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THE HORMUZ INFLECTION
Energy Security *and* Connectivity Networks *in the* Middle East

Mannat Jaspal • Leigh Mante • Cauvery Ganapathy

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Contents

1 **Introduction** 7

The Energy Security Imperative

From Single Corridors to a Web of Networks

Mapping the Regional Energy Network

Trade-offs and Constraints

2 **Electricity Grid Interconnectors** 21

Infrastructure

IMEC Route

Alternate Route #1 – via Egypt

Alternate Route #2 – via Iraq and Syria

Alternate Route #3 – via Maghreb (Algeria, Morocco, Tunisia)

Electricity Trading and Market Design

3 **Hydrogen and Derived Commodities** 30

Green Hydrogen Derived Commodities

Infrastructure

IMEC Route

Alternate Route #1 – via Egypt

Alternate Route #2 – via Maghreb (Algeria, Morocco, Tunisia)

Supply-Demand Dynamics and the Importance of Off-takers and Regulatory Clarity

4 **Natural Gas** 44
Infrastructure
IMEC Route
Alternate Route #1 - via Egypt
Alternate Route #2 - via Iraq and Syria

5 **Nuclear Energy** 49
Ongoing Partnerships in Civilian Nuclear Energy
Strategic Opportunities Across the Nuclear Value Chain

6 **Critical Minerals** 58
Green Industrial Corridor and Industrial Competitiveness

7 **Policy Recommendations** 62

8 **Conclusion** 70

1

Introduction

The Energy Security Imperative

The United States-Israel war on Iran and the consequent disruptions at the Strait of Hormuz have exposed critical vulnerabilities in strategic maritime chokepoints, underscoring the risks associated with excessive dependence on single routes, suppliers, and energy sources.

Energy security has once again emerged as a vital pillar of national security. Since the war began on 28 February, the price of crude has increased by over 84 percent from US$68 to US$126 per barrel.[1] Almost 20 percent of the global oil and gas reserves pass through the Strait of Hormuz,[2] making it one of the world's most important energy corridors. At the height of the crisis, the tanker traffic dropped by as much as 95 percent.[3] Shipping movement remains sporadic and ad-hoc despite the ceasefire announcements between Iran and the United States.

While it is the first time that the Hormuz Strait has been held hostage, the weaponisation of energy supply chains is not new. Multiple episodes from modern history have exposed the fragility of global energy supply chains, among them: the oil embargos of the 1970s; the Tanker wars of the 1980s; the COVID-19 pandemic beginning in 2020; the Russian Ukraine conflict in 2022; the Houthi attacks on the Red Sea in 2023; and the growing rivalry between the West and China. These events have underlined the vulnerability of traditional maritime routes and demonstrated the imperative for greater diversification and built-in redundancies in supply chains.

Countries that invested early in alternative export infrastructure are in a better position to cushion the blow from the effects of the current crisis—most notably, Saudi Arabia with its 1,200-km-long East-West Crude pipeline from Abqaiq to Yanbu in the Red Sea.[4] With an export capacity of around 5 mbpd, the country can reroute large parts of its 7 mbpd of exports that would otherwise pass via the Strait of Hormuz.[5] The Kingdom also operates a parallel Petroline for natural gas liquids (NGLs). Similarly, The United Arab Emirates (UAE) has benefitted from its 380-km Abu Dhabi Crude Oil Pipeline (ADCOP) running from Habshan to the Fujairah port. Able to move between 1.5–1.8 mbpd, roughly half of UAE's total daily oil export capacity, the pipeline allows the UAE to bypass the Strait of Hormuz entirely.[6]

However, not all producers have such alternatives. Qatar, for instance, has no option for its LNG exports given it is effectively locked into the Strait of Hormuz.[7] Kuwait and Iraq are similarly heavily dependent on the Strait. Given limited diversion options, Iraq has recorded the steepest export supply declines by as much as 90 percent in April and May 2026 from pre-war levels.[8] Rising energy prices have escalated prices across other sectors and industries including fertiliser, food, transport, and manufactured products. Insurance costs have also risen, further raising the geopolitical cost of energy transit.

To be sure, the alternative capacities of certain countries have helped offset some of the market pressure,[9] as have the easing of Iranian and Russian sanctions, the release of strategic emergency reserves, and falling demand particularly from the region's largest importer, China, by as much as 1 mbpd. However, the current uncertainty shrouding the future of such passageways have prompted the Middle Eastern producers and the global markets to reassess the resilience of energy supply chains.

Indeed, energy security is no longer about procuring additional supply but about creating a flexible and diversified energy supply chain that can withstand geopolitical shocks. The concentration of production, storage, export, or liquefaction capacity in one or few countries heightens the risk of disruptions. These geopolitically sensitive interdependencies can prove to be disastrous in periods of political tension or energy weaponisation, reinforcing the case for diversified infrastructure and resilient supply chains.

It is therefore unsurprising that the Gulf countries are already gearing up to build out that alternative capacity to reduce their dependence on the Strait of Hormuz. Existing pipelines alongside seven additional pipeline and export-infrastructure projects that are under construction, planned, or considered potentially feasible, can reportedly insulate more than 45 percent of the pre-war level of Persian Gulf producers' exports from future disruptions in the Hormuz Strait.[10] By the end of 2028, the number could rise to more than 60 percent.[11] The West-East pipeline in the UAE and the Basra-Haditha (potentially further connecting

Aqaba in Jordan) Pipeline in Iraq are already under construction.[12] In addition, a new port on the coast of the UAE is being considered to reduce the pressure on the port of Fujairah.[13] Despite the rerouting buildout, 7-9 million barrels of crude and refined products per day would continue to remain exposed.[14]

Besides the global implications, the disruptions in the Bab el Mandeb, the Strait of Hormuz, and along the Suez Canal have exacted high costs on the energy production and national security calculations of the Middle Eastern countries.[15] The costs of disruptions along this route are particularly severe for a region that acts as a bridge and anchor across India, the world's third largest energy consumer,[16] the increasingly urbanising populations of the Middle East, and Europe that is concertedly seeking a diversification of its energy portfolio away from its previous Russian dependence.

From Single Corridors to a Web of Networks

Middle East occupies a unique geographic advantage between Asia and Europe, and is therefore well placed to emerge as a diversified, multimodal, and resilient connectivity hub for ensuring energy security. The region has the potential to integrate capital with markets and capacity gaps with skill sets to support energy trade and energy transition agendas. It may offer an opportunity for cross-sectoral and cross-continental diversification and development as well.

The India-Middle East-Europe Economic Corridor (IMEC), first proposed under India's G20 Presidency in 2023, represents this important step to realise the vision of establishing a multimodal and multi-commodity route connecting the ports of India to those of Europe through the Arabian Gulf, Jordan, and Israel. The objective of the Corridor is to strengthen energy, digital, and infrastructure connectivity and cooperation among the partner countries—namely, India, the United Arab Emirates (UAE), Saudi Arabia, France, Germany, Italy, the European Union (EU), and the United States (US). Israel, Jordan, and Greece, although not permanent signatories of the IMEC, will serve as nodes to make the identified route and current arrangement work.

However, normalisation in Arab-Israeli relations is crucial to make the IMEC agenda a reality. Given the unresolved Israel-Gaza conflict since the October 2023 Hamas attack and the wider geopolitical disruptions in the region, the Arab (notably, Saudi Arabia) and Israeli relationship is likely to remain frozen in the near future. The primary obstacles to IMEC are therefore not physical, but political[17] and has less to do with infrastructure and more with security. In essence, the operationalisation of the Haifa port in Israel, which

is a key node to enter Europe via the Mediterranean, remains a bottleneck. Other than the political stagnation, the economic bottlenecks associated with such multi-decadal and cross-continental infrastructure projects have also derailed progress.

The Iran war has only reinforced that a single route of connectivity is detrimental to the broader diversification agenda and any weaponisation in a single country, port, or transit corridor can disrupt the entire supply chain. Therefore, building diversification, redundancy, and optionality, is essential through a complementary infrastructure framework that maximises commercial returns while enhancing long-term regional energy security.

This report argues that IMEC should evolve into an interconnected web of corridors across the region, instead of a linear bi-directional route. Complemented by existing infrastructure, as well as regional and national connectivity strategies and plans, such an approach can reinforce long-term energy security, economic diversification, and supply-chain resilience.

This study aims to map the energy-based trade interlinkages along the region's geographic scope that could effectively diffuse risks through a diversification of energy sources and forms that also help deliver on the decarbonisation agendas of the countries concerned. The objective is not to replace, but to supplement, the existing IMEC proposal and initiatives. The analysis identifies and evaluates existing transport and energy infrastructure that can be strategically leveraged to support alternative routing options across the IMEC region.

It should be noted that the envisioned network will not emerge all at once; rather, sub-sections of the corridors are expected to become operational progressively, reflecting differences in project readiness, financing, infrastructure development, and geopolitical conditions. The proposed networks should be considered a blueprint for a long-term vision on energy security and diversification planning for the Middle East region.

At the core of this analysis is diversification across two dimensions:

Diversification of Routes. This analysis considers other viable routes of possible energy trade and transit in the region to act as tributaries complementing the main IMEC route, as well as pathways of circumvention in the event of chokepoints and blockages. Other than the originally proposed IMEC route, the analysis considers two principal alternatives: the Iraq–Syria corridor to the east and the Egypt–Suez Canal corridor to the west. Together, these routes create a more resilient and flexible network capable of sustaining cross-regional energy flows under varying geopolitical and commercial conditions.

The analysis also covers certain countries in North Africa, primarily the Maghreb region, which are increasingly recognised for their capacity to supply low-cost, low-carbon energy to Europe and other energy-demanding IMEC nations. The inclusion of North African energy systems underscores their potential as key contributors to transcontinental energy trade and green energy corridors.

Diversification of Energy Forms and Clean-Energy Supply Chains. Building on IMEC's original mandate, the report argues for diversification of both energy forms and energy sources to expand the scope of the proposed energy integration. It proposes a diversification of the markets accessible to energy importers and exporters through the expansion of energy infrastructure by way of multimodal transport networks, electricity grid interconnectors, LNG infrastructure and natural gas pipelines, hydrogen transport corridors, civil nuclear energy, and SMR co-development, as well as critical mineral partnerships.

