

Implementing the OECD Framework for Industry's Net-Zero Transition in Egypt

Accelerating Green Hydrogen Development



Green Finance and Investment

Implementing the OECD Framework for Industry's Net-Zero Transition in Egypt

ACCELERATING GREEN HYDROGEN DEVELOPMENT

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Foreword

Industry decarbonisation is a key priority for Egypt's policymakers and industry actors. Green hydrogen is emerging as one of the promising solutions to support this ambition, aligned with Egypt's Vision 2030 and the Nexus of Water, Food and Energy platform, which – among other objectives – aims to decommission 5 gigawatts (GW) of inefficient fossil-fuel capacity and deploy 10 GW of renewable energy. To meet the climate targets outlined in Egypt's updated Nationally Determined Contribution (NDC) of 2023 and reduce industrial carbon dioxide emissions, the country will need to significantly scale up green hydrogen deployment and mobilise substantial investment and financing. Advancing decarbonisation will not only help achieve climate goals but also strengthen the competitiveness and resilience of Egypt's industrial sector in global markets, particularly as mechanisms such as the European Union's Carbon Border Adjustment Mechanism (EU CBAM) increase demand for low-carbon industrial goods.

Egypt has made notable progress in establishing a regulatory framework for green hydrogen development, including the creation of the National Council for Green Hydrogen and its Derivatives in 2023 and the launch of the National Low-Carbon Hydrogen Strategy in 2024. Despite these advances, low-carbon hydrogen – like many other low-carbon technologies that are critical for industry decarbonisation – remains at an early commercialisation stage in Egypt, as in most countries. High capital expenditure across the value chain and elevated financing costs, driven by multiple risks, limit quick returns on investment and make private capital providers hesitant to engage. To enable projects to reach final investment decisions and mobilise private capital, Egypt will need to further strengthen investment conditions through a mix of de-risking measures and tailored financing instruments.

This report, developed under the Egypt–OECD Country Programme, supports the implementation of Egypt's National Low-Carbon Hydrogen Strategy by providing targeted financial solutions and investment enablers to improve project bankability and accelerate investment decisions. Like many emerging markets and developing economies, Egypt faces persistent barriers to private sector participation, including limited access to affordable finance, grid constraints, infrastructure gaps and skill shortages. The solutions proposed in this report aim to mitigate risks and unlock opportunities for investment.

Drawing on a techno-economic assessment, the report provides a range of levelised production cost estimates for hydrogen and its derivatives (green ammonia, green iron and e-methanol) and explores possible optimal site configurations. For example, the analysis shows that Egypt has strong potential to competitively produce these derivatives for export to the European Union. The same hydrogen could also be used domestically and contribute to decarbonising Egypt's industry. In high-resource areas, the Levelised Cost of Hydrogen can be as low as USD 3.7 per kilogramme under current conditions. This is, however, still higher than the cost of fossil fuel-based hydrogen in many countries. Closing the cost-competitiveness gap will require lowering upfront costs for electrolyzers and storage, streamlining regulations and grid integration, improving access to concessional and blended finance and expanding domestic manufacturing of hydrogen equipment. Over time, technological learning, economies of scale and supportive policies are expected to help reduce capital costs.

Investment needs are substantial. Given the capital-intensive nature of green hydrogen production, scaling Egypt's green hydrogen sector to an annual capacity of 1.5 million tonnes is estimated to require approximately USD 45.6 billion in cumulative investment between 2025 and 2030. By the end of 2025, around 30 Memoranda of Understanding (MoUs) for green hydrogen and related projects have been signed in Egypt's Suez Canal Economic Zone, with expected early investment already exceeding ten billion dollars. Further work is needed to translate these commitments into final investment decisions. The analysis highlights that scaling up green hydrogen production also requires embedding ongoing reform efforts within wider considerations for hydrogen development. This includes, among others, advancing on power sector reforms, investing in common-user infrastructure and strengthening local skills development and manufacturing to ensure broad-based sustainable development.

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Abbreviations and acronyms

ATR	Autothermal reforming
BAT	Best available techniques
BAU	Business-as-usual scenario
Bcm	Billion cubic meters
BESS	Battery energy storage system
BOO	Built-own-operate
CAPEX	Capital expenditure
CBAM	EU Carbon Border Adjustment Mechanism
CfD	Contracts for difference
CCfD	Carbon contracts for difference
CCS	Carbon capture and storage
CEFIM	OECD Clean Energy Finance and Investment Mobilisation Programme
CO ₂	Carbon dioxide
CUI	Common user infrastructure
DAC	Direct air capture
DFI	Development finance institutions
DRI	Direct reduced iron
DSRA	Debt Service Reserve Account
EBRD	European Bank for Reconstruction and Development

ECA	Export Credit Agency
EETC	Egyptian Electricity Transmission Company
EFF	Extended Fund Facility
EGAC	Egyptian Accreditation Council
EGP	Egyptian Pound
EgyptERA	Egyptian Electric Utility and Consumer Protection Regulatory Agency
EIB	European Investment Bank
EMDEs	Emerging markets and developing economies
EPC	Engineering, procurement and construction
EU	European Union
FEI	Federation of Egyptian Industries
FDI	Foreign direct investment
FID	Final investment decision
FX	Foreign exchange
FY	Fiscal year
GWh	Gigawatt-hour
GIZ	German Corporation for International Co-operation
H ₂	Hydrogen
HDVC	High-voltage direct current
IDA	Industrial Development Authority
IDB	Inter-American Development Bank
IDSC	Information and Decision Support Center
IEA	International Energy Agency
IFI	International financial institutions
IMF	International Monetary Fund

IRENA	International Renewable Energy Agency
LCOA	Levelised Cost of Ammonia
LCOE	Levelised Cost of Electricity
LCOH	Levelised Cost of Hydrogen
LCOM	Levelised Cost of Methanol
LNG	Liquified natural gas
Mt	Million tonnes
MoERE	Ministry of Electricity and Renewable Energy, Egypt
MPED	Ministry of Planning and Economic Development
Mol	Ministry of Industry, Egypt
MoPMR	Ministry of Petroleum and Mineral Resources, Egypt
Mtoe	Million tonnes of oil equivalent
NCGH	National Council for Green Hydrogen and its Derivatives
NDC	Nationally Determined Contribution
NH ₃	Ammonia
NWFE	The Nexus of Water, Food and Energy Platform
NDC	Nationally Determined Contribution
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the petroleum exporting countries
OPEX	operating expenditure
PSA	Pressure swing adsorption
PPP	Public-Private Partnership
R&D	Research & Development
RSF	Resilience and Sustainability Facility (IMF)
SMR	Steam methane reforming

SMR	Steam methane reforming
SPV	Special purpose vehicles
SCZone	Suez Canal Economic Zone
SOE	State-owned enterprises
UN	United Nations
UNIDO	United Nations Industrial Development Organization
USD	United States Dollar
VCM	Voluntary carbon market
WACC	Weighted average cost of capital
WB	The World Bank Group
WPFIEG	OECD Working Party on Finance and Investment for Environmental Goals

Executive summary

Egypt holds significant potential to become a regional leader in green hydrogen

With abundant solar and wind resources, a mature ammonia industry and proximity with key export markets in Europe, Asia and within Africa, Egypt is well-positioned to become a regional hub for green hydrogen. Unlocking green hydrogen is a strategic priority for Egypt, offering a pathway to meet the objectives of its updated Nationally Determined Contribution (NDC) of 2023, while positioning the country as a competitive player in emerging global energy markets. Moreover, low-carbon hydrogen can support domestic industrial decarbonisation, attract foreign investment and open new trade opportunities.

Adopted in 2024, the central scenario of the country's National Low-Carbon Hydrogen Strategy aims to capture 5%-8% of the global green hydrogen market by 2040 supported by annual production of 5.8 million tonnes of green hydrogen and the creation of more than 100 000 jobs. This report aims to support the implementation of Egypt's strategy and, more broadly, the work of Egypt's National Council of Green Hydrogen and its Derivatives by identifying tailored financial solutions and enabling investment conditions that improve project bankability and accelerate investment decision-making.

There is strong political ambition, notable progress in establishing the legal and regulatory framework and a robust and expanding project pipeline. Building on this momentum, Egypt can further strengthen its institutional capacity to help mitigate investment risks and attract financing, thereby effectively mobilising private capital. However, at the end of 2025, only a few low-carbon hydrogen projects in Egypt have progressed beyond the feasibility stage.

Moreover, the global rise of carbon border measures, such as the European Union's Carbon Border Adjustment Mechanism (EU CBAM), is accelerating the need for industry decarbonisation. As a major exporter of steel, fertilisers and petrochemicals, Egypt faces growing competitiveness risks in carbon-sensitive markets. Green hydrogen presents a strategic opportunity to reduce emissions, safeguard market access and position Egypt as a competitive supplier within emerging regional and global value chains.

Progress has been made in establishing Egypt's legal and regulatory framework for low-carbon hydrogen, but further clarity is needed

Law No. 2 of 2024 provides a comprehensive set of incentives to attract foreign investment and promote sustainable development. It introduces tax exemptions, including a cash rebate of up to 55% on income tax, fast-track licensing through the Golden License mechanism and local content requirements to ensure technology transfer and job creation. These measures are designed to position Egypt as a competitive and reliable hub for low-carbon hydrogen production and export, aligned with its climate goals and Egypt's Vision 2030. However, the current national reform agenda can benefit from additional operational regulatory measures, especially regarding infrastructure usage (e.g. third-party access to energy infrastructure, including electricity grids and hydrogen transport networks) and the development of hydrogen certification schemes. Emphasising the importance of certification systems is critical.

Egypt can work towards narrowing the cost-competitiveness gap between green and fossil-based hydrogen

The production of green hydrogen in Egypt currently remains far more expensive than fossil-based counterparts. The OECD's assessment of four project scenarios – conducted under current conditions – revealed a Levelised Cost of Hydrogen (LCOH) in Egypt ranging between USD 3.7 and USD 4.8 per kilogramme (kg) of hydrogen (H₂). This is at least double the price of USD 1.8/kg H₂ envisioned in Egypt's National Low-Carbon Hydrogen Strategy by 2040, which assumes an annual production scale of 6-9 Mt by 2040.

Egypt's National Low-Carbon Hydrogen Strategy uses price estimates to analyse the projected economic impact and export potential. In contrast, the LCOH estimations presented in this study are an independent assessment conducted by the OECD based on a techno-economic assessment and a consistent set of assumptions. Therefore, they have not been derived from Egypt's National Low-Carbon Hydrogen Strategy. As with any such assessment, estimates vary depending on the underlying assumptions such as technology performance characteristics and costs, financing conditions and operational parameters. Findings should thus be considered indicative and comparative rather than definitive.

According to the OECD's assessment, the most cost-effective setup under is a co-located system combining on-site renewables, electrolysers and pressurised storage, particularly in high-resource areas like Gharib Cape, where the LCOH can be as low as USD 3.7/kg H₂ under current conditions. This hybrid model, which draws 2%-5% of electricity from the grid during low-generation periods, avoids costly oversizing of renewable and storage capacity.

Egypt could significantly narrow the cost-competitiveness gap between current hydrogen production estimates and its strategic targets to 2040 by implementing measures to strengthen its enabling investment environment and by developing and implementing financing instruments. Key levers include reducing upfront investment costs, especially for electrolysers and storage infrastructure to ensure stable output; further improving regulatory clarity, permitting processes and grid integration of renewables; enhancing access to concessional finance and blended finance instruments; and scaling up domestic manufacturing capacity for hydrogen equipment. Technological learning is expected between now and 2040 – driven by innovation, economies of scale and policy support – and will lower notably the capital costs of equipment over time.

Green ammonia, green iron and e-methanol demonstrate strong cost-competitiveness when produced for export to the European Union

The lowest Levelised Cost of Green Ammonia (LCOA) is estimated at USD 844 per tonne for when hydrogen is converted to ammonia for stable storage and long-distance transport to the EU. Production remains highly capital-intensive, with upfront costs representing nearly 80% of the LCOA.

For green Direct Reduced Iron (DRI), the lowest estimated cost is USD 733 per tonne, covering the whole value chain including DRI production in Egypt and subsequently exported. This is about 25% cheaper than the estimated production cost of DRI in the EU (USD 967 per tonne).

The lowest Levelised Cost of E-methanol (USD 714 per tonne) is estimated when integrating grid electricity to the system and crediting surplus renewable power sale back to the grid, which reduces the need for oversized systems and battery storage. Sourcing carbon dioxide (CO₂) from nearby industrial emitters improves cost-efficiency, while relying on direct air capture could raise costs by USD 415 per tonne.

These findings highlight Egypt's potential as a competitive exporter of green hydrogen derivatives but also stress the need to overcome high capital costs, infrastructure constraints and lack of offtake guarantees to scale deployment.

Unlocking large-scale investment is key to scaling up green hydrogen production

To develop an annual green hydrogen production capacity of 1.5 Mt by 2030 as outlined in Egypt's National Strategy for Low-Carbon Hydrogen, Egypt will need an estimated USD 45.6 billion in investment between 2025 and 2030. Approximately 65% of this investment will be required for renewable energy capacity and 24% for electrolyser systems.

An investor survey and impact assessment identified a suite of financial solutions (economic and de-risking instruments) to close the cost-competitiveness gap with fossil fuel-based hydrogen. Capital expenditure (CAPEX) grants and concessional loans are the most effective, reducing the gap by up to 70%-90% across low-carbon hydrogen, e-methanol and green iron, while green premiums and carbon pricing alone are insufficient to close the gap. Contracts for Difference (CfDs) also play a critical role in ensuring offtake certainty and lowering operational costs amid market volatility. In parallel, key enabling investment conditions such as grid access reform, standardised wheeling charges, peer-to-peer markets and common user infrastructure are complementing the identified financial instruments.

Key recommendations

The report puts forward the following suggested recommendations to support the implementation of Egypt's National Low-Carbon Hydrogen Strategy:

- **Effectively deploy CAPEX grants combined with risk mitigation tools like Debt Service Reserve Account (DSRA) and performance guarantees.** A dedicated government-backed entity could co-ordinate concessional finance and prioritise strategic projects.
- **Mitigate foreign exchange risks** by engaging local banks for Egyptian Pound (EGP)-denominated components and leveraging foreign exchange (FX) guarantees from international finance institutions (IFIs) or government-backed facilities.
- **Implement CfDs through a dual-auction model**, adapted from H2Global and supported by IFIs, to de-risk early domestic and export investments.
- **Advance power sector reforms** – grid access, wheeling charges, and unbundling – alongside peer-to-peer trading and pooled renewable markets to reduce investor risk and support certification.
- **Invest in common user infrastructure**, including pipelines, desalination and export terminals to lower costs and improve bankability, while **embedding environment, social and governance safeguards to attract institutional capital**.
- **Develop local skills and manufacturing to reduce import reliance**, strengthen the hydrogen value chain and enhance Egypt's global competitiveness.

1 Unlocking low-carbon hydrogen investment in Egypt: scene-setting

Chapter 1 provides an overview of Egypt's enabling environment for green hydrogen production, examining the economic environment, relevant policies and sectoral factors that influence its investment potential. It explores six core dimensions: the macroeconomic context, financial sector, energy landscape, industrial demand, policy and regulatory frameworks, as well as the current status of low-carbon hydrogen projects. While Egypt has introduced multiple strategies and incentives to position itself as a global green hydrogen hub, significant implementation challenges persist. This chapter underscores that realising Egypt's green hydrogen ambition will require translating strategic planning into targeted financial solutions and creating enabling investment conditions to make green hydrogen projects more bankable.

Context and objective

The Government of Egypt has taken steps to strengthen its role in global climate action. Despite contributing less than 0.6% of global greenhouse gas (GHG) emissions in 2021, Egypt has adopted a reform agenda that includes transforming its energy and industrial systems. This includes the second updated Nationally Determined Contribution (NDC), which sets a target of generating 42% of its electricity from renewable and clean energy sources by 2030, and the National Climate Change Strategy 2050, which outlines priorities for GHG emissions reduction, climate resilience and sustainable economic development (Government of Egypt, 2022^[1]; Government of Egypt, 2023^[2]).

Low-carbon hydrogen has emerged as a strategic priority within Egypt's industrial decarbonisation pathway. In September 2022, Egypt established the National Council for Green Hydrogen and its Derivatives (NCGH) to co-ordinate and advance investment in green hydrogen and its derivatives (Ahrum Online, 2023^[3]). In February 2024, the Supreme Council of Energy approved the National Strategy for Low-Carbon Hydrogen, a forward-looking plan that seeks to position Egypt as a global leader in the low-carbon hydrogen economy (State Information Service, 2024^[4]). Despite Egypt's growing ambition in this sector, no project has yet reached final investment decision (FID). However, Egypt has established an enabling legislative and policy framework offering a wide range of incentives to attract investment in green hydrogen and renewable energy. These efforts are reinforced by strengthened bilateral and multilateral co-operation, led by the Ministry of Planning and Economic Development (MPED), in close collaboration with key partners such as the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB) and Scatec, a company based in Norway.

Moreover, the NCGH's objectives are closely aligned with the overarching goals of the Nexus of Water, Food and Energy (NWFE) Platform (Box 1.2), ensuring coherence between sectoral strategies and the country's integrated climate and development agenda. Through its focus on investment mobilisation, policy co-ordination and the creation of an enabling environment, the Council actively supports all three NWFE pillars, namely:

- Water: by promoting renewable-powered desalination solutions;
- Food: by enabling sustainable energy supply chains that lower agricultural production costs and emissions;
- Energy: by accelerating the deployment of large-scale renewable energy projects for green hydrogen and ammonia production. Flagship projects include a Green Ammonia Plant in Damietta supporting low-carbon fertiliser production, the Solar-plus-Storage Project and the Nagaa Hammadi Solar Power Plant powering the aluminium complex.

Backed by a consortium of international financiers, the flagship projects conducted under the energy pillar exemplify Egypt's strategy to integrate renewable energy into industrial decarbonisation, while positioning the country as a competitive hub in the emerging global hydrogen economy.

To support the implementation of Egypt's National Low-Carbon Hydrogen Strategy, this report applies the OECD Framework for Industry's Net-Zero Transition (hereinafter "the Framework") in close collaboration with Egyptian key stakeholders and international development partners (Acknowledgements). Using its step-by-step methodology, the report identifies tailored financial solutions and enabling investment conditions to scale up low-carbon hydrogen production in Egypt. This analysis focuses on bridging the cost-competitiveness gap between green hydrogen (and its derivatives) and fossil fuel-based alternatives, using the price of USD 1.8/kg H₂ by 2040 as envisioned in Egypt's National Low-Carbon Hydrogen Strategy to guide the assessment.¹

The report is structured into four chapters, each applying a dedicated methodology to support the identification of financial solutions and enabling investment conditions:

- **Chapter 1** provides an overview of Egypt's economic, financial, industrial and energy landscape, alongside relevant policy and regulatory frameworks. These contextual elements help to build comprehensive view to identify barriers and opportunities for developing Egypt's low-carbon hydrogen sector.
- **Chapter 2** evaluates the production cost of low-carbon hydrogen and green hydrogen derivatives using techno-economic modelling to assess cost-competitiveness gap against fossil-fuel based counterparts. It estimates the LCOH for low-carbon hydrogen and green hydrogen derivatives under various scenarios and project configurations.
- **Chapter 3** estimates the cumulative investments required to meet Egypt's national green hydrogen targets and assesses the effectiveness of selected economic and de-risking instruments in bridging the competitiveness gap with conventional hydrogen.
- **Chapter 4** builds on the insights from Chapters 2 and 3 and presents identified financial solutions. It also explores ways to improve the enabling investment conditions to improve project bankability and accelerate final investment decisions.

1.2. Framework implementation process in Egypt

1.2.1. Description of the Framework

The OECD Framework for Industry Net-zero Transition: Developing financial solutions in emerging and developing economies is a step-by-step approach to assist emerging and developing economies to improve the enabling investment conditions and identify financial solutions that can accelerate industry's transition at a country level, in alignment with climate goals (Figure 1.1). The ultimate objective of the Framework is to create a conducive environment for investment in low-carbon technologies² and enhance the availability of finance to reduce GHG emissions of the industry sector (OECD, 2022^[5]).

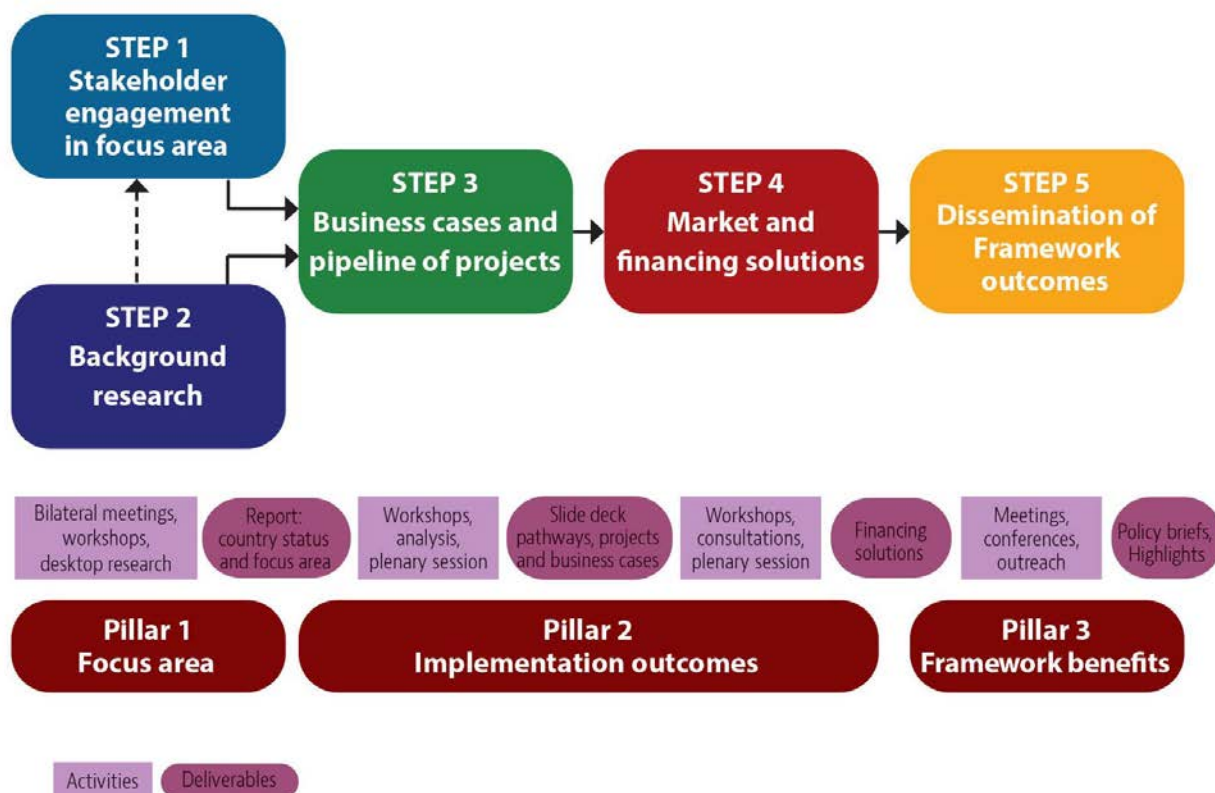
The Framework offers a flexible, context-sensitive methodology to support industrial decarbonisation across countries and sectors. Rather than developing comprehensive sectoral roadmaps, it focuses on identifying and enhancing the viability of critical low-carbon technologies through targeted policies and financial instruments. It promotes a holistic strategy encompassing the full value chain, infrastructure development as well as industrial and trade policies. Implemented in collaboration with policymakers, industry actors and financial institutions, the Framework provides each stakeholder group with tailored insights – informing national policies, improving enabling investment conditions for technology deployment and guiding investment priorities to support a just and effective industry transition.

The Framework proposes a five-step approach with an expected implementation of 12 to 24 months (Figure 1.1). Pillar 1 of the Framework encompasses Steps 1 and 2. Its objective is to identify the industry scope/subsector (hereinafter referred to as the “focus area”) and a group of key stakeholders to engage with. The selection is informed by background research and data collection undertaken by the OECD team on socioeconomic, industrial, energy and investment issues that are critical for the decarbonisation of the manufacturing industry (i.e. GDP contribution, employment, energy use, emissions, foreign and domestic direct investment). In Egypt, low-carbon hydrogen has been designated as a focus area at the direct request of the government to support the decarbonisation of hard-to-abate sectors and position the country as a green hydrogen export hub, creating economic opportunities and jobs.

Pillar 2 presents the analytical core of the Framework's implementation. It consists of Step 3, focused on assessing the business case of low-carbon hydrogen and Step 4, centred on developing solutions for improving the enabling investment conditions and financial solutions to operationalise the selected low-carbon technology and approaches based on their business cases. Pillar 3, which involves Step 5, revolves around the dissemination of the Framework's outcomes through outreach activities to help

stakeholders gain insights about the benefits of the Framework for industry transition. Annex E provides some insights into the methodology behind each step of the analysis, as well as the stakeholder engagement process supporting the Framework's implementation.

Figure 1.1. The step-by-step approach of the OECD Framework implementation process



Source: (OECD, 2022^[5]).

Proposal approval

The Arab Republic of Egypt and the OECD have agreed to implement a project under the Clean Energy Finance and Investment Mobilisation (CEFIM) Programme. This project falls under Pillar 5 on Sustainable Development within the Egypt-OECD Programme, inaugurated in 2021 (OECD, 2024^[6]; OECD, 2023^[7]). The objective is to support the Government of Egypt in mobilising clean energy investment and advancing economy-wide decarbonisation activities to help the country achieve its clean energy transition aligned with its NDC and Egypt's Updated Vision 2030 (Government of Egypt, 2023^[2]; Government of Egypt, 2024^[8]). More specifically, the Ministry of Electricity and Renewable Energy (MoERE) and the OECD have agreed to support the operationalisation of this potential through implementation of the OECD Framework.³

The project proposal was approved in October 2023, following a cross-ministerial meeting in June 2023 that included representatives from MoERE, the Ministry of Petroleum and Mineral Resources (MoPMR), the Ministry of Planning and Economic Development (MPED), the Ministry of Industry (MoI), the Industrial Development Authority (IDA), the Suez Canal Economic Zone (SCZone) and the Egyptian Electricity Transmission Company (EETC). To avoid duplicating efforts in green hydrogen initiatives in Egypt, it was agreed that the Framework implementation would be conducted in close co-operation with the United Nations Industrial Development Organization (UNIDO) which undertook green hydrogen production

potential feasibility study and on skills gap assessment throughout green hydrogen production value chain (UNIDO, 2023^[9]).

Implementation timeline and scope

Effective governance is crucial for the successful implementation of the Framework. It was initially planned to set up a Steering Committee to co-ordinate the activities of the Framework's stakeholder groups, provide guidance and monitor the progress of its implementation, with the committee making final decisions when necessary. However, to avoid duplication, it was decided that the Framework's implementation would be overseen by Egypt's existing Green Hydrogen Technical Advisory Executive Committee, established under the Prime Minister's Office (Box 1.1). The Framework's implementation plan and scope were presented to the Committee in January 2024. Following consultations, MoERE was nominated to provide technical guidance for the Framework's implementation while MPED plays a key role as national co-ordinator of the Egypt-OECD Country Programme. In addition, NCGH, MoPMR and MoI provided valuable inputs during the finalisation of the report, contributing to the alignment of the Framework with Egypt's broader industrial and energy strategies.

Box 1.1. Egypt's Green Hydrogen Technical Advisory Executive Committee under the National Cabinet of the Prime Minister

Egypt's Green Hydrogen Technical Advisory Executive Committee was established in 2023 under the auspices of the National Council for Green Hydrogen and its Derivatives, chaired by the Prime Minister. It serves as the national co-ordinator for all aspects of the green hydrogen sector, ensuring strategic alignment across ministries, overseeing land allocation and facilitating investment partnerships.

Four key government bodies are at the forefront of Egypt's green hydrogen development, each playing a distinct and strategic role:

- **The New and Renewable Energy Authority (NREA)** is responsible for granting land for renewable energy infrastructure development. It manages applications for green hydrogen project proposals and conducts pre-feasibility studies. NREA charges an annual land use fee of 2% of the renewable energy production revenue, aligning with existing Build-Own-Operate (BOO) projects in operation.
- **The Egyptian Electricity Transmission (EETC)** is responsible for providing transmission services across the national grid. It acts as the sole buyer of electricity generated in Egypt and takes a flat wheeling fee⁴ on electricity revenue for grid integration. This fee has raised concerns among developers about the increased costs of green hydrogen production, as electricity generation accounts for approximately 70% of total hydrogen production costs. However, for green hydrogen projects – typically structured as private-to-private ventures – a policy decision has been made requiring developers to construct and operate their own transmission infrastructure. This applies specifically to the transfer of renewable electricity from the generation site to the hydrogen production facility and reflects the distinct nature of these projects outside the scope of public grid planning.
- **The General Authority of Suez Canal Economic Zone (SCZone)** manages and regulates green hydrogen facilities, most of which are located within the SCZone. It supports prospective investors by providing necessary administrative services and infrastructure support.
- **The Sovereign Fund of Egypt (TSFE)** co-ordinates all parties involved in green hydrogen projects. Established in 2018 with total assets of USD 2.42 billion, TSFE works closely with the Egyptian government to manage investment deals related to state-owned assets. It participates in green hydrogen projects as an equity partner and provides support for signing green hydrogen memorandums of understanding.

Complementing this co-ordination, Egypt has enacted Law No. 2 of 2024, establishing a robust regulatory and incentive framework that includes tax exemptions, fast-track licensing and local content requirements to attract foreign investment and support sustainable development in the hydrogen sector.

Source: (OECD/The World Bank, 2024^[10]; The Sovereign Fund of Egypt (TSFE), 2025^[11]).

1.3. Egypt's country context

Egypt is a fast-growing emerging economy with a strategic geographic location, serving as a key regional hub linking Africa, the Middle East and Europe. Home to over 110 million people and experiencing steady population growth, Egypt's large domestic market presents both opportunities and structural challenges. The economy is characterised by a diverse structure, with significant contributions from the industry, services and agriculture sectors. In recent years, Egypt has pursued ambitious reforms to enhance

macroeconomic stability, attract foreign investment and promote private sector development. However, it continues to face persistent socio-economic pressures, including high inflation, external financial needs and the need for inclusive and sustainable growth to absorb a rapidly expanding labour force (World Bank, 2023^[12]; OECD, 2024^[13]).

1.3.1. Macroeconomic conditions

Over the past decade, Egypt's economy has experienced rapid growth, supported by government efforts to enhance macroeconomic stability. Egypt's gross domestic product (GDP) grew by 3.5% in 2024, reaching Egyptian Pound (EGP) 13.3 trillion (equivalent to United States dollars [USD] 261.3 billion).⁵ Despite continued economic expansion, Egypt's growth rate remains below the 4.3% average projected for Organization of the Petroleum Exporting Countries (OPEC), reflecting persistent structural and macroeconomic challenges.

Inflation remained high at 24%, though it has declined from its peak in 2022. This moderation was partly driven by lower electricity and fuel prices, alongside a cumulative 1 900 basis-point increase in the Central Bank of Egypt's policy interest rate between March 2022 and March 2024 (Trading Economics, n.d.^[14]; Ahram Online, 2024^[15]). The EGP appreciated by 10 percentage points against the USD in the first quarter of fiscal year (FY) 2024/25 after successive years of devaluation (Ministry of Planning, Economic Development and International Cooperation, 2024^[16]; World Food Programme, 2025^[17]). Foreign exchange reserves rose to EGP 2.1 trillion (USD 47 billion) in October 2024, supported by ongoing financial assistance from the International Monetary Fund (IMF) (Egyptian National Competitiveness Council, n.d.^[18]; EBRD, 2023^[19]; Central Bank of Egypt, 2023^[20]; IMF, 2024^[21]). In March 2025, the IMF completed the fourth review of Egypt's Extended Fund Facility (EFF), enabling a disbursement of USD 1.2 billion to support economic reforms and macroeconomic stability. Concurrently, the IMF approved a new USD 1.3 billion arrangement under the Resilience and Sustainability Facility (RSF) to further bolster Egypt's reserves and advance its broader reform agenda (IMF, 2025^[22]).

Egypt's elevated country risk – reflected in its “highly speculative” sovereign credit rating – continues to deter capital inflows and raise the financing costs for infrastructure projects. In 2024, the US Sovereign Rating Action Moody's downgraded Egypt's rating to Caa1 from B3 (Moody's Rating, 2024^[23]).⁶ Moreover, Egypt was excluded from J.P. Morgan's GBI-EM index, citing fiscal imbalances, currency volatility and inflation risks. Despite efforts to stabilise capital markets, such as the introduction of a 20-year benchmark yield curve, government bond yields remain high, with the 10-year bond reaching 24.5% as of January 2025. This underscores the urgency of improving Egypt's investment environment to unlock funding for large-scale low-carbon infrastructure projects, including green hydrogen.

Despite progress in recent years, Egypt continues to grapple with a complex and persistent debt crisis and outstanding structural reform needs. The country faces significant refinancing needs, with 17% of its public debt (EGP 1.3 trillion or USD 26 billion) maturing within a year (Central Bank of Egypt, 2024^[24]). In 2022, external debt accounted for 35% of the country's GDP. However, government and IMF-led reforms have reduced Egypt's debt to 89% of GDP in 2024, targeting to reach below 80%-levels by FY 2025/26 (State Information Service, 2024^[25]). The fiscal deficit also declined to 3.6% of GDP in FY 2023/24 and is expected to decrease further, driven by higher tax revenues, expenditure controls, enhanced debt management, diversification of financing sources, adherence to investment ceilings and the privatisation of large state-owned enterprises (SOEs) (Zawya, 2024^[26]; Zawya, 2025^[27]; The Middle East Observer, 2025^[28]).⁷ Egypt has also strengthened international partnerships to fund climate action, job creation and green energy initiatives. For instance, in 2023, Germany signed a debt swap agreement⁸ with Egypt worth EGP 2.8 billion (USD 89.6 million) to support Egypt's clean energy transition (German Embassy Cairo, 2023^[29]) within the NWFEE Platform (Box 1.2).

Box 1.2. The Nexus of Water, Food and Energy Platform

Launched in 2022, within the framework of Egypt’s COP27 Presidency, the Nexus of Water, Food and Energy (NWFE) Programme plays a pivotal role in advancing the implementation of Egypt’s National Climate Change Strategy 2050 and its NDC. The NWFE Programme, which is the Arabic translation of the phrase “Fulfilling Pledges”, serves as a strategic co-ordination mechanism to mobilise climate finance and foster strategic partnerships across the water, food and energy sectors. It identifies policy reforms, supports the design, structure and preparation of climate projects, leverages technical co-operation and mobilises financing with instruments such as debt swaps, guarantees, concessional loans, grants and private investments. The NWFE Programme translates these strategies into actionable projects across the three interconnected pillars and the extended NWFE+ for sustainable transport.

The energy pillar, supported by the European Bank for Reconstruction and Development (EBRD), is a critical component of delivering Egypt’s energy-specific NDC goals. Specifically, it aims at decommissioning 5 gigawatt (GW) of inefficient oil and gas power plants, mobilising USD 10 billion to develop an additional 10 GW of renewable energy capacity by 2028 and upgrading and expanding the transmission network to enhance grid resilience and integration. The energy pillar leverages innovative financing mechanisms to accelerate the transition to renewable energy and reduce CO₂ emissions. These mechanisms include blended finance, concessional financing, debt swaps and facilitation of private sector investment. The approach aims to mobilise both concessional and commercial capital for priority projects such as renewable energy generation and transmission grid enhancement. In addition, a dedicated grants platform is being activated to channel funding toward projects identified under the energy pillar, further supporting implementation and impact.

Between 2022 and 2024, NWFE made major strides in attracting international pledges. Under the first pillar (“Replacing inefficient thermal power plants with renewable energy”) about 1.1 GW of thermal power plants were decommissioned. For the second pillar (“investments in renewable energy”), NWFE mobilised USD 4 billion in development financing to establish seven renewable energy projects totalling 4.2 GW, with further projects expected in 2025 to add 3.4 GW. Under the third pillar (“transmission network investment”), the Platform secured USD 1.2 billion in development financing, primarily from international public sources such as bilateral development partners (e.g. France, Germany) or investment banks (e.g. European Investment Bank (EIB), EBRD). Technical assistance has also been provided by the EBRD and other development partners through three support programmes aimed at strengthening green supply chains and renewable energy developments, improving the electric network and promoting a just energy transition. Additional to the pillars, Egypt attracted a USD 10 billion investment from the Norwegian company Scatec for green hydrogen projects and now hosts 33 green hydrogen development projects.

Source: (Government of Egypt, 2025^[30]).

1.3.2. Egypt’s financial sector

A mature domestic financial sector is critical to mobilising long-term capital for renewable energy and green hydrogen, given their high upfront costs and extended payback periods. Egypt’s financial system remains dominated by the banking sector, which accounts for 92% of total financial assets – equivalent to 117% of GDP by end 2023. In contrast, the non-bank financial sector – an important source of capital for green investments globally – remains underdeveloped, representing only 10% of GDP (Central Bank of Egypt, 2024^[31]). Limited local lending capacity can hinder project bankability and over-reliance on foreign

currency loans increases exposure to exchange rate volatility. While the Central Bank's Financial Stability Index improved from 0.34 to 0.44 between March 2023 and March 2024, structural challenges persist (Central Bank of Egypt, 2024^[31]; Central Bank of Egypt, 2024^[32]). The persistently low loan-to-deposit ratio indicates a structural underutilisation of available capital for infrastructure projects, including green hydrogen (Mohieldin, 2019^[33]).

To diversify capital sources and enhance investor confidence, Egypt is strengthening its non-bank financial sector while enhancing its overall investment climate. These reforms contributed to a 12% increase in FDI inflows between 2022 and 2023, from EGP 166 billion (USD 8.9 billion) to EGP 190 billion (USD 10 billion) (UNCTAD, 2024^[34]). Egypt is also working towards deepening integration with global financial markets; improved access to international clearing systems like Euroclear or Clearstream could attract more cross-border investment.

Egypt is scaling efforts to mobilise sustainable finance to invest in low-carbon technologies such as green hydrogen and renewables. A cornerstone of this strategy is the Green Financing Framework, launched in 2020, and the issuance of Egypt's first sovereign Green Bond valued at EGP 38 billion (USD 750 million) of 5.25% interest rate over five years. It aims to channel capital into low-carbon projects including renewable energy, clean transportation and sustainable water (Ministry of Finance, 2021^[35]). This milestone set a precedent for the private sector, leading to Egypt's sustainable bond market reaching EGP 55 billion (USD 1.1 billion) in 2023 (Climate Bonds Initiative, n.d.^[36]). In late 2024, Egypt received EGP 25.3 billion (USD 500 million) sustainability bond, backed by the International Finance Corporation, the EBRD and British International Investment to advance Egypt's green transition (IFC, 2024^[37]). Additionally, Samurai and Panda bonds,⁹ first issued in FY 2022/23, contributed to support industry decarbonisation, by offering competitive pricing and lower borrowing costs making it more feasible for the government and businesses to invest in green industrial initiatives, and allowing industries to benefit from cheaper financing to adopt low-carbon technologies (O'Bang Law, 2024^[38]). The government plans to issue new sukuk¹⁰ and green bonds worth EGP 5-10 billion (USD 100-200 million) by the end of FY 2024/25 (State Information Service, 2024^[39]).

Complementing these efforts, the Sovereign Fund of Egypt (TSFE) lays a strategic role in de-risking investments, co-financing flagship hydrogen ventures and facilitating blended finance mechanisms that attract both domestic and international capital. These combined efforts are crucial for building a resilient financial ecosystem to support Egypt's green hydrogen development and illustrate the country's ongoing commitment to strengthening local financing mechanisms for low-carbon technologies.

Building on this momentum, Egypt launched Africa's first Voluntary Carbon Market (VCM) in August 2024 to further mobilise capital for its green transition (Shehata and Partners, 2024^[40]; Delegation of the European Union to Egypt, 2024^[41]). The VCM aims to increase exposure and engagement of the private sector towards emission reduction initiatives in Egypt and establish a framework for international co-operation moving forward. Within less than a year, Egypt has completed four initial transactions amounting to 4 850 carbon credits. While modest in scale, this early activity reflects positive momentum.

1.3.3. Egypt's energy landscape

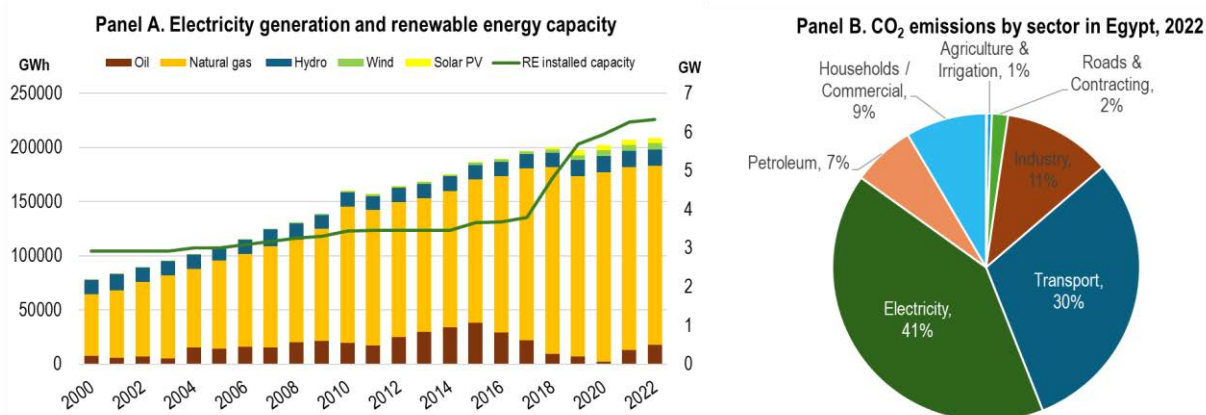
Renewable energy accounted for a small share of Egypt's total final energy consumption, despite the country's abundant renewable resources. In 2022, renewable energy made up about 12% in total electricity generation and the total installed renewable energy generation capacity (6.2 GW) represented about 20% of its peak load (31 GW), mainly coming from hydropower, wind and solar. By 2023, Egypt had installed an additional 6.7 GW of renewable capacity, led by hydropower (2.8 GW), wind (1.9 GW) and solar (1.8 GW). Despite steady growth in absolute terms and the resource potential the country offers, renewables have not expanded fast enough to meet rising electricity demand. Instead, natural gas has increasingly filled the gap in electricity generation, reinforcing Egypt's dependence on fossil fuels (IRENA, 2025^[42]).

