

Middle East & Africa Hydrogen Projects 2024

Challenges and opportunities

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MEA Hydrogen Projects 2024 Report

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Middle East & Africa Hydrogen Projects 2024 Report includes:

- Understand each of the 50-plus green and blue hydrogen projects across the Middle East and Africa
- A detailed and comprehensive description of each hydrogen plus future phasing, timelines and spending plans when known
- Details of known project components such as ammonia plants, air separation units and export facilities
- Identification of the key stakeholders and decision makers at each hydrogen project
- Details on how companies can register and prequalify for each project

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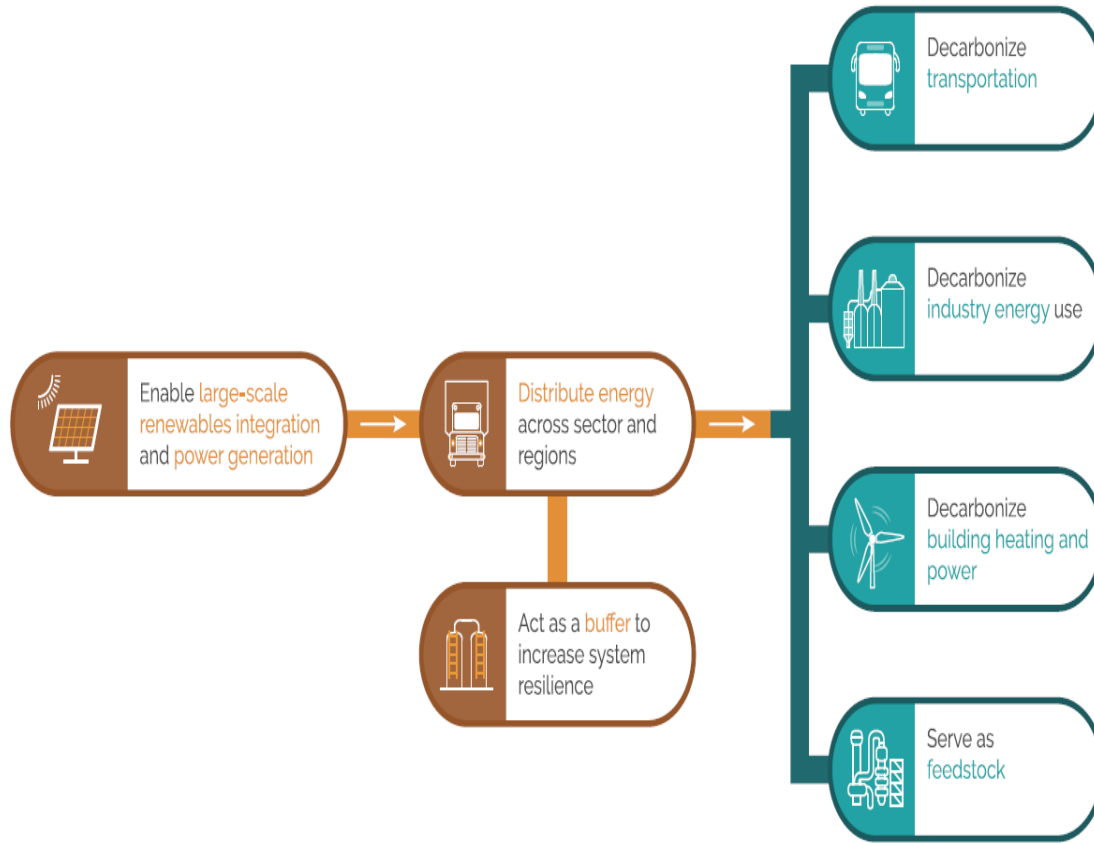
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Applications

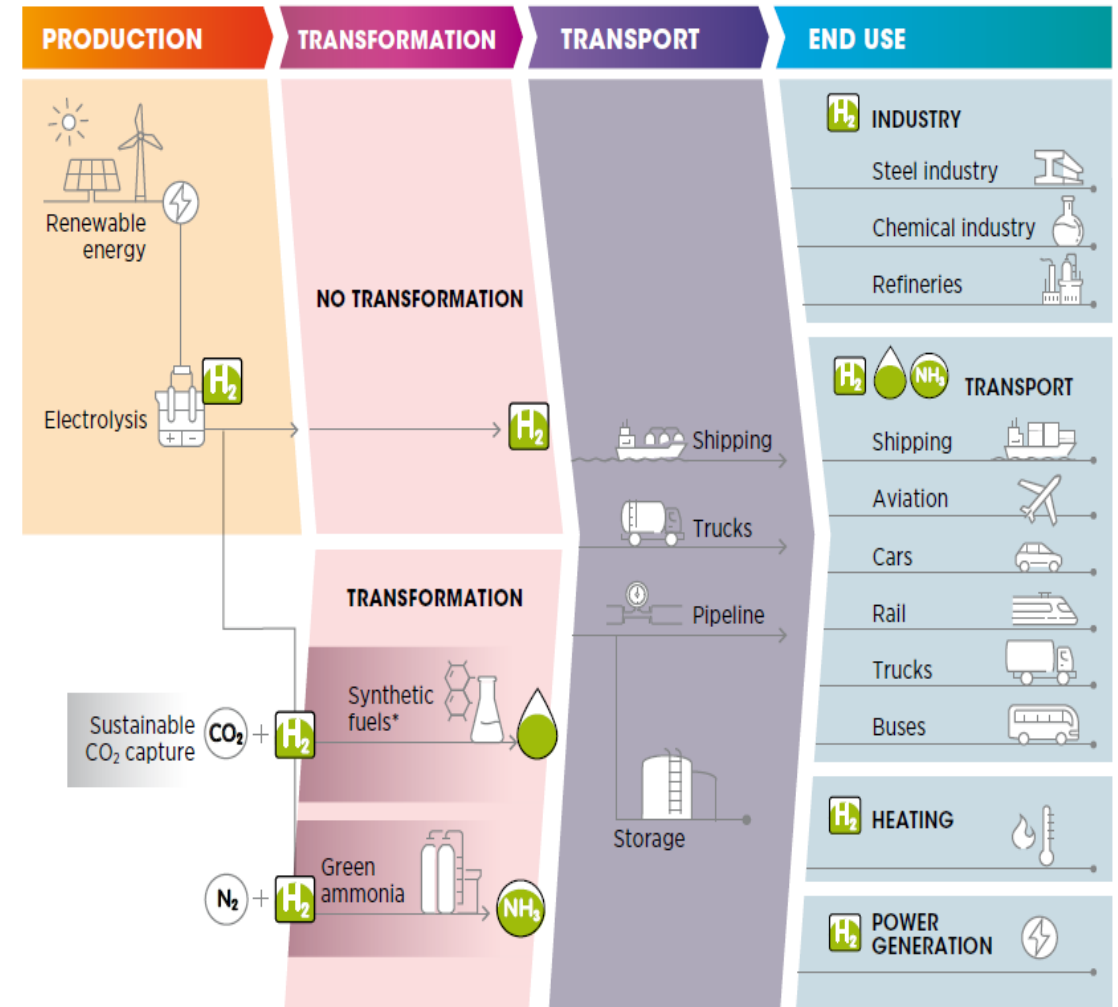
Green hydrogen is seen as a partial solution in the journey towards net zero. It has multiple end uses and transportation methods and is viewed as a particularly flexible fuel source.

Hydrogen applications and decarbonisation



Enable the renewable energy system → Decarbonize end uses

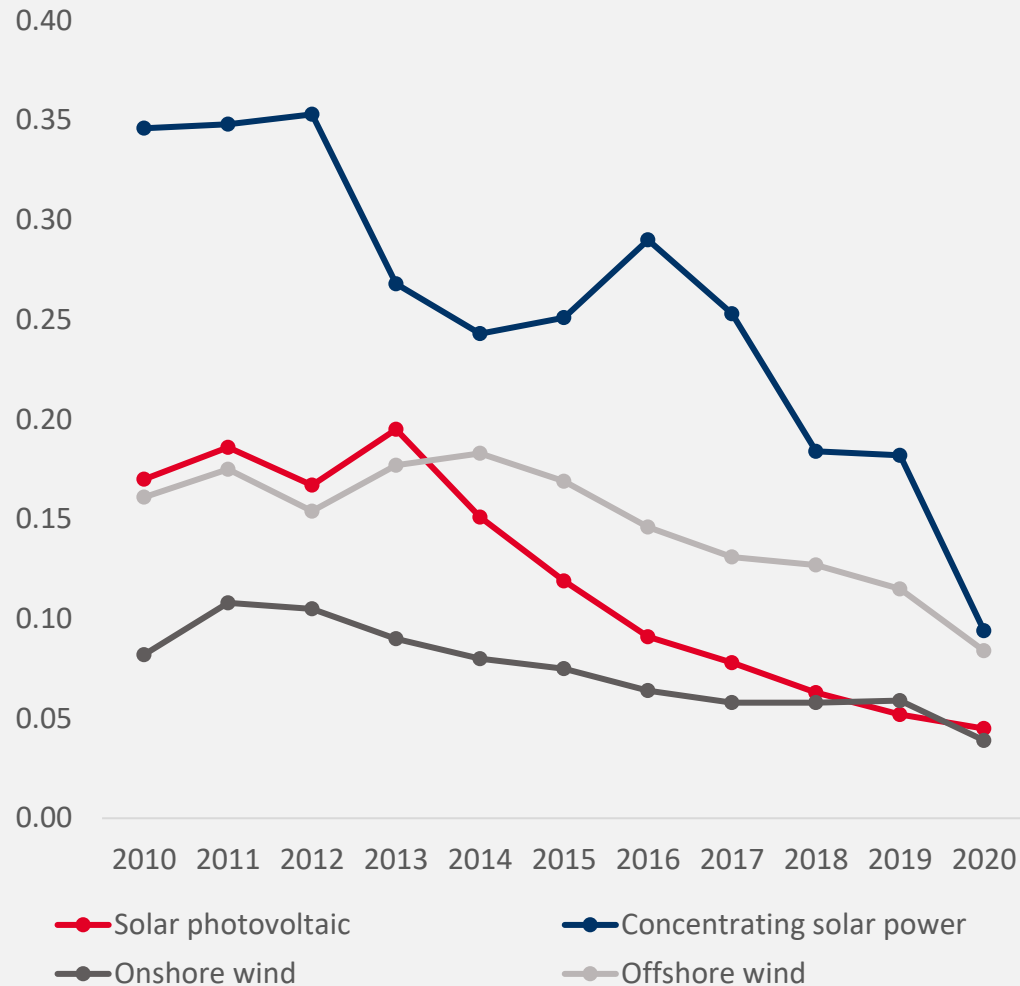
Green hydrogen production, conversion and end uses across the energy system



