port	Ammonia	350 kt Ammonia/year using 80 kt Hydrogen/year	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	France: EDF UAE: ZeroWaste	Framework Agreement, phase 2	Nov 2022	2030	\$3,000	Concept
4	Ain Sokhna port	Hydrogen ; Ammonia	200 kt Ammonia/year	NA	UK: Actis (PE)	MoU	Aug 2022	NA	\$1,500	Feasibility study
5	Ain Sokhna port	Hydrogen	2.2 Mt Hydrogen/year	NA	India: ACME	MoU	Aug 2022	NA	\$13,000	Feasibility study
6	Ain Sokhna port	Hydrogen	230 kt Hydrogen/year	NA	UAE: K&K	MoU	Aug 2022	NA	N/A	Feasibility study

7	Ain Sokhna port	Ammonia	120 kt Ammonia/year	Mediterranean Energy Partners (MEP)	NA	MoU	Aug 2022	NA	\$230	Feasibility study
8	Ain Sokhna port	Ammonia	230 kt Ammonia/year	NA	UAE: Alcazar	MoU	Aug 2022	NA	\$2,000	Feasibility study
9	Ain Sokhna port	Hydrogen ; Methanol	NA	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	Denmark: Maersk	MoU	Mar 2022	NA	N/A	Feasibility study
10	Ain Sokhna port	Ammonia	1 GW electrolyser, 800 kt Ammonia/year	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	UAE: AMEA	Framework Agreement	Nov 2022	2027	\$2,000	Concept
11	Ain Sokhna port	Ammonia	100 kt Ammonia/year, 20 kt Hydrogen/year	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	India: ReNew Power	Framework Agreement , phase 1	Nov 2022	2026	\$710	Concept
12	Ain Sokhna port	Ammonia	1.1 Mt Ammonia/year, 200 kt Hydrogen/year	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	India: ReNew Power	Framework Agreement , phase 2	Nov 2022	2029	\$7,150	Concept

13	Ain Sokhna port	Hydrogen	1 GW electrolyser, 150 kt Hydrogen/year	TAQA Arabia; Government of Egypt (provides land); The Sovereign Fund of Egypt (TSFE)	France: VoltaLia	MoU	Dec 2022	NA	N/A	Concept
14	Ain Sokhna port	Ammonia	500 kt Ammonia/year using 100 kt Hydrogen/year	ETC (developer) The New and Renewable Energy Authority (NREA); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	Saudi Arabia: Alfanar	Framework Agreement	Oct 2022	Phase-1: 2025	\$3,500	Concept
15	East Port Said	Hydrogen	1GW LOHC Hydrogen Hub, 300 kt Hydrogen/year	General Authority for Suez Canal Economic Zone	Germany: H2 Industries	MoU	June 2022	NA	\$4,000	Feasibility study
16	Mediterranean coast; Suez Canal Economic Zone	Hydrogen ; Ammonia	4 GW electrolyser, 2.3 Mt Ammonia/year, 480 kt hydrogen/year	Hassan Allam Utilities; Infinity Power Holding	UAE: Masdar	MoU, phase 2	Apr 2022	2030	N/A	Concept
17	Suez Canal Economic Zone	Ammonia	NA	Benchmark Power International (BPI); Chemical Industries Holding Company (CIHC); The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	NA	MoU	Dec 2022	NA	\$750	Concept

18	Suez Canal Economic Zone	NA	NA	Benchmark Power International (BPI); Chemical Industries Holding Company (CIHC); The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	India: Ocior Energy	MoU	Dec 2022	NA	N/A	Concept
19	Suez Canal Economic Zone	NA	NA	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	Germany: DAI Global	MoU	Dec 2022	NA	N/A	Concept
20	Suez Canal Economic Zone	Hydrogen	NA	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	UK: British Petroleum	MoU	Dec 2022	NA	N/A	Feasibility study
21	Suez Canal Economic Zone	NA	NA	Benchmark Power International (BPI); Chemical Industries Holding Company (CIHC); The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	Saudi Arabia: ACWA Power	MoU	Dec 2022	NA	N/A	Concept

22	Suez Canal Economic Zone	Ammonia	300 kt Ammonia/year	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	France: TotalEnergies	Framework Agreement	Nov 2022	NA	N/A	Concept
23	Suez Canal Economic Zone	Hydrogen	330 kt Hydrogen/year	New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	Australia: Fortescue Future Industries (FFI)	Framework Agreement	Nov 2022	2030	N/A	Concept
24	Suez Canal Economic Zone	Hydrogen, Ammonia	2 GW electrolyser	Hassan Allam Utilities; Infinity Power Holding; The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	UAE: Masdar	Framework Agreement	Nov 2022	2026	N/A	Concept
25	Suez Canal Economic Zone	Ammonia	3.6 GW electrolyser, 2 Mt Ammonia/year	The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	UK: Globeleq	Framework Agreement	Nov 2022	2026	\$11,000	Concept

26	Suez Canal Economic Zone	Ammonia	300 kt Ammonia/year	Enara Capital; The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	France: Total Eren	MoU, phase 1	May 2022	2025	N/A	Feasibility study
27	Suez Canal Economic Zone	Ammonia	1.5 Mt Ammonia/year	Enara Capital; The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	France: Total Eren	MoU, phase 2	May 2022	2030	N/A	Concept
28	Suez Canal Economic Zone	Methanol	100 kt Methanol/year	Hassan Allam Utilities	UAE: Masdar	MoU, phase 1	Apr 2021	2026	N/A	Feasibility study
29	NA	Hydrogen ; Ammonia	140 kt Hydrogen/year	Benchmark Power International (BPI); Chemical Industries Holding Company (CIHC); The New and Renewable Energy Authority (NREA); The Egyptian Electricity Transmission Company (EETC); The General Authority for Suez Canal Economic Zone (SCZONE); The Sovereign Fund of Egypt (TSFE)	NA	MoU	Dec 2022	NA	N/A	Concept
30	NA	Hydrogen	100-200 MW electrolyser	Egyptian Electricity Holding Company (EEHC)	Germany: Siemens Energy	MoU	Aug 2022	NA	N/A	Concept

31	Mediterranean Sea	Hydrogen	500 MW electrolyser	Gharably Integrated Engineering Company (GIECO); Ministry of Electricity and Renewable Energy; Ministry of Oil and Mineral Resources; Egyptian Navy	Belgium: Dredging, Environmental and Marine Engineering Group (DEME Group), Fluxys, Antwerp Port	Partner Agreement	Nov 2022	NA	N/A	Feasibility study
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Source: IEA 2021; compiled by the authors from different open online resources by December 2022