Egypt's energy mix remains heavily dominated by natural gas and oil, accounting for 50% and 40% of primary energy consumption, respectively, in 2022 (IEA, 2025^[43]). The country ranked as the third-largest natural gas producer in Africa, after Algeria and Nigeria, driven by significant offshore natural gas discoveries in the mid-2010s (Nour Moharram, 2022^[44]). Egypt is also a significant oil producer, although its output remains modest compared to Africa's top producers Nigeria, Algeria, Angola and Libya (OECD, 2024^[45]). In 2023, the country ranked as the second-largest non-member of the Organisation of Petroleum Exporting Countries (OPEC) producer of total liquid fuels on the continent, with an annual output of 32 million tonnes of oil equivalent (Mtoe).

Despite strong domestic production, Egypt remains a major gas importer, reflecting growing supply-demand imbalances. Between 2000 and 2022, natural gas consumption rose by 264%, driven by abundant availability (through both domestic production and imports), operational flexibility and comparatively lower CO₂ emission intensity of gas (IEA, 2025^[43]). This expansion was further accelerated by rapid population growth and economic development, which intensified pressure on electricity generation. While 47% of domestically produced natural gas is exported, only 43% is consumed locally. In 2024, Egypt imported 14.6 billion cubic meters (bcm) of liquefied natural gas (LNG) and pipeline gas (Business Today Egypt, 2025^[46]; IEA, 2025^[43]). Meanwhile, declining crude oil output has led to further reliance on gas imports.

Egypt's reliance on fossil fuels has significant implications for its emissions profile. In 2022, the country emitted an estimated 240 Mt of CO₂, accounting for roughly 15% of the continent's total CO₂ emissions. Per capita CO₂ emissions stood at 1.9 tonnes in 2021, exceeding the African average of 1.2 tonnes but remaining well below the OECD average of 8.4 tonnes (IEA, 2025^[43]). The electricity sector is the single largest contributor to Egypt's emissions profile, responsible for 40% of the country's total fossil fuel related CO₂ emissions. Electricity demand has been growing at an average annual rate of 1.5% since 2022 and is projected to rise by around 2% per year through 2026, driven by population growth and expanding industrial activity (IEA, 2024^[47]). Industry was the third-largest CO₂ emitter in Egypt, after electricity and transportation, contributing approximately 11% of Egypt's total emissions (27 Mt CO₂) (Figure 1.2, panel B) (CAPMAS, 2024^[48]). These trends underscore the need to accelerate renewable energy deployment and decarbonise both the electricity and industrial sectors to meet Egypt's climate and energy security goals.

Figure 1.2. Electricity remains the largest CO₂ emitter in Egypt



Note: CO₂: carbon dioxide; RE: renewable energy; solar PV: solar photovoltaic.

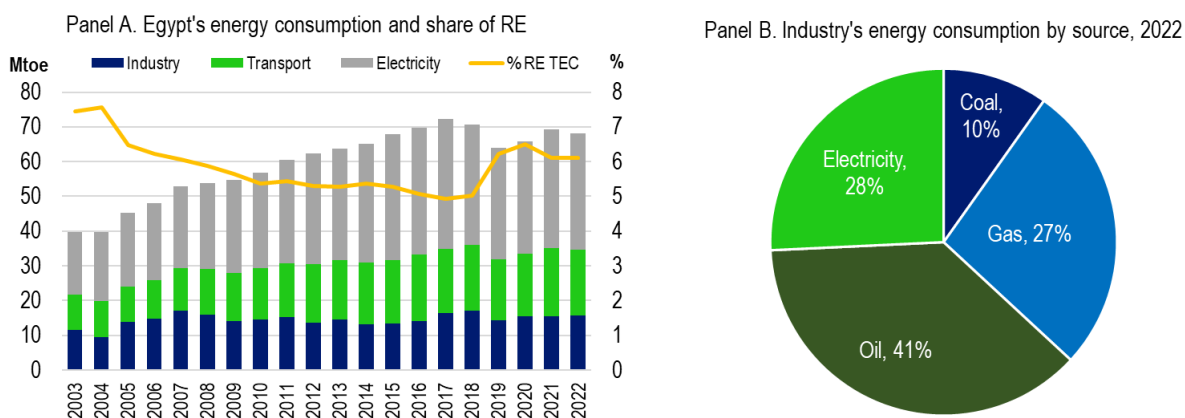
Source: (IEA, 2024^[49]; IRENA, 2025^[42]; Minister of Petroleum and Mineral Resources, 2023^[50]).

In response to these challenges, Egypt has taken steps to reform its energy sector and improve efficiency. Between 2014 and 2019, the government implemented far-reaching energy subsidy reforms, significantly raising domestic fuel prices (WRI, 2021^[51]; OECD, 2024^[45]). Since then, a fuel price adjustment mechanism has been in place, helping reduce energy subsidies to 5-7% of GDP in recent years (Economic Research Forum, 2025^[52]; Fossil Fuel Subsidy Tracker, n.d.^[53]; World Bank, 2024^[54]). Egypt is also working towards decarbonising its oil and gas sector, notably through the Petroleum Sector Energy Efficiency Strategy 2022-2035, which targets a 10% reduction in energy consumption by 2027 and 18% by 2035 (Ministry of Petroleum and Mineral Resources, n.d.^[55]; Egypt Energy Show, 2024^[56]). The country has also pledged to reduce methane emissions from flaring by 65% by 2030, compared to 2015 levels. Over 30 flare gas recovery projects are already in progress to support this commitment.

Egypt is actively pursuing FDI in renewable energy to accelerate deployment and reduce fossil fuel reliance. Between 2015 and 2022, the country attracted over USD 45 billion in FDI for renewable energy projects, placing it among the top ten developing economies globally in this area (OECD, 2024^[45]). Nonetheless, the relatively high cost of capital reflects prevailing investment risks such as macroeconomic volatility, policy uncertainty and constrained access to concessional finance (IRENA, 2023^[57]).

Egypt is also prioritising the decarbonisation of its industrial sector, which is a key driver of high fossil fuel consumption. As the third-largest energy consuming sector after electricity generation and transportation, industry accounts for 26% of Egypt's final energy consumption Figure 1.3, Panel A). Egypt's non-metallic minerals (cement, bricks, etc.) account for 42%, iron and steel for 22%, and chemicals (including fertilisers and ammonia) for around 15-18% of total final industry energy consumption, also driving high demand for fossil fuels (IEA, 2024^[49]). Oil is the primary energy source in industry (41%), followed by electricity (28%), gas (27%) and coal (10%) (Figure 1.3, Panel B). This explains why fossil fuels remain deeply embedded in Egypt's energy system, including for industrial uses as fuel and feedstock.

Figure 1.3. Egypt's industry relies heavily on fossil fuels, with a low share of renewables



Note: In Panel A, renewable energy share in total final energy consumption (RE TEC). Information is extracted from annual reports 2007-08, 2013-14, 2017-18 and 2021-22. In Panel B, electricity refers to gross electricity production measured at the terminals of all alternators sets in a station, including conventional thermal, hydro, geothermal and solar stations. Electricity generation in hydropower plants includes output from pumped-hydrogen storage plants.

Source: (Ministry of Electricity and Renewable Energy, n.d.^[58]; IEA, 2024^[49]).

1.3.4. Egypt's industry sector

In 2024, Egypt's industry¹¹ emerged as the largest contributor to the country's GDP, accounting for 16% (EGP 1.9 trillion or USD 38 billion), surpassing other key sectors such as wholesale and retail (14%), agriculture (11%) and real estate (10%) (Invest in Egypt, 2024^[59]). The growth of Egypt's industrial sector

is largely driven by steel, fertilisers and petrochemicals. The sector also played a crucial role in Egypt's trade landscape, contributing to half of the country's total exports in 2022, amounting to EGP 63.5 billion (USD 25.9 billion) (UNIDO, 2023^[9]).

In 2019, Egypt produced approximately 1.8 Mt of grey hydrogen from natural gas via steam methane reforming (SMR), a carbon-intensive process emitting 8-10 kg CO₂/kg H₂ (IEA, 2024^[60]; The Oxford Institute for Energy Studies, 2021^[61]). In 2022, energy-intensive industries – such as fertilisers, petrochemicals and refineries – were the main hydrogen consumers, accounting for 36% of Egypt's natural gas use (IEA, 2025^[43]). Egypt's dependence on natural gas in these energy-intensive industries resulted in 36 Mt of CO₂ emissions, accounting for 16% of the country's total. Of this, hydrogen production alone was responsible for 17 Mt CO₂, or 6% of national emissions (UNIDO, 2023^[9]). Replacing grey hydrogen with green hydrogen in hydrogen consuming sectors could reduce process-related emissions (IEA, 2023^[62]). These savings reflect the potential to avoid nearly all CO₂ emissions from natural gas-based hydrogen production, while harnessing Egypt's abundant solar and wind resources to scale up renewable electricity generation (UNIDO, 2023^[9]; Hydrogen Europe, 2024^[63]). Technical pathways for decarbonising Egypt's industry using green hydrogen are discussed in Chapter 2.

The global emergence of carbon border measures, such as the EU Carbon Border Adjustment Mechanism (EU CBAM), is intensifying the urgency of industry decarbonisation and the transition to green hydrogen. For major exporters like Egypt, particularly in sectors like steel, fertilisers and petrochemicals, EU CBAM measures could pose competitiveness risks in markets that favour, low-emission production. Green hydrogen offers a strategic pathway to mitigate these trade risks, enhance access to carbon-sensitive markets and position Egypt as a competitive supplier as regional markets develop (Box 1.3).

In parallel, Egypt has advanced its industrial decarbonisation agenda through institutional and regulatory reforms aligned with CBAM requirements. The Egyptian Accreditation Council (EGAC) became the first Arab and African body recognised by European Accreditation, accrediting several national Validation and Verification Bodies (e.g. GOEIC, EOS, EOL, TUV Nord). In late 2024, high-level decrees established a Ministerial Committee and a National Executive Secretariat involving 30 stakeholders to co-ordinate CBAM and decarbonisation efforts. A National Action Plan was endorsed, structured around 13 pivots covering Scope 1, 2 and 3 emissions. Sectoral action plans for steel, cement, aluminium and fertilisers are currently under development in collaboration with Egypt's Information and Decision Support Centre (IDSC) and the MoE.

Box 1.3. Carbon border measures in the European Union and the United Kingdom

The European Union's Carbon Border Adjustment Mechanism (EU CBAM), scheduled to enter into force as of 2026, is a climate policy instrument established to prevent carbon leakage and support global decarbonisation efforts. It functions by placing a carbon price on imports of certain carbon-intensive goods from countries with less stringent climate policies. The CBAM aims to ensure that the price of embedded carbon in imported products is equivalent to that of products produced within the EU under the EU Emissions Trading System (EU ETS), thereby maintaining a level playing field.

Egypt is particularly vulnerable to the impacts of EU CBAM, as exports to the EU constitute 38% of its total domestic exports. Given the high energy and emissions intensity of Egypt's industrial sector, key exports, including cement, iron, steel, aluminium, fertilisers, electricity and hydrogen, will be directly impacted by EU CBAM. According to the World Bank's CBAM Exposure Index, Egypt ranks among the most exposed countries to this policy, facing an additional cost of EGP 111 (USD 2.2) per tonne of CO₂ to access the European market. For example, in 2022, Egypt exported an estimated 560 000 tonnes of steel to the European market. Assuming an emissions intensity of 2 tonnes of CO₂ per tonne of steel – a common estimate for conventional production – this could result in an extra cost of over USD 2.4 million.

Starting in January 2027, the United Kingdom will implement its own Carbon Border Adjustment Mechanism (UK CBAM), covering the aluminium, cement, fertiliser, hydrogen, iron and steel. Egypt's exporters will need to account for the carbon emissions embedded in their products. If these emissions exceed UK benchmarks or if Egypt lacks an explicit carbon pricing mechanism, importers may face additional charges, potentially affecting the competitiveness of Egyptian goods in the UK market.

Source: (European Commission, 2025^[64]; World Bank, 2023^[65]; Alexandra Gritz, 2024^[66]; HM Treasury, 2024^[67]).

1.3.5. Country strategy, policies and mechanisms

Key national strategy and development plans

In its first updated NDC of 2022, Egypt established several emissions reduction targets at sector level to be realised by 2030, as compared to business-as-usual (BAU) scenario. This includes the electricity sector (a 33% reduction relative to BAU, equalling 70 Mt CO₂-equivalent (CO₂-eq) per year), the transport sector (7% or 9 Mt CO₂-eq relative to BAU) and the oil and gas sector (65% relative to BAU, equalling 1.7 Mt CO₂-eq). However, it is important to note that these reductions are relative to a projected increase in emissions under the BAU scenario. This means that, in absolute terms, emissions in these sectors are still expected to rise compared to current levels.

In its second updated NDC of 2023, Egypt committed to achieving 42% of clean energy in its electricity mix by 2030 (five years earlier than the previous NDC target) and a GHG emission reduction target in the power sector of up to 37% relative to BAU. These targets are conditional to securing international financing, which is estimated at EGP 9 trillion (USD 196 billion) for climate change mitigation and EGP 2.3 trillion (USD 50 billion) for adaptation measures (Government of Egypt, 2023^[2]). Yet, it is key for Egypt to update its sectoral strategies, such as the National Strategy for Sustainable Agriculture and the Integrated Energy Plan, to ensure an alignment with the latest NDC targets (OECD, Forthcoming^[68]). The relevant sectoral strategies are listed in Table 1.1.

Table 1.1. Policies relevant to Egypt's energy transition and industry decarbonisation

Policy name	Description	Year	Actor leading implementation	Link with energy transition/ industry decarbonisation
Egypt's economic strategy for 2024-2030 (State Information Service, n.d. ^[69] ; IEA, 2024 ^[70])	The document outlines eight priority areas that will guide Egypt's development plans during the 2024-2030 presidential term.	2024	Government of Egypt	For the electricity and renewable energy, the strategy includes: (i) Increasing the renewable and clean energy penetration in the Egyptian power grid to 42% by 2030; (ii) finalising the different electricity interconnection projects with Saudi Arabia, Sudan, Jordan, Greece and Italy. The strategy also set a target to increase local content in manufacturing to 60-80% by 2030. Incentives were introduced for projects meeting a 50% local content threshold, particularly in renewable energy, automotive and mining sectors, including customs benefits, operating cost subsidies, workforce training support and tax incentives.
Sovereign Sustainable Financing Framework (SSFF) (African Development Bank, 2022 ^[71])	This is the updated version of the Green Financing Framework of 2020, which aimed to support the issuance of green bonds by the government. It incorporates additional green and social projects that align with Egypt's Sustainable Development Strategy: Egypt Vision 2030.	2022	Government of Egypt	The SSFF leverages sovereign sustainable finance to accelerate the energy transition using clean transportation, renewable energy, energy efficiency, pollution prevention, water and waste management, among others.
Egypt's National Climate Change Strategy 2050 (NCCS) (Government of Egypt, 2022 ^[11])	Provides a comprehensive institutional framework for the articulation of climate action to 2050 with two goals on mitigation and adaptation priorities and three enabling goals intended to overcome the governance, financing and technology and awareness constraints.	2022	Government of Egypt	It promotes the energy transition by increasing the share of all renewable and alternative energy sources in the energy mix and increasing the use of renewable energy to generate electricity within industrial facilities and the applications of solar thermal energy in industrial processes. It also mentions the inclusion of new alternative energy sources, such as green hydrogen, blue hydrogen and nuclear energy.
National Solid Waste Management Strategy (Ministry of Planning, Economic Development and International Cooperation, 2022 ^[72])	Comprehensive plan designed to address the country's waste management challenges and pave the way for a sustainable and environmentally friendly future.	2022	Ministry of Environment and Local Authorities	Contributes to circular economy goals, reduces methane emissions from waste and promotes waste-to-energy technologies supporting decarbonisation.
National Energy Efficiency Action Plan II (2018-2022) (Government of Egypt, 2018 ^[73])	Strategic framework aimed at improving energy efficiency across key sectors to support sustainable development and reduce energy consumption. It is the second phase of Egypt's energy efficiency efforts.	2018-2022	Government of Egypt	Emphasises measures for using renewable energy, whether for electricity generation or water heating in the sectors of buildings, tourism, industry, public lights and educational buildings. It also sets out measures for deploying high efficiency electric motors in the industrial sector.
National Water Resources Plan (2017-2037)	Strategic framework designed to ensure sustainable management of	2017-2037	Ministry of Water Resources and Irrigation	It aims to increase the use of desalinated water in coastal areas and treating wastewater for reuse in agriculture and industry. It also

Policy name	Description	Year	Actor leading implementation	Link with energy transition/ industry decarbonisation
(Ministry of Water Resources and Irrigation, 2017 ⁽⁷⁴⁾)	the country's water resources to meet the demands of a growing population, support economic development and adapt to climate change impacts.			encourages private sector participation in financing and managing water infrastructure projects.
Sustainable Development Strategy: Egypt's Vision 2030 (Ministry of Planning, Economic Development and International Cooperation, 2023 ⁽⁷⁵⁾)	Comprehensive national agenda aiming to achieve sustainable development across economic, social and environmental dimensions, aligning with the UN Sustainable Development Goals.	2016, updated in 2023	Government of Egypt	Sets targets for increasing clean energy share to 42% by 2030, reducing GHG emissions, and promoting sustainable industrial practices.
Integrated Sustainable Energy Strategy 2035	Strategic plan to diversify Egypt's energy mix, enhance energy efficiency and increase the share of renewable energy in electricity generation.	2015	Supreme Energy Council	The strategy intends to increase the supply of electricity generated from clean sources to 42% by 2030, and the private sector is expected to provide most of this power supply.
National Strategy for Disaster Risk Reduction 2030 (The Cabinet of Egypt, 2017 ⁽⁷⁶⁾)	It aims to increase Egypt's resilience in dealing with climate change risks and disasters, while promoting sustainable development.	2011	The Cabinet of Egypt Information and Decision Support Center Crisis Management and DRR Sector	As part of its Priority for Action (3): Financing and Investment in Disaster Risk Reduction, the strategy focuses on promoting investments in renewable energy sources
National Strategy for Adaptation to Climate Change (Cabinet of Egypt Information and Decision Support Center, 2011 ⁽⁷⁷⁾)	Multi-sectoral document that addresses climate change and adaptation measures as part of an integrated strategy of the Egyptian government and its sustainable development programmes and plans.	2011	The Cabinet of Egypt Information and Decision Support Center; UNDP	It promotes the use of new and renewable energy in the housing and building sectors. It also stresses the need to mitigate carbon emissions deriving from the industrial sector and to prepare industry for severe climate change scenarios.
Sustainable Agricultural Development Strategy towards 2030 (Government of Egypt, 2009 ⁽⁷⁸⁾)	National strategy to modernise Egyptian agriculture based on achieving food security and improving the livelihood of the rural inhabitants, through the efficient use of environmental assets.	2009-2030	Ministry of Agriculture and Land Reclamation	It promotes the sustainable use of natural agricultural resources; increased productivity of both water units; higher food security for strategic food commodities; and the scale-up of climate-related for agricultural investment.
Industrial Development Strategy 2030	Strategy feeds into Egypt's Vision 2030, aimed at transforming the country into a competitive, diversified and innovation-driven industrial economy.	2024	Ministry of Planning and Economic Development (MPED)	It aims to accelerate inclusive and sustainable growth by expanding the industrial base, boosting private sector participation and enhancing competitiveness.

Source: Information provided by the Government of Egypt.

Renewable energy and electricity sector policies

The NREA works as the national focal point for the development and implementation of renewable energy projects. It supervises the implementation of the Integrated Sustainable Energy Strategy (ISES) 2035 and the updated energy targets of the NDC, which aim to reach 42% of electricity generation from clean and

renewable energy sources by 2030, reduce oil and gas production, phase out coal and install 4-5 GW of nuclear energy capacity by 2030 (Government of Egypt, 2016^[79]; Government of Egypt, 2023^[2]).

Mechanisms supporting this transition include two Feed-in Tariff (FiT) schemes launched in 2014 and 2016, targeting 2.3 GW of solar PV and 2 GW of wind capacity, with key projects such as the Benban Solar Park, the world's largest solar photovoltaic parks or the Zafarana site for solar and wind power. Between 2014 and 2019, FiTs facilitated 1.47 GW of solar installations. After the FiT successfully attracted private sector participation, the electricity sector transitioned to Build-Own-Operate (BOO) models and competitive auctions. These mechanisms offered greater flexibility in accommodating renewable technology costs and opened up new investment opportunities (Res4Africa, 2018^[80]). Egypt's first renewable Independent Power Producers (IPP) scheme, the Ras Ghareb Wind Farm, became operational in 2019. It marked a major milestone in Egypt's energy transition and private sector participation in renewable energy. Phase 1 has a total installed capacity of 500 MW. In the case of auctions, embraced by Egypt's Renewable Energy Law No. 203 of 2014, competitive bidding mechanisms were introduced to diverse financing options and attract private investment. Early auctions focused on solar PV and wind projects under Engineering, Procurement and Construction (EPC)¹² or BOO¹³ models, with IPPs selling power under Power Purchase Agreements (PPAs) with the EETC. In response to evolving market needs, EETC, with EBRD support, is actively redefining its auction processes to enhance procurement frameworks for renewable energy projects (PV Magazine, 2018^[81]).

The IPP scheme allows private producers to sell electricity directly to consumers through bilateral contracts or the wheeling scheme, using public transmission grids for a fee. This model reduces upfront public investment needs while increasing competition and ensuring continuous private-sector involvement. In addition, a shift towards smart and cost-reflective pricing would be more efficient than Egypt's current flat wheeling fee. A more dynamic approach – combining distance-based fees and time-of-use discounts – would better align grid usage with actual costs and system needs. Projects located closer to grid nodes could benefit from lower fees (e.g. within 50 km of Suez industrial zones), encouraging strategic siting and reducing transmission losses. Meanwhile, offering discounted wheeling rates during off-peak periods would incentivize generation when the grid can absorb it, supporting system flexibility and renewable integration. In parallel, self-gridding incentives could allow developers to build private transmission corridors (e.g. 10 km lines) for direct renewable-to-electrolyser supply, exempt from wheeling fees, thereby unlocking investment in green hydrogen and industrial decarbonisation. These reforms would enhance investment signals, improve grid efficiency, and support Egypt's clean energy transition (Denis, 2026^[82]).

The Golden License, along with Egypt's NWFE platform, is also a key mechanism to attract private capital in low-carbon infrastructure.¹⁴ Since its introduction in 2022, the Golden License has contributed to a 6% increase in renewable energy capacity between 2022 and 2023 amounting to 6.7 GW (Ministère de l'Économie, des finances et de la souveraineté industrielle et numérique, 2022^[83]; IRENA, 2024^[84]). Securing Golden Licenses has helped a USD 850 million solar project by AMEA Power and a 1.1 GW Suez Wind Project of USD 1.1 billion by the African Development Bank. It contributed to avoiding lengthy and cumbersome processes of obtaining individual permits for construction, operation, land use, and grid connection, significantly accelerating the timeline of each project (Vasileva, 2024^[85]; African Development Bank, 2024^[86]).

Additional regulatory frameworks include the Green Bond Guidelines (2018), the Environmental Sustainability Criteria Guidelines (2021), the Guiding Principles on Sustainable Finance issued by the Central Bank of Egypt (2021) and Decrees 107 and 108 (2021), which require companies to submit environmental, social and governance (ESG) reports (Ministry of Planning and Economic Development, 2021^[87]; Central Bank of Egypt, n.d.^[88]).

1.4. Egypt's low-carbon hydrogen ambition

The National Strategy for Low-Carbon Hydrogen (Arab Republic of Egypt, 2024^[89]), announced at the 27th Conference of Parties to the United Nations Framework Convention on Climate Change (COP27), was approved in 2024 by the Supreme Energy Council (SEC) in collaboration with the EBRD and the Arab Union for Sustainable Development and Environment (AUSDE). The strategy is designed to harness Egypt's competitive potential in green hydrogen production, aiming to secure 5-8% of the global market by 2040 – equivalent to approximately 6.5 Mt annual production of green hydrogen – while requiring an estimated USD 60 billion in investment. The strategy estimated that green hydrogen production will boost Egypt's GDP by USD 18 billion and generate over 100 000 jobs by 2040.

This ambition is underpinned by Egypt's significant potential to develop green hydrogen, supported by its abundant renewable energy resources and strategic geographic location (UNIDO, 2023^[9]). The country's annual electricity generation potential includes approximately 73 700 terawatt hours (TWh) from concentrated solar power (CSP), 7 650 TWh/year from wind, 36 TWh/year from photovoltaic (PV), 15 TWh/year from bioenergy, 26 TWh/year from geothermal and 80 TWh/year from hydropower (Salma Salah, et al., 2022^[90]). Egypt's geographic location between the Mediterranean and Red Sea positions the country as a key global hub for shipping and hydrogen trade (Oxford Institute For Energy Studies, 2021^[91]).

Egypt's established ammonia industry and extensive gas infrastructure provide a strong foundation for scaling up green hydrogen production. As Africa's largest ammonia producer, with an output of around 6 Mt annually, Egypt is well-positioned to convert and store green hydrogen in the form of green ammonia – the most cost-effective and scalable liquid hydrogen carrier currently available (Rouwenhorst, 2022^[92]). In parallel, the country's vast gas pipeline network – comprising 60 000 km of distribution and 7 500 km of transmission lines – could be partially repurposed or leveraged in the future to support domestic hydrogen transport and blending (Salma Salah, et al., 2022^[90]).

Translating this potential into export leadership requires overcoming significant infrastructure and investment challenges. Advanced technologies for hydrogen production and conversion remain underutilised due to limited investment across the hydrogen value chain, including in conversion, storage and export capacity (Hassan and El-Amry, 2025^[93]). A key constraint is the absence of direct hydrogen-compatible pipeline infrastructure to Europe. Combined with high transport and logistics costs, this continues to restrict Egypt's export competitiveness. Thus, substantial investment will be required in dedicated infrastructure for the large-scale transport, conversion, as well as export of hydrogen and its derivatives to fully capitalise on international market opportunities.

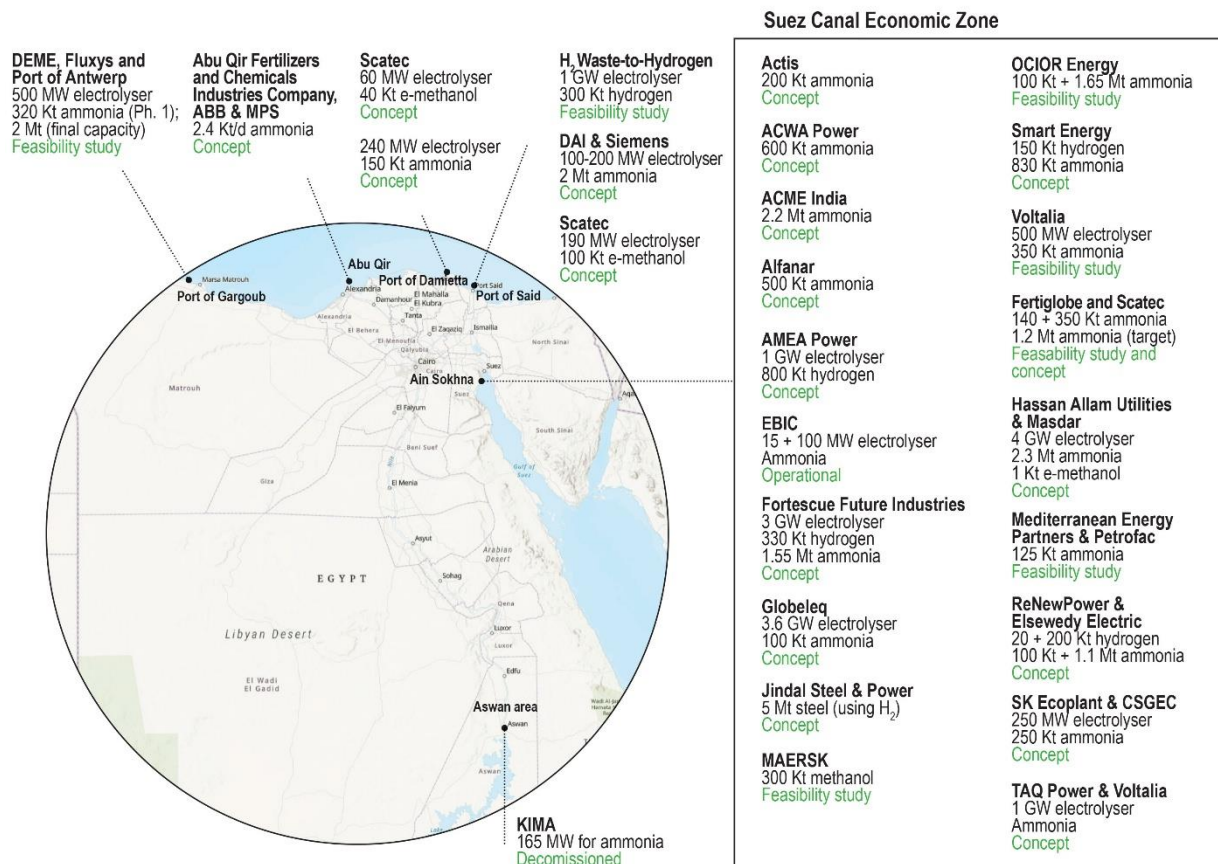
Egypt's high perceived country risk remains a key barrier to scaling green hydrogen. Closely tied to sovereign credit risk, country risk significantly increases financing costs in emerging markets and developing economies (Lee and Saygin, 2023^[94]). In January 2025, Egypt's country risk premium stood at 10% (Damodaran, 2025^[95]), reflecting investor concerns over macroeconomic stability and directly driving up the cost of capital, thereby undermining the competitiveness of green hydrogen production in Egypt. Therefore, any strategy to accelerate Egypt's low-carbon hydrogen deployment must tackle underlying macroeconomic risks that contribute to this elevated risk premium.

1.4.1. Egypt's green hydrogen project landscape

As of June 2024, Egypt signed 32 Memoranda of Understanding for green hydrogen projects worth around USD 175 billion (GH2, 2024^[96]). Most green hydrogen projects are situated in the Suez Canal Zone (SCZone) due to its strategic location near key manufacturing hubs, export terminals and ammonia production facilities, making it an ideal site for integrated hydrogen-ammonia value chains (Figure 1.4). In addition, the SCZone qualifies for various investment incentives such as the one under Investment Law

No. 72 of 2017, including a 50% tax deduction on eligible costs, reinforcing its position as Egypt's strategic hub for low-carbon industrial development (Table 1.2).

Figure 1.4. Green hydrogen and derivatives projects in Egypt, 2025 snapshot



Note: The map does not reflect Egypt's full territory and is used solely to illustrate the locations of projects. It uses the administrative divisions of Egypt's governorates, sourced from Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS). The information presented in this map is extracted from publicly available sources. Data is subject to limitations due to incomplete or partial sources. For instance, it excludes projects which have not disclosed their geographic location. The large majority of projects are planned for implementation in the Suez Canal Economic Zone, with many concentrated in Ain Sokhna. While some projects are designed for export markets, others aim to supply low-carbon hydrogen and its derivatives to the domestic market. Some projects are designed to be implemented in multiple phases, with full production capacity expected to be reached by 2030 and beyond.

Source: Data from (IEA, 2025^[97]). Unless otherwise specified, all production figures are reported as annual outputs.

Egypt established a legal and regulatory framework to support the implementation of its National Low-Carbon Hydrogen Strategy. This includes several cabinet decrees (No. 20, 981 and 983), Law No. 2 of 2024 and a range of incentive policies and measures. Notably, the Green Hydrogen Incentives Law introduces a comprehensive package of fiscal and non-fiscal incentives designed to accelerate project development and reinforce the green hydrogen value chain (OECD, 2024^[98]).

Egypt does not yet provide local regulations and certification to verify the origin and quality of low-carbon hydrogen. Thereby, projects are still governed by the existing Gas Market Law No. 196 of 2017. Nevertheless, Egypt is making strides to align its hydrogen accreditation framework with European market standards, but both sides are still navigating fragmented and evolving discussions. On the European side, standard-setting is a work in progress, and Egypt must strategically position itself to engage with these developments. While the 2022 EU-Egypt MoU laid the groundwork for co-operation, Egypt's current system

lacks a unified, independent certification methodology that meets EU criteria for carbon intensity, traceability and guarantees of origin. Emphasising the importance of certification systems is critical, and Egypt would benefit from developing a fair, internationally compatible framework to ensure future market access and credibility. Connecting relevant sections of the strategy to these international processes could strengthen alignment and signal readiness to meet global standards.

Table 1.2. Policies relevant to Egypt’s low-carbon hydrogen development

Law	Ministerial Decree	Year	Actor	Overall description
Law No. 2/2024 (OECD, 2024 ^[98])		2024	Government of Egypt	Offers targeted incentives for green hydrogen projects under recent laws. Law No. 2 of 2024 provides a 35-55% income tax refund, while Law No. 160 of 2023 introduces a general cash refund for investments under Sectors A and B, likely applicable to green hydrogen with foreign contributions. Additional benefits include usufruct rights for land and a 30% discount on port and marine service fees.
Circular letter (2/2023) (Egyptian Electric Utility and Consumer Protection Regulatory Agency, n.d. ^[99])		2023	EgyptERA	Outlines the regulatory rules for the purchase of electric power produced from renewable energies.
	Cabinet Decrees No. 981 of 2022 and No. 20 of 2022 (UN Trade and Development, 2022 ^[100])	2022	Government of Egypt	Identify specific geographic zones designated for the production, storage and export of green ammonia and green hydrogen, and specify which projects are eligible for benefits under the 2017 Investment Law.
Investment Law No. 72 of 2017	Cabinet Decrees No. 104, 981 and 983 of 2022 Cabinet Decree No. 983 of 2022 (UN Trade and Development, 2022 ^[100])	2022	Government of Egypt	Law No. 72/2017 establishes an investment incentive framework for green projects, offering tax deductions of 30% or 50% of eligible investment costs – 50% for Sector A and 30% for Sector B – based on specific criteria. Cabinet Decree No. 104 specifies the sectors eligible for these incentives, including green hydrogen and derivatives. Decree No. 981 identifies designated geographic zones for hydrogen and ammonia projects. Decree No. 983 mandates GAFI to co-ordinate with other authorities to prioritise and implement these investments.
	Green Bond Guidelines, Decrees No. 107 and 108	2021	Financial Regulatory Authority	Sets the disclosure rules for companies in non-banking financial services and for companies that issue securities on the Egyptian Stock Exchange.
Seawater Desalination Strategy 2050		2021	Ministry of Housing, Utilities and Urban Communities	Outlines a long-term plan to scale up desalination powered by renewables, aiming for 8.85 million m ³ /day by 2050.
Law No. 72/2017	Decree No. 571/2019	2019 2025	Ministry of Industry	Put the local content manufacturing ratio at 45% for licensing domestic automotive assembly operations and specify that projects with more than 50% local content may be eligible for additional investment incentives. Amended Automotive Industry Development Program (AIDP).
Presidential Decree No. 116/2016		2016	Egypt’s New and Renewable Energy Authority (NREA)	Allocates around 7600 km ² of land to NREA with the purpose of implementing renewable energy project
Renewable Energy Law No.		2014	EgyptERA	Provides several options for support to renewable energy projects, including competitive bids, feed-in

Law	Ministerial Decree	Year	Actor	Overall description
203/2014 (Government of Egypt, 2014 _[101])				tariff and independent power production through third party access.
Special Economic Zone Law No. 83 of 2002 (SC Zone, 2002 _[102])	Ministerial Decree No. 1625 of 2002, No. 2282 of 2015	2002 2015	Government of Egypt	Establishes special economic zone in the Northeast Gulf of the Suez Canal (20 km ² of land), which offers special incentives (tax and customs) and non-financial to boost investment.
	Ministerial Decree No. 566 for 2002	2002	Ministry of Transport	Outlines the necessary terms and conditions to practice some of the activities at Egyptian ports.
Environment Protection Law No. 4 of 1994 (Government of Egypt, n.d. _[103])	Ministerial Decree No. 338 for 1994	1994	Ministry of Environment	Aims at protecting the environment (land, air and water) from pollution. It also establishes the Environmental Affairs Agency (EEAA) for the protection and promotion of the environment.
Capital Markets Law No. 95 of 1992	Prime Ministerial Decree No. 4664 of 2022	1992 2022	Government of Egypt	Regulates the capital markets in Egypt and grants the Capital Market Authority (CMA) the legal authority and status necessary to ensure the effective execution and enforcement of securities market legislation and regulation. The 2022 Decree establishes the legal basis for the Financial Regulatory Authority and the Egyptian Stock Exchange.

Note: The investment incentives applied to SCZone also applies to other zones, namely: ii) al-Muthalath al-Dhaby (Golden Triangle) economic zone; (iii) the New Administrative Capital; and (iv) the *geographic locations most urgently in need of development*, including the area south of the Giza governorate, governorates affiliated to the Suez Canal region (i.e. parts of Port Said, Ismailia and Suez governorates on the easts of the canal and the border governorates (e.g. Red Sea and the Upper Egypt governorates, New Valley, Matrouh). Additional areas may be decided by the Prime Minister.

Source: Information provided by the Government of Egypt.

Egypt has introduced a broad and ambitious policy framework to support the development of a green hydrogen economy, combining fiscal incentives, spatial planning and regulatory guidelines. Laws such as Law No. 2/2024 and Investment Law No. 72/2017, along with their accompanying cabinet decrees, offer tax rebates of up to 55% for green hydrogen projects, land usufruct rights and port fee reductions. Complementary instruments, like Cabinet Decrees No. 981 and 983 of 2022, identify designated zones for hydrogen production and task GAFI with co-ordinating implementation. Additionally, measures such as Circular Letter 2/2023 and the Green Bond Guidelines aim to establish market mechanisms for clean energy procurement and enhance transparency in green finance. Together, these policies create a theoretically robust enabling environment for hydrogen deployment across production, storage and export.

However, the implementation of these policies and mechanisms have lagged behind their legal articulation. While Egypt has introduced generous incentives and designated zones for green hydrogen development, project realisation remains limited. Most initiatives are still in the memorandum of understanding or pre-feasibility stage. Fragmented co-ordination among regulatory authorities, particularly on grid access, environmental permitting and infrastructure planning, continues to impede progress. Although investment laws offer attractive terms and procedural streamlining, investors often face bureaucratic delays and regulatory uncertainty. This reflects a broader challenge: Egypt's strength in policy formulation is not yet matched by the implementation capacity needed to deliver large-scale, bankable projects.

As a result, no green hydrogen projects in Egypt have yet reached final investment decision. Nevertheless, the hydrogen economy represents a critical opportunity for Egypt to capitalise on its renewable energy potential, address domestic energy needs and position itself as a regional export hub. Realising this potential requires overcoming the barriers that delay project progression to FID. The economic, regulatory and sectoral insights presented in Chapter 1 form the basis for the following chapters, which explore financial solutions and enabling investment conditions to move projects toward implementation.

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Notes

¹ The national price estimate of USD 1.8/kg H₂ by 2040 is used for comparative purposes. As highlighted earlier in the report, the OECD calculations of LCOH use a consistent set of assumptions, which are not directly derived from Egypt's National Low-Carbon Hydrogen Strategy. Findings should thus be considered indicative and comparative rather than definitive, especially as the estimated future price of low-carbon hydrogen cannot easily be compared with LCOH. Moreover, it is important to note that this cost-versus-price comparison does not account for potential reductions in CAPEX due to technological learning expected between now and 2040. While such advancements are likely to lower costs over time, their impact is deliberately excluded from this assessment to maintain consistency in assumptions. As with any technical-economic analysis, results should be interpreted as indicative and comparative rather than definitive.

² Low-carbon technologies refer to all technologies that offer a lower or near-zero emission solution to conventional production processes that emit CO₂.

³ Under the Egypt-OECD Country Programme, CEFIM is implementing two work streams: (i) developing low-carbon hydrogen under the *OECD Framework for Industry net-zero transition: Developing financing solutions in emerging and developing economies* and (ii) financing transmission grid in Egypt by developing case studies to identify financing model (Denis, 2026^[82]).

⁴ A wheeling fee is a charge paid by a private electricity producer to the EETC for using its transmission grid infrastructure when supplying electricity to end users.

⁵ The EGP to USD conversion used in this document is based on exchange rates of the first quarter of 2025 (Ministry of Planning, Economic Development and International Cooperation, n.d.^[104]). All calculations in USD are indicative and may no longer reflect the current exchange rate.

⁶ The GBI-EM is designed to track the performance of bonds issued by emerging market governments and includes only those countries that are accessible by most of the international investor base.

⁷ Egypt pledged to bring all SOEs – including army-owned companies – within a unified framework for transparent financial management and reporting, to publish comprehensive and detailed annual and twice-yearly tax expenditure reports, to end tax exemptions for SOEs, and to improve customs procedures and information sharing. (Sayigh, 2025^[105]).

⁸ The swaps are a financial tool that enables countries to allocate fiscal resources toward climate resilience and nature conservation while maintaining the flexibility to address other development priorities without exacerbating fiscal strain.

⁹ Samurai and Panda bonds are foreign-denominated bonds issued by non-resident entities in Japan and China, respectively.

¹⁰ Sukuk bonds are Islamic financial certificates like a bond in Western finance, that comply with Islamic religious law.

¹¹ The industrial sector comprises manufacturing industries as defined in the International Standard Industrial Classification of All Economic Activities (ISIC).

¹² Engineering, Procurement and Construction (EPC) is a form of contract used to undertake construction works by the private sector on large-scale and complex infrastructure projects. The procurement scheme entails a variety of clauses, in terms of price, completion date, performance and if well specified, can substantially cover the upfront

investment risks perceived by lenders. Moreover, EPC helps if the lender lacks the required engineering expertise to develop a renewable energy project.

¹³ The BOO contract is a particular form of project financing that consists in a public private partnership where the private company builds, owns and operates the power plant independently from the government, under specified agreement and time conditions.