Why Now?

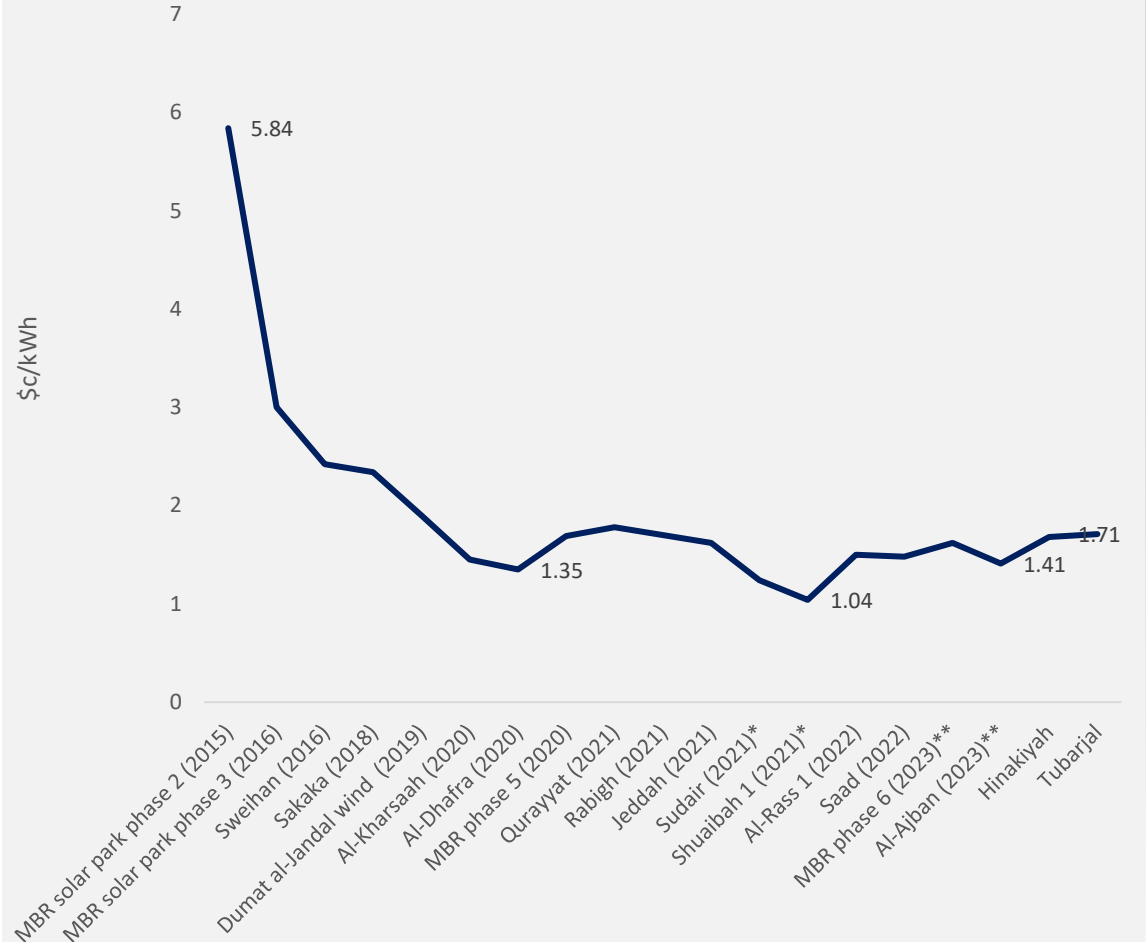
A major factor behind the acceleration in hydrogen project activity is the rapid reduction in renewable energy costs, barring the temporary disruption in 2021-2022. Solar PV costs are as low as \$0.049 a kilowatt hour, and on an IPP basis developers in the region have been offering a LCOE to offtakers as little as 0.0141 cents a kilowatt hour (3 times cheaper than the global average)

Global renewable energy costs (\$/kWh)



Source: IEA

GCC solar photovoltaic IPP tariffs, Low bid – LCOE (\$cents/kWh)

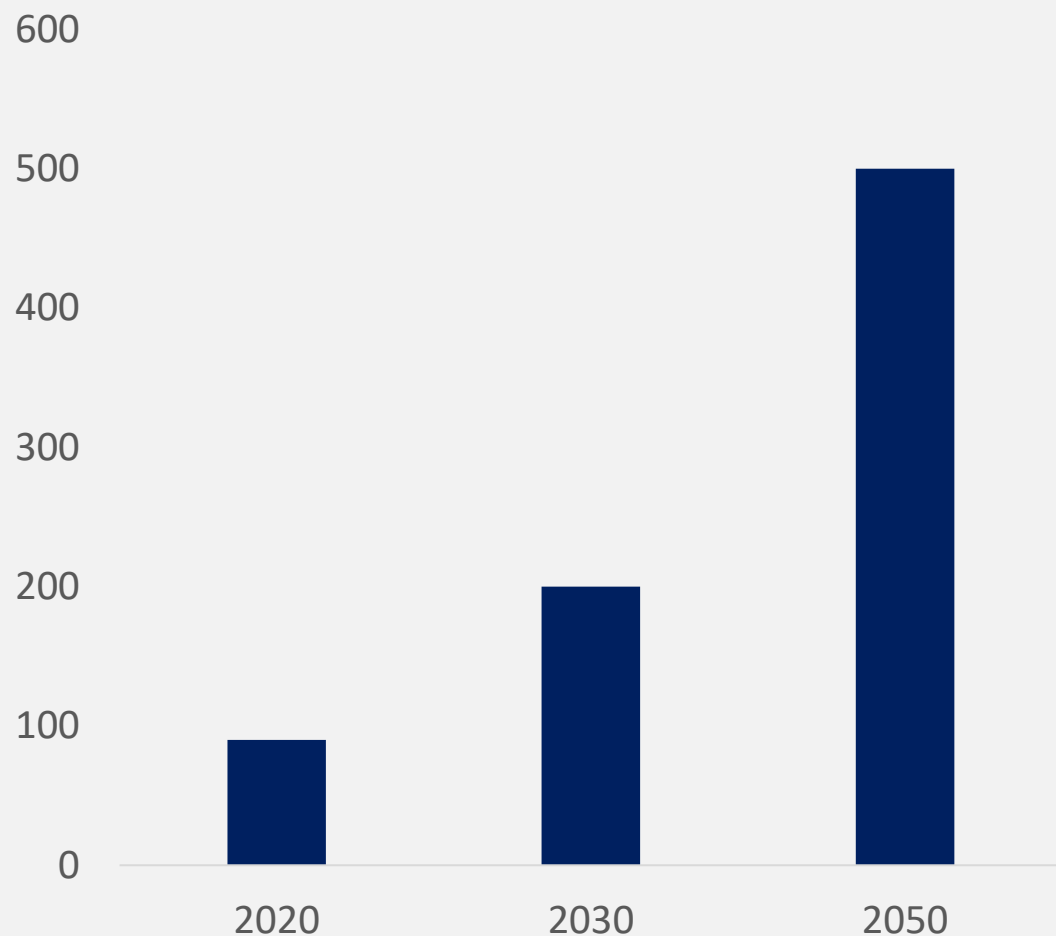


Source: MEED

Why Now?