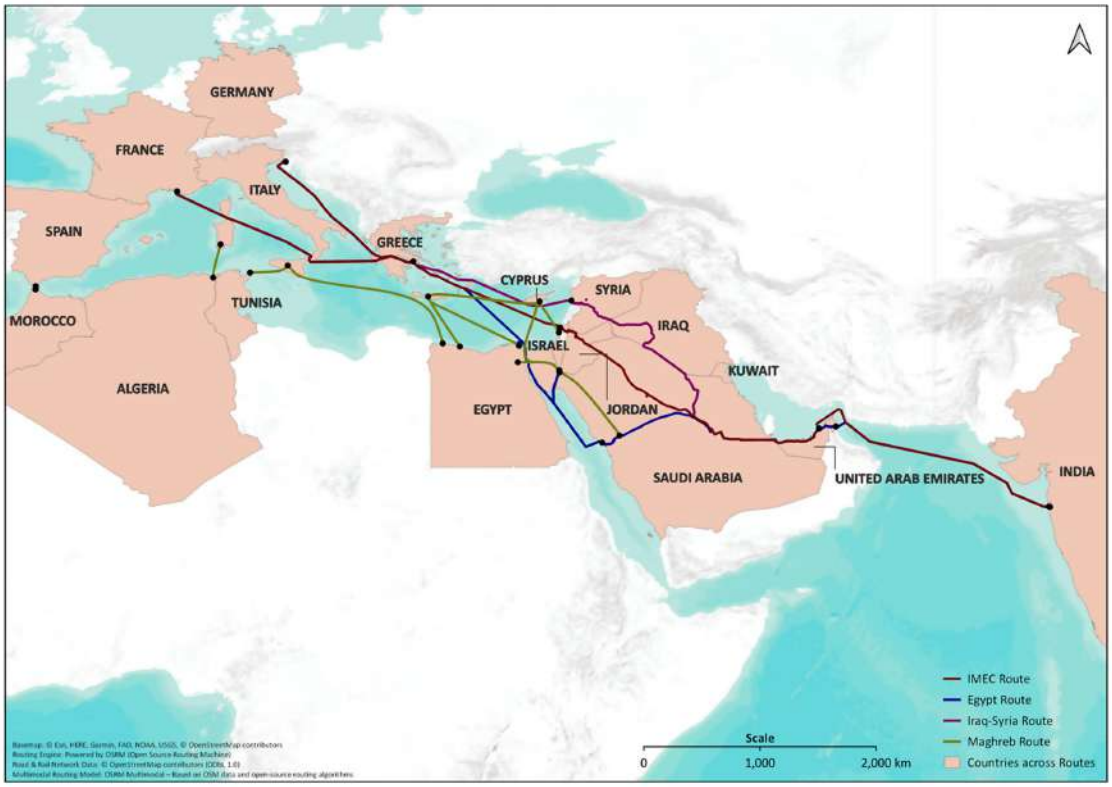
A key objective is to ensure that the transition away from fossil fuels does not create new strategic dependencies in clean-energy technologies. The report therefore examines opportunities to diversify the sourcing of critical minerals and other raw materials essential for the energy transition, alongside the development of alternative clean-energy value chains. These energy assets and supply chains are assessed for their potential to enhance long-term energy security, support decarbonisation objectives, and foster a more resilient and diversified clean-energy ecosystem across the IMEC region.

Mapping the Regional Energy Network

This section outlines the strategic rationale for the participation of the principal regions and examines the networks and ecosystems underpinning each of the routes considered in this study: IMEC; Iraq-Syria; Egypt; and Maghreb.

These alternative routes are considered as viable paths to mitigating any disruptions to the original route and thereby contribute to forging a more resilient model of diversification that coincides with the IMEC's larger vision of inter-regional integration while building a throughline of integrated energy cooperation stretching from the Indian Ocean to the Mediterranean Sea.

Map 1: The Proposed Web of Networks



Source: Map created by cartographer, Nishalini Virumandi.

There is a strong rationale for each of the three regions—India, the Middle East, and Europe—to cooperate on energy. The diplomatic engagements over the years across India, the Gulf, and Europe signal that the governments are positioning connectivity not merely as an instrument to strengthen logistical capabilities across these regions but as a means to reinforce cross-regional security and minilateral allegiance.

India. It integrates the country into the rising demand centres and funding opportunities from the Middle East and Europe. Already, India is investing heavily in infrastructure projects and deep-sea ports including Vadhavan in Maharashtra and Vizhinjam in Kerala, and is expected to enhance its container handling capacity by more than 23 million Twenty-foot Equivalent Units (TEUs) by 2040.[18] The country has a US$ 1.2-trillion National Master Plan for Multi-Modal Connectivity which aims to integrate the manufacturing hubs to its western ports serving IMEC.[19] With a string of trade agreements such as the 2022 India-UAE CEPA, India-EU FTA, India-UK CETA, and the trilateral alliances such as the UFI (UAE, France and India) on infrastructure and port development, all these efforts signal greater willingness for trade integration.

The Middle East. IMEC is closely aligned with the long-term vision of both Saudi Arabia and the UAE to emerge as global logistics, trade, and industrial hubs besides diversifying their economies and decreasing dependence on hydrocarbons. It also allows Gulf capital to invest more in the demand-generating geographies of India and tie up with Europe's investment agenda in the Global South at a time when the US appears to be retracting from the global decarbonisation and energy transition agendas. The Gulf Railway Project, relaunched in 2024, is momentous for building a 2,100-km rail network linking all six Gulf Cooperation Council (GCC) countries.[20] The project is expected to cost some US$250 billion in investments.[21]

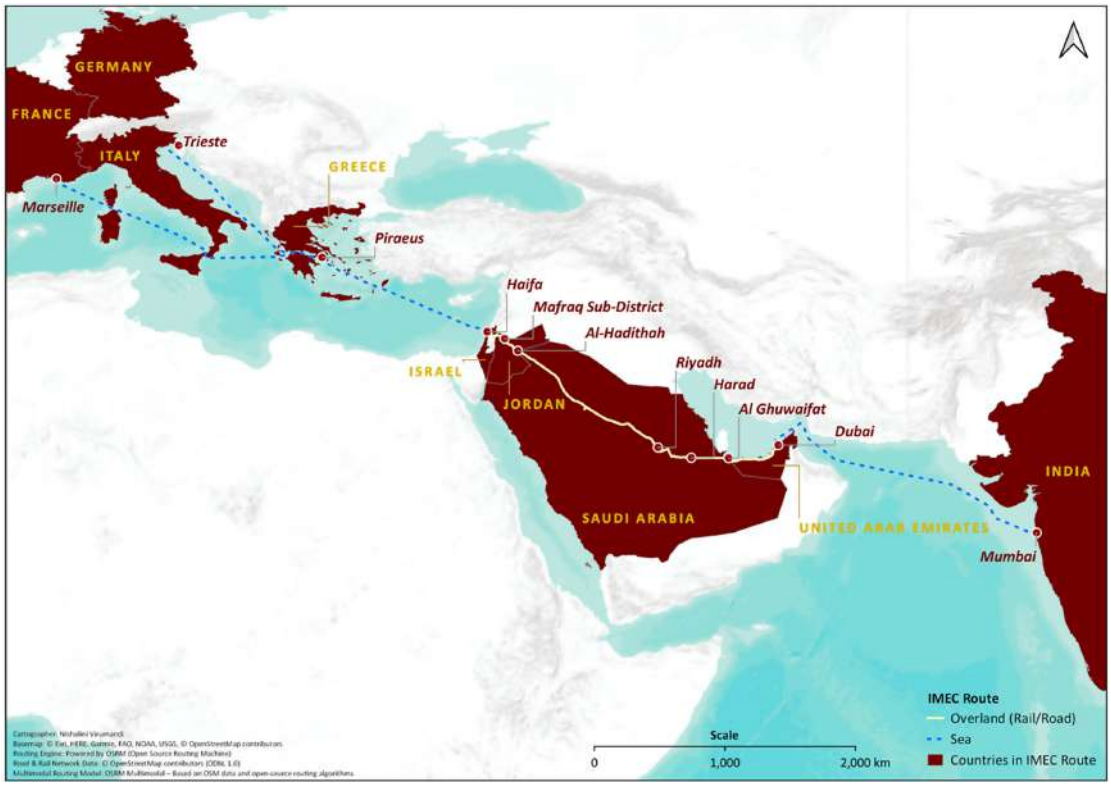
The UAE, meanwhile, boasts of ports in Fujairah and Khor Fakkan, which have risen in prominence since the eruption of the Iran war due to its location outside the Strait of Hormuz. The country also has a strong Etihad Rail network. Saudi Arabia has ports and terminals across both sides of the Gulf, headlined by ports in Jeddah, Yanbu, and NEOM on the Red Sea and ports in Dammam and Jubail on the Arabian Gulf.

Europe. The move away from Russia and the trouble with the US forces a fresh look at the opportunities on the eastern flank for energy and economic diversification and security. It aligns well with the EU's Global Gateway Initiative which is finding avenues to underwrite transition architecture and related finance globally, but particularly in the Global South. The initiative's commitment to mobilise up to 300 billion euros in infrastructure financing by 2027 creates a potential funding mechanism for IMEC segments.[22]

The proposed Web of Networks across the Middle East traverses through four complementary corridors that collectively strengthen regional connectivity and resilience.

The IMEC Route

Map 2: The IMEC Corridor



Source: Map by cartographer, Nishalini Virumandi.

The India-Middle East-Europe Economic Corridor (IMEC) was launched in September 2023 at the G20 Summit in New Delhi by India, the UAE, Saudi Arabia, France, Germany, Italy, the EU, and the US, through a Memorandum of Understanding (MoU).[23] It was proposed in the backdrop of the destabilising supply chain risks of the COVID-19 pandemic years, the commodity shortfalls from the fallout of the Ukraine War, and the emerging ambitions of countries to diversify their economic models, energy portfolios, and geopolitical alignments.

The objective was to establish a multilateral framework built around a multimodal connectivity corridor that proposes to link maritime routes with advanced railway infrastructures across India, the Middle East, and Europe. By reducing transport costs and transit times while strengthening regulatory coordination, IMEC aims to improve market access, deepen economic integration, and reinforce resilient supply chains. It rests on three mutually reinforcing pillars: energy, digital, and transport infrastructure.

Goods would travel by ship from the western coast of India (Mumbai Port, Jawaharlal Nehru, or Mundra) to the UAE (Jebel Ali Port, Fujairah, or Khalifa); continue by rail through Saudi

Arabia and Jordan to Israel's port of Haifa; for onward shipment to destinations across Europe, to ports such as Piraeus (Greece), Trieste (Italy), and Marseille (France).[24]

The UAE's logistics advantage is underpinned by the Etihad Rail network, operational since 2023, which links the country's major ports with the Saudi border. In addition, the strategic location of Fujairah on the Gulf of Oman enables maritime traffic to bypass the Strait of Hormuz, reducing exposure to geopolitical risks and enhancing the reliability of regional trade and energy flows.