¹⁴ In 2018, Egypt introduced a Special Incentive scheme that permits investors to deduct 30% or 50% of investment costs, with a focus on capital expenditures rather than income-based deductions. This expenditure-based approach is generally more effective in lowering upfront investment barriers. Initially targeted at sectors such as renewable energy and green manufacturing, the scope of the incentive was broadened in March 2022 to include projects of strategic environmental importance, including green hydrogen, green ammonia, waste management, e-mobility and alternatives to single-use plastics. However, as the incentive remains available to both green and non-green projects, its effectiveness in specifically advancing the green transition may be limited by the absence of targeted differentiation (OECD, 2024^[45])

2 Assessing cost competitiveness of low-carbon hydrogen and green derivatives in Egypt

This chapter presents a techno-economic assessment of low-carbon hydrogen production in Egypt, examining both green and blue hydrogen pathways. Using scenario-based modelling tailored to Egypt, the analysis estimates the levelised cost of hydrogen across various configurations and identifies the most cost-competitive production routes. The chapter also evaluates production cost of key green hydrogen derivatives – ammonia, iron and e-methanol – highlighting Egypt’s potential as major exporter. These findings provide critical input for identifying financial solutions and enabling investment conditions, further explored in Chapters 3 and 4.

2.1. Objective and methodology

This chapter assesses the cost-competitiveness of low-carbon hydrogen production in Egypt including green and blue hydrogen, as well as green derivatives such as green ammonia, green iron and e-methanol. The analysis is designed to inform recommendations on enabling investment conditions and financial solutions for Egypt's low-carbon hydrogen development. Given that no operational low-carbon hydrogen projects currently exist in the country, the results do not reflect actual on-the-ground conditions. Instead, they provide an indicative assessment of Egypt's potential cost-competitiveness, based on assumptions and data drawn from both national and international sources. These findings should be interpreted with caution due to inherent uncertainties in input assumptions. The OECD conducted extensive consultations with key public and private stakeholders throughout the assessment process to ensure relevance and alignment with Egypt's emerging hydrogen market (Annex E).

The main assessment was conducted by calculating the Levelised Cost of Hydrogen (LCOH) using a dedicated techno-economic model, with different hydrogen production scenarios specifically tailored to Egypt. The LCOH represents the total production cost over the investment's lifespan, covering capital expenditures (CAPEX) and operating costs (OPEX), such as maintenance, feedstock and other inputs. Details of methodology, input data and assumptions are summarised in Annex A. The techno-economic model used by the study simulated the full hydrogen production process by tracking energy and material flows throughout the defined system boundaries for a number of scenarios. The system boundary of each scenario is explained in Section 2.2.1. A key distinguishing feature is the integration of a power system model for green hydrogen production, enabling a full-year simulation with hourly temporal resolution. This approach optimises the sizing and operational dispatch of solar PV and onshore wind generation assets, low-temperature electrolysis units and both battery and hydrogen storage systems. By simulating renewable electricity supply and green hydrogen production on an hourly basis, the model captures the variability of renewable energy resources and operational dynamics more realistically. This results in a more robust estimation of production costs and system requirements, reflecting the technical complexities associated with achieving continuous electrolyser operation under variable renewable energy inputs.

The LCOH for the blue hydrogen case is calculated by developing process models, using the commercial process simulation software Aspen Plus. Instead, for green hydrogen production, mixed integer linear programming (MILP) models are developed in MATLAB to compute the economic optimal size and optimal operation strategy for the different system components. A bottom-up approach is adopted for calculating the CAPEX of each of the modelled plants. Finally, the LCOH is calculated coupling the estimated CAPEX with the OPEX for each of the simulated scenarios.

The LCOH for both blue and green hydrogen was estimated under four scenarios to identify the most suitable technological and production conditions for Egypt. Additionally, the second part of Chapter 2 evaluates green hydrogen derivatives – green ammonia, green iron and e-methanol – by analysing their cost competitiveness and export potential, leveraging Egypt's renewable energy strengths and corresponding production pathways. Each derivative pathway was assessed by calculating the levelised cost of the final product, factoring in the cost of green hydrogen as a key input. For consistency, the hydrogen input cost was derived from the low-cost scenario identified in the LCOH analysis (Scenario B), assuming a dedicated renewable energy share of 98%. The models incorporated detailed process configurations and energy requirements for each conversion pathway.

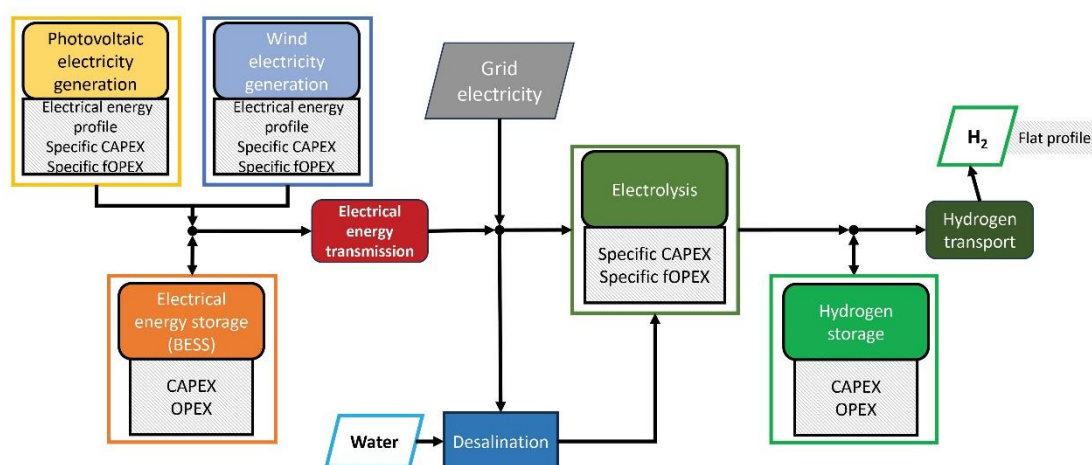
The Chapter 2 analysis informs Chapter 3, which examines economic and de-risking instruments to help bridge the cost gap toward the price of USD 1.8/kg H₂ envisioned in Egypt's National Low-Carbon Hydrogen Strategy by 2040 – a key parameter considered throughout this report, which should be considered indicative and comparative rather than definitive.¹

2.2. Analytical scope

2.2.1. Green hydrogen production system

The cost of green hydrogen production depends on the cost of renewable power and the capital cost of equipment, notably electrolyzers, as well as financing costs (indicated by the cost of capital) (OECD/The World Bank, 2024^[1]; Lee and Saygin, 2023^[2]). Indeed, green hydrogen is produced by splitting water into hydrogen and oxygen through electrolysis powered by renewable energy sources. The systematic approach encompassing the entire green hydrogen value chain is complex and varies based on national circumstances (Cordonnier and Saygin, 2022^[3]). Figure 2.1 provides a schematic representation of the green hydrogen production system assessed for cost competitiveness.

Figure 2.1. Green hydrogen production: system configuration



Note: BESS: Battery Energy Storage System; CAPEX: capital expenditure; OPEX: operating expenditure; fOPEX: fixed operating expenditure; H₂: hydrogen.

Source: Schematic representation prepared by the OECD Secretariat.

CAPEX and OPEX include a range of costs associated with the development and operation of a green hydrogen system producing 100 kilotonnes (kt) of H₂ per year, covering renewable power generation, electrolysis, storage, transmission infrastructure and grid electricity use, with OPEX calculated as a percentage of CAPEX across components. The CAPEX includes costs for the renewable power generation plant, battery energy storage system (BESS), low-temperature electrolysis system and hydrogen storage system. Additionally, investment costs for constructing new electricity transmission lines and hydrogen transport pipelines are factored in based on different scenarios set up. For OPEX, annual fixed Operations and Maintenance (O&M) costs are calculated as a percentage of the CAPEX for each component. Grid electricity prices in Egypt are also incorporated for the portion of power sourced from the grid. The technological parameters for each part of the value chain are summarised as below. The underlined assumption is that the green hydrogen production system generates 100 kt H₂ per year, maintaining a constant hourly production rate of 11 414 tonnes of H₂ throughout the year (Annex A).

The following production factors have been considered (Annex A):

- **Electricity:** The cost of electricity has substantial impact on LCOH as it powers electrolyser to produce green hydrogen. The electrolyser can be powered by electricity produced from either: (i) a dedicated renewable energy source, such as wind or solar power with or without battery storage; or (ii) the power grid. However, the contribution of electricity from the national grid is limited to a

maximum of 10%² of the total electricity required for hydrogen production and compression. The analysis reflected recent regulatory change in Egypt allowing surplus electricity sales through business-to-business (B2B) agreements. It is to consider a scenario of selling excess renewable electricity at the same rate as grid electricity purchases, set at 21 EUR/MWh.³ It is important to note that selling excess renewable electricity to the grid at this rate assumes that the electricity will be absorbed by the grid when surplus is generated. However, in a future scenario with high renewable energy penetration, this may coincide with periods of low demand or oversupply from other renewable sources. For the purposes of this analysis, this potential constraint has not been considered.

- **Water:** Given the need for water as feedstock to green hydrogen production and its scarcity in Egypt, the production route of hydrogen must include desalination from sea water using renewable electricity. Considering an average water consumption of 10 kg water per kg of H₂, the levelised cost of desalination would add up to USD 0.02/kg H₂ to the LCOH. The analysis does not detail the operation of a desalination unit and considers a specific consumption of electricity and a specific total cost.
- **Electrolyser:** Besides electricity cost, electrolyser is another key factor influencing hydrogen production costs (Cordonnier and Saygin, 2022_[3]). The analysis assumes low-temperature electrolysis with a minimum load factor of 20%. Downstream, a compressor is included to pressurise hydrogen up to 220 bars for storage.
- **Storage:** To enhance system efficiency and prevent excessive oversizing of the renewable power generation plant, both lithium-ion battery energy storage systems (Li-ion BESS) and pressurised hydrogen storage vessels are incorporated for short-duration energy storage.

For the green hydrogen production system, the model is structured within an optimisation framework that determines the optimal sizes of system components and their operation schedule, aiming to minimise the LCOH while ensuring a constant hourly hydrogen output throughout the year. This objective is formulated as a mixed-integer linear programming (MILP) optimisation problem. A cost-optimisation algorithm is implemented in MATLAB and solved using the Gurobi™ solver. The model simulates system operations over an entire year with hourly time resolution. Hourly solar PV and wind electricity generation profiles are based on historical data for the selected plant location, representing a typical year. For each hourly time step, the equations governing the behaviour of each system component are solved, determining the energy flows entering and exiting each component. Economic assumptions for green hydrogen are summarised in Table 2.1.

Table 2.1. Proposed economic assumptions of green hydrogen production

Category	CAPEX		Unit
	Value		
	Low estimate	High estimate	
Solar PV electricity generation plant	600		USD per kilowatt nominal capacity (kWnom)
Onshore wind electricity generation plant	1 100		USD/kWnom
Low-temperature electrolyser	800		USD/kWnom
Ammonia synthesis (from nitrogen and hydrogen)	1.72		Million USD/MW nominal ammonia capacity (MWNH3nom)
Battery Energy Storage System	200	400	USD/kWhe
Ammonia cracking	1.42	2.24	Million USD/MWNH3nom
Discount rate	10%		

Note: Annex A provides the full set of economic assumptions. The analysis adopts a one-year operational time horizon with hourly resolution to assess the Levelised Cost of Hydrogen, allowing for realistic simulation of renewable generation variability and system performance. USD/kWhe refers to dollars per kilowatt-hour of electricity. The USD value assumptions are selected to be in line with the various references in the available literature.

Source: Economic assumptions defined by the OECD Secretariat for the main model system components.

2.2.2. Scenarios for green hydrogen production

Four scenarios are analysed, each differing in the geographic location of renewable electricity generation, hydrogen production and hydrogen demand (Figure 2.2). These variations help identify the optimal system configuration for Egypt to produce the most cost-competitive green hydrogen. For instance, one of key factors that was key aspect to develop these scenarios was availability of renewable energy sources which is key to produce low-cost electricity. In this work, data are extracted for the historical year 2019 from Ninja Renewables (Ninja Renewables, 2025^[4]). The generation output is assumed to increase proportionally with the installed capacity, leveraging the modular nature of the systems considered. The selected locations are Suez area, Gharib Cape and Aswan area. Table 2.2 summarises the renewable generation potential. It is worth mentioning that the PV power generation profiles assume a tilt of 30 degrees, an azimuth of 180 degrees, without tracking. Additionally, 10% system electricity losses⁴ are considered.

Table 2.2. Renewable power generation potential in the selected locations

Location	Solar PV		Onshore wind	
	Average capacity factor	Number of hours without electricity generation	Average capacity factor	Number of hours without electricity generation
Suez	21.7%	4 336	33.5%	6
Gharib Cape	22.3%	4 325	51.1%	3
Aswan area	21.9%	4 304	33.6%	270

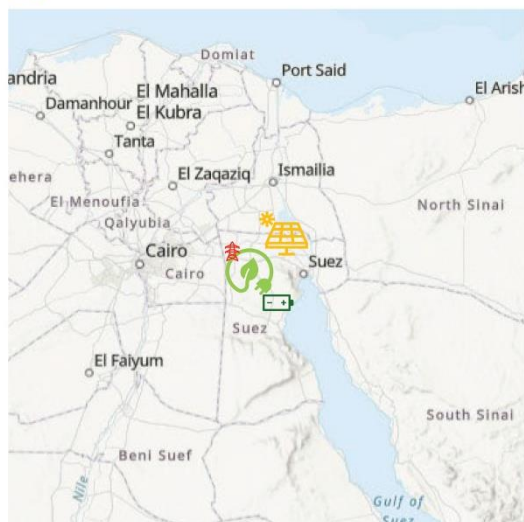
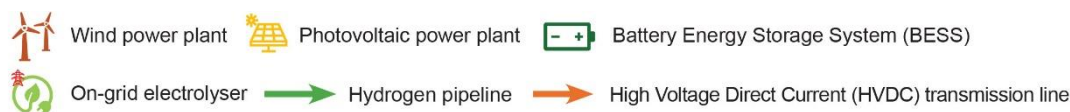
Note: The assumption in this analysis is that PV plants do not generate electricity from sunset to sunrise. Since the model uses an hourly resolution, the number of "dark" hours must be considered. Further details are provided in Annex A.

Source: (Ninja Renewables, 2025^[4]).

The scenarios are defined as follows (Figure 2.2):

- **Scenario A:** This scenario involves establishing a co-located hydrogen production hub near the demand site, with Suez identified as a potential location. Green hydrogen production would be powered by a dedicated local PV and/or wind energy system, with the option to source up to 2%, 5% or 10% of the required electricity from the national grid. Additionally, a sub-scenario is considered, exploring the use of ammonia as an intermediate storage solution. This alternative eliminates the need for pressurised hydrogen tanks and instead requires an ammonia production unit, an ammonia storage tank and an ammonia cracking unit (Section 2.5.1).
- **Scenario B:** This scenario involves establishing a co-located production hub that integrates renewable power generation and electrolysis, with hydrogen transported to demand centres. Gharib Cape has been selected as the production hub, where hydrogen will be generated and then transported via a 230 km pipeline to Suez, the designated demand location.
- **Scenario C:** This scenario involves separating electricity generation from hydrogen production. Renewable power is generated in Gharib Cape and transmitted via a dedicated 230 km high-voltage direct current (HVDC) transmission line to Suez, where green hydrogen is produced and consumed. This approach ensures that green hydrogen production remains close to the demand centre while utilising optimal renewable energy resources from a different location.
- **Scenario D:** In this scenario, electricity generation, green hydrogen production and green hydrogen demand are in different regions, necessitating both electricity transmission and hydrogen transport. Renewable power is generated in the Aswan area and transmitted via a 525 km HVDC transmission line to Gharib Cape, where green hydrogen production occurs. The produced green hydrogen is then transported through a 230 km pipeline to Suez, the designated demand centre.

Figure 2.2. The four proposed scenarios for green hydrogen production



Scenario A



Scenario B



Scenario C



Scenario D

Note: These maps do not reflect Egypt's full territory and are used solely to illustrate the four proposed scenarios. The maps use the administrative divisions of Egypt's governorates. They are sourced from Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS).

Source: Prepared by the OECD Secretariat on the basis of chosen scenarios.

2.3. Blue hydrogen

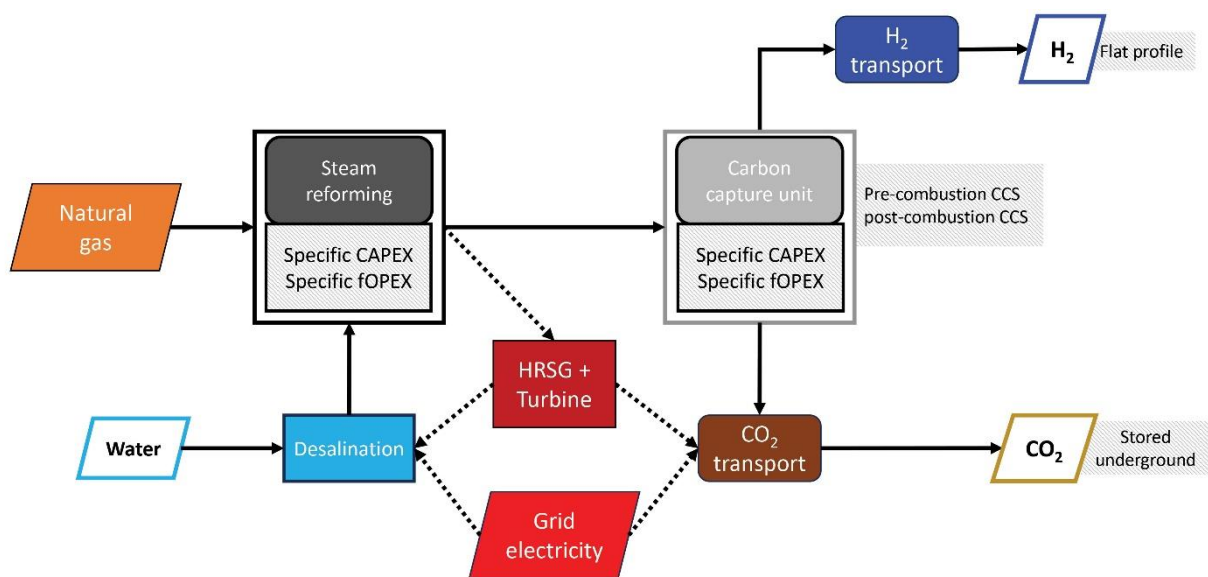
The cost of blue hydrogen depends on the chosen production technology, gas prices and CO₂ transport and storage costs, with carbon capture typically adding USD 0.3-0.5/kg to grey hydrogen cost (Oni et al., 2022^[5]). An additional uncertainty in the estimation of the expected cost of blue hydrogen is associated to the gas price, transportation and storage costs of CO₂ (Oxford Institute for Energy Studies, 2024^[6]).

The analysis considers two different technological options for blue hydrogen production: steam methane reforming (SMR) with post-combustion carbon capture (Figure 2.3) and autothermal reforming (ATR) with carbon capture improving energy efficiency (Figure 2.4).

- **SMR**, in which a typical industrial plant consists of a desulphurization section, a pre-reformer, the primary reformer, water gas shift (WGS) reactors, H₂ purification by pressure swing adsorption (PSA) and a CO₂ separation section from the SMR furnace flue gas. This can be implemented as a retrofit on existing grey hydrogen production plants.
- **ATR**, in which a typical industrial plant consists of a desulphurization section, an air separation unit (ASU), a pre-reformer, the primary reformer, water gas shift (WGS) reactors, a CO₂ separation section from the syngas flow and H₂ purification by PSA.

Both options assume an hourly production capacity of 100 000 normal cubic meters (Nm³) of hydrogen and include the transport of captured CO₂ with a dedicated 250 km pipeline to a potential CCS hub. Details of the methodology, plant configurations and input data can be found in Annex A.

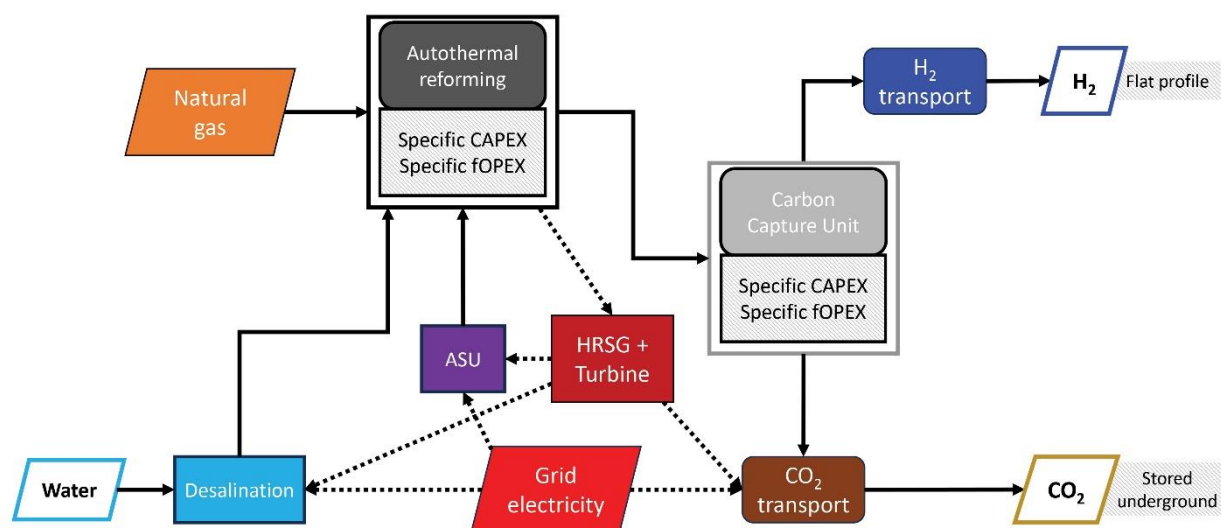
Figure 2.3. Blue hydrogen production via steam methane reforming: system configuration



Note: CAPEX: capital expenditure; CCS: Carbon Capture and Storage; CO₂: carbon dioxide; H₂: hydrogen; HRSG: Heat Recovery Steam Generator; OPEX: operating expenditure; FOPEX: fixed operating expenditure.

Source: Schematic representation prepared by the OECD Secretariat.

Figure 2.4. Blue hydrogen production via autothermal reforming: system configuration



Note: ASU: Air Separation Unit; CAPEX: capital expenditure; CCS: Carbon Capture and Storage; CO₂: carbon dioxide; H₂: hydrogen; HRSG: Heat Recovery Steam Generator; OPEX: operating expenditure; FOPEX: fixed operating expenditure.

Source: Schematic representation prepared by the OECD Secretariat.

2.4. Caveat on green hydrogen and blue hydrogen

Blue hydrogen was included in this report following initial OECD consultations held during the interministerial scoping meeting in June 2023. However, several factors impose significant limitations on its consideration. Existing blue hydrogen projects are not often driven by strict environmental regulations or carbon market mechanisms. Therefore, most plants have been designed to achieve only partial carbon capture rates (typically around 60-70%), which helps in achieving a business case under the current regulatory and market conditions. Higher capture efficiencies of over 90% have not been pursued so far because of the lack of policies justifying the higher cost of CO₂ capture. In a context of stronger regulatory pressure or significantly higher carbon pricing, plants could be designed differently to achieve much higher capture rates, but this has not been the case in large-scale projects so far.

Technically, achieving high capture rates, particularly using ATR, is believed to be feasible, despite the lack of blue hydrogen industrial references. Existing ammonia plants combining SMR and ATR already demonstrate CO₂ capture efficiencies greater than 99% for syngas streams. However, achieving 90% capture from SMR flue gases remains less common, although certain industrial plants have been designed for such purposes, particularly for supplying CO₂ for urea manufacturing (Maporti et al., 2024^[7]). Publicly available performance data from operating facilities remains limited, which introduces uncertainty around real-world capture efficiencies at scale.

Additionally, methane leakages across the natural gas supply chain pose a significant challenge to the environmental credibility of blue hydrogen. Leakage rates are highly site-dependent and given methane's high global warming potential, even small leakages can severely impact the life-cycle emissions of blue hydrogen (Sanchez, 2022^[8]), making robust monitoring and supply chain management essential (Goita et al., 2025^[9]).

Broader uncertainties persist regarding the economic viability, market acceptance, scalability and the management of captured CO₂ in the production process of blue hydrogen. Carbon capture and storage (CCS) remains an emerging technology. Confidence in its commercial viability will depend on the successful realisation of upcoming projects over the next few years (Martin-Roberts et al., 2021^[10]). Finally,

cost and emission intensity estimations for blue hydrogen vary significantly depending on assumptions about capture rates, methane leakage and technology choices (IEEFA, 2022^[11]).

These findings reinforce the view that green hydrogen, despite its higher production cost, offers higher overall viability and is increasingly recognised as the preferred pathway to replace fossil fuel based conventional hydrogen production, accelerate industrial decarbonisation and to decarbonise hard-to-abate sectors. While the analysis presented for blue hydrogen illustrates its theoretical cost competitiveness, the practical limitations – including incomplete CO₂ capture rates, methane leakage risks, regulatory uncertainty and challenges in large-scale CCS deployment – constrain its real-world effectiveness. In contrast, green hydrogen eliminates direct carbon emissions and aligns more closely with Egypt's long-term policy ambitions for sustainable, low-carbon growth. Given Egypt's abundant solar and wind resources, green hydrogen presents a more economically, politically and environmentally viable solution for driving both domestic industrial decarbonisation and green hydrogen exports positioning the country as a competitive player in the global hydrogen economy.

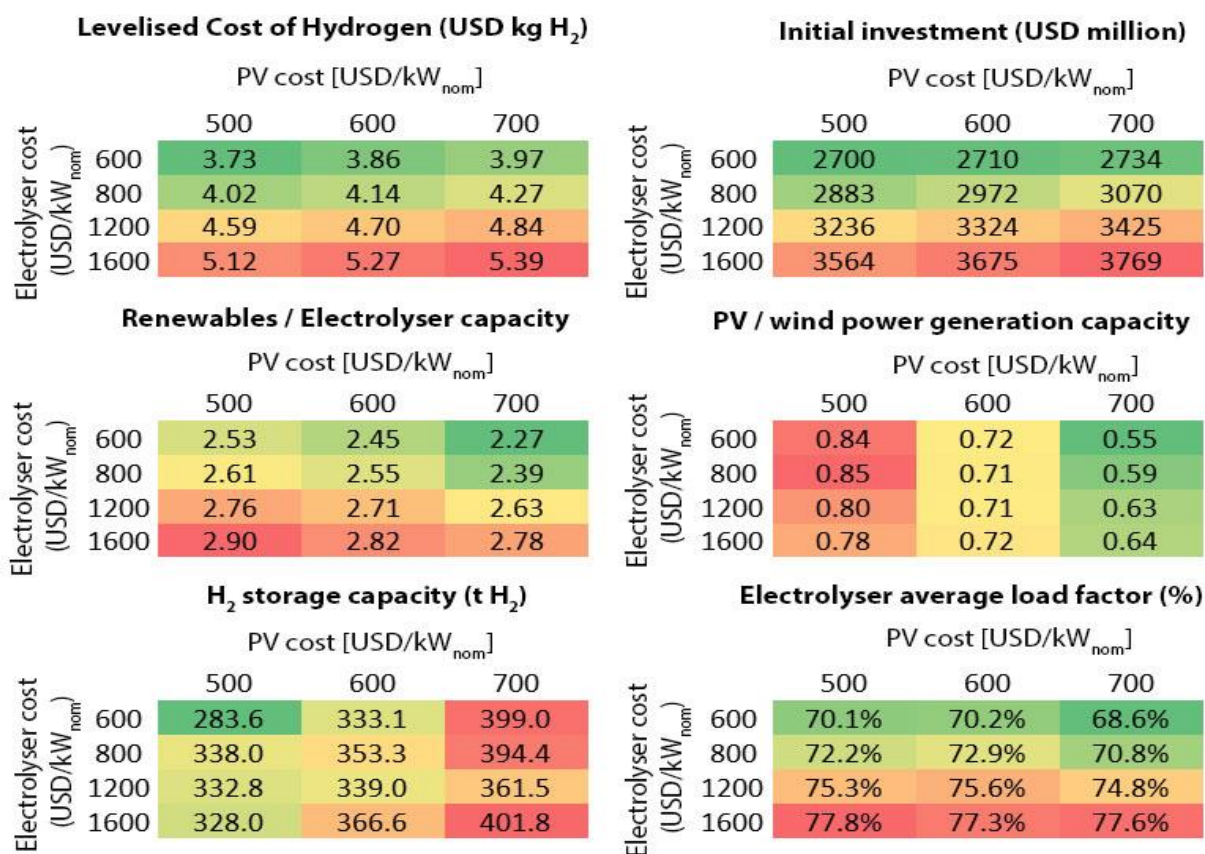
2.5. Results

2.5.1. Green hydrogen

A geographical area with higher wind and solar availability leads to the lowest LCOH, even when accounting for the additional cost of building hydrogen pipelines or HVDC transmission lines (Figure 2.6). This is evident in Scenario B where hydrogen is produced at a co-located hub in Gharib Cape and transported via a 230 km pipeline to Suez and Scenario C where electricity is generated in Gharib Cape and transmitted 230 km via HVDC to Suez for hydrogen production near demand centres. In both cases, superior renewable resource availability in Gharib Cape significantly offsets transport infrastructure costs (Annex B).

The LCOH for optimised systems is estimated at USD 3.7-4.2 per kg H₂ (Figure 2.6). However, the cost remains highly sensitive to electrolyser CAPEX. For instance, doubling the electrolyser cost from USD 800 to 1 600 per kW results in a 27% increase in hydrogen production cost from USD 4.14 to 5.27 per kg of H₂ (Figure 2.5).

Figure 2.5. Sensitivity analysis at 98% dedicated renewable energy sources



Note: Values refer to the case constrained to 4 h of hydrogen storage.
Source: Results of sensitivity analysis prepared by the OECD Secretariat.

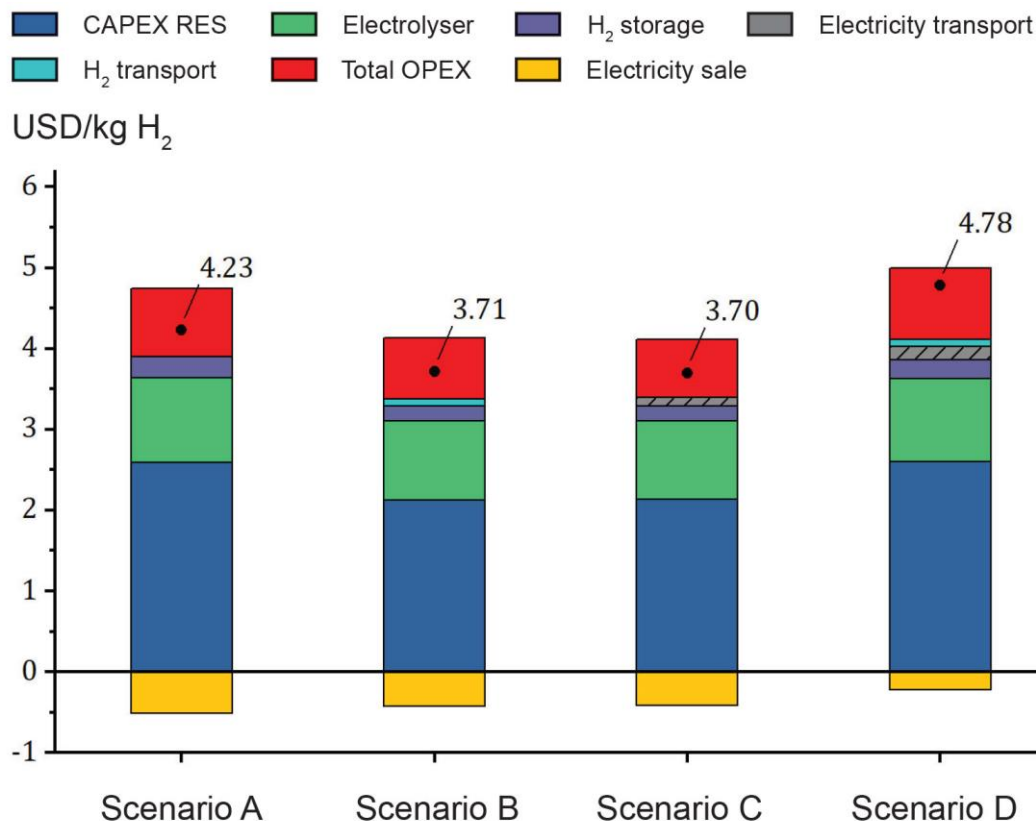
Increasing the share of grid electricity reduces oversizing of renewable energy systems and lowers the need for battery storage, leading to a more cost-effective solution and a significant reduction in LCOH. This approach also stabilises power supply to the electrolyser and helps minimise overall capital costs. However, sourcing electricity from a non-decarbonised grid results in significant indirect emissions, which is incompatible with low-carbon hydrogen standards. For instance, in Scenario A, when taking into account the potential revenue from selling surplus electricity to the grid (rather than curtailing it), the LCOH is USD 8.5/kg H₂ at 98% dedicated renewable input. Allowing for larger grid purchase (e.g. 5% or 10% of the annual electrolyser consumption) leads to lower LCOH values of USD 6.8/kg H₂ and USD 5.5/kg H₂, respectively. The possibility of selling surplus electricity to the grid impacts in a more moderate way the LCOH, for instance by increasing it by approximately USD 1.5/kg H₂. Such increase is, in absolute terms, larger at higher share of dedicated renewable energy sources (RES).

Scenario D demonstrates the benefit of incorporating a mix of RES and grid electricity to reduce oversizing, minimise curtailment and lower overall costs. However, there is a trade-off: increasing the share of dedicated RES from 90% to 100% raises the LCOH from USD 4.19/kg H₂ to USD 5.34/kg H₂ due to additional RES and hydrogen storage capacity required. This illustrates that full reliance on RES is rarely the most cost-effective option.

The most efficient hydrogen production systems have a RES-to-electrolyser nominal power ratio close to 3, supporting higher renewable integration and improved system performance. The RES-to-electrolyser nominal power ratio refers to the ratio between the installed capacity of the RES and the nominal power

capacity of the electrolyser (Hofrichter et al., 2023^[12]). High renewable availability and low seasonal fluctuations allow optimised systems to operate with minimal hydrogen storage, reducing costs and improving overall efficiency. Modelling based on solar and wind profiles in the Suez and Gharib areas identifies an optimal PV/wind capacity ratio of 0.6-0.8 and a renewable-to-electrolyser capacity ratio between 2.5 and 4, supporting cost-effective system performance (Table 2.3).

Figure 2.6. Levelised Cost of Green Hydrogen for the four proposed scenarios



Note: CAPEX RES: capital expenditure for renewable energy sources; H₂: hydrogen; OPEX: operating expenditure.
Source: Results of the techno-economic assessment prepared by the OECD Secretariat. \$

Table 2.3. Optimised renewable energy sources/electrolyser nominal capacity ratio

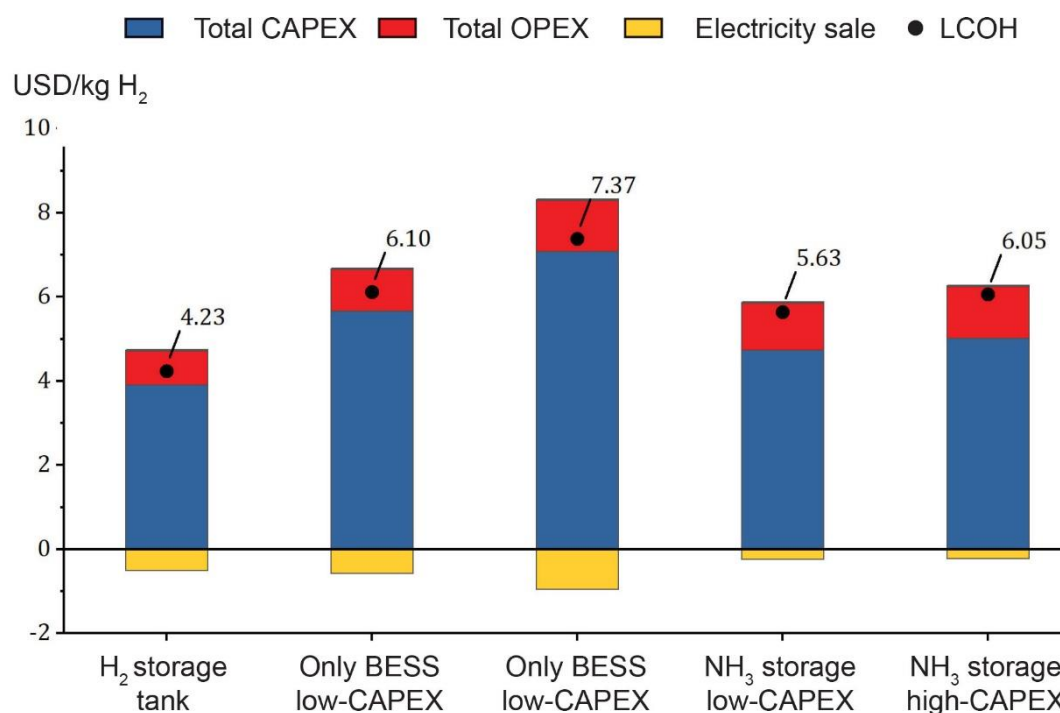
	PV/Wind nominal capacity	RES/Electrolyser nominal capacity
Scenario A	0.76	2.94
Scenario B	0.71	2.55
Scenario C	0.72	2.59
Scenario D	0.95	3.11

Note: PV: photovoltaic; RES: renewable energy sources
Source: Results of the techno-economic assessment prepared by the OECD Secretariat

Pressurised hydrogen tanks emerge as the most cost-effective storage option for hydrogen with lowest LCOH of USD 4.23/kg H₂ (Figure 2.7). Using ammonia as a hydrogen storage vector results in a higher LCOH, increasing by 33% under the low CAPEX estimate and up to 43% under the high CAPEX estimate. The increased storage costs are due both to higher CAPEX of the ammonia production and cracking plants

and to the higher energy losses in hydrogen-to-ammonia-to-hydrogen conversions. The highest LCOH is observed in BESS cases, reaching USD 7.37/kg H₂ for the high CAPEX estimate. The LCOH calculations account for surplus electricity sales at grid price, reflected as negative values in Figure 2.7. Annex B provides a detailed analysis of the four green hydrogen LCOH scenarios.

Figure 2.7. Levelised Cost of Green Hydrogen with different storage options



Note: The estimates are calculated at 98% dedicated renewable energy sources. BESS: Battery Energy Storage System; CAPEX: capital expenditure; H₂: hydrogen; LCOH: Levelised Cost of Hydrogen; NH₃: ammonia; OPEX: operating expenditure.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

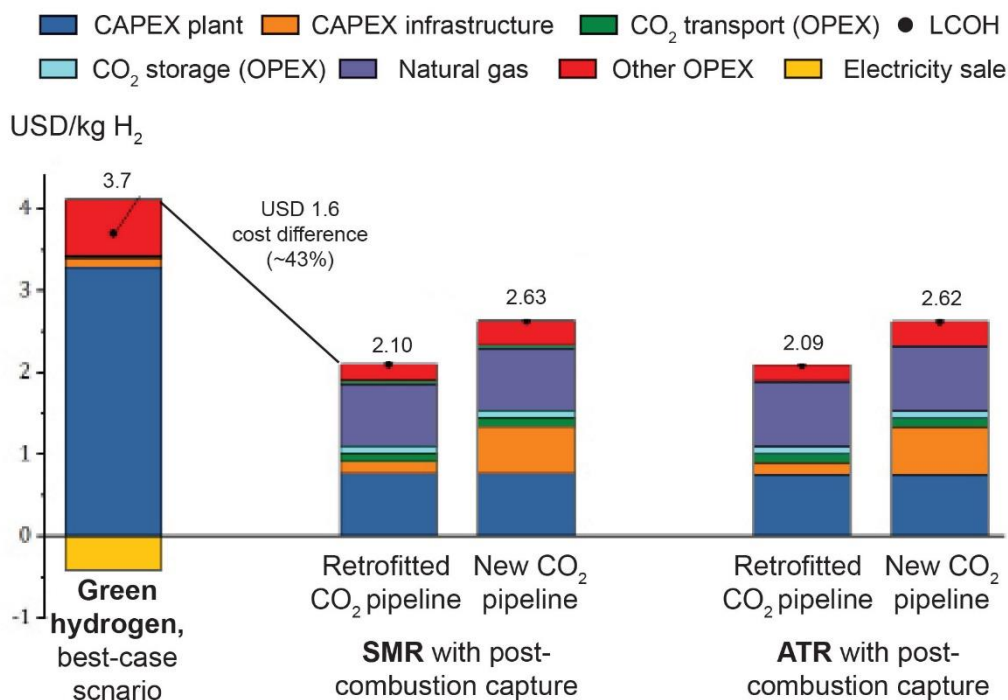
2.5.2. Blue hydrogen

Blue hydrogen produced with ATR or SMR technologies have very similar results with a slightly lower LCOH for ATR. The retrofitting of existing pipelines is cheaper compared to building new CO₂ pipelines. While ATR with pre-combustion capture and the potential use of an existing pipeline shows the lowest LCOH, the cost advantage over SMR is marginal. However, a key cost driver in both cases is the CO₂ transport and storage infrastructure. These costs could be significantly reduced if shared with other emitters, such as cement plants, highlighting the potential value of a co-ordinated, hub-based approach to CO₂ infrastructure.

Natural gas prices are the dominant cost driver for blue hydrogen production, making the overall cost structure highly sensitive to fuel price volatility. In this analysis, a natural gas price of USD 6.0/MMBtu is assumed (Annex B), consistent with Egypt's regional market conditions. The results show only a marginal difference between the two technologies. These findings highlight the critical importance of transparent and realistic gas price assumptions when assessing the cost competitiveness of blue hydrogen relative to green alternatives. Even modest shifts in gas prices could substantially alter the LCOH, reinforcing the economic uncertainty surrounding blue hydrogen pathways.

Comparing blue hydrogen with the best-case scenario for green hydrogen production, blue hydrogen production (using both SMR and ATR technologies) remains 43% cheaper than green hydrogen (Figure 2.8). However, for blue hydrogen to be classified as low carbon, emissions across the entire value chain, particularly methane leakage, must be carefully monitored.