Thanks to a combination of factors such as net zero targets, diversity and security of supply, and increasing gas prices, growth for hydrogen is expected to increase dramatically. As more production comes onstream and technology improves, the average cost of green hydrogen is forecast to decrease to about \$2 a kilo in 2030 from \$5 today

Forecast global hydrogen demand (million metric tonnes a year)

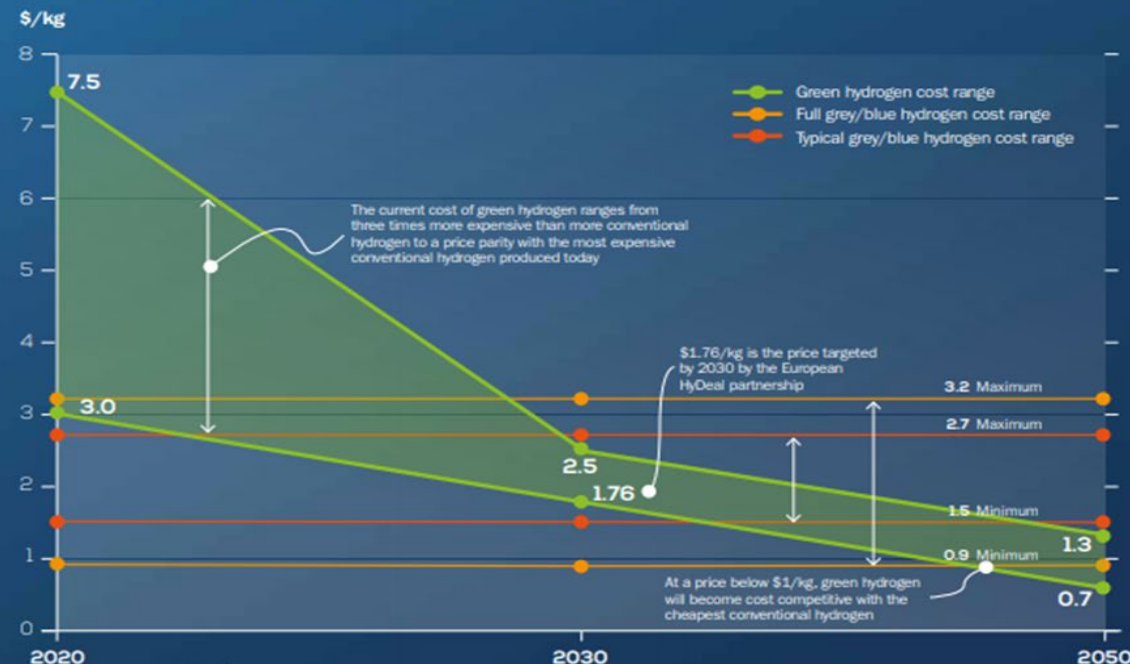


Source: IEA

GREEN DREAM

The rise of hydrogen as a post-fossil-fuel green alternative anticipates a significant decrease in the cost of its production over the next 30 years

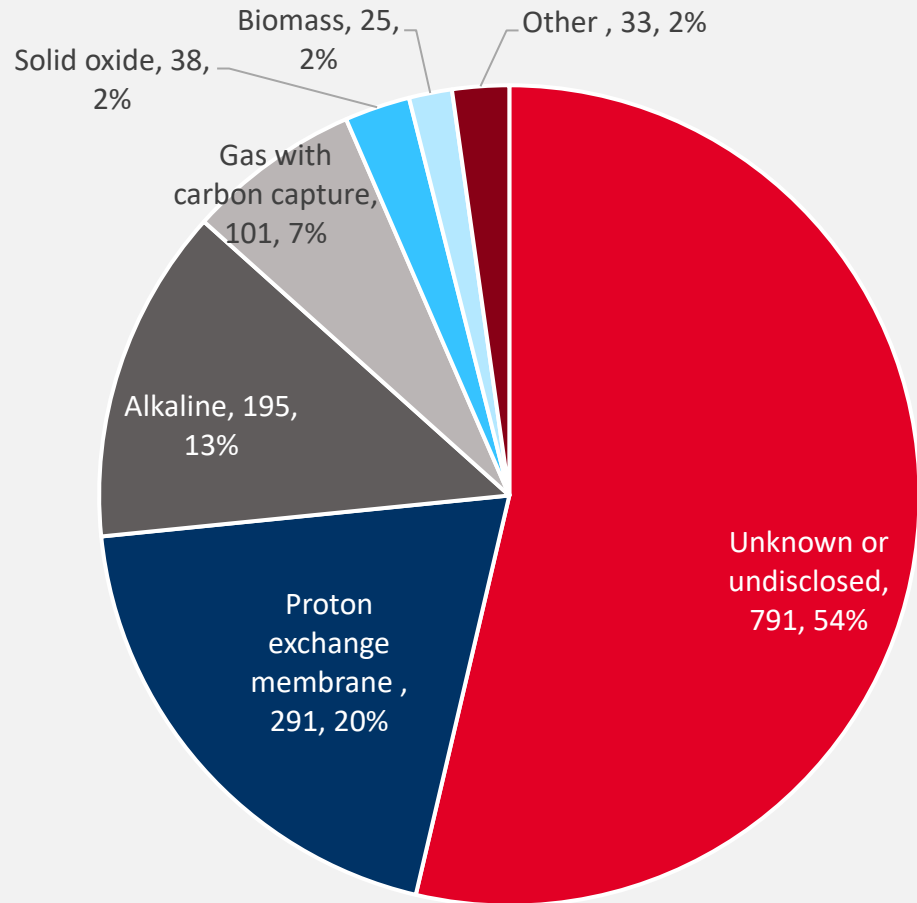
GREEN HYDROGEN PRODUCTION PRICE TRAJECTORY



Technology and Output

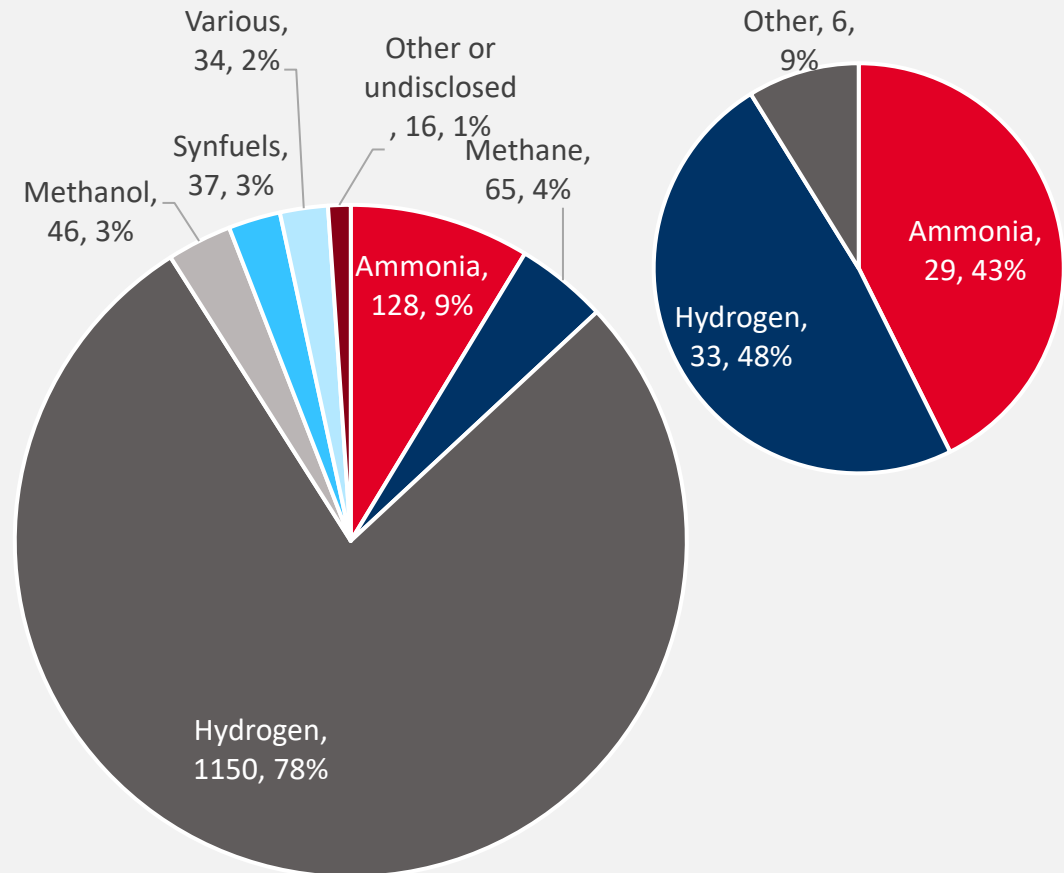
Although most currently planned hydrogen capacity is destined for export, MEA has great potential for the development of domestic demand using existing gas pipeline networks. Almost all announced projects to date will produce either hydrogen or green ammonia. There is a paucity of data, but it is likely that most MEA schemes will utilise either PEM or Alkaline electrolysis technologies