Table 1: Status of Infrastructure Linkages through the IMEC Corridor

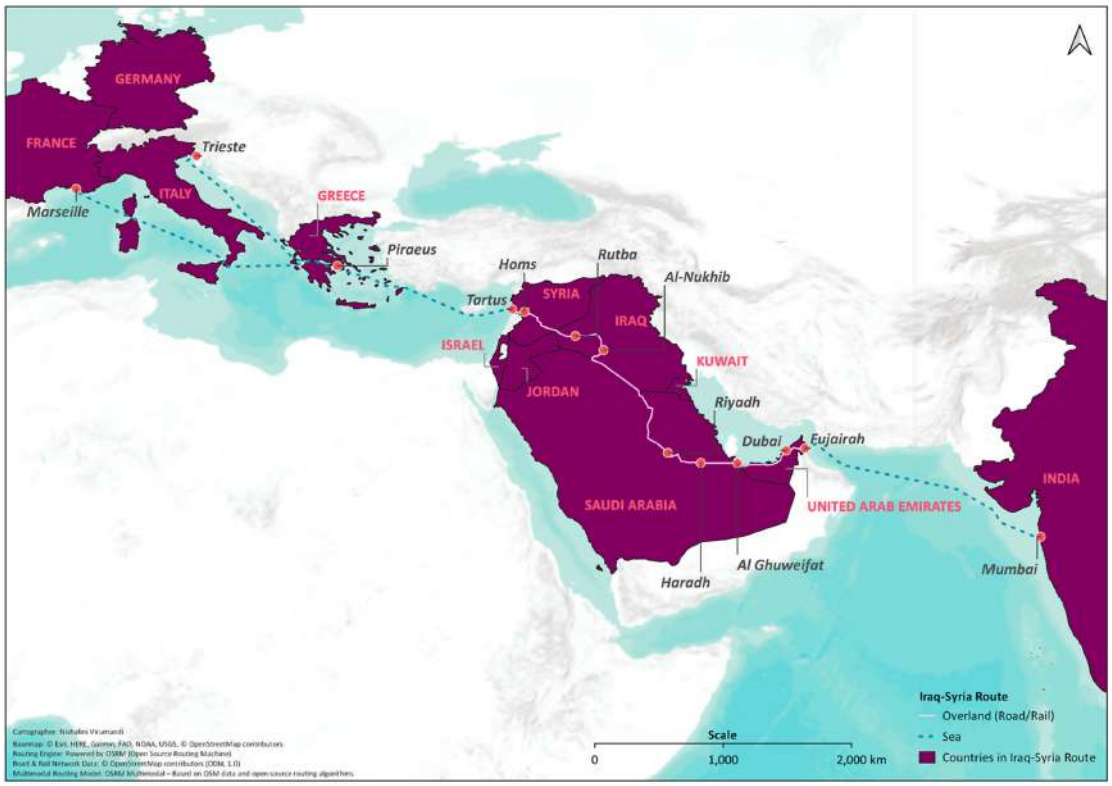
Component	Status
India–Gulf ocean freight	Fully operational
UAE domestic rail (Etihad Rail)	Operational for freight within UAE
UAE-Saudi rail link	269-km rail gap between al-Ghuwaifat in the UAE and Haradh in Saudi Arabia
Saudi–Jordan–Israel rail link	Saudi-Jordan rail link exists, but the Jordan-Israel rail link is missing and there is no confirmed construction start date
Haifa, Israel –Europe ocean leg	Route exists, but hinges on rail leg above

Sources: MEI[25] and Shipmnts[26]

The India to Gulf flank via the UAE is well established and operational. However, there is still a 269-km rail gap between al-Ghuwaifat in the UAE and Haradh in Saudi Arabia which is expected to cost around US$2 billion.[27] Furthermore, the Saudi-Jordan and Israel (Haifa) connection, which is expected to link the Gulf to Europe, is yet to be completed. The tip of Saudi Arabia's North-South Railway (al-Hadithah) is to be linked with the Jezreel Valley railway in Beit She'an, Israel (which connects to the Port of Haifa) via some uneven terrain in northern Jordan.[28] The freight rail line connecting Saudi Arabia to the Jordan border is now complete, but there has been little progress on the construction of a rail line connecting Jordan to Israel.[29]

Given the geopolitical tensions in the region, it is unlikely that the Haifa port will be utilised under the IMEC framework. In such a scenario, countries such as Iraq and Syria could serve as alternative nodes for transit until the geopolitical climate becomes stable enough to attract the required investments to complete the northern leg of the IMEC route via Israel.

Map 3: The Iraq-Syria Route



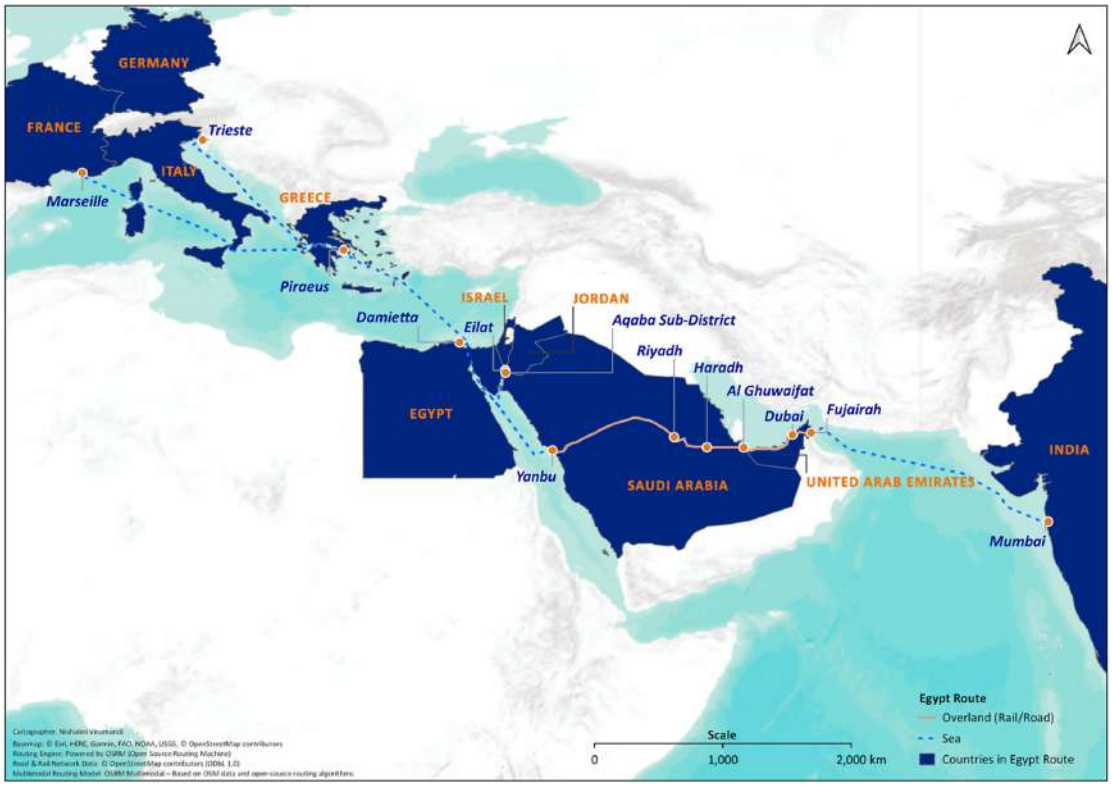
Source: Map by cartographer, Nishalini Virumandi.

The Iraq–Syria corridor represents one of the most strategically significant alternatives to the traditional IMEC route, offering a complementary westward land bridge from the Gulf to the Mediterranean. Saudi Arabia's contiguous borders with Iraq, and Iraq's onward connectivity through Syria to Mediterranean ports, provide a natural extension of the Gulf segment of IMEC. Rather than competing with the original corridor, this route has the potential to strengthen its resilience by providing an additional pathway for energy trade, logistics, and transport during periods of disruption affecting the region or key maritime chokepoints.

Launched in 2023, Iraq's Development Road Project—a 1,200-km multimodal corridor—is a national infrastructure project to reposition Iraq as a regional connectivity hub linking the Grand Faw Port in Iraq to Turkey (Ceylan), Syria (Baniyas), and Jordan (Aqaba). The Rabi'a Crossing, which reopened in 2026 after more than 12 years,[30] is an important land corridor between Iraq and Syria for trade and passenger transport. The reopening of border crossings such as Rabi'a and al-Tanf, together with the establishment of truck-based shipments from Iraq to Syria and onwards to the Mediterranean,[31] demonstrate Baghdad's and Damascus' willingness to cooperate and the potential to strengthen regional trade and energy security in the region. Iraq has allocated nearly US$5 billion towards the rehabilitation of the Basra–Haditha pipeline, connecting Iraq's southern oil fields with export routes towards Ceyhan (Turkey), Aqaba (Jordan), and Baniyas (Syria).[32]

At the same time, the easing of sanctions on Syria has created new opportunities to restore the country's historical role as a regional transit state linking the Gulf with Europe. The country's ambitious Four Seas Initiative and its Nine Corridors Initiative is aimed at positioning the country as a link between the Arabian Gulf, the Caspian, the Mediterranean, and the Black Sea.[33] Trade through the ports of Lattakia and Tartous in Syria has also increased, rising from 5.3 million tonnes in 2023 to 9.7 million tonnes in 2025.[34] Saudi Arabia is also investing in Syria, committing US$16 billion across the areas of energy, real estate, infrastructure, and telecommunications.[35] The UAE and Qatar have also extended both solidarity and financial commitments in an effort to strengthen ties with the country.[36]

Map 4: The Egypt Route

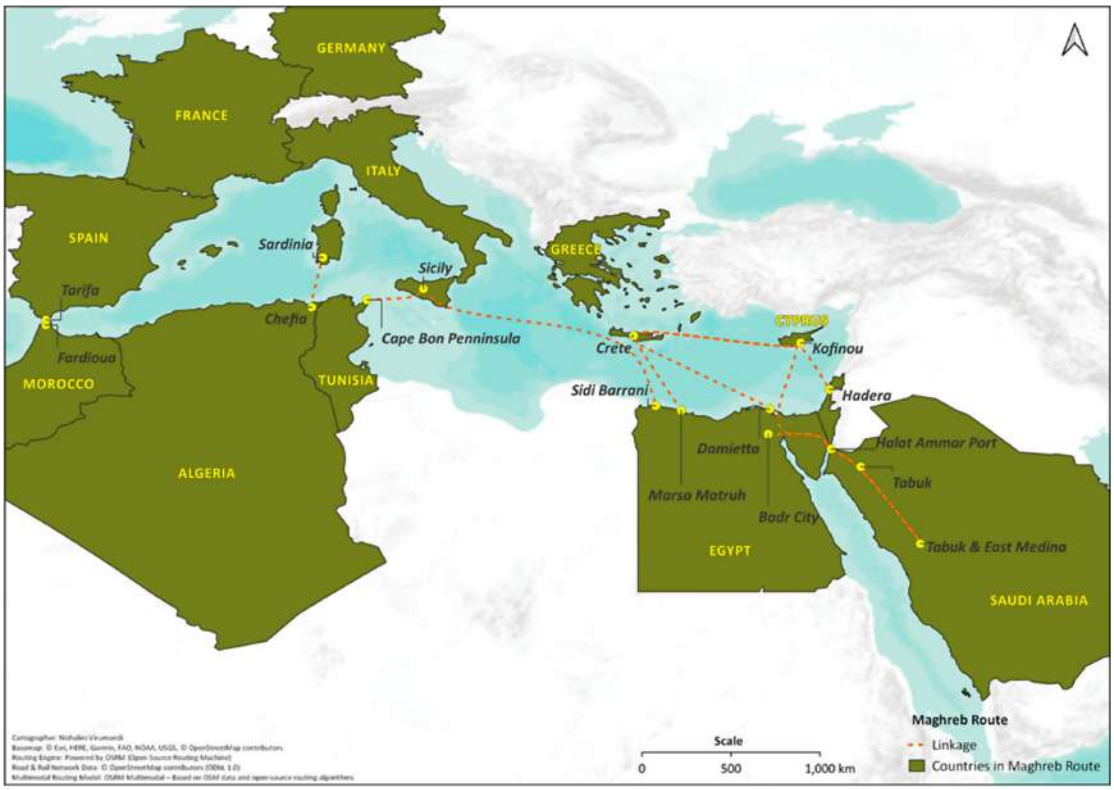


Source: Map by cartographer, Nishalini Virumandi.

