

MEED

Middle East business intelligence

The Middle East's Drive Toward Net Zero – Projects, Strategies, and Themes

Current and future trends, challenges and opportunities

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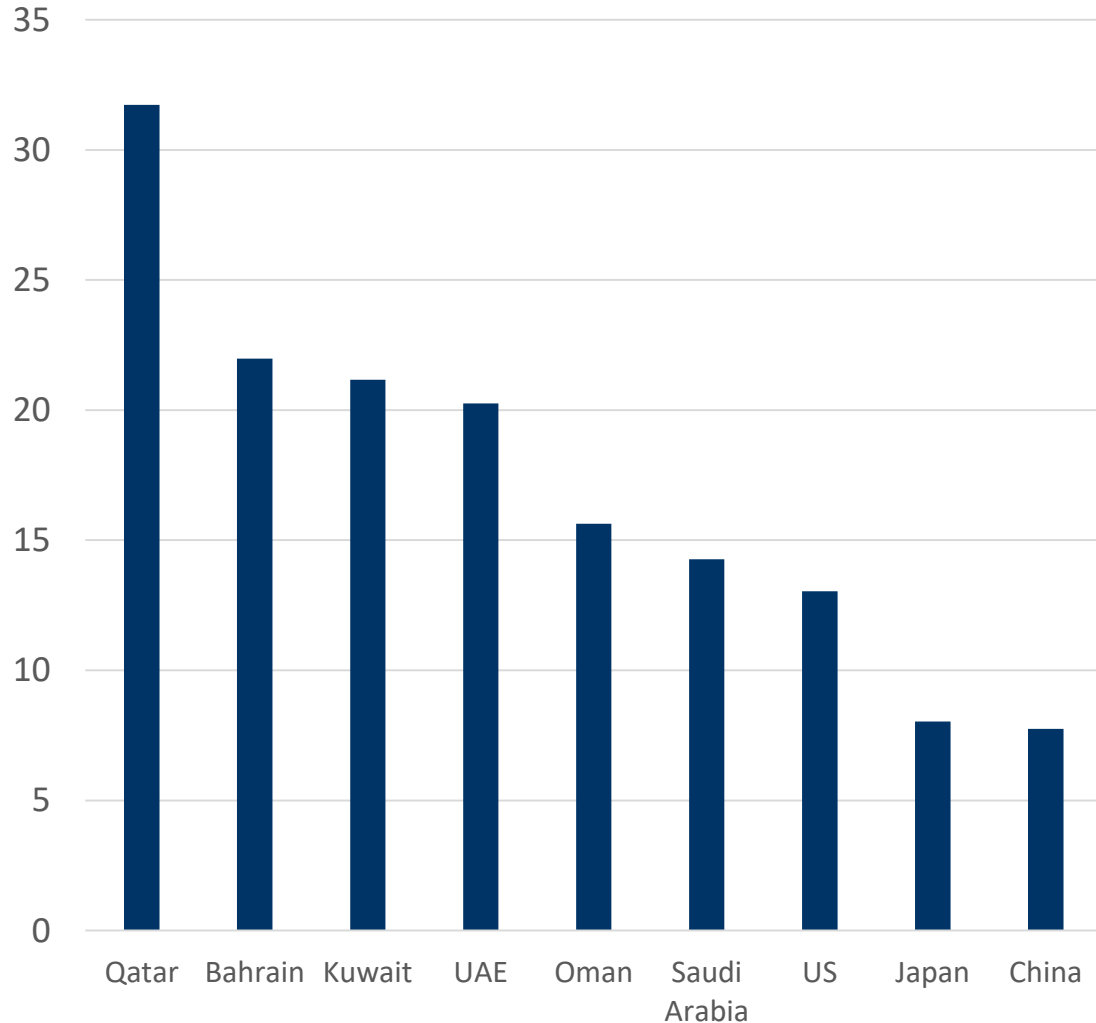
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The Challenge

On a relative scale, the MENA region has comparatively lower total emissions, but on a per capita basis is one of the highest on Earth. This excludes the emissions created from their exported hydrocarbons

Carbon dioxide emissions per capita (tonnes), 2020



Source: World Bank, MEED

WHY?

The GCC states' high carbon-intensity position today is a result of legacy issues and geographical realities:

1. Cheap power production encouraged intensive energy use
2. Desalination historically energy-intensive
3. Extreme heat requires massive power during summer for cooling
4. Heavy industries based on cheap power like aluminium, cement and steel
5. Strong economic and population growth
6. Increase oil production
7. Car culture
8. Energy-inefficient buildings
9. Environmental issues considered threat to oil revenue and therefore inaction on climate control

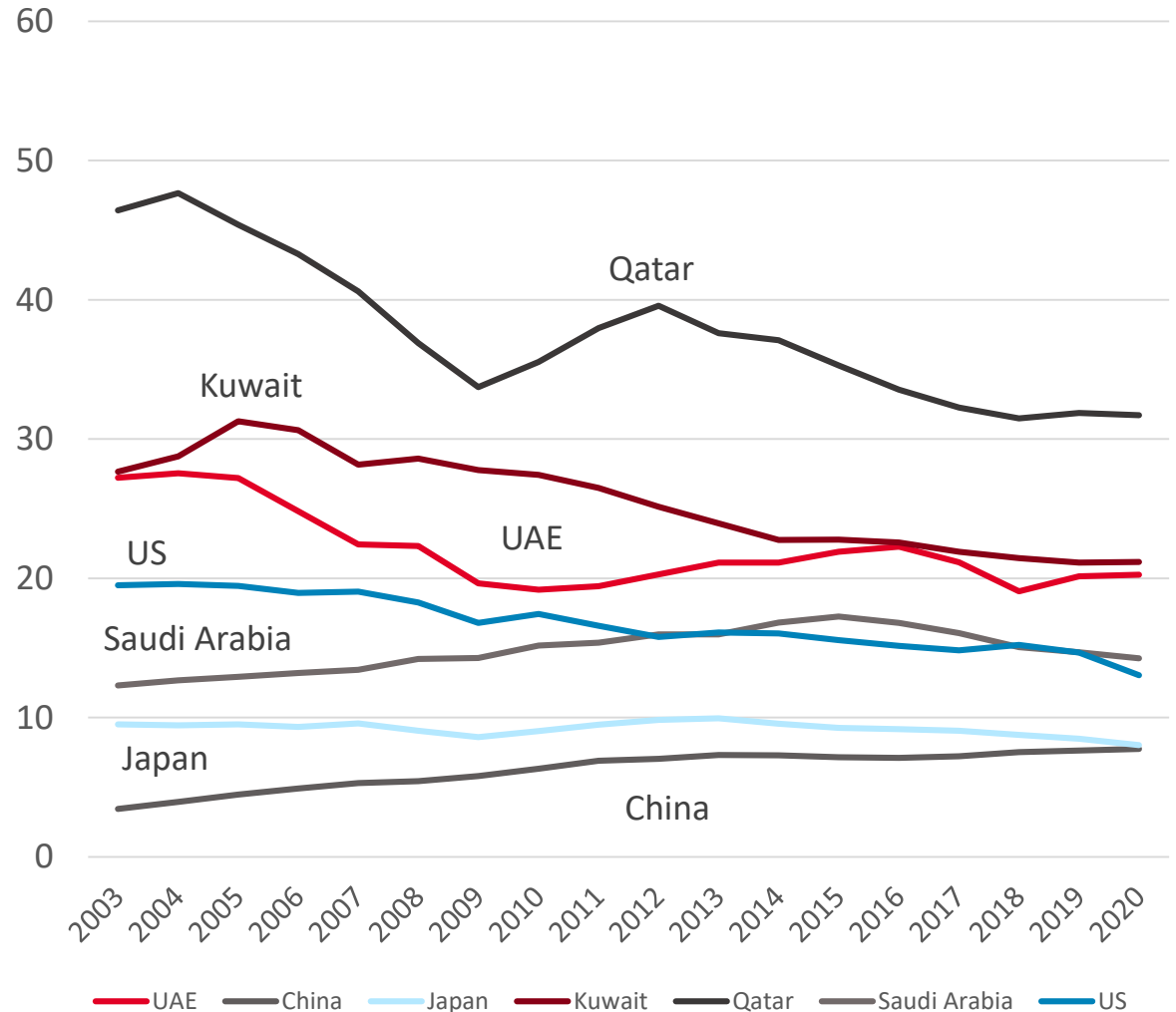
Action

Since the mid-2000s there has been a reversal in the region’s policies toward global warming. Today the GCC and North African states have all set net-zero targets and taking active roles in global climate talks culminating in the hosting of COPs 27 and 28 in Egypt and the UAE

Actions 2005-23

1. Move from oil-fired to gas-fired power production
2. Increase in electricity and tariffs and reduction in subsidies
3. Market rates for gasoline
4. Adoption of less-energy intensive RO desalination technology
5. Building codes mandating power conservation
6. Investment in public transportation
7. Development of renewable energy production
8. Policies to encourage energy conservation

Annual carbon dioxide emissions per capita (tonnes), 2003-20



Source: World Bank, MEED

What now?