Number of planned or operational hydrogen projects by electrolysis technology



Source: MEED, GlobalData, IEA

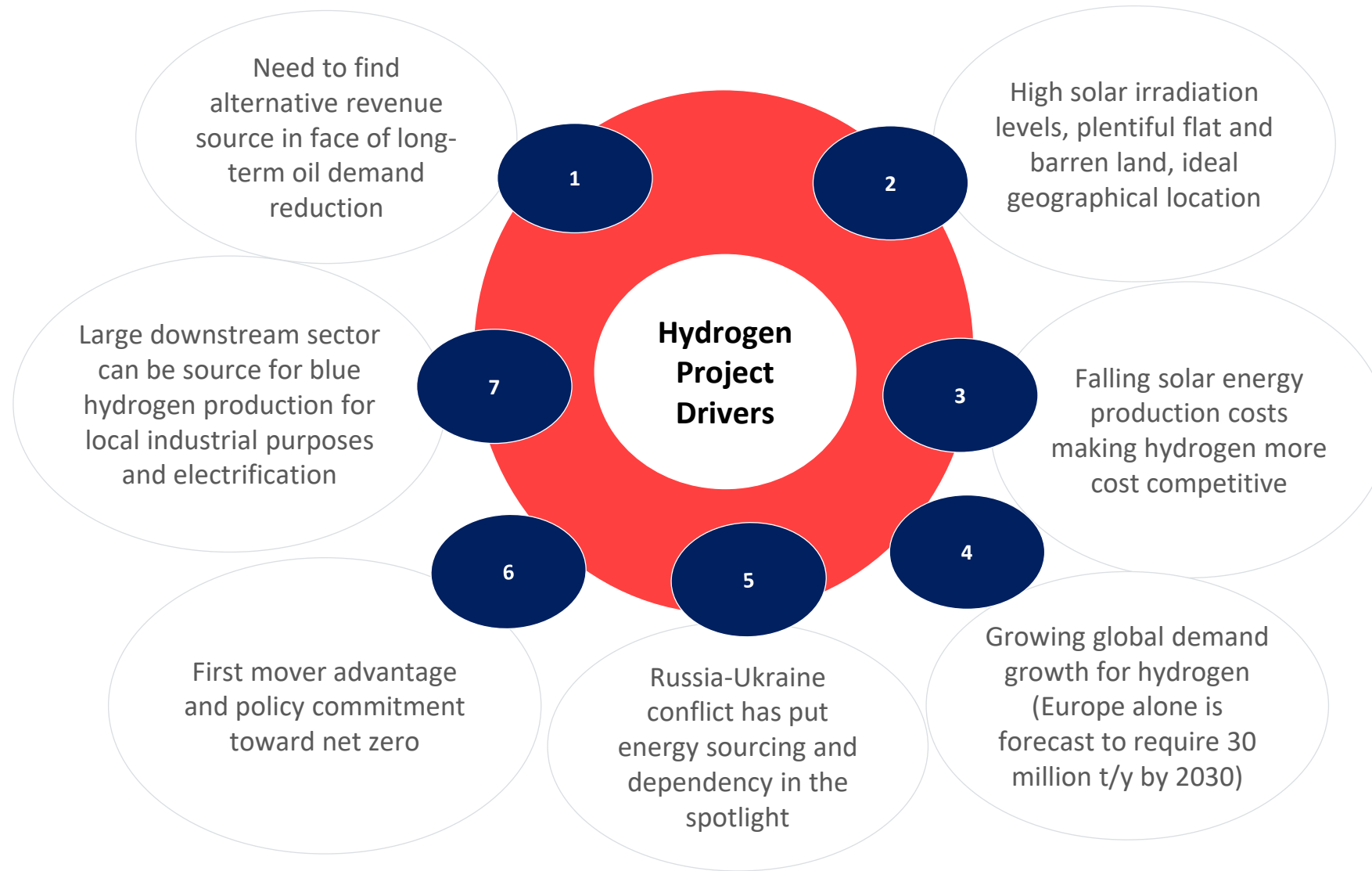
Global and MEA number of planned or operational hydrogen projects by output



Source: IEA, MEED

Market Drivers

There are multiple reasons for the sudden growth in hydrogen projects. Perhaps the biggest is the region's understanding that in the long-run, it needs to replace hydrocarbons exports with a cleaner fuel as the world undergoes energy transition. Thanks to high irradiation levels, space and location, the region is acting fast to take first mover advantage and secure offtake agreements globally, and as a consequence retain some of its position as the world's prime energy exporter.



Mena: Policies and regulations



Strategy and policy updates

Tax incentives, land and infrastructure allocation and government support are being developed to support Mena countries' hydrogen strategies

Morocco

National Hydrogen Commission (2019) ; Green hydrogen roadmap (2021); royal support (2022); multi-sectoral Green H2 Maroc (2021) domestic industries and export focus

Proximity to Europe, port infrastructure

Roadmap

- 2020-2030: hydrogen for local green ammonia production and export
- 2030-2040: production and export of green hydrogen green ammonia and synthetic fuels – hydrogen as electricity storage vector and transport fuel
- 2040-2050: global trade, use in domestic industry, residential heating and transport

Egypt

- Lowest cost of \$1.7/kg and capture 8% of global H2 market by 2050
- National Council for Green H2 (2023)
- tax exemptions ranging from 33% - 55%; dedicated funding facilities for green hydrogen projects; exemption from value-added taxes on production and essential substances

Jordan

National H2 Strategy completed but yet to be published

Abu Dhabi (DoE)

- Production, trading and supply are open to market, while storage and transportation through pipelines are likely to be natural monopoly arrangement that in due course, will be regulated like other activities in the energy sector.
- Early-stage regulation to ensure access to clean energy and water, public safety, security and other key technical standards.
- Covers the entire low-carbon hydrogen ecosystem including enabling hydrogen valleys, where different low-carbon hydrogen production technologies can be collocated to drive system-wide cost optimisation, including sharing of infrastructure and facilities.
- “Developers have option to source clean electricity from the grid or through captive RE plants

UAE H2 strategy

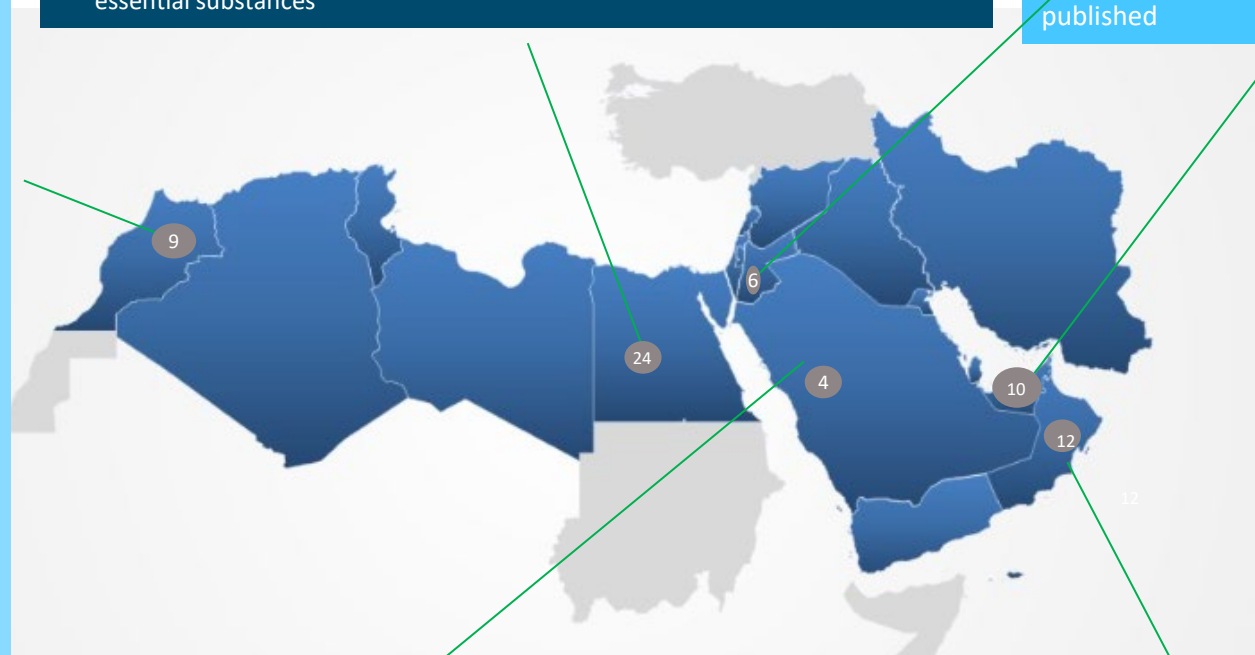
- 1.4 million tons per annum (mtpa) by 2031 (consisting of 1 mtpa of green hydrogen and 0.4 mtpa of blue hydrogen)
- 7.5 mtpa by 2040, and
- 15 mtpa by 2050
- local demand of low-carbon hydrogen to reach 2.7 mtpa by 2031

Saudi Arabia

- Official H2 policy under development
- Current focus: gain large market share in blue hydrogen
- Clean hydrogen production target: 2.9 MTPA by 2030,
- 12 MTPA of green H2 and 6 MTPA of blue H2 by 2035
- Clean hydrogen strategy will be contingent on CCUS development

Oman

- Net-zero by 2050 to require \$190bn (power, hydrogen, EV, pipelines infra); additional \$230bn to unlock hydrogen economy ; private sector to account for 70-80%
 - Hydrogen-based steel production (8%)
- full electrification of light vehicles and short-distance heavy vehicles and a transition to hydrogen fuel cells for long-distance heavy vehicles
 - Sustainable hydrogen costs need to fall to \$2-3kg for it to scale
 - 1-1.25MTPA 2030 green H2 production
 - 8MTPA of green hydrogen exports by 2050