Egypt is viewing IMEC with caution, concerned that it could divert trade from the Suez Canal, one of the world's most important maritime chokepoints and a major source of national revenue. Rather than competing with the Suez Canal, however, the proposed Egypt corridor can complement IMEC by providing greater redundancy and resilience in regional connectivity.

Egypt's ongoing investments in Alexandria, Damietta, and East Port Said, together with upgrades to its rail network, position it as a valuable partner within a broader connectivity framework.[37] The proposed Moses Bridge linking Saudi Arabia to Egypt's Sinai Peninsula could further strengthen Gulf–Africa connectivity.[38]

Map 5: The Maghreb Route



Source: Map by cartographer, Nishalini Virumandi.

The Maghreb corridor, comprising Algeria, Morocco and Tunisia, represents the western pillar of a diversified IMEC network, combining established natural gas infrastructure with world-class renewable energy resources. As Europe seeks to diversify both its energy sources and import routes, the region is well positioned to emerge as a major supplier of natural gas, electricity, green hydrogen, and hydrogen-derived fuels.

Oman and Turkey

Given its geographic position outside the Strait of Hormuz, Oman occupies a strategically important place within the Gulf's broader transport and logistics architecture. The country has been expanding at its Duqm and Salalah ports, and strengthening the Hafeet Rail connection between Sohar Port and Al Ain in the UAE.[39] These initiatives signal increased cooperation among the GCC countries to strengthen multimodal connectivity in the region.

However, this report does not include Oman as a core component of the proposed connectivity framework for two reasons. First, the UAE has played a more central role within IMEC and has a much stronger strategic and economic partnership with India, rather than any limitation in Oman's potential contribution. The bilateral trade between India and the UAE reached US$101.25 billion in fiscal year 2025–26, since the Comprehensive Economic Partnership Agreement took effect in 2022.[40] Both governments have revised their target upward to US$200 billion by 2032.[41] Second, Chinese investments in Oman are considered among the most ambitious and significant BRI investments in the region, and routing a Western-aligned corridor though the Chinese-invested ports raise serious concerns.[42]

However, as the trade volumes from India and the wider Indo-Pacific continue to grow, Oman could play a valuable complementary role by providing additional port capacity and logistics infrastructure, thereby reducing pressure on the UAE ports and further enhancing the resilience and flexibility of the broader IMEC network.

Given Turkey's opposition to IMEC's current configuration and the geopolitical complexities surrounding its regional relationships, this report excludes Turkey from its analytical scope.

Trade-offs and Constraints

A resilient network capable of adapting to changing geopolitical and commercial realities is favourable. It does carry, however, the risk of fragmentation and competition. Political tensions, economic challenges, infrastructure gaps, poor interoperability between financial customs, and other national security concerns can stall progress.

While the chokepoint disruptions have strengthened the case for alternative hubs and corridors, it does not insulate them from future supply disruptions and volatility. If diversification reduces systemic risks, it also could, at the same time, multiply the points of failure. The trade-offs exist and the stakeholders will have to develop an empirical framework to identify the most appropriate approach—one that delivers on both the diversification and decarbonisation objectives.

A more concerted and willing effort is required of the countries in the region if they aim to stake their claim on an energy-secure future. The authors acknowledge that any such coordination will have to overcome deep-rooted rivalries in the region, and sovereign states may prioritise absolute gains and national energy independence, especially when transit routes traverse hostile and unstable territories. However, a multi-route, multi-commodity and multimodal option can help address some of the challenges discussed above, undergirded by strong political will and sound economic synergies.

At the same time, the energy corridors proposed in this report may compete for the same capital and demand pool, thereby stripping down the others' bankability. The authors, however, do not propose that all four corridors across all five commodity types be built out simultaneously. What could be more feasible is a progression based on prioritisation, political feasibility, and availability of financial resources.

The other elephant in the room is China's flagship Belt and Road Initiative (BRI), which has undertaken massive investments in the region and which could undercut IMEC and the entire commercial logic of the proposed Regional Web. However, reducing dependence on any single actor, including China, in itself provides a strong rationale to pursue independent and diversified infrastructure projects.

2

Electricity Grid Interconnectors

ELECTRIFICATION HAS TODAY become the fastest decarbonisation lever, provided cleaner energy sources—solar, wind, hydro, biomass, geothermal, nuclear, power plants with carbon capture and storage, and others—are utilised. The transmission of electrons, i.e., electricity, is arguably the most viable option available to policymakers in the energy connectivity tool kit. Renewable electricity can be generated at one location and transmitted to another through power lines, either over land using overhead lines or under sea via specialised subsea HVDC (high voltage direct current) cables. The latter is preferable over long distances for its efficient transmission capabilities across water bodies. HVDC-receiving substations are established at both ends to manage frequency and voltage before connecting to the main grid.

Within the broader vision of establishing multimodal transport and energy corridors between India, the Middle East, and Europe, grid interconnectivity offers immense potential through round-the-clock renewable energy arbitrage driven by seasonal, time zone, and price variations. This can help countries manage supply and demand peaks, provide access to cheaper alternative sources of power, and improve grid stability—mitigating local shortages, blackouts, or disruptions especially during natural disasters or cyberattacks.

In a world that increasingly scrutinises embedded carbon, cross-border electricity trade can reduce reliance on fossil fuels imports and amplify the benefits of existing renewable energy markets across the border. An interconnected grid can also

reduce overall investment costs, lowering the total reserve requirements. Furthermore, as demand increases and grids are overwhelmed with peak demand management and greater fluctuations, interconnections are useful to manage unpredictability in both domestic demand and supply. There is also a strong case for arbitrage which should be leveraged: the cost of solar generation is lowest in the Gulf states and higher in European countries. The geographic spread of IMEC will allow countries to take advantage of differential geographic endowments and capabilities while adding to system redundancy, flexibility, and peak power output. It will improve security of supply and increasing the operational flexibility across electricity systems.

HVDC cables are not uncommon—there are 485 undersea power cables in operation worldwide, the longest being the Viking link between the United Kingdom (UK) and Denmark spanning 765 km and transmitting 1,400 MW of renewable energy across the North Sea.[43] Though 80 percent of the electricity trade occurs within Europe which has a single market and well-established infrastructure.[44] High upfront capital costs, vulnerability to physical disruption, limited flexibility with regard to fossil fuels, exposure to geopolitical risks, and the danger of fostering a new form of dependency, have all constrained cross-border grid integration.

By 2050, more than 50 percent of final energy use will come from electrification compared to only 20 percent today.[45] The share of renewables in power generation is expected to grow from 25 percent to 85 percent by 2050.[46] Given the vast economic implications of this transition, reliance on domestic generation alone will not suffice, especially for emerging economies with rapidly expanding demand.

Countries will increasingly turn to external partnerships, preferably though multiple interconnections to reduce reliance on a single route. A diversified network will reduce concentration risk, mitigate exposure to geopolitical or physical infrastructure disruptions, and allow arbitrage between varying seasons, time zones, and price points. Round-the-clock (RTC) renewable supply by bundling solar, wind, storage, and cross-border imports will be a key driver in accelerating both decarbonisation and development goals in the Global South.

Table 2: Renewable Energy Capacities, Countries in the Regional Energy Network

	2024^					
Country	Solar PV Capacity (MW)[47]	Wind Capacity (MW)[48]	Total Renewable Capacity (MW)[49]	Peak Demand (MW)	Renewable Power Generation (TWh)[50]	Total Power Generation (TWh)[51]
India	97 042	48,163	204 485	242490[52]	397.1	2,030
UAE	5 411	99	6 815	Dubai: 10, 760[53] Abu Dhabi: 14,105	15.6	167.5
Saudi Arabia	4 290	403	4 743	72900[54]	9.8	454
France	21 528 e	24 592	74 340	86,000[55]	150.8	561.3
Germany	89 943	72 823	178 655	87500[56]	284	497.3
Egypt	2570 e	2199	7 752	38,000[57]	26.6	237.4
Cyprus	724 u	158	895	1290[58]	1.3	5.7
Syria	60 e	1	1557	NA	NA	NA
Morrocco	394 e	2128	4375	7580[59]	9.8	43.5
Iraq	42 e	NA	1599	48000[60]	1.8	169.5
Italy	36 008 o	12 992	72 115	57500[61]	133.3	272.4
Algeria	437 e	10	601	19500[62]	0.8	101.1
Greece	9269 u	5357	18231	10798[63]	26.1	55.7
Israel	5363	343	5981	15400^[64]	10.7	80.6
Tunisia	773 e	245	1084	3073[65]	NA	18
Lebanon	1005 e	3	1297	NA	NA	4.135[66]
Jordan	2077 e	631	2725	4100[67]	NA	25.1[68]

Source: Authors' own, using various sources as cited.
Notes: ^2023 year in certain cases as listed in brackets
"e" follows figures that have been estimated by IRENA from a variety of different sources
"u" follows figures that have been obtained from unofficial sources, such as industry associations and news articles
" "o" are figures that have been obtained from official sources such as national statistical offices, government departments, regulators and
power companies"

Infrastructure

a. IMEC Route

India → Gulf Connectivity

India and the Gulf states are leaders in low-cost solar generation. India entered into agreements with Saudi Arabia in 2023[69] and the UAE in 2024[70] to explore grid connectivity through undersea cables across the Arabian Sea to transport electricity. The proposed subsea cable to Saudi Arabia is expected to measure 1,700 km and cost INR 470 billion, while the UAE link may extend up to 1,400 km and cost INR 435 billion. A similar arrangement is being explored with Oman.[71]

The objective is to transform regional energy trade via bi-directional electricity flows especially during peak demand and emergencies. Technical feasibility studies are underway. The proposal envisions an initial 3 GW (2 x 1.5 GW) in Phase-I expanding to almost 20 GW over the next decade.[72] These ambitions align with India's One Sun One World One Grid (OSOWOG) initiative that envisions a globally interconnected renewable energy grid. For context, India already exchanges about 4,100 MW of electricity with its neighbouring countries, such as Nepal, Bangladesh, Bhutan, and Myanmar.[73]

Intra-Gulf Connectivity

The GCC Interconnector (GCC-I), launched in 2009 by the Gulf Cooperation Council Interconnection Authority (GCCIA),[74] has demonstrated the technical viability of regional grid interconnection among the gulf countries—Saudi Arabia, the UAE, Bahrain, Qatar, Kuwait, and Oman. However, commercial electricity trading has been limited except in emergencies. This is largely due to regulatory fragmentation and divergent subsidy regimes across Gulf states. The GCCIA is now making substantial investments to strengthen the grid network among the six Gulf countries and further expand the Gulf electricity market to neighbours in Iraq, Jordan, and Egypt by 2026, and possibly Syria in the future.[75]

Gulf/ME → Europe Interconnectivity

Currently, no GCC-to-Europe power interconnector exists nor is one being planned. However, linking the GCC grid to Europe via Egypt, Jordan, or Iraq could enable seasonal two-way power exchanges, leveraging complementary demand cycles. However, the Great Sea Interconnector (GSI) links Israel, Cyprus and Greece and even though Israel is not an official IMEC signatory, it does have the potential to serve as a long-term interconnection node.[76]

Israel

Israel sits at the most crucial axis connecting the East and the West. The EuroAsia Interconnector connects Israeli electricity grid with Cyprus and Greece through HVDC submarine cables to facilitate renewable electricity trade between the Eastern Mediterranean and Europe.[77] The project is supported by the European Union. However, Gulf connectivity to Israel remains unlikely at present and will be contingent on normalisation in the region and the evolution of the peace process.