The MENA region's net-zero strategies are now focused on a number of key areas. They are:

- The development of continued renewable energy – solar, wind and hydropower, along with associated battery storage
- Nuclear power development
- Production of green hydrogen as a means of taking control of clean energy and fuel production
- Carbon capture and storage and the deployment of blue hydrogen
- Electric vehicles

Country	Net Zero Year Target
Bahrain	2060
Egypt	None official
Iraq	None official
Kuwait	2060
Morocco	None official
Oman	2050
Qatar	None official
Saudi Arabia	2060
UAE	2050

Renewables



Renewable Facts

After a slow start, the Middle East is now fully engaged with building renewable energy production particularly in solar energy as costs come down

Middle East and North Africa renewable energy installed capacity (MW, 2021-2022)

Country	Renewable energy capacity	Hydropower (renewables)	Solar/CSP/Wind/Biopower	Total installed capacity	Total renewable as % of overall installed capacity	Non-hydropower renewable as % of overall installed capacity	Target RE as % of electricity production energy mix
Algeria	686	228	458	25,161	2.7%	1.8%	27% by 2030
Bahrain	12	-	12	8,774	0.1%	0.1%	10% by 2035
Egypt	6,226	2,832	3,394	60,119	10.4%	5.6%	42% by 2030
Iran	11,929	11,152	777	86,178	13.8%	0.9%	10% by 2035*
Iraq	1,594	1,557	37	30,138	5.3%	0.1%	12% by 2030
Jordan	2,371	16	2,355	6,606	35.9%	35.6%	25% by 2030
Kuwait	105	-	105	20,258	0.5%	0.5%	30% by 2030
Lebanon	372	282	90	3,412	10.9%	2.6%	15% by 2030
Libya	6	-	6	11,069	0.1%	0.1%	22% by 2030
Morocco	3,522	1,769	1,753	10,661	33.0%	16.4%	52% by 2030
Oman	687	-	687	12,556	5.5%	5.5%	16% by 2025
Qatar	43	-	43	10,622	0.4%	0.4%	20% by 2030
Saudi Arabia	842	-	842	80,505	1.0%	1.0%	50% by 2030
Tunisia	472	62	-	5,034	9.4%	8.1%	30% by 2030
UAE	3,472	-	3,472	37,759	9.2%	9.2%	50% by 2050
Total	32,339	17,898	14,031	408,852	7.9%		

Source: MEED *Excluding hydropower

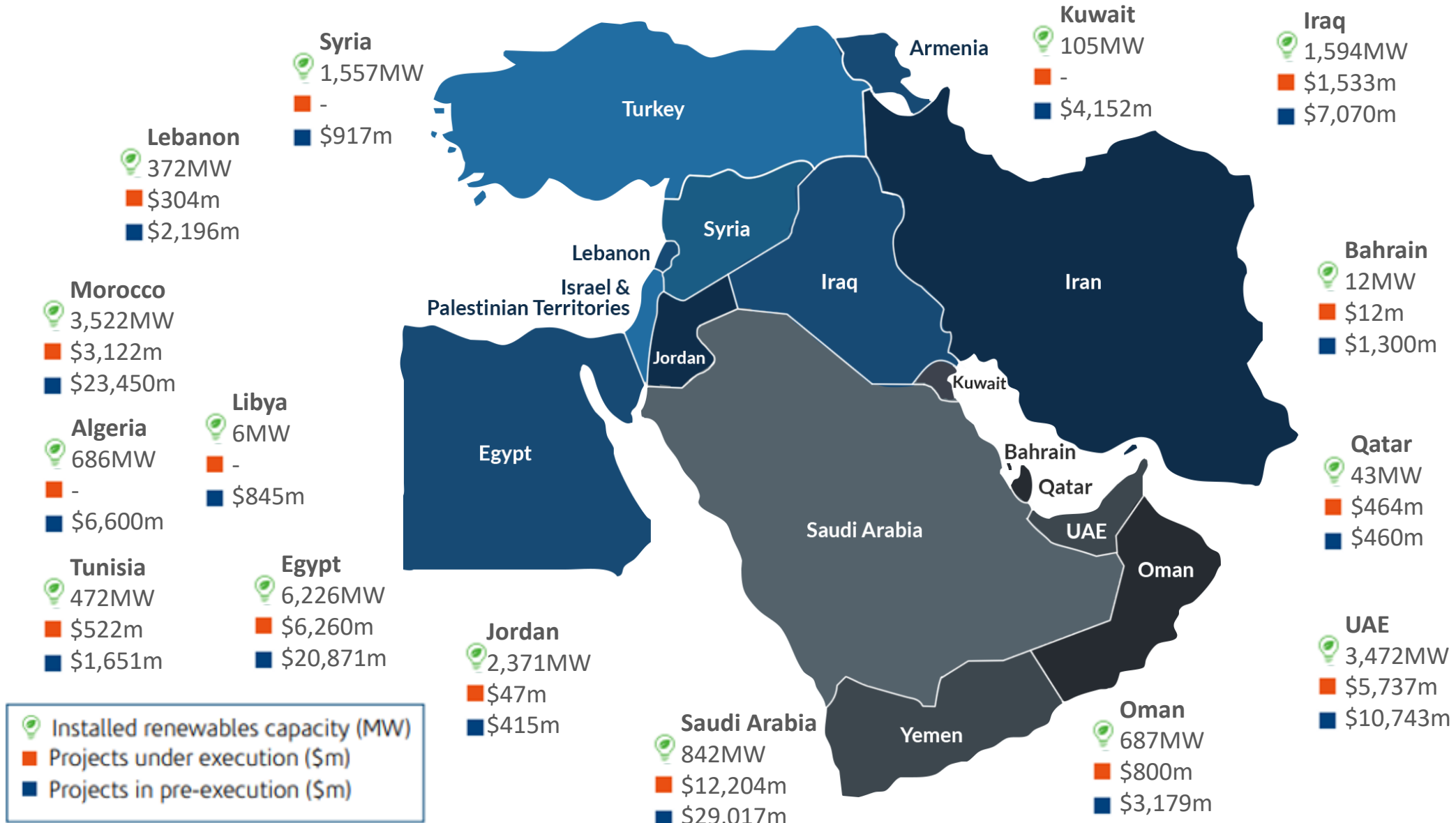
MENA Renewable Energy Projects Market – Targets

Based on ambitious renewable energy production targets as a percentage of total power generation, there must be a rapid acceleration in investment in renewable energy projects if the objectives are to be met

Renewable energy targets by country

Country	Target RE as % of electricity production energy mix	Current 2022 installed RE capacity (MW)	Implied 2030 RE installed capacity based on 2022 installed capacity (MW)
Algeria	27% by 2030	686	6,793
Bahrain	10% by 2035	12	877
Egypt	42% by 2030	6,226	25,250
Iran	10% by 2035*	11,929	10,341
Iraq	12% by 2030	1,594	7,535
Jordan	25% by 2030	2,371	1,982
Kuwait	30% by 2030	105	3,039
Lebanon	15% by 2030	372	1,021
Libya	22% by 2030	6	2,435
Morocco	52% by 2030	3,522	5,544
Oman	16% by 2025	687	3,767
Qatar	20% by 2030	43	2,124
Saudi Arabia	50% by 2030	842	40,253
Tunisia	30% by 2030	472	1,510
UAE	50% by 2050	3,472	18,880
TOTAL	-	32,339	131,351