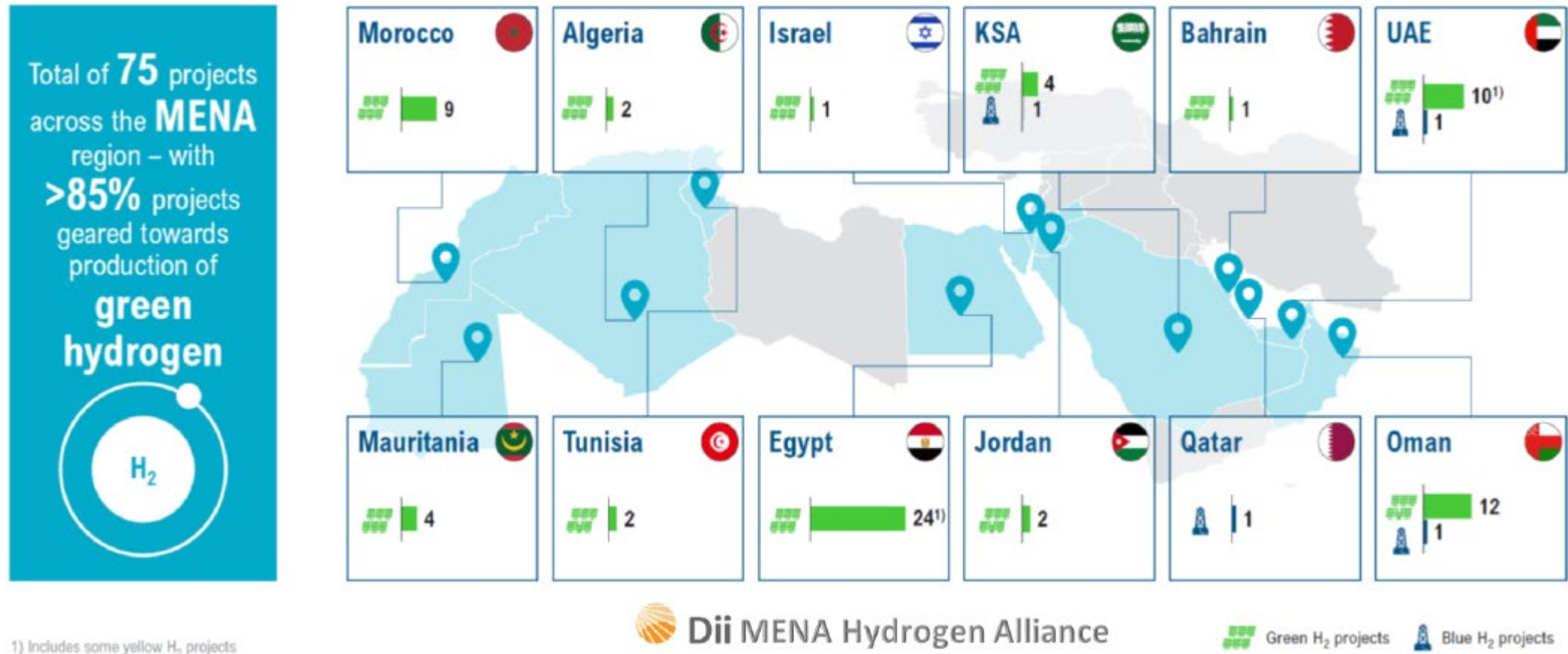
Hydrogen Projects



Mena Projects Pipeline

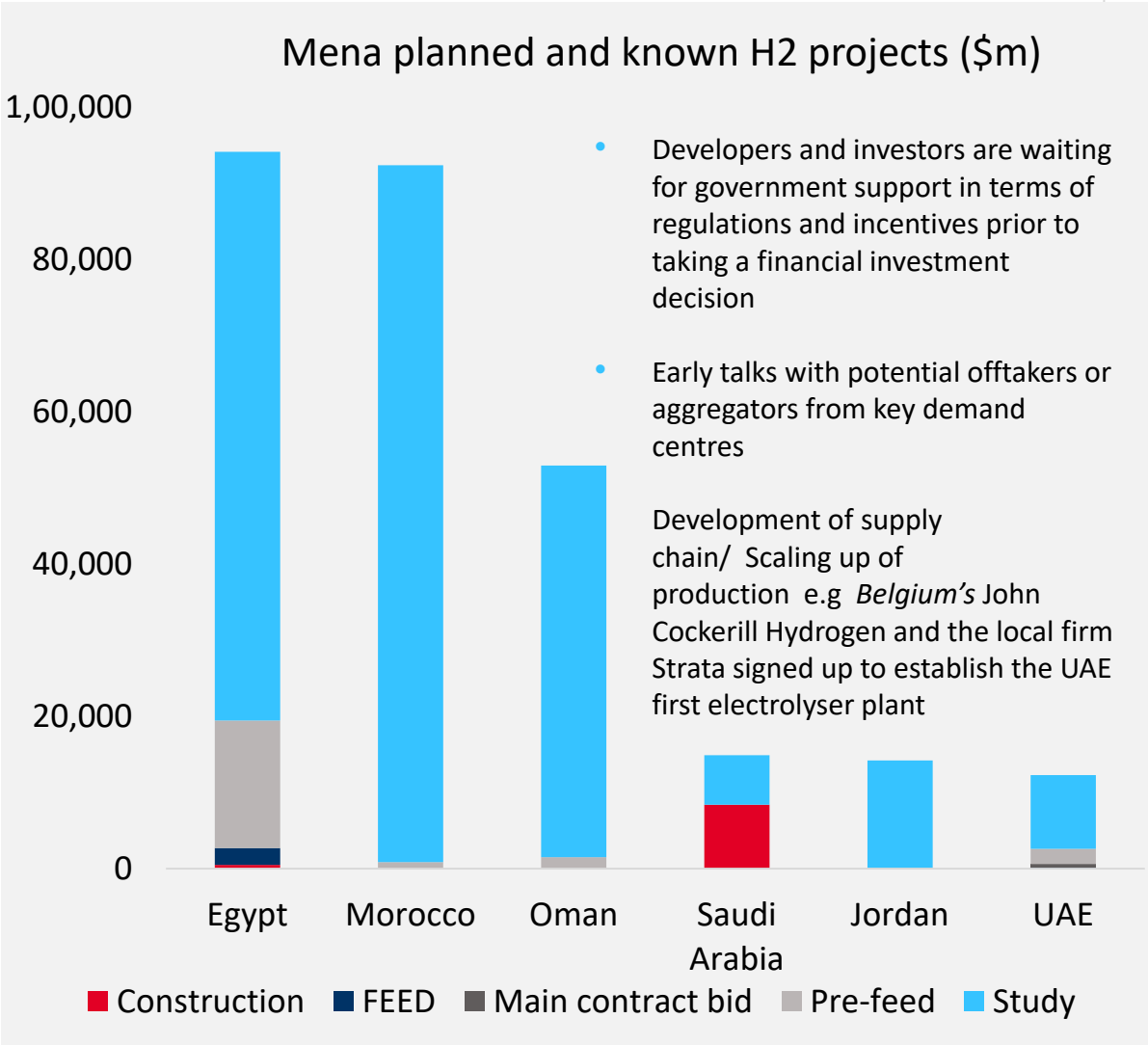
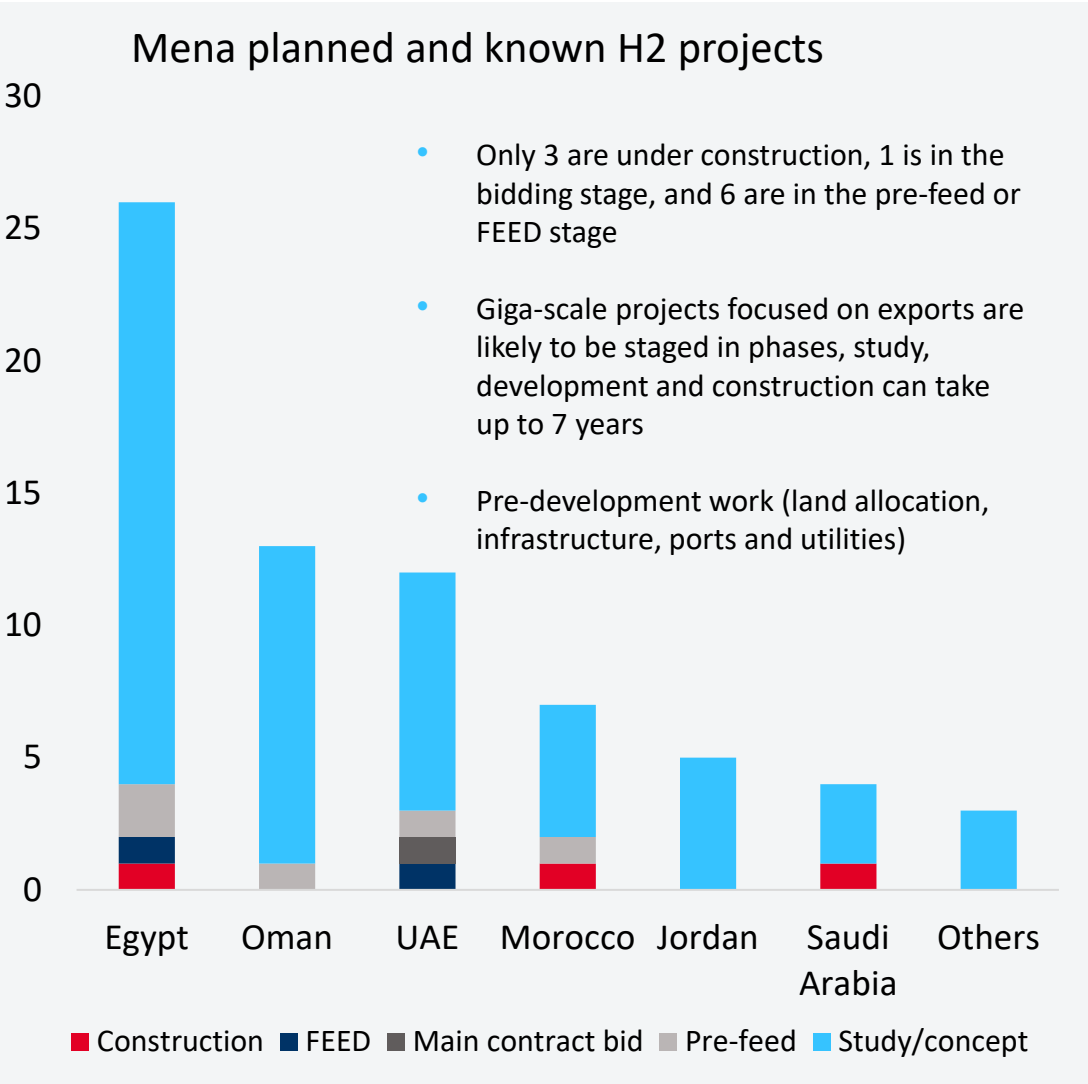
GCC states and Egypt seek to take advantage of cheap renewable energy to enhance their position as global energy exporters, while others like Morocco and Jordan seek to export clean energy and reduce imports.