Intra-Europe Grid Connectivity

The ENTSO-E (European Network of Transmission System Operators for Electricity) is responsible for the cooperation between European transmission system operators (TSOs) to ensure security of the inter-connected power system at the pan-European level and the development of European interconnected electricity markets.[78] It also oversees the integration of electricity generated from renewable energy sources and of emerging technologies. The ENTSO-E is undertaking feasibility research exploring the potential of linking Europe's electricity market with those of the Middle East and North Africa.

The EU has committed €584 billion over the period 2022-30 to expand the region's transmission and distribution infrastructure, which will include efforts to expand cross-border transmission capacity by 64 GW across the bloc.[79] This will be deployed to increase renewable capacity and reduce congestion costs. Expanding this network to non-EU countries, MENA and the wider Mediterranean region will strengthen the cross-collaboration efforts in electricity interconnections. Green Aegean Interconnector (Germany – Greece) is another example of regional interconnections. It is also important to highlight the role of the TYNDP in this regard, which is a Ten-Year Network Development Plan responsible for the electricity transmission infrastructure, managed every two years by ENTSO-E for electricity and ENTSOG for gas. It identifies investment gaps, including cross-border capacities, proposes infrastructure projects and supports adequate cross-border interconnections.[80]

b. Alternate Route #1 – via Egypt

Egypt's geopolitical centrality and existing infrastructure positions the country as a regional hub for energy integration. The EuroAfrica interconnector (Greece – Cyprus – Egypt), proposes HVDC submarine cables linking Burullus in Egypt to Kofinou in Cyprus (498 km) and then to Fodele in Crete (898 km) and eventually to mainland Greece.[81] It will have a bidirectional capacity of 2,000 MW through water depths up to 3,000 metres.[82] This project aims to provide a direct link between the European and African grids, facilitate the export of renewable energy, and enhance energy security across both regions. A feasibility study is underway to address technical challenges.

Separately, the Greece-Egypt interconnector (GREGY) would run from Sidi Barrani on the North-Western Egyptian coast directly to Nea Makri in mainland Greece near Athens, bypassing Crete and Cyprus.[83] It will have a 3,000-3,500 MW capacity intended to carry exclusive renewable electricity (75 percent wind and 25 percent solar).[84] Another proposal includes the Green Vein project from West Sohag in Egypt to the Dolo Substation near Venice in Italy, running 2,800 km and 3,000 metres deep with a capacity of 3,000 MW.[85] Connecting Egypt to the Gulf grid could further enhance this corridor's strategic value.

c. Alternate Route #2 – via Iraq and Syria

The shortest route between India and Europe would run via the UAE, Iraq, and Syria. While attractive on the drawing board, this option is constrained by regional instability, sanctions, and damaged infrastructure due to prolonged conflict and disruptions. Power stations and grids in Iraq and Syria have suffered from years of massive neglect, destruction, and under-investment. The GCC Grid is working on a link to Iraq through Kuwait with an initial planned capacity of 0.5 GW going up to 1.8 GW.[86] Syria is also witnessing a surge in investments, particularly from Saudi Arabia, alongside enjoying goodwill from Europe and the US. If stabilisation continues, this route may regain visibility.

d. Alternate Route #3 – via Maghreb (Algeria, Morocco, Tunisia)

Another complementary source of renewable electricity to Europe is via North Africa—the Maghreb region, primarily, including Morocco, Tunisia, and Algeria.

The Morocco-Spain connection is one of the strongest existing ones facilitating electricity trade between the EU and the MENA region via two high-voltage direct current (HVDC) submarine cables across the Strait of Gibraltar.[87] Another project is the proposed Xlinks to connect Morocco to the UK via a 2,300-mile subsea cable delivering 3.6 GW of solar and wind power, almost 8 percent of British electricity demand.[88] Italy is also in discussions with Tunisia (0.6 GW) and Algeria (up to 2 GW), for renewable electricity supplies via subsea cables.[89] The lack of storage capacity presents a strong case for passing on the excess energy to neighbouring countries and expanding the north-south interconnections. The ELMED (Italy-Tunisia) interconnector between Tunisia (Mlaabi, Cape Bon Peninsula) and Sicily (Partanna) is a 220-km submarine cable with a HVDC that will operate at a rated power of 600 MW.

Electricity Trading and Market Design

Other than physical interconnectors, a compatible market design for electricity trading is crucial to ensure seamless cross-border electricity trade. Electricity is unique in one aspect—without advanced storage technologies—the entire value chain from generation, transmission, distribution to consumption should take place in real-time. This makes the job of grid operators critical in order to manage the demand and supply through balancing mechanisms and ancillary services that maintain system volume, frequency, and voltage stability. As renewable penetration increases—particularly intermittent solar and wind—this balancing function becomes more complex and valuable.

A structural asymmetry exists: different countries operate under varied market dynamics. The EU, for example, operates under a liberalised and integrated wholesale electricity market; meanwhile, India has a hybrid model of privatised generators and public distributors; and majority of the utilities in the Middle East enjoy government subsidies and have historically been shielded from competition. Oman is the only country in the Gulf which has a genuine market for electricity, launched in March 2022. For cross-border trade to function efficiently, reforms may be required in areas such as third-party grid access, congestion pricing, exchange platforms, and financial settlement systems.

A resilient cross-border strategy should distinguish between baseload security and peak flexibility.[a] This report argues that given how baseload underpins a country's economic and political sovereignty, it should be secured domestically. Above the baseload threshold lies variable and peak demand. During heatwaves, cold spells, unexpected outages or for specific industrial purposes such as data centres—cross-border electricity arrangements are imperative. Building sufficient domestic generation to cover seasonal peak events is economically inefficient.

The seasonal arbitrage between the west and east offers another reason to trade. During peak periods, imported renewable electricity may be cheaper than ramping domestic gas or coal generation, especially where carbon pricing affects short-run marginal costs. Countries will have to enter power purchase agreements for a set capacity and price over the year based on peak load projections and rely spot pricing on any additional capacity demands. Harmonised grid codes, settlement procedures, and balancing arrangements are critical to maintaining system integrity across borders.

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a 'Baseload' refers to the minimum continuous level of electricity required to sustain an economy over a full day and includes critical sectors such as industrial demand, healthcare, and transport infrastructure, among others.

Table 3: Challenges to Interconnections in Electricity

Technical	Much of the existing transmission infrastructure across the participating countries continue to rely on old grids leads which were designed for domestic power systems and alternating current (AC) transmission. This can lead to inefficiencies and difficulties in cross-border integration, as the transmission networks are not compatible to adjust and import electricity through modern HVDC networks that are increasingly preferred for long-distance electricity trade. Furthermore, differing grid frequencies, voltage standards, operating procedures, and grid codes complicate system interoperability. In the case of renewable energy generation, the situation is compounded by the intermittency challenge which requires advanced storage solutions, grid balancing and management, and flexible backup generation.
Economic	The commercial viability of large-scale cross border electricity projects remains uncertain given the high upfront capital costs, the long asset lifecycles, and extended and slower payback periods. Investments required in HVDC transmission systems, subsea cables, converter stations, and associated grid upgrades will be significant. Moreover, fluctuating global energy prices, future electricity demand, the direction of national electrification pathways, and renewable energy deployment of the participating countries will also dictate the economic rationale of such investments. While national assets will be the responsibility of the member countries, the question arises of who pays for the cross-border undersea cables in international waters when countries not directly linked may also benefit. If the linkages are not complete, there is another issue of stranded assets and sunk costs.
Security	Countries are not prepared to rely on external countries for their crucial electricity supply. It raises concerns of energy security, national sovereignty, and the potential weaponisation of electricity supplies during periods of geopolitical tension. These concerns are compounded when the routes are passing through politically sensitive regions. There is also the risk of infrastructure being the subject of either cyberattacks, sabotage, or military strikes during periods of conflict.
Geopolitical	Persistent instability and unresolved conflicts in the region reinforce the need for redundancy and alternative corridors, and at the same time make long-term infrastructure investment risky, particularly for the private sector. Proposed transit routes through countries such as Syria and Iraq continue to face uncertainty, making long-term infrastructure commitments difficult to justify for both governments and private investors.

Regulatory	Cross-border electricity exchanges among countries is relatively complicated due to varying regulatory standards and electricity market liberalisation stages of participating countries. There is regulatory fragmentation across jurisdictions, which makes interoperability a challenge in terms of grid codes, market structures, tariff methodologies, pricing mechanisms, electricity trading and infrastructure planning, transmission access rules, and revenue-sharing arrangements. This makes a comprehensive electricity market integration in the near term nearly impossible. However, cross-border electricity interconnections can be feasible with a stronger regulatory coordination. The high CapEx and lengthy regulatory approvals for subsea cables further complicate project development.
Socio-Environmental	Middle East, Asian and North African countries are seeing rising electricity domestic demand due to increasing populations and urbanisation, as well as bold national AI ambitions that could pose a challenge to cross-border electricity exports. For instance, Egypt is already experiencing periodic gas shortages and electricity supply constraints, placing pressure on national power systems. Governments are thus likely to prioritise domestic energy security before committing generation capacity for export. At the same time, large-scale electricity infrastructure must comply with increasingly stringent environmental and sustainability requirements, including ecosystem protection, land-use considerations, marine biodiversity impacts associated with subsea cables, and broader climate and social safeguards.