Figure 2.8. Levelised Cost of Blue Hydrogen production for the proposed cases



Note: ATR: autothermal reforming; CAPEX: capital expenditure; CO₂: carbon dioxide; LCOH: Levelised Cost of Hydrogen; OPEX: operating expenditure; SMR: steam methane reforming.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

2.6. Green hydrogen derivatives

Green hydrogen derivatives include green ammonia, green steel/reduced iron and e-methanol. Green hydrogen can be converted or synthesised into other energy carriers or hydrogen-based products when refined with either nitrogen for e-ammonia or CO₂ for e-methanol and e-kerosene. Derivative commodities produced using green hydrogen will play a significant role in low-carbon hydrogen market growth (IRENA, 2024^[13]). Moving gaseous green hydrogen itself over long distances may be technically challenging due to its low volumetric energy density. Therefore, the derivatives may be easier to ship intercontinentally. To ensure the credibility and market acceptance of these products, reliable certification schemes are essential to verify their environmental integrity and build consumer confidence (IRENA-RMI, 2023^[14]). The following sections present the results of the assessment on green hydrogen derivatives, focusing on green ammonia, green steel and reduced iron, as well as e-methanol.

2.6.1. Green ammonia

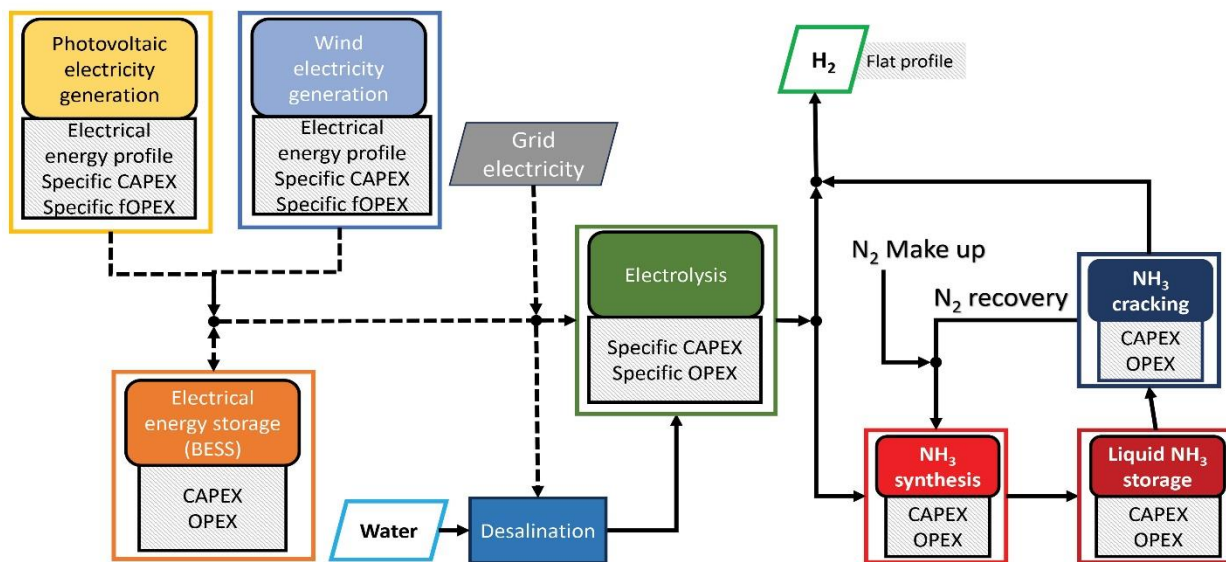
Ammonia has been produced on an industrial scale and serves as a fundamental chemical with various applications globally. Particularly, ammonia plays a crucial role in the agriculture sector as about 80% of ammonia is used to produce fertilisers. Egypt is considered the 8th largest ammonia exporter and the

average ammonia production reaching 5.5 million tonnes in 2020 (UNIDO, 2023^[15]). Currently, ammonia is primarily produced using the Haber-Bosch (HB) process, which combines hydrogen and nitrogen (Kojima and Yamaguchi, 2022^[16]). The hydrogen required for this process is sourced from natural gas through steam reforming, making the ammonia industry a significant CO₂ emitter, contributing over 400 Mt of CO₂-eq annually worldwide (Müller et al., 2024^[17]) and accounting for more than 1.2% of the world's carbon emissions (Irfan et al., 2024^[18]).

Ammonia is emerging as a promising low-emission energy carrier, particularly for hydrogen transport globally (IEA, 2024^[19]). Ammonia has a key advantage over pure hydrogen due to its higher energy density and lower liquefaction temperature, making it much easier to store and transport (IEA, 2021^[20]). Additionally, unlike hydrogen, ammonia already has well-established infrastructure and handling practices for storage, distribution and export (Erdemir and Dincer, 2024^[21]). As such ammonia is widely recognised as cost-effective hydrogen carrier, particularly for long-distance transport (e.g. Australia to Japan or Chile to Europe (Thyssenkrupp, n.d.^[22]). However, ammonia is highly toxic, and the safety measures required for its use are stringent and comprehensive, involving strict protocols for transport and handling. While ammonia holds significant potential as a low-emission energy carrier, its deployment at scale will depend on balancing its logistical benefits with robust safety standards and risk management practices.

In Scenario 1 of the green hydrogen analysis presented earlier, the cost competitiveness of green ammonia production was evaluated by examining the Levelised Cost of Ammonia (LCOA). The case is considered as an alternative approach to short term hydrogen storage. Instead of using pressurised hydrogen tanks, the system boundary converts hydrogen into ammonia for storage, later breaking it back down into hydrogen to ensure a steady and reliable supply (Figure 2.9).

Figure 2.9. Green ammonia for local storage: system configuration

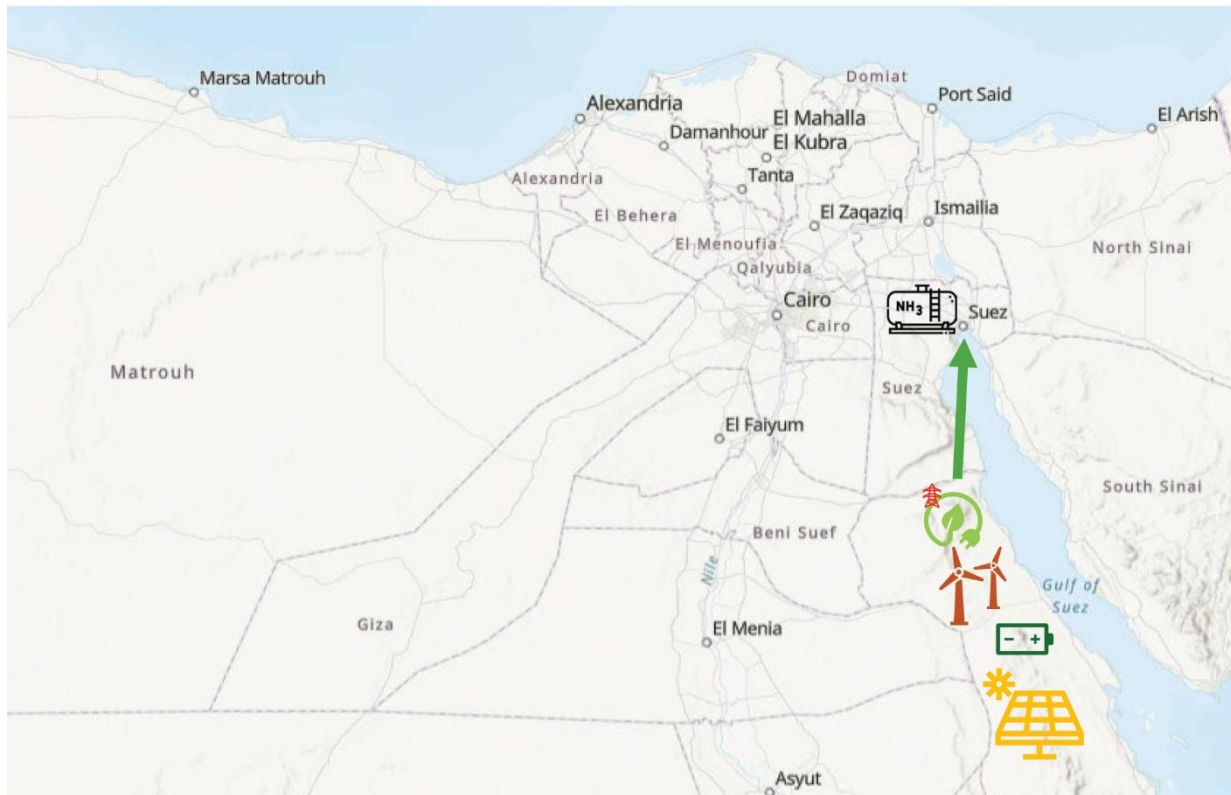
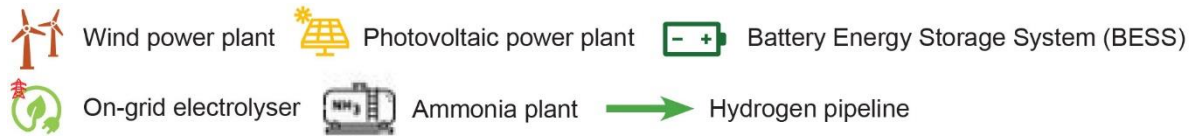


Note: BESS: Battery Energy Storage System; CAPEX: capital expenditures; H₂: hydrogen; N₂: nitrogen gas; NH₃: ammonia; OPEX: operating expenditure; fOPEX: fixed operating expenditure.
 Source: Schematic representation prepared by the OECD Secretariat.

The analysis has been conducted under the assumption that 50 kt/year of green ammonia (corresponding to 8.8 kt H₂/year) is produced for export. The system size assumption aligns with Egypt's Scatec project. The hydrogen is assumed to be produced in Gharib Cape, then transported 230 km to the Suez area where the production of ammonia will take place as illustrated in Figure 2.10. The green ammonia is then exported

to northern Europe considering a shipping distance of 6 000 km with an added cost of USD 1 per gigajoule (GJ_{LHV}) (USD 18.8/ t_{NH_3}) (Figure 2.10).

Figure 2.10. Green ammonia for export

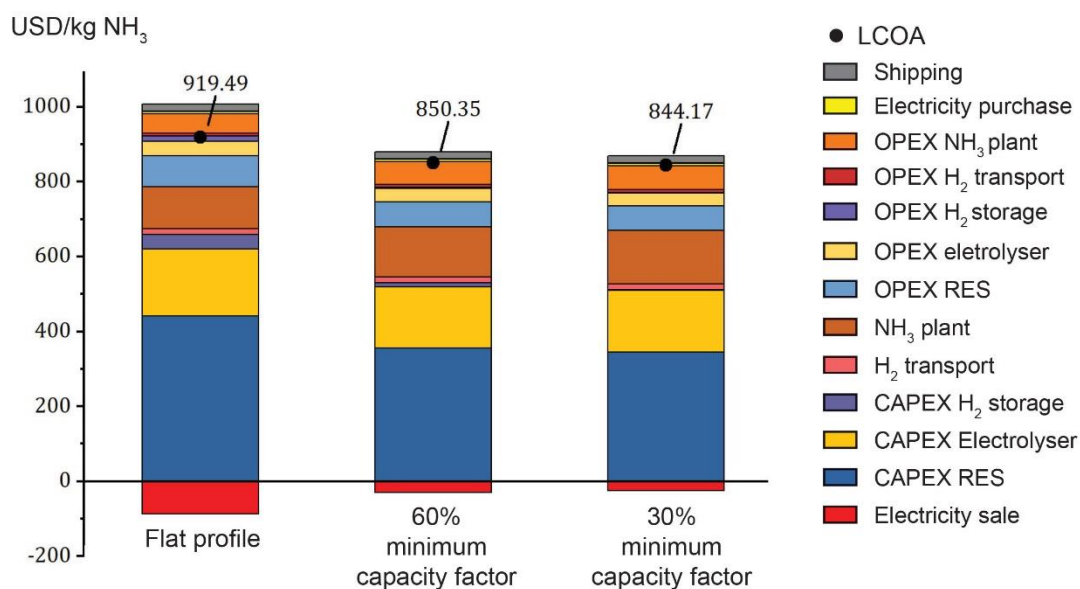


Note: This map does not reflect Egypt's full territory and is used solely to illustrate the proposed scenario. The map uses the administrative divisions of Egypt's governorates, sourced from Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS).

Source: Prepared by the OECD Secretariat on the basis of the chosen scenario.

The lowest LCOA was USD 844/ t_{NH_3} , assuming a flexible ammonia plant with 30% minimum capacity factor (Figure 2.11). The added flexibility on ammonia plant results in a reduction of the LCOA compared to inflexible ammonia plant with flat production profile. Similar to the green hydrogen cases, green ammonia production CAPEX is intensive, representing more than 79% of the LCOA with the RES plant representing more than 51% of the total CAPEX.

Figure 2.11. Green ammonia: impact of the NH₃ synthesis minimum capacity factor



Note: CAPEX: capital expenditure; H₂: hydrogen; LCOA: Levelised Cost of Ammonia; NH₃: ammonia; OPEX: operating expenditure; RES: renewable energy sources.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

2.6.2. Green steel: green iron for export to the European Union

The steel industry is the second-largest emission intensive sector globally, accounting for approximately 8% of the total global CO₂ emissions, primarily due to its reliance on coal (Aziz et al., 2022^[23]). Iron is manufactured through two major routes, namely blast furnace (BF) and direct reduction iron (DRI) (Fan and Friedmann, 2021^[24]). The integrated blast furnace - basic oxygen furnace (BF-BOF) steel production route is the most common steel production route, accounting for roughly 70% of global steel production (IEA, 2020^[25]). The large majority of emissions of steel production stem from the iron-making stage (Aziz et al., 2022^[23]). In the BF-BOF route, representing around 70% of steel production worldwide, the production of one tonne of crude steel results in approximately 1.8 tonnes of CO₂, reflecting best available technology (BAT) levels or the performance of newly constructed facilities. However, Egypt does not operate BF-BOF plants, and its iron production primarily relies on natural gas – based direct reduced iron (DRI) processes, which emit approximately 1 tonne of CO₂ per tonne of crude steel (Worldsteel, 2024^[26]).

The use of green hydrogen presents a transformative solution for decarbonising the steel industry. In DRI plants, iron is typically produced by a H₂-CO-CH₄ reducing gas produced from natural gas. By replacing coal- or natural gas-based methods with green hydrogen, the world steel industry could cut significantly emissions annually while maintaining high-quality iron and steel production (Bararzadeh Ledari et al., 2023^[27]). Replacing conventional blast furnace steelmaking with green hydrogen-based DRI can reduce carbon emissions by up to 95%, cutting CO₂ intensity from around 1.8-2 t CO₂/t steel to as low as 0.1-0.76 t CO₂/t steel. In Egypt, three steel companies operate DRI plants, namely Ezz Steel, Beshay Steel and Suez Steel Company (Oxford Institute For Energy Studies, 2021^[28]). However, green hydrogen is not yet used as it lacks economic competitiveness.

For all three scenarios analysed, Suez is selected as a potential hydrogen production location and shipping port connecting Egypt to the European market. The analysis uses a simplified approach in which hydrogen is considered to be purchased at a cost equal to the LCOH, selecting the lowest value obtained in LCOH analysis for green hydrogen earlier. The percentage of the dedicated renewable electricity selected for this

analysis is 98%. The analysis is also limited to the DRI production, without including the costs for the conversion of DRI into steel in electric arc furnaces. Detailed assumptions for this analysis are specified in Annex A.

In order to assess the current cost competitiveness of green iron production in Egypt, the assessment explores three scenarios reflecting the country-specific context and production conditions (Figure 2.12):

- **Scenario 1, local production:** green hydrogen and green DRI are co-produced in Egypt and shipped 6 000 km to Germany via Gibraltar.
- **Scenario 2, pipeline hydrogen transport:** green hydrogen is produced in Egypt and transported via a 1 000 km submarine pipeline to Greece, then continues 2 000 km via pipeline to Germany for green steel production.
- **Scenario 3, green ammonia as a hydrogen carrier:** green hydrogen from Egypt is converted into green ammonia to reduce transportation costs. The liquefied NH₃ is shipped 6 000 km to Germany, where it is reconverted (cracked) into hydrogen for green steel production.

Figure 2.12. Three proposed scenarios for green iron export to the European Union

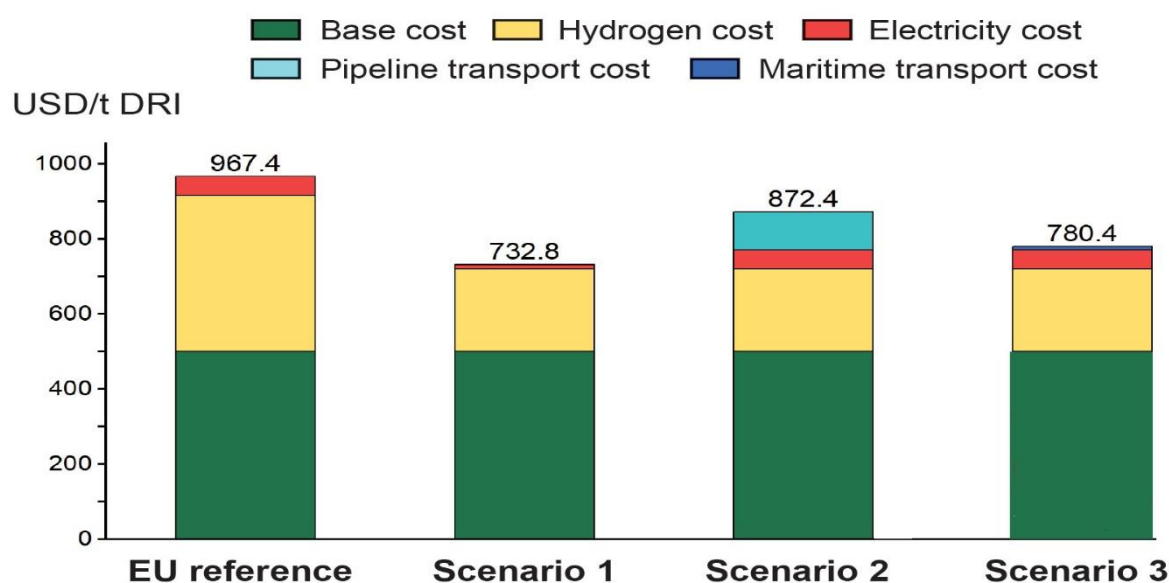


Source: Prepared by the OECD Secretariat on the basis of chosen scenarios.

The analysis shows that producing green iron in Egypt offers a significant cost advantage. This is primarily driven by Egypt's access to low-cost green hydrogen and renewable electricity, maritime transport having minimal impact on overall costs. Scenario 1 yielded the lowest Levelised Cost of Iron (LCOI), at USD 732.8 per tonne of Direct Reduced Iron (DRI), largely due to Egypt's competitive energy inputs. It makes nearly 25% more cost-effective than EU-based green iron production (Figure 2.13).

Maritime transport is found to have a minor impact on the cost by adding only USD 1.8/t DRI. It is because producing green hydrogen in Egypt significantly reduces the LCOI, nearly halving the hydrogen cost per tonne of DRI from USD 416.8 in the EU to USD 220.4 in Egypt. Additionally, Egypt's lower renewable electricity costs reduce DRI production electricity expenses from USD 50.6/t DRI in the EU to USD 10.6/t DRI. The green section of Figure 2.13 represents the base cost, which includes iron ore supply, DRI CAPEX depreciation and DRI OPEX. Scenario 3 is the second most cost-effective option at USD 780.4/t DRI, while Scenario 2 results in the highest LCOI with USD 872.4/t DRI. This is however still more competitive than the EU-based production cost of green iron estimated at USD 967.4/t DRI (Table 2.4).

Figure 2.13. Levelised Cost of Green Iron for the three proposed scenarios



Note: DRI: Direct Reduced Iron.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Table 2.4. Cost breakdown of proposed scenarios per tonne of Direct Reduced Iron

Type of costs	EU reference	Scenario 1	Scenario 2	Scenario 3
	Green H ₂ & DRI production in EU	H ₂ & DRI production in Egypt	H ₂ production in Egypt + H ₂ transport + DRI production in EU	H ₂ production in Egypt + NH ₃ transport + DRI production in EU
Base cost	500	500	500	500
Hydrogen production	416.8	220.4	220.4	220.4
Electricity input to DRI plant	50.6	10.6	50.6	51.1
Electricity input to NH ₃ synthesis (in Egypt) and cracking (in EU)	-	-	-	0.51
Maritime transport	-	1.8	-	8.9
Pipeline transport	-	-	101.4	-
Total, USD/t_{DRI}	967.4	732.8	872.4	780.4

Note: DRI: Direct Reduced Iron; EU: European Union; H₂: hydrogen; NH₃: ammonia.

Source: Results of techno-economic assessment prepared by the OECD Secretariat.

2.6.3. E-methanol

Methanol (MeOH) is produced from synthesis gas, a mixture of hydrogen, carbon dioxide and carbon monoxide. As of 2019, global methanol production reached approximately 98 million tonnes per year, generating an estimated 300 Mt of CO₂ emissions annually – around 10% of total emissions from the chemical and petrochemical sector (IRENA and Methanol Institute, 2021^[29]). Methanol production can transition to biomass-derived or synthetic feedstocks using CO₂ and renewable hydrogen, thereby significantly reducing emissions (Saygin and Gielen, 2021^[30]).

As the global push toward carbon neutrality and associated socio-economic benefits increases, market demand for sustainable alternatives to fossil fuels is rising, particularly in hard-to-abate sectors such as

shipping and chemical production. Produced by combining green hydrogen with captured CO₂, e-methanol offers a viable low-carbon shipping fuel and feedstock solution for chemicals production (Palys and Daoutidis, 2022^[31]; Mærsk Mc-Kinney Møller Center, 2011^[32]). E-methanol has several benefits compared to fossil fuels. The combustion of this fuel results in lower levels of harmful pollutants, and thereby also contributes to improving air quality. As a liquid, it is easier, safer and more cost-effective to store, transport and handle, especially since existing infrastructure can be leveraged. It is also a highly efficient and versatile fuel as it is produced from renewable hydrogen (IRENA and Methanol Institute, 2021^[29]).

According to ECHEM,⁵ Egypt produced one million tonnes of methanol in 2019, and half of the production is consumed domestically. As of April 2025, Egypt is discussing the implementation of e-methanol projects.⁶ Egypt's growing pipeline on green methanol production, despite the differing production routes and feedstocks of green methanol and e-methanol,⁷ presents a significant opportunity to decarbonise the sector. Leveraging its ample renewable energy resources, Egypt can utilise these resources for green hydrogen production, specifically enabling large-scale e-methanol manufacturing, and thereby contributing to a circular carbon economy and substantial GHG emission reductions.

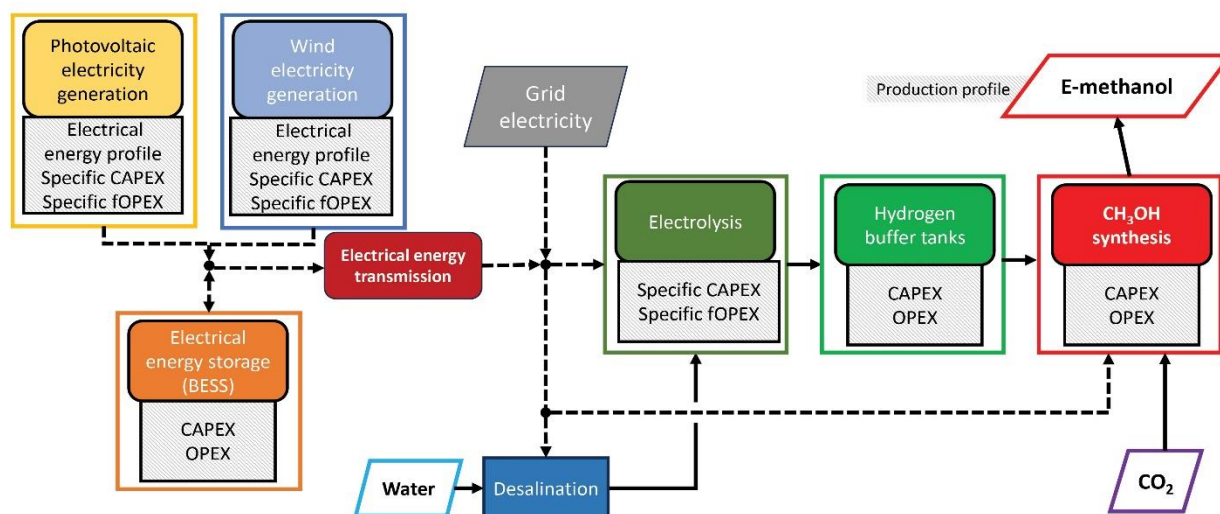
Reflecting these market developments, the analysis explores the potential conversion of hydrogen to methanol for export with a view to evaluating the cost competitiveness of e-methanol production in Egypt. The analysis assumes the production of 500 kt/year of e-methanol, corresponding to 93.5 kt H₂/year. The evaluated e-methanol production system is schematised in Figure 2.11. Under this scenario, green hydrogen is produced in Gharib Cape, then transported for 230 km through a pipeline to the Suez area where the production of e-methanol takes place. Flexible operation of the methanol production plant is considered with a minimum capacity factor of 30%. The technical and economic assumptions are specified in Annex A.

The analysis evaluates three scenarios to assess the impact of renewable electricity share and CO₂ sourcing on the Levelised Cost of Methanol (LCOM):

- Scenario 1: 100% dedicated renewable energy sources with CO₂ supplied via direct air capture (DAC), assuming a cost of USD 300/t CO₂.
- Scenario 2: 98% dedicated renewable energy sources (allowing up to 2% grid electricity) with CO₂ also sourced via DAC at the same cost assumption.
- Scenario 3: 98% dedicated renewable energy sources, with CO₂ captured from an industrial emitter, assuming zero CO₂ cost since capture costs are borne by the emitter.

The CO₂ supply is adjusted based on hydrogen availability in all cases. These scenarios are compared based on their resulting LCOM to identify the most cost-effective configuration.

Figure 2.14. E-methanol production: system configuration



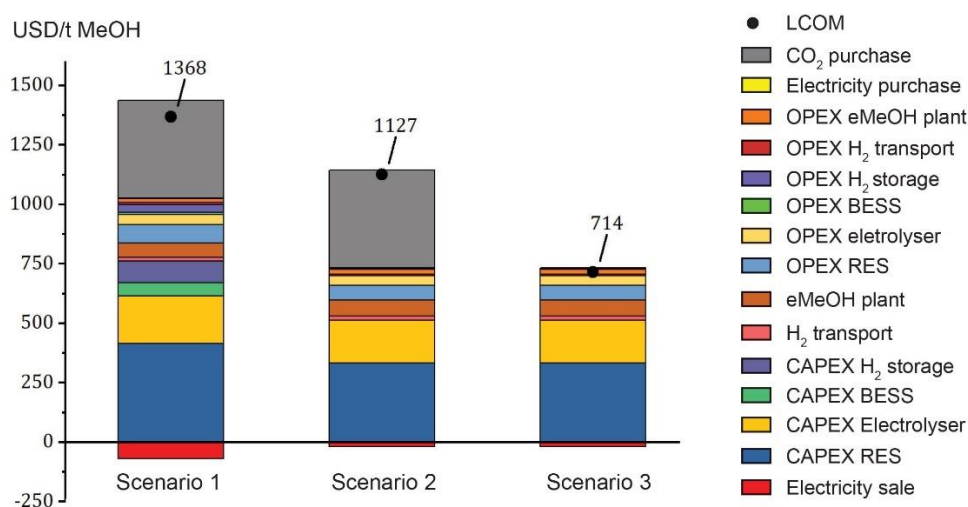
Note: BESS: Battery Energy Storage System; CAPEX: capital expenditure; CH₃OH: methanol; CO₂: carbon dioxide; H₂: hydrogen; N₂: nitrogen gas; NH₃: ammonia; OPEX: operating expenditure; FOPEX: fixed operating expenditure.

Source: Schematic representation prepared by the OECD Secretariat.

Utilising CO₂ from industrial emitters, combined with the option to sell surplus electricity, offers the lowest-cost pathway for green methanol production. Scenario 3, which utilises CO₂ from an industrial emitter with 98% dedicated renewable energy sources, results in an LCOM of USD 732/t MeOH. This estimate slightly decreases to USD 715/t MeOH when the revenues from excess electricity sales are factored in. Scenario 2, which uses CO₂ from DAC with 98% dedicated RES (allowing up to 2% grid electricity for flexibility), has an estimated LCOM of USD 1 127-1 144/t MeOH, depending on how excess electricity sales are accounted for. Scenario 1, relying on CO₂ from DAC with 100% dedicated renewable energy supply, results in the highest LCOM at USD 1 368-1 438/t MeOH. In all three scenarios, the CAPEX of the renewable energy plants and electrolysers represents the biggest contributor (Figure 2.15). For Scenarios 2 and 3, considering DAC, the provision of CO₂ accounts for USD 412.5/t MeOH.

The LCOM for e-methanol is highly sensitive to the renewable energy configuration and the degree of grid reliance. In Scenario 1, which relies on 100% dedicated renewable energy, the LCOM reaches USD 1 368/t MeOH. This is due to the need for significant oversizing of renewable capacity and the inclusion of 486 MWh of BESS and 855 t of H₂ storage to ensure uninterrupted production. The RES-to-electrolyser capacity ratio in this case is 2.3 (Table 2.5). By comparison, Scenario 2 allows up to 2% of electricity demand to be met by grid supply, reducing the LCOM to USD 1 127/t MeOH. This flexibility lowers the RES-to-electrolyser ratio to 1.9 and eliminates the need for BESS and H₂ storage. The increase in LCOM between Scenario 2 and Scenario 1 highlights the cost penalty of achieving a fully off-grid renewable configuration.

Figure 2.15. Levelised Cost of E-methanol for the three proposed scenarios



Note: BESS: Battery Energy Storage System; CAPEX: capital expenditure; eMeOH: methanol; H₂: hydrogen; LCOM: Levelised Cost of Methanol; OPEX: operating expenditure; RES: renewable energy sources.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Table 2.5. Proposed economic assumptions of scenarios for e-methanol production

Item	Unit	Scenario 1	Scenario 2	Scenario 3
CO ₂ source	-	DAC	DAC	Industrial emitter
Percentage of dedicated RES	%	100	98	98
PV power generation plant	MW	592	233	233
Onshore wind power generation plant	MW	1 447	1 295	1 295
Low-temperature electrolyser	MW	884	802	802
Battery Energy Storage System	MWh	486	-	-
Equivalent energy storage capacity	H	0.73	-	-
H ₂ storage	ton _{H₂}	855	-	-
Equivalent H ₂ storage capacity	H	80.1	-	-
H ₂ transport pipelines	Km	230	230	230
e-Methanol synthesis	t/h	68	77	77
Grid electricity share	%	-	2.0	2.0
Levelised Cost of E-methanol	USD/t _{MeOH}	1 438	1 144	732

Source: Techno-economic assessment prepared by the OECD Secretariat.

2.7. Key findings and conclusions

This chapter presented a comprehensive techno-economic assessment of low-carbon hydrogen production in Egypt, focusing on both green and blue hydrogen pathways. Using a robust modelling framework tailored to Egypt's context, the analysis simulates hourly system operations to estimate the LCOH across four green hydrogen scenarios.

Results indicate that Egypt's abundant and stable renewable energy resources enable highly cost-competitive green hydrogen production. The most efficient configurations achieve an LCOH as low as USD 3.7/kg H₂, supported by optimal renewable-to-electrolyser capacity ratios and minimal reliance on

costly storage. This remains, however, above the price of USD 1.8/kg H₂ by 2040 envisioned in Egypt's National Low-Carbon Hydrogen Strategy, which assumes a production scale of 6-10 Mt per year.

Egypt could significantly narrow the gap between cost estimates in this report and strategic price targets by implementing measures to strengthen its enabling investment environment. Moreover, potential reductions in CAPEX thanks to technological learning are expected between by 2040. While such advancements – driven by innovation, economies of scale and policy support – are likely to lower costs over time, their impact is deliberately excluded from this assessment to maintain consistency in assumptions. Readers should therefore interpret the findings as indicative and comparative rather than definitive.

In assessing green hydrogen derivatives, the findings highlight Egypt's potential to competitively produce green ammonia, green iron and e-methanol for export markets. Producing green iron domestically and exporting it results in a 25% cost advantage over producing green hydrogen based DRI in the EU, primarily due to lower green hydrogen production and renewable electricity generation costs. For e-methanol, sourcing CO₂ from industrial emitters yields the lowest production cost at USD 732/t MeOH, underlining the importance of accessible CO₂ sources.

These findings reinforce Egypt's potential to become a regional hub for low-carbon hydrogen and its derivatives, if investment conditions and infrastructure are strengthened. Building on this analysis, Chapter 3 assesses investment needs to scale up low-carbon hydrogen in Egypt and relevant financial solutions required to close the competitiveness gap for green hydrogen and its derivatives against fossil fuel-based counterpart in Egypt.

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Notes

¹ As indicated earlier in the report, the OECD estimations are not derived from Egypt's National Low-Carbon Hydrogen Strategy. Instead, they result from a technical-economic assessment based on a consistent set of assumptions. As with any such assessment, results may vary depending on underlying assumptions, including technology costs, financing conditions and operational parameters.

²The 10% grid electricity share reflects the upper bound of a sensitivity analysis, not a fixed design parameter. Incorporating a limited grid contribution can significantly reduce the required installed capacity of renewables and storage, whose production and deployment carry notable embedded emissions. Although this may slightly increase operational emissions, the net impact can be a lower overall carbon footprint. The final scenario assumes only 2% grid electricity, limiting its influence on both LCOH and lifecycle emissions negligible.

³ This is the wholesale price announced by EgyptERA. While this reflects currently subsidised tariffs, subsidies may be phased out in the future.

⁴ The 10% system losses account for internal losses within the generation plant such as inverters, transformers, self-consumption, etc. In scenarios with electricity transmission, additional transmission losses are included.

⁵ Methanex is the only company that produces methanol in Egypt and the plant is located in Damietta with a total annual production capacity of 1.3 Mt.

⁶ In 2023, Egypt has made a step towards establishing the country's first green methanol production project which will include investments of about USD 450 million and produce 40 000 tonnes of green methanol per year led by Egypt's Alexandria National Refining and Petrochemicals Company (ANRPC) and Norwegian renewable energy solutions provider Scatec in collaboration with the Egyptian Bioethanol Company (Minister of Petroleum and Mineral Resources, 2023^[34]). In addition, in December 2024, Scatec ASA signed a memorandum of understanding to develop a USD 1.1 billion green methanol facility near the Suez Canal, featuring a 190-MW electrolysis plant powered by 317 MW of wind and 140 MW of solar energy, to produce 100 000 tonnes of green methanol annually by 2027 for ship bunkering.

⁷ Green methanol is produced from biomethanol (i.e. gasification of biomass and agricultural wastes) and e-methanol (i.e. CO₂ captured and green hydrogen from electrolysis) (Varela et al., 2024^[33]).

3

Assessing financial solutions for low-carbon hydrogen in Egypt

Chapter 3 estimates that scaling Egypt's green hydrogen sector to achieve a production capacity of 1.5 Mt per year is estimated to require approximately USD 46 billion in cumulative investment between 2025 and 2030. To help attract this investment and the related financing need, an investor survey was conducted to identify effective financial solutions that comprise a suite of economic and de-risking instruments such as CAPEX grants, green premiums, carbon price, foreign exchange guarantees, offtake guarantees and concessional loans. Building on the survey results, further analysis and stakeholder consultations identified a blended approach – prioritising CAPEX grants and concessional loans – as the most practical and cost-effective option for scaling green hydrogen and its derivatives. In addition, Contracts for Difference (CfDs) emerge as a critical instrument for providing offtake certainty in uncertain market conditions.

3.1. Objective

Based on the cost competitiveness analysis of green hydrogen and its derivatives compared to fossil fuels counterparts (Chapter 2), this chapter aims to assess viable financial solutions and enabling investment conditions that can reduce this cost-competitive gap. To ensure their applicability in Egypt, the chapter assesses: (i) the required infrastructure for green hydrogen production in Egypt, including transmission grid and green hydrogen pipelines; (ii) investment needs required to fulfill Egypt's National Low-Carbon Hydrogen Strategy targets; and (iii) the relevant economic or de-risking instruments identified based on discussions with key stakeholders, including industry representatives, policymakers, investors and international partners.

3.2. Required infrastructure for green hydrogen production in Egypt

3.2.1. Renewable energy and battery energy storage systems

Deploying additional renewable energy capacity is critical to unlock green hydrogen production in Egypt. As discussed in Chapter 1, Egypt aims to improve its regulatory framework and enabling environment to encourage green investment, notably in renewable energy projects (i.e. Benban Solar Park expansions, ACWA Power's 2 GW wind farm, AMEA Power's 1 GW solar project, and the Masdar-led 10 GW wind farm). Battery Storage Energy Systems (BESS) help mitigate the intermittency of solar and wind power generation by storing excess energy during peak production for later use. This enables more stable and efficient electrolyser operation, reduces reliance on grid power and avoids the need to oversize renewable energy capacity, ultimately reducing the LCOH (Kwon et al., 2024^[1]). Deployment of renewable energy and BESS can ensure consistent and reliable renewable power supply, lowers the LCOH and enhances the overall economic viability and efficiency of green hydrogen production, making it a more competitive and scalable solution for decarbonising various sectors.

Recent project developments in Egypt indicate a clear preference for integrating BESS with large-scale renewable energy projects. AMEA Power is actively developing major standalone BESS projects (totalling 1.5 Gigawatt-hour [GWh] across Zafarana and Benban) alongside solar-plus-storage initiatives, including a 1 GW solar project paired with 600 MWh of BESS in Benban and a 500 MW solar expansion at Abydos with 300 MWh of BESS (Colthorpe, 2025^[2]). Similarly, Scatec is progressing with a 1 GW solar project combined with a 100 MW/200 MWh BESS (Scatec, 2025^[3]). These investments demonstrate a strategic move to stabilise the grid and enhance the reliability of intermittent renewable energy sources, both of which are essential for supporting a steady and cost-effective power supply for developing green hydrogen electrolysers in the future.

3.2.2. Transmission grid and hydrogen pipelines

Transmission grid

Unlocking transmission grid capacity and investment is critical to ensure grid-scale renewable integration and green hydrogen production in Egypt (Denis, 2026^[4]). To support Egypt's growing generation capacity in line with its renewable and clean energy targets for its power mix – 42% by 2030 – as well as the deployment of green hydrogen projects requiring between 19 GW and 41 GW of installed renewable energy capacity (as outlined in the National Low-Carbon Hydrogen Strategy), EETC is actively expanding and modernising the high-voltage grid infrastructure. In 2020 alone, EETC allocated approximately EGP 7.7 billion to improve network efficiency and reduce transmission losses (United Nations Economic Commission for Africa, 2023^[5]). The MoERE developed a USD 2 billion investment programme to 2028 to strengthen the transmission network and enhance grid stability as the system shifts to a new model based

on increasing volumes of intermittent renewable energy (EBRD, 2024^[6]). Concurrently, the government is advancing the reform of distribution utilities and promoting private sector investment to further enhance the sector's performance. Several business and financing models for transmission grid investment – for supporting grid-scale renewable power integration and other objectives – are discussed, along with as the challenges and unique conditions for unlocking transmission grid investment in Egypt. These insights are based on their implementation experiences in four different countries as presented in *Transmission grid financing: international case studies for Egypt*¹ (Denis, 2026^[4]).

Given Egypt's abundant renewable energy resources, a key strategy to optimise green hydrogen costs involves reinforcing the national grid capacity. This is a way not just to accommodate the variability of solar and wind energy by improving system-wide flexibility of its power sector, but also to transmit power from renewable energy resource areas to energy demand centres (Chapter 2). For the specific case of green hydrogen production, a strong grid system can improve cost-effectiveness by enabling the grid to absorb surplus electricity and drawing power from the grid when needed, which prevents oversizing of renewable energy generation solely for hydrogen production. Simultaneously, developing regional energy trade infrastructure is crucial for mitigating renewable energy curtailment and intermittency, thereby improving power system flexibility. By facilitating the export of excess renewable power and allowing for energy exchange with neighbouring countries, Egypt can ensure greater utilisation of its renewable assets, thereby improving the reliability of renewable electricity supply for green hydrogen production and enhancing the overall economic viability of the sector. This aligns with recent developments, most notably the planned 2 GW Euro-Africa interconnection through Cyprus and Greece, which will enhance regional energy integration. While natural gas remains the primary source of electricity generation in Egypt, cross-border electricity trade is gaining momentum. For instance, the Egypt-Sudan grid connection is expected to reach a capacity of 300 MW upon full completion. These efforts are part of Egypt's broader strategy to export up to 20% of its electricity production (Hamilton, 2021^[7]).

Hydrogen pipelines

Repurposing gas pipelines to support hydrogen transport can support green hydrogen production in Egypt. This potential for interconnection and export is closely linked to Egypt's well established gas infrastructure. While Egypt is accelerating its green transition, the country still relies heavily on fossil fuels, with natural gas accounting for 53% of energy supply in 2022/2023, of which 27% is used in the industrial sector (the highest consumption was in fertiliser and methanol) (Arab Republic of Egypt, 2025^[8]). The Egyptian Natural Gas Company (GASCO) operates the gas grid with a total length of 22 000 kilometres (Development Aid, 2023^[9]). Egypt's national Low-Carbon Hydrogen Strategy acknowledges the potential for blending up to 20% hydrogen into the existing natural gas grid with minimal infrastructure modifications (HyWay 27, 2021^[10]) which equates to 11 million tonnes of hydrogen per year. While Egypt does not have an extensive hydrogen pipeline to export hydrogen, this could serve as an initial step to integrate hydrogen into industrial and energy sectors, utilising the existing pipeline infrastructure for hydrogen transport over shorter distances to industrial clusters. According to the European Network of Transmission System Operators for Gas (ENTSOG), there is significant opportunity to reduce hydrogen infrastructure investment costs by 50% to 80% through the strategic repurposing of existing natural gas pipelines. However, other analyses highlight critical concerns regarding the integrity of repurposed pipelines for hydrogen transport, particularly due to risks such as hydrogen embrittlement, leakage, combustion and explosion (Li, Song and Zhang, 2024^[11]). Therefore, hydrogen-mixed natural gas pipelines must be carefully assessed to ensure safety and reliability.