Hydrogen project announcements in MENA



Mena Projects Pipeline

There are at least 70 known, planned green hydrogen projects in Mena. Estimated budgets for these projects exceed \$250bn, twice the estimates made a year earlier



www.meedprojects.com

Country and project profiles



Saudi Arabia

The world's largest green hydrogen and ammonia production plant is under construction in Saudi Arabia. Public Investment Fund (PIF) is holding discussions with partners for three potential green hydrogen projects

1) Team South Korea green hydrogen

Posco, Kepco, Korea Southern Power Company, Korea National Oil Corporation, and Samsung C&T Corporation

Potential location: Yanbu Industrial City

Cost: \$6.5bn

Construction timeline: 2025-2029

Land area: 396,694 square metres

Ammonia production capacity: 1.2 million t/y

Status: Pre-feed



2) Engie

MoU signed in July 2023

Status: Study

3) Marubeni Corporation

The green hydrogen-based derivatives and products being explored by both parties may now include green ammonia, sustainable aviation fuel and green steel

Status: Study

Saudi Arabia: Neom green hydrogen

Overview

Located on a 300 sq km land on Neom's Oxagon industrial complex, the integrated facility will produce hydrogen to be synthesised into carbon-free ammonia for export exclusively by Air Products to global markets.

It comprises 2,000MW of electrolyzers to produce 650 tonnes of hydrogen a day and air separation units to produce nitrogen for the conversion of hydrogen into 1.2 million tonnes of ammonia a year.

Neom Green Hydrogen Company (NGHC), the joint venture implementing the project, is equally owned by Neom, Saudi utility developer Acwa Power and Air Products.



Stakeholders

Neom Green Hydrogen Company (NGHC), the joint venture implementing the project, is equally owned by Neom, Saudi utility developer Acwa Power and Air Products.

Main EPC: Air Products
Sub-EPC (RE): L&T

Electrolyzers:
Thyssenkrupp (20MW alkaline water electrolysis modules)

Air Products is the exclusive offtaker for the green ammonia produced at the facility for over 30 years.

Status

NGHC reached financial close on the project in May 2023

Construction is under way, with the first wind turbines for the renewable energy plant delivered in November 2023

Capex recently increased to \$8.4bn from \$6.4bn

Project	Neom Green Hydrogen Company
Country	Saudi Arabia
Location	Oxagon, Neom
Client/Project Company	Neom Green Hydrogen Company
Estimated cost (Budget)	\$8.4bn
Hydrogen capacity	650 tonnes a day
Ammonia capacity	1,200,000 t/y
Electrolyser capacity	2,000MW
Renewable energy capacity	4,300 (MW) + 400MW Bess
Project sponsors	Air Products, NEOM, ACWA Power
Start date	-
Full completion	2026



2020

2023

2026

Project was announced

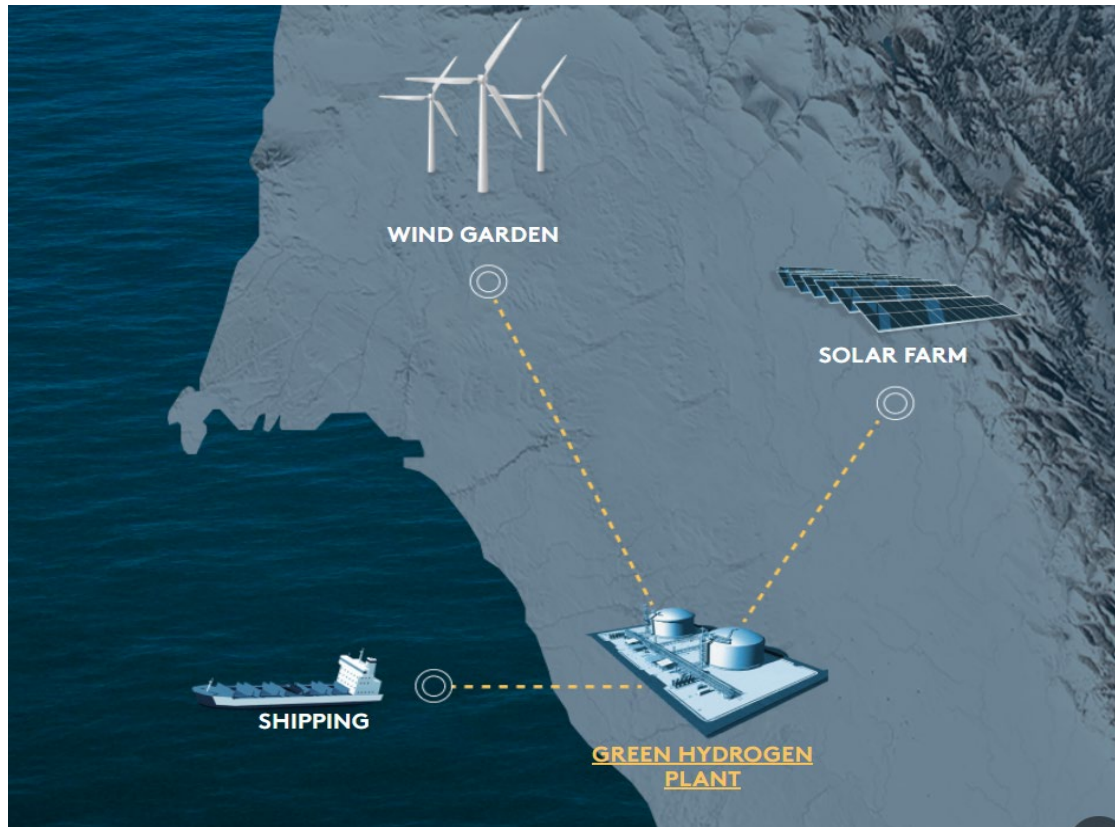
Project reaches financial close

Project completion and commissioning

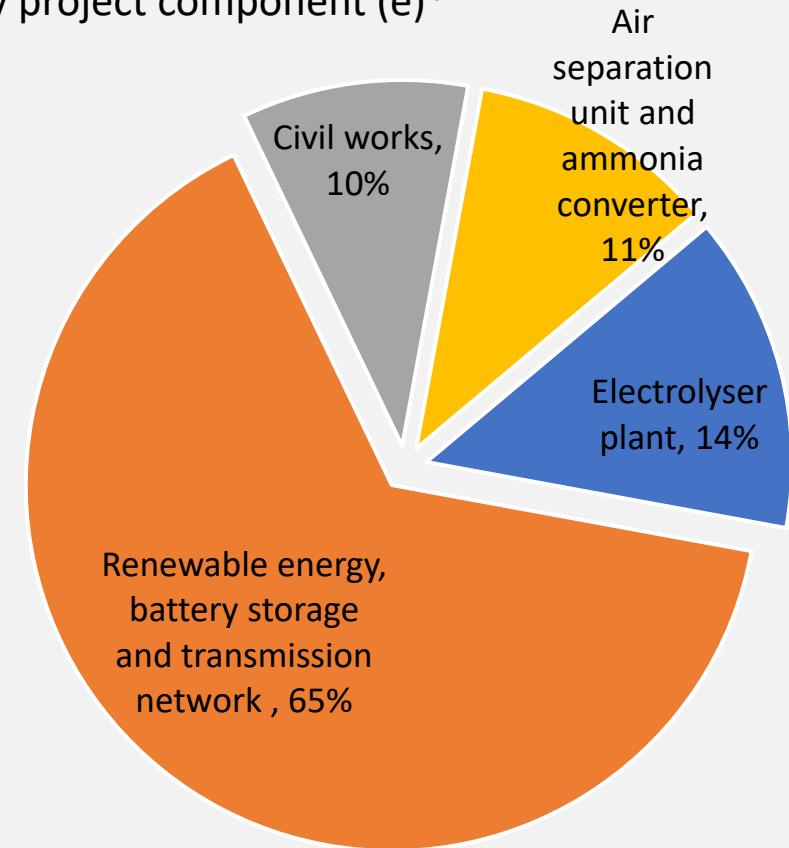
Saudi Arabia: Neom green hydrogen project

One of the most complex projects in Saudi Arabia ever to be financed. The project cost increased from an initial \$6.5bn to \$8.4bn

The total financing consists of \$5.85bn of senior debt and \$475m of mezzanine debt facilities.



