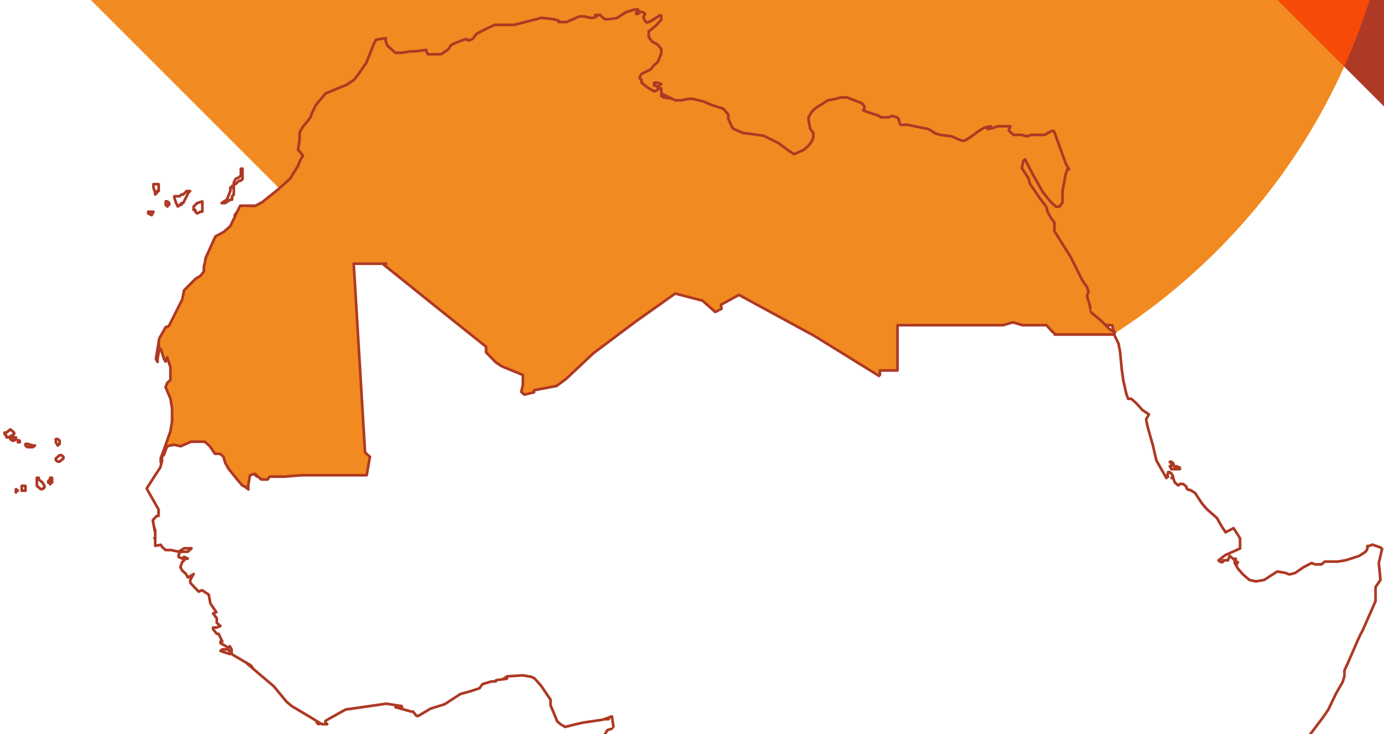
IRENA
International Renewable Energy Agency

ENABLING GREEN HYDROGEN DEVELOPMENT

North Africa



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About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.
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ABBREVIATIONS

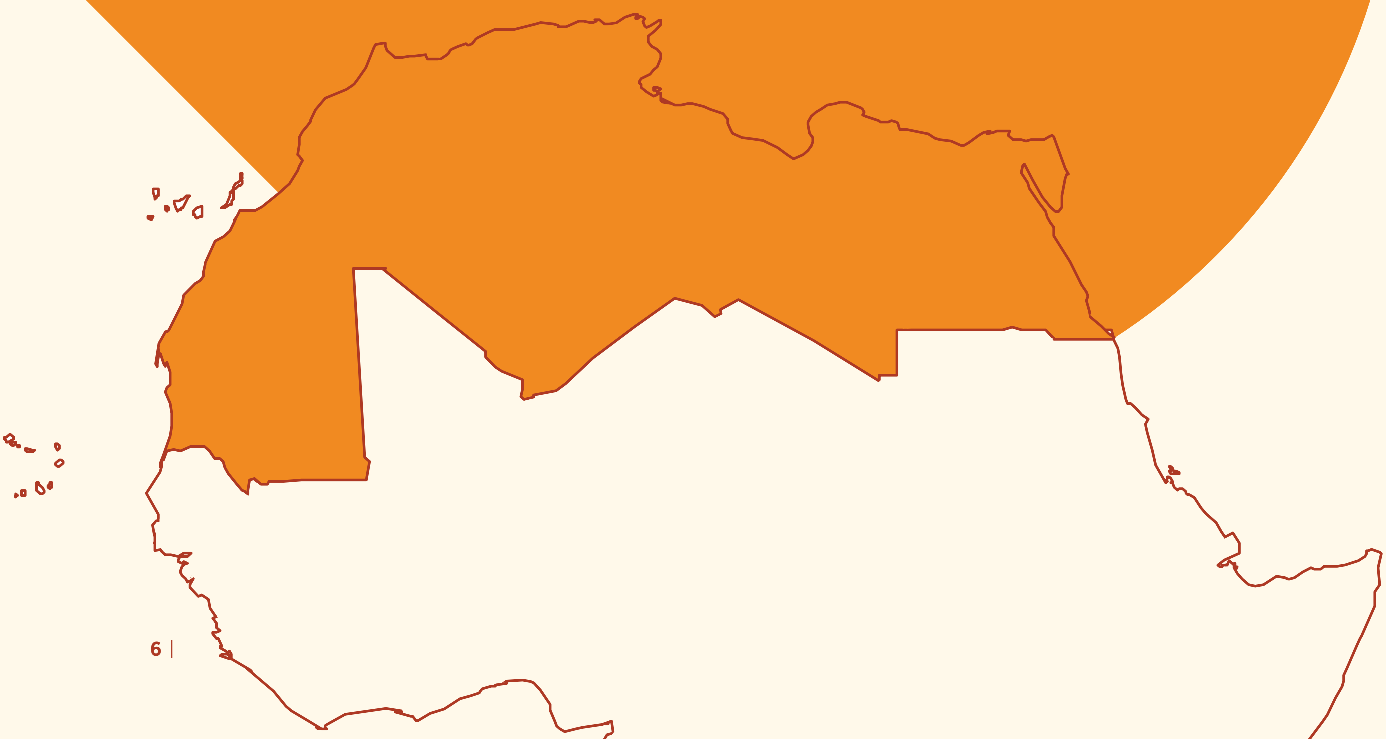
CO_2	carbon dioxide
CSP	concentrated solar power
DRI	direct reduced iron
EU	European Union
EUR	Euro
FID	final investment decision
GDP	gross domestic product
GW	gigawatt
HBI	hot-briquetted iron
IRENA	International Renewable Energy Agency
LNG	liquefied natural gas
LTES	long-term energy scenarios
MAD	Moroccan dirham
MoU	Memorandum of Understanding
MW	Megawatt
NDC	Nationally Determined Contribution
PEM	proton exchange membrane
PV	photovoltaic
QI	quality infrastructure
SCZONE	Suez Canal Economic Zone
TWh	terawatt hour
USD	United States dollar

EXECUTIVE SUMMARY

The North Africa region (defined in this report as the six countries of Algeria, Egypt, Libya, Mauritania, Morocco and Tunisia) features rich solar and wind resources that could allow it to produce competitive green hydrogen that could be used to decarbonise local industries – either directly, or indirectly through the use of green hydrogen-based commodities such as ammonia, methanol and green steel. A local hydrogen economy could create economic opportunities and high-quality jobs, and improve the trade balance of producer countries, thanks to foreign direct investment and import substitution. The region's proximity to Europe positions it as a viable exporter of green hydrogen as well as decarbonised products with higher value added.

Despite this potential, many challenges impede the deployment of a hydrogen economy in North Africa. A primary obstacle is the difficulty faced in financing local hydrogen projects, due in part to investor perceptions of risk in Africa, a lack of knowledge about these emerging (hydrogen) markets, currency risks, and general uncertainties about off-taker markets. Moreover, a larger skilled workforce is required for developing, installing and operating hydrogen-related projects. Skills are needed not only on the maintenance side of hydrogen projects, but also on the development and technical sides.

Strong regulatory frameworks are needed to provide stability and attract investment in green hydrogen. Developing the necessary infrastructure – including ports, roads and water supply – requires significant investment and planning. Critical concerns include the competitiveness of green hydrogen and its derivatives compared to fossil fuel-based alternatives, as well as ensuring local uptake and acceptability.



This report presents brief country profiles for the six countries in the North Africa region, describing their energy and industrial sectors, and highlighting recent developments in relevant policies and roadmaps for renewable energy and green hydrogen. Although most of these countries remain heavily reliant on fossil fuels, many (in particular Egypt, Mauritania and Morocco) have developed solid policy frameworks that provide a clear vision for, and support to, renewable energy development.

Algeria, Egypt, Mauritania, Morocco and Tunisia have published green hydrogen roadmaps and associated strategies, with ambitions to produce more than 5.2 million tonnes annually of combined green hydrogen by 2030 and 25 million tonnes annually by 2050. Although local industrial uses are considered, all hydrogen strategies focus heavily on exports to the European Union (EU), both as hydrogen via pipelines and in the form of ammonia, methanol and green steel. Exports are driven by the desire to attract foreign direct investment and by the strong buying capacity of European off-takers, facilitated and subsidised through auctions such as H2Global.

The six countries' industry and trade profiles provide insights into opportunities for integrating green hydrogen and its derivatives into existing infrastructure and markets. A simple trade analysis highlights the opportunities for import substitution of basic commodities such as natural gas, methanol, ammonia and fertilisers. Substitution of imported natural gas is of interest both in countries that rely heavily on natural gas imports (such as Morocco and Egypt) and in countries that rely partially but increasingly on such imports (such as Tunisia). Meanwhile, natural gas exporting countries such as Algeria and Libya can benefit from leveraging existing export infrastructure to deliver green hydrogen to the EU.

Ammonia is currently imported for the production of fertilisers in Egypt, Morocco and Tunisia, where green hydrogen can substitute these imports. Large ammonia producers with existing fossil fuel-based hydrogen facilities – such as Algeria, Egypt, Libya and Morocco – already have domestic off-takers for green hydrogen, that can reduce investment risks. Mauritania provides an attractive case for upgrading domestically produced iron ore with green hydrogen to produce direct reduced iron (DRI) and green steel, which is already being developed at a large scale.

To enable these opportunities, the report presents a number of enabling measures that are organised into four pillars of the green hydrogen transition, with illustrative examples from North African countries that are already implementing them. The four pillars are: 1) Policies and regulations; 2) Technologies and infrastructure; 3) Markets, business and finance and 4) Supply chains, skills and community engagement.

1. POLICIES AND REGULATIONS

require a clear government commitment and vision that underpins a comprehensive green hydrogen strategy, developed and agreed by all major stakeholders. This hydrogen strategy should prioritise "no-regret" applications (*i.e.* sectors where green hydrogen or its derivatives will not be outcompeted by alternative decarbonisation technologies) and should ideally be embedded in long-term energy scenarios (LTES) to guarantee the strategy's coherence with developments in the energy and industrial sectors. Morocco's Hydrogen Offer is an example of a comprehensive and integrated policy support package that has made green hydrogen projects attractive to investors.

2. TECHNOLOGIES AND INFRASTRUCTURE

for green hydrogen are concentrated in Europe, Asia and North America. However, North Africa will play an important role in integrating these new technologies. The region could benefit from technology transfer as well as the development of innovative domestic ecosystems by manufacturing some of the renewable power technology and electrolysis balance-of-plant components locally (rather than having to import them). Morocco's green hydrogen cluster is an example of how to create such an ecosystem locally and thus develop both skills and locally adapted technologies. Furthermore, water risk can be managed and turned into an opportunity by performing impact assessments and value sharing (also known as value capture), bringing together various actors to invest collectively in desalination infrastructure that will produce more water than hydrogen projects consume. Egypt's Suez Canal Economic Zone is an example of such a strategy.

3. MARKETS, BUSINESS AND FINANCE

are key for projects to reach final investment decision (FID). Project developers need to provide enough certainty to investors that all conditions have been met to produce green hydrogen at a low enough cost and ensure there is a secure off-taker to buy the product. Strategies to diversify the off-taker risk include selling to local off-takers, selling by-products (pure oxygen), selling to government-supported schemes in nearby European markets and stacking green premiums. For example, Morocco's HydroJeel (INNOVX) deal with fertiliser producer OCP was able to successfully leverage a local off-taker to make the project bankable.

4. SUPPLY CHAINS, SKILLS AND COMMUNITY ENGAGEMENT

are critical for the development of a successful hydrogen economy. Green hydrogen requires a sufficiently skilled workforce that covers the entire value chain from project development to infrastructure development and policy making. This can be achieved by creating institutional capacity among public authorities and regulators; developing curricula at academic institutions re-skilling and up-skilling workers from the fossil fuel industry; and by expanding the talent pool to include a diverse workforce. Multilateral and bilateral co-operation among countries is shown to be effective, as in the case of successful German co-operation with Algeria and Tunisia. Although developing adequate skills with a sufficiently large workforce is often a challenge, some North African countries possess diversified and industrialised economies that already have a significant talent pool, such as in Egypt, where the KIMA electrolysis-based ammonia plant in Aswan had been operating since 1963, before it was updated to run on natural gas in 2019.