Currently, there are about 70 ongoing retrofitting/repurposing gas pipeline projects to ensure gas infrastructure can support hydrogen transport in Europe, with potential to integrate Egypt's future hydrogen supply into the European market (European Parliament, 2024^[12]). The development of major hydrogen transport corridors like H2MED (connecting the Iberian Peninsula and France, with potential links to Germany) and the SouthH2 Corridor (aiming to connect North Africa, including Algeria and potentially

Tunisia, to Italy, Austria and Germany) further underscore the strategic importance of leveraging existing gas infrastructure. The potential to integrate Egypt's future hydrogen supply into the European market via these emerging corridors is significant. Direct interconnection via new or repurposed pipelines, or indirect connection through North African partners in the South2 Corridor, could provide a pathway for Egypt to export its green hydrogen to meet European demand. The EU hydrogen and gas decarbonisation package, adopted in May 2024, is expected to provide momentum for the development of hydrogen infrastructure (European Commission, 2025^[13]).

3.2.3. Electrolyser

Electrolyser is a critical technology to produce green hydrogen from renewable electricity. Global electrolysis capacity for dedicated hydrogen production has been growing in the past few years, reaching an installed capacity of 1.4 GW at the end of 2023 (IEA, 2024^[14]). Moreover, electrolyser manufacturing capacity has doubled since 2022, reaching 25 GW per year by the end of 2023. The electrolyser market is currently dominated by a few key players. In 2024, about 68% of global electrolyser manufacturing capacity was located in China with manufacturing capacity to GW electrolyser (BloombergNEF, 2024^[15]). However, in terms of track record of reliable technology performance, only a limited number of green hydrogen projects globally have shown reliable results, typically over operational periods of approximately three years or less. In Egypt, there is currently no domestic electrolyser manufacturer or onshore manufacturing plant. Electrolysers are mainly imported from European manufacturers such as a recent shipment of a 5 MW electrolyser module by Plug Power to Fertiglobe in Ain Sokhna, Egypt. This initial module is part of a larger 100 MW project under the Egypt Green initiative, a consortium involving the Sovereign Fund of Egypt, Fertiglobe (OCI and ADNOC), Scatec and Orascom Construction (OCI, 2021^[16]).

3.2.4. Desalination

Access to purified water is a critical enabler for green hydrogen production, as electrolysis – the primary method for producing green hydrogen requires large volumes of purified water as an input. In regions with limited freshwater availability, such as Egypt, desalination infrastructure plays a pivotal role in securing the water supply needed to scale up hydrogen production. Egypt has significantly expanded its desalinated water infrastructure, with 125 desalination plants across six governorates: North Sinai, South Sinai, Red Sea, Matrouh, Ismailia and Suez (Daily News Egypt, 2025^[17]). These operational plants collectively contribute with a total capacity of 1.31 million m³ per day. Within current installed capacity, there are two desalination plants in Suez with approximately 286 000 m³ per day, which is approximately 31% of Egypt's current desalination plant capacity and where most announced green hydrogen projects are located (Elsaie et al., 2023^[18]). The current cost structure indicates an average desalination expense range between USD 0.7 (Elsaie et al., 2023^[18]) and USD 1.6 (Wahish, 2022^[19]) per m³, a crucial economic factor influencing the feasibility and scalability of future projects. Within the Suez Canal Zone, the port authority aims to construct additional desalination plants to have a production capacity of around 250 000 m³ per day with support from EBRD to support hydrogen production (Smart Water Magazine, 2024^[20]).

3.2.5. Port infrastructure for export of low-carbon hydrogen and its derivatives

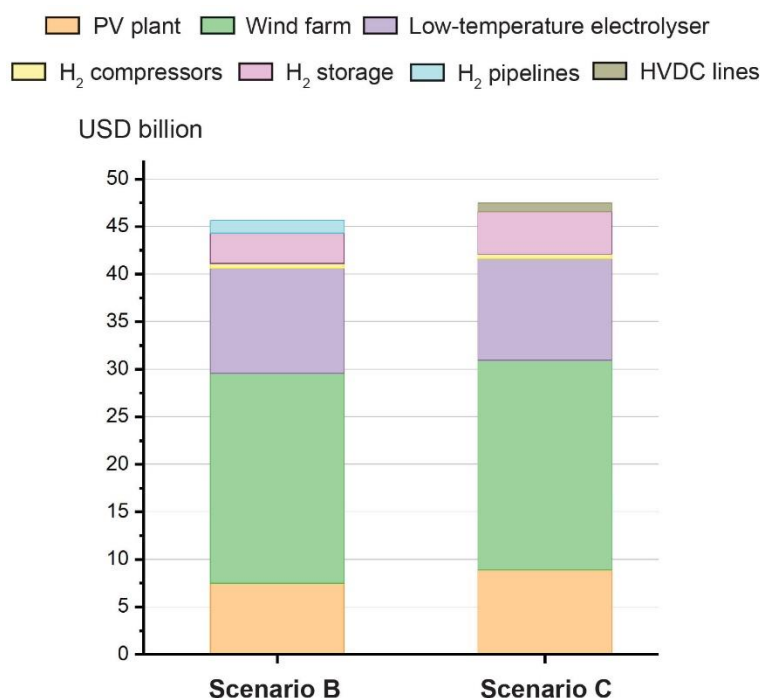
Developing adequate port infrastructure is paramount for the successful export of green hydrogen and its derivatives. This necessitates the construction of specialised terminals and berths capable of handling vessels designed for liquid hydrogen, ammonia or methanol, along with new jetties to accommodate large carriers (as seen in projects like the Ras Shukeir green ammonia terminal). Substantial investment in dedicated, safe storage facilities for these carriers, considering their specific properties like cryogenic temperatures (U.S. Department of Energy, 2025^[21]) or toxicity, is essential, alongside buffer storage to manage production and shipping variations. Efficient handling and loading/unloading equipment, including specialised marine loading arms (FCW, 2024^[22]) and robust pumping/compression systems, will be

required (Notteboom and Haralambides, 2023^[23]). Ports may also house optional but likely on-site conversion facilities such as liquefaction plants for liquefied hydrogen (LH₂) and synthesis or cracking/reforming plants for ammonia and methanol to facilitate both import and export (UNCTAD, 2024^[24]). Seamless integration with inland transportation networks, including pipelines, road and rail is needed to ensure efficient distribution. Finally, establishing bunkering infrastructure for green ammonia and methanol will capitalise on the growing demand for sustainable maritime. In 2024, Egypt signed a memorandum of understanding with the Port of Rotterdam to further strengthen necessary infrastructure investment to upgrade its port to export hydrogen or hydrogen derivatives.

3.3. Assessing the investment needs

While the previous section highlights the substantial infrastructure investment required to scale up green hydrogen in Egypt, this section offers an estimate of investment needs to meet the targets of Egypt's National Low-Carbon Hydrogen Strategy, based on two selected scenarios from Chapter 2. To determine the level of investments needed to achieve the production target of the National Low-Carbon Hydrogen Strategy, this report uses the conservative scenario from the national strategy, targeting 1.5 Mt/year green hydrogen production capacity by 2030.² Scenarios B and C are evaluated, as they demonstrated the lowest LCOH while assuming a 2% national grid-connected electricity share (Figure 3.1). The same assumptions outlined in Chapter 2 are applied, including for the CAPEX of various components of the green hydrogen plant configurations.

Figure 3.1. Initial investment cost for green hydrogen production



Note: H₂: hydrogen; HVDC: High Voltage Direct Current.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Analysis shows that considering the central scenario of Egypt Green Hydrogen strategy to achieve production capacity of 1.5 Mt/year by 2030, USD 45.6 billion needs to be invested with high initial

investment requirement in electrolyser and renewable energy systems. Scenario B is found to be somewhat less investment intensive due to higher availability of renewable energy sources (i.e. higher capacity factors) as presented in Figure 3.1. While electricity transmission infrastructure is less expensive than hydrogen transport infrastructure, this cost advantage does not fully offset the solar PV installation costs associated with Scenario C. Nonetheless, the overall cost differences are relatively modest and installation decisions may ultimately depend on additional factors such as safety, operational management and regulatory considerations.

The key difference between two scenarios lies in how energy is managed over time. Greater storage capacity or a more robust grid connection provides more flexibility in utilising renewable energy sources, which can lead to minor adjustments in the optimal RES mix (e.g. a slightly higher proportion of solar PV in one scenario). The system components were sized to ensure continuous production of 1.5 Mt/year of green hydrogen. As detailed in Annex C, the analysis indicates that storage needs and grid connections differ between the scenarios, while the installed capacity of renewable energy plants and electrolysers shows only minor variations (+17% for PV, with wind and electrolysis capacity remaining stable). Essentially, both scenarios are designed to produce the same amount of hydrogen. Therefore, the total energy input required from RES and the size of the electrolyser to process that energy will be broadly similar. Annex C provides a detailed breakdown of this assessment.

3.4. Identifying financial solutions and enabling investment conditions

The OECD, with support from the Federation of Egyptian Industries (FEI), undertook an investor survey to identify the necessary financial solutions for closing the competitiveness gap in green hydrogen. Because low-carbon hydrogen projects are not yet widely implemented, it is difficult to identify and assess the effectiveness of frequently employed economic and de-risking instruments designed to mitigate risk (OECD/The World Bank, 2024^[25]). Given the limited track record of large-scale green hydrogen projects, the analysis extended to examining instruments previously deployed in other asset types, namely LNG, offshore wind, thermal power and grey hydrogen. The following criteria were considered to select instruments for further investigation (OECD/The World Bank, 2024^[25]):

- Amount of private investment mobilised and leverage ratio of public finance used.
- Proven track record or implementation globally (where data on single instruments was preferred, as it gives a better understanding of their replicability potential, compared to complex packaged risks which may be specific to a given project structure).
- Proven impact on financing costs if project level information is available (e.g. in a very few cases the improvement of the debt-service coverage ratio [DSCR] and its positive on debt sizing has been considered).

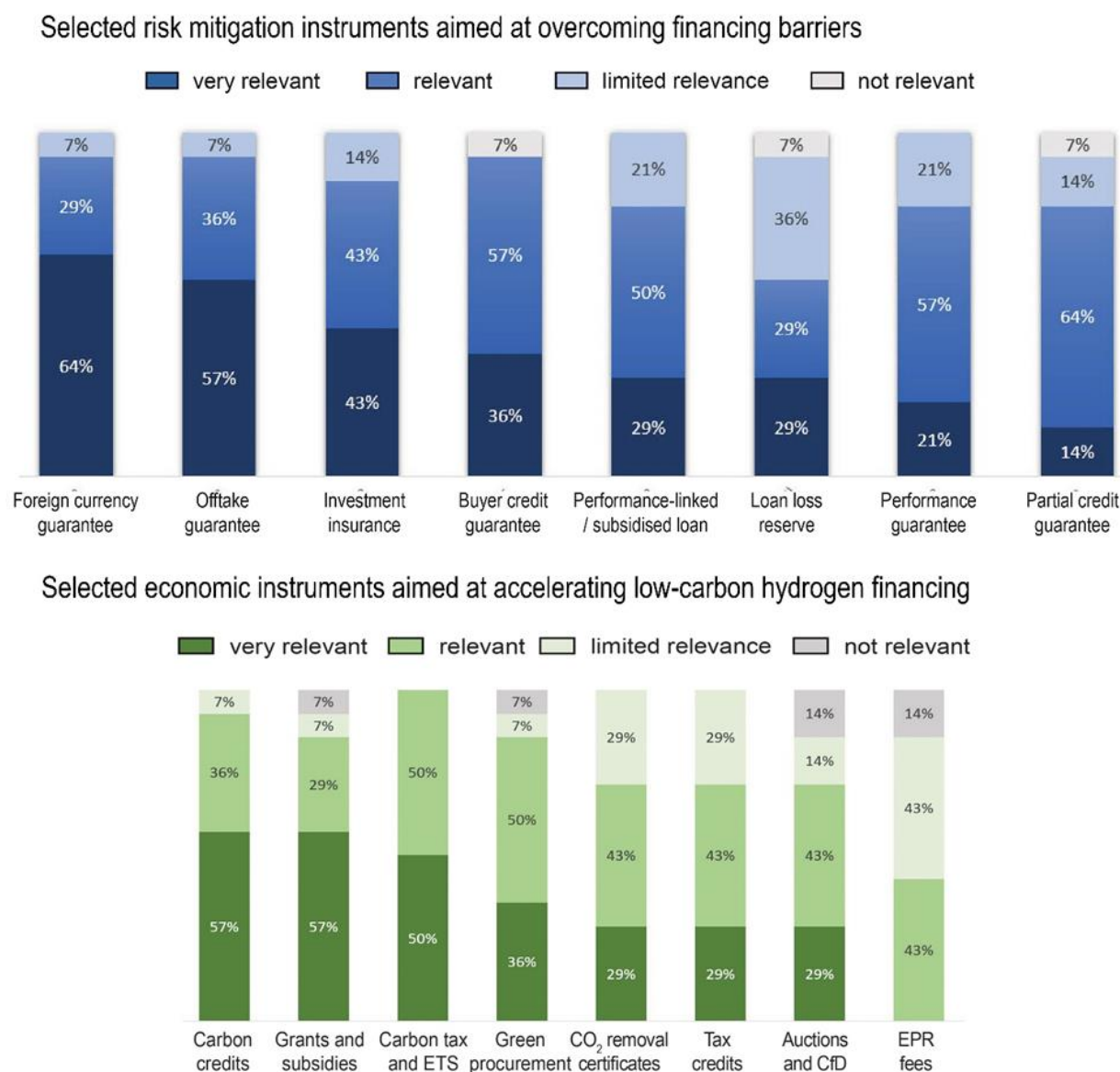
Egyptian stakeholders were surveyed to prioritise a list of instruments relevant to the country's green hydrogen projects. The survey comprised three principal sections designed to elucidate investment in and financing of green hydrogen initiatives. The initial section aimed to categorise the organisations active in the hydrogen sector. The subsequent section investigated the current and anticipated investment allocations of these organisations within Egypt's hydrogen value chain, encompassing clean energy sources, hydrogen production, storage, transportation, utilisation and vertically integrated projects, as well as their typical investment scales. The final section explored potential financial instruments to enhance the fundability of green hydrogen projects in Egypt. Annex D provides the survey methodology and questionnaires.

- **Economic instruments**,³ including auctions and CfD, carbon credits, carbon taxes and emissions trading systems, carbon removal certificates, extended producer responsibility fees, grants and subsidies, green procurement incentives and tax credits.

- **De-risking instruments**,⁴ such as buyer credit guarantees, contractors-all-risk insurance, credit default swaps, foreign currency guarantees, interest rate swaps, loan loss reserves, offtake guarantees, partial credit guarantees, performance guarantees, political risk investment insurance and subsidised or performance-linked loans.

The survey identified priority instruments, categorised as: (i) economic instruments, including carbon pricing and green procurement, along with direct financial support such as grants and subsidies; and (ii) de-risking instruments, encompassing foreign currency guarantees, offtake guarantees and political risk guarantees (Figure 3.2). However, the number of survey responses was limited (14 out of 66 identified stakeholders), and the results should therefore be interpreted with caution.

Figure 3.2. Findings from the OECD investor survey in Egypt



Note: The survey was distributed to 66 stakeholders between 30 January and 27 February 2025, with 14 completed responses. The survey methodology and results are available in Annex D. CfD: contracts for difference; CO₂: carbon dioxide; EPR: extended producer responsibility; ETS: emission trading system.

Source: Key findings from the OECD investors survey conducted by the OECD Secretariat.

Based on the survey results, the following economic and de-risking instruments were identified: carbon pricing, CAPEX grant, green premium (as proxy to green procurement⁵), FX guarantee, offtake guarantee and concessional loans to assess its effectiveness on closing competitiveness gap. The competitiveness gap refers to the difference between the estimated LCOH and the price of USD 1.8/kg H₂ by 2040 as envisioned in Egypt's National Low-Carbon Hydrogen Strategy.

FX risk mitigation and offtake guarantees were identified as important instruments from the survey, but they were excluded from the impact assessment scope in this chapter. Assessing the impact of FX guarantees was challenging due to the limited availability of project-level data on actual hedging costs and the highly context-specific nature of currency exposure. These factors constrained the application of a consistent quantitative methodology across all instruments. Similarly, offtake guarantees are more closely linked to the broader investment climate and the maturity of green hydrogen markets. As such, their direct quantitative impact on narrowing the competitiveness gap could not be reliably captured within the applied assessment framework.

Instead, both instruments are discussed in Chapter 4 within the broader analysis of financial solutions and enabling investment conditions, where their potential applications are examined in the context of Egypt's green hydrogen market. Their contribution to reducing perceived investor risk and enhancing project bankability is assessed qualitatively, reflecting local market dynamics and institutional realities. This approach is further informed by expert interviews with practitioners actively involved in Egypt's green hydrogen sector.

As a result, the following instruments were selected for detailed impact assessment: carbon pricing, green premium, CAPEX grants and concessional loans while the latter also providing partial insights into the role of guarantees (Box 3.1). These instruments were then evaluated to assess their effectiveness in closing the competitiveness gap between green hydrogen (or its derivatives) and fossil-based alternatives.

Box 3.1. Impact of guarantee and concessional loan on competitive gap analysis

While the analysis focuses on the impact of concessional loans – modelled through adjusted discount rates – it is important to recognise that guarantees can achieve a similar outcome in improving the competitiveness of green hydrogen relative to grey hydrogen. By mitigating specific project risks, guarantees can lead to more favourable financing conditions, such as lower interest rates, effectively reducing the cost of capital. Although guarantees and concessional loans differ in their financial structures, the reduction in the discount rate observed under concessional lending can serve as a reasonable proxy for the potential impact of guarantees on project valuation and competitiveness.

However, the actual impact of a guarantee on the discount rate depends on factors such as the scope of risk coverage, market perceptions and the credibility of the guarantor. Moreover, the fees or costs associated with obtaining guarantees must be taken into account, as they may partially offset the financing benefits. For instance, the cost of guarantees can typically vary per coverage, credit rating of applying entities and project structure. They are typically priced as an annual premium range from 0.2-3% in the case of partial credit guarantees (PCGs) (SystemIQ, 2023^[26]). It is also important to note that guarantees may offer additional strategic benefits, such as attracting private capital or enabling participation in riskier markets, that are not fully captured through a simple discount rate adjustment.

While discount rate adjustments provide a useful lens for approximating the financial impact of guarantees, the indirect nature of this modelling approach requires careful interpretation. Assumptions should be clearly stated. Where feasible, complementary analysis should also explore the broader implications and costs of deploying guarantees to better inform financing strategies for green hydrogen projects.

3.5. Key assumptions: impact of different risk mitigation instruments

3.5.1. Green premium

A green premium is the price differential reflecting the extra cost associated with producing or purchasing lower-carbon product or service relative to its traditional counterpart (CRU Group, 2023^[27]). This analysis evaluates the financial benefits of applying a green premium to the selling price of green hydrogen, methanol and steel, reflecting their lower carbon footprint compared to conventional production. Two green premium scenarios – 15% and 30% above the total production cost – are considered, and the study evaluates how the share of green product sales achieved at these premium prices impacts overall economic viability. The green premium acts as a potential revenue enhancer for green producers, aiming to close the cost gap with fossil fuel-based alternatives.

Willingness to pay (WtP) varies significantly across sectors, with stronger demand observed for green steel (Eurometal, 2024^[28]) and increasing momentum for green fuels in hard-to-abate sectors such as aviation (BCG, 2025^[29]). These differences in WtP reflect how the value of the green premium is perceived across end-use markets and determine its potential as a revenue-enhancing mechanism. These sectoral differences in WtP directly influence the effectiveness and viability of green premium strategies as a tool for closing the competitiveness gap. WtP for green premium could be triggered by multiple aspects. At the industry or company level, players often driven by company's ESG mandate, sectoral net-zero target, ambition to reduce Scope 3 emission, as well as to obtain stronger market share in green export markets to advance company's reputation (Shi and Jiang, 2022^[30]). The green premium could be also triggered by regulatory instruments such as carbon pricing, green public procurement mandates, border carbon adjustment mechanisms, and low-carbon product certification schemes, which reinforce market differentiation (Bryant, 2023^[31]). Uptake varies across sectors. For example, buyers of green steel (OECD, 2023^[32]) may show higher WtP than construction firms, while interest in green fuels is growing in hard-to-abate sectors like aviation and shipping.

3.5.2. CAPEX grant

CAPEX grants and subsidies are prominent and frequently discussed economic instruments for advancing hydrogen deployment at project level. For instance, Scatec's green hydrogen project in Egypt, with a total CAPEX of around EUR 500 million, received a EUR 30 million grant from the German PtX Development Fund (Markosyan, 2024^[33]), highlighting the role of development co-operation in mitigating risks associated with significant investments. Similarly, the EU Innovation Fund provided Elcogen in Estonia with a EUR 24.9 million grant to scale up its production of solid oxide electrolyser cells, a critical component in green hydrogen production, directly supporting the capital investment needed for expansion. National initiatives like the UK's Net Zero Hydrogen Fund also feature dedicated CAPEX support, offering grants up to GBP 30 million to cover a significant portion of the initial costs for new low-carbon hydrogen facilities. In addition, the European Hydrogen Bank also extends CAPEX support, underscoring the multifaceted approach to financially backing green hydrogen deployment. These instances collectively illustrate the crucial role of CAPEX grants in mitigating the high initial investment barriers associated with green hydrogen projects and accelerating their realisation.

The CAPEX grant leads to a decrease in the LCOH, thus narrowing the competitiveness gap with fossil-based products. As such in this analysis, three cases are evaluated: (1) Grant to cover percentage of the total CAPEX, (2) to cover percentage of the RES CAPEX, (3) to cover percentage of the electrolyser CAPEX.

3.5.3. Concessional loans

Concessional loans (inclusive to subsidised loan) are emerging as a significant financial instrument to support the capital-intensive development of hydrogen projects. These loans, characterised by favourable terms such as lower interest rates and extended repayment periods, aim to reduce the overall cost of capital for developers, thereby enhancing the economic viability of hydrogen initiatives. For instance, the EBRD provided a concessional loan as part of a larger financial package for a green hydrogen pilot facility in Uzbekistan (EBRD, 2024^[34]), specifically to help decarbonize fertiliser production and power generation. Similarly, the Green Climate Fund (GCF) has offered concessional financing to support IFC's investment in a green hydrogen and battery storage project in Barbados, aiming to lower electricity tariffs and enhance grid resilience. These examples highlight how concessional loans from development banks and climate funds are being strategically deployed to mitigate risks of early-stage hydrogen projects and make them more attractive to investors, ultimately contributing to developing a nascent green hydrogen economy. To evaluate the effect of concessional financing on project feasibility and investment attractiveness, a sensitivity analysis is conducted on the discount rate, which reflects the cost of the capital. A lower discount rate, representing the terms of a concessional loan, enhances the economic appeal of the investment.

3.5.4. Carbon price

A carbon price – whether through a carbon tax or an emissions trading system (ETS) – would primarily affect industrial users of fossil-based hydrogen and its derivatives, particularly in the fertiliser, chemical and steel sectors by increasing their OPEX. This is due to the high emission intensity of grey hydrogen production (approximately USD 10 kg CO₂/kg H₂). In Egypt, the estimated cost of grey hydrogen is around USD 1.8/kg H₂, which is also the price for green hydrogen envisioned in Egypt's National Low-Carbon Hydrogen Strategy by 2040.

Grey methanol production emits around 0.8 tonnes of CO₂ per tonne of methanol (Zaryab et al., 2024^[35]), while traditional steelmaking via the BF-BOF route emits approximately 1.84 t CO₂ per tonne of iron, compared to around 1.44 t CO₂ for gas-based DRI (Rhee et al., 2024^[36]) (Box 3.2). These emission intensities mean that carbon pricing would directly affect cost structures in these sectors, influencing their competitiveness and their incentive to shift to low-carbon alternatives.

In this context, the EU CBAM is particularly relevant. Designed to prevent carbon leakage, CBAM imposes a carbon cost on imports of high-emission goods such as iron, steel, fertilisers and hydrogen (Dechezleprêtre et al., 2025^[37]). For exporters like Egypt, CBAM introduces a compliance cost that reinforces the economic rationale for adopting low-carbon production pathways. In sectors such as steel, fertilisers and petrochemicals, aligning with low-emission standards is becoming essential to maintain access to the EU market and avoid potential trade-related risks. This externally induced regulatory shift underscores the strategic importance of accelerating the transition to green hydrogen in Egypt as a means to safeguard competitiveness and secure long-term market opportunities.

However, the implementation of carbon pricing in Egypt poses considerable political economy challenges. Egypt currently levies no explicit carbon tax, and fuel excise taxes apply to only about 53% of GHG emissions (OECD, 2023^[38]). Moreover, fossil fuel subsidies remain significant, covering roughly 7% of emissions and resulting in a net effective carbon rate of EUR 6.47 per tonne of CO₂ (OECD, 2023^[38]), indicating that subsidisation outweighs taxation. These distortions suppress the price signals needed to drive low-carbon investment.

From the perspective of industrial users, particularly in energy- and trade-intensive sectors who benefit from subsidised energy prices, passing through the cost of carbon could undermine their competitiveness in both domestic and export markets. Moreover, extending carbon pricing to residential or transport sectors raises equity concerns, as this may disproportionately impact vulnerable households (Carnegie

Endowment for International Peace, 2025^[39]). Therefore, any carbon pricing mechanism must be accompanied by social safeguards and mechanisms for revenue recycling.

3.6. Impact of different instruments on the Levelised Cost of Hydrogen

The impact assessment on the competitiveness gap indicates that full CAPEX grants consistently emerge as the most effective instrument to bridge the cost gap between low-carbon products (such as green hydrogen, green ammonia, green iron and e-methanol) and their conventional fossil-based counterparts. To ensure alignment with Egypt's National Low-Carbon Hydrogen Strategy – which targets a production capacity of 1.5 Mt H₂ per year – an optimisation modelling was undertaken. This model was based on the LCOH from Scenario B, which yielded the lowest production cost in the previous analysis (Chapter 2). Under these assumptions, the estimated hydrogen production cost was calculated at USD 4.14/kg H₂ (Table 3.1).

Table 3.1. Results of optimisation model under Scenario B to produce 1.5 Mt H₂ per year

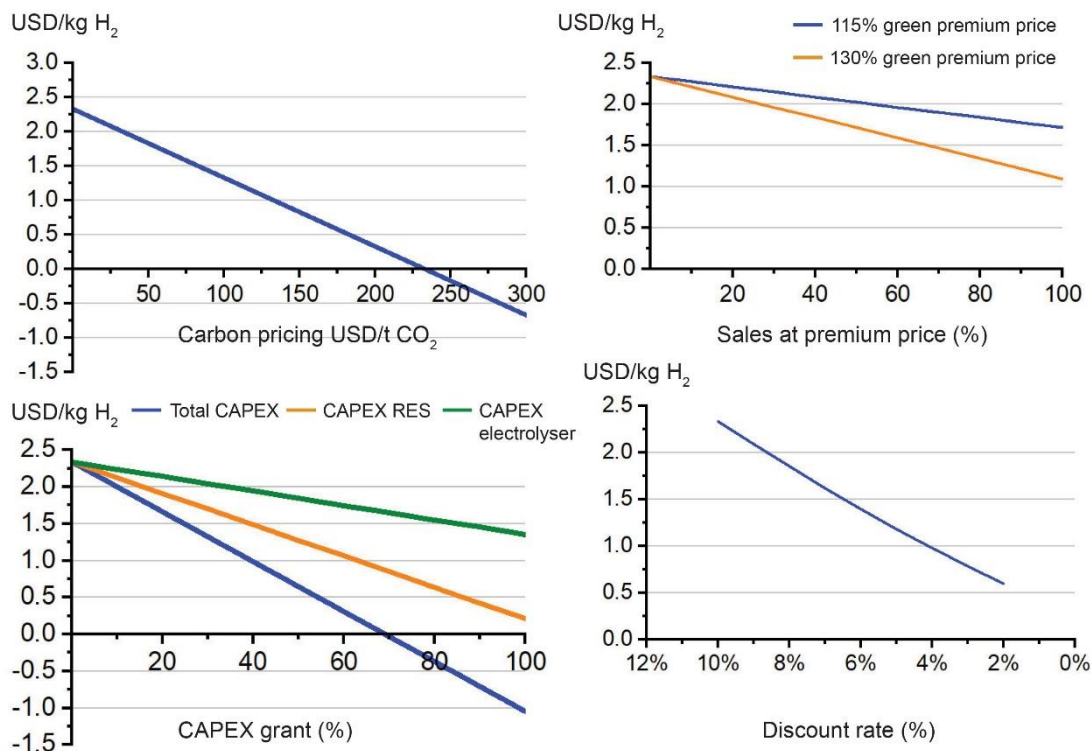
Category	Installed capacity	
PV power generation plant	MW	923.3
Onshore wind power generation plant	MW	1 296.5
Low temperature electrolyser	MW	870.3
Hydrogen compressors (30-220 bar)	MW	20.1
H ₂ storage	t H ₂	353.3
H ₂ transport pipelines	Km	230
LCOH	USD	4.14

Source: Results of techno-economic assessment conducted by the OECD Secretariat.

With a calculated LCOH of USD 4.14/kg H₂ for green hydrogen and an estimated cost of USD 1.8/kg H₂ for grey hydrogen in Egypt (a target aligned with the National Low-Carbon Hydrogen Strategy); the initial competitiveness gap stands at around USD 2.34/kg H₂. The following analysis assesses how instruments such as carbon prices, concessional loans, green premiums and CAPEX grants can narrow this identified USD 2.34/kg H₂ difference.

Figure 3.3. Instrument effectiveness in reducing the cost of green hydrogen

Competitiveness gap



Note: CAPEX: capital expenditure; CO₂: carbon dioxide; H₂: hydrogen; RES: renewable energy sources

Source: Results of the techno-economic assessment conducted by the OECD Secretariat.

The analysis revealed the following results:

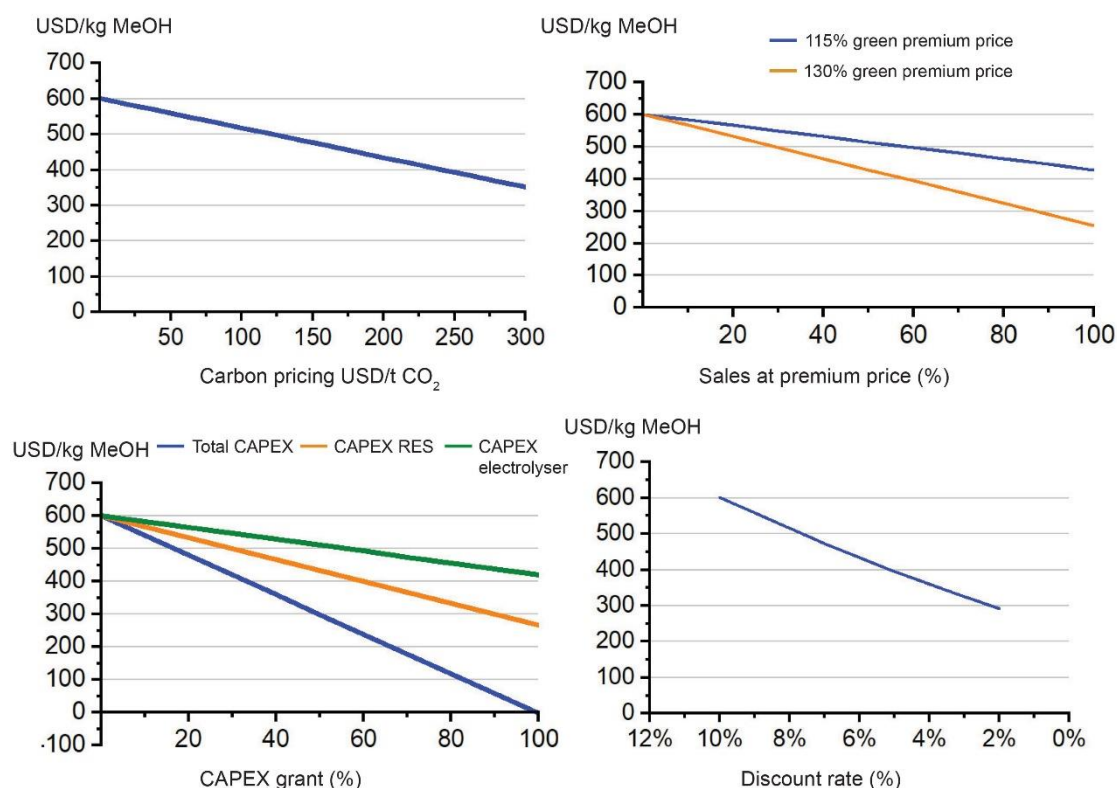
- **Green premium:** Even with a substantial 30% green premium applied to all green hydrogen sales, this financial instrument alone is insufficient to bridge the competitiveness gap.
- **CAPEX grant:** Closing the competitiveness gap would require a CAPEX grant covering approximately 70% of the total investment. While a CAPEX grant specifically targeting renewable power generation significantly reduces the competitiveness gap, it is not sufficient on its own to fully close the gap. Similarly, providing a CAPEX grant for electrolysers decreases significantly the competitiveness gap, reducing it from USD 2.34/kg H₂ to USD 1.36/kg H₂. However, securing a consistent and widespread 70% CAPEX subsidy for green hydrogen projects may be economically and politically challenging for governments. Current international practices reflect a more measured approach: the UK Net Zero Hydrogen Fund offers CAPEX grants covering up to 30% of eligible costs; the EU Innovation Fund typically supports 40-60% of the incremental costs for innovative low-carbon technologies, including hydrogen; and the German PtX Development Fund's contribution to Scatec's Egypt project covers about 6% of total CAPEX. These examples illustrate the broader policy trend of balancing early-stage support with the goal of establishing a competitive, self-sustaining green hydrogen sector without excessive reliance on public funding.
- **Concessional loans:** Reducing the discount rate from 10% to 2% through concessional loans is shown to significantly narrow the competitiveness gap from USD 2.34 to USD 0.6/kg H₂.

- **Carbon price:** A carbon price of USD 230/t CO₂ is projected to eliminate the competitiveness gap, raising the market price of grey hydrogen to USD 4.14/kg. Impact of instruments on e-methanol and green iron.

In addition to previous assessment on green hydrogen, the same assessment has been conducted for green derivatives. An indicative recent market price for grey methanol in Europe is USD 550/t MeOH (Methanex, 2025^[40]) while green e-methanol is expected to be around USD 1 150/t MeOH. The competitiveness gap for methanol is determined by the difference between the LCOM of e-methanol and the indicative market price of grey methanol.

Figure 3.4. Instrument effectiveness in reducing the cost of e-methanol

Competitiveness gap



Note: CAPEX: capital expenditure; CO₂: carbon dioxide; MeOH: methanol; RES: renewable energy sources.

Source: Results of the techno-economic assessment conducted by the OECD Secretariat.

The analysis revealed the following results:

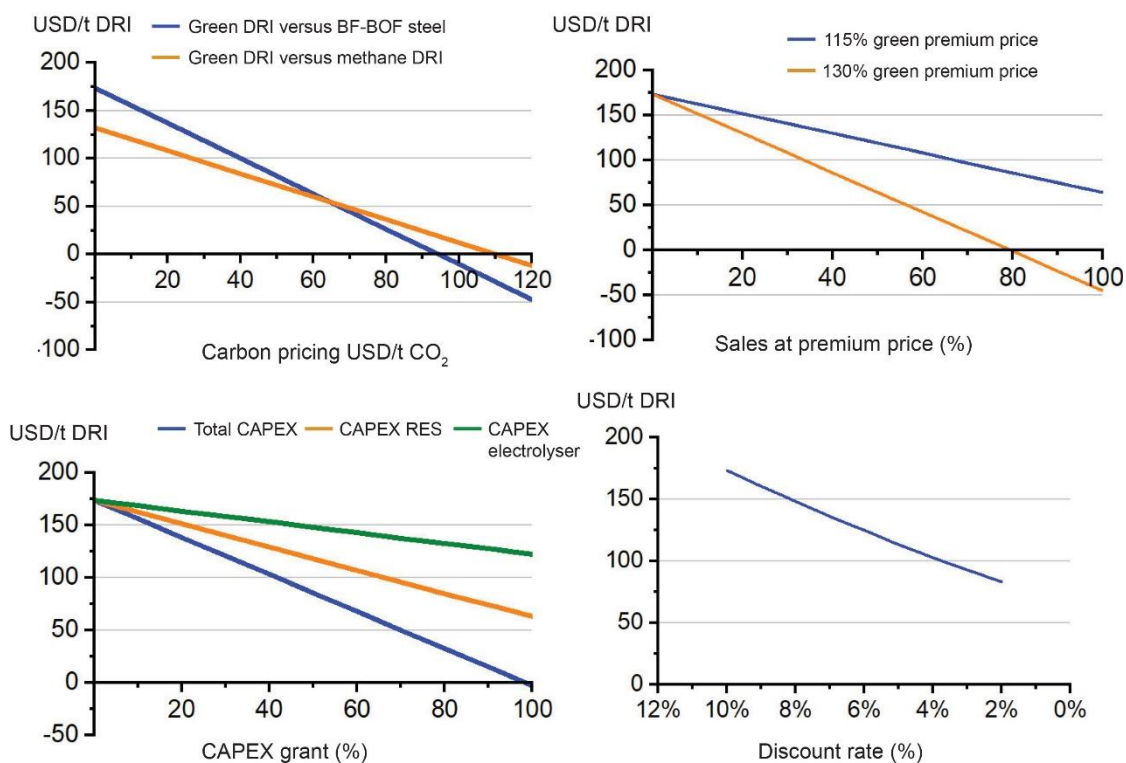
- **Green premium:** With a 30% green premium across all produced e-methanol, a substantial competitiveness gap of USD 256/t MeOH persists, indicating that this instrument alone has a limited effect in making green hydrogen cost-competitive.
- **CAPEX grant:** Addressing the competitiveness gap for e-methanol would necessitate a full CAPEX grant. The analysis of targeted grants shows that covering the initial investment in renewable energy power generation reduces the gap from USD 601/t MeOH to USD 268/t MeOH. In contrast, a grant for the electrolyser CAPEX alone lowers the gap to USD 421/t MeOH only.

- **Concessional loans:** Reducing the discount rate via concessional loans from 10% to 2% is shown to have a considerable impact on the e-methanol competitiveness gap, bringing it down from USD 601/t MeOH to USD 292/t MeOH.
- **Carbon price:** A carbon price, even at a substantial level of USD 300/tCO₂, is insufficient to close the competitiveness gap for methanol despite a reduction in the cost of e-methanol from USD 601/t MeOH to USD 352/t MeOH.

For green iron, the LCOI for production in Egypt is estimated at USD 733/t DRI (Chapter 2). The competitiveness gap with BF-based grey iron is estimated at USD 174/t DRI while for methane DRI a competitiveness gap of USD 132/t DRI is estimated, assuming that the cost of BF-based iron and methane DRI are USD 670/t DRI and USD 720/t DRI.

Figure 3.5. Instrument effectiveness in reducing the cost of green iron

Competitiveness gap



Note: BF-BOF: blast furnace - basic oxygen furnace; CAPEX: capital expenditure; CO₂: carbon dioxide; DRI: Directed Reduced Iron; RES: renewable energy sources.

Source: Results of the techno-economic assessment conducted by the OECD Secretariat.

The analysis revealed the following results:

- **Green premium:** When applying a 15% premium on all the produced DRI, a significant competitiveness gap of USD 65/t DRI remains. A premium of 30% could potentially bridge the gap given that 80% of the produced DRI is sold at the premium price.
- **CAPEX grant:** A full CAPEX grant for green iron production is required to achieve cost competitiveness. Focusing on specific components revealed that a grant for renewable energy power generation CAPEX reduces the gap from USD 174/t DRI to USD 63/t DRI, whereas a grant for electrolyser CAPEX lowers it to USD 123/t DRI.

- **Concessional loans:** A reduction in the discount rate from 10% to 2% via concessional loans is shown to considerably narrow the competitiveness gap for green iron, from USD 174/t DRI down to USD 83/t DRI.
- **Carbon price:** A carbon price of about USD 90/tCO₂ would allow closing the competitiveness gap for green iron compared to BF route. A higher carbon price of USD 110/t CO₂ is needed to close the gap with natural gas DRI.

3.7. Summary and conclusions

CAPEX grants and concessional loans are the most effective instruments, reducing the cost gap by up to 70-90% across green hydrogen, e-methanol and green iron (Table 3.2). In contrast, green premiums and carbon pricing alone are insufficient to fully close the competitiveness gap.

Table 3.2. Overview of instrument effectiveness

Instrument	Green hydrogen	Green iron	E-methanol
Green premium	Limited 30% premium is not sufficient.	15% premium (gap reduced by USD 89)	63% (at 30% premium)
CAPEX grant	Reduced gap 42% (from USD 2.34 to USD 1.36/kg)	55% (RE grant from USD 601 to USD 268/t)	64% (renewable energy grants: from USD 174 to USD 63/t)
Concessional loan (discount rate 10% to 2%)	Reduced gap approximately 74% (from USD 2.34 to USD 0.6/kg)	51% (to USD 292/t)	52% (to USD 83/t)
Carbon price	Gap closed, if carbon price is at USD 230/tCO ₂ (raises grey H ₂ price to USD 4.14)	41% (to USD 352/t)	100% (gap closed at carbon price of USD 90-100/tCO ₂)

Source: Results of the techno-economic assessment conducted by the OECD Secretariat.

While the instruments show the potential viability to closing the competitiveness gap,⁶ practical implementation remains constrained. Effectively addressing this constraint necessitates a strategic combination of various instruments to optimise cost burden and de-risk the project (Lee and Saygin, 2023^[41]; OECD/The World Bank, 2024^[25]). For instance, a combined strategy prioritising CAPEX grants and concessional loans, supplemented by moderate carbon pricing or market-based incentives, offers the most pragmatic and effective approach to scale up green hydrogen, e-methanol and green iron competitively (Box 3.2).