Source: Authors' own

3

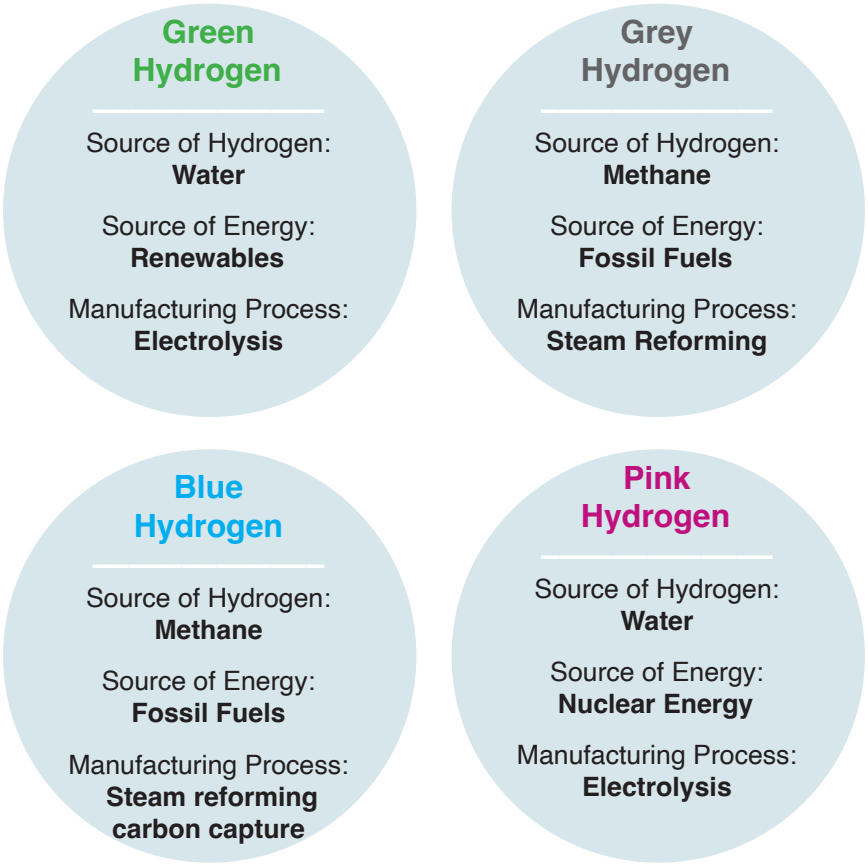
Hydrogen and Derived Commodities

HYDROGEN HAS GAINED TRACTION as a potential long-term solution to long-term energy security and accelerating industrial decarbonisation. Disruptions to fossil fuel trade due to the crisis in the Middle East positions domestic low-carbon hydrogen development as a security imperative to safeguard industries reliant on hydrocarbon feedstock or fuel from geopolitical volatility. Moreover, industry accounts for over 21 percent of global greenhouse gas emissions, while iron, steel, cement, and chemicals compose 71 percent.[90] These sectors are among the most challenging to decarbonise because production processes are highly carbon-emitting and require high temperatures and high energy density.[91] For instance, steel production requires high heat to strip oxygen from iron ore;[92] cement requires high temperatures to produce its primary component, calcium oxide, and the chemicals industry requires fossil fuel feedstocks to transform into final products.[93] There are few cost-effective and commercially scalable substitutes to make these industries less energy-intensive and reduce their emissions as well.

Green hydrogen, produced from renewable-driven electrolysis of water, can fill this gap, at least in theory, due to its cross-cutting applicability. Demand for hydrogen is most relevant in sectors where there are few scaled and cost-effective alternatives and electrification is not possible. To illustrate, approximately 60 percent of the value of

green hydrogen stems from end-use applicability in hard-to-abate industries compared to 25 percent from production and 15 percent in mid-stream. Hydrogen can be converted into carriers such as ammonia, methanol, and liquid organic hydrogen carriers (LOHCs).[94] Hydrogen carriers such as ammonia can be transported and applied directly as feedstock in fertiliser and chemicals or reconverted into hydrogen through "ammonia cracking" at destination markets.[95] Reconverted low-carbon hydrogen can replace fossil fuels to generate direct reduced iron (DRI) from iron ore through the hydrogen-DRI method.[96] In the long-term, hydrogen can be used as a fuel for heavy road and maritime transport industries, in addition to supporting grid stability in the power sector as it increasingly accounts for the variability of renewables.[97]

Figure 1. Types of Hydrogen and Manufacturing Processes



Source: Anemel 2023[98]

Although European, Middle East, and Asian countries have established ambitious hydrogen targets to harness these benefits, the pace of infrastructure implementation has declined due to technical challenges associated with transporting hydrogen across long distances, high financing costs for electrolysers and batteries, regulatory fragmentation, a lack of secure offtake agreements, and pressure on limited water resources in arid areas.[99]

Hydrogen Transport Options and Trade-offs

Transporting hydrogen in its gaseous or liquid form requires large-scale infrastructure for transport, storage, and conversion.[100] To illustrate, hydrogen can be compressed as a gas and transported through pipelines for large volumes or tube trailers for smaller deliveries in emerging markets. Tube trailers are less economically viable for long distances, while pipeline delivery is cost-effective for distances up to 1,500 km. However, a limited number of hydrogen pipelines (4,500 km) currently exist globally.[101] Constructing new pipelines or retrofitting existing natural gas infrastructure is also costly, requiring long-term planning coordination and off-takes between exporting and importing countries. Moreover, despite the appeal of retrofitting, it faces technical challenges such as hydrogen embrittlement.[b]

To increase transport capacity, hydrogen can be converted into liquid and transported through cryogenic tanker trucks or marine shipping.[102] While cryogenic tanker trucks can carry up to 4,000 kg of liquid hydrogen, there are risks of energy loss from liquid vaporisation. Marine shipping of liquid hydrogen can enable inter-continental transport, but transport requires specialised carrier ships which are costly. Converting hydrogen into its liquid form is also energy-intensive due to low-temperature cooling needs, and results in an initial loss of hydrogen content.

Hydrogen can also be chemically converted into derivative hydrogen carriers such as liquid ammonia.[103] This conversion facilitates the transport process since ammonia liquefaction is less energy-intensive, ammonia is highly dense, and transport can occur through existing global infrastructure. However, ammonia cracking technologies to reconvert ammonia to hydrogen gas at destination facilities are yet to mature.[104] Similarly, liquid organic hydrogen carriers can also be transported using existing infrastructure but faces energy loss drawbacks from dehydrogenation to release the hydrogen.

High Production Costs

Levelised cost of hydrogen (LCOH) remains largely costly, but LCOH is projected to decline in regions such as the Middle East. In 2023, the average green hydrogen production costs US$ 4.5 - 12/kg, which is significantly higher than blue and grey hydrogen which costs US$ 1.8-4.7/kg and US$ 0.98 - 2.93/kg, respectively.[105] Because of these cost differences, demand for ‘grey’ hydrogen currently dominates, while ‘green’ hydrogen comprises less than 1 percent of global supply.[106]

Nevertheless, LCOH remains capital-driven, shaped by the financial, industrial, and geographic profiles of countries. For example, Middle East countries boast an abundance of solar and wind, desalination technologies to meet water demand from electrolysers,

b Hydrogen embrittlement is a process where metal components become brittle and crack because hydrogen gas enters inside them.

policy momentum, and infrastructure progress—all of them contributing to favourable cost conditions. To illustrate, the LCOH for green hydrogen produced from electrolysis using solar photovoltaics is expected to fall from US$ 5.9 - 8.2/kg in 2025 to US$ 3.6 - 6.1/kg in 2030.[107]

While the Hormuz crisis has contributed to higher fossil fuel prices which temporarily reduces the cost gap between low-emissions hydrogen and fossil fuels, the trend of high fossil fuel prices would need to be prolonged in order to make a tangible impact on project de-risking and investment decisions.[108]

The following analysis examines the infrastructure status underwriting production, transit, and storage of ammonia, methanol, and hydrogen gas through the IMEC corridor and the alternative routes proposed in this report.

Table 4: IMEC Country Hydrogen Targets, Demand, and Production

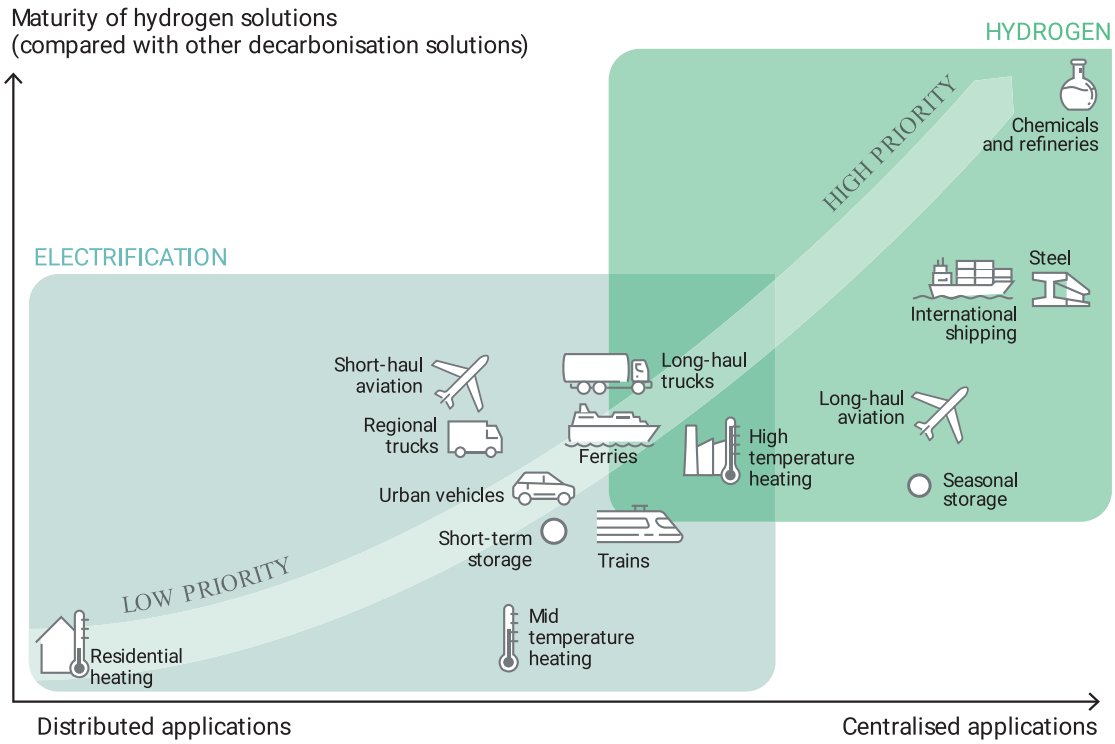
Category	India	UAE	Saudi Arabia	Jordan[109]	Israel[110]	Italy[111]	Germany[112]	France[113]	EU[114]	US[115]
Targets	By 2030: - 5 Mtpa green hydrogen production [116] -125 GW of new renewable energy capacity dedicated to green hydrogen production[117]	By 2031: - 1.4 Mtpa blue and green hydrogen by 2031 -15.3 GW Solar PV capacity and 8.7 GW electrolyser capacity for green hydrogen[118]	By 2030: -2.9Mtpa blue and green hydrogen production -63.8 GW Renewable Energy capacity tendered by 2030	By 2030: 500,000 tpa for maritime export of green H2 -By 2030: 8GW of renewables and 5GW of electrolyser capacity	By 2030: 5GW of electrolyser capacity	By 2030: 0.3Mtpa hydrogen production By 2030: 5 GW of electrolyser capacity[119]	By 2030: 1 mtpa green hydrogen production By 2030: 10GW green hydrogen electrolysis capacity[120]	By 2030: 4.5 GW electrolysis by 2030[121]	By 2030: Produce 10Mtpa domestically[122] By 2030: 40 GW of domestic electrolyser capacity[123]	By 2030:10Mtpa[124]
Projected Hydrogen Demand	By 2030: total hydrogen could reach 15-20 mmpta	By 2031: 2.7 mpta of domestic low-carbon hydrogen demand	By 2030: Saudi aims to fill 10 percent of global hydrogen demand	By 2030: domestic hydrogen demand is projected to reach up to 128 kt	By 2050: 0.55 Mtpa projected demand	By 2030: hydrogen will compose 2 percent of final energy demand.	By 2030: Hydrogen demand will be 95-130 TWh (hydrogen and its derivatives together), of which 50-70 percent will be met by imports from abroad[125]	By 2030: -Electricity demand for hydrogen will be 20-30 TWh -Transport: 0.15-0.18 Mt/yr -Steel, fertilisers, & chemical: 0.05-0.19 Mt/yr[126]	By 2030: renewable fuel of non-biological origin must account for at least 42 percent of hydrogen used in industry[127]	Projected demand for power-to-liquid fuels, steel, methanol, energy storage
Current Average Levelised Cost of Hydrogen Production	2023: 3.2 US$/kg for green hydrogen[128] 2023: 727 US$/tonne for green ammonia[129]	2023: 2.7 US$/kg for green hydrogen 2023: 629 US$/tonne for green ammonia[130]	2023: 2.9 US$/kg for green hydrogen 2023: 686 US$/tonne for green ammonia[131]	2023: US$ 3.89/kg	-	3.25 EUR/kg - 9.77 EUR/kg[132]	3.15 EUR/kg - 8.99 EUR/kg[133]	3.33 EUR/kg - 7.43 EUR/kg[134]	3.3 EUR/kg - 10.5 EUR/kg[135]	2020 baseline cost for hydrogen: $5/kg[136]