The International Renewable Energy Agency (IRENA) emphasises inclusive and participatory approaches to engage local communities effectively in the development of large-scale green hydrogen projects, as well as the renewable energy projects they rely on. Based on IRENA's Community Energy Toolkit, the report presents the methodologies that best engage local communities. Key principles are centred around the prioritisation of community well-being and socio-economic benefits, active and meaningful participation, the building of trust and dialogue, local capacity building and knowledge sharing, and need-based community benefit schemes. Following these guidelines should not only improve the support that local communities have for green hydrogen projects, but also optimise benefits for these communities.

Section 1

INTRODUCTION: GREEN HYDROGEN IN NORTH AFRICA

The North Africa region features rich solar and wind resources that could allow it to produce competitive green hydrogen that could be used to decarbonise local industries – either directly, or indirectly through the use of green hydrogen-based commodities such as ammonia, methanol and green steel. A local hydrogen economy could create economic opportunities and high-quality jobs and improve the trade balance of producer countries, thanks to foreign direct investment and import substitution. The region's proximity to Europe positions it as a viable exporter of green hydrogen molecules as well as decarbonised products with higher value added.

Despite this potential, many challenges impede the deployment of a hydrogen economy in North Africa. A primary obstacle is the difficulty faced in financing local hydrogen projects, due in part to investor perceptions of risk in Africa, a lack of knowledge about these emerging (hydrogen) markets, currency risks and general uncertainties about off-taker markets, both locally and in export markets. Moreover, a larger skilled workforce is required for developing, installing and operating hydrogen-related projects. Skills are needed across the entire value chain, from policy making to technical development and operation of hydrogen projects.

Strong regulatory frameworks are needed to provide stability and attract investment in green hydrogen. Developing the necessary infrastructure – including ports, roads and water supply – requires significant investment and planning. Critical concerns include the competitiveness of green hydrogen and its derivatives compared to fossil fuel-based alternatives, as well as ensuring local uptake and acceptability.

The objective of this report is to enhance the understanding of the potential of, and measures needed to enable, the deployment of green hydrogen and green commodities and to develop international markets in North Africa. This report collates findings from desk-based analysis and from insights shared in dialogue with public and private stakeholders in the region. The geographical scope of this report covers Algeria, Egypt, Libya, Mauritania, Morocco and Tunisia.

The report first presents brief profiles for the six countries in the region (section 2), describing their energy and industrial sectors and highlighting recent developments in and relevant policies for renewable energy and green hydrogen. In each country, advances, challenges and opportunities are identified for developing a green hydrogen economy. Section 3 then presents enabling measures that address (most of) these challenges, which are organised in four pillars of the green hydrogen transition, with illustrative examples from North African countries that are already successfully implementing them. The four pillars are: 1) Policies and regulations; 2) Technologies and infrastructure; 3) Markets, business and finance and 4) Supply chains, skills and community engagement.

Table 1 Overview of North African countries' production and export targets for green hydrogen and its derivatives for 2030 and 2050, based on national hydrogen strategies

	2030			2050		
Country	**Green hydrogen production** (million tonnes)	**Green commodities production** (million tonnes)	**Export targets** (million tonnes)	**Green hydrogen production** (million tonnes)	**Green commodities production** (million tonnes)	**Export targets** (million tonnes)
Algeria	–	–	–	1.2 (by 2040)	–	–
Egypt	3.2	–	–	9.2 (by 2040)	–	–
Libya	–	–	–	–	–	–
Mauritania	1.2	6.9 (ammonia)	–	4.3	6.9 (ammonia)	24.4 (ammonia) 5.5 (methanol) 18.7 (direct reduced iron steel)
Morocco (reference scenario)	0.51	0.5 (ammonia)	0.25 (power-to-liquids)	2.5	3.7 (ammonia)	2.72 (power-to-liquids)
Tunisia	0.32	–	0.3 (hydrogen)	8.3	–	6.4 (hydrogen)

Section 2

COUNTRY PROFILES

2.1 ALGERIA

Algeria is one of the leading fossil fuel exporters in the North Africa region. The country's natural gas exports rose from 39 billion cubic metres in 2020 to 49 billion cubic metres in 2024, including pipeline gas and liquefied natural gas (LNG), although exports fell somewhat in 2024 due to lower European demand and increased domestic consumption. Domestic gas consumption has grown significantly, reaching about 53 billion cubic metres in 2024, or just over half of marketed production, indicating that roughly half of Algeria's gas production is exported (Elcano, 2025). Most of the country's natural gas production is exported to Europe, mainly through the Enrico Mattei pipeline (via Tunisia) to Italy, and through the Medgaz pipeline to Spain (IRENA, 2023a).

RENEWABLES, WATER AND GREEN HYDROGEN POLICIES

RENEWABLES

Renewables do not yet feature prominently in Algeria's energy mix. However, the country's 2015 Nationally Determined Contribution (NDC) submission[1] included the conditional objective to reach 27% of electricity generation from renewables by 2030, up from 1% in 2014 (IRENA, 2023a). Algeria has some off-grid renewable capacity, mostly in the country's isolated southern grids. However, Algeria aims to have 22 gigawatts (GW) of renewable capacity installed by 2030, including 13.5 GW of solar photovoltaics (PV), 5 GW of wind and 2 GW of concentrated solar power (CSP) (IRENA, 2023a).

WATER

Algeria is one of the most water-scarce countries globally and is facing severe water stress, with annual per capita water availability below 600 cubic metres, which is well under the water stress threshold of 1 000 cubic metres per capita per year (Grida, 2021). The country's total renewable water resources are estimated at around 17.3 billion cubic metres annually, while water demand exceeds 20 billion cubic metres, leading to a persistent deficit (Blue Community, 2024).

To address the situation, Algeria's water management strategy focuses on integrated water resources management (IWRM) to balance supply and demand sustainably. The government has committed more than USD 5 billion to expand critical water infrastructure – including desalination and dam construction – under national development plans addressing climate change and resource scarcity (Energy Capital & Power, 2025a). The strategy emphasises securing drinking water supply, expanding irrigation capacity and promoting water re-use to ensure sustainable water availability.

HYDROGEN

Algeria's national hydrogen strategy (MEM, 2023) includes a target of installing 2.5 GW of PEM electrolysers by 2040, which should produce 40 terawatt hours (TWh) of green hydrogen per year (equivalent to 1.2 Mtpa). This will require a cumulative investment of around USD 25 billion (Aboushady

[1] *This was the latest NDC submitted by the country as of June 2025.*

and Jaroudi, 2024). Desert regions in Algeria have been identified as the most ideal locations to set up green hydrogen production facilities due to the availability of ample solar and wind resources (Benchenina *et al.*, 2025).

In February 2024, Algeria and Germany agreed to set up a bilateral hydrogen taskforce with the aim of promoting policies to support the production, storage and transport of green hydrogen and its derivatives. This hydrogen taskforce will drive investments in both countries to contribute towards energy security as well as meeting international climate commitments (BMWK, 2024).

In October 2024, Algeria's Sonatrach and Sonelgaz signed a Memorandum of Understanding (MoU) with Austria's VERBUND, Germany's VNG AG, and Italy's Snam and SeaCorridor to explore the feasibility of projects for large-scale production of green hydrogen in Algeria and export it to these three European countries via the planned South H2 Corridor (VNG AG, 2024). The 3 300 kilometre dedicated hydrogen pipeline corridor would supply renewable hydrogen produced in North Africa to demand clusters in Italy (*e.g.* Augusta, Taranto and northern Italy), Austria (*e.g.* Linz, Styria and Vienna) and southern German states (*e.g.* Bavaria). The South H2 Corridor is listed as Hydrogen Corridor Italy – Austria – Germany in the sixth list of energy Projects of Common Interest (PCIs) and Projects of Mutual Interest (PMIs) adopted by the European Commission in November 2023 (Barreto Gómez, 2024).

Algeria's Sonatrach also signed an MoU with the Spanish company Cepsa to carry out a feasibility study for developing an integrated green hydrogen project to supply hydrogen and its derivatives to the European market (CESPA, 2024).

For domestic use, a noteworthy project is the HydrogeneSolareMethane (HySolThane) project, which aims to enrich compressed natural gas with hydrogen and to use this fuel to power buses operating in Algiers. The intended goal is to determine appropriate strategies to integrate hydrogen technologies in the Algerian economy (Benchenina *et al.*, 2025).

MAIN INDUSTRIES AND TRADE PROFILE

AMMONIA

Algeria has an existing fossil fuel-based ammonia industry, with Fertial being the largest company with a production capacity of 1 million tonnes per year. This company covers most of the domestic requirements and exports especially to Europe. A portion of the locally produced ammonia is used as an input material to produce nitrogen and phosphate fertilisers that are used to cover the requirements from Algeria's agricultural industry (Barreto Gómez, 2024).

METHANOL

Domestic methanol production in Algeria is still in its infancy. However, in March 2025, the Souakri Group and Azerbaijan Methanol Company LLC (AzMeCo) signed an MoU to support Algeria in establishing the Algeria Methanol Company. This planned entity will have an initial capacity of 1 million tonnes per year as well as support the production of additional products such as ammonia, urea, formaldehyde and other methanol-based chemicals (CBS4, 2025).

STEEL

Three main companies are driving the steel production industry in Algeria: Sider El Hadjar, Algerian-Qatari Steel Company and Tosyali Group. The latter two entities have announced plans to double their production capacity in the future, in the wake of a new investment law that lifted restrictions on the share of foreign ownership (Aboushady *et al.*, 2024).

2.2 EGYPT

Egypt has transitioned from a net exporter of oil and gas to a net importer since 2010 due to rising energy demand and depleting domestic resources. Natural gas dominates the energy supply (54% of total energy supply in 2020), followed by oil (33.7%), with renewables contributing only 7.1% (IRENA, 2023b).

RENEWABLES, WATER AND GREEN HYDROGEN POLICIES

RENEWABLES

Between 2010 and 2022, Egypt's renewable power capacity grew 83.9%, reaching 6 322 megawatts (MW) in 2022, including hydropower (2 832 MW), solar PV (1 704 MW), wind (1 643 MW), bioenergy (123 MW) and CSP (20 MW).

The Renewable Energy Law (Decree No. 203/2014) supports investments in renewables, leading to the development of projects such as Benban Solar Park (1 465 MW) and Gabal El-Zeit Wind Power Plant (580 MW). Egypt aims for 42% renewable energy in the electricity mix by 2030 (Egypt NDC, 2023), supported by subsidy reductions (down to 1.3% of gross domestic product in 2020-2021), smart grid development, demand-side energy efficiency and regional interconnections (Egypt NDC, 2023).

WATER

Egypt relies heavily on the Nile River for 97% of its fresh water, supporting agriculture, industry and power generation. The government is prioritising desalination for green hydrogen production, with Law No. 2 of 2024 requiring 95% of the output from desalination and solar plants to support hydrogen projects (Barreto Gómez, 2024). Egypt's coastal areas, which host 20% of the population and 40% of industry, are key for the desalination and hydrogen infrastructure.

Challenges in meeting the various demands for fresh water include decreasing freshwater availability (543 cubic metres per capita in 2020, near the water scarcity threshold) due to climate change and upstream Nile projects. Rising sea levels further threaten coastal areas (IRENA, 2023b).

HYDROGEN

In 2021, Egypt consumed 1.8 million tonnes of fossil fuel-based hydrogen (grey hydrogen) for the production of ammonia (756 kilotonnes per year), steel[2] (643 kilotonnes per year) and refineries (300 kilotonnes per year) (Barreto Gómez, 2024).

Egypt aims to supply 5-8% of the global tradeable hydrogen market by 2040. The country's 2024 hydrogen strategy proposes in its "green scenario" the targets of producing 3.6 million tonnes for domestic consumption and 5.6 million tonnes for export by 2040, requiring 76 GW of electrolyser capacity and 114 GW of additional renewable power (Table 2) (Advisian and EBRD, 2024).

To support the development of green hydrogen projects, Law No. 2 of 2024 offers tax breaks (33-55%), exemptions in value-added tax (VAT) for the import of equipment and export of hydrogen, exemptions and discounts on other taxes (*i.e.* on real estate and use of ports) and single licences for projects producing green hydrogen and derivatives, while also mandating 20% minimum local content (Riad&Riad, 2024).

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[2] *The use of (grey) hydrogen in steel production is not that common and makes Egypt a particularly interesting case. This is further detailed in the "steel" section of this report.*

Table 2 Egypt's green hydrogen targets for 2030 and 2040, according to the green scenario of the national hydrogen strategy

	2030	2040
Hydrogen production – domestic (million tonnes)	0.4	3.6
Hydrogen production – export (million tonnes)	2.8	5.6
Electrolyser capacity	27 GW	76 GW
Additional renewable energy capacity requirement	41 GW	114 GW
Electrolyser Investment required	USD 22 billion	USD 34 billion

Source: (Advisian *et al.*, 2024).

By July 2024, Egypt had signed more than 30 MoUs for green hydrogen projects worth around USD 175 billion. Key projects include green ammonia and methanol initiatives in the Suez Canal Economic Zone (SCZONE) (Table 3).

