Institute for Energy Economics and Financial Analysis

Green steel opportunity in the Middle East and North Africa

Region can lead green hydrogen use in steel sector

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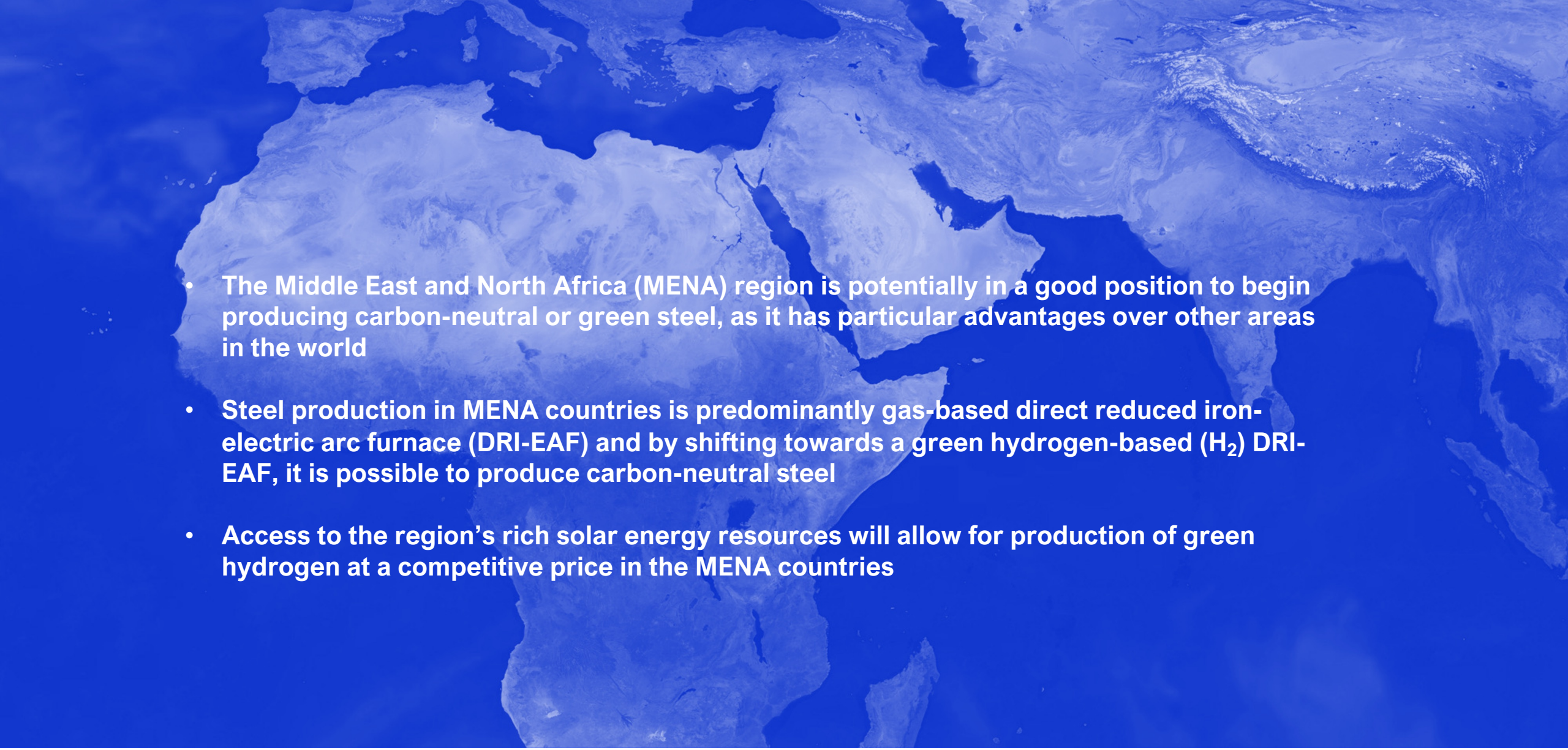
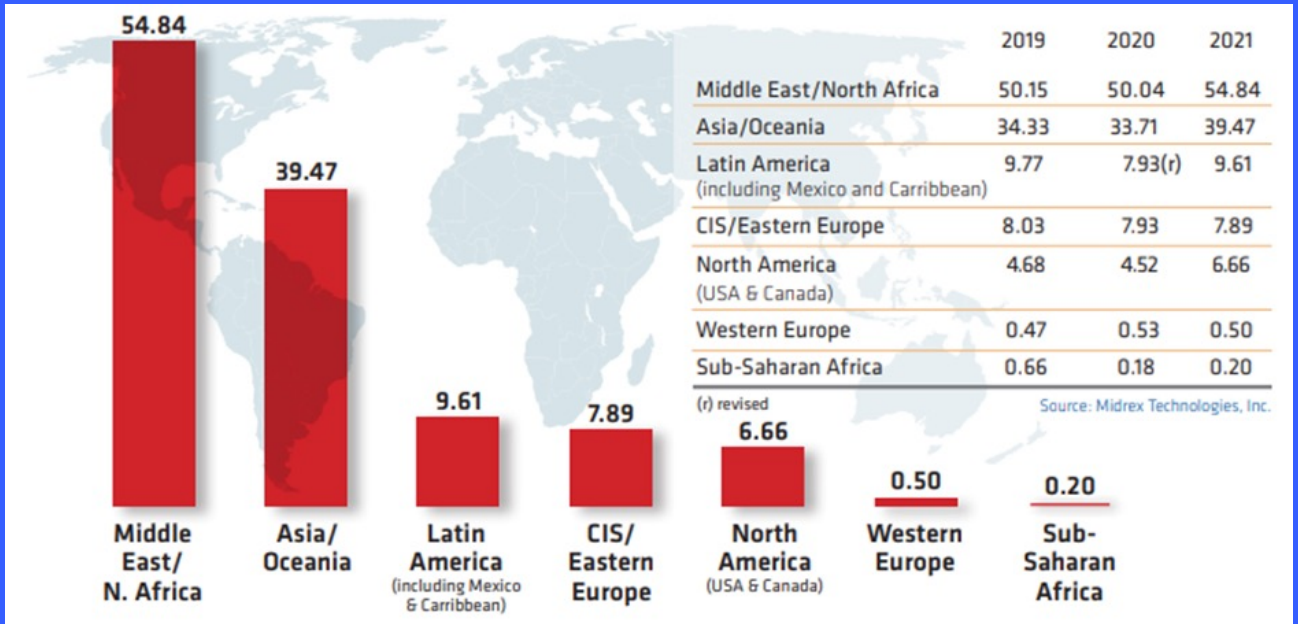