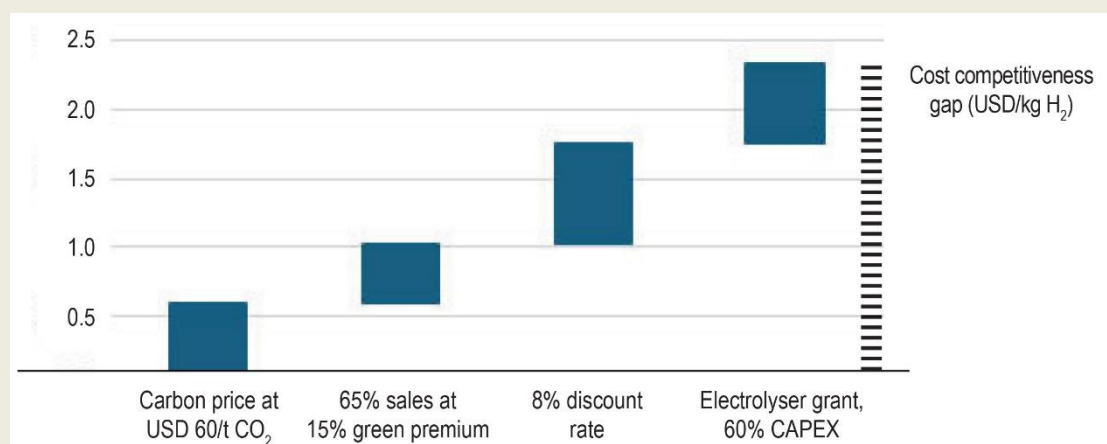
Box 3.2. Integrating multiple instruments: A practical example

Numerous combinations of the analysed instruments can be employed to bridge the cost gap between green and grey hydrogen. The results presented here illustrate one potential combination of multiple instruments for closing the competitiveness gap and do not necessarily represent an absolute optimum solution.

Table 3.3. Cost impact of selected instruments

Instruments	Δ [USD/kgH ₂]
Carbon price of 60 USD/tCO ₂	0.60
Sale of 65% of green H ₂ production at a premium of 15%	0.43
De-risking instruments to achieve a discount rate of 8%	0.71
Grant of USD 420k representing 60% of the electrolyser initial investment	0.59

Figure 3.6. Impact of multiple instruments to close the cost-competitiveness gap



Note: CAPEX: capital expenditure; CO₂: carbon dioxide; H₂: hydrogen.

Source: Results of the techno-economic assessment conducted by the OECD Secretariat.

Building on the survey findings and the analysis in Section 3.5, additional stakeholder consultations were conducted during the stakeholder workshop that was conducted in Egypt in April 2025 (Annex E). The discussions aimed to reflect Egypt's specific country context, as well as the enabling investment conditions necessary to effectively apply each of the identified instruments.

Consistent with the assessment presented in Section 3.5., across green hydrogen, e-methanol and green iron production, CAPEX grant consistently emerges as the most effective instrument for closing the competitiveness gap with conventional fossil-based alternatives. While recognising the effectiveness of the grant, political and fiscal challenges are likely to limit the feasibility of providing full grant support. Alternatively, deploying CAPEX grant blending with concessional loans that reduce financing costs are identified as a highly attractive complementary measure across all three sectors, substantially narrowing the cost gap at lower public expense. The potential application of these instruments in the context of Egypt is further discussed in Chapter 4.

Green premiums and carbon pricing were not considered further in the discussion of enabling investment conditions and financial solutions at Chapter 4 for the following reasons: for green premiums, the analysis in Section 3.5. shows only partial improvements, which are insufficient on their own. Therefore, this instrument has not been considered further. While carbon pricing could be particularly relevant for green iron, achieving sufficiently high carbon prices remains politically challenging. However, it could be developed as part of a broader climate policy framework.

The feedback received during the workshop also indicated a cautious approach toward the implementation of carbon pricing in Egypt. While the long-term benefits of a carbon market in driving emissions reductions and attracting green finance are recognised, the prevailing limitations in institutional readiness, industrial competitiveness and the need for further development of essential monitoring and regulatory frameworks suggest that widespread and effective implementation remains a considerable challenge for the Egyptian market (Arab Finance, 2024^[42]). For instance, Monitoring, Reporting and Verification (MRV) systems need to be further developed. While Egypt has submitted its first biennial transparency report (UNFCCC, 2024^[43]), indicating progress in this area, the comprehensive and granular data collection and verification across all relevant sectors required for a functional ETS may still need further development and investment. Nevertheless, green premiums and carbon pricing remain important long-term instruments and should be revisited in future policy analysis as Egypt's regulatory and institutional frameworks continue to mature.

Beyond the assessed instruments, the consultation revealed the importance of CfD which was not discussed in the survey. CfDs is critical for providing revenue certainty to green hydrogen producers by guaranteeing a pre-agreed “strike price” for their output over a specified period. This mechanism effectively mitigates market price volatility risks, which are particularly acute for emerging green hydrogen markets that currently lack stable demand and clear price signals. CfDs can be referenced against gas market prices, material input costs or carbon prices. When linked to a carbon price, the effectiveness of the CfDs depends on the existence of a functional carbon market, which introduces certain caveats related to market liquidity, price stability and regulatory robustness. Although the precise quantitative impact of CfDs is difficult to assess, the next chapter will explore key design considerations for their successful implementation, alongside other financial mechanisms and enabling investment conditions for accelerating green hydrogen deployment in Egypt.

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Notes

¹ The report finds that while common challenges persist across financing models, stable regulation and long-term planning are essential for investment security and effective grid design. Egypt's renewable targets and rising demand point to high near-term investment needs, with existing PPP capacity supporting the potential for independent and generation-linked transmission projects.

² According to Egypt's National Low-Carbon Hydrogen Strategy, two key scenarios – the Central Scenario and the Green Scenario – outline pathways to scale up low-carbon hydrogen production by 2030 and 2040. Under the Central Scenario, Egypt aims to produce 1.5 Mt of green hydrogen by 2030 and 5.7 Mt by 2040 per year. In contrast, the Green Scenario sets more ambitious annual production targets of 3.2 Mt by 2030 and 9.2 Mt by 2040. For the purposes of this report, the Central Scenario has been considered.

³ The OECD defines economic instruments as "a means by which decisions or actions of government affect the behaviour of producers and consumers by causing changes in the prices to be paid for these activities (Svatikova, Brown and Börkey, 2025^[46]). It includes market-based instruments which are policy instruments that use markets, prices and/or other monetary means to provide incentives for producers and consumers to reduce or eliminate environmental and other externalities (Nachtigall et al., 2022^[45]).

⁴ De-risking instruments refer to tools designed to reduce or mitigate specific financial, operational or political risks in investment projects to enhance their bankability and attract private capital (OECD/The World Bank, 2024^[25]).

⁵ Green premium analysis offers a useful proxy for assessing the financial viability of green procurement by indicating market willingness to pay and the level of support needed to bridge cost gaps, particularly in price-sensitive sectors. (Clean Energy Ministerial, 2013^[47]).

⁶ The competitiveness gap is estimated as the difference between the cost of producing low-carbon products and the cost of fossil fuel-based products, including the cost of their associated CO₂ emissions.

4

Financial solutions and enabling investment conditions

Chapter 4 presents a targeted package of solutions to operationalise Egypt's National Low-Carbon Hydrogen Strategy by accelerating investment, closing the cost-competitiveness gap and enhancing project bankability. Priority financial instruments identified include CAPEX grants, concessional loans, FX risk guarantees and CfDs. The chapter also highlights critical enabling investment conditions – such as grid access reform, standardised wheeling charges, peer-to-peer electricity markets and CUI – to effectively mobilising private capital. In addition, the chapter outlines practical pathways for implementation, including the deployment of FX risk guarantee, stronger engagement of local banks, and a dual-auction CfD model designed to ensure offtake certainty while maintaining fiscal space. Collectively, these measures provide a coherent framework to translate Egypt's green hydrogen ambition into bankable and investable projects.

4.1. Objective

The objective of this chapter is to support Egypt in translating its National Low-Carbon Hydrogen Strategy into more granular, action-oriented implementation measures. Building on the analysis presented in Chapters 2 and 3, this chapter discusses the financial solutions and enabling investment conditions needed to accelerate green hydrogen deployment in Egypt. It also reflects on ongoing policy discussions relevant to green hydrogen development, including electricity market regulatory reforms, strengthening domestic industrial capacity and government fiscal constraints. Each proposed solution is illustrated with real-world implementation case studies, including those from EMDEs where applicable.

4.2. Identified financial solutions and recommendations for improving the enabling investment conditions

Table 4.1. Summary of recommendations

Identified solution	Financial instruments	Enabling investment condition	Illustrated operational model	Relevant case study
Targeted use of CAPEX grants	<ul style="list-style-type: none"> • CAPEX grants • Debt Service Reserve Accounts (DSRA) • Liquidity Reserve Accounts (LRA) • First-loss guarantee mechanism linked to electrolyser performance KPI • Concessional Loan 	<ul style="list-style-type: none"> • Independent facility (SPV) to manage CAPEX grants 	<ul style="list-style-type: none"> • Government-hosted grant and loan facility co-ordinated through a dedicated SPV 	<ul style="list-style-type: none"> • Chile's Green Hydrogen Facility • Oman's Hydrom
Mitigating foreign exchange currency risk through participation of domestic banks	<ul style="list-style-type: none"> • Foreign Currency Guarantee 	<ul style="list-style-type: none"> • Enable local bank participation in infrastructure project 	<ul style="list-style-type: none"> • Local bank lending for EGP-denominated costs • Blended facility with embedded FX guarantees 	<ul style="list-style-type: none"> • EBRD Green Economy Financing Facility
Addressing offtake risk: Contract-for-difference	<ul style="list-style-type: none"> • Contracts-for-difference • Carbon Contracts for Difference 	<ul style="list-style-type: none"> • Structured long-term offtake mechanism • Government facility or third-party intermediary to oversee the CfD process 	<ul style="list-style-type: none"> • Dual-auction model with domestic intermediary enabling concessional offtake without fiscal liability 	<ul style="list-style-type: none"> • UK Hydrogen Business Model • Japan Subsidy Scheme • H2Global
Power sector reform as a foundation for green hydrogen investment		<ul style="list-style-type: none"> • Clear grid access regulation • Transparent wheeling charge • Transmission sector unbundling and establish an independent TSO • Private-2-Private power purchase agreements • Expand pooling and trading mechanisms 	<ul style="list-style-type: none"> • P2P Pooling Structure for Green Hydrogen • Future pooled renewable market with green certification 	
Prioritise investment in common user infrastructure (CUI) ensuring both accessibility and high quality		<ul style="list-style-type: none"> • Integrated planning of CUI in industrial zones • Early integration of ESG considerations in infrastructure development • Ensure third-party access to shared infrastructure for green 	<ul style="list-style-type: none"> • Public-private model for shared CUI anchored in industrialised zone 	<ul style="list-style-type: none"> • Namibia Hyphen Project • Brazil Pecém Industrial and Port Complex

		hydrogen project developers		
Strengthening the skillset and domestic industry		<ul style="list-style-type: none"> • Workforce training and localisation strategy Strengthening domestic manufacturing capacity		

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

4.2.1. Targeted use of CAPEX grants

As discussed in Chapter 3, the study identified CAPEX grants as the most effective instrument and foreign currency guarantee to close the competitiveness gap for green hydrogen, green ammonia, e-methanol and green iron. In Egypt's context, where large-scale green hydrogen investments are nascent, such instruments can play a catalytic role in improving project bankability. The primary objective of CAPEX grants is to enhance project bankability and unlock CAPEX-intensive investments in electrolyser deployments by addressing the financial uncertainties associated with large-scale, multi-year operations, where stable performance track records beyond two years are still limited globally. This approach directly tackles the major CAPEX barrier, facilitating the deployment of electrolyser technology at scale and accelerating the transition to green hydrogen production.

Allocation of CAPEX grants could prioritise projects with strong technical feasibility and a credible pathway to long-term, stable operations, helping to mitigate the current uncertainty around large-scale project performance. Chile's Green Hydrogen Facility (OECD, 2024^[1]) offers a relevant benchmark for Egypt, as it proposes using CAPEX grants strategically to reduce the substantial upfront costs for electrolyser technologies, particularly for projects exceeding 100 MW in size. Additionally, the facility tailored sub-loans to cover up to 40% of the capital expenditure for green hydrogen production projects across Chile's key hydrogen valleys. These sub-loans design to help finance essential components – including electrolysers, storage systems and dispensing units – which typically account for 60-80% of overall project costs. In addition, Chile's experience highlights the critical role of a government-hosted facility – such as Chile's Concessional Credit Lines – in ensuring the effective deployment of concessional financing to green hydrogen project developers, particularly those struggling to access commercial finance. For Egypt, combining CAPEX grants with targeted risk mitigation instruments such as Debt Service Reserve Accounts (DSRA), Liquidity Reserve Accounts (LRA) or a first-loss guarantee mechanism linked to electrolyser performance indicators could provide a viable model to crowd in private capital.

Establishing Special Purpose Vehicles (SPVs) with government oversight could serve as a critical institutional mechanism to effectively operationalise CAPEX grant facility for large-scale green hydrogen projects in Egypt (OECD, 2024^[1]). For instance, Oman's strategic establishment of Hydrom, a dedicated subsidiary under Energy Development Oman (EDO), presents an effective model for mobilising private capital while minimising direct public expenditure in the burgeoning green hydrogen sector (OECD, 2024^[2]). Functioning as a central orchestrator, Hydrom is tasked with master planning, regulatory co-ordination and auction design, facilitating investor engagement and ensuring alignment with national energy objectives. Its role in enabling shared infrastructure development and regulatory clarity has been key to de-risking investments, enhancing bankability and reducing the need for large-scale public subsidies. This has contributed to the advancement of flagship projects such as HyDuqm toward FID. Egypt could adopt a similar model – potentially through a dedicated entity under a government-affiliated structure – to co-ordinate planning, manage auctions, and guide infrastructure roll-out, particularly in strategic zones such as the SCZone.

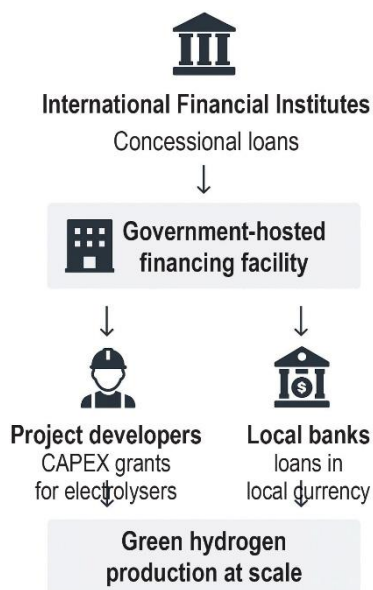
4.2.2. Mitigating FX currency risk through participation of domestic banks

Effectively managing FX risk is essential for green hydrogen projects, as long-term capital intensity and reliance on foreign investment amplify exposure to currency volatility, which can erode project returns and deter investor participation. In Egypt, effectively managing currency-related risks requires a comprehensive and co-ordinated approach. A key challenge lies in the mismatch between revenue streams, often denominated in Egyptian pounds, and project costs and debt servicing obligations, which are typically in foreign currencies. This exposure to inconvertibility and FX volatility constitutes a major structural barrier, especially given developers' reliance on international financing due to limited access to long-term local capital. Without adequate risk mitigation, FX mismatch can significantly undermine project bankability. Introducing targeted FX guarantee instruments – whether embedded in government-backed financing facilities or offered by development finance institutions – could play a pivotal role in protecting investors and lenders from currency-related shocks.

Moreover, to ensure a more balanced and resilient financing structure, the engagement of local banks should be strengthened, particularly for financing the EGP-denominated components of green hydrogen projects. Under Egypt's green hydrogen incentive law, a portion of project financing may be required to come from the local financial sector, particularly when foreign investment accounts for at least 70% of the project's capital. This makes addressing FX risks even more critical. Currently, while 20-30% of hydrogen project costs are typically incurred in EGP, domestic financial institutions have only limited participation, as discussed in Chapter 1. Expanding local bank involvement in financing EGP-denominated portions would allow developers to hedge part of their currency exposure, thereby enhancing overall financial resilience and reducing project vulnerability to exchange rate fluctuations. Coupling such local currency financing with an FX guarantee mechanism – whether structured as a partial credit guarantee or a hedging product tied to foreign debt repayments – could further enhance bankability, especially for large-scale anchor projects.

Building on successful models such as the EBRD's Green Economy Financing Facility (GEFF) in Egypt (Cordonnier and Saygin, 2023^[3]), which channels financing through local banks to support SMEs, a similar structure could be adapted for hydrogen infrastructure projects. Within this facility, FX guarantees could be integrated as part of a broader blended finance package – alongside CAPEX grants and EGP-denominated sub-loans – to improve project-level risk-return profiles. In addition, prioritising export-oriented hydrogen projects – which generate revenues in hard currencies – can serve as a natural hedge against FX volatility. This approach would not only improve project bankability but also strengthen incentives for local banks to engage more actively in the sector's financing ecosystem (Figure 4.1).

Figure 4.1. Leveraging CAPEX grants and local currency loans for green hydrogen



Source: Schematic representation prepared by the OECD Secretariat.

4.2.3. Addressing offtake risk: contract-for-difference

The survey conducted in Chapter 3 identified offtake risk as a critical challenge. Despite strong global aspirations for hydrogen, its widespread adoption is hindered by several obstacles. The absence of clear pricing, a liquid trading market and consistent legal frameworks creates uncertainty, deterring investors and resulting in a supply-demand deadlock (Lee and Saygin, 2023^[41]) (Lee and Saygin, 2023^[41]). To overcome this and reach a critical turning point, the green hydrogen market needs support mechanisms to stimulate market demand. These include secure investment environments, clearly established long-term purchase contracts, financial mechanisms to address the cost gap between green and fossil fuel-based hydrogen and a structured competitive landscape that generates transparent price signals and encourages efficiency improvements.

CfD is a financial agreement where two parties exchange the difference between the asset's market value and a pre-agreed strike price over the life of the contract. In the energy sector, particularly for renewables, CfDs have been vital for incentivising investment by offering long-term price stability through a guaranteed strike price (Mohd Safuan, Ahmad and Mat Zain, 2022^[51]). This protects generators from market volatility and provides consumers with price certainty. Current discussions focus on optimising CfD design for greater cost-effectiveness, stronger market integration and adaptation to emerging technologies such as green hydrogen production (Chaton and Metta-Versmessen, 2024^[61]).

In the context of green hydrogen, CfDs are increasingly being explored as a tool to stabilise project revenues by mitigating OPEX risks, particularly those arising from volatile electricity and input costs (Ason and Dal Poz, 2024^[71]). When CfDs are linked specifically to carbon prices – commonly referred to as Carbon Contracts for Difference (CCfDs) – they aim to hedge against carbon price volatility to support low-carbon hydrogen production. However, implementing CCfDs requires the existence of a functioning carbon market, bringing additional considerations related to carbon pricing mechanisms and market maturity. While challenges such as the high upfront costs of green hydrogen and infrastructure needs remain, CfDs offer a pathway to de-risk investments, lower financing costs and accelerate the scaling of clean hydrogen technologies.

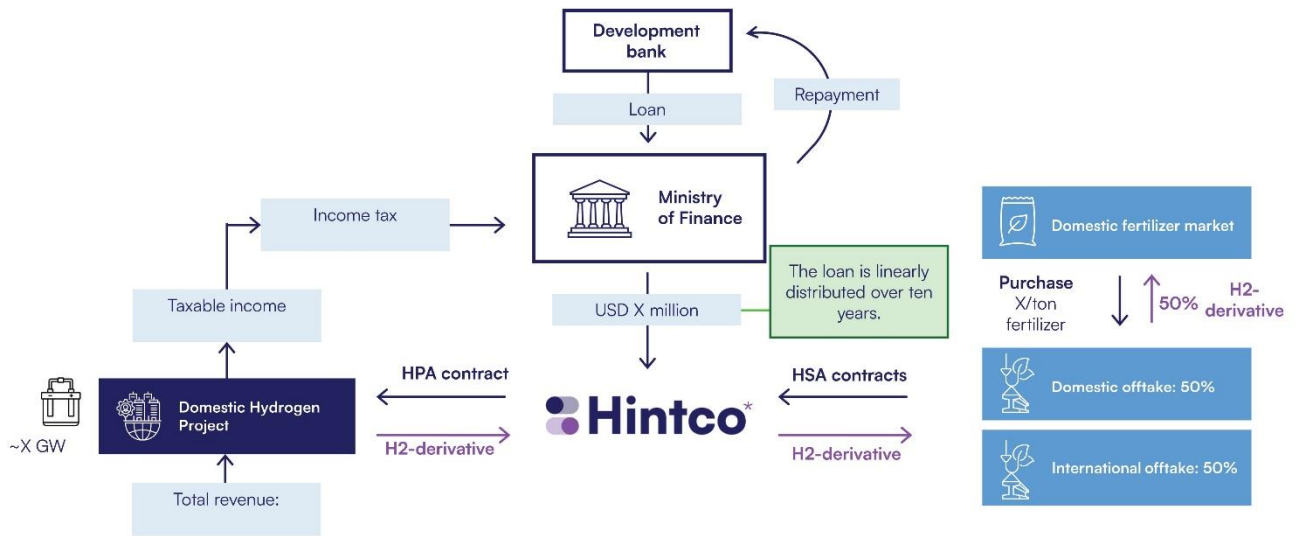
In the UK Hydrogen Business Model, CfDs are a central pillar, with the government proposing a strike price based on the cost of green hydrogen production, aiming to make it competitive with fossil fuel equivalents for industrial users (Oxford Institute for Energy Studies, 2024^[8]). The design of this UK CfD mechanism involves a competitive allocation process and a variable premium model, where the generator receives the difference between the strike price and a reference price. The UK's first Hydrogen Allocation Round (HAR1) awarded CfDs to eleven green hydrogen projects with a total capacity of 125 MW and an average strike price of GBP 241/MWh (2022 prices), backed by over GBP 2 billion in revenue support and GBP 90 million in capital grants, targeting operation by 2025 (Department of Energy Security and Net Zero, 2023^[9]) (Department of Energy Security and Net Zero, 2023^[9]).

Japan introduced a CfD subsidy programme in 2023 to support low-carbon hydrogen production, aiming to bridge the cost gap between low-carbon hydrogen and fossil fuel-based equivalents (OECD, 2024^[10]). The scheme will fund both domestic and imported low-carbon hydrogen, including green and blue hydrogen, with JPY 3 trillion (~USD 20.86 billion) allocated over 15 years (GH2, 2024^[11]). Payments will be based on a reference price, currently tied to LNG for hydrogen and coal for ammonia, with producers receiving top-up payments if their costs exceed the reference price or paying the government if their costs are lower (Parkes, 2024^[12]).

The H2Global instrument (Cordonnier and Saygin, 2023^[3]) is used by the governments of Australia, Canada, Germany and the Netherlands to provide certainty in hydrogen supply and demand through a dual auction system. Developers bid for 10-year contracts, while HintCo organises a separate auction for off-takers, typically with 1-year contracts. Government-backed grants de-risk the market for early movers. Unlike standard CfD models, H2Global uses a decreasing price gap approach, assuming increased market willingness over time, reducing reliance on public subsidies and enhancing long-term sustainability (Bollerhey et al., 2023^[13]). The first auction results included a project in Egypt's SCZone, cleared at EUR 811/tonne, with a maximum contracted volume of 400 000 tonnes/year, with expected delivery by 2027 (Pearce, 2024^[14]).

Drawing upon the potential effectiveness of CfDs in relevant markets, the following paragraphs proposes a tailored implementation strategy (Figure 4.2). Considering Egypt's prevailing fiscal environment, CfD with double auction mechanism presents a pragmatic approach to stimulate the clean hydrogen and ammonia sectors while minimising the reliance on substantial public expenditure. The strategic deployment of concessional loans from IFIs would greatly enhance viability of the mechanism.

Figure 4.2. H2Global replicability tailored to the Egyptian context



Note: The model assumes a minimum project size of EUR 500 million per lot, ensuring sufficient scale to justify long-term offtake agreements and attract international investment. The proposed auction model tailored to Egypt assumes no direct fiscal subsidy from the national budget. Source: H2Global and its replicability in Egypt, H2Global at OECD Egypt Low carbon hydrogen stakeholder workshop, April 2025.

Figure 4.3. Tax revenue from the simulated H2Global renewable ammonia auctions

State-perspective, simulation



Note: The net present value (NPV) of the funding instrument reaches approximately USD 390 million, based on a 50/50 domestic and export offtake split. The simulation assumes total domestic sales of USD 4.2 billion, export revenues of USD 3.9 billion and a total investment of USD 1.6 billion. Ammonia sales prices are assumed to range between USD 600 and 750 per tonne. Tax revenues from newly created projects exceed total and annual funding demand in this simulation.

Source: H2Global and its replicability in Egypt, H2Global at OECD Egypt Low carbon hydrogen stakeholder workshop, April 2025.

The proposed framework for establishing a renewable ammonia production sector in Egypt comprises several key stages (Figure 4.2):

- Initially, a competitive tendering process (supply auction) will be initiated to identify and select viable projects to produce renewable ammonia within Egypt.
- Successful bidders will proceed to the final investment decision phase, culminating in the operationalisation of their production facilities.
- Subsequently, operational projects will be granted long-term purchase agreements through a designated Egyptian government intermediary. During the initial phase, operational responsibilities could be temporarily delegated to an experienced intermediary such as HintCo, which possesses the technical capacity for implementation and can support institutional strengthening through capacity-building for government officials.
- These agreements aim to ensure stable pricing and make the projects more financially viable. A key feature of the contract could be potentially considering the 50/50 Offtake Model, which ensures that half of the produced ammonia is reserved for domestic use, helping Egypt meet its industrial decarbonisation goals. The remaining 50% will be directed towards export markets, serving to generate foreign currency revenue. The ratio can be adjusted over time to reflect Egypt's evolving strategic objectives in line with the targets of its hydrogen strategy.
- The offtake allocation ratio can be flexibly adjusted over time in line with the government's evolving priorities and the targets outlined in Egypt's national hydrogen strategy. For example, in the initial phase, an 80/20 offtake model – with 80% directed to export markets and 20% for domestic use – could be applied to maximise foreign exchange earnings while market readiness develops.
- Under this structure, Government of Egypt retains no exposure to direct price risk. Instead, it benefits from increased tax revenues generated by the domestic hydrogen project – revenues which, according to fiscal simulations, exceed both annual and total repayment obligations (Figure 4.3). This model supports a fiscally neutral or even revenue-positive pathway to de-risk early hydrogen investment, while maintaining Egypt's fiscal space and leveraging concessional international finance.

Establishing a dedicated institution to govern the implementation mechanism is crucial for success. To ensure effective management, it is essential that the overseeing institution has the technical and financial expertise to evaluate all aspects of project viability. Capital expenditure for these projects could be facilitated through concessional loans sourced from IFIs, rather than through direct grants or public funding. These loans could be featuring favourable terms, including extended tenors, grace periods and reduced interest rates, and will be disbursed linearly over a ten-year period. This structured disbursement schedule aims to ensure manageable repayment obligations for project developers and mitigate initial capital constraints. This integrated model strategically leverages blended finance mechanisms to mitigate risks of early-stage hydrogen initiatives, thereby establishing a robust foundation for a self-sustaining hydrogen economy within Egypt.

4.2.4. Power sector reform as a foundation for green hydrogen investment

As discussed in previous chapters, Egypt's 2024 National Strategy for Low-Carbon Hydrogen and the subsequent Green Hydrogen Incentives Law signal growing political commitment. However, the implementation of concrete regulatory and operational frameworks remains incomplete. The scale and speed of investment deployment depends significantly on investors' expectations regarding the persistence of supportive policies and clarity on relevant regulations over time (Nemet et al., 2017^[15]). To unlock the country's potential as a green hydrogen hub, reforms in the power sector are particularly critical. Without such enabling investment conditions, investor uncertainty will continue to hamper the scale-up of green hydrogen projects. Moreover, all de-risking and economic instruments identified in this report such

as concessional loans, CAPEX grants and CfDs cannot be effective unless underpinned by a coherent, stable and supportive regulatory and policy environment.

First, Egypt could accelerate the development of a clear and co-ordinated regulatory and technical framework for grid connection to support the timely deployment of large-scale green hydrogen projects. As discussed in Chapter 2, relying solely on dedicated renewable energy supply risks oversizing generation capacity and inflating the LCOH, making a hybrid model involving both dedicated and grid connected renewables more cost effective. Realising this requires well defined technical standards, clear connection timelines and a delineation of responsibilities between project developers and the EETC. While current regulations formally allow developers to construct dedicated transmission lines, implementation has been limited. Contractual constraints, particularly those inherited from legacy power purchase agreements, as well as the dominant role of the state-owned grid operator, have hindered progress. No developers have yet built independent transmission infrastructure due to high upfront investment costs, fragmented permitting processes and the absence of a comprehensive grid planning and cost sharing framework.

Complementing this, it is critical to accelerate the unbundling of the transmission sector and establish a fully independent Transmission System Operator (TSO) to ensure non-discriminatory grid access. Building on the need for a hybrid model, even projects with dedicated renewable supply will require interaction with the national grid – for reliability, balancing or scalability. However, Egypt currently lacks clear operational and regulatory protocols for managing such hybrid configurations. This regulatory gap, combined with the absence of an independent TSO, creates significant uncertainty, undermining investor confidence and slowing infrastructure rollout. The gradual unbundling of EETC offers a strategic opportunity to address these issues, but progress remains delayed due to the lack of detailed implementing regulations. Without decisive action to operationalise the unbundling process and upgrade the national transmission network, Egypt risks missing its renewable energy targets. Meeting the estimated 160 GW of renewable capacity required for green hydrogen production will necessitate substantial and timely investments in high-voltage transmission infrastructure. Advancing regulatory reform, grid planning and institutional restructuring is therefore essential to position Egypt as a credible and competitive green hydrogen hub.

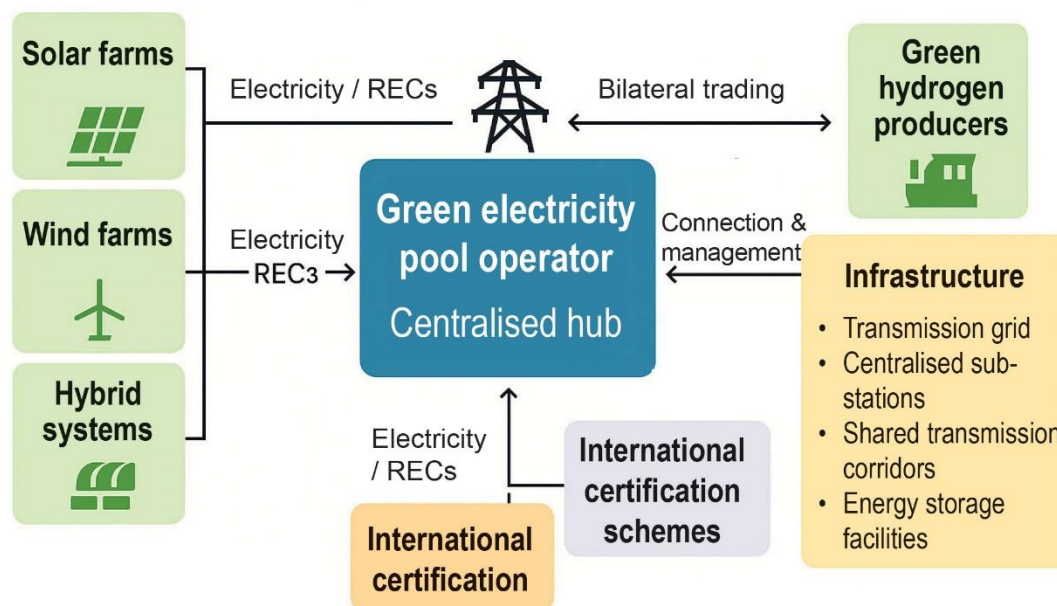
In parallel, Egypt could establish a transparent and standardised wheeling charge framework to support green hydrogen developers that depend on access to the national grid. Wheeling charges are particularly relevant for projects that cannot construct fully dedicated transmission lines and must use existing infrastructure. Currently, EETC applies a flat 7% charge on electricity revenues for grid access, raising concerns about added costs and financial uncertainty. The absence of clear, predictable methodologies – accounting for factors such as distance, voltage level and grid congestion – further complicates project planning. Moreover, limited public information exists on tariff structures tailored specifically to green hydrogen. Introducing a consistent and transparent wheeling charge mechanism would complement the broader grid access reforms, enhance cost visibility, reduce investor risk and accelerate grid-based hydrogen project development in Egypt (Denis, 2026^[16]).

To further enable renewable energy market flexibility, Egypt could consider implementing a structured pooling and trading mechanism in future phases of its Private-2-Private¹ framework. Egypt is currently piloting the first phase of its P2P PPA framework, overseen by EgyptERA. This framework allows direct electricity transactions between private producers and consumers, promoting a more competitive and efficient electricity market. Although still in its early stages, the P2P initiative marks a practical step toward attracting private investment, improving grid efficiency and accelerating the deployment of renewable energy – all of which can contribute to lowering production costs for green hydrogen, as discussed in Chapter 2. The framework outlines a structured process: eligible producers and consumers must register with EgyptERA; new renewable energy facilities (wind or solar) are permitted, each capped at 100 MW; and projects must comply with predefined contractual rules. The pilot phase targets a total generation capacity of 500 MW. Under this scheme, producers may engage with up to three consumers, with any surplus electricity allowed to be sold to EETC. EgyptERA evaluates applications through a scoring system

that assigns base points to new facilities and consumption sites, while incorporating modifiers based on factors such as grid connection status, geographical proximity, inclusion of desalination or green hydrogen production and timeliness of implementation.

The effective implementation of P2P would allow multiple renewable energy generators to aggregate their output into a common pool, from which green hydrogen producers could procure electricity under standardised and traceable agreements. Such a system would ensure that only newly added renewable capacity is used, aligning with certification requirements under global standards like the EU Renewable Energy Directive (RED II/III) (European Commission, 2018^[17]) and voluntary schemes such as CertifHy. The pooled market could be supported by shared infrastructure investments – such as central substations, transmission corridors, and storage facilities – which could lower system costs by up to 30% compared to a decentralised approach (IRENA and Methanol Institute, 2021^[18]). An independent green electricity pool operator could oversee renewable generation verification, supply allocation and settlement, while enabling auctions or bilateral trading among hydrogen producers. Over time, this system could evolve into a broader market platform, helping Egypt meet international green hydrogen certification standards and enhancing export competitiveness (Figure 4.4).

Figure 4.4. Peer-to-peer pooling structure for green hydrogen in Egypt



Note: REC: renewable energy certification.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

4.2.5. Prioritise investment in common user infrastructure, ensuring both accessibility and high quality

Common user infrastructure (CUI) plays a critical enabling role in the development of green hydrogen projects by offering multiple advantages that support cost-efficiency and scalability. As discussed in Chapter 3, shared infrastructure significantly reduces production costs by creating economies of scale, allowing multiple projects to access the same facilities and thereby lowering overall capital expenditure. Key components such as pipelines, storage systems and export terminals help avoid duplication of assets and optimise resource utilisation, resulting in substantial cost savings. In addition to cost benefits, CUI accelerates project timelines, as developers are not required to build all infrastructure independently. This

in turn enhances project bankability by reducing upfront investment needs and mitigating development risks, making green hydrogen ventures more attractive to investors.

In the Egyptian context, the projects within the industrial zone or special economic zone (i.e. SCZone) exemplify the importance of CUI, with plans to establish a hub where producers can leverage common export facilities, pipelines and renewable energy sources. Egypt aims to allocate a portion of its substantial green hydrogen sector investments to develop this CUI, including extensive port facilities in the SCZone. Large-scale projects, such as the Egypt-France collaboration (FCW, 2025^[19]) near Ras Shokeir, also underscore the need for shared resources like new port facilities and transmission corridors. Key CUI components include pipeline networks for hydrogen transport, dedicated export terminals, transmission lines and substations for renewable energy integration and large-scale, centralised electrolyser plants. A notable example in the SCZone is the planned seawater desalination plant, a public-private partnership that will supply water to green hydrogen producers could help reducing their capital expenditure, ensuring a reliable water supply and promoting cost-effective desalination.

Many countries with green hydrogen ambitions are advancing the development of CUI to enable cost-effective scale-up. For instance, in Namibia, Hyphen is developing a CUI comprising desalination facilities, pipelines, transmission lines and storage and export terminals to support its project and future developments within the Southern Corridor Development Initiative (SCDI). By enabling open, transparent access for subsequent projects, the CUI creates economies of scale, reduces project-specific infrastructure burdens and supports Namibia's goal of producing up to 3 million tonnes of green hydrogen annually. This integrated approach not only enhances investment appeal but also reinforces Namibia's potential as a regional hub for green hydrogen production (OECD, 2024^[20]). Egypt could draw from this model to design CUI – particularly in the Suez Canal Economic Zone – to reduce duplication, enhance infrastructure bankability and support the development of a competitive hydrogen export platform.

Egypt can also benefit from these insights by aligning hydrogen hub planning with port development strategies, leveraging existing industrial zones to integrate production, storage and export infrastructure under cohesive regulatory and investment frameworks. In Brazil, green hydrogen hubs are under development within Export Processing Zones (ZPEs) strategically located near major ports, including the Pecém Industrial and Port Complex (CIPP) in Ceará and the Port of Suape in Pernambuco (OECD, 2024^[21]). These hubs integrate hydrogen production, transportation infrastructure and downstream or export facilities within a single operational zone. Successful implementation relies on the development of large-scale production assets, conversion facilities, pipelines and storage systems to enable efficient distribution and export of clean hydrogen and ammonia. The shared use of port infrastructure helps reduce CAPEX concentration, mitigate operational risks and enhance the probability of reaching FID. Stable policy environments, clear regulatory frameworks, targeted incentives, and strong PPPs are critical to ensuring industrial competitiveness, operational excellence and mobilising investment at scale.

Developing CUI must also prioritise environmental and social sustainability. While green hydrogen presents a significant opportunity for decarbonisation and economic growth, it introduces distinct environmental, social and governance (ESG) risks that must be proactively managed to ensure project bankability and long-term sustainability. From an environmental perspective, green hydrogen production is highly resource-intensive: producing one kilogramme of green hydrogen requires theoretically nine litres of purified water (Kumar et al., 2024^[22]). Large-scale facilities place further strain local water resources, particularly in arid regions like most of Egypt. Additionally, the renewable energy infrastructure needed to power electrolysers demands significant land use, potentially disrupting ecosystems and biodiversity. Without comprehensive environmental impact assessments and mitigation plans, cumulative impacts could undermine local resilience.

As desalination is used to meet water demand, energy consumption and brine disposal must be carefully managed through clear water governance frameworks to avoid secondary social effects and environmental harms. Poorly planned green hydrogen projects can lead to land use conflicts, involuntary resettlement

and occupational safety risks due to the high flammability and storage pressures of hydrogen gas. Data from the ILO shows that hydrogen-related industrial activities could introduce new occupational hazards, necessitating specialised safety standards and workforce training. On the governance side, regulatory uncertainty remains a major barrier; for example, less than 30% of countries with hydrogen roadmaps currently have enforceable standards for production, transportation and certification (IRENA, 2023^[23]). The absence of standardised ESG reporting frameworks across emerging hydrogen markets further complicates investor risk assessments. Implementing internationally recognised standards such as ISO/TC 197 for hydrogen technologies will be vital to ensuring safety, enhancing transparency and improving access to sustainable finance instruments like green bonds and sustainability-linked loans.

Embedding ESG considerations from the earliest stages is essential not only to attract initial investment but also to ensure long-term financial viability and alignment with the expectations of global institutional investors, who increasingly prioritise resilient, low-carbon infrastructure. Egypt could benefit from adopting a similar approach to that of Oman's Sohar Port, where the early integration of ESG principles and sustainability reporting has helped strengthen investor confidence and improve access to international sustainable finance for green hydrogen and industrial projects (OECD, 2024^[24]).

Box 4.1. Blue Dot Network, Infrastructure Certification Scheme

The Blue Dot Network (BDN) is the first global certification framework aligned with the G20 Principles for Quality Infrastructure Investment. It provides a structured approach to evaluating infrastructure projects against ten comprehensive criteria, including economic efficiency, debt transparency, environmental and social safeguards, transparent procurement, anti-corruption, skills transfer, gender equality, climate risk management, open access and the promotion of inclusive economic development.

It offers multiple strategic advantages:

- **Improved transparency and investor confidence** through enhanced disclosure and governance standards;
- **Reduced due diligence costs** and transaction inefficiencies by aligning with internationally recognised benchmarks;
- **Enhanced access to finance**, particularly in global capital markets where investors increasingly prioritise ESG-aligned assets.

Moody's and the World Bank report that sovereign and sub-sovereign entities implementing strong ESG practices, such as those embedded in the BDN framework, can access green bond markets at interest spreads 30-70 basis points lower than conventional bonds, resulting in significant financing cost savings.

In Egypt, where the state plays a central role in green hydrogen and infrastructure development, embedding an internationally recognised certification framework such as the BDN into procurement processes or investment incentive schemes can significantly enhance project credibility. These frameworks promote alignment with international environmental, social, financial and economic standards, thereby streamlining project preparation, strengthening investor confidence and facilitating access to finance from both public and private sources.

Moreover, such a certification can optimise the broader environmental and social benefits of infrastructure projects at the national level. For example, El Dorado International Airport in Colombia, a BDN-certified project, achieves a 73% reduction in Scope 1 and 3 emissions compared to its 2018 baseline, enhances biodiversity outcomes, supports over 35 000 direct and indirect jobs, and enhances the value of the asset through strengthened ESG alignment and risk mitigation, ultimately boosting investor confidence.

Source: (Blue Dot Network, 2024^[25]).

4.2.6. Strengthen the skillset and domestic industry

Building strong local capacity is critical for Egypt's ambition to become a global hub for green hydrogen production and export. Green hydrogen offers Egypt a transformational opportunity to stimulate both upstream and downstream industrial activity. On the upstream side, there is potential to expand manufacturing capabilities for critical components such as electrolysers, pipelines and desalination technologies, while downstream industries such as fertiliser and steel production are poised to become major domestic off-takers.