Table 3 Projects in the Suez Canal Economic Zone (SCZONE)

Project name and developers	Scale of production	Off-taker	Investment	Significance
Egypt Green Hydrogen Project Scatec ASA (Norway), Fertiglobe, Orascom Construction, Sovereign Fund of Egypt, Egyptian Electricity Transmission Company	By 2027: 100 MW electrolysers, and annually 13 000 tonnes green hydrogen, 74 000 tonnes green ammonia. By 2033: potential expansion to 1-3 million tonnes ammonia annually	Hintco (Germany) via H2Global auction (19 500 tonnes ammonia in 2027, scaling to 397 000 tonnes by 2033)	EUR 500 million capital expenditure, plus EUR 30 million grant	First green hydrogen plant in Africa, proof of concept for Egypt's green hydrogen ambitions, pilot export to India in 2023 (Box 1).
SK Ecoplant and CSCEC Project SK Ecoplant (Republic of Korea), China State Construction Engineering Corporation	Annually by 2029: 50 000 tonnes green hydrogen, 250 000 tonnes green ammonia	Not specified	USD 2 billion (total), USD 549 million capital expenditure plus USD 33 million grant	Strengthens Egypt's green ammonia export capacity, leverages international expertise in renewables and construction.
Masdar, Hassan Allam Utilities, Infinity Power, and BP Consortium Masdar (United Arab Emirates), Hassan Allam Utilities (Egypt), Infinity Power (Egypt), BP (United Kingdom)	Capacity under feasibility study, multi-phase project focused on exports; target date not specified	Not specified (export-focused, likely Europe)	Part of USD 40 billion SCZONE pipeline, specific amount undisclosed	Combines major renewable and oil company expertise to scale Egypt's green hydrogen exports.

Table 3 Projects in the Suez Canal Economic Zone (SCZONE) (continued)

Project name and developers	Scale of production	Off-taker	Investment	Significance
EDF Renewables and Zero Waste Egypt Project EDF Renewables (France), Zero Waste Technologies (Egypt)	350 000 tonnes green fuel (hydrogen/ammonia) for maritime use/year, target date not specified	Ships passing through Suez Canal	EUR 7 billion)	Targets maritime bunkering, aligns with global demand for green fuels in shipping.
ACWA Power Green Hydrogen Project ACWA Power (Saudi Arabia), local partners	Up to 2 million tonnes green hydrogen/year (first phase), target date not specified	Not specified (export-focused)	Over USD 4 billion (first phase)	One of the largest planned projects, leverages ACWA Power's green hydrogen expertise (e.g. NEOM).
H2 Industries Waste-to-Hydrogen Plant H2 Industries (US)	300 000 tonnes green hydrogen/year from 4 million tonnes municipal waste, targeted for post-2022	Not specified	USD 4 billion	Unique waste-to-hydrogen approach, addresses clean energy and waste management.
AMEA Power Green Hydrogen Facility AMEA Power (United Arab Emirates)	390 000 tonnes green ammonia/year by end of 2025	Europe (export-focused)	USD 800 million to USD 3 billion	Supports Egypt's export-oriented green hydrogen strategy, rapid timeline for operations.

Box 1 Scatec, EBIC and Fertiglobe: Green Ammonia (winner of EU H2Global auction)

Scatec's Egypt Green Hydrogen project, announced as Fertiglobe's successful bid under H2Global's first-ever green ammonia auction, aims to produce the feedstock for renewable ammonia at the adjacent Egypt Basic Industries Corporation (EBIC) production plant. Plant owner Fertiglobe will act as off-taker for a period of 20 years. From Egypt, the company intends to ship a total of 397 000 tonnes of renewable ammonia to the Port of Rotterdam in the Netherlands between 2027 and 2033 (74 kilotonnes per year), with a potential expansion to 1-3 million tonnes of green ammonia per year. The project represents an investment of EUR 500 million, with a USD EUR 30 million grant from the PtX Development Fund (Germany) (Ammonia Energy Association, 2024; Scatec, 2024).

Inaugurated at the 2022 United Nations Climate Change Conference in Sharm el-Sheikh, Egypt (COP 27), the project is Africa's first green hydrogen plan and exported its first green ammonia shipment to India in November 2023. The project's final investment decision (FID) has been delayed several times and, as of May 2025, was planned for the second half of 2025 with construction lasting into 2027 and beyond (Hydrogen Insight, 2025a).

MAIN INDUSTRIES AND TRADE PROFILE

AMMONIA

Egypt is an important global ammonia player, with a combined production capacity of fossil fuel-based ammonia of 6 million tonnes per year, making it the sixth largest producer of urea fertiliser and the fifth largest urea exporter. Egypt had one of the last operational electrolysis-based ammonia plants in the world, fed with hydropower. The KIMA plant operated with alkaline electrolysers and hydroelectricity from the Aswan Dam and was closed down in 2019 (Ammonia Energy Association, 2022).

In 2023, Egypt exported USD 404 million worth of fossil fuel-based ammonia, making it the world's seventh largest exporter of ammonia. The same year, it imported around USD 19.5 million worth of fossil fuel-based ammonia, mainly from Libya (USD 15.3 million) and Oman (USD 4.2 million) (OEC, 2025a).

METHANOL

Egypt has a single methanol production facility, operated by Methanex Egypt. The facility is a joint venture between Methanex Corporation (Canada), which holds a 50% stake, and the Arab Petroleum Investments Corporation (APICORP). Located in Damietta on the Mediterranean Sea, this facility has been operational since 2011 and has a production capacity (fossil fuel-based) of 1.3 million tonnes of methanol per year (Methanex, 2025).

In May 2023, an agreement to establish Egypt's green methanol production project was signed between Alexandria National Refining and Petrochemicals Company (ANRPC), Norway's Scatec and the Egyptian BioEthanol Company (EBIOL) (Ministry of Petroleum & Mineral Resources, 2023). In May 2024, the AD Ports Group and Orascom Construction signed an MoU to develop a green methanol storage and export facility in the Suez Canal area. The purpose of this facility will be to supply low-carbon fuel for maritime transport (AD Ports Group, 2024).

STEEL

Egypt is one of main steel producers in the Middle East and North Africa region, with crude-to-steel production increasing 6% to 7.9 million tonnes between January and September 2024 (Arab Iron and Steel Union, 2024).

In Egypt, three steel companies have direct reduction plants, where (grey) hydrogen is used to reduce iron ore at a combined capacity of capacity of 8.95 million tonnes per year (OEI, 2021). Ezz Steel is the largest independent steel producer in North Africa and the Middle East and one of the largest DRI producers in the world with a capacity of 5 million tonnes per year spread over four plants (EZZSteel, 2024). Beshay Steel (2 million tonnes per year) and Suez Steel Company (1.95 million tonnes per year) are Egypt's second and third largest producers of direct reduced iron (DRI) respectively (OEI, 2021).

2.3 LIBYA

According to the latest statistics from the International Renewable Energy Agency (IRENA), a majority of Libya's total energy supply originates from fossil fuels (94% in 2021) (IRENA, 2024a). The country's economy depends heavily on fossil fuels, with 59% of oil and gas production exported in 2019, mainly to Europe using the Greenstream pipeline that connects directly to Italy (IRENA, 2023a).

RENEWABLES AND GREEN HYDROGEN POLICIES

RENEWABLES

Renewables remain nascent in the country and accounted for only 4% of the total energy supply in 2022 (IRENA, 2024a). IRENA statistics showed that only 5 MW of solar capacity had been installed in Libya by 2022 (IEA, 2025; IRENA, 2023a, 2024a).

The main legislative frameworks in place to support renewable energy development in the country are (IRENA, 2024a):

- Libya's Renewable Energy Strategic Plan 2013-2025
- Council of ministers' decree No. 32 for 2012, which provides structure on the organisation of the oil and gas ministry
- Council of ministers' decree No. 341 for 2012, which approves the organisation of the General Authority for the Environment
- Law No. 426 of 2007, establishing the Renewable Energy Authority of Libya (REAOL).

As of June 2025, Libya had signed but not yet ratified the Paris Agreement, and thus has not submitted an NDC towards reducing greenhouse gas emissions (IRENA, 2023a). However, the country has started to prioritise and initiate efforts to increase the share of renewables in its energy economy. The national grid provider (GECOL) has begun working with private sector players to develop solar and wind projects to take advantage of the country's solar resource in its large desert (Energy Capital & Power, 2024).

Libya has set an ambitious target to generate 4 GW of renewable energy by 2035, which would account for 20% of the energy portfolio (Energy Capital & Power, 2024; PV Knowhow, 2025). The government is focusing on large-scale solar projects and wind power to achieve this goal.

PowerChina and France's EDF are exploring the possibility of developing a 1.5 GW solar plant in eastern Libya, and in 2026 France's TotalEnergies aims to enter commercial operation of a 500 MW solar plant in Al-Sadada (Energy Capital & Power, 2024; PV Knowhow, 2025).

HYDROGEN

Although Libya has a large technical potential to develop green hydrogen, no projects existed as of June 2025 (Imbayah *et al.*, 2024; Wood Mackenzie, 2025).

MAIN INDUSTRIES AND TRADE PROFILE

AMMONIA

Libya has an existing ammonia market given its vast oil and gas resource. In 2023, the country's ammonia exports were valued at USD 158 million, making it the 14th largest ammonia exporter worldwide. The main export destinations were Türkiye, Morocco, Spain, Egypt and Greece (OEC, 2025b). Libya also imported USD 176 000 worth of ammonia, with the top importing sources being Belgium, the United Kingdom, the United Arab Emirates, Egypt and France (OEC, 2025b).

In 2024, Libya's Fertilizer Company announced that it had restarted its second urea plant (with an ammonia production capacity of 800 tonne per day), after it was closed following an annual overhaul that resulted in the repair of a boiler and the installation of a high-pressure reactor and washing device (TrendsNAfrica, 2022; Zaptia, 2024).

METHANOL

As with ammonia, Libya is leveraging its existing fossil fuel resources to produce methanol locally. The country's first methanol plant, operated by the Sirte Oil Company (a subsidiary of the Libya National Oil Company), recently underwent an overhaul. This included replacement of its 540 thermal synthesiser pipes in 20 days (a process that usually takes around 60 days). The update and maintenance allowed an increased capacity of methanol production to 1000 metric tonnes per day (Bueno, 2024; Energy Capital & Power, 2025b).

STEEL

Libya is starting to invest in domestic steel production capabilities. In April 2024, the Libyan Iron and Steel Company (LISCO) and Danieli signed an MoU to start the development of a direct reduction plant to produce 2 million tonnes per year of DRI and hot-briquetted iron (HBI), which would be used by LISCO and also sold to steelmakers in Italy as part of an agreed off-take agreement (Danieli, 2024). As of May 2025, activity had increased at the Mistara port, where LISCO has been at the import/export interface of iron ore pellets and HBI from countries such as Brazil and Spain; this underscores the company's readiness and strategic role to support Libya's steel industry and national economy overall (Harathy, 2025).

2.4 MAURITANIA

Mauritania is undertaking an energy transition that leverages its significant solar and wind resources, allowing for low-cost renewable electricity production. These resources are also a considerable asset for green hydrogen production, which can upgrade the country's iron ore into DRI steel.

RENEWABLES, WATER AND GREEN HYDROGEN POLICIES

RENEWABLES

Mauritania has a large potential for renewable energy, boasting high capacity factors for solar PV (21%), offshore wind (37%) and onshore wind (60%) in a hybrid system (IEA, 2023). By allocating just 5% of its coastal territory to wind and solar energy, the country could install an estimated 363 GW of renewable power capacity, capable of generating around 696 TWh per year. For context, Mauritania produced 2 TWh of electricity in 2020 (IEA, 2023.

Mauritania's NDC commits the country to increasing its renewable energy share to 50% by 2030, with the construction of a 50 MW solar plant (desert-to-power initiative), the development of the Aman Green Hydrogen project (see Box 8 on page 40) and the expansion of the Nouakchott wind power plant from 30 MW to 50 MW (EITI, 2022). In addition to producing green electricity, renewable energy can greatly improve mining operations, the country's largest industry. Switching from diesel and heavy fuel oil to renewables can reduce emissions by 60%, lower costs, increase efficiency and enhance energy security (IEA, 2023).

The large-scale deployment of renewables faces challenges such as a relatively high cost of capital and the need to greatly expand and strengthen the grid to connect generation centres to distant demand centres. The state-owned utility SOMELEC faces financial challenges from issues such as poor payment collection, illegal connections, cost increases, operational problems and high system losses of 10-19% (EITI, 2022; IEA, 2023).

WATER

Project developers are considering oversizing desalination capacity, taking advantage of economies of scale from large hydrogen projects. Oversizing a desalination plant supplying water for a facility producing 1.5 million tonnes of hydrogen per year by 50% could be sufficient to cover Mauritania's potable water shortage.

For example, the Aman Project aims to produce 50-150 cubic metres of desalinated water per year, more than its direct hydrogen production requirements. The Nour Project aims for renewables-powered decentralised desalination for remote rural areas. Desalination practices can also contribute to infrastructure development (water pipelines, pumps, tanker trucks), job creation (construction, operation) and food security (irrigation) (IEA, 2023; MPME, 2022).

The primary challenge of desalination is its potentially large distance from locations with the best renewable resources. Common environmental impacts of desalination include brine discharge, which can harm marine ecosystems due to high salinity and temperature.

HYDROGEN

Mauritania has considerable potential and ambition for producing both green and blue hydrogen (hydrogen produced from natural gas through steam methane reforming).

As of May 2025, the country's pipeline of announced projects totalled more than 5 million tonnes per year, to become operational between 2029 and 2038 (Wood Mackenzie, 2025). Several large-scale green hydrogen projects have been announced by international developers in partnership with the Mauritanian government. These projects were still in the early feasibility stages as of June 2025 and include:

- Aman Project (joint venture between CWP Global and Woodside) in the north: 30 GW of announced renewable capacity, targeting 1.7 million tonnes of green hydrogen and 10 million tonnes of green ammonia output (Hydrogen Insight, 2024).
- Nour Project (Chariot and TotalEnergies) in the north near Nouadhibou port: 10 GW of announced renewable capacity, targeting 1.2 million tonnes of green hydrogen by 2030, with an MoU signed with the Port of Rotterdam for export (OECD, 2024).
- Nassim Project (Initially by BP, which has sold to Sahamco): 30 GW of announced capacity, targeting 10 million tonnes of ammonia output (IEA, 2023).
- Green Ammonia Project (Conjuncta, Infinity Power, Masdar) near Nouakchott: Phase 1 targets 400 MW of renewables and 0.28-0.3 million tonnes of ammonia, with total potential capacity up to 10 GW of electrolysers and 8 million tonnes of ammonia (IEA, 2023).