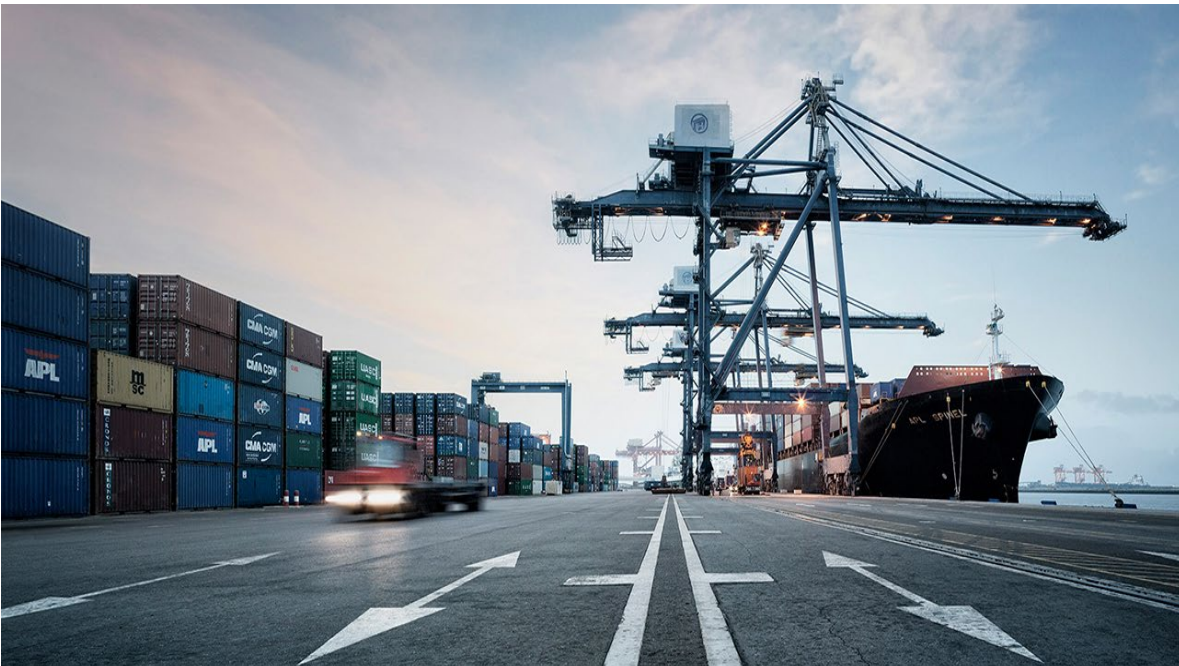
% cost by project component (e)*



- NGHC is providing guidance and learnings in terms of project structuring, offtake terms and O&M
- The upward capital revision accounted for project financing costs, upfront fees, interest during construction, additional joint venture costs and land

Oman aims to produce 1.0 to 1.25 million tonnes of green hydrogen by 2030 : strong renewable resources, relatively stable economy and politics, and attractive free zones for investors

- Hydrom: fully owned by Energy Development Oman and regulated by the Ministry of Energy & Minerals
- Develop the green H2 sector in Oman
- Delineate & allocate (auction) government-owned lands for green H2 projects
- Structure/projects manage the auction process
- Coordinate the common infrastructure and facilitate development of connected ecosystem industries
- Oversee projects execution
- Managing data repository



Source: Hydrom

- Hydrom / OQ Gas Networks: collaboration in green hydrogen pipeline development
- Energy Development Oman and Siemens Energy: collaboration in hydrogen technology, innovation and expertise exchange
- Hydrom will provide developers with desalinated water and hydrogen pipelines as part of the agreements, in exchange for a stake in the projects that could range between 5%- 20%

Oman: Hydrom

Hydrom awarded land concession agreements for H2 projects in June, where FIDs can take up to 2 – 3 years. Consortiums that have won concession licences have up to 7 years to develop the assets. Hydrom has also designated several “legacy projects”

Legacy projects (March 2023)

Project	Developer/s	Renewable capacity (MW)	Green hydrogen capacity (t/y)
Dhofar green hydrogen project	BP Alternative Energy Investment	1,700	80,000
Duqm green hydrogen project	BP Alternative Energy Investment	1,600	70,000
Green Energy Oman	InterContinental Energy, OQ, Shell, EnerTech Holding Company	25,000	9,900,000
SalalaH2	OQ, Linde, Marubeni, Dutco	400 (electrolysis)	
Hyport Duqm	Deme Group, OQ	2000 (1000 Electrolysis)	
Green Hydrogen and Chemicals	Acme Group	1,000	38,000

Land concession agreements (June 2023)

Consortium	Members	Land area (sq km)	Estimated investment (\$m)	Renewable energy capacity (MW)	Electrolysis (MW)	Hydrogen capacity (t/y)	Ammonia capacity (t/y)
Amnah	Copenhagen Infrastructure Partners (Denmark) / Blue Power Partners (Denmark) / Al-Khadra (Bahwan Group/local)	320	6,000	4,500	tbc	215,000	tbc
South Korea and France	Posco (South Korea) / Engie (France) / Samsung Engineering (South Korea)/ Korea Southern Power / Korea East-West Power / PTTEP (Thailand)	340	6,700	5,000	tbc	220,000	1,200,000
Hyport Coordination Company	Deme Group (Belgium) / OQ Alternative Energy (local)	0.793	tbc	1,300	500	50,000 (first phase)	tbc

Sources: MEED, Hydrom, other secondary sources

Green Energy Oman– >\$28bn

Overview

25GW solar and wind energy capacity
Estimated to be \$28bn
14GW electrolyser capacity
Transforming this renewable energy through electrolysis to produce >1.8m tons of green hydrogen per annum
Production, storage and export of ammonia of up to 10m tons annually
Resource:
9m/s wind speed
2,000 kWh/m2 solar irradiation

Stakeholders

OQ – Oman’s integrated energy company
ICE - Hong Kong based green fuels developer
Enertech – Kuwait government-backed clean energy investor and developer
Shell – UK-based oil & gas company

Status

Energy Yield Assessment by DNV across Al Wusta. The study spans 2 years of data monitoring.
Feasibility study by Worley Group to optimize generation, transfer and transformation through electrolysis into hydrogen and production, storage and export of ammonia
Environmental & Social Impact Assessment by HMR
Prequalification of EPC contractors expected to start in 2025

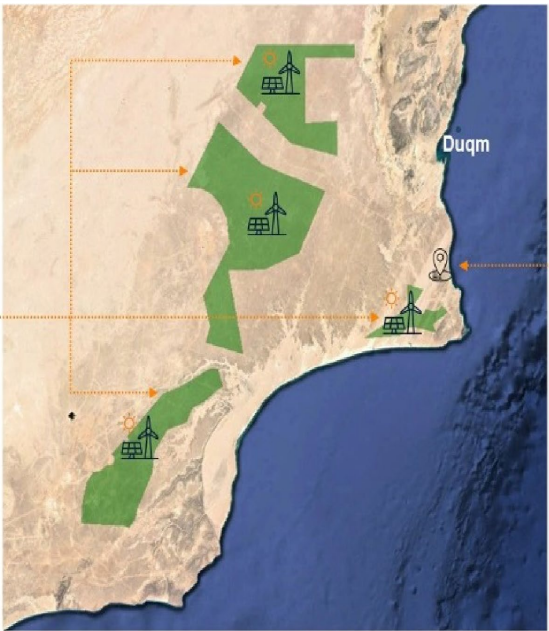


Key facts

Project	Green Energy Oman
Country	Oman
Location	Duqm
Client/Project Company	Green Energy Oman
Estimated cost	>\$28bn
Hydrogen capacity	1.8 million t/y (all phases)
Ammonia capacity	9.9 million t/y (all phases)
Electrolyser capacity	14GW
Renewable energy capacity	14GW wind, 10GW solar
Project sponsors	OQ, Intercontinental Energy, EnerTech, Shell
Start date	2026
Full completion	2038