In this context, UNIDO has led efforts on skills development and workforce readiness. This work was also informed by insights from the OECD's analysis captured in this report. Recognising that industrial transformation cannot occur without human capital, UNIDO's work is systematically assessing existing skillsets and identifying gaps across the entire hydrogen value chain, in alignment with the ILO International

Standard Classification of Occupations. Targeted workforce training programmes are being developed to ensure that Egyptian workers are equipped to meet the evolving technical demands of green hydrogen production, transportation and application sectors. By investing in local manufacturing capabilities and human capital, Egypt can reduce project costs, lower reliance on imported technologies, boost domestic value addition, and secure a more resilient, competitive position in the emerging global green hydrogen economy (ILO/IRENA, 2021^[26]). Currently, local supply chain development – particularly in the manufacturing of electrolyzers and storage tanks – remains underdeveloped and strategically underexplored. Hydrogen projects rely heavily on imported components, which exposes Egypt to global supply chain disruptions and limits domestic value creation. Untapped opportunities in local manufacturing and related socio-economic benefits merit further analysis to better understand Egypt's industrial potential, technology gaps and strategic entry points for value chain development.

4.3. Conclusions and areas of future analysis

While the report is focusing on priorities to unlock green hydrogen projects in Egypt, maturing green hydrogen also requires significant international co-operation. These initiatives focus on research and development, risk mitigation, financial assistance, capacity-building, policy support and co-ordination (OECD/The World Bank, 2024^[27]). Given the strategic importance of green hydrogen, international co-operation and co-ordination efforts are rapidly expanding. For Egypt to sustain and accelerate its current momentum in the green hydrogen sector, it will be essential not only to continue strengthening domestic enabling investment conditions but also to actively engage with and leverage ongoing international initiatives.

Beyond production, Egypt has significant potential to become a green shipping gateway, leveraging its location along the Suez Canal to serve as a refuelling and export hub for hydrogen-based fuels like ammonia and methanol. Yet, competition from other regional players underscores the need for Egypt to accelerate infrastructure development to fully capitalise on its geographic and energy advantages. An assessment of the existing port infrastructure that could be used or repurposed for hydrogen exports would significantly strengthen the analysis of Egypt's export readiness and strategic positioning in global hydrogen markets.

Many of the outcomes presented in this report are closely aligned with Egypt's current policy priorities and the evolving green hydrogen market landscape. The report particularly focuses on outlining actionable steps over the next years to help align with the 2030 target of the National Low-Carbon Hydrogen Strategy that was considered throughout the report. To ensure the strategy is accessible and actionable for a wide range of stakeholders across the green hydrogen sector, it will be important to consolidate these efforts into a clear and transparent action plan, structured in a phased and manageable approach.

A number of issues, such as the development of local supply chains and the analysis of environmental impacts – especially water scarcity and the impact of brine disposal² – require further analysis. Similarly, it is important to deepen the assessment of the socio-economic impact of Egypt's green hydrogen sector, particularly on jobs across its value chain, including infrastructure development. This includes identifying opportunities for local employment in manufacturing, construction, operation and maintenance as well as mapping the skills gap and designing targeted training programmes to equip workers with the technical and safety competencies required for hydrogen technologies. A more detailed and integrated analysis would help ensure that green hydrogen production contributes meaningfully to inclusive economic development, workforce resilience and social equity. These topics were not covered in this report and merit further attention in future assessments.

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[14]

Notes

¹ Egypt is currently developing a regulatory framework for smart mini-grid to enhance renewable energy integration and support green hydrogen production using surplus solar PV generation. While the ongoing consultations consider frameworks for green hydrogen-dedicated mini-grids, the current discussions focus on systems slightly above 50 MW in capacity, thus excluding larger-scale green hydrogen projects from the immediate regulatory scope.

² This topic was raised during the OECD workshop organised in April 2025 and deserves further attention. While initial analysis suggests that brine disposal may have a limited effect on overall hydrogen production costs, specific cases indicate that it could significantly increase operational expenses and pose environmental risks, particularly in coastal areas. Negative environmental impacts are also highlighted in the OECD Green Growth Policy Review of Egypt (OECD, 2024_[26]).

Annex A. Methodology and input data

Methodology

This Annex describes the methods and input data used for the estimation of the Levelised Cost of Hydrogen (LCOH) that was presented in Chapter 2. LCOH corresponds to the overall production cost of the hydrogen produced over the lifespan of the investment which depends on CAPEX and OPEX.

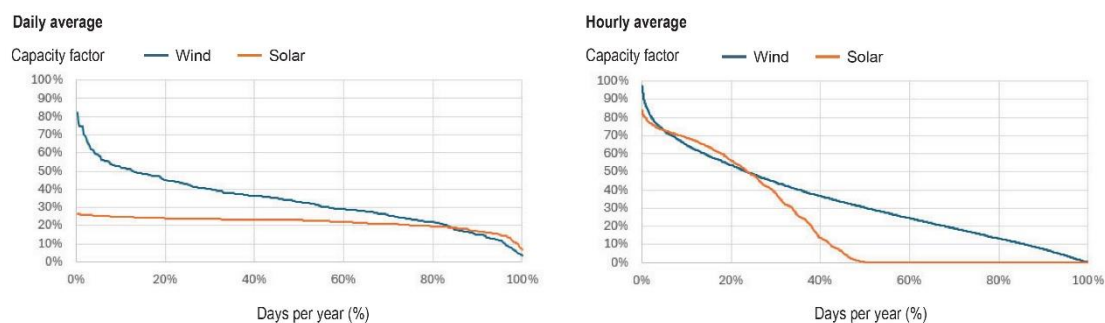
Green hydrogen

For the green hydrogen production system, the model is structured within an optimisation framework that determines the optimal sizes of system components and their operation schedule, aiming to minimise the LCOH while ensuring a constant hourly hydrogen output throughout the year. This objective is formulated as a mixed-integer linear programming (MILP) optimisation problem. A cost-optimisation algorithm is implemented in MATLAB and solved using the Gurobi™ solver.

The model simulates system operations over an entire year with hourly time resolution. Hourly PV and wind electricity generation profiles are based on historical data for the selected plant location, representing a typical year. For each hourly time step, the equations governing the behaviour of each system component are solved, determining the energy flows entering and exiting each component. The full set of techno-economic assumptions is detailed in Tables A A.1., A A.2. and A A.3.

Specific technological assumptions were discussed in Chapter 2 to produce 100 kt H₂ per year with a constant hourly demand all year round (11 414 t H₂/h). Regarding storage, both Li-ion BESS and hydrogen storage in pressurised vessels are considered for short-duration balancing to minimise the oversizing of the renewable power generation plant. The storage system sizes are determined by the optimisation algorithm to minimise the LCOH while ensuring the hourly hydrogen demand is met. Given the seasonal stability of renewable power generation Figure A A.1), seasonal hydrogen storage in salt caverns is not considered. For both storage systems, non-negative annual balances are imposed to ensure that the stored amount at the end of the simulated year matches the initial amount, enabling identical performance in subsequent years and ensuring multi-year plant operation.

Figure A A.1. Duration curves for wind and solar power generation for Suez area in 2019



Source: (Ninja Renewables, 2025_[11]).

Blue hydrogen

For blue hydrogen production, two technologies (SMR and ATR) are evaluated by developing models using Aspen Plus process simulation software to work under steady state conditions. A third technological option for blue hydrogen production would be the SMR with a CO₂ separation section from the syngas flow. This is more complex to be implemented as a retrofit solution and yields lower overall carbon capture reduction (in the range 60-70% of the total inlet C). Hence, this configuration is not further discussed.

Input data

The calculation of the LCOH needs input data as following: (i) economic data about technology investment and operation costs; (ii) cost of commodities; (iii) technical data about performances of technologies (i.e. efficiencies, lifetime); (iv) location-specific availability of the renewable sources (wind and solar).

Economic and technical data

Economic data including capital investment and O&M costs for the components of the hydrogen production systems were obtained from the relevant sources recently published. Fixed O&M for each component is considered as a percentage of the original investment cost. Natural gas, desalinated water and grid electricity costs are considered constant values equivalent to the current prices in Egypt. A 10% discount rate is assumed for the analysis.

Investment and fixed O&M costs are expected to decrease over time due to greater technology adoption and economies of scale. To account for this, two cost scenarios are considered for LCOH estimation: the base case, which reflects current technology costs, and the future scenario, which incorporates projected cost reductions. To address uncertainties in battery storage and ammonia cracking costs, two CAPEX values are used. For BESS, a low estimate of USD 200/kWhel and a high estimate of USD 400/kWhel are considered. For the ammonia cracking plant, CAPEX values of USD 1.42 M /MWNH₃nom and USD 2.24M / MWNH₃nom are based on recent studies.

The renewable energy efficiencies are embedded in hourly generation profiles. Battery storage has a charge/discharge efficiency of 90% (81% round-trip efficiency) and a 4-hour energy-to-power ratio. Electrolyser efficiency is based on recent studies (UNIDO, 2023_[21]). Hydrogen storage assumes no leakage in pressurised tanks. Electricity transmission losses are 3.5% per 1 000 km for HVDC cables and 1.5% for AC/DC and DC/AC conversions. Hydrogen transport pipelines assume a 0.1% loss per 1 000 km and an energy use of 0.027 kWhel/km/kg H₂.

For the blue hydrogen simulations, the economic analysis follows a bottom-up approach, where capital costs for each installed component are estimated using cost functions. All costs are adjusted to the reference year 2023 using the Chemical Engineering Plant Cost Index (CEPCI), with a 2023 index value of 797.6.

The values used in the herein presented work are summarised in Table A A.1, Table A A.2 and Table A A.3. References for the selected values are included in each table.

Table A A.1. Green hydrogen production, techno-economic assumptions

Components	CAPEX		CAPEX reference values	OPEX	Performance parameters
	Base case	Future			
PV power generation plant	USD 600 /kWnom	USD 350 /kWnom	(IRENA, 2022 ^[3]): USD 876/kWnom in 2022; USD 707/kWnom in 2030 via power law regression of historical data. (LUT, n.d. ^[4]): Optimally tilted PV: USD 432/kWnom in 2020; USD 278/kWnom in 2030 (may scale x2 compared with historical IRENA data). (IRENA, 2019 ^[5]): USD 340-834/kWnom in 2030 (with an avg. of USD 587/kWnom).	2%/y of CAPEX	Profile = f(location) Lifetime = 25 years
Onshore wind power generation plant	USD 1 100 /kWnom	USD 1 100 /kWnom	(IRENA, 2022 ^[3]): Global average: USD 1 274/kWnom in 2022; African average: USD 1 685/kWnom in 2022. (LUT, n.d. ^[4]): 1 000 USD/kWnom	2%/y of CAPEX	Profile = f(location) Lifetime = 30 years
Battery Energy Storage System (BESS)	USD 200-400 /kWh	USD 175/kWh	(IEA, 2023 ^[6]): USD 290/kWh in 2023; USD 175/kWh in 2030.	2%/y of CAPEX	$\eta_{\text{charge}} = 0.9$ - $\eta_{\text{discharge}} = 0.9$ Self-discharge = 3%/month Lifetime = 20 years Replacement cost = 60% initial CAPEX (at year 10) Energy/Power ratio = 4 kWh/kW
Low-temperature electrolysis system	USD 800 /kWnom	USD 400 /kWnom	(IRENA, 2020 ^[7]): USD 500-1000/kWe, with avg. range @100MWmodules of USD 400-500/kWe in 2020. (LUT, n.d. ^[4]): USD 685/kWe in 2020; USD 363/kWe in 2030. (IRENA, n.d. ^[8]): USD 540/kWe in 2030.	3%/y of CAPEX	$\eta = 0.6$ (55.56 kWh/kgH ₂) Min. load fraction = 20% Lifetime = 20 years Replacement cost = 40% initial CAPEX (at year 10)
Hydrogen compressors	USD 1 600 /kWh		(Crespi et al., 2021 ^[9]): EUR 1 600 /kWe. Compressor has very small impact on the analysis.	1%/y of CAPEX	$\eta_{\text{compressor}} = 0.63$ Delivery pressure = 220 bar Lifetime = 25 years
Electricity transmission line (overhead cables)	HVDC USD 300 /GW/m		JRC Technical Report, HVDC submarine power cables in the world (Ardelean, 2015 ^[10])	1%/y of CAPEX	HVDC Power Loss = 3.5% EEtrans/1 000 km AC/DC & DC/AC converters loss = 1.5% EEconv Lifetime = 40 years
H₂ storage	USD 500 USD/kg H		US DOE targets (DOE, n.d. ^[11]): USD 450/kgH ₂ (160 bar); USD 600/kgH ₂ (high pressure). FCHJU 2020-2030 targets (Clean Hydrogen Partnership, n.d. ^[12]): EUR 350/kg H ₂	4%/y of CAPEX	Negligible leakage Lifetime = 30 years
H₂ transport pipelines	USD 0.988/km/kWLHV H ₂		(Galimova et al., 2023 ^[13])	5%/y of CAPEX	Loss = 0.1%/1000 km
Grid electricity	(EgyptERA, 2024 ^[14]) Energy Cost: USD 21 /MWh - Grid fees: USD 0.65 /MWh				
Desalination	UNIDO-POLIMI recent work: Levelized cost of demi inlet water: USD 0.01/kgH ₂				
Others	Discount rate = 10%				

Table A A.2. Blue hydrogen production, techno-economic assumptions

Steam reforming with carbon capture					
Category	Parameter	Unit	Reference size	Reference cost 2023 [M USD]	Scaling exponent
Pre-reformer (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	Natural gas flow rate	[kg/s]	17.7	4.6	0.67
Sulphur guard bed (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	Natural gas flow rate	[kg/s]	17.7	2.2	0.67
Syngas coolers (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	Syngas flow rate	[kg/s]	67.4	25.6	0.67
Cooling water system (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	H ₂ flow rate	[kg/s]	5.6	51.1	0.67
Fired tubular reformer (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	Syngas flow rate	[kg/s]	67.4	85.6	0.67
Furnace air blower (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	Air flow rate	[kg/s]	165	5.5	0.67
Water gas shift reactor (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	Syngas flow rate	[kg/s]	67.4	16.8	0.67
MEA CO ₂ capture plant (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	CO ₂ flowrate	[kg/s]	22.2	98.3	0.67
CO ₂ compression and drying (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	CO ₂ flowrate	[kg/s]	55.5	93.3	0.67
CO ₂ compression aftercoolers (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	CO ₂ flowrate	[kg/s]	55.5	6.4	0.67
Pressure Swing Adsorber (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	H ₂ flow rate	[kg/s]	5.6	34.0	0.67
Hydrogen compressor (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	H ₂ flow rate	[kg/s]	5.6	15.4	0.67
Feedwater and miscellaneous BOP systems	H ₂ flow rate	[kg/s]	5.6	196.3	0.67
Autothermal reforming with carbon capture					
Air separation unit (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	O ₂ flow rate	[kg/s]	35.5	216.9	0.5
Autothermal reformer (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	Syngas flow rate	[kg/s]	72.2	13.9	0.67
PSA off gas boiler, ductwork and stack (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	Exhausts flow rate	[kg/s]	45.1	20.2	0.67
MDEA CO ₂ capture plant (de Cataldo et al., 2024 ^[15] ; IEAGHG, 2017 ^[16])	CO ₂ flowrate	[kg/s]	34.8	48.2	0.67
Natural gas (GASREG, 2024 ^[17])	4.85	USD /GJLHV	Grid electricity (EgyptERA, 2024 ^[14])	21	USD/MWh
CO ₂ storage cost	10	USD /tCO ₂	Levelised cost of desalinated water	0.01	USD/kgH ₂
CAPEX of CO ₂ transport (1) New pipeline (EgyptERA, 2024 ^[14]) (2) Retrofitted pipeline (EgyptERA, 2024 ^[14])	(1) 1.21 (2) 0.3	USD bn/ 1000 km	CO ₂ storage cost	10	USD/tCO ₂
OPEX-CO ₂ transport	0.05	USD /kgCO ₂ /1000 km	CO ₂ emission tax	0	USD/tCO ₂
Construction period	3	years	Construction	3	Years

			period		
Plant lifetime	25	years	Plant lifetime	25	Years
Discount rate	10	%	Capital expenditure curve	20/45/35%	First/second/third year)
Average salary	30 000	USD /year	Capacity factor	91%	8 000 eq. hours/year
Discount rate	10%	Inflation rate	2%	Owner's cost	7%
Average salary	USD 30 000 /year	Annual O&M	1.5% of CAPEX	Annual insurance and taxes	1% of CAPEX

Table A A.3. Ammonia-related systems, techno-economic assumptions

Category	CAPEX	CAPEX Reference values	OPEX	Performance parameters
Ammonia synthesis (from N ₂ and H ₂)	1.72	MUSD/MW _{NH₃nom}	Hank et al. (Hank et al., 2020 ^[18]) ¹	5% /y of CAPEX
NH ₃ storage	810	USD/t _{NH₃}	Nayak-Luke et al. (R.M. Nayak-Luke, 2021 ^[19])	3% /y of CAPEX
Ammonia cracking	1.42 – 2.24	M USD/MW _{NH₃nom}	Values herein reported are from (de Cataldo et al., 2024 ^[15]) In (Yun et al., 2024 ^[20]), CAPEX of 0.92 M USD/MW _{NH₃nom} is estimated for a plant size of 35 kt _{NH₃} /y. In (Devkota et al., 2024 ^[21]), CAPEX of 2.69 M USD/MW _{NH₃nom} is estimated for a plant size of 1 kt _{NH₃} /y.	5% /y of CAPEX
N ₂ cost	50	(Zhang et al., 2020 ^[22])		

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Annex B. Techno-economic assessment results

Objective

This Annex describes detailed technical assessment results that is presented in Chapter 2, using methodology and input data from Annex A.

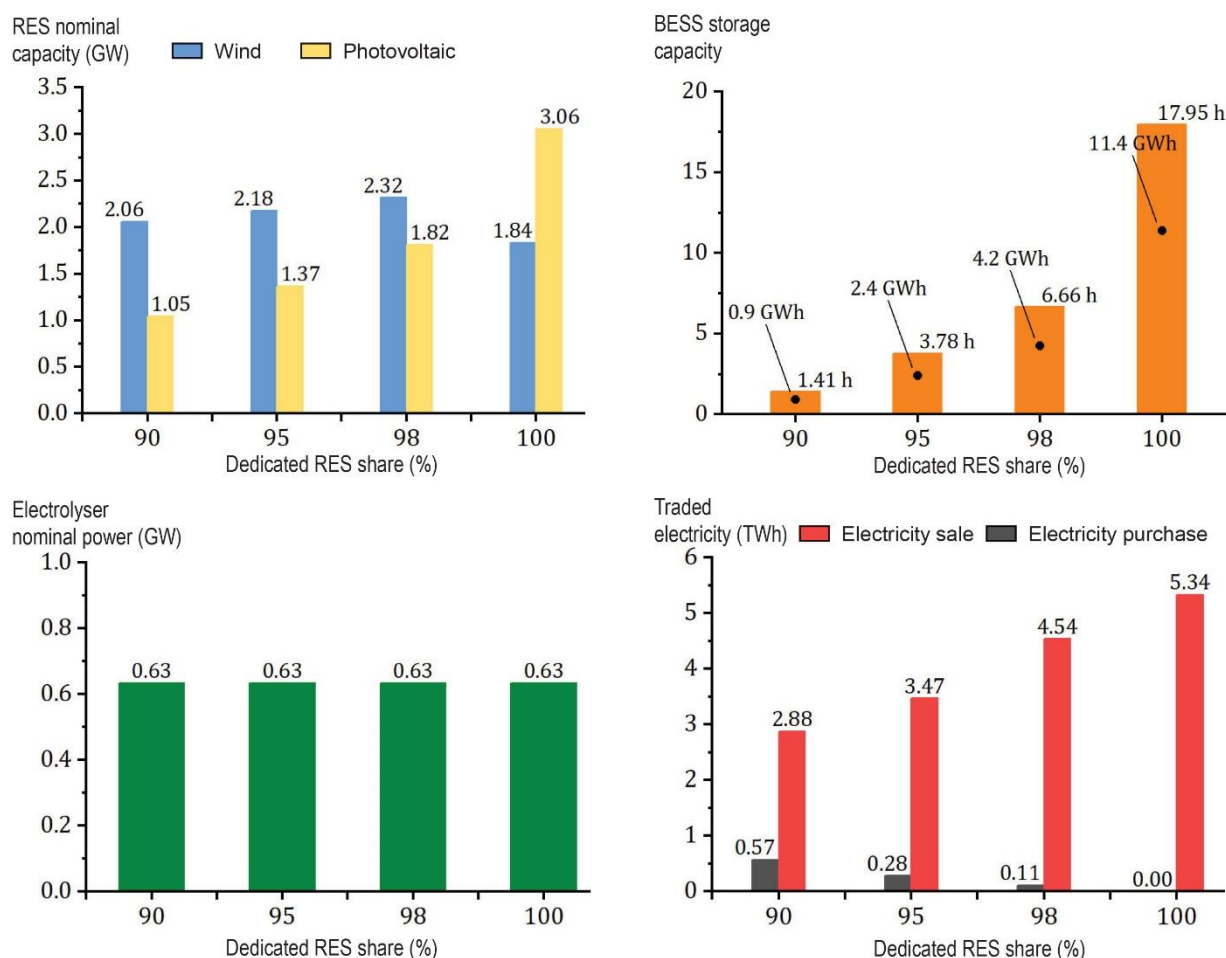
Green hydrogen: Scenario A

Scenario A involves setting up a co-located production hub near hydrogen demand locations, with Suez chosen as a potential site for the calculations. In this setup, hydrogen demand is met by an electrolyser powered primarily by local, dedicated PV and/or wind energy, with up to 10% of the required electricity sourced from the national grid. The analysis explores different shares of dedicated renewable energy supply (98%, 95% and 90%), with the remaining electricity (2%, 5% and 10%) coming from the grid. This is significant to prevent oversized PV and wind power generation plants.

Scenario A: case without hydrogen storage

In this scenario, the analysis first considers a case without hydrogen storage. The results, shown in Figure A B.1, highlight a significant need for BESS, which decreases as grid electricity contribution increases. When the grid share rises from 2% to 10%, storage capacity requirements drop accordingly. Additionally, a higher grid contribution reduces surplus generation by allowing for smaller renewable capacity.

The optimisation process reveals that increasing grid electricity from 2% to 10% leads to a 42% reduction in optimised PV capacity and an 11% decrease in wind power generation size. In the absence of hydrogen storage, the electrolyser must operate continuously at full capacity to meet hydrogen demand. Since hydrogen demand solely determines electrolyser size, grid electricity contribution has no impact on its capacity.

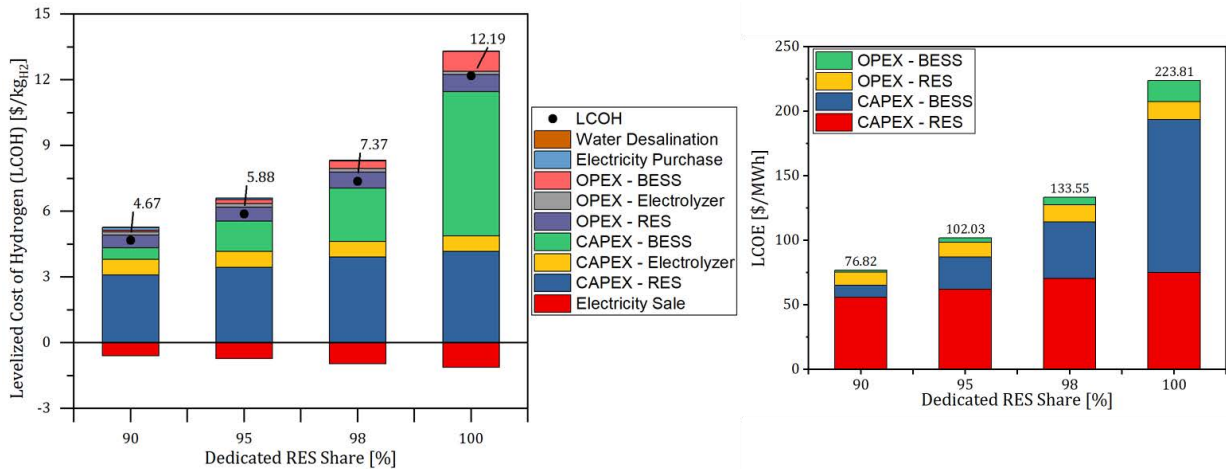
Figure A B.1. Scenario A: impact of the absence of H₂ storage (BESS only)

Note: BESS: Battery Storage Energy System; RES: renewable energy sources.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Increasing the grid electricity share reduces renewable oversizing and optimises electricity storage capacity, as well as economic approach that can significantly lower the LCOH. As shown in Figure B.2 Panel 1, without selling surplus electricity, LCOH drops from USD 8.5/kg H₂ (98% renewable contribution) to USD 6.8/kg H₂ (95%) and USD 5.5/kg H₂ (90%). If surplus electricity is sold, these values further decline to USD 7.37, USD 5.88 and USD 4.67/kg H₂, respectively. The surplus electricity contribution, shown in red in Figure B.2 Panel 1, can be considered when assessing LCOH without surplus sales. In addition, grid contribution has impact on LCOE. At high RE shares, LCOE rises sharply due to the need for larger BESS capacity and oversized renewable generation. As illustrated in Figure A B.2, Panel 2, the calculated LCOE at high-RE shares is significantly higher than the assumed grid electricity price, making partial grid integration a more cost-effective approach.

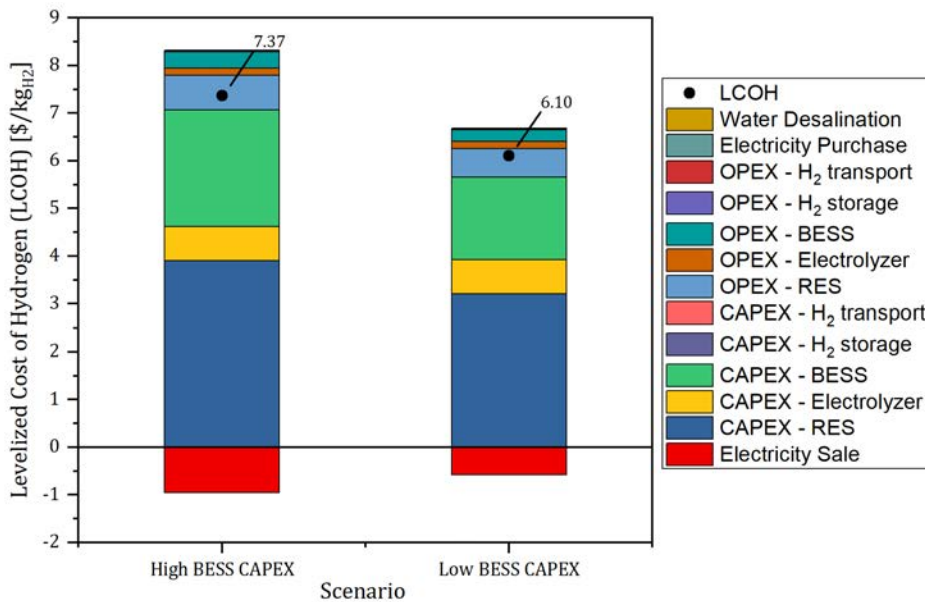
Figure A B.2. Scenario A: results in the absence of H₂ storage



Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

With the rapid advancement of BESS technology and declining capital costs, a sensitivity analysis on LCOH shows that reducing BESS CAPEX to USD 200/kWh lowers LCOH of the 98% RES share from USD 7.37/kg H₂ to USD 6.10/kg H₂ (Figure A B.3). This also optimises the renewable energy mix, increasing PV capacity from 1.82 GW to 2.21 GW while reducing wind capacity from 2.32 GW to 1.82 GW. Additionally, BESS capacity increases by 41.8%, reducing the need for oversized renewable generation and lowering the RES/electrolyser nominal capacity ratio from 6.57 to 5.89. The decreased oversizing minimises surplus electricity production, ultimately reducing both capital and operational costs for renewables and storage, leading to a lower LCOH.

Figure A B.3. Scenario A: LCOH varies with BESS CAPEX at 98% dedicated RES



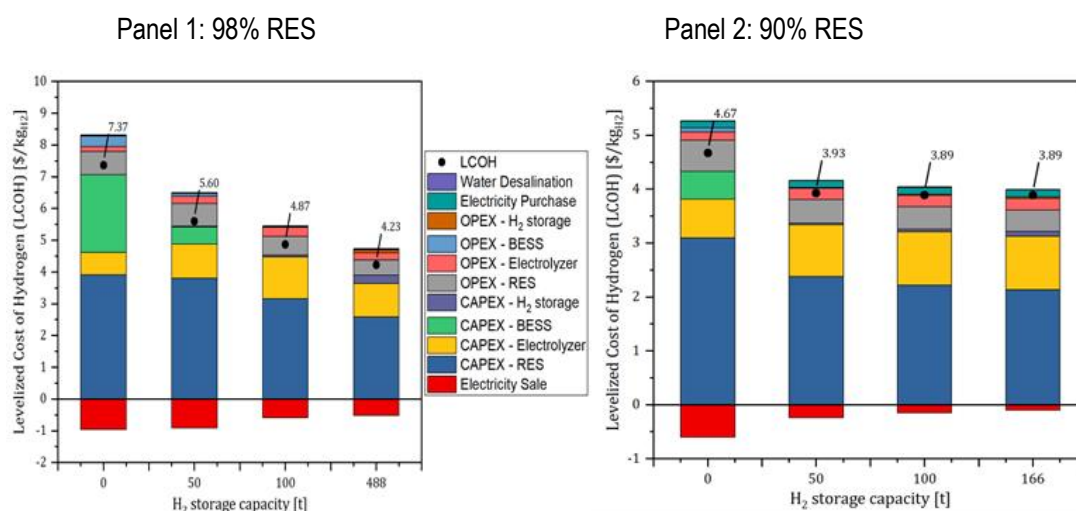
Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Scenario A: Case with hydrogen storage

The next scenario considers the use of pressurised hydrogen tanks, which optimises renewable energy utilisation by reducing the need for oversized renewable power plants while increasing electrolyser capacity. This approach helps in efficiently managing renewable energy output and enhances hydrogen production, resulting in a more cost-effective and balanced system. When excess electricity is available, the oversized electrolyser produces additional hydrogen, which is stored in pressurised tanks for use during periods of lower renewable generation under 98% share of dedicated renewable energy. The equivalent storage capacity in hours is used to compare BESS and pressurised hydrogen tanks, incorporating key efficiency and energy storage parameters into the calculations. Notably, one equivalent operating hour corresponds to 0.64 GWh of BESS or 11.4 tons of stored hydrogen, providing a clear comparison between the two storage options in terms of capacity and performance.

The LCOH decreases as hydrogen storage capacity increases, due to a gradual reduction in the size of renewable power generation plants (Figure B.4, Panel 1). Initially, this reduction is balanced by an increase in the electrolyser's nominal capacity. However, beyond a certain threshold – when hydrogen storage exceeds one equivalent operating day – it becomes more cost-effective to reduce the electrolyser size, leveraging the larger storage capacity to ensure stable hydrogen supply. Similar trends are evident when considering only 90% of dedicated RES (Figure A B.4), Panel 2), coupling the possibility to use grid electricity with the presence of H₂ storage in pressurised tanks leads to a significant reduction of the LCOH (Figure B.4, Panel 2), dropping down to 3.89 USD/kg H₂.

Figure A B.4. Scenario A: LCOH decreases with higher H₂ storage capacity



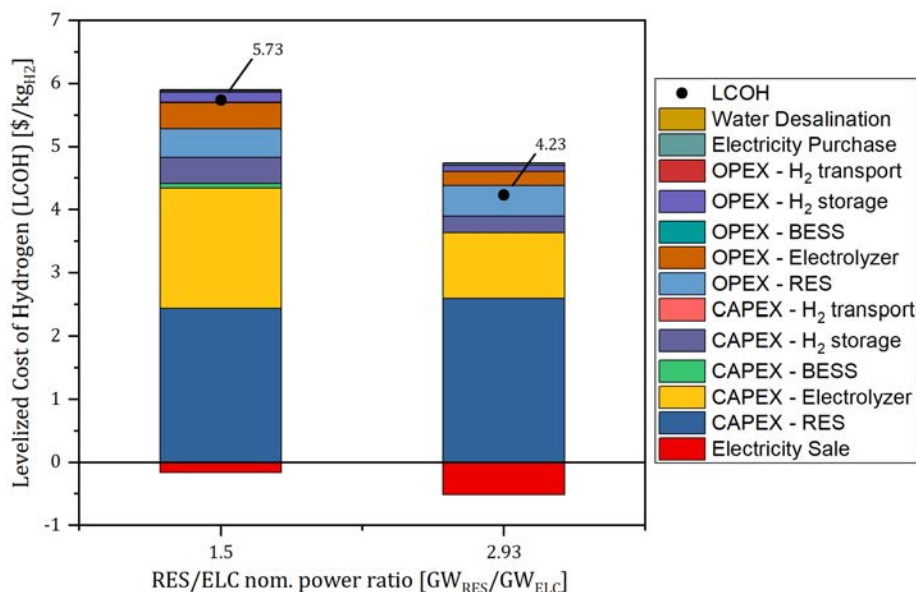
Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Scenario A: case with the renewable nominal power to electrolyser nominal power ratio (RES/ELC)

Building on the previous analysis of hydrogen storage under Scenario A, additional assessments were conducted to evaluate the impact of the renewable nominal power to electrolyser nominal power ratio (RES/ELC). The RES/ELC ratio represents the proportion between the installed capacity of renewable power generation and the electrolyser's nominal capacity. In all simulated cases, this ratio exceeds two, leading to an analysis of a scenario with a constrained RES/ELC ratio of 1.5 to assess its impact on the system's performance and cost efficiency.

A constrained renewable-to-electrolyser capacity ratio (RES/ELC) of 1.5 leads to a higher LCOH, increasing from USD 4.23/kg H₂ to USD 5.73/kg H₂ (Figure A B.5). This is due to significant electrolyser oversizing and a substantial increase in hydrogen storage to meet constant demand. Unlike the unconstrained case, a BESS is required to maintain the electrolyser's minimum capacity factor. These factors collectively drive-up costs, making the system less economically efficient compared to higher RES/ELC ratios.

Figure A B.5. Scenario A: LCOH decreases with higher RES to electrolyser nominal power ratio



Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

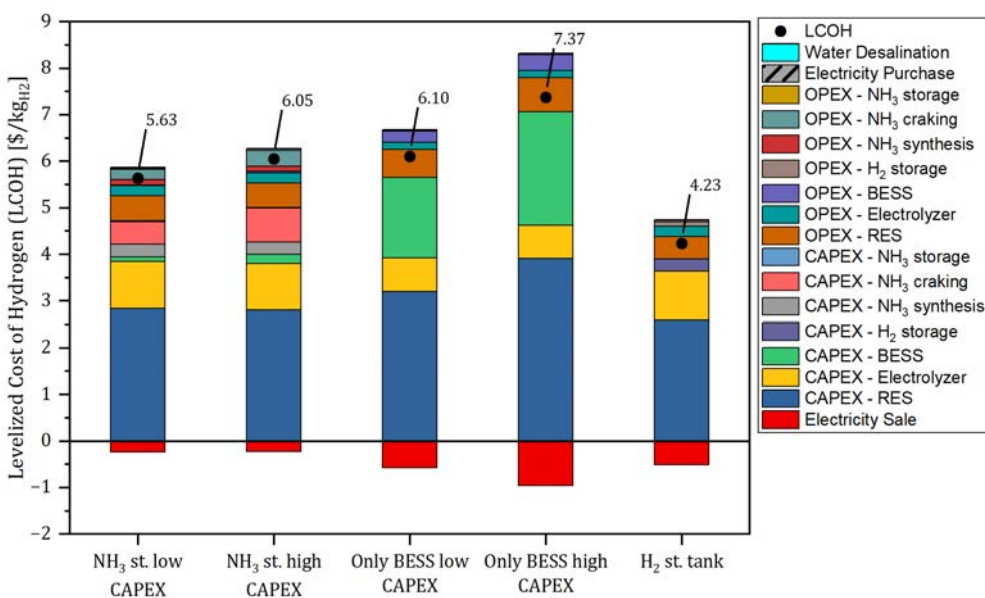
Scenario A: hydrogen carrier options

The storage of hydrogen can be achieved in the form of another hydrogen carrier, such as ammonia (NH₃). Several studies suggest converting green hydrogen into green ammonia, which is then stored in liquid form in refrigerated atmospheric tanks. This method, widely used in the fertiliser industry, is technically and economically feasible (Pagani, Hajimolana and Acar, 2024^[1]). However, if hydrogen is the final product, additional processing via ammonia cracking is required to re-release hydrogen. While thermodynamically possible at high temperatures and catalysed, this technology is still at a low technology readiness level. Therefore, analysis focused on identifying economical storage option for hydrogen.

Regarding energy efficiencies, the pressurised hydrogen tank system achieves the highest power-to-hydrogen efficiency at 58.6%, followed by the BESS at 47.7% and liquid ammonia storage at 41.2%. Each hydrogen storage option has different round-trip energy efficiencies, influenced by the losses in their respective components. Notably, the hydrogen-to-hydrogen efficiency for ammonia-based storage is 67.9%, factoring in ammonia synthesis, cracking and hydrogen compression losses, which is significantly lower than the 96.3% efficiency observed in pressurised hydrogen storage systems.

Besides energy efficiency, storing hydrogen in pressurised tanks is also resulting lowest LCOH USD 4.23/kg H₂ (Figure A B.6). BESS has been showing highest LCOH followed by the option of using NH₃ as H₂ storage vector. It is worth to note that given the high level of uncertainty arising from the low technology readiness level of NH₃ cracking, the analysis of using liquid NH₃ as H₂ storage vector considers a sensitivity of the ammonia cracking CAPEX on the LCOH.

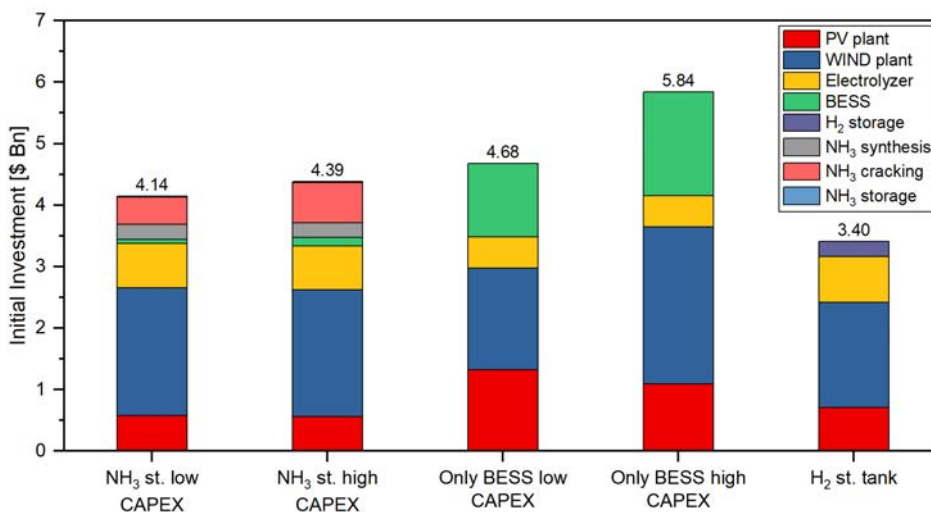
Figure A B.6. Scenario A: LCOH varies with different storage options



Note: Configuration at 98% dedicated renewable energy sources.
 Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

The analysis shows that storing hydrogen in pressurised tanks requires the lowest initial investment (USD 3.4 billion) compared to the other storage options. The assessment considered the initial investment required for a system capable of producing 100kt_{H2} (Figure A B.7).

Figure A B.7. Scenario A: initial per different storage options



Note: Configuration at 98% dedicated renewable energy sources.
 Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

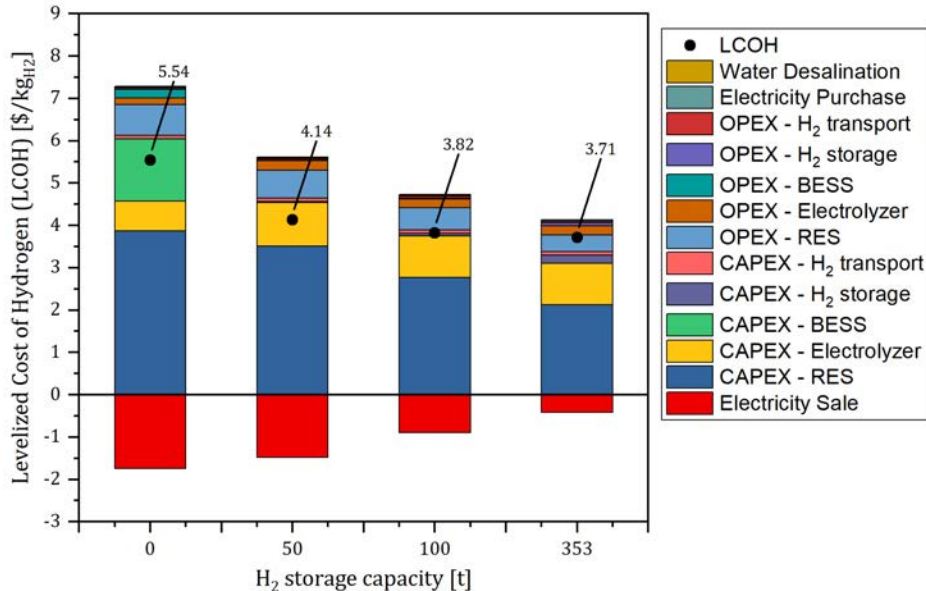
Green hydrogen: Scenario B

Scenario B: hydrogen transport

In this scenario, green hydrogen is produced at a dedicated hub where renewable energy powers electrolysis. The hydrogen is then transported through a 230 km pipeline to Suez to demand centres. Gharib Cape is chosen as the location for this production hub. The higher availability of renewable energy in the Gharib Cape area leads to smaller renewable energy capacities and less need for storage, resulting in a significant reduction in the LCOH, even after including the hydrogen transport costs.