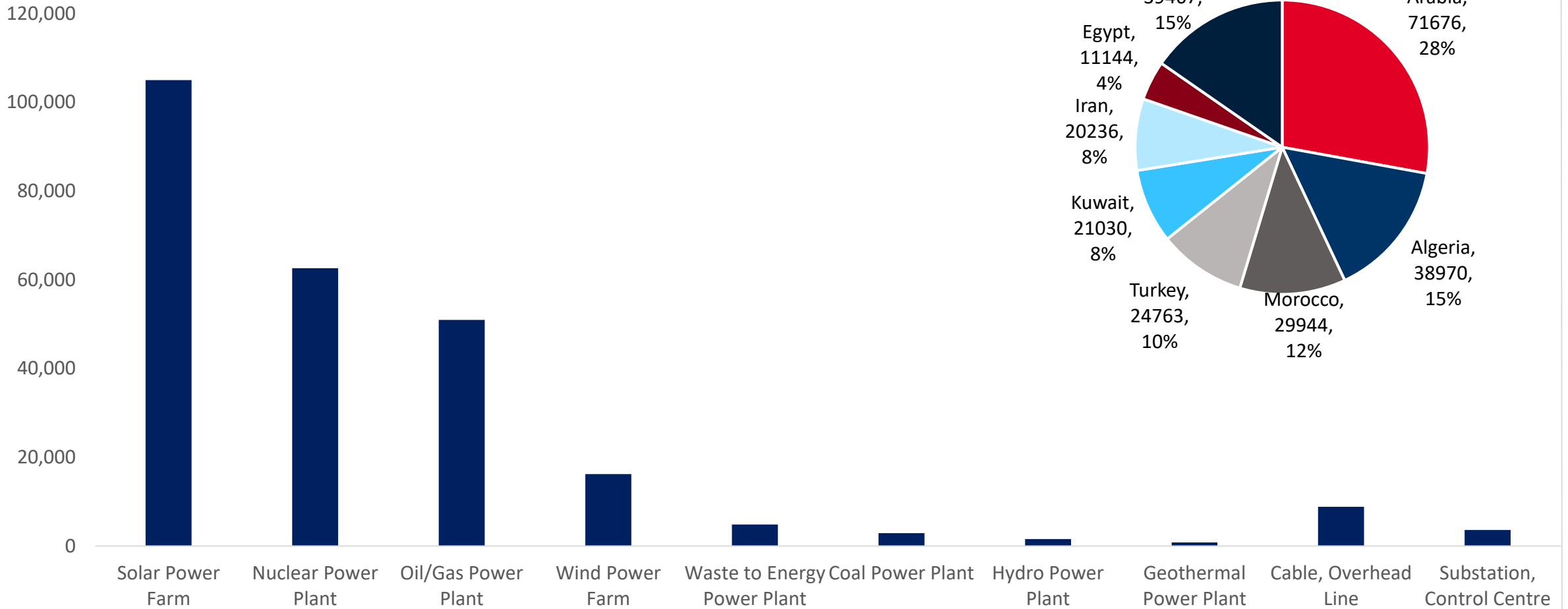
MENA Renewable Energy Planned Investment



Future Capex

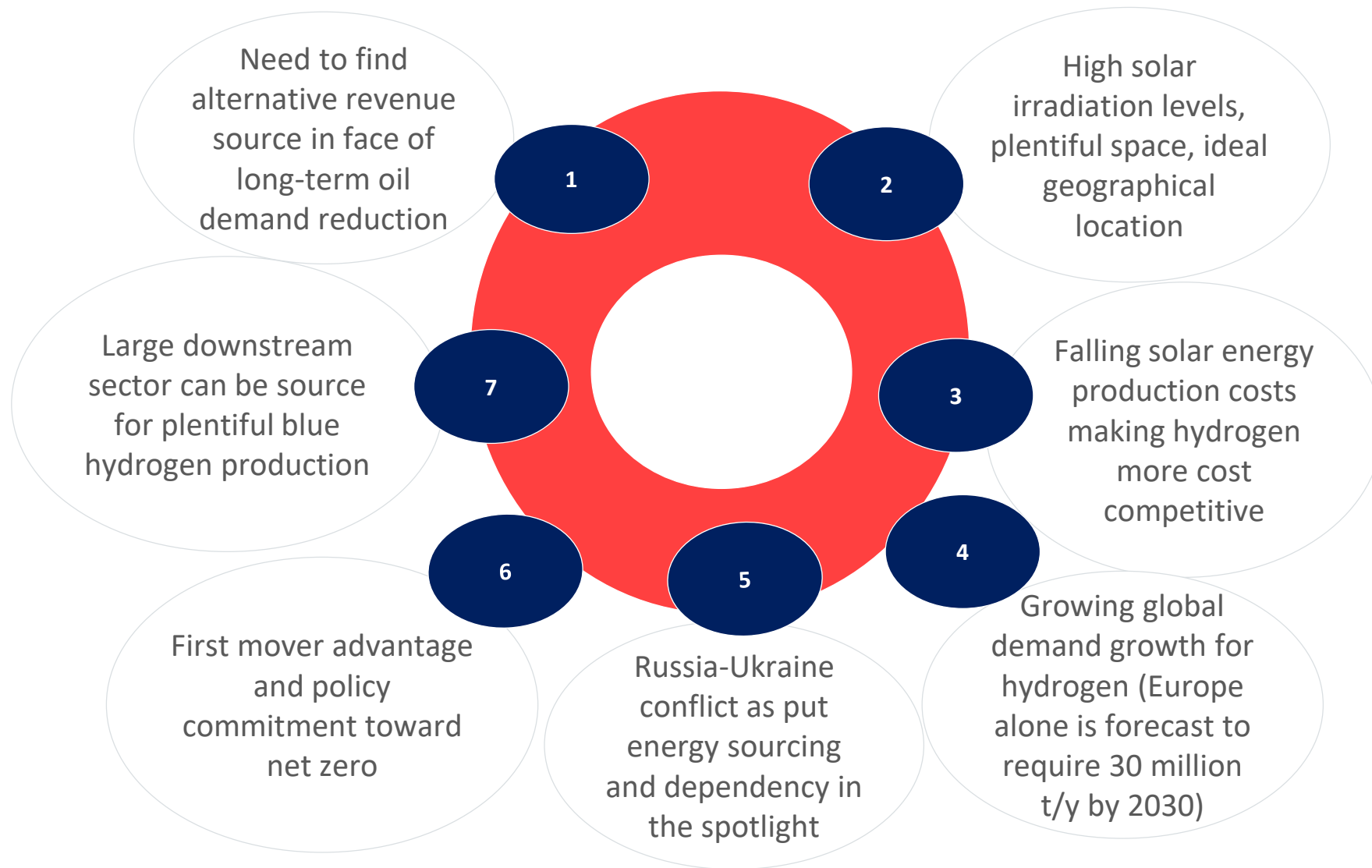
Solar power projects form the greatest single segment of future power production in the region, while Saudi Arabia is the largest known future market

Value of known planned and unawarded power sector (\$m)



Hydrogen

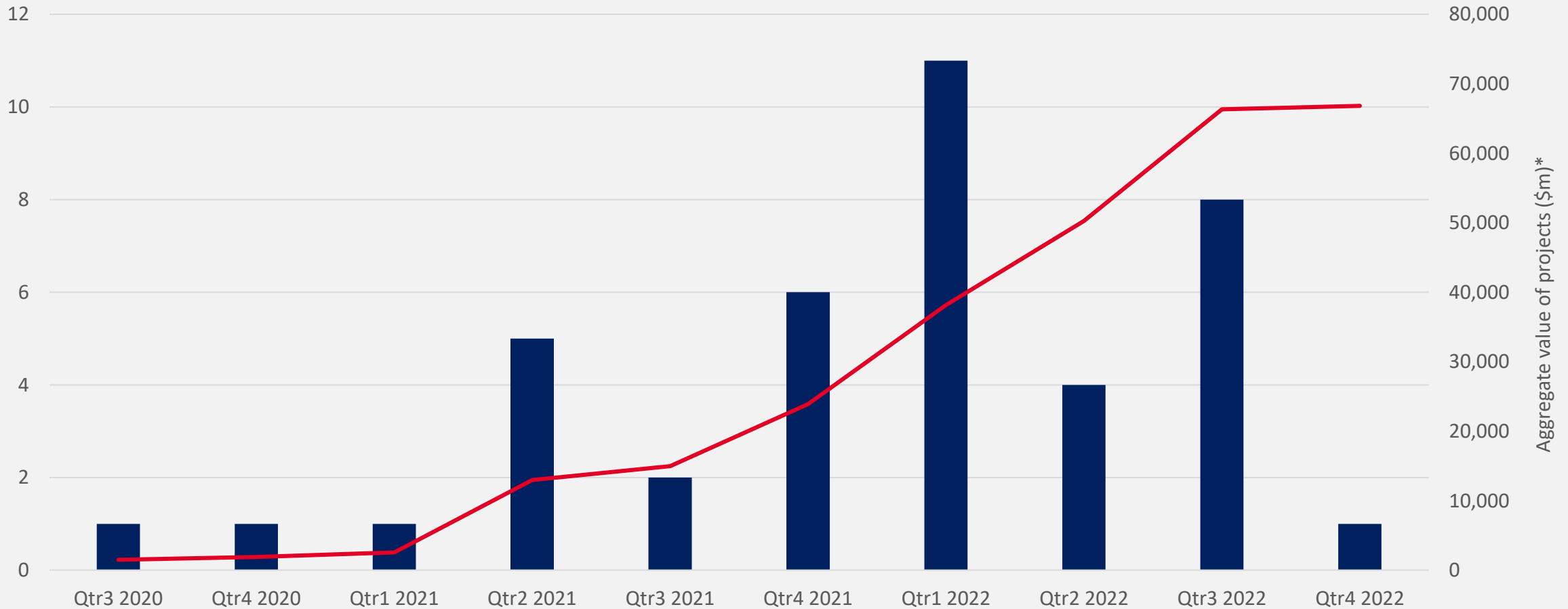




Hydrogen Projects

Hydrogen is fast emerging as MENA states seek to take advantage of cheap solar energy and enhance their position as global energy exporters. More than \$100bn of planned hydrogen projects but only 2 so far under construction (Ain Sokhna pilot and NEOM)