GEO Study Area

Upstream Wind & Solar Power Generation



Downstream Processing & Export



2021	2025	2028	2032	2038
Announcement date	Financial investment decision for Phase 1 (8,000MW)	First production from the planned facility	Final phase	Full capacity

Egypt has the largest green hydrogen and ammonia production pipeline, the majority of which were announced around or after the Cop27 climate summit. The majority of these projects are in the concept or design stage

Project	Investment (\$m)	Status	Electrolyser capacity (MW)	Renewable capacity (MW)	Green hydrogen (t/y)	Ammonia (t/y)	Stakeholders and partners
Acme Group green H2 hub	13,000	Study					Acme Group
Globeleq SCZone hydrogen plant 4	11,000	Study					Globeleq Company
Masdar - Hassan Allam SC Zone green H2	10,000	Study	4,000		480,000		Masdar, Hassan Allam
RenewPower SCZone green H2 project	8,000	Study			220,000		Renew Power, Elsewedy Electric
Ra - East Port Said H2 project	10,000	Pre-feed		6,300		2,000,000	Siemens Energy, DAI Infrastruktur
China Energy green hydrogen project	6,750	Pre-feed					China Energy
Scatec Suez green ammonia project	6,000	Study					Scatec
Ras Garboub green hydrogen plant	3,500	Study	500	1,700			Deme Group, Fluxys, Gharably
Phelan green ammonia project	3,500	Study				2,500,000	Phelan Energy Group
Alfanar SCZone hydrogen plant 1	3,500	Study					Alfanar
SCZOne - EDF hydrogen and ammonia plant	3,500	Study		2,000		80,000	EDF, Zero Waste
1GW waste-to-hydrogen project	3,000	Study			300,000		SCZOne, H2Industries
Amea Suez green ammonia project	2,200	FEED	1,000	2,400		800,000	Amea Power
K&K hydrogen project	2,000	Study					K&K
Alcazar Energy hydrogen plant	2,000	Study					Alcazar Energy
Fortescue Future Industries hydrogen plant	1,900	Study					Fortescue Future Industries
Actis green H2 project	1,500	Study					Actis Group
Siemens green hydrogen plant	750	Study	100				EEHC, Siemens
Green Fuel Alliance green hydrogen & ammonia	600	Study		650		390,000	EDF Renewables, Zero Waste
Fertiglobe 100MW green hydrogen plant	500	Construction	100	260	15,000	90,000	Fertiglobe, Scatec, SFE
Ain Sokhna green ammonia plant	450	Study				125,000	MEP, Petrofac
Scatec Damietta green methanol project	450	Study	60	160		200,000	Scatec
North Abu Qir for Agricultural Nutrients	na	Study					China Energy
Eni green hydrogen plant	na	Study					ENI, EEHC, ENGHC
Waste-to-hydrogen, biofuel and graphene at Fayoum	na	Study					Energy3 International (E3i)

Source: MEED, other secondary sources

Egypt: Ra (East Port Said) – DAI Infrastruktur

Overview

Development of a green ammonia production facility with a capacity of 2 million metric tonnes a year

Project entails 6,300MW renewable energy plants

Ammonia is intended to be sold to offtakers in Germany and Europe

Estimated to cost \$10bn

Freepan Holding signed a reported 10-year offtake agreement covering 800,000 tonnes a year (t/y) of ammonia

First green ammonia delivery to Freepan expected in 2028

Stakeholders

Germany's DAI Infrastruktur will develop the project

China Power Engineering Consulting Group to build a 2,000MW solar photovoltaic power plant that will cater to the Ra project.

Freepan Holding is one of the offtakers

DAI
Infrastruktur



SIEMENS
ENERGY

Status

The project is still in the initial stage of development

Siemens Energy will supply the electrolyzers for the project as well as auxiliary plant systems and critical equipment making up the hydrogen island of the project.

KBR to provide ammonia technology

Project	RA-East Port Said
Country	Egypt
Location	East Port Said Industrial Zone
Client/Project Company	DAI Infrastruktur (Germany)
Estimated cost (Budget)	\$10bn
Hydrogen capacity	-
Ammonia capacity	2,000,000 MTPA
Electrolyser capacity	TBC
Renewable energy capacity	-
Project sponsors	DAI Infrastruktur
Start date	-
Full completion	2028



Egypt: Deme Group Ras Gargoub hydrogen project

Overview

To be developed in three phases, the planned Ras Gargoub green hydrogen production facility will require \$3bn in investment on its first phase.

This involves the construction of a solar PV plant with a capacity of 800MW and wind farm with a capacity of 700MW.

The low-carbon fuel derived from the plant will be shipped to the Port of Antwerp-Bruges, where it will be used as feedstock for the chemicals industry.

Belgium's Deme Group, Fluxys, the Port of Antwerp-Bruges and Egypt's Gharably Integrated Engineering Company are the main proponents of the project

The consortium s

Stakeholders

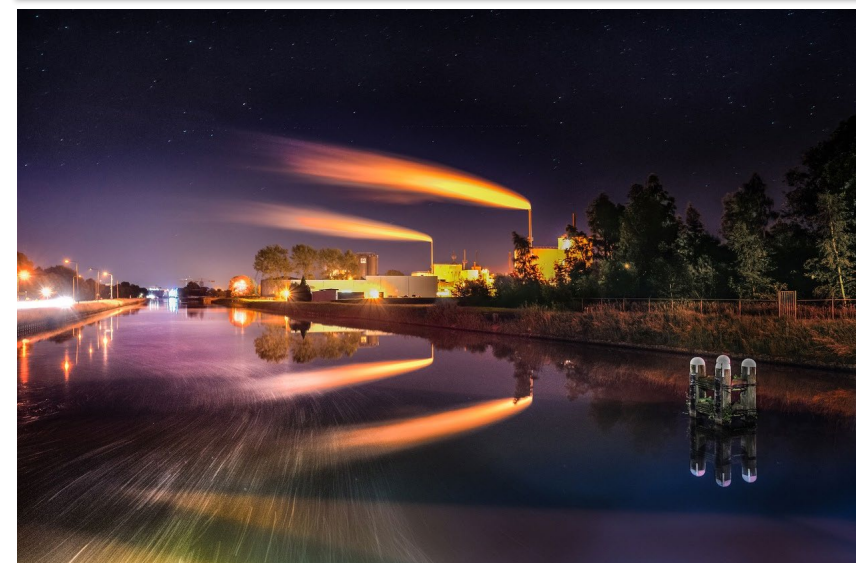


The project is still in the initial stage of development

The results of the initial feasibility study was submitted by the contracted consultant, Germany's Roland Berger, to the Egyptian government in 2021

Status

Project	Ras Gargoub hydrogen project
Country	Egypt
Location	Gargoub Port, Marsa Matrouh
Client/Project Company	Deme Group
Estimated cost (Budget)	\$3bn
Hydrogen capacity	-
Ammonia capacity	-
Electrolyser capacity	500MW
Renewable energy capacity	1,700MW
Project sponsors	Deme Group, Fluxys, the Port of Antwerp-Bruges and Egypt's Gharably Integrated Engineering Company (Gieco)
Start date	-
Full completion	-



Challenges

1 Only 3 projects have reached the construction stage, 1 in the bidding stage and several others are in the pre-feed or FEED stage. **Feasibility studies and development works will take some time**

2 Current price still **not economically feasible**. **Regulations, policies and standards** are being developed

3 **Neom green hydrogen project** is providing insights into suitable project structure to make future projects bankable

4 **Offtake risk** is being tackled by aggregation or middlemen buying green H2 for many clients

6 Almost all announced Mena green hydrogen projects appear to be export orientated (e.g **carbon pricing** will drive fossil fuel cost in the EU); focus also on **SAF and green steel applications**

7 There has been limited impetus to utilise future output locally. Local offtake agreements will require **domestic political input** given the oil-dominated economies of the region.

5 **Technology risk** addressed by working with industry partners as well as use of proven technology such as **alkaline electrolyzers**; global electrolyser manufacturing capacity as well as individual electrolyser capacity need to scale

8 A lot of lobbying for and against green hydrogen; debate on applications outside decarbonising **hard-to-abate industries**; market and regulatory environment favour greening current grey H2 or ammonia, fertiliser and steel production



9 **Hydrogen** represents a project opportunity and companies are advised to prepare for a rush of new projects
PIF, Kezad, Hydrom, Egypt, Morocco, Jordan, others

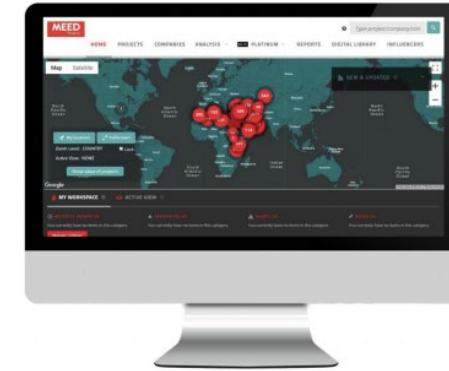
10 Key investors: TotalEnergies, BP, Shell; Acwa Power Marubeni, Engie, Posco, Emirates Steel, Jindal Shadeed, Fortescue, CIP, Actis, Amarenco, others
Chemicals and aggregators: Air Products, Linde, Uniper, Fertiglobe

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