Source: Authors' own, using national hydrogen roadmaps, the IEA Global Hydrogen Review 2025,[137] European Commission,[138] and GH2.[139]

Green Hydrogen Derived Commodities

Expanding end-use markets that can benefit from low-emissions hydrogen production will also help unlock near-term demand.[140] Nevertheless, given the unique cost, technical feasibility, and geopolitical considerations, hydrogen integration should be prioritised in sectors with few viable electrification alternatives. Michael Liebreich's Hydrogen Ladder categorises these distinctions, prioritising hydrogen end-use applications based on whether or not the sector has a clear decarbonisation alternative.[141] To illustrate, hydrogen exhibits the most potential for the fertiliser sector which has undergone global shortages due to Strait of Hormuz trade disruptions, revealing the sector's supplier overconcentration vulnerabilities and lack of scalable alternatives for ammonia.[142] Shipping and steel also exhibit potential for hydrogen adoption, while chemicals and aluminium rank lower because less costly electrification or bio-based options are available at scale (see Table 5).

Figure 2: Renewable Hydrogen Priority Setting



Note:

On the x-axis, the end uses are placed according to the estimated average daily hydrogen demand for industry, refuelling stations and combustion devices, with a power relationship. On the y-axis the end uses are placed according to the differences between the technological readiness levels of hydrogen-based vs electricity-based solutions. This is not a static picture and priorities could change over time according to advances in technologies.

Source: IRENA 2022[143]

Table 5: Commodity Applications of Hydrogen

Hydrogen Commodity Applications	Role of Hydrogen and Rationale	Key Policies and Infrastructure	Supply-Demand Dynamics and Restrictions
Green Fertilisers	Green ammonia can serve as a chemical feedstock for fertiliser. This reduces emissions from the Haber-Bosch process and import dependence on natural gas.[144]	**India:** Mandated its fertiliser sector to increase green hydrogen use from 5 percent in 2024 to 20 percent in 2028.[145] This is supported by demand-aggregation tenders like the Solar Energy Corporation of India (SECI) which issued procurement of renewable ammonia for 13 pre-selected fertiliser plants.[146] **Oman**: Leveraging water electrolysis-based green hydrogen for fertiliser production as of 2024.[147]	**Geopolitical Vulnerability:** The Middle East crisis doubled urea prices, accelerating rationale for domestic green ammonia to safeguard national food security. **Market Uptake:** Well-positioned for domestic uptake in India and Europe, though production costs remain higher than fossil-based equivalents.[148]
Green Steel	Green hydrogen serves as a reducing agent for direct-reduced-iron (DRI), replacing coal in the blast furnace.	**Germany:** 12 projects in the pipeline[149] **UAE**: Masdar and Emirates have instituted an operational pilot project that produces green steel using green hydrogen.[150] **UAE:** Masdar and EMSTEEL have developed an operational pilot to produce green steel from green hydrogen.[151] **Oman:** A hydrogen project was announced in Duqm SEZ and Salalah FZ for green ammonia and steel export. **India:** As the second largest global steel producer, India has several pilots underway, including a 25MW green hydrogen project between JSW Energy and JSW Steel in Vijayanagar, Karnataka, India.[152]	**Delayed FIDs:** Tenders for green steel in Europe have been delayed or stalled due to high upfront capital costs and rising regional risk premiums.[153] **Carbon Pricing Dependency:** Although steel production yields high emissions, its low energy-to-product cost ratio makes low carbon hydrogen's economic viability dependent on carbon prices to offset the "green premium".[154]

Green Chemicals	Hydrogen gas can be used as a feedstock for the (petro)chemical industry or as an alternative heat source to natural gas. Replacing fossil fuel feedstock with green ammonia could reduce chemical production emissions by up to 32 percent.[155]	**France:** Masshylia project is expected to contribute to biofinery decarbonisation in the Fos-Berre industrial-port zone.[156] **Germany:** a 54MW PEM electrolyser will produce 8000 tonnes of green hydrogen for a chemicals company. Germany's Energy and Climate Fund also allocates EUR 45 million to transition the steel, cement, and chemical industries[157]	**Alternative Feedstocks:** Bio-based feedstock alternatives exist for chemicals, reducing hydrogen's applicability. **Capital-Intensive Infrastructure Limitations:** Captive steam methane reforming systems will need to undergo capital-intensive alterations to electrolysis-based ones to integrate green ammonia.[158] **Chokepoint Replication Risk:** Reliance on methanol and chemical exports from the Middle East increases trade vulnerabilities for the global supply chain.
Cement and Aluminium	Although cement and aluminium production rely heavily on fossil fuels to generate high-temperature heat, hydrogen is only being piloted for specific high-heat recycling furnaces.[159]	**Germany:** Established green procurement standards to encourage green hydrogen use in aluminium and cement sectors.[160] **UAE:** Emirates Global Aluminium is producing aluminium using solar power but is expanding to hydrogen.[161] There are also significant but unharnessed opportunities for India's cement industry to take advantage of green hydrogen as a tool for sector decarbonisation.[162]	**Electrification Alternatives:** Direct electrification and CCUS are more efficient and lower-cost alternatives compared to hydrogen **Capital-Intensive Infrastructure Limitations:** High regional interest rates have slowed investments required for cement CCUS and aluminium kiln retrofits.

Source: Authors' own

Infrastructure

a. IMEC Route

Given rising industrial demand, energy security, and technical considerations, India, Saudi Arabia, and the UAE can, in theory, serve as production and export hubs for green ammonia, with domestic industries and the EU as the primary market.

India: In 2022, India's Ministry of Power launched a Green Hydrogen Policy which outlines standards for sourcing renewable electricity for green hydrogen production, establishes provisions to aggregate demand across sectors, and allocates land for renewable energy parks. In 2023, the Ministry of New and Renewable Energy launched the National Green Hydrogen Mission to create demand for green hydrogen as a substitute for fossil fuel and fertiliser imports; incentivise supply of green hydrogen through the Strategic Interventions for Green Hydrogen Transition (SIGHT) programme which provides gap funding for green hydrogen production and supports electrolyser manufacturing; and strengthen the enabling environment. Consequently, at least six states have introduced dedicated hydrogen policies. Despite strong policy signalling, infrastructure development has encountered delays.[163] As of August 2025, 2.8 percent of green hydrogen projects in India were operational and 94 percent of the planned capacity has not surpassed the announcement stage, largely due to conflicting global demand signals.[164]

Saudi Arabia: As the largest green hydrogen project under construction and rapidly approaching operationality, NEOM will have a 4GW solar and wind plant powering a hydrogen-ammonia plant to produce 1.2 Mtpa of green ammonia using 2.2 GW of electrolysers.[165] NEOM secured full FID from a joint venture between the nation's sovereign wealth Public Investment Fund, ACWA Power, and Air Products.[166] In late 2025, Saudi Arabia also announced plans for the Yanbu Green Hydrogen Hub, a self-sustaining plant that will generate electricity from renewables and leverage desalination to supply water for electrolysis and ammonia conversion, aiming to double the capacity of NEOM and reach operationality by 2030.[167] Although half of Saudi Arabia's projects would rely on the Strait of Hormuz for exports, Yanbu's alternative positioning along the Red Sea strengthens the resilience of export prospects.[168]

UAE: The UAE aims to catalyse domestic use and export of hydrogen and ammonia through its National Hydrogen Strategy, targeting 1Mtpa of green hydrogen per year in 2031.[169] The DEWA-Siemens Joint Venture Green Hydrogen Pilot 1 Plant serves as an operational pilot plant leveraging a 1.25 PEM electrolyser to produce 400kg of green hydrogen gas daily.[170]

Derivatives: Ammonia and methanol can then be transported through the Port of Aqaba in Jordan or Israel to meet the bulk of demand which lies in Europe.