MEA Hydrogen Project launches by year and quarter 2020-2022



www.meedprojects.com

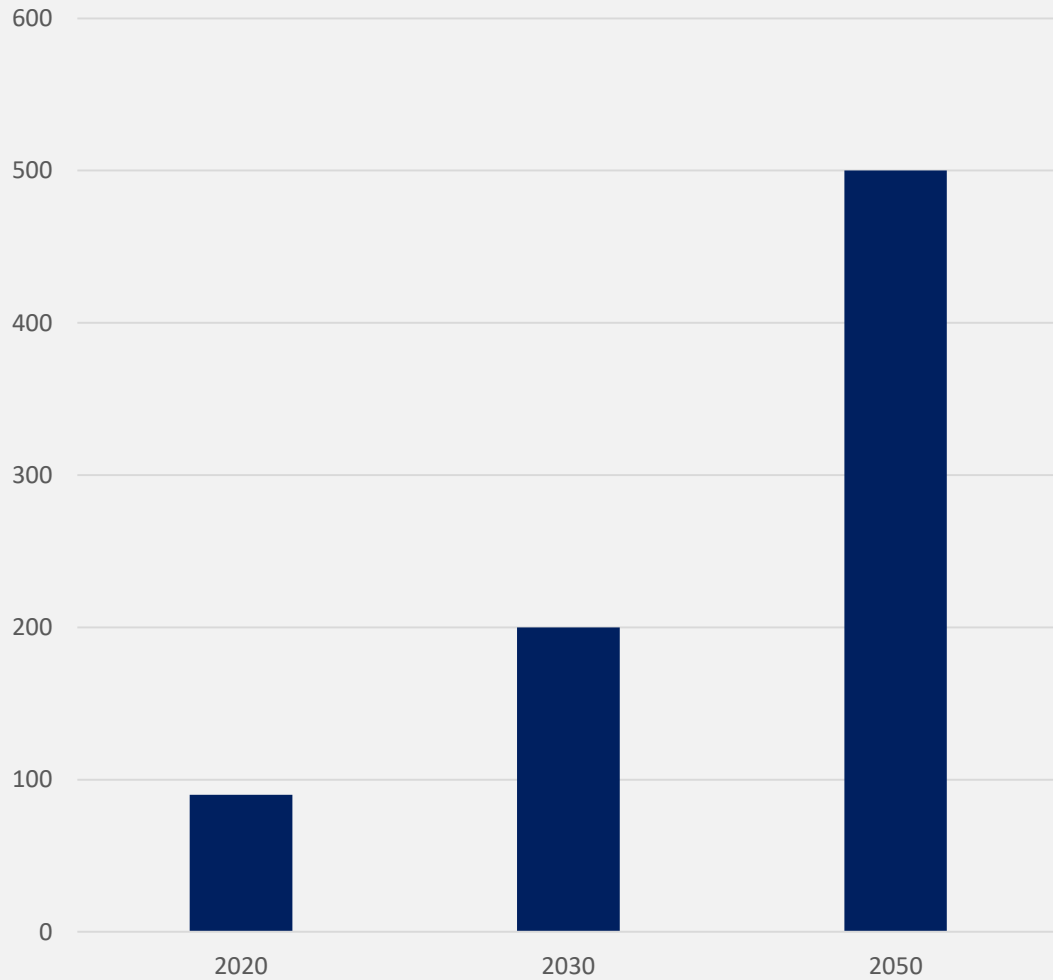
Source: MEED Projects

* Covers only hydrogen plant element

Why now?

Hydrogen is fast emerging as MENA states seek to take advantage of cheap solar energy and enhance their position as global energy exporters.

Forecast global hydrogen demand (million metric tonnes a year)

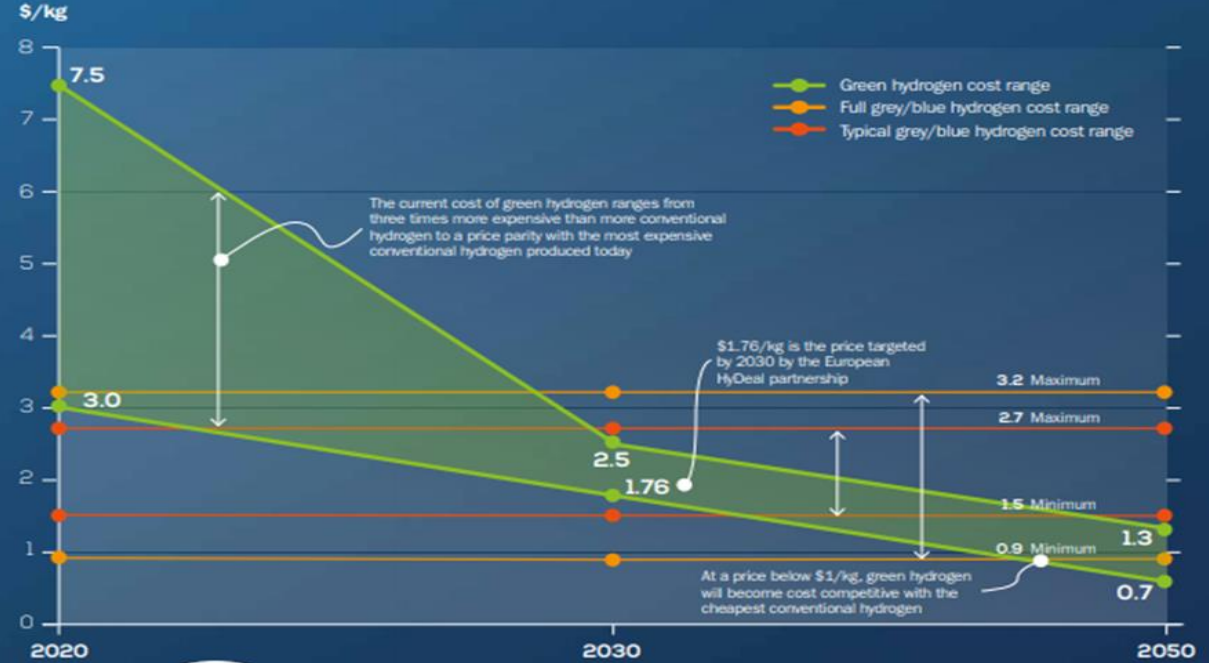


Source: IEA

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



Sources: Cranmore, IEA, S&P PwC, MEED

New Projects

Hydrogen is fast emerging as MENA states seek to take advantage of cheap solar energy and enhance their position as global energy exporters. More than \$100bn of planned hydrogen projects but only 2 so far under construction (Ain Sokhna pilot and NEOM)

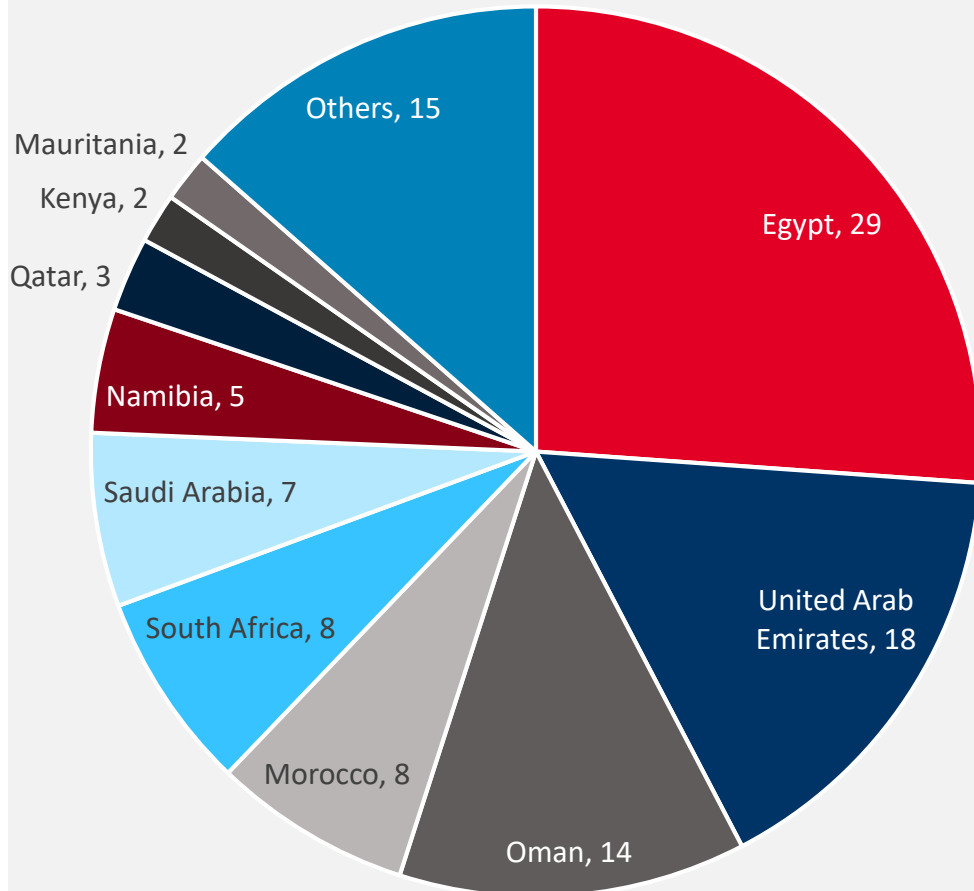
Selected active MEA renewable energy projects