Mauritania plans to export most of its hydrogen-based commodities to Europe and is considering three export pathways (MPME, 2022):

1. Shipping hydrogen as ammonia: Mauritania's hydrogen strategy aims to export 6.9 million tonnes of ammonia by 2030 and 24.4 million tonnes by 2050 (MPME, 2022).
2. Exporting hydrogen-reduced iron (green iron): This pathway leverages Mauritania's existing iron ore mining industry by using renewable hydrogen to produce a higher-value product (DRI) for export to Europe.

3. Pipelining hydrogen to Europe: Mauritania could transport hydrogen via a pipeline to Spain and potentially onward to central Europe (around 5 000 kilometres). As of June 2025, feasibility studies were ongoing for a sub-sea pipeline, although several experts have questioned the economic feasibility of this method due to prohibitively high costs linked to the large distance.

To support these ambitions, the government has developed a national hydrogen roadmap (*Feuille de route pour l'industrie d'hydrogène à faible empreinte de carbone en Mauritanie*) (MPME, 2022) with medium- and long-term goals. Key action plan priorities include establishing an adapted legal and contractual framework, defining strict international standards, developing a skilled workforce and building necessary transverse infrastructure. Proposed new institutions such as the Direction Hydrogène and Agence Hydrogène are intended to provide strategic steering, regulation and project oversight.

Promoting Mauritania through international agreements and participating in global events is crucial for attracting investors and securing export markets. In October 2024, a green hydrogen code (Law n° 2024-037) was passed to regulate investments in the green hydrogen sector in the country; it also contains a fiscal incentive package (Clifford Chance, 2025). According to this law, the Mauritanian Agency for Green Hydrogen (AMHV) will be created and tasked with overseeing and regulating projects while streamlining investment procedures. The regulatory framework defines clear pathways for securing the necessary authorisations and licences for green hydrogen production and export. The law further stipulates that green hydrogen projects be structured around two key agreements with the Mauritanian state: a Framework Agreement (Accord-Cadre) and a General Convention (Convention Globale) (Islamic Republic of Mauritania, 2024).

MAIN INDUSTRIES AND TRADE PROFILE

NATURAL GAS

Mauritania has major offshore natural gas prospects and recently became an exporter of LNG with the start of operations of phase 1 of the Greater Tortue Ahmeyim (GTA) offshore project, being developed in co-operation with Senegal (BP, 2025). Significant resources have also been confirmed at the The Bir Allah field, although development has yet to take place, with production expected to start in 2030 (Offshore-Technology, 2024). Mauritania's NDC includes the planned construction of two natural gas-fired power plants (200 MW and 300 MW) to substitute existing diesel plants, indicating an increase in domestic demand for renewable power as well (EITI, 2022).

AMMONIA

Mauritania did not produce or consume significant amounts of ammonia as of June 2025. The country's agricultural sector relies on traditional methods, and imported fertilisers are minimal due to economic constraints and low mechanisation levels.

Mauritania's hydrogen roadmap includes ambitious plans for the production and export of green ammonia. Export goals include 6.9 million tonnes of green ammonia by 2030, 15.9 million tonnes by 2040 and 24.4 million tonnes by 2050. Announced projects such as Aman and Nassim also have large-scale ammonia output targets (around 10 million tonnes per year each), and the Green Ammonia project aims for total output of 8 million tonnes (MPME, 2022).

Realising these planned export volumes will require investments in new port infrastructure, including deepwater jetties, as well as storage tanks and import capabilities for green hydrogen-related equipment.

METHANOL

Mauritania's hydrogen roadmap includes plans for e-methanol production and export as part of its diversification strategy. The country aims to export 1.8 million tonnes by 2040 and 5.5 million tonnes by 2050 (MPME, 2022).

Common challenges for e-methanol production include sourcing low-cost biogenic carbon dioxide (CO_2), which would require the presence of biomass-processing facilities such as biogas plants, pulp and paper mills, etc.

STEEL

Mauritania is positioning itself as an important producer of green steel, leveraging its abundant iron ore resources and significant renewable energy potential. Exporting hydrogen-reduced iron (DRI) to Europe is identified as a potential pathway. This would enable the export of a higher value-added product compared to exporting raw iron ore, generating more local benefits and stimulating the economy (IEA, 2023; MPME, 2022).

2.5 MOROCCO

RENEWABLES, WATER AND GREEN HYDROGEN POLICIES

RENEWABLES

Since 2009, Morocco's national energy strategy has promoted the development of renewable energy and energy efficiency. The country has set ambitious targets to leverage solar and wind energy, capitalising on its abundant natural resources and aiming to reduce its 90% dependency on energy imports.

Between 2009 and 2023, Morocco's installed capacity of renewable power increased from just under 2 GW to more than 4.6 GW. By 2030, Morocco aims for 52% of its energy mix to come from renewables, with significant investments in solar projects such as the Noor Solar Complex and wind farms (Ministère de la Transition Énergétique et du Développement Durable, 2024; Royaume du Maroc, 2021).

WATER

Morocco is addressing water scarcity through planned desalination stations, such as those in Casablanca and Dakhla, which could supply water for hydrogen production. These stations align with national water security goals, but their development is still in the early stages.

HYDROGEN

In 2021, Morocco published its green hydrogen roadmap (Royaume du Maroc, 2021), which aims to leverage green hydrogen as a key component of the country's energy transition, focusing on replacing imports, decarbonising industries, and expanding into transport and export markets. The roadmap emphasises a progressive scaling through pilot projects in the short term and then leading to widespread adoption by 2030-2050, with ambitious targets in industries such as fertilisers and transport (Table 4). Exports play a significant role (particularly exports to the European Union (EU) including neighbouring Spain and Portugal), positioning Morocco as a potential leader in green hydrogen production and trade.

Table 4 Projected demand and export of green hydrogen and its derivatives in Morocco

	Scenario	2030	2040	2050
Hydrogen domestic demand (million tonnes)		0.012	0.024	0.042
Ammonia domestic demand (million tonnes)	Reference	0.5	2.5	3.7
	Optimist	1.2	3.6	3.8
Hydrogen (million tonnes)	Reference	0.219	0.978	2.442
	Optimist	0.462	1.953	4.884
Power-to-liquids export (million tonnes)	Reference	0.25	1.09	2.72
	Optimist	0.52	2.18	5.46

Source: Morocco's Green Hydrogen Roadmap (Royaume du Maroc, 2021).

In 2023, the government presented the *Offre Maroc* (Moroccan Offer), an integrated framework to support the development of green hydrogen in the country, in line with the 2021 roadmap (see Box 2 on page 29).

As of 2025, an ambitious plan is in place to export hydrogen and ammonia via maritime transport to Europe, with significant growth projected by 2030 and continuing to 2050. This includes a project to export hydrogen and methane to Spain and Portugal through a gas pipeline, with full implementation by 2030 and growth to 2050.

Pilot projects are also being planned to use hydrogen to stabilise the local electricity network towards 2030-2045. Potential pilots are contemplated for underground hydrogen storage, starting around 2035 and scaling up to 2050, supported by geological saline formations that could allow for the large-scale and seasonal storage of hydrogen.

MAIN INDUSTRIES AND TRADE PROFILE

Morocco's economy is driven by a diverse range of industries, with the main sectors being agriculture, tourism, mining (particularly phosphate extraction), manufacturing (textiles, automotive, etc.) and fisheries. These industries, supported by strategic infrastructure and trade agreements, position Morocco as a regional economic hub.

Morocco imports around 90% of its energy needs, which is a major driver for supporting the production of local energy and commodities including hydrogen, ammonia and methanol.

NATURAL GAS

Morocco's natural gas sector relies heavily on imports, primarily through the Maghreb-Europe Gas Pipeline (historically supplied by Algeria) and LNG terminals. In 2021, diplomatic fallout with Algeria disrupted pipeline supplies, pushing Morocco to explore LNG imports and domestic gas fields such as Tendrara. Green hydrogen could partially replace natural gas in industrial heating and grid stabilisation by 2045 (Royaume du Maroc, 2021). The government's push for pipeline exports of hydrogen-methane blends to Portugal and Spain by 2030 indicates a transition strategy from natural gas to green hydrogen.

NH_3

AMMONIA

Morocco is highly reliant on imports for its ammonia consumption, having imported USD 1.8 billion worth of anhydrous ammonia in 2021 (OEC, 2025c); this makes ammonia the third most imported product in Morocco. Imports are mainly from Trinidad and Tobago (USD 740 million), Saudi Arabia (USD 340 million), the Russian Federation (USD 206 million), the United States (USD 118 million) and Egypt (USD 99.7 million) (UN Comtrade, 2025). The Moroccan state-owned fertilizer giant OCP Group uses ammonia as a key ingredient, alongside phosphate, to manufacture both Mono-Ammonium Phosphate (MAP) and Di-Ammonium Phosphate (DAP) fertilizers. These fertilizers are then exported to various markets (Hydrogen Insight, 2023).

CH_2OH

METHANOL

Morocco is a net methanol importer, importing mainly from Spain, Germany and France. The imported methanol is used primarily in industrial and chemical applications, notably in the production of fertilisers, with growing interest in its role as a green fuel and energy carrier.

Morocco's green hydrogen roadmap (Royaume du Maroc, 2021) mentions the possibilities of combining green hydrogen with (renewable) sources of CO_2 to produce green e-methanol, as well as other synthetic fuels and products such as e-methane and e-kerosene. Some of this methanol would be exported to help the decarbonisation of partner countries, mainly in Europe (Royaume du Maroc, 2021).

STEEL

Morocco's steel industry, led by companies such as Maghreb Steel, relies on imported coal and natural gas for production. Green hydrogen could decarbonise steelmaking by replacing fossil fuels in direct reduction processes, aligning with industrial heating pilots planned for 2030-2045. Morocco's Industrial Acceleration Zones, offering a 15% corporate tax rate and investment grants up to 30%, could attract steel manufacturers to adopt hydrogen-based technologies. Additional information on steel trade volumes or hydrogen integration is required.

2.6 TUNISIA

Tunisia aims to become a key player in the production of green hydrogen due to its ample renewable energy resources and proximity to hydrogen demand centres in Europe (Tunisia MIME, 2024).

RENEWABLES, WATER AND GREEN HYDROGEN POLICIES

RENEWABLES

Tunisia is already leveraging its abundant renewable energy resources, with 2 600 kilowatt hours of annual solar radiation per square metre in the south and a 1 300 kilometre coastline suitable for offshore wind. As of 2023, installed capacities included 275 MW of onshore wind power and 506 MW of solar PV, contributing 11.9% to electricity generation (IRENA, 2023a) (GiZ, 2023). The country aims for 35% renewable power by 2030, 50% by 2035, and 100% by 2050, with a target of 100 GW of renewable capacity by 2050 to support green hydrogen production (Ministry of Industry and Energy Tunisia *et al.*, 2024).

Key legislation includes Law No. 96-27 (1996) for private electricity generation via concessions and Law No. 2015-12 for renewable energy proliferation, enabling self-generation, independent power production and export. The Energy Transition Fund (FTE), created in 2013 under Finance Law No. 54-2013, funds energy transition through subsidies, loans and equity.

Energy challenges for the country include:

- A heavy reliance on natural gas (97.5% of electricity mix), with 48% imported in 2022, impacting energy security and increasing trade deficits (IRENA, 2021; World Bank, 2024). High energy subsidies (USD 2.6 billion per year) strain public finances.

- Complex project execution involving multiple ministries and institutions, leading to delays and conflicting roles (IRENA, 2021).

- Low market attractiveness for private investment due to high energy subsidies for end users on natural gas and electricity – reaching 5.3% of GDP in 2022 (World Bank, 2023) – and a relatively unstable investment climate (due to policy uncertainty); however, large projects typically sell to the national utility through power purchase agreements (PPAs) and are not affected as much.

WATER

Tunisia faces significant water scarcity, with a 96% water stress co-efficient. In response, the strategy prioritises seawater desalination as the primary source of water for green hydrogen and its derivatives, ensuring that no scarce fresh water will be used. The strategy links this to the need to identify suitable areas for the placement of electrolysers (in the public maritime domain) while considering the need for concessions or temporary occupation of these locations. This process involves the Ministry of Agriculture, Hydraulic Resources and Fisheries and the Coastal Protection and Planning Agency (APAL) (Ministry of Industry and Energy Tunisia *et al.*, 2024). The legal and regulatory framework for desalination is further embedded in the broader Water Code of 1975, which governs the allocation, use and conservation of water resources.

HYDROGEN

Tunisia aims to produce 8.3 million tonnes of green hydrogen by 2050, with 6.4 million tonnes for export to Europe and 1.9 million tonnes for domestic use (Table 5) (Ministry of Industry and Energy Tunisia *et al.*, 2024). The strategy includes developing the Tunisian Hydrogen Backbone pipeline network for domestic and export purposes, with investment costs estimated at EUR 9.6-13.4 billion.

Table 5 Green hydrogen targets for domestic and export markets in Tunisia, according to the national hydrogen strategy

Targets (million tonnes per year)	**2030**	**2040**	**2050**
Green hydrogen production	0.32	2.1	8.3
Green hydrogen export	0.3	1.63	6.4
Green hydrogen domestic demand	0.02	0.48	1.9

Source: (Ministry of Industry and Energy Tunisia *et al.*, 2024).