- The Middle East and North Africa (MENA) region is potentially in a good position to begin producing carbon-neutral or green steel, as it has particular advantages over other areas in the world
- Steel production in MENA countries is predominantly gas-based direct reduced iron-electric arc furnace (DRI-EAF) and by shifting towards a green hydrogen-based (H_2) DRI-EAF, it is possible to produce carbon-neutral steel
- Access to the region's rich solar energy resources will allow for production of green hydrogen at a competitive price in the MENA countries

World DRI production by region (million tonnes), 2021



	2019	2020	2021
Middle East/North Africa	50.15	50.04	54.84
Asia/Oceania	34.33	33.71	39.47
Latin America (including Mexico and Carribbean)	9.77	7.93(r)	9.61
CIS/Eastern Europe	8.03	7.93	7.89
North America (USA & Canada)	4.68	4.52	6.66
Western Europe	0.47	0.53	0.50
Sub-Saharan Africa	0.66	0.18	0.20

(r) revised

Source: Midrex Technologies, Inc.

- The MENA region produced just 3% of global crude steel in 2021 but it accounted for nearly 46% (55 Mt) of the world's DRI production
- Gas-based DRI-EAF is the dominant primary steelmaking technology in the MENA region, explained by the abundance of natural gas in the region and the lack of high-quality coking coal reserves
- MENA's steel industry is relatively low carbon compared to the rest of the world, where steel production is dominated by blast furnaces