Project	Country	Budget (\$m)	Status	Electrolyser capacity (MW)	Renewable energy capacity (MW)	Green hydrogen (t/y)	Ammonia (t/d)	Stakeholders
Green Energy Oman (GEO)	Oman	28,000	Study	13,000	25,000		10,000,000	OQ, InterContinental Energy, EnerTech
Amun	Morocco	16,000	Study		15,000			CWP Global
Acme Group green hydrogen hub	Egypt	13,000	Study					Acme Group
SCZone hydrogen plant 4	Egypt	11,000	Study					Globeleq Company
Masdar - Hassan Allam SC Zone green hydrogen project	Egypt	10,000	Study	4,000		1,315		Masdar, Hassan Allam
RenewPower SCZone green hydrogen project	Egypt	8,000	Study			220,000		Renew Power, NREA, EETC, TSE
Neom Green Fuels	KSA	6,500	Execution	2,000	4,000	650,000	3,290	Acwa Power, Air Products, Neom, Baker Hughes, Thyssenkrupp
Posco green ammonia plant	Oman	5,000	Study		4,000			Posco
H2 Oman	Oman	5,000	Study	2,200	3,500	1,000,000	2740	Acwa Power, OQ, Air Products
Engie-Masdar hydrogen hub	UAE	4200	Study					Engie, Masdar
Sohar Port/ Port of Rotterdam project	Oman	4,000	Study		3,500			Sohar Port, Port of Rotterdam
Green hydrogen export plant	KSA	4,000	Study					PIF, Posco and Samsung C&T
Phelan green ammonia project	Egypt	3,500	Study				6,849	Phelan Energy Group
SCZone hydrogen plant 1	Egypt	3,500	Study					Alfanar
1GW waste-to-hydrogen project	Egypt	3,000	Study			300,000		SCZOne, H2Industries
Sasol Boegoebaai Green Hydrogen Project	KSA	3,000	Study	2,800		400,000		Sasol, Itochu
SCZone hydrogen plant 1	Egypt	3,500	Study					Alfanar
1GW waste-to-hydrogen project	Egypt	3,000	Study			300,000		SCZOne, H2Industries
ACME green hydrogen & ammonia facility	Oman	2,500	Study				2,200	Acme Group, Tatweer, Scatec
Hyphen Green Hydrogen Complex	Namibia	2,000	Study			125,000		Enertrag, Nicholas Holdings
Taqa – AD Ports green ammonia plant	UAE	2,000	Study			2,000		Taqa, Abu Dhabi Ports, Thyssenkrupp
Taqa-Emirates Steel	UAE	2,000	Study					Taqa, Emirates Steel
Sonangol Angola Hydrogen Project	Angola		Study					Sonagol
HDF Energy Swakopmund Hydrogen Project	Namibia		Study					Hydrogene de France

Geographic Distribution

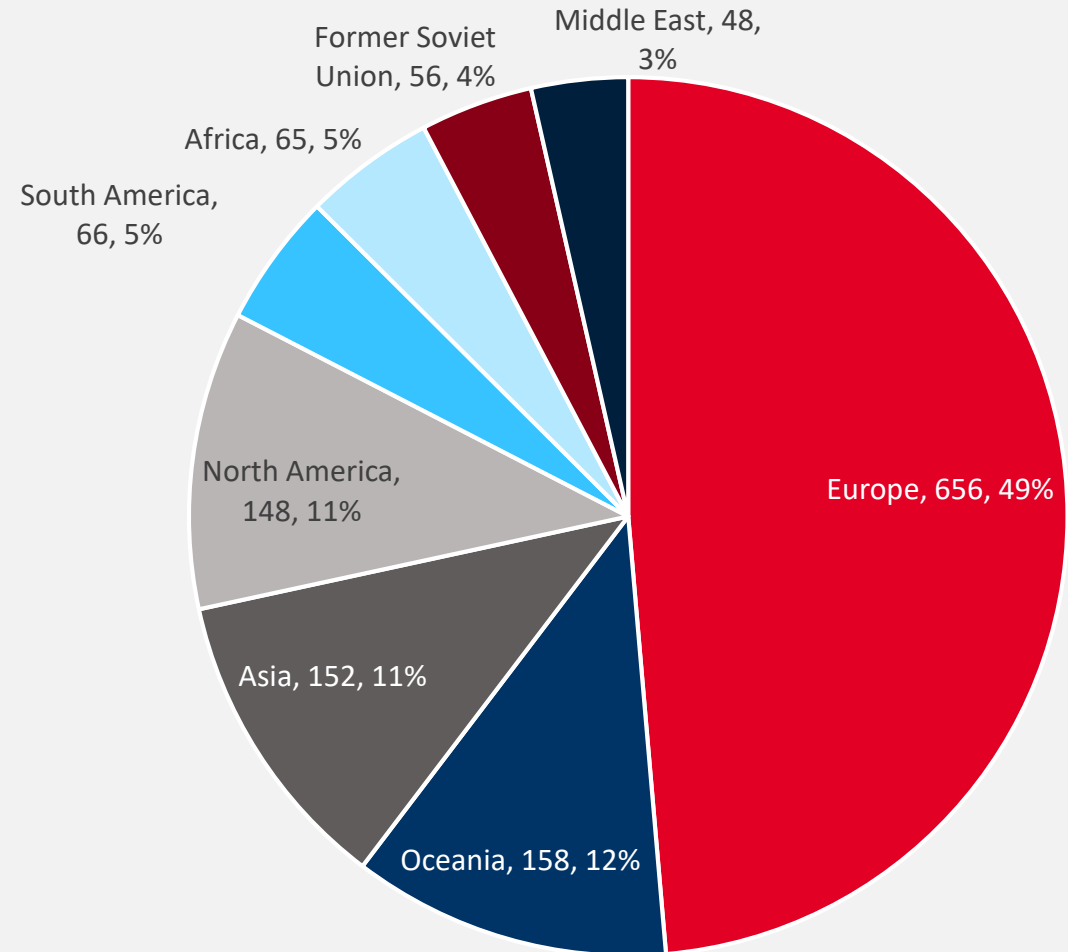
Although most currently planned hydrogen capacity is destined for export, the Middle East has great potential for the development of domestic demand