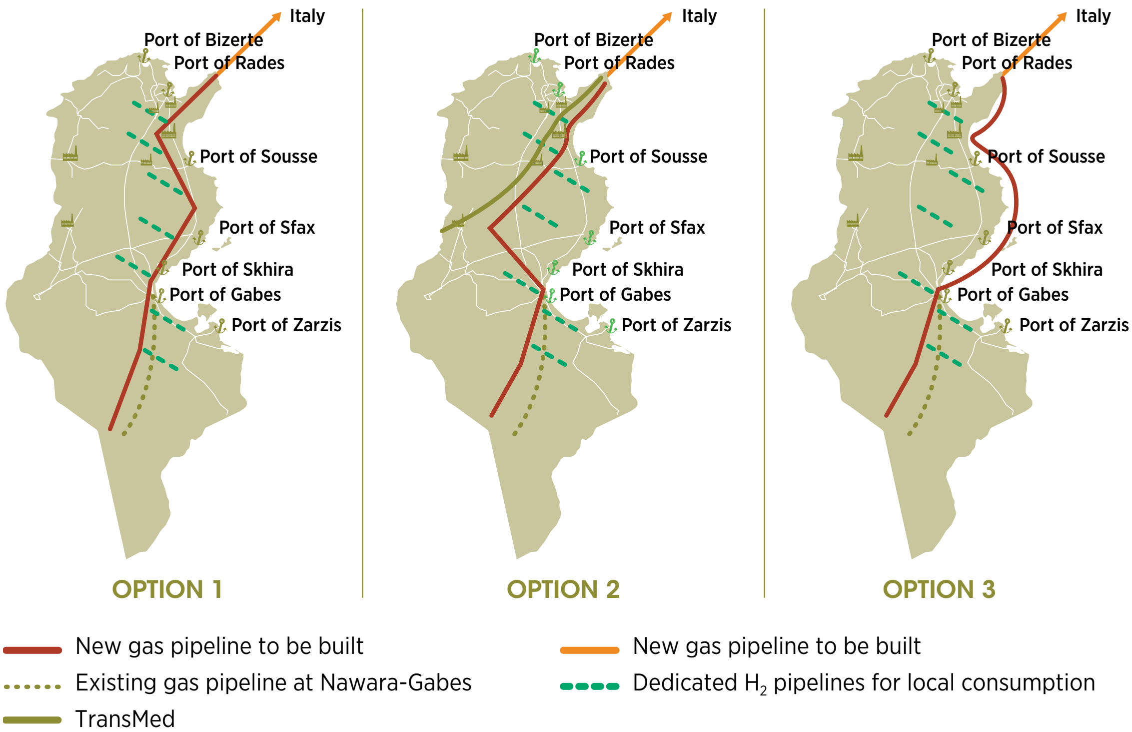
New legislation is under development to define green hydrogen, establish safety standards, authorise projects, and provide fiscal incentives such as injection rights, feed-in tariffs and guarantees of origin. Six MoUs were signed with European companies and the Tunisian government in 2024 for green hydrogen production (Renewables Now, 2024).

Challenges in the deployment of a green hydrogen economy in Tunisia include the reluctance of off-takers to use hydrogen-natural gas blends[3], favouring instead dedicated hydrogen pipelines. In the medium term, the demand for natural gas remains strong, so the capacity is not being freed. The nascent green hydrogen industry also requires further development of a legal and regulatory framework.

Opportunities for local production of green hydrogen include tariffs exemptions on importing equipment for both renewable energy and hydrogen production as well as corporate tax exemptions for renewable hydrogen projects for the first five years (Barreto Gómez, 2024).

Tunisia is not considering the option of repurposing the Transmed gas pipeline (Trans Tunisian Pipeline Company and Trans-Mediterranean Pipeline Company) to transport solely hydrogen, given that Tunisia has signed agreements with both Algeria and Italy to increase natural gas trade with these countries. Hence, the national strategy includes a target to set up a pipeline network called the Tunisian Hydrogen Backbone, with the objective of collecting the green hydrogen produced in different parts of the country. This network would be used for exporting as well as providing hydrogen to meet local demand in different sectors. Tunisia envisions using this new pipeline to export hydrogen to Italy and using it as the gateway to the EU market (Ministry of Industry and Energy Tunisia *et al.*, 2024). The pipeline construction options are shown in Figure 1.

Figure 1 Pipeline constructions being considered by Tunisia for domestic use and export of green hydrogen



Source: (Ministry of Industry and Energy Tunisia *et al.*, 2024).

[3] *Hydrogen-natural gas blends are only of interest for energy use, but they are problematic when used as chemical feedstocks, which requires expensive separation technologies.*

MAIN INDUSTRIES AND TRADE PROFILE

NATURAL GAS

Natural gas dominates Tunisia's energy mix, accounting for 97.5% of electricity generation; however, 72% of the total domestic consumption was imported in 2024, primarily from Algeria (Mees, 2025). Domestic natural gas production has declined greatly in recent years, increasing reliance on imports and exacerbating trade deficits (Mees, 2025).

AMMONIA

Tunisia has a domestic ammonia industry, driven by the Tunisian Chemical Group (Groupe Chimique Tunisien), which imports ammonia to produce fertiliser for domestic and export markets. The national strategy prioritises green ammonia production using green hydrogen via Haber-Bosch synthesis.

A planned project in Gabes (planned for 2028-2030) will use an 8 MW solar farm and desalination unit to produce 220 tonnes of green hydrogen, yielding 630 tonnes of ammonia (Ministry of Industry and Energy Tunisia *et al.*, 2024). A much larger project, the Amarenco Green Hydrogen and Ammonia Hub, was also announced through the signing of an MoU between developers Amarenco and H2 Global Energy and the Tunisian government. It aims to install between 1.5 GW and 1.8 GW of electrolysers, producing 180 000 tonnes per year of green hydrogen. The project seeks to begin construction in 2028, with commercial operations starting in 2031 (GH2, 2025a).

METHANOL

Tunisia has no significant methanol production today, but its hydrogen strategy and coastal infrastructure position it to develop methanol for maritime fuel markets.

Methanol trade is minimal, although future green methanol production could target international shipping markets, leveraging Tunisia's strategic location.

STEEL

Tunisia's steel industry, led by companies such as El Fouladh, focuses on long steel products (rebar, wire rod) with an annual capacity of around 200 000 tonnes (MEPS International, 2024). Steel production relies on imported scrap and energy-intensive processes, primarily using natural gas. Green hydrogen could replace natural gas in DRI processes, aligning with decarbonisation goals (IRENA, 2024b).

Tunisia exports steel products to regional markets (*e.g.* North Africa and Europe) but faces high energy costs and import dependency. Green hydrogen adoption could enhance competitiveness.

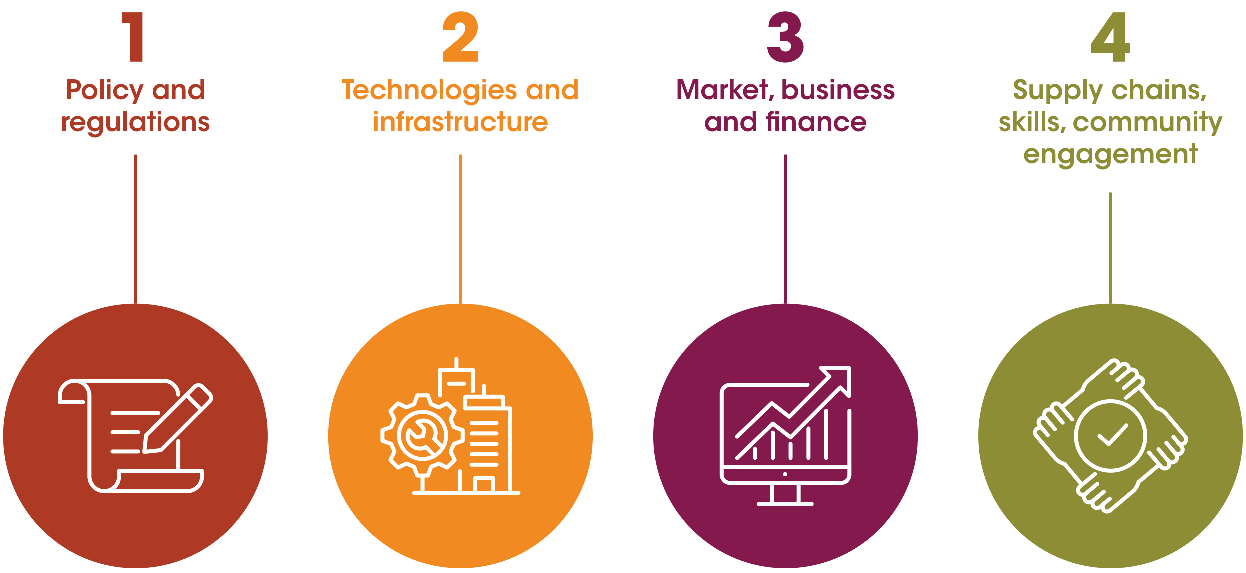
Section 3

ENABLING PILLARS FOR THE DEPLOYMENT OF GREEN HYDROGEN AND ITS DERIVATES

Green hydrogen and derivative commodities offer an opportunity for North African countries to achieve domestic decarbonisation while also advancing economic and industrial development. To enable development and encourage investment, governments in the region could consider a range of measures, including developing policy and regulatory frameworks that build confidence and provide assurance. Industries such as fertilisers, agriculture, steel and transport are all important emitters in the region. By integrating green hydrogen into their energy strategies and value chains, countries can foster sustainable industrial growth, enhance energy security and improve trade balances.

To enable these developments and their benefits, countries can build on IRENA's four enabling pillars for the energy transition (IRENA, 2019), adapted to the specifics of green hydrogen and local needs. These pillars centre around 1) policies and regulations, 2) technologies and infrastructure, 3) market, business and finance, and 4) supply chains, skills and community engagement (Figure 2).

Figure 2 IRENA's systemic innovation framework for deployment of hydrogen and hydrogen derivatives



3.1 PILLAR 1 – POLICIES AND REGULATIONS

In the area of policies and regulations, enabling strategies should aim to create a supportive and predictable framework for the growth of the green hydrogen sector, to spur investment. As most North African countries are fossil fuel producers, it can be challenging to reconcile objectives for renewable energy development alongside existing energy policies. This is compounded by import dependencies, as many countries rely heavily on foreign energy supplies, limiting their ability to shift towards self-sustaining renewable energy models. Additionally, a lack of clarity on safety and technical standards creates uncertainty that slows the adoption of new technologies. Finally, the production of green hydrogen and its derivatives faces obstacles due to high costs and regulatory uncertainty, hindering the investment appetite in the region.

Key enabling strategies to address these challenges are discussed in the following sections.

CLEAR GOVERNMENT COMMITMENT AND VISION

A comprehensive green hydrogen strategy, developed and committed to by all major stakeholders – including the government, private sector, academia and civil society – can provide clarity on the sectors to be prioritised, the important targets, and milestones along a clearly defined pathway.

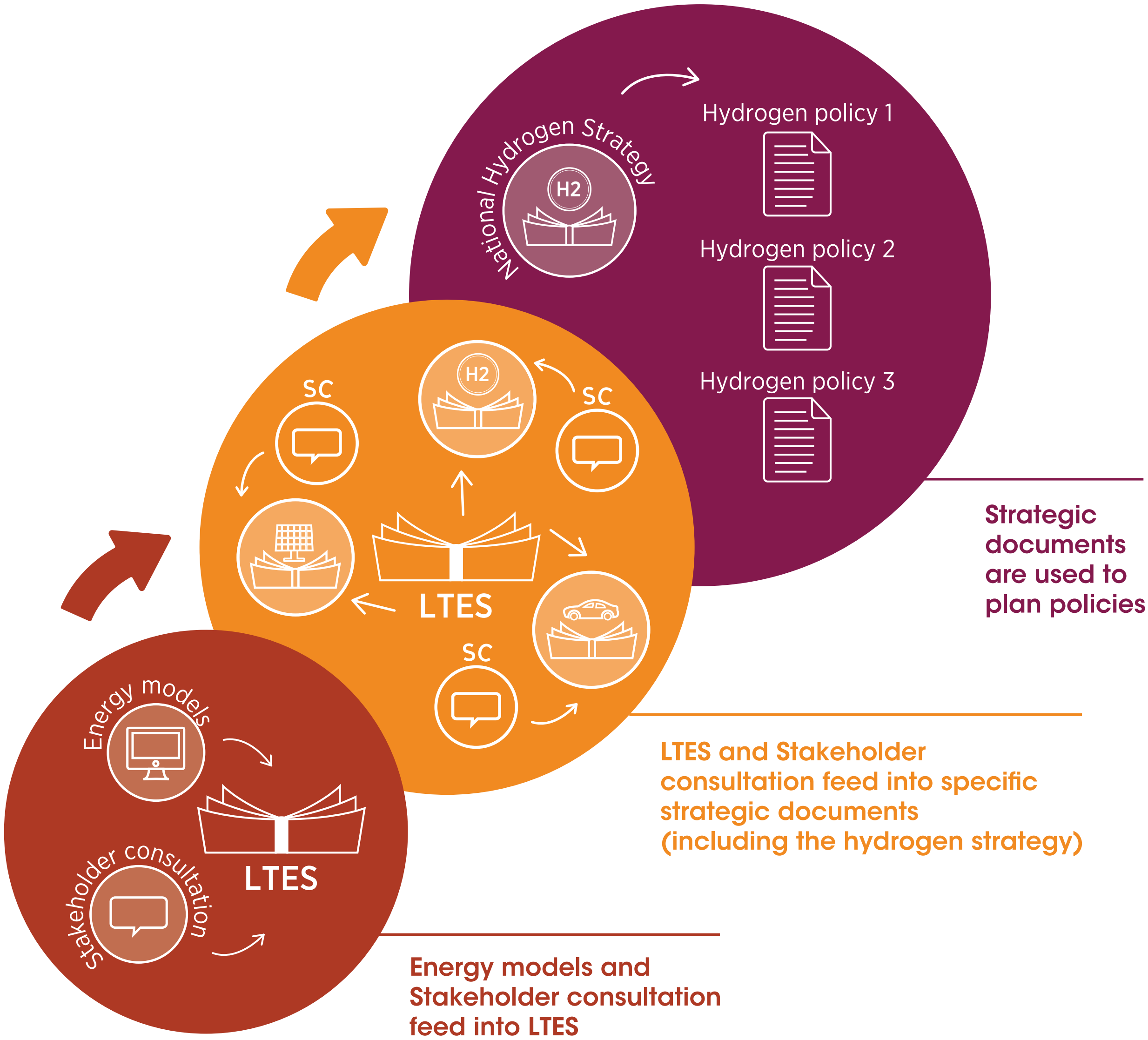
The hydrogen strategy should prioritise "no-regret" applications – that is, sectors where green hydrogen and its derivatives will not be outcompeted by alternative decarbonisation technologies such as biofuels or direct electrification. These are mostly sectors where the chemical properties of hydrogen are required (such as steel reduction, ammonia, methanol or derivatives, and the chemical industry) (UNIDO *et al.*, 2024). This priority becomes more relevant for countries that have industries or proven resources that can serve as a basis for such applications, such as iron ore production, the chemical industry or ammonia.