Jordan: Jordan is eager to become a Power-to-X regional player, strengthening investments to retrofit existing port infrastructure, ramping up local demand, and solidifying plans to export green ammonia and methanol to Europe and Asia.[171] Jordan's draft National Green Hydrogen Strategy underscores efforts to transport green ammonia via sea, from the Port of Aqaba in the short-term and indicates plans to transport hydrogen as a gas through

pipelines in the medium to long-term.[172] To increase hydrogen production viability, Jordan is actively enacting land concessions and enabling special rights and advantages in the Aqaba special economic zone.[173,174]

Israel: Transmission hub infrastructure is also emerging, albeit in largely nascent stages, in Israel. Israel's National Hydrogen Strategy fosters the enabling environment for green hydrogen production.[175] The country has approved the construction of a 400-km hydrogen pipeline[176] spanning the Jezreel Valley in the north to Eilat in the south, with plans to connect the Gulf to Europe.[177] Green ammonia can also be transported by tanker from the port of Ashdod to European ports and reconverted into green hydrogen through cracking.[178] Moreover, in late 2025, Israel announced a 40-million shekels plan to transform Eastern Negev into a hydrogen and innovation valley with refuelling stations and pilots.[179] However, connecting hydrogen from NEOM in Saudi Arabia to Israel would require normalisation between the two countries and hefty infrastructure investments.[180]

EU: Hydrogen is central to the European Union's emissions reduction strategies, yet each IMEC-affiliated country prioritises domestic production versus imports differently, setting back EU Hydrogen Backbone ambitions to develop cross-continental hydrogen pipelines, storage facilities, and import corridors. Broadly, the European Union has devised two targets: to produce 10 million tonnes (MT) of green hydrogen domestically, and to import 10 MT of green hydrogen. In support of low-carbon hydrogen production, the EU has developed the European Hydrogen Bank, European Clean Hydrogen Alliance, REPowerEU, and the Fit for 55 packages.[181]

However, the EU states have their own priorities. France, for example, is focusing on domestic hydrogen production and internal deployment through hydrogen valley development to decarbonise refineries or leverage as ammonia, placing less emphasis on investments in cross-border interconnectivity.[182] Conversely, Germany exhibits an import-oriented strategy, with policies aiming to meet 50 to 70 percent of industrial demand through imports, while scaling domestic electrolysis capacity remains a secondary objective.[183] Italy, for its part, forecasts both domestic production and import pathways, with its National Hydrogen Strategy outlining two scenarios: one plan meets 70 percent of demand with internal production and the remaining 30 percent through imports, while the second plan meets 20 percent of demand domestically and 80 percent through imports.[184] These policy divergences are reflected in the infrastructure progress of the European Hydrogen Backbone. Although the plan outlines tens of thousands of kilometres of hydrogen pipelines, only segments in Germany and the Netherlands with third-party access are operational or under construction.[185]

b. Alternate Route #1 – via Egypt

Given geopolitical uncertainty across the Middle East, an alternative transit route for green ammonia and e-methanol exists through Egypt and the Suez Canal.[186] Egypt has invested US$63.8 billion in green hydrogen efforts, six times more than what Saudi Arabia and the UAE have earmarked for theirs.[187] Infrastructure development is already underway to support this route, enabling Egypt's energy security amidst declining gas resources.[188] Egypt is actively developing a hydrogen hub in Ain Sokhna to cluster production with the Suez Canal Economic Zone. This would facilitate centralised production, storage, and export facilities to lower costs and promote infrastructure development. Egypt's green hydrogen pursuits are compatible with Europe's plans to import 10 million tonnes of green hydrogen by 2030.[189] As part of H2Global's contracts, the UAE's Fertiglobe was awarded a contract to supply 397 kt of ammonia via the port of Rotterdam from Egypt's Ain Sokhna port from 2027 to 2033.[190] In tandem, the UAE's Masdar envisages producing renewable bunker methanol in the Suez Canal, with plans to expand production to 2.3 million tonnes of renewable ammonia annually from 2026 onwards, though there has been no official update at the time of writing this report.[191]

Developing an alternative route through Egypt and the Suez Canal would be beneficial for green hydrogen trade since demand is highly localised and centralised production would help the area become a green refuelling station for ships in the future.[192] Egypt's access to relatively low-cost and abundant solar and wind power resources would also help reduce the costs of green hydrogen production in the long-run, pending coinciding reductions in electrolyser technology costs.[193] Limitations include renewables being redirected towards green hydrogen production in lieu of supplying the domestic grid, the potential for goods to be entrapped in the Suez Canal bottleneck, and potential competition with Saudi Arabia's green fuel bunkering aspirations in the Red Sea.[194] However, Saudi Arabia has already established an agreement to support green ammonia production in Egypt.

c. Alternate Route #2 – via Maghreb (Algeria, Morocco, Tunisia)

The North Africa region has high potential for low-cost hydrogen production and supply up to 18 percent of Europe's demand by 2050 due to projected competitive costs, close geographic proximity, high renewable energy potential, and availability of adaptable gas infrastructure.[195] IRENA projects a highly competitive LCOH in North African countries to US$ 1-1.5/kgH2 by 2050, which nearly parallels the current cost of grey hydrogen.[196] Other green hydrogen initiatives, such as Italy's Hydrogen Backbone and the EU REPowerEU Strategy, support infrastructure development to catalyse imports from North Africa and the Middle East.[197,198] The SouthH2 Corridor is a pre-established 3,300-km hydrogen pipeline linking Algeria and Tunisia in North Africa to Austria and Germany in Central Europe through Italy, capitalising on imports of hydrogen from Tunisia through a hydrogen valley in Sicily.[199]

Pipeline transport is currently a more cost-effective option for hydrogen transport over short to medium distances, making this development appealing to meet the EU's long-term demands.[200] Production would also feed into the Central European Hydrogen Corridor via Greece.[201] IMEC signatories such as the UAE and Germany have also started investing in Morocco's green hydrogen industry. CMMZE Invest UAE and Gaia Future Energy signed a Joint Development Agreement to develop a green hydrogen project that will deploy 200 MWe electrolyser capacity to generate hydrogen for export via the Port of Agadir. Likewise, the German Moroccan Energy Partnership marks joint efforts to develop green hydrogen for domestic use and export to Germany.[202]

Despite strong European backing, renewable energy progress and green hydrogen exports in Algeria and Tunisia are not expected to keep up with EU import expectations. Algeria and Tunisia do not currently produce green hydrogen, and solar accounts for less than 5 percent of electricity generation in both countries. While the EU is projected to have the capacity to import 4 million tonnes of hydrogen per year by 2030, Algeria and Tunisia are expected to have a combined export capacity of 330,000 tonnes of hydrogen which is only 8 percent of the pipeline's capacity.[203] Similar to Egypt, other trade-offs include the diversion of hydrogen from domestic decarbonisation needs and diversion of water away from domestic use.[204] This is particularly pronounced in countries like Morocco, Tunisia, and Algeria which all face water insecurity.

Morocco and Egypt carry strategic advantages as renewable energy-rich countries with the capacity to circumvent the Strait of Hormuz.[205] Morocco's 2021 Green Ammonia Roadmap highlights how it plans to leverage solar and wind renewables for ammonia synthesis to meet domestic fertiliser needs and enable exports.[206] In March 2026, Morocco approved US$ 32.5 billion worth of green hydrogen projects including ammonia, in partnership with the UAE's Taqa and Spain's Cespa.[207] Similarly, Egypt's Alexandria Fertilizers Company signed an MoU with China's UEG to develop a green hydrogen hub based in Alexandria.[208]

Supply and Demand Dynamics and the Importance of Off-Takers and Regulatory Clarity

The demand for green hydrogen and its derivatives is expected to be driven by a growing need to replace grey hydrogen in hard-to-abate industrial sectors and long-term energy security.[209] However, despite strong political backing, subsidies, and commitments to industrial decarbonisation, a widening gap has emerged between ambition and execution. The International Energy Agency (IEA) forecasts slashed hydrogen development by nearly a quarter by 2030 due to cost pressures and policy uncertainty.[210]

The EU's Import Bottleneck and Infrastructure Pivot

This downward trend is highly visible in Europe, where countries[211] have curtailed investments and delayed green hydrogen project development in 2025 due to slow technological maturation,[212] prohibitively high production costs resulting in a lack of cost-competitiveness with fossil fuels, and faltering domestic demand.[213] While REPowerEU aims to import 10 million tonnes of clean hydrogen by 2030, current forecasts suggest only a fraction of projects are backed by FIDs.[214]

To bridge this gap, the EU's domestic strategy focuses on expanding its multi-molecule terminals, synergising between ammonia, methanol, and LNG regasification, and retrofitting. For instance, France's Medhyterra project will redevelop Elengy's FOs Tonkin LNG terminal into a low-carbon ammonia import terminal.[215] Italy has partnered with Austria and Germany to develop a hydrogen corridor as part of the EU hydrogen backbone.[216] Germany is also developing a Green Energy Hub in Wilhelmshaven, expected to be operational by 2030, which will accept supply from the sea, connect to the distribution grid, and generate electricity from green hydrogen.[217]

India and the Gulf's Export Frontier and Limitations

While Europe is incrementally developing its import architecture, momentum for green hydrogen continues in the Gulf states and India due to strong domestic demand and long-term energy security prospects. However, these emerging exporters face uncertainties with export prospects due to high costs and strict regulatory requirements from the importing markets.[218]

In India, energy and food security priorities drive hydrogen demand. The crisis in the Middle East has subjected India to the dual impacts of reduced natural gas feedstock for domestic ammonia production and reduced ammonia imports from the Gulf. Previously, domestic demand for green ammonia was secured through a guaranteed off-take agreement with the Solar Energy Cooperation of India (SECI).[219] Following the conflict, Indian fertiliser manufacturers locked in additional long-term contracts for green ammonia.[220] This domestic demand is supplemented by joint partnerships. The India-Saudi Arabia Hydrogen partnership, for instance, promotes joint hydrogen R&D, trade facilitation, and cooperation on hydrogen storage and transport to help accelerate India's energy transition.[221] Despite partnerships helping to scale India's technologies, the country currently faces high capital expenditures for electrolysers and limitations in storage and transport infrastructure, inhibiting export prospects and trade facilitation.[222]

Likewise, the UAE, Saudi Arabia, and Oman are combining hydrogen development with a need to develop alternative trade corridors to minimise future vulnerabilities and reallocate risk. To illustrate, Abu Dhabi's TA'ZIZ methanol company secured domestic off-take and feedstock agreements from European and Asian financial institutions in May 2026.[223] Although the region faces higher insurance premiums and pressure on alternative routes, its ongoing financial investments and infrastructure progress reflect a commitment to become a structural anchor for hydrogen development.

Bridging the Supply-Demand Divide

Connecting Indian and Gulf supply to European demand signals requires overcoming deep regulatory and financial friction. The EU has positioned itself as an important market for green hydrogen and derivatives while actively exerting influence over regulatory standards in other countries through Renewable Fuels of Non-Biological Origin (RFNBO) rules, certification, and import frameworks.

However, these regulatory frameworks have created burdens on exporting countries and industries. The EU's Carbon Border Adjustment Mechanism (CBAM), for one, complicates the flow of exports from India, placing the burden of emissions measurement, reporting, and reductions on Global South countries.[224] Furthermore, the EU's strict RFNBO rules have created structural risks for countries such as Oman which have pre-emptively designed costly hydrogen systems in accordance with complex, yet subject to change EU regulatory frameworks. Recent proposals to loosen RFNBO criteria increase policy uncertainty and fuel perceptions of the EU as an unpredictable trade partner.[225]

To prevent Indian and Gulf supply from being absorbed by domestic markets or diverted to less restrictive import markets like Asia, the EU must expand its approach beyond a regulatory entity. First, bridging the supply-demand gap will require concrete off-take agreements.[226] For instance, the AM Green-Rotterdam Corridor Agreement between India and Northwestern Europe in May 2025 aims to build a supply chain of green ammonia, indicating an early-stage trade partnership.[227] Additionally, the EU can improve its regulatory credibility by streamlining certification schemes and providing targeted technical assistance to reduce administrative burdens for exporters.

Lastly, demand for end-use hydrogen applications