Distribution of MEA hydrogen projects by country



Source: MEED, GlobalData

Number of hydrogen projects by region

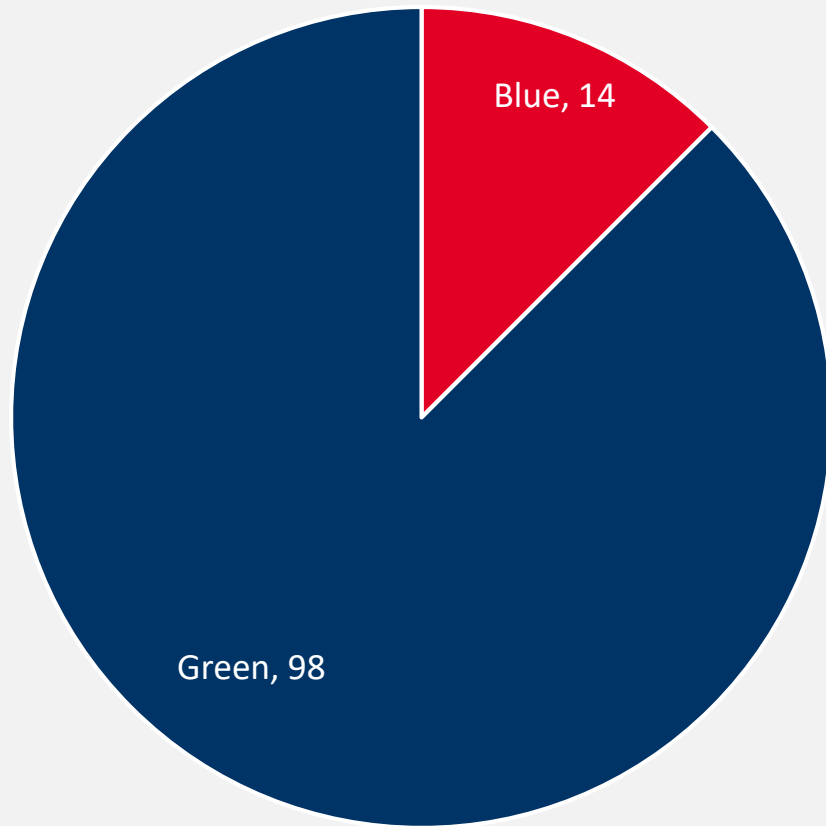


Source: MEED, Globaldata

Type and Source

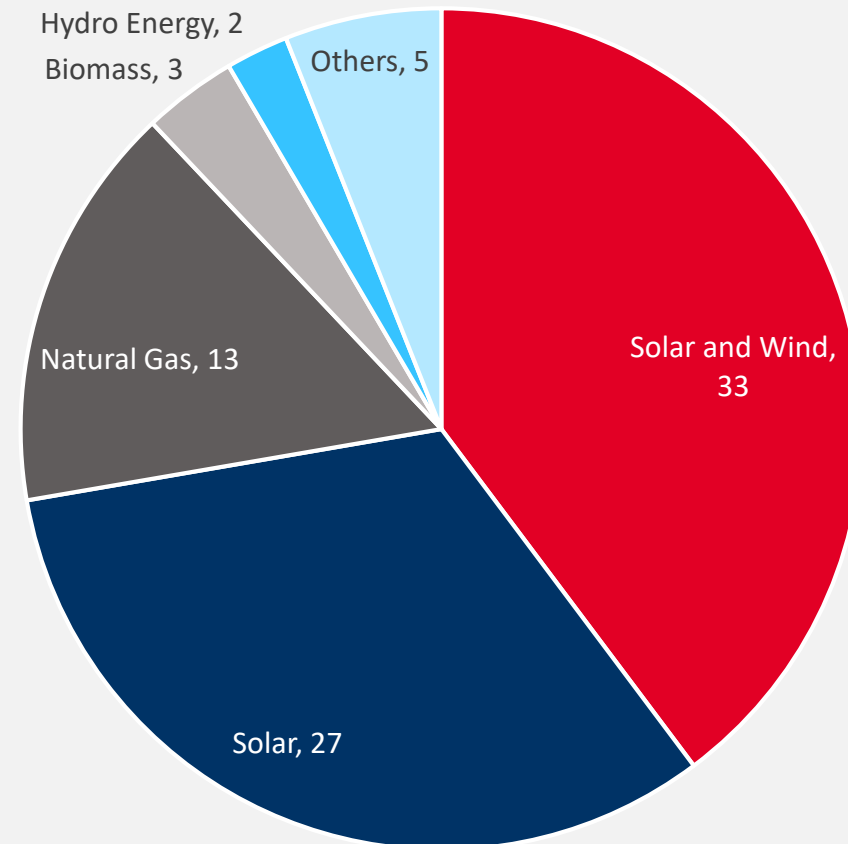
Although most currently planned hydrogen capacity is destined for export, the Middle East has great potential for the development of domestic demand

Breakdown of MEA hydrogen projects by type



Source: MEED, GlobalData

Breakdown of MEA hydrogen projects by known electricity source

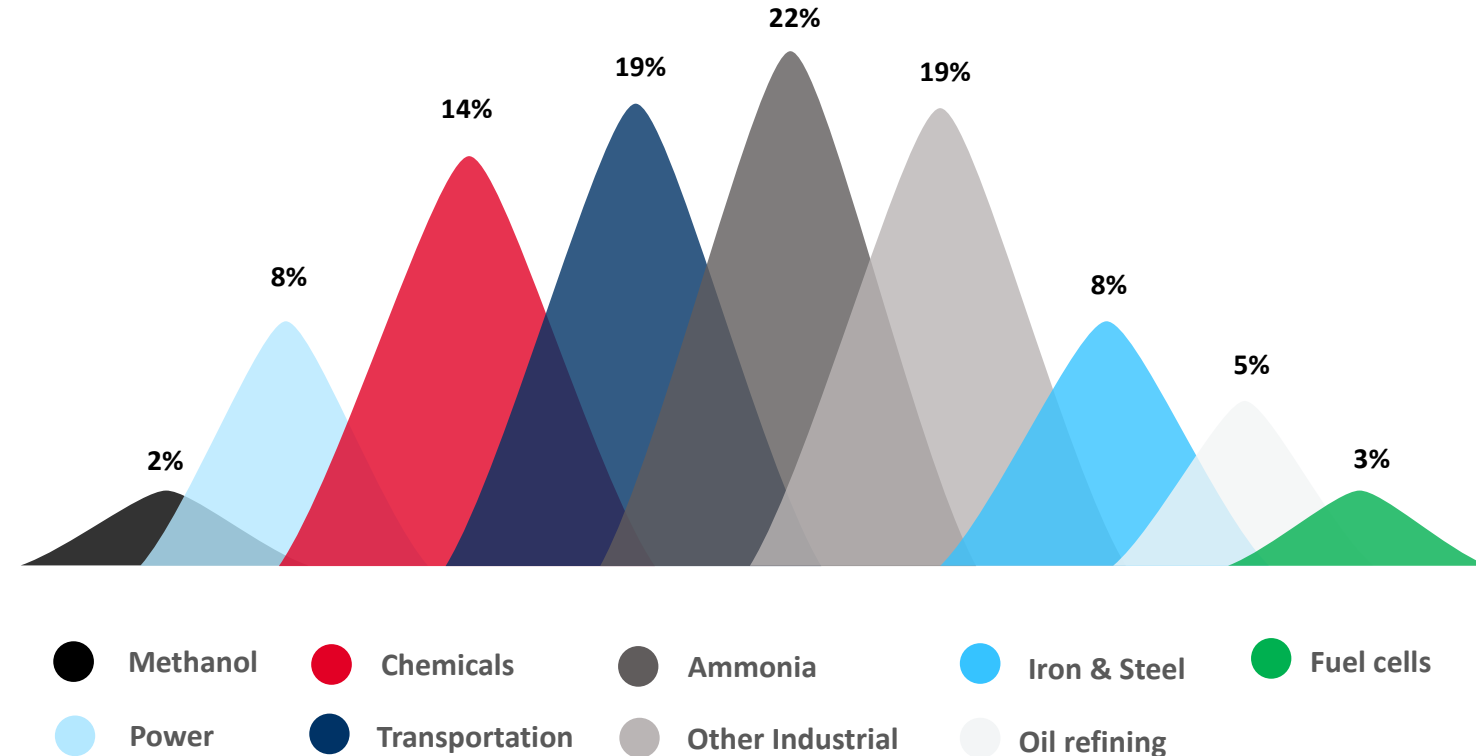


Source: MEED, Globaldata

Intended Use Sectors for Hydrogen

Hydrogen producers mainly expect a highest growth in the ammonia sector

Target end use sectors for low-carbon hydrogen plants



Sources: GlobalData analysis, GlobalData Hydrogen Service

Summary

- The chart on the right displays the sectoral allocation of hydrogen end uses for all active and upcoming low-carbon plants in the Middle East.
- Conversion to ammonia is the most commonly occurring end use, much of which could be intended for export as ammonia conversion is one of the favoured methods for transporting hydrogen. There is an existing fertilizer industry that uses ammonia as well.
- Interest in the burgeoning hydrogen transportation sector is significant, as are more traditional uses in chemicals and industry. Chemicals could also be included with ammonia in some cases. Power and iron & steel, newer uses of hydrogen, have seen some interest as well. The oil refining sector, one of the largest current users of hydrogen, shows less demand.

Hydrogen policy developments

Today, there are no specific regulations for implementing hydrogen projects in the Middle East, but other related frameworks are in place.