Hydrogen strategies benefit from being embedded in long-term energy scenarios (LTES) that can provide insights into how the energy system will evolve, including links to hydrogen production and consumption. Energy models that perform multi-sectoral or integrated analysis of energy systems should be preferred. IRENA's 2024 report *Green hydrogen strategy: A guide to design* (IRENA, 2024c) provides more in-depth guidance on how to integrate the hydrogen strategy in national and regional energy planning using long-term energy scenarios (Figure 3).

The green hydrogen strategy should be complemented by a coherent supportive and predictable policy framework that provides investors and developers with assurance of investment and operating conditions, as well as defining clear roles for government agencies responsible for regulating business operations, safety, trade, etc. Governments can attract more investments in green hydrogen projects by committing to such a framework. An important component of supporting policy frameworks includes creating a stable demand for green hydrogen, for example using demand quotas for certain industries, carbon contracts for difference, auctions or the mandated retirement of fossil fuel-based solutions (IRENA, 2022, 2024c).

Both strategies and supportive policies should be integrated into existing programmatic documents and long-term energy scenarios to avoid fragmented decision making and duplication of efforts.

Figure 3 Integrating a national hydrogen strategy in long-term energy scenarios (LTES) using modelling



Source: (IRENA, 2024d).

STREAMLINING ADMINISTRATIVE PROCESSES AND ELIMINATING REGULATORY BARRIERS

This involves measures such as simplifying procedures for renewable energy permitting, for small-scale green hydrogen installations (to facilitate pilots).

Box 2 Example of an integrated hydrogen policy framework: Morocco's Green Hydrogen Offer

Morocco's Green Hydrogen Offer is a strategic initiative launched in March 2024 to position the country as a global leader in green hydrogen, leveraging its abundant renewable energy resources, strategic location and infrastructure. The framework covers the entire green hydrogen value chain, from renewable energy generation and electrolysis to the production of derivatives such as ammonia, methanol, and synthetic fuels, as well as associated logistics.

Box 2 Example of an integrated hydrogen policy framework: Morocco's Green Hydrogen Offer (continued)

The programme aligns with Morocco's New Development Model, which advocates a new energy paradigm at the national level and is driven by the directives of King Mohammed VI, aiming to foster sustainable energy production, economic growth and global energy transition (GH2, 2025b; MASEN, 2024; MEM, 2024). Its integrated approach is designed to drive economic development by attracting significant foreign direct investment and creating jobs by fostering local value chains, integrating industries such as fertiliser production, electric mobility, and green manufacturing, with a focus on employment for women, youth and rural populations. Human capital development is reinforced through programmes such as INJAZ Al-Maghrib and IRESEN (MEI, 2024).

As part of the programme, the government has allocated 1 million hectares of public land for green hydrogen projects, with an initial 300 000 hectares available for investors. The framework offers a clear mechanism for land reservation and allocation to ensure accessibility for investors. It establishes a single focal point for green hydrogen projects (Masen), simplifying the process from application to investment decisions.

The framework offers a clear and attractive incentive system, including tax benefits and support for public-private partnerships. The government has designated 12 Industrial Acceleration Zones (formerly industrial free trade zones) to attract foreign investment and boost economic activity. Operators in these zones benefit from several advantages including a corporate tax rate of 15%, tolerance for local sales (since 2018, companies can sell up to 15% of their previous year's export turnover on the Moroccan market, providing flexibility in sales strategies), and support services such as turnkey buildings, rental offices, maintenance, security, banking, catering, telecoms, recruitment support, logistics, and administrative services through a one-stop-shop, making them attractive locations for investment and business operations (MEFZ, 2022).

Outside the Industrial Acceleration Zones, the Investment Charter (Charte de l'investissement) offers companies grants for up to 30% of the eligible investment amount, depending on specific criteria such as the number of jobs created (*e.g.* more than 150 permanent jobs) or the investment's location and sector (Casainvest, 2025). Furthermore, territorial premiums of 10% or 15% of the eligible investment amount are offered for projects in designated provinces or prefectures, categorised as A or B. This encourages investment in less-developed or rural regions to reduce regional disparities. An additional 5% bonus is provided for investments in priority sectors, including industry, transport, renewable energy and waste valorisation. This directs capital towards high-potential and future-oriented industries.

Projects deemed strategic – with an investment of at least around USD 200 million (MAD 2 billion) – qualify for special incentives. These projects must contribute greatly to areas such as water, energy, food, or health security, or enhance Morocco's international economic standing. Incentives can include tailored financial support and streamlined administrative processes.

Although not fully detailed in the charter's framework law, complementary measures (*e.g.* under the Finance Law 2023) offer tax incentives. Companies investing at least MAD 1.5 million (approximately USD 165 thousand as of June 2025) over five years (starting January in 2023) can benefit from a capped corporate tax rate of 20% for several years, provided that they sign an agreement with the government. The Investment Charter further facilitates investment through decentralised approval processes (via Regional Investment Centers for projects under MAD 250 million (approximately USD 27 million) and digital platforms, reducing bureaucratic hurdles. This indirectly lowers the cost and time of setting up operations.

Finally, a transparent investor selection processes for hydrogen projects, accompanied by regular assessments, ensure project progress and mutual success. As of the March 2025 meeting of the steering committee, five investors had been selected to develop six green hydrogen projects, representing a total investment of MAD 319 billion (USD 35 million) from nearly 40 projects that applied (Hydrogen Insight, 2025b; Médias24, 2025).

REGULATION, STANDARDISATION AND CERTIFICATION AS TOOLS FOR BUILDING MARKET CONFIDENCE

Regulations that provide definitions for what is considered "green" hydrogen or "low-emission" hydrogen-derived ammonia or methanol can help increase confidence in the early stages of developing markets for these commodities. International standards can also help provide shared methodologies for calculating and understanding the greenhouse gas emissions associated with producing volumes of these commodities in a given location and project configuration. Establishing certification schemes for renewable and low-carbon hydrogen and its derivatives can play an important role in providing evidence of the emissions produced or saved in each case. This can be particularly useful when countries are seeking to facilitate opportunities for international trade, to ensure that hydrogen produced in the country meets environmental standards and can address the requirements of the importing markets.

In the North African case, particular export ambitions are focused on accessing the EU market. It is especially important for producers in the region to understand how they can certify volumes of hydrogen, ammonia or methanol produced, to evidence adherence to the EU's regulatory conditions. Prior IRENA analysis on this topic highlighted a need for countries to work towards "interoperability" of standardisation and certification systems, so that similar methodologies are adopted in different geographies to reduce barriers to co-operation and international trade (IRENA, 2024e).

3.2 PILLAR 2 – TECHNOLOGIES AND INFRASTRUCTURE

TECHNOLOGIES

One of the main barriers for the deployment of green hydrogen is its high cost compared to its fossil fuel-based equivalent (grey hydrogen). Among the key strategies for reducing costs are improvements in electrolyser technologies, in particular alkaline electrolysis (IRENA, 2024d). Technical innovation in developing novel electrolysers and related technologies is concentrated in Europe, Asia and North America. However, North Africa will play an important role in integrating these new technologies. The region could benefit from technology transfer and even develop innovative domestic ecosystems by manufacturing some of the renewable power technology, as well as electrolysis balance-of-plant components such as cables, pipelines, and many other technologies locally (rather than having to import them) (Box 3).

Box 3 Local technology development: Egypt aims to develop its own module factories

Egypt's large solar resource, with direct solar potential of 2 000 to 3 200 kilowatt hour per square metre per year of direct solar makes PV technology a cornerstone of its renewable energy strategy. The country is scaling up solar capacity to support both domestic electricity needs and green hydrogen production. To shorten its supply chains, develop local skills and potentially reduce costs, the country promotes the development of local manufacturing of PV cells and modules.

In 2024, Singapore-headquartered manufacturer EliTe Solar announced an 8 GW per year solar cell and module manufacturing plant in the Suez Canal Economic Zone (SCZONE), with a first phase of 2 GW production to be ready by September 2025. This facility aims to position Egypt as a PV manufacturing hub in the Middle East and North Africa region, revolutionising local supply chains and reducing reliance on imported components (PV Tech, 2024a).

Box 3 Local technology development: Egypt aims to develop its own module factories (continued)

In late 2024, the United Arab Emirates' state-owned power developer Masdar signed a number of MoUs to develop 4 GW of new solar manufacturing capacity in Egypt, in addition to 2 GW of new battery manufacturing capacity and several large-scale solar plants (PV Tech, 2024b). The Egyptian government is also actively working with a global alliance (including Belgium's Alkaline Electrolyser manufacturer John Cockerill, Norway's Scatec, Italy's Technip and Schlumberger) to localise the production of electrolyser components in Egypt. The goal is to establish an industrial plant for manufacturing these components, particularly in the SCZONE. The government has expressed strong support for these efforts, aiming to reduce reliance on imports of these key components (ZAWYA, 2024).

QUALITY INFRASTRUCTURE

An often-overlooked aspect in developing a hydrogen economy is the requirement for a robust and resilient quality infrastructure (QI). This is often linked to a lack of knowledge of quality infrastructure as well as its associated benefits for hydrogen stakeholders. The International Network on Quality Infrastructure (INetQI) formally defined quality infrastructure as *"the national system of organisations, policies, legal framework and practices required to assure products and services are safe and sustainable. It serves as a fundamental element in the smooth functioning of domestic markets and facilitates international market access"* (IRENA, 2024f).

Quality infrastructure includes the following pillars (components): metrology, standardisation, accreditation, conformity assessment (including testing, certification, verification/validation and inspection) and market surveillance. A cross-cutting aspect is technical regulations, which define the mandatory requirements to safeguard human health, safety and the environment (IRENA, 2024f). An overview of these pillars is provided below:

- **Metrology** "is the science of measurement. The key service offered through metrology is the calibration or verification of measurement devices, wherein an instrument for measurement is compared to a measurement standard representing a higher hierarchy. supports standardisation, the regulatory framework, certification methods and testing regimes" (IRENA, 2024f).

- **Standardisation** "provides the technical requirements and specifications to ensure that products, processes and services are fit for their purpose. The process of standardisation involves creating and distributing standards, as well as informing interested parties about them" (IRENA, 2024f).

- **Accreditation**, "provided by a national accreditation body or co-ordinated through a national focal point for accreditation, is a third-party attestation related to a conformity assessment body conveying formal demonstration of its competence to carry out specific conformity assessment tasks" (IRENA, 2024f).

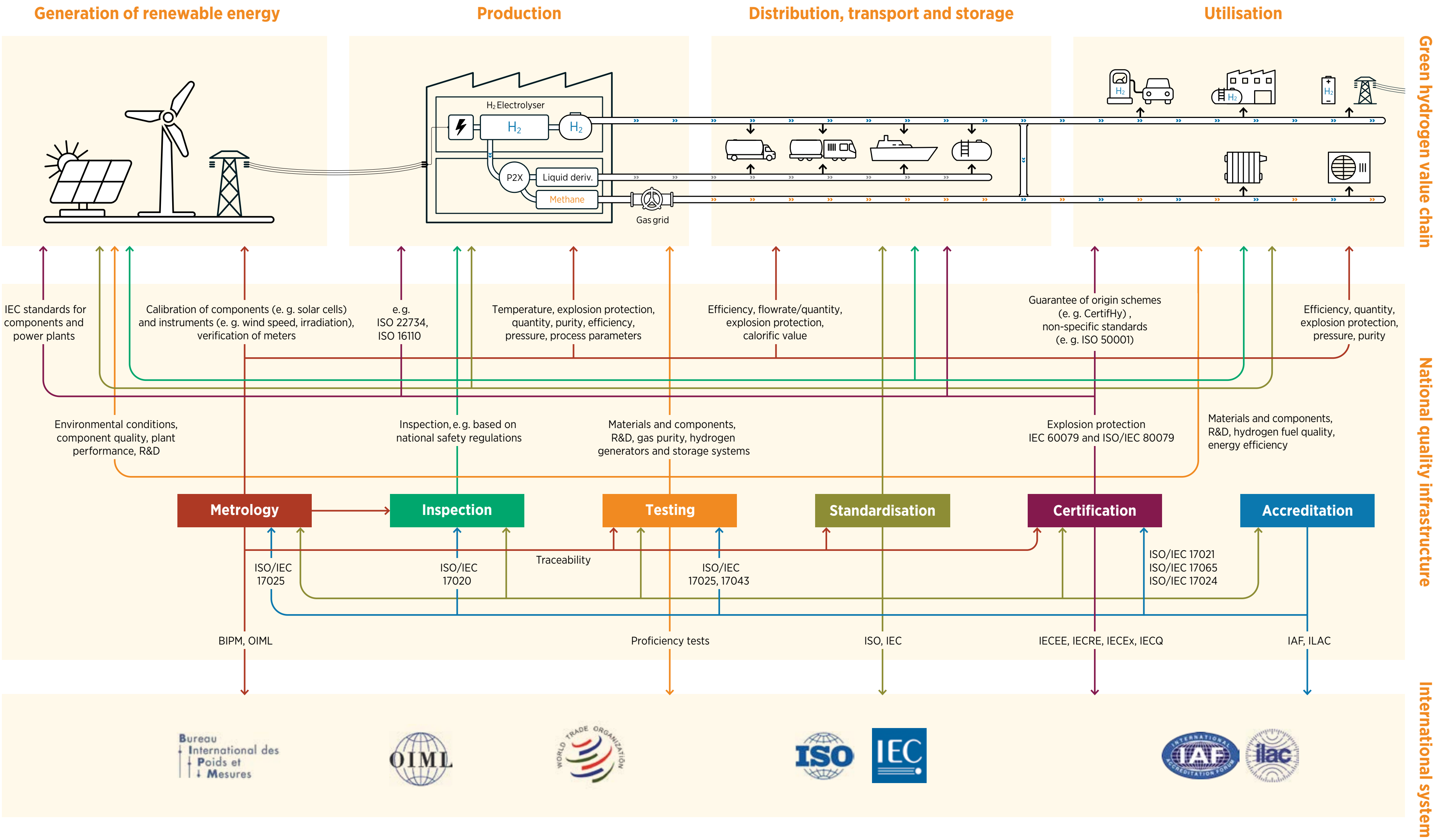
- **Testing** "allows the characteristics or performance of a product or process to be determined following a specific procedure. It involves evaluating one or more properties of an object or product against the specifications outlined in a standard" (IRENA, 2024f).