Under this scenario the lowest LCOH was USD 3.71/kg H₂ when the storage capacity is increased, reducing the oversizing of renewable energy systems and minimising surplus electricity generation. This optimisation leads to more efficient use of renewable energy and a significant reduction in LCOH (Figure A B.8). In this optimised case, with 353 tonnes of hydrogen storage, CAPEX represents 81.6% of the LCOH. Of this, only 2.6% is attributed to the cost of the hydrogen transport pipeline.

Figure A B.8. Scenario B – LCOH decreases with higher H₂ storage capacity

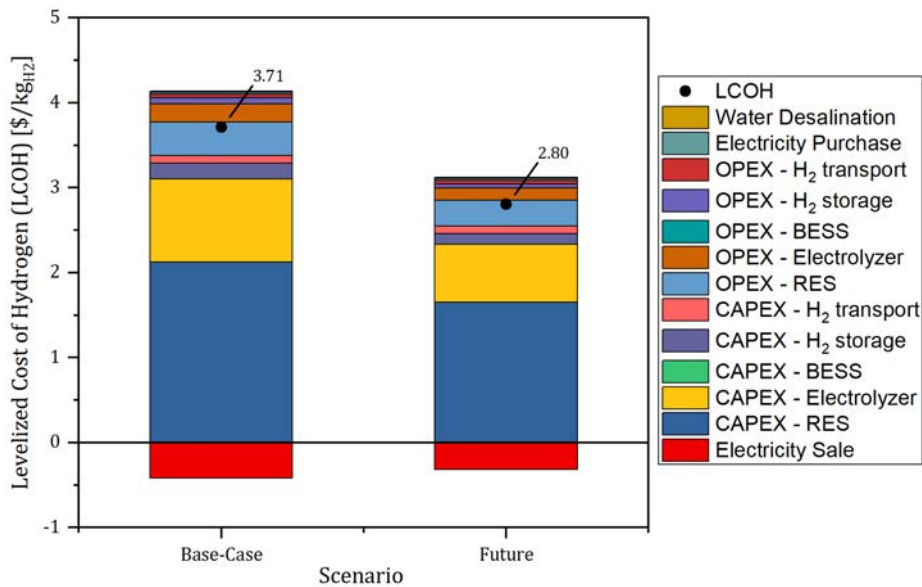


Note: Configuration at 98% dedicated renewable energy sources.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

The analysis in Scenario 2 demonstrates that the LCOH could be significantly reduced in the future through two combined factors: a reduction in electrolyser CAPEX and a decrease in hydrogen storage size. The anticipated decrease in electrolyser CAPEX allows for lower capacity factors and larger installed capacities, while the reduction in hydrogen storage size further contributes to cost reductions. Additionally, the ratio between the nominal power of RES and electrolyser nominal power decreases from 2.5 to 2.1. The expected drop in PV CAPEX also influences the optimal PV-wind mix determined through optimisation. These changes collectively lead to a significant reduction in the LCOH (Figure A B.9).

Figure A B.9. Scenario 2 – estimated LCOH for current and future scenarios



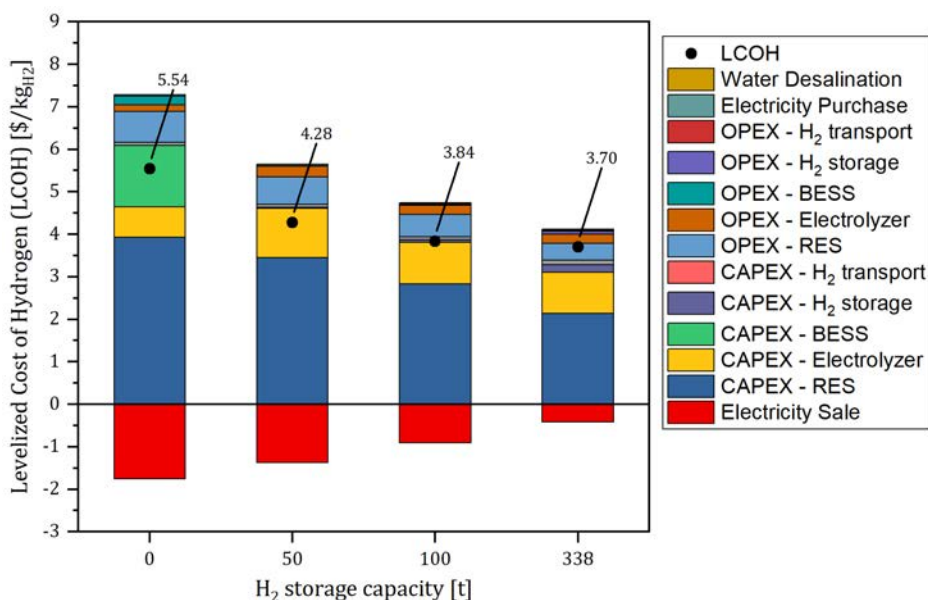
Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Green hydrogen: Scenario C

Scenario C: electricity transport

Scenario C involves decentralising electricity generation from the green hydrogen production process. Electricity is transmitted through a dedicated grid to green hydrogen production site, which is located near the demand. For this scenario, Gharib Cape is selected for power generation. The electricity is then transmitted via 230 km transmission lines to Suez, where both green hydrogen production and consumption occur.

Under this scenario, optimising the hydrogen storage capacity to 338 tonnes yields the lowest LCOH at USD 3.70/kg H₂, cheaper than USD 5.54/kg H₂ with no storage or USD 4.28/kg H₂ with 50 tonnes of storage (Figure A B.10). When hydrogen storage is included, a slight oversizing of the electrolyser is observed. This occurs because the electrolyser needs extra capacity to handle periods of excess renewable energy generation, producing more hydrogen to fill the storage. However, as the hydrogen storage capacity increases, the electrolyser’s oversizing decreases. This is because the system becomes more flexible, allowing it to better adapt to fluctuations in renewable energy generation. The larger storage capacity helps the system manage variations more efficiently, reducing the need for an oversized electrolyser.

Figure A B.10. Scenario C: LCOH decreases with higher H₂ storage capacity

Note: Configuration at 98% dedicated renewable energy sources.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Green hydrogen: Scenario D

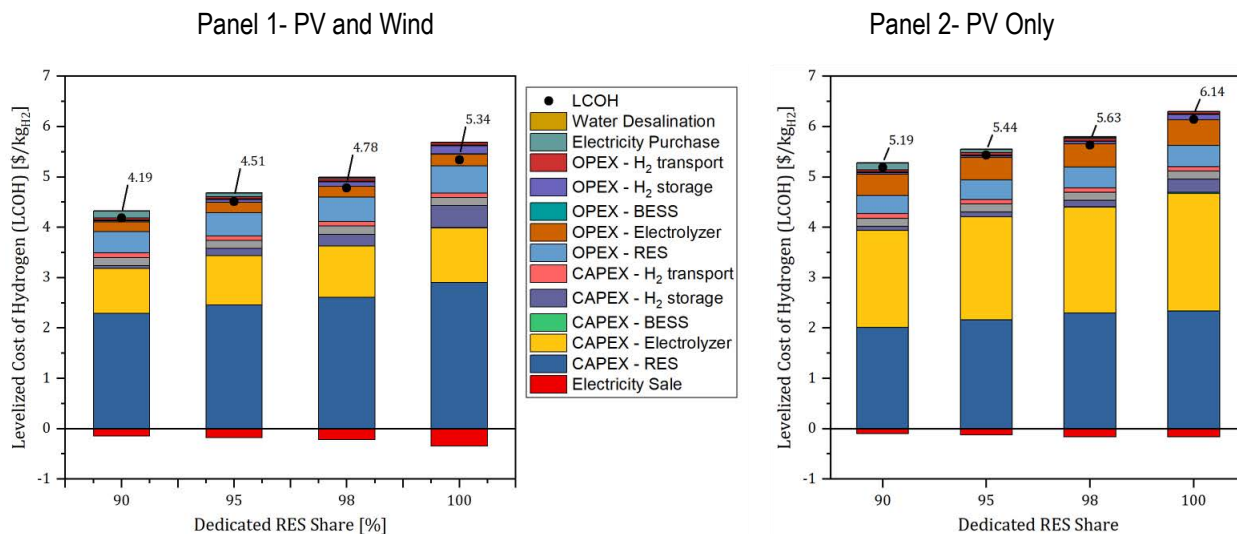
Scenario D: electricity and hydrogen transport

In this scenario, electricity generation, green hydrogen production and green hydrogen demand are in different regions, requiring both electricity transmission and hydrogen transport. Power is generated in the Aswan area and transmitted via a 525 km transmission line to Gharib Cape, where green hydrogen production occurs. The produced hydrogen is then transported through a 230 km pipeline to Suez to meet the demand.

This scenario explores the use of renewable power sources located far from a sustainable water source, requiring both electricity transmission and hydrogen transport, which adds extra costs compared to previous scenarios. Due to Aswan's lower wind potential compared to Suez and Gharib Cape, the optimal renewable energy mix differs from the other scenarios.

Scenario D shows that increasing the percentage of dedicated RES from 90% to 100% raises the LCOH from 4.19 USD/kg H₂ to 5.34 USD/kg H₂ (Figure A B.11, Panel 1) due to the additional RES and H₂ storage capacity required. A similar trend is observed in the analysis considering only PV power generation (Figure A B.11, Panel 2), which results in significant oversizing of the electrolyser and the need for higher hydrogen storage capacity. This results the PV-only system leads to a higher LCOH compared to a system that combines both PV and wind. For example, at 98% dedicated RES, the PV and wind scenario results in an LCOH of USD 5.63/kgH₂, whereas the PV-only system reaches USD 6.76/kgH₂. This difference highlights the advantage of incorporating varies RES and grid electricity to reduce RES oversizing, minimise curtailment, and lower overall costs. As in previous scenarios, the optimisation analysis continues to favour hydrogen storage in pressurised storage over BESS.

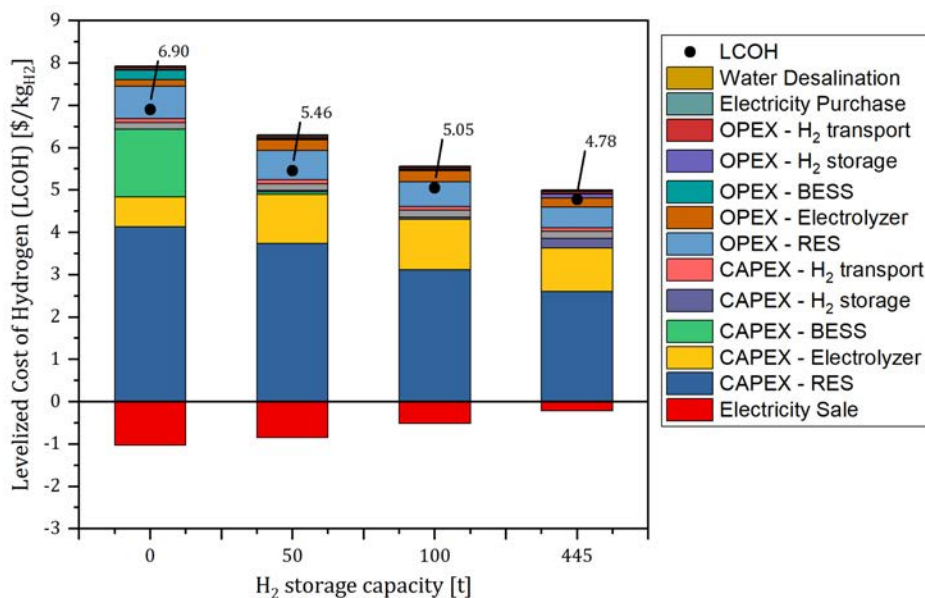
Figure A B.11. Scenario D: LCOH increases with a larger share of dedicated renewable energy sources



Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

A higher dedicated RES share increases the need for hydrogen storage to enhance system flexibility, ultimately reducing LCOH. This trend is consistent with Scenarios A and B, demonstrating that regardless of geographic location within Egypt, an optimal green hydrogen production system with 98% dedicated RES converges toward a RES-to-electrolyser nominal power ratio of 3, coupled with several tens of equivalent hours of hydrogen storage.

Figure A B.12. Scenario D: LCOH decreases with a larger H₂ storage capacity



Note: Configuration at 98% dedicated renewable energy sources.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

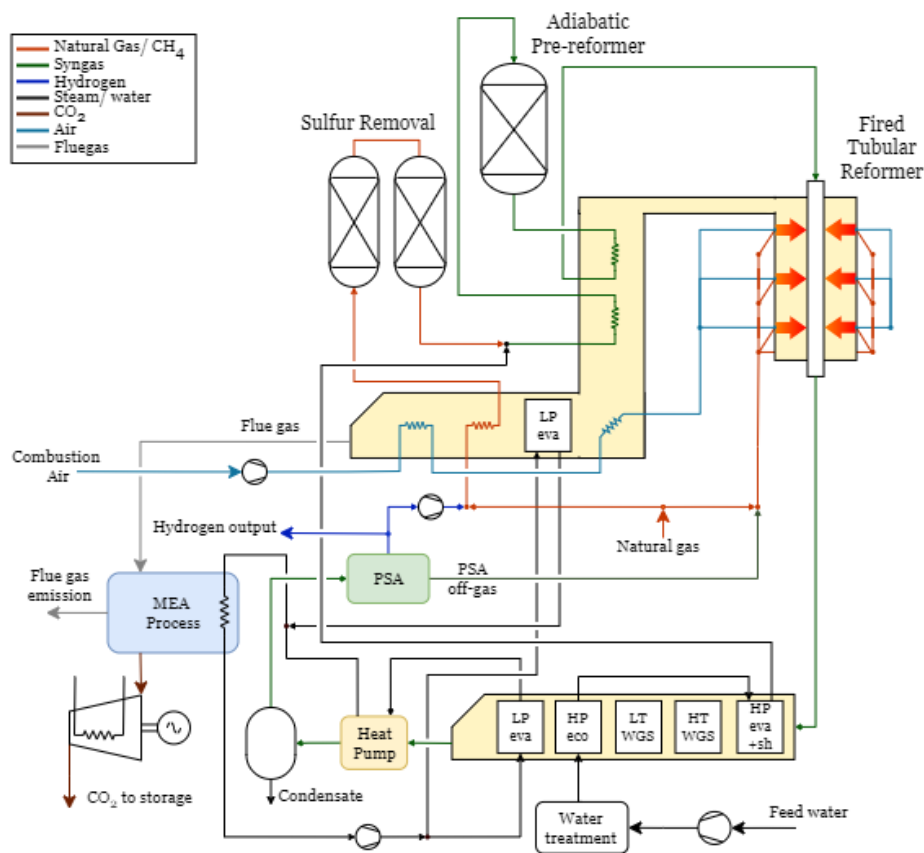
Blue hydrogen

For blue hydrogen, two technologies are compared for the blue hydrogen production, namely the steam methane reforming (SMR) with post-combustion carbon capture and the autothermal reforming (ATR) with carbon capture. The analysis includes a comparison between the two plants, all having the same capacity of 100 000 Nm³/h (9 t_{H2}/h) of hydrogen, with the CO₂ to be transported for 250 km to a potential carbon capture and storage (CCS) hub.

Steam methane reforming with post-combustion carbon capture

As shown Figure A B.13 in the modelled plant includes a desulfurization section, a pre-reformer, the primary reformer, water gas shift (WGS) reactors, hydrogen purification using pressure swing adsorption (PSA) and a CO₂ separation unit for the SMR furnace flue gas. SMR technology can be used to retrofit existing grey hydrogen production plants. Technical operating conditions and data are provided in Table A B.1. The simulations show an overall hydrogen production efficiency of 77.3%, with 90.2% of the carbon in the feedstock captured. The different key performance indicators (KPIs) calculated for the SMR plant with post combustion CCS are summarised in Table A B.2.

Figure A B.13. Steam methane reforming with carbon capture plant for blue hydrogen production



Source: Schematic representation prepared by the OECD Secretariat.

Table A B.1. Operating conditions for SMR with post combustion CCS plant

Reformer outlet temperature	[°C]	890
Pressure	[bar]	32
Steam/carbon	[-]	3.4
Pre-reforming temperature	[°C]	490
HT-WGS inlet temperature	[°C]	340
LT-WGS inlet temperature	[°C]	195
CO ₂ separation efficiency	[%]	90
PSA H ₂ recovery	[%]	89

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Table A B.2. Computed KPIs for SMR with post combustion CCS plant

Category	Symbol	Value	Unit	Specifications
Natural gas input	\dot{m}_{NG}	7.71	kg/s	Natural gas input
Natural gas input	V_{NG}	37072	Nm ³ /h	Natural gas input
Natural gas thermal input	$\dot{m}_{NG}LHV_{NG}$	358.7	MW	Natural gas thermal input
Hydrogen output	\dot{m}_{H_2}	2.31	kg/s	Hydrogen output
Hydrogen output		199.55	ton/day	Hydrogen output
Hydrogen output	V_{H_2}	100 000	Nm ³ /h	Hydrogen output
Hydrogen thermal output	$\dot{m}_{H_2}LHV_{H_2}$	277.2	MW	Hydrogen thermal output
Grid electricity demand		13.3	MW	Grid electricity demand
Environmental KPIs				
CO ₂ captured	$\dot{m}_{CO_2}^{cap.}$	19.81	kg/s	CO ₂ captured
CO ₂ specific capture	$\dot{m}_{CO_2}^{cap.}/\dot{m}_{H_2}$	8.58	kgCO ₂ /kgH ₂	CO ₂ specific capture
CO ₂ emitted	$\dot{m}_{CO_2}^{emit.}$	2.16	kg/s	CO ₂ emitted
CO ₂ emitted		62.3	Mt/y	CO ₂ emitted
CO ₂ specific emission	$\dot{m}_{CO_2}^{emit.}/\dot{m}_{H_2}$	0.94	kgCO ₂ /kgH ₂	CO ₂ specific emission
CO ₂ specific emission		7.81	gCO ₂ /MJH ₂	CO ₂ specific emission
Carbon capture ratio	$\dot{m}_{CO_2}^{cap.}/(\dot{m}_{CO_2}^{cap.} + \dot{m}_{CO_2}^{emit.})$	90.2	%	Carbon capture ratio
Hydrogen production KPIs				
H ₂ production efficiency	$\dot{m}_{H_2}LHV_{H_2}/\dot{m}_{NG}LHV_{NG}$	H ₂ production efficiency	0.773	MWH ₂ /MWNG
H ₂ delivery pressure	P_{H_2}	H ₂ delivery pressure	29	bar
CO ₂ delivery pressure	P_{CO_2}	CO ₂ delivery pressure	80	bar

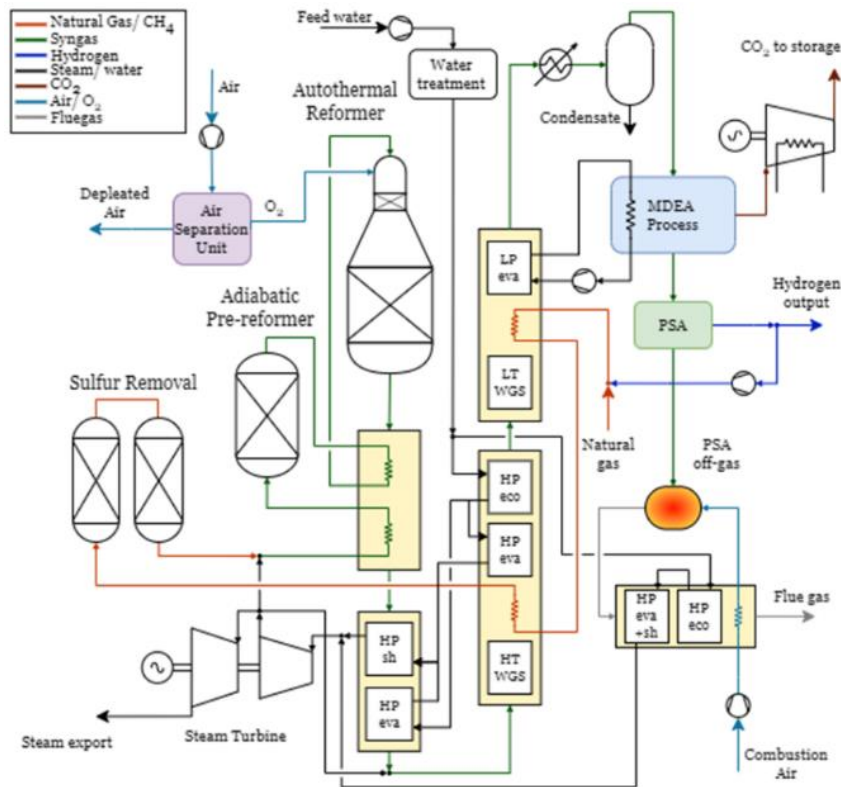
Note: KPIs: key performance indicators. The simulations show an overall hydrogen production efficiency of 77.3% while capturing 90.2% of the fed carbon.

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Autothermal reforming with post combustion carbon capture

The second technology evaluated is ATR with post-combustion CCS. A typical plant setup (Figure A B.14) includes several key components: a desulfurization section, an air separation unit (ASU), a pre-reformer, an autothermal reformer, water gas shift (WGS) reactors, a CO₂ separation unit and hydrogen purification using pressure swing adsorption (PSA). This analysis assumes the construction of a new hydrogen production plant. Technical details and input data can be found in Annex A. The simulation results show an overall hydrogen production efficiency of 73.5%, with 93.8% of the carbon in the feedstock captured.

Figure A B.14. Autothermal reforming with combustion carbon capture plant for blue hydrogen production



Source: Schematic representation prepared by the OECD Secretariat.

Blue hydrogen LCOH analysis

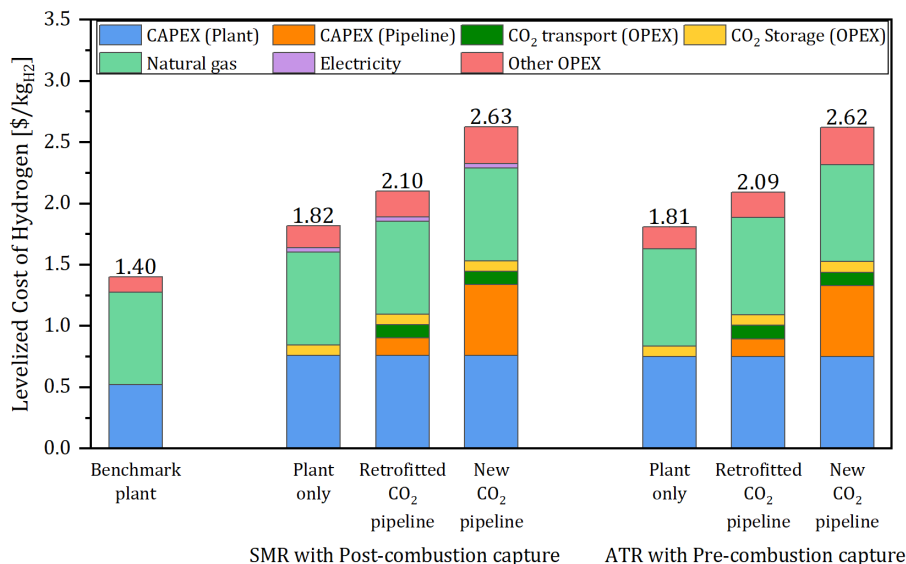
The two different technologies are compared to a commercially available grey hydrogen production plant using SMR technology without CCS. For CO₂ transport, two scenarios are considered: constructing a new pipeline and retrofitting existing assets. The computed LCOH for the benchmark plant at the same operating conditions reported in without considering CO₂ separation is USD 1.40 /kg_{H2}.

Considering the hypothetical case without the added cost of CO₂ transport, the LCOH increases to USD 1.82/kg_{H2} and USD 1.81/kg_{H2} on considering the SMR with CCS and the ATR with CCS technologies respectively. The calculated LCOH increases by USD 0.28 /kg_{H2} and 0.81 USD/kg_{H2} for retrofitting of existing pipelines and the construction of new pipeline respectively. It is worth mentioning that the assumed cost of the CO₂ transport pipeline does not depend on the amount of CO₂ transported, which could lead to discrepancies in the results. The LCOH for the simulated cases is shown in Figure A B.15.

While both SMR with CCS and ATR with CCS technologies yield comparable LCOH, ATR with CCS demonstrates a slight advantage over SMR with CCS in terms of economic efficiency. Both SMR with CCS and ATR with CCS technologies result in a higher LCOH compared to the benchmark plant without CO₂ separation, primarily due to the added costs of CO₂ capture and transport. Specifically, the LCOH increases to USD 1.82 /kg H₂ for SMR with CCS and USD 1.81 /kg H₂ for ATR with CCS when considering the CO₂ capture. Furthermore, when CO₂ transport is included, the calculated LCOH increases by USD 0.28 /kg_{H2} for retrofitting existing pipelines and by USD 0.81 /kg H₂ for constructing a new pipeline. The assumed cost of the CO₂ transport pipeline, which does not depend on the amount of CO₂ transported,

could result in discrepancies in the results, highlighting the importance of accurate cost assumptions in evaluating overall economics.

Figure A B.15. Levelised Cost of Hydrogen for the two different simulated plants

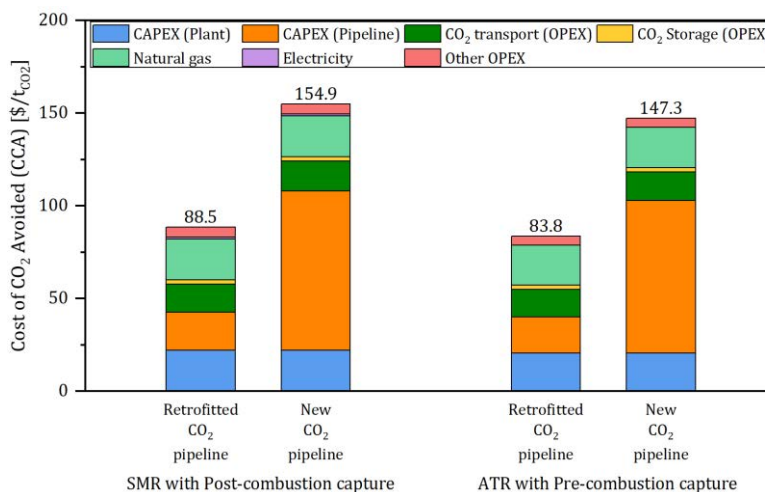


Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Blue hydrogen cost of CO₂ avoided

The cost of CO₂ avoided (CCA) for the two technologies, SMR with CCS and ATR with CCS, also favours ATR. The CCA analysis is instrumental in assessing both the environmental and economic benefits of CO₂ capture and storage. This analysis plays a vital role in determining the cost-effectiveness of implementing CCS in blue hydrogen production and comparing it to other emission-reduction technologies. The findings indicate that ATR offers a slight economic advantage, whether retrofitting an existing pipeline or constructing a new CO₂ pipeline, as its CCA is lower than SMR in both cases (Figure A B.16).

Figure A B.16. Cost of CO₂ avoided for the two simulated plants

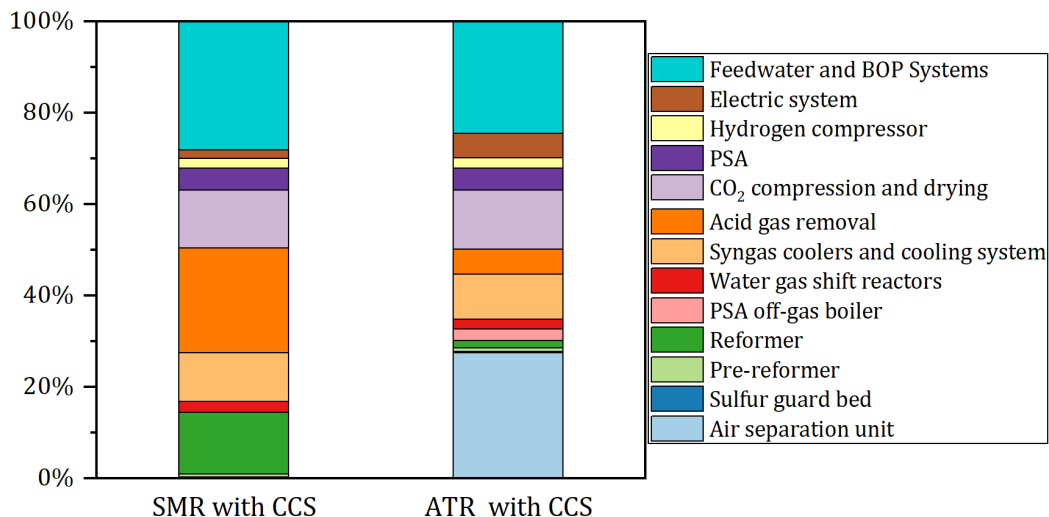


Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Blue hydrogen initial investment required for production per different technology choices

The high upfront investment required for both technologies was assessed, with the results consistently favouring ATR with CCS. The calculated initial investment for an SMR with CCS plant is USD 522.9 million, while for an ATR with CCS, it is USD 517.4 million. The breakdown of the initial investment for both simulated plants is shown in Figure A B.17. Additionally, the estimated investment for retrofitting a 250 km pipeline is USD 75 million, which increases to USD 302.5 million if a new pipeline is constructed.

Figure A B.17. Breakdown of the initial investment for blue hydrogen production



Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Annex C. Investment need assessment

Objective

This annex includes detailed results of the investment need assessment that is discussed in Chapter 3.

Result

The two scenarios used for the LCOH calculation of green hydrogen presented in Chapter 2 were selected based on achieving the lowest LCOH values. In particular, based on the results of Scenario B, several important considerations emerge. The estimated land footprint for PV power plants with a total capacity of 12.47 GW is approximately 171.5 km². For nearshore wind power plants with a capacity of 20.07 GW, the estimated land requirement is significantly larger, at around 624.3 km². In addition, storing 6 438.6 tonnes of hydrogen (tH₂) at a pressure of 200 bar would necessitate high-pressure storage tanks with a combined capacity of approximately 400 000 m³.

Table A C.1. Green hydrogen system components optimised sizing for the Scenarios B and C

Category	Unit	Optimisation results	
		Scenario B	Scenario C
PV power generation plant	GW	12.47	14.82
Onshore wind power generation plant	GW	20.07	20.01
Low-temperature electrolyser	GW	13.79	13.39
Hydrogen compressors	MW	318.6	309.6
Battery Energy Storage System	MWh	0	0
H ₂ storage	t _{H₂}	6439	8866
Equivalent H ₂ storage capacity	h	37.6	51.8
HVDC transmission line	km	0	230
HVDC transmission line capacity	GW	0	13.4
H ₂ transport pipelines	km	230	0
Levelised cost of hydrogen	USD/kg _{H₂}	4.24	4.38

Source: Results of the techno-economic assessment prepared by the OECD Secretariat.

Annex D. Investment survey

Objective

This annex presents detailed results from the survey used to identify financial solutions and enabling investment conditions discussed in Chapter 3.

Survey methodology

The survey targeted industry, the private sector and government agencies actively engaged in the development of green hydrogen (the survey questions are available in the following section). The selection of survey participants was carefully carried out by the OECD and the FEI to ensure data quality and relevance. The following aspects were considered:

- profile of stakeholders (e.g. industrial developers, financial institutions, policymakers)
- geographical location
- business segment within the green hydrogen value chain
- ticket size of the projects
- years of experience in the sector

The survey was structured into three key sections, designed to assess the investment profile of relevant stakeholders and identify the most effective financial solutions to accelerate green hydrogen development. The first section aimed to map out key players in the hydrogen industry by categorising respondents based on their institutional type (e.g. Multilateral Development Banks [MDBs], insurance companies, Export Credit Agencies [ECAs], investment funds, non-profit organisations). The second section sought to pinpoint the specific steps within the low-carbon hydrogen value chain where respondents are currently investing or plan to invest in the short term (6-18 months) in Egypt. These steps included renewable energy/power, production, storage, transport and distribution, end-use applications and integrated end-to-end project structures. Additionally, participants were asked to indicate their investment ticket size, ranging from below USD 100 million to over USD 10 billion. The third section explored financial instruments that could help overcome financing barriers for green hydrogen projects in Egypt. Respondents were asked to assess the relevance of:

- **De-risking instruments**, such as buyer credit guarantees, contractors-all-risk insurance, credit default swaps, foreign currency guarantees, interest rate swaps, loan loss reserves, offtake guarantees, partial credit guarantees, performance guarantees, political risk investment insurance and subsidised or performance-linked loans.
- **Economic instruments**, including auctions and contracts for difference, carbon credits, carbon taxes and emissions trading systems, carbon removal certificates, extended producer responsibility fees, grants and subsidies, green procurement incentives and tax incentives.

The survey was distributed from 30 January to 27 February 2025 to 66 targeted stakeholders, with 14 completed responses, resulting in a response rate of 21%. The majority of respondents (65%) were from industrial corporations, including developers from cement, chemicals, steel and power companies. Other respondents included representatives of private banks, governments and non-profit organisations located

in Egypt. The survey was distributed via email and was conducted under confidentiality guidelines, ensuring that responses were anonymised and aggregated to provide meaningful insights for the report.

The results show that industrial corporations dominate the stakeholder landscape, comprising 65% of all actors, while non-profit organisations account for the next largest share at 14%. Private banks, international organisations and government bodies each represent an equal 7%. Respondents were asked to choose one of the following categories: bilateral development bank, export credit agency, government, industrial corporation, insurance corporation, international organisation, investment fund, multilateral development bank, non-profit organisation, pension fund, private bank or research/think tank.

The survey results on work experience in the clean hydrogen industry reveal that the sector is dominated by relatively new professionals, with nine respondents (64% of participants) having only 2-4 years of experience. In contrast, only one person each reported experience in the 5-8-year and 8-10-year ranges. Meanwhile, three respondents (21%) claimed more than 10 years of experience.

Most investors in Egypt's low-carbon hydrogen sector are focusing their short-term (6-18 months) commitments on upstream activities, with renewable energy/power generation topping the list (11 responses) as the critical foundation for green hydrogen. Production follows as the next priority (6), while far fewer stakeholders are targeting storage (2), transport and distribution (2), or integrated project development (2). End-use applications rank lowest (1), indicating that, for now, market players are primarily intent on securing clean power supply and electrolysis capacity before scaling downstream infrastructure or consumer-facing hydrogen solutions.

The survey reveals that most organisations (8 out of 22) are targeting relatively small-scale low-carbon hydrogen and associated projects in Egypt, with expected ticket sizes below USD 100 million. A smaller group (3) plans mid-range investments between USD 100-500 million, while very few are eyeing larger undertakings: one respondent each in the USD 500 million-1 billion, USD 1-3 billion, and > USD 10 billion brackets, and none in the USD 3-10 billion range. This distribution suggests a market still in its early stages, where stakeholders favour more modest, lower-risk commitments while a handful are preparing to back large-scale

Results show that foreign currency guarantees and offtake guarantees are viewed as the most crucial tools, with 64% and 57% of respondents rating them as "very relevant," respectively (Figure 3.2). Political risk investment insurance and buyer credit guarantees follow with moderate importance. The instruments deemed least critical are partial credit guarantees, with only 14% considering them "very relevant" despite 64% seeing them as "relevant." Performance guarantees show a mixed assessment with 21% rating them "very relevant" and 57% as "relevant." Subsidised loan terms/Performance Based Incentives and loan loss reserve (LLR) have identical ratings for "very relevant" (29%) but differ in their overall relevance distributions. Across all instruments, the percentage of "not relevant" responses remains consistently low (7-14%), indicating broad recognition of these financial tools' importance in Egypt's investment landscape.

Results show that carbon credits and grants/subsidies emerge as the most critical tools, with 57% of respondents rating both as "very relevant." Carbon tax and emission trading systems follow closely with 50% considering them "very relevant" and the remaining 50% as "relevant," making them uniquely rated with no negative assessments. Green procurement shows moderate importance with 36% "very relevant" ratings and 50% "relevant". The remaining instruments (CO₂ removal certificates, tax incentives, and auctions/contracts for difference) all received 29% "very relevant" ratings with varying distributions of other assessments. Extended producer responsibility fees rank lowest, with no "very relevant" ratings and the highest combined "not relevant" and "limited relevance" percentages (57%). Overall, direct financial incentives (grants, credits) and carbon pricing mechanisms are viewed as most effective for developing Egypt's low-carbon hydrogen sector, while extended producer responsibility approaches appear less appealing.

Annex E. Framework consultation process

Objective

This annex outlines the analytical steps taken to implement the OECD Framework for Industry's Net-Zero Transition (the Framework) and summarises the stakeholder consultations conducted throughout the process.

Framework implementation process

Analytic process

Steps 1 and 2, the Framework focused on market landscape research and data collection rather than the technical assessment of various technological choices for decarbonizing industrial sectors (e.g. steel, petrochemicals), as agreed upon under the guidance of the Steering Committee. The initial research findings were submitted to the Government of Egypt for review and served as the basis for consultations with various stakeholders to identify and validate the most up-to-date data available.

Step 3 involved a techno-economic assessment to evaluate the cost-competitiveness of low-carbon hydrogen production in Egypt under a range of production scenarios, as detailed in Chapter 2. This included modelling the LCOH for both green and blue hydrogen, using inputs such as Weighted average cost of capital (WACC), electricity costs, transport and carbon mitigation costs. The analysis also covered derivative products – green ammonia, e-methanol and green iron – by calculating their respective levelised costs, based on the lowest-cost hydrogen obtained from LCOH calculation of green hydrogen. In addition, infrastructure investment needs were assessed to meet national targets align with Egypt's National Low-Carbon Hydrogen Strategy.

Step 4 focused on identifying and evaluating financial and market-based instruments through an investor survey and their effectiveness on addressing the cost-competitiveness gap. As detailed in Chapter 3, this analysis assessed the impact of these instruments – such as CAPEX grants, concessional loans, and CfDs – on closing the cost-competitiveness gap against the price of USD 1.8/kg H₂ envisioned in Egypt's National Low-Carbon Hydrogen Strategy by 2040. The selection of these instruments was based on investor survey. It also examined the enabling investment conditions needed to scale hydrogen deployment in Egypt. The findings were subsequently validated through consultations with government officials, international financial institutions and industry stakeholders, ensuring that the proposed instruments reflect both market realities and policy priorities. This process fed directly into the development of the targeted solutions presented in Chapter 4, which aim to enhance project bankability and operationalise Egypt's national low-carbon hydrogen strategy.

Step 5 includes a range of dissemination and outreach activities. In particular, the findings from this report aims to be integrated into various training programmes (i.e. Green Hydrogen Centre of Excellence in Cairo). In addition, solutions presented in this report, such as the double auction mechanism for green hydrogen (i.e. H2Global), will be explored for potential testing in the Egyptian market. These efforts aim to enhance the expertise and capacity of key stakeholders, including policymakers and private sector actors, who play a crucial role in advancing green hydrogen discussions in Egypt.

Stakeholder consultation process

According to the Framework, the three key stakeholder groups that were engaged in the Framework implementation are: policymakers, industry and finance institutions. The OECD team identified and so far, engaged with and reached out to the following stakeholder groups from Egypt for the Framework implementation:

- **Policymakers:** MoRE, MoPED, MoF, MoIC, EgyptERA, Egyptian Electricity Transmission Company (EETC), Egyptian Electricity Holding Company (EEHC), New and Renewable Energy Authority (NREA) and the Egyptian Competition Authority, etc.
- **Industry and IFIs:** BP, French EDF, BP, Scantec, Masdar, ReNew Power, AMEA, Globeleq, China Energy, TotalEnergies, Fortescue Future Industries, Siemens Energy, Egyptian Basic Industries Company, etc.
- **Financial institutions:** The Sovereign Fund of Egypt, Nation Development Bank of Egypt, European Bank for Reconstruction and Development (EBRD), African Development Bank, French Development Agency (Afd), German Agency for International Cooperation (GIZ), Green Climate Fund, KfW, United States Agency for International Development, European Investment Bank, Climate Investment Funds (CIF), the World Bank, International Finance Corporation, etc.
- **Others:** African Green Hydrogen Alliance, United Nations Development Programme (UNDP), United Nations Industrial Development Organisation (UNIDO), World Economic Forum (WEF), International Energy Agency (IEA), OECD Directorate for Science, Technology and Innovation, etc.

In addition to these stakeholders, the OECD team convened three public-private stakeholder workshops as part of the consultation process. These workshops intended to serve as the technical advisory group for the Framework implementation, as follows:

- [On 30 January 2024](#), the OECD organised its first stakeholder meeting to assess the progress of low-carbon hydrogen implementation in Egypt. The OECD team presented a detailed implementation timeline, outlining the scope of work, methodology and planned deliverables. The purpose of this initial consultation was to showcase the Framework to a broader stakeholder group and foster synergy with ongoing work in the country. This meeting also served as a platform to align expectations among key stakeholders and ensure a co-ordinated approach to advancing Egypt's hydrogen economy.
- [On 29 May 2024](#), the OECD organised a second stakeholder meeting to explore the financing and industrial applications of low-carbon hydrogen. The focus of this meeting was to understand key barriers and potential solutions from the perspective of industry sector players in Egypt. The OECD team presented initial findings on the LCOH for green hydrogen projects.
- [On 15-16 April 2025](#), the OECD hosted a stakeholder workshop in Cairo to present a comprehensive analysis of the opportunities and challenges related to Egypt's ambition to establish itself as a major player in the low-carbon hydrogen economy. During the workshop, the OECD team shared findings of the competitiveness gap, assessed investment needs and presented initial results of selected financial instruments impact on narrowing this gap.

Implementing the OECD Framework for Industry's Net-Zero Transition in Egypt

Accelerating Green Hydrogen Development

With abundant solar and wind resources, a mature ammonia industry and proximity to major export markets in Europe, Asia and Africa, Egypt is well-positioned to become a regional hub for green hydrogen and its derivatives. The country has taken major steps to establish an enabling framework including the creation of the National Council for Green Hydrogen and its Derivatives (2023) and the launch of a National Low-Carbon Hydrogen Strategy (2024). The strategy targets annual production of 1.5 million tonnes of green hydrogen, aims to capture 5-8% of the global market by 2040 and create more than 100 000 jobs. Yet, despite a large project pipeline, only a handful of projects have moved beyond feasibility.

This report identifies tailored financial solutions and investment enablers to improve green hydrogen project bankability and accelerate investment decisions. Based on techno-economic analysis, it assesses cost competitiveness across different scenarios. The report also examines the effectiveness of various financial instruments and identifies measures to further strengthen the enabling environment for mobilising private capital.



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