Strategy	Description	Current Policies
<i>UAE-Germany Hydrogen Partnership</i>	<ul style="list-style-type: none"> The UAE and Germany entered a partnership in 2017 to collaborate on renewable energy projects, including hydrogen. 	<p>The UAE released a Hydrogen Leadership Roadmap during COP26 to align with the country’s Net Zero 2050 Strategic Initiative. The Roadmap targets a 25% global market share of low-carbon hydrogen in 2030.</p>
<i>Saudi Arabia-Germany Hydrogen Agreement</i>	<ul style="list-style-type: none"> In March 2021, Germany and Saudi Arabia signed an agreement to cooperate on developing a green hydrogen economy. 	<p>Oman plans to release a hydrogen strategy in 2022 with the goal to build a hydrogen-centric economy by 2040. A national hydrogen alliance was created in 2021 to support the sector’s development.</p>
<i>UAE-Japan Agreement</i>	<ul style="list-style-type: none"> In April 2021, the UAE and Japan agreed to collaborate on developing a hydrogen value chain to supply Japan’s future demand for the fuel. 	<p>Saudi Arabia and Egypt are both finalising their own hydrogen strategies and are expected to announced them by the end of the year</p>
<i>Abu Dhabi Hydrogen Alliance</i>	<ul style="list-style-type: none"> ADNOC, the state oil company of Abu Dhabi, and other state-owned companies joined the Alliance to make the emirate a leader in blue and green hydrogen production. 	<p>Existing partnerships clearly demonstrate that future hydrogen-importing countries, such as Germany and Japan, show strong interest in the hydrogen production capabilities of the MEA region.</p>
<i>Saudi Arabia Vision 2030</i>	<ul style="list-style-type: none"> Oman’s Ministry of Energy and Minerals signed an agreement with BP in January 2022 to develop multi-gigawatt renewable energy and green hydrogen capacity by 2030. 	
<i>Oman-BP Partnership</i>	<ul style="list-style-type: none"> In July 2021, Italy’s Eni signed an agreement with the Egyptian Electricity Holding Company and the Egyptian Natural Gas Holding Company to assess the feasibility of hydrogen production. 	
<i>Egypt-Eni Partnership</i>		

Carbon Capture and Storage



CCS/CCU Policies

Carbon capture and storage (CCS) projects are gathering momentum in Middle East to support the region’s transition to clean technologies

CCS technologies are attractive in the Middle East, due to the high level of hydrocarbon activities in the Gulf states. They promise CO2 emissions reduction within their current operations while transitioning into cleaner technologies without compromising their energy security and economic strength given by hydrocarbon business.

Currently the Gulf states already account for 10% of the global CCS capacity with almost 4mtpa. The core vision of the region is to keep hydrocarbon technologies as central part of their energy mix, reducing emissions rather than reducing fossil fuels use.

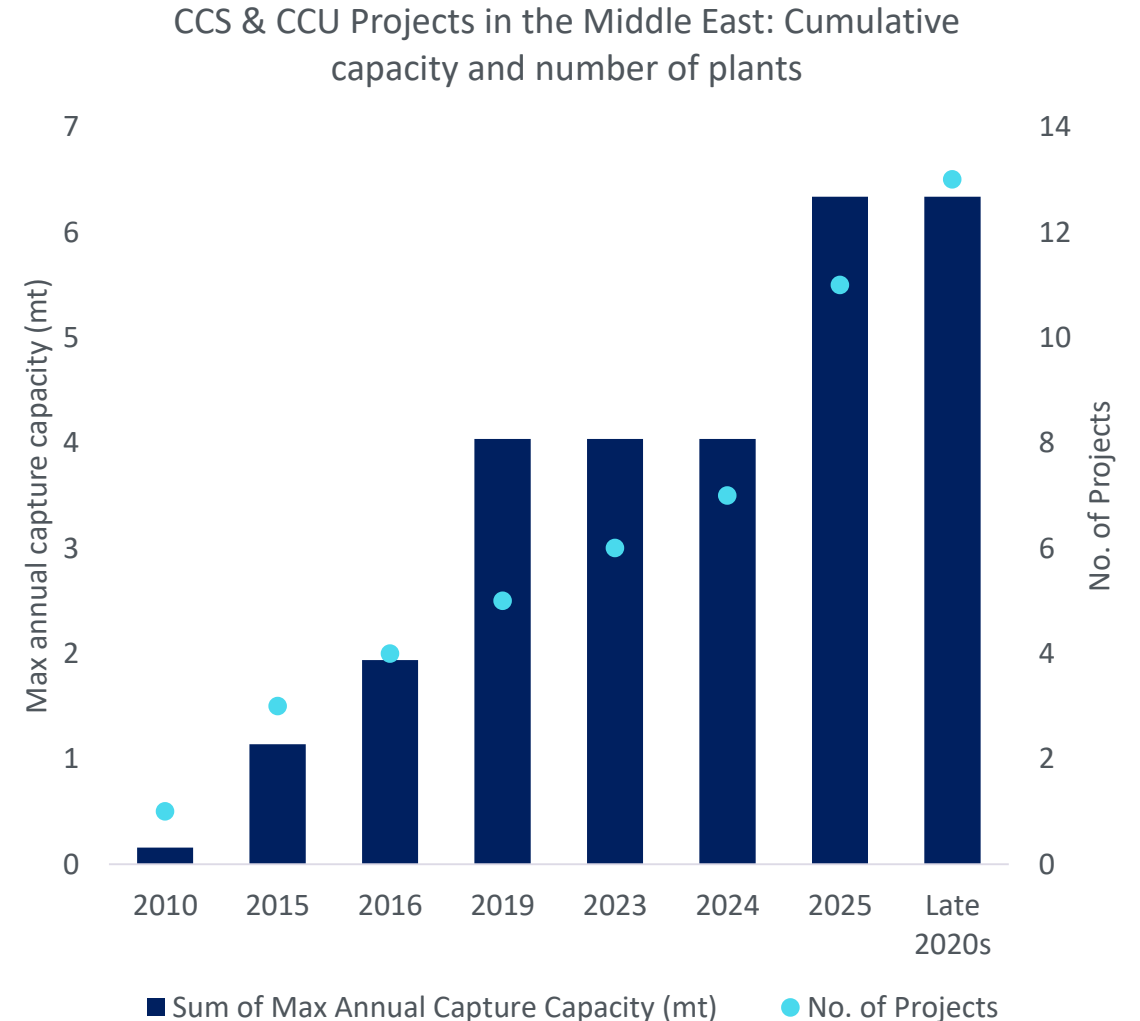
- **Investing in CCS**

Currently in Middle East, there is no mandate for including CCS in any facility. However, Saudi Arabia has announced the establishment of an investment fund to support CCS developments as part of a US\$10 billion package, unveiled in October 2021, at the inaugural Middle East Green Initiative summit.

- **Scaling up CCS technologies**

Scaling up CCS technology use across fossil fuel facilities will enable the region to reach its goals of reducing its emissions, especially in emission intensive industries such as oil and gas production and power plants.

By scaling up CCS project capacity, the Global CCS Institute has projected that CO2 capture might reach 60 mtpa by 2035 in the Middle East region.



Current CCS projects

Abu Dhabi Cluster is currently one of the biggest in the world capturing in between 2.7 – 5 mtpa of CO₂ per year.

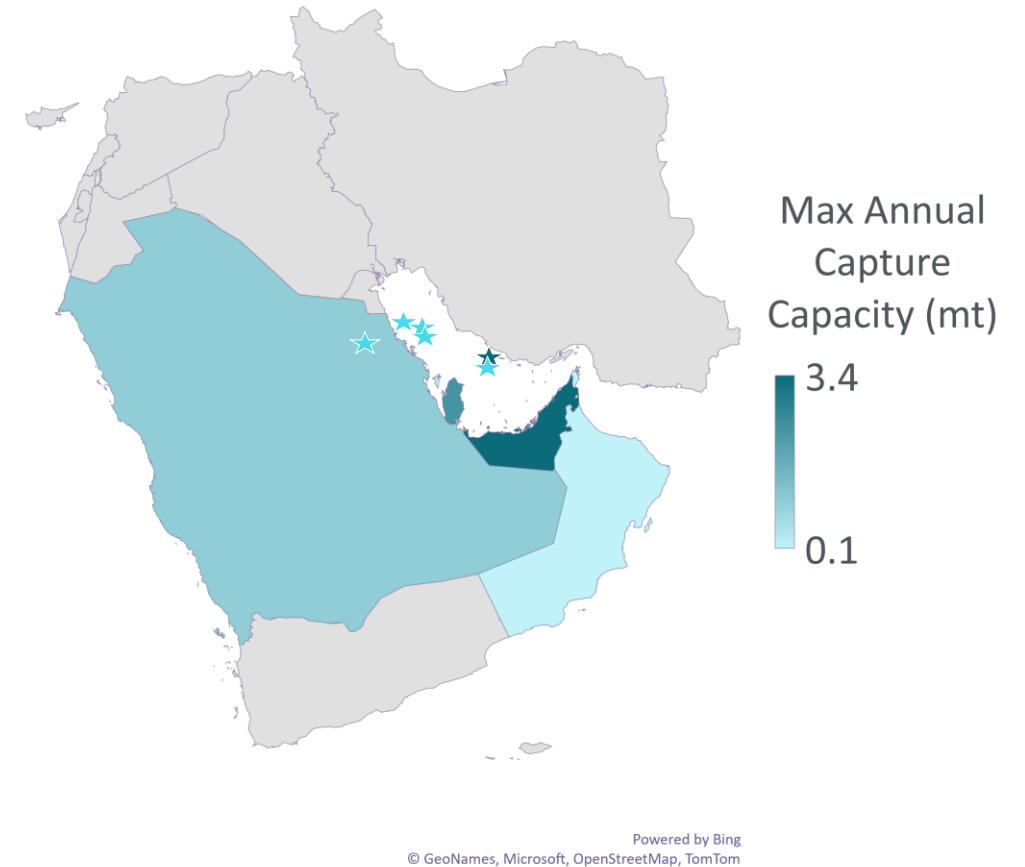
It supports reducing emissions from the following sectors:

- Natural gas processing
- Hydrogen Production
- Iron & steel production

Active and Upcoming CCS projects

Project Name	Country	Development Stage	Active Year	Capacity (mtpa)
★ Abu Dhabi CCS Project Phase 2: Natural gas processing Plant	United Arab Emirates	FEED	2025	2.30
★ Ras Laffan LNG CCS Project	Qatar	Completed	2019	2.10
★ Uthmaniyah CO ₂ -EOR Demonstration Project	Saudi Arabia	Completed	2015	0.80
★ Abu Dhabi CCS Project Phase 1	United Arab Emirates	Completed	2016	0.80
★ Qatar Fuel Additives Mesaieed Hydrogen Project	Qatar	Completed	2015	0.18
★ GPIC Sitra Complex CCS	Bahrain	Completed	2010	0.16
Abu Dhabi Ruwais Blue Ammonia Project	United Arab Emirates	FEED	2025	
North Field Expansion CCS Project	Qatar	FEED	2025	
Abu Dhabi - Ghasha CCS Project	United Arab Emirates	FEED	2025	
Saudi Aramco Jafurah Blue Hydrogen Project	Saudi Arabia	Feasibility	2024	
ARA - Sumitomo Hybrid Hydrogen Project	Oman	Feasibility	2023	
ENEOS Aramco Blue Hydrogen Project	Saudi Arabia	Feasibility	Late 2020s	
Abu Dhabi Blue Hydrogen Project	United Arab Emirates	Feasibility	Late 2020s	

Main ME CCS Projects



Electric Vehicles



Regional Policy

As electrification becomes mainstream, electric vehicles are becoming more prominent as many countries attempt to tackle climate change

Region / City

Policies

Abu Dhabi

- The city has a Low-Emission Vehicle Strategy, aiming to support the uptake of low-emission vehicles, develop charging infrastructure and establish a network of electric vehicle charging stations across the UAE capital
- Emirate's Low Emission Vehicle Strategy - diversifying the sources of energy used in the transition towards electrification.
- In May 2022, the Abu Dhabi Department of Energy released a regulatory policy for EV charging infrastructure. The policy set out the criteria for establishing a network of EV charging stations across the city. The policy also outlined the principles for ownership, installation, and management of Electric Vehicle Supply Equipment and the pricing mechanism.

Dubai

- In September 2020, the Dubai Supreme Council of Energy issued Directive No.2 to update the targets of the Green Mobility Initiative. According to the directive, government organisations in Dubai are required to increase the percentage of hybrid and electric vehicles to at least 10% of their overall annual procurement of vehicles until the end of 2024. Bids for EV strategy recently submitted to DEWA.

Qatar

- Qatari initiative to ensure that 25% of the public bus network is powered by electricity by 2022. The initiative aims to fully electrify the public transportation system by 2030.

Saudi Arabia

- The Public Investment Fund (PIF), the kingdom's investment arm, invested more than \$1 billion in Lucid Motors in 2018, gaining a majority stake in the California-based manufacturer of luxury electric vehicles.
- In April 2022, the Saudi government agreed to buy 50,000 – 100,000 electric vehicles from Lucid Motors within ten years. Lucid is building a manufacturing plant in Rabigh
- Neom is planned to be a zero-emissions city that reduces or eliminates the need for private passenger vehicles.

Regional Developments

Delay of national electric vehicle policies have caused private sector investment and uptake by Middle Eastern consumers to lag.

Region / City Projects

- UAE**
 - Under the “Green EV Charger Initiative”, which was launched in 2015, the Dubai Electricity & Water Authority (DEWA) installed 100 EV chargers across the city. The network has since expanded to over 530 charging points across Dubai.
 - In March 2022, M Glory Group laid the foundation stone for the first EV factory in UAE. Located in Dubai Industrial City, the plant is expected to produce 55,000 vehicles per year.
- Oman**
 - In November 2021, Oman’s first EV plant, located in the Special Economic Zone at Duqm, introduced the first batch of electric buses bearing the “Made in Oman” label.
 - The plant is owned by Karwa Motors, a joint venture between Mowasalat, the national transport company in Qatar, and Oman Investment Authority (OIA).
 - In February 2022, Oman launched its first electric car. The car produced by Mays Motors, a venture funded by Oman Technology Fund. Mays announced that orders have been placed for 100 vehicles.
- Qatar**
 - In November 2020, Qatar Free Zones Authority (QFZA) signed a multilateral framework with Yutong, a Chinese E-bus manufacturer, and Mowasalat, the major transport services provider in Qatar, to establish e-buses factory in Qatar.
 - Swiss-Swedish company ABB was awarded a contract in July 2021 to provide high power charging infrastructure for the E-bus fleet. The project will see ABB supplying over 125 MW of charging capacity, 1,300 connectors for destination charging and 89 opportunity chargers.
- Saudi Arabia**
 - The deal is part of a Qatari initiative to ensure that 25 per cent of the public bus network is powered by electricity. The initiative aims to fully electrify the public transportation system by 2030.
 - Lucid Motors is currently building a factory to assemble its electric vehicles in the kingdom. The factory will be the company’s first plant overseas and it is expected to be completed in 2025.
 - Hyzon Motors plans to supply up to 10,000 FCEVs, mainly medium-and heavy-duty vehicles, annually to Saudi Arabia’s Neom city and other GCC countries.

Company	Country	Annual production capacity	Investment (\$m)
Lucid (US)	Saudi Arabia	155,000	tbc
Admiral Mobility (US) / Geely (China)	UAE	5,000	tbc
Enovate Motors (China) / Somou (saudi Arabia)	Saudi Arabia	100,000	500
M Glory Holding Group (UAE)	UAE	55,000	408
Ceer (Saudi Arabia)	Saudi Arabia	170,000	tbc
Human Horizons	Saudi Arabia	tbc	5,600

MEED

Middle East business intelligence

Summary



Executive Summary

A summary of the trends in Middle East's energy transition from a fossil fuel-dominated market into one that embraces renewable sources.

Sector status and sector leaders

- The Middle East's power market is dominated by traditional fossil fuel sources, mainly gas-based thermal power. The region has abundant oil and gas reserves and is a major exporter of hydrocarbons. It accounts for almost 20% of total global natural gas supply and approximately 30% of the world's supply of crude oil.

Power Outlook and generation

- The existence of massive oil and gas reserves and the low cost of production makes it cheaper for many countries in the region to burn fuel for power generation. The pace of adoption of renewable energy is still therefore quite slow.
- With most countries targeting a 30% minimum of power production from renewable energy, there is expected to be an exponential increase in renewable energy output

Electric Vehicles

- The adoption of electric vehicles as a means of reducing CO2 emissions has progressed in the region in the last few years. This progress is still heavily concentrated in the Gulf region, however.
- Although the policy framework for electric vehicles is still immature, several commercial partnerships and governmental initiatives have emerged. UAE, Qatar, Oman, and Saudi Arabia now have robust plans to locally produce EVs and ambitious intentions for exports as well.

CCS/CCU

- Given the extensive scale of oil and gas operations in the region and the need for achieving zero-emissions targets, the CCS/CCU projects are gaining more momentum. The CCS capacity in the Gulf countries currently stands at 4mtpa, representing 10% of the global annual capacity. CSS capacity is set to increase to 6mtpa with 13 projects expected to come online by the end of the decade.

Hydrogen

- The Middle East region is situated in an advantageous position when it comes to potential hydrogen production due to its abundant gas reserves, land, and solar irradiation. There are currently multiple hydrogen projects in the feasibility phase, with most of them are expected to be operational around the middle of the current decade.