- **Certification** "is the provision of written assurance (a certificate) that a product, service, process, person or system fulfils certain requirements" (IRENA, 2024f).

- **Inspection** "can be used to determine whether a product or process complies with certain requirements, and involves the examination of the respective sites, equipment or processes" (IRENA, 2024f).

Figure 4 shows the interplay between various QI elements as well as the green hydrogen value chain.

Figure 4 How quality infrastructure maps on to the green hydrogen value chain



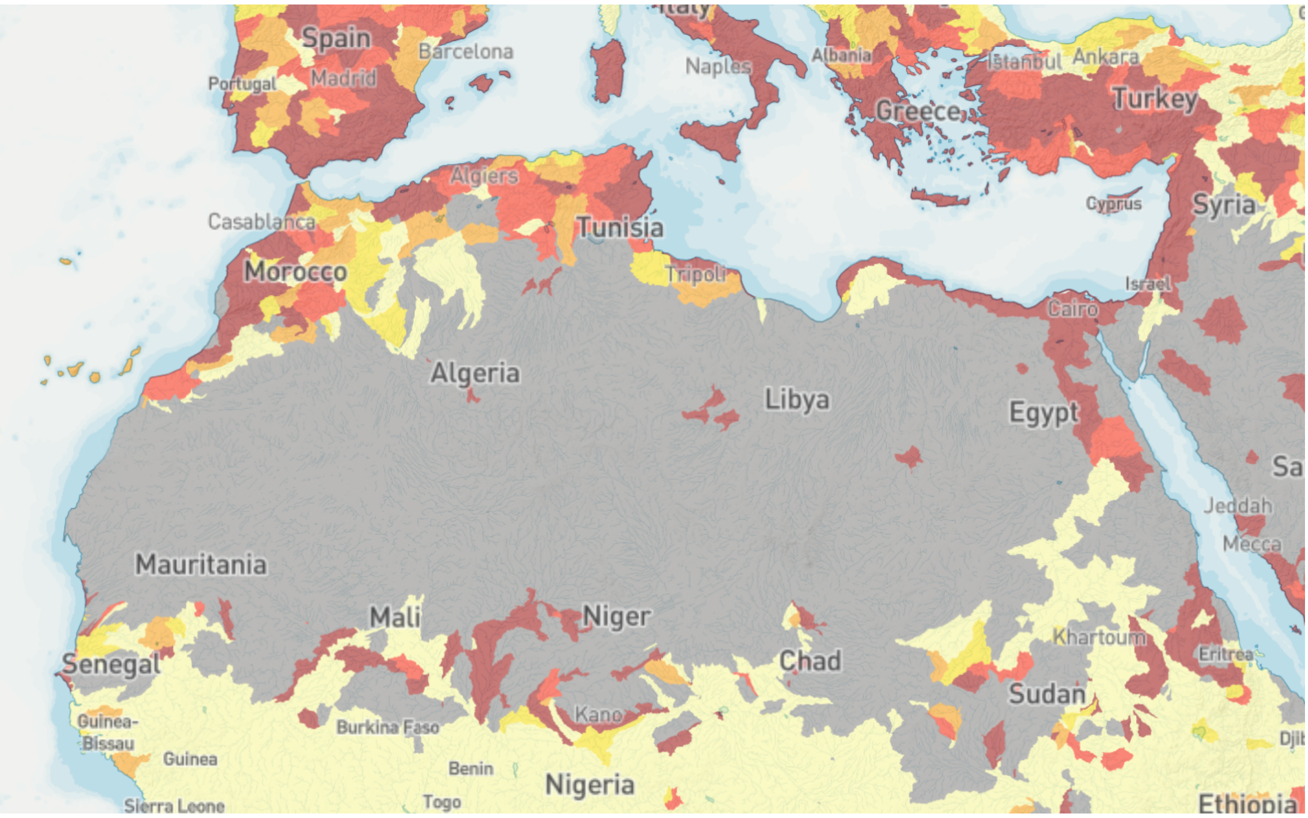
Source: (IRENA, 2024f).

A well-functioning QI system facilitates innovation by ensuring the availability of reliable measurements and control systems. Developing a QI system for green hydrogen requires effective awareness raising on the importance of QI and identifying the priority areas for intervention. Where QI services are missing or non-adequate, these gaps can be addressed through co-operation between relevant national, regional and global stakeholders. It is worth stressing that QI will be required across the entire hydrogen value chain, regardless of the production pathway (IRENA, 2024f).

WATER AND POWER INFRASTRUCTURE

All countries in the North Africa region are experiencing varying levels of water stress in at least some parts of the countries (Figure 5), and this is poised to worsen towards 2050 (WRI, 2023, 2025). Green hydrogen projects can increase this water stress if not properly managed, which could lead to environmental degradation and social resistance to hydrogen projects. Conversely, with adequate planning and following some recommendations below, green hydrogen projects can be part of water-positive solutions and improve both access to and quality of water. Enabling measures to foster this positive role of green hydrogen include long-term planning of water resources, making use of desalinated seawater, selection of efficient technologies, and value sharing among public and private actors.

Figure 5 Baseline water stress in the North Africa region



Water Stress

Low (<10%)	Low-medium (10-20%)	Medium-medium (20-40%)	High (40-80%)	Extremely high (>80%)

Arid and low water use   No data

Note: Baseline water stress measures the ratio of total water demand to available renewable surface and groundwater supplies. Water demand include domestic, industrial, irrigation and livestock uses. Available renewable water supplies include the impact of upstream consumptive water users and large dams on downstream water availability. Higher values indicate more competition among users.

Source: (WRI, 2025).

Countries should evaluate and plan for long-term availability of and demand for fresh water, taking into account that green hydrogen projects have a typical lifetime of 20-30 years.

Governments can require project developers to conduct comprehensive water risk and impact assessments before permits are released, and require operating companies to include water use metrics in their environmental compliance reports. Where surface or groundwater are likely to be stressed, policy makers can prioritise water-efficient technologies with preferential permits, subsidies, tax incentives or expedited regulatory approval for water-efficient hydrogen projects. Developers can chose efficient technologies to limit water usage, such as PEM electrolysers and water desalination to supply water from the sea (IRENA and Bluerisk, 2023).

Since all countries in the North Africa region have access to either the Atlantic Ocean or the Mediterranean Sea, water desalination can be an attractive option. Although desalination increases infrastructure costs, it typically adds only USD 0.02-0.05 to the cost of a kilogram of hydrogen (IRENA and Bluerisk, 2023).

Value sharing, also known as value capture, allows governments to deliver enabling infrastructure for water and power by involving mainly private stakeholders that will benefit from it as co-investors. This approach can greatly reduce the overall cost to the government while fostering industry involvement in project development. Despite its benefits, value sharing is often perceived as a difficult proposition as the discussion focuses on the costs (who will pay?) rather than on the benefits (what do we get?). To foster a more successful dialogue about co-investment, it is essential to emphasise the value propositions for all stakeholders, including industry, landowners, businesses and government (IRENA, 2025a).

Determining who will benefit from renewable power, green hydrogen and water infrastructure projects involves understanding the unique opportunities and challenges of industry and community, as well as identifying the specific value propositions for each stakeholder. By adopting value sharing, governments can create enabling frameworks that encourage corporate co-investment in infrastructure projects (Box 4). This would involve, in addition to the power lines, all the infrastructural needs for a modern power grid as well as water infrastructure, including desalinisation, advanced water purification and wastewater re-use. Part of the water produced/sourced could be diverted towards local populations, for a reduced rate.

Box 4 Shared desalinated water infrastructure in Egypt's Suez Canal Economic Zone (SCZONE)

Egypt's Suez Canal Economic Zone (SCZONE) has developed a centralised and phased water desalination strategy to support its green hydrogen projects, ensuring that multiple projects can access desalinated water without duplicating infrastructure and benefiting from the scale of common infrastructure (Business Monthly, 2023; Pumps Africa, 2024).

The shared infrastructure revolves around the Sokhna Desalination Plant, which is being implemented in phases. A first phase will lead to a capacity of 250 000 cubic metres per day and is expected to be operational by mid-2026; subsequent phases will scale up to 1 million cubic metres per day, with timelines aligned with the growth of green hydrogen production. The technology will likely be reverse osmosis, the most common and energy-efficient desalination method, powered by renewable energy (solar and wind) to align with the green credentials of the hydrogen projects.

Box 4 Shared desalinated water infrastructure in Egypt's Suez Canal Economic Zone (SCZONE) (continued)

Shared access: The plant is designed as a centralised facility, with water distributed via pipelines to project sites within the SCZONE. This reduces the need for each project to build its own desalination plant, lowering capital costs and environmental impact. The SCZONE has allocated specific areas for shared infrastructure, including desalination plants, seawater intake systems, and water storage facilities, ensuring efficient access for multiple developers. The SCZONE General Authority co-ordinates the development and operation of the desalination infrastructure, ensuring equitable access for all projects. This includes managing water allocation based on each project's production capacity and timeline.

Project structuring: The desalination plant is likely developed through public-private partnerships, with private desalination companies collaborating with the Egyptian government to fund, build and operate the facility. This model reduces financial strain on individual hydrogen project developers. Developers share operational costs proportional to their water usage, making the infrastructure economically viable. This approach incentivises collaboration among projects such as those by Scatec, ACWA Power and AMEA Power.

EXPORT INFRASTRUCTURE FOR GREEN HYDROGEN DERIVATIVES

Green hydrogen that is not consumed domestically can be exported to neighbouring or remote international off-takers. It can be exported in many forms, following different pathways including (compressed) gaseous hydrogen through pipelines, road transport in tube tankers, and export as green hydrogen derivatives such as green ammonia, green methanol and liquid organic hydrogen carriers. Green hydrogen can also be used to produce higher value added products such as DRI steel that are typically exported in bulk carrier vessels overseas.

For long-distance transport between the North Africa region and the EU or other overseas destinations, compressed hydrogen through pipelines and maritime shipping of ammonia are emerging as the primary pathways, each with distinct advantages and challenges. The optimal choice for each country will depend on many factors, including distance, scale, existing infrastructure and its suitability for reconversion as well as energy balances, all of which affect the economic and environmental viability. These considerations are further discussed in IRENA's 2024 report *Shaping sustainable international hydrogen value chains* (IRENA, 2024g).

All options require major infrastructure to be built out and planned for, including onshore and offshore pipelines, hydrogen or ammonia storage, and seaport development to handle these products as well as receive large ammonia carriers where this is not the case.

Sometimes, the development of green hydrogen value chains includes the need for upstream import infrastructure to service the renewable energy projects that will supply power to the electrolysers, such as large seaports that are able to import large onshore or offshore wind turbines. There is a need for ports and pipelines not only to export hydrogen-derived commodities such as ammonia, methanol, and green steel, but also to import renewable energy capacity (wind farms).

3.3 PILLAR 3 – MARKET, BUSINESS AND FINANCE

For commercial projects to reach a final investment decision (FID), project developers need to provide enough certainty to investors that all conditions (regulatory, economic, environmental) have been met to produce green hydrogen at a low-enough cost.

SECURE OFF-TAKE

Getting commitment(s) to buy the product from a credit-worthy off-taker is the most important step in securing finance – the key component to get to FID – for a green hydrogen or green hydrogen derivative project. This is required for banks to be comfortable in providing the large loans (typically representing 60% to 80% of the total investment costs) required for these projects.

Strategies to diversify the off-taker risk include selling to local off-takers, selling by-products (pure oxygen), selling to government-supported schemes in nearby European markets and stacking green premiums.

Local off-takers

Finding local off-takers (as opposed to remote off-takers) brings the advantage of reducing the dependence on complex infrastructure such as hydrogen pipelines, which are not only costly but also introduce potential regulatory barriers and time delays. One of the most attractive examples is to produce green hydrogen in the vicinity of existing demand centres for hydrogen (ones that formerly consumed grey hydrogen). A typical example is the substitution of grey hydrogen with green hydrogen in refineries or building twin green hydrogen and green ammonia facilities side by side.

An example is Morocco's Jorf hydrogen platform, that feeds directly into OCPs ammonia production plants (Box 5). Another example that is highly relevant to Mauritania is the development of a DRI and green steel industry. As the second largest iron ore producer in Africa, the country possesses high-quality iron ore resources and has an established production capacity.