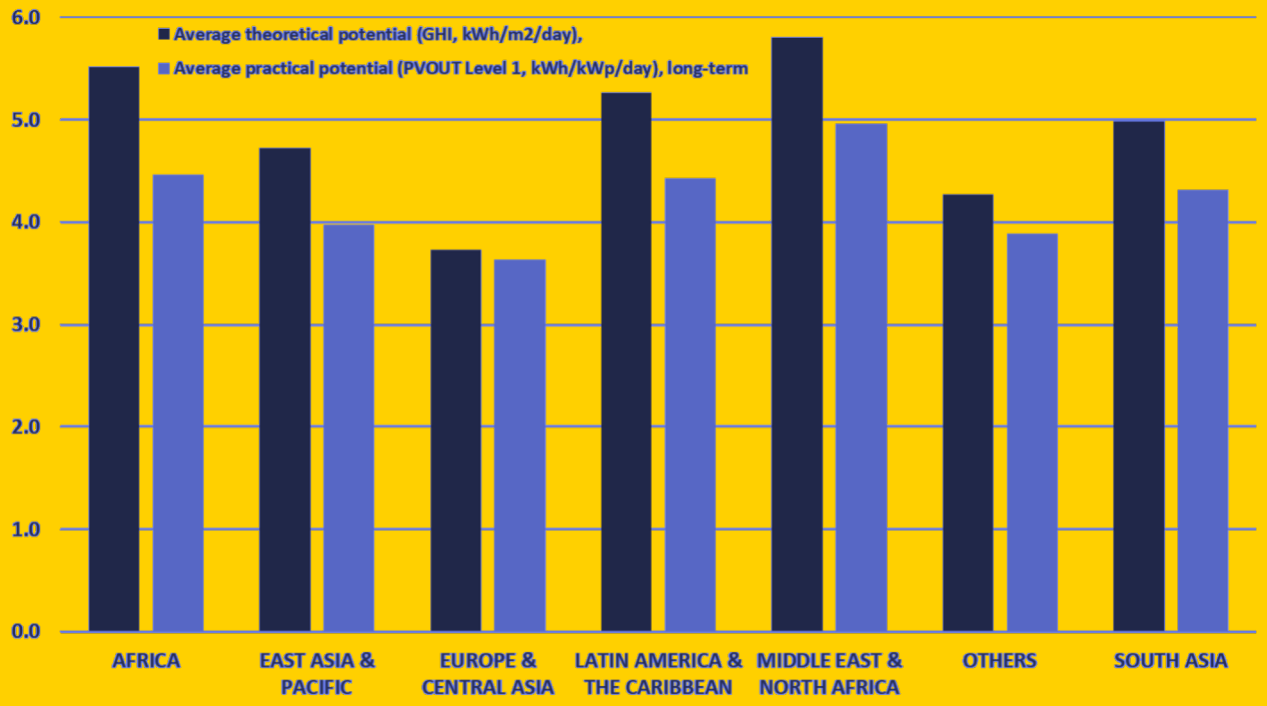
MENA steel and DRI production (million tonnes), 2021

Country	Crude Steel Production	Share of Electric Furnace (%)	Share of Basic Oxygen Furnace (%)	DRI Production*
Iran	28.5	90.3	9.7	31.85
Saudi Arabia	8.7	100	-	6.13
Egypt	10.3	100	-	5.23
UAE	3.0	100	-	3.66
Algeria	3.5	87.5 (2020)	12.5 (2020)	3.08
Oman	2.0	100	-	1.70
Bahrain	0.7	100	-	1.51
Libya	0.5	100	-	0.88
Qatar	1.2	100	-	0.79

- The global steel industry is eyeing a switch to DRI using green hydrogen to reduce emissions
- The International Energy Agency (IEA) modelled in its 2021 Net Zero Emissions scenario that H_2DRI-EAF's share of global primary steel production would reach 29% by 2050
- Under its own net zero by 2050 scenario, BloombergNEF models 56% of primary steel production would come from H_2DRI-EAF by 2050, equivalent to 840Mt annually

Source: World Steel Association and Midrex Note: At the time of writing, 2021 crude steel production figures for Bahrain, Libya and Qatar were not published and 2020 figures were applied.*
Table excludes countries in the region that produce steel from scrap-EAF: Morocco, Tunisia, Kuwait, Jordan and Israel.