Box 5 HydroJeel (INNOVX) with OCP in Morocco

The Jorf Hydrogen Platform, led by HydroJeel and part of OCP Group's broader green ammonia programme, is being developed in Jorf Lasfar, a key industrial hub for Morocco's chemical and energy sectors. The plant will be powered by newly built wind and solar farms and is expected to produce up to 100 000 tonnes of green ammonia annually by 2026. The produced green ammonia will help Morocco reduce its imports of fertilisers.

In the medium term, OCP and HydroJeel plan to increase production to 3 million tonnes of green ammonia per year, which could supply nearly 2% of global ammonia demand. The project has received a EUR 30 million subsidy from the EUR 270 million PtX Development Fund, launched by the German Ministry for Economic Cooperation and Development (7 News, 2025; Fuelcellsworks, 2025; Innovx, 2025).

European off-takers

Europe is set to be a large demand centre for green hydrogen, although it will likely not able to meet this demand with local production alone. EU policy makers and private sector players are planning for import infrastructure and supply projects, in particular from the North Africa region due to its geographic proximity and rich renewable resources.

European demand for green hydrogen and hydrogen derivatives (ammonia, methanol and green e-fuels) are driven by its need to decarbonise its so-called hard-to-abate sectors, namely its chemical, steel, aviation and shipping sectors. Overall, the use of these hydrogen-based energy carriers would increase from negligible values today to a demand of 37 million tonnes of hydrogen equivalent by 2050 in IRENA's 1.5 degree Celsius scenario (IRENA, 2025b).

Stacking green premiums

To make projects bankable, developers can cumulate or "stack" different revenue sources that in combination can make a project bankable. When the conditions allow, typical revenue streams that could be stacked include government subsidies, green premiums paid by buyers or governments, renewable energy certificates and sector-specific incentives. Guaranteed premiums improve cash flow predictability, reduce reliance on volatile market prices, and de-risk the project, allowing for higher leverage (more debt) and better returns on equity.

ACCESS TO ADEQUATE FINANCE

Although many plans exist for green hydrogen projects around the world, there has been relatively little experience in financing these projects by banks, particularly in the North Africa region. As showcased in the four enabling pillars, the depth of local knowledge required to understand the risks pertaining to technology, renewable power, water, local acceptance, etc., requires new capacities that are not always available from local or even international banks.

Technical and financial support from multilateral development banks, such as the World Bank, can address some of these off-takers. One of the challenges particularly relevant to North African countries is the high cost of capital and the perceived risks, which can delay the financial close of green hydrogen projects. A blended funding approach and support from development banks can help mitigate these risks.

3.4 PILLAR 4 – SUPPLY CHAINS, SKILLS AND COMMUNITY ENGAGEMENT

INSTITUTIONAL CAPACITY AND SKILLS

The development of a successful hydrogen economy requires a sufficiently skilled workforce, including on the side of project developers as well as in infrastructure development and policy making.

During the research for this report, several policy officers from the North Africa region mentioned the difficulty in understanding the requirements of off-taker markets in the EU, in particular related to green hydrogen sustainability certification requirements, the suitability of renewable energy credits and the translation of the concept of "bidding zones" to local power markets.

To integrate green hydrogen in the energy system and existing industry structures, political decision makers, regulators and public authorities need to be equipped with skills and expertise to understand the challenges and opportunities. Successful capacity building involves elements for formal training that can be enhanced by exchanges with peer practitioners from other countries. One successful training course on green hydrogen is the Green Hydrogen Policy Accelerator, organised by the Green Hydrogen Organisation in partnership with the International Solar Alliance (GH2, 2024).

A long-term capacity building strategy should include the development of curricula and capacity building for educators. This can be done through comprehensive educational programmes focused on green hydrogen technologies to build local expertise and technical know-how. These programmes introduced by universities and technical institutes should aim not only to directly educate the workforce but also to train local instructors of the next generation of engineers, scientists and technicians in the principles and applications of green hydrogen production, storage and use.

By investing in education, governments can increase the availability of qualified professionals who are equipped with the skills necessary to advance the green hydrogen sector. Collaboration with international institutions with a history of developing hydrogen-related curricula can aid in curriculum development and faculty training. Partnering with countries and organisations that are leaders in green hydrogen can bring valuable expertise and technology transfer to the region.

In addition to government officials and academic institutions, employees from the fossil fuel industry can be re-skilled and up-skilled to the needs of the green hydrogen sector. Programmes should cover the design, financing, construction, operation, and maintenance of green hydrogen projects, as well as renewable energy projects that support green hydrogen production.

The pool of talent within the green hydrogen sector needs to expand to include a diverse workforce. This including encouraging the participation of under-represented groups such as women, young professionals and individuals from marginalised communities. Promoting close collaboration between industry and educational institutions would be essential to create accessible career pathways for all. Targeted scholarships, mentorship programmes and apprenticeship opportunities can help build a diverse workforce and wider talent pool base that is equipped with the required skills. Broadening perspectives will foster innovation and strengthen the green hydrogen industry to drive the energy transition forward (Box 6).

Box 6 German development co-operation with Algeria and Tunisia to develop skills for green hydrogen

Co-operation between Germany and Algeria

Germany and Algeria have established a taskforce to work together on green hydrogen production. This co-operation was facilitated by a Joint Economic Commission agreed in 2011, and by an Energy Partnership programme created in 2015. Through this programme, Germany will support Algeria with know-how and technical expertise and will provide financing for the construction of a 50 MW green hydrogen pilot plant by the national oil company Sonatrach in Arzew (Barreto Gómez, 2024).

Co-operation between Bavaria and Tunisia

In a programme titled Strengthening the Bavarian-Tunisian Technology and Innovation Hub for Green Hydrogen, the German Federal Ministry for Economic Cooperation and Development (BMZ), together with the Chancellery of the Federal State of Bavaria, are supporting Tunisia with establishing a strong and sustainable institutional basis for the Bavarian-Tunisian green hydrogen hub as a professional establishment. Once an organisational concept and a business plan have been agreed, the next step will be to equip the hub with the necessary resources. The knowledge transfer and partnership building activities implemented in the first phase will continue in various forms, such as study visits, presentations, expert discussions, forums and information events (GiZ, 2023).

COMMUNITY ENGAGEMENT

IRENA emphasises inclusive and participatory approaches to engage local communities effectively in the development of large-scale green hydrogen projects, and the renewable energy projects they rely on.

The two IRENA publications *Community Energy Toolkit: Best practices for broadening the ownership of renewables* (IRENA Coalition for Action, 2021) and *Community energy benefits: Powering universal wellbeing* (IRENA Coalition for Action, 2024) describe methodologies that best engage local communities not only to improve their support for the projects but also to optimise the benefits of the projects for the communities. The toolkit provides 11 case studies for renewable energy initiatives from across the world, showcasing ways that communities actively participate in energy decision making, bringing socio-economic impacts to societies.

Key principles and practices for engaging local communities in the development of renewable energy and green hydrogen projects include:

- **Prioritise community well-being and socio-economic benefits**: Energy projects should be designed to maximise value and socio-economic benefits for the community where they operate. Evaluation should go beyond technical and financial parameters to include local social performance, community needs and preferences. Benefits should be distributed equitably, which could involve revenue sharing, reductions on energy bills for vulnerable populations, or allocation to community projects benefiting locals (Box 7).

- **Enable active and meaningful participation**: This involves engaging communities in all stages of project development, from conceptualisation to construction and operation.

- **Build trust and nurture dialogue**: Partnerships with external actors require efforts to cultivate and deepen relationships. Regular and transparent sharing of project performance and costs facilitates continued engagement. Mutual understanding among stakeholders can be facilitated by using a mediator or facilitator.

- **Understand and integrate local contexts, values and culture**: It is vital to help partners develop an understanding of local contexts, values and needs. Decision-making processes should be compatible with a community's cultural values and practices.

- **Invest in capacity building and knowledge sharing**: Communities often require specialised knowledge and skills. Building capacity through technical training, understanding regulations and financial know-how is key.

- **Establish clear governance and decision-making processes**: A community should implement a governance framework that places community members at the centre of decision making.

- **Implement community benefit schemes (especially for large infrastructure)**: For larger infrastructure such as transmission lines where community ownership might not be feasible, providing benefits and engaging affected communities can mitigate opposition. These schemes should address citizens' concerns early through pro-active and meaningful public engagement and consultation. This can lead to tailor-made, locally relevant benefits.

- **Leverage community knowledge for environmental siting and protection**: Local communities are often the best stewards of their environment. Their active involvement helps ensure that projects align with local priorities for preserving nature and biodiversity and minimise negative impacts. Engaging communities in the siting process can increase buy-in, avoid conflicts, and bring tangible benefits, such as incorporating agrivoltaics or aligning with conservation goals. Community knowledge can identify local materials and ensure responsible waste management.

Box 7 Engaging local communities: Morocco's AMUN project

Morocco's AMUN project, led by CWP Global, is a 15 GW green hydrogen and ammonia production initiative in the Guelmim-Oued Noun region near Tan Tan. The project aims to harness wind and solar energy to produce green hydrogen and ammonia for decarbonising sectors such as fertilisers and maritime transport, with a focus on both local and export markets (*e.g.* Europe). While the project is still in its early stages, its engagement with local communities has been a noted aspect of its development (AEA, 2022) and aims to avoid past experiences with large-scale projects such as Noor (RIFS, 2023).

Among notable characteristics, the project (AEA, 2022; Hydrogenious, 2023):

- Is expected to generate significant employment opportunities for the local population, during both the construction and operational phases. This includes a mix of skilled and unskilled jobs, contributing to sustained economic development in the region.
- Is actively involved in building local capacity, which encompasses training and upskilling community members to participate in the renewable energy and green hydrogen value chain.
- Aims to provide clean energy to the local area, which can help improve local energy security and reduce reliance on fossil fuels.
- Supports local industry and agriculture by delivering green ammonia as fertiliser feedstock, which can enhance local agricultural productivity and sustainability.
- Is being deployed in three phases, allowing for gradual scaling and integration with local economic structures. This approach helps maximise local participation and adaptation as the project grows.

Overall, Morocco expects to create more than 30 000 jobs in the hydrogen sector. These jobs are only one component of a broader plan to generate 300 000 positions across critical sectors, including decarbonisation, electric mobility and industry (MoroccoWorldNews, 2025).

CLUSTERING (HYDROGEN VALLEYS)

Clustering green hydrogen activities into regional ecosystems – often termed hydrogen valleys (in Europe), clusters or hubs (in the United States) – facilitates project development by consolidating production, infrastructure and demand within a defined geographic area (Box 8). This strategy brings benefits in terms of cost efficiency, demand security, scalability and funding alignment (Clean Hydrogen Partnership, 2025; WBCSD, 2023).

- **Cost efficiency**: Co-locating production and demand minimises transport needs, which is critical given hydrogen's high transport costs. Repurposing existing pipelines (*e.g.* natural gas infrastructure) further cuts capital expenditures.
- **Demand security**: Proximity to large industrial off-takers (*e.g.* steel, fertiliser, refining) ensures baseload demand, de-risking investments. For example, replacing grey hydrogen in industrial clusters with green hydrogen reduces the risks associated with hydrogen infrastructure development, as the (grey) hydrogen infrastructure is already there.
- **Scalability and funding**: Concentrating projects enables economies of scale, facilitating the attraction of funding. Moreover, such projects typically align well with regional decarbonisation goals, making them eligible for EU funding programmes such as the Projects of Common Interest (PCI).

Box 8 Clustering green hydrogen projects in North Africa: Mauritania's Green Hydrogen Export Hub, including green steel

The AMAN project, led by CWP Global, is a large-scale green hydrogen hub in Mauritania designed to capitalise on the country's abundant wind and solar resources. Spanning 8 500 square kilometres, the hub integrates a 30 GW renewable energy complex to produce 1.7 million tonnes of green hydrogen and 10 million tonnes of green ammonia annually. The hub encompasses production, storage, and export facilities, primarily targeting European markets, with shipments planned to the Port of Rotterdam in the Netherlands.

Launched in 2020, the first phase is in accelerated pre-FEED (Front-End Engineering Design), with FEED expected in the second half of 2025, following two years of resource measurement. The initial phase (3-5 GW) targets production of 1 million tonnes per year of green ammonia and 2.5 million tonnes per year of direct reduced iron (DRI) for green steel, with flexibility to adjust proportions based on off-taker needs. The final, full-scale project aims to reach 910 million tonnes per year of green ammonia or a combination of off-take products, including green hydrogen and DRI, depending on market demand (EITI, 2022; RMI, 2024).

Mauritania's AMAN hub is strategically positioned to integrate green steel production, leveraging the country's vast iron ore reserves (4 billion tonnes, 69% iron content) and existing iron ore export infrastructure (13 million tonnes per year, valued at USD 1.2 billion). CWP Global is in discussions to develop a fully integrated hot briquetted iron (HBI) hub, including a 3.5 million tonnes per year green DRI plant. This would use green hydrogen to reduce iron ore into DRI, a key input for low-carbon steel production. This green DRI and HBI production are aimed at European markets, supported by the EU-Mauritania Global Gateway partnership, highlighted during the European Commission President's February 2024 visit, emphasising demand for Mauritania's green hydrogen and green iron (EC, 2024). Further iron ore expansions are planned (*e.g.*, Sabic and Glencore joint ventures) that could add 21 million tonnes per year of iron ore production, providing feedstock for green steel production within the hub.

Developing the AMAN project as an integrated hub offers multiple advantages including economies of scale and diversified demand (multiple off-takers of ammonia and DRI for green steel), mitigating financial risks and ensuring greater market stability, with flexibility to adjust output ratios based on demand. By integrating green hydrogen and green steel production, the AMAN hub positions Mauritania as a key player in the global low-carbon economy, meeting Europe's demand for sustainable energy and materials while maximising the use of local resources.

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