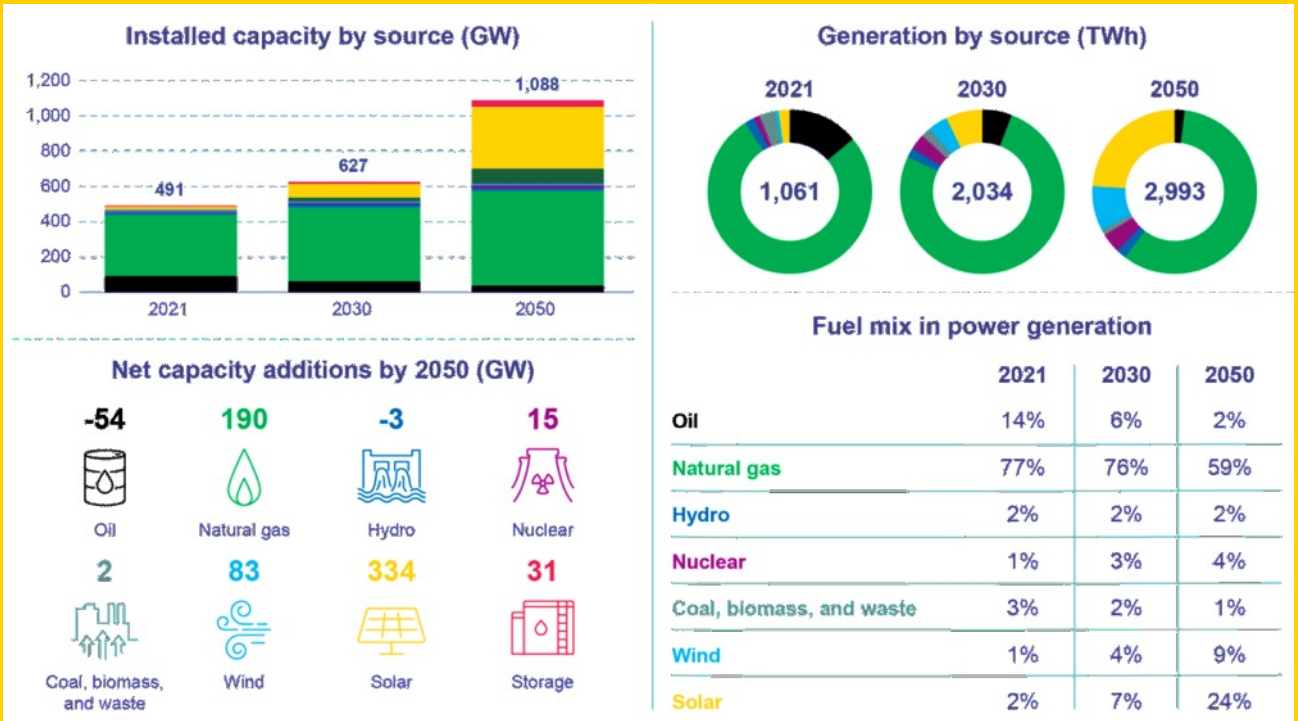
MENA’s photovoltaic power potential chart



- Almost all breakthrough technologies in steelmaking remain technically dependent on electricity, and H_2DRI as a green solution is no exception
- While MENA’s share of renewable energy is currently much lower than the global average, the region is blessed with reliable solar radiation and has the highest photovoltaic (PV) power potential globally
- The International Renewable Energy Agency (IRENA) assessed that producing solar PV electricity in the Middle East at US$0.01/kWh is possible

Source: World Bank

MENA’s power market



- New renewable capacities will change the power mix in MENA by 2050
- IHS Markit forecasts that 83GW of wind and 334GW of solar power will be added by 2050
- This will increase the respective shares of wind and solar from 1% and 2% to 9% and 24%

Source: IHS Markit

Green Hydrogen

- The IEA predicts that by 2030, the installed global capacity of electrolysers will reach 54GW and the Middle East with 3GW will sit below Europe, Australia and Latin America
- As there is higher solar energy potential in MENA, hydrogen-based steelmaking could break even the transition to green steel at a lower price than European contenders
- BloombergNEF suggests that with delivered green hydrogen priced below US$1.5/kg, H_2DRI-EAF technology could be cost competitive by 2050

Other MENA region competitive advantages

MENA's steel and mining sector has already invested in the upstream value chain and can supply the high-quality pellets to feed steel companies. Iran, Oman and Bahrain have the largest production capacity of DR-grade pellets in this area.

MENA's knowledge of this specific steel technology is an invaluable asset. Among the most important steel decarbonisation pillars, this production knowledge, coupled with further work on iron ore beneficiation, pelletising and DR plants, will greatly assist MENA's green transition.

Compared to other regions, MENA has in situ capacity of DRI-EAF, which means no extra investment is needed for replacing the base technology. All new investment could be focused on producing green hydrogen and expanding renewables.

MENA could possibly replace 30% of its natural gas with hydrogen in the existing fleet of DR plants without major modification of the equipment, then move towards 100% green hydrogen in a second phase.

PV installation covers acres of lands, a matter of lesser importance in the MENA area given the expanse of uninhabited lands with ample sunlight to allocate to this purpose.

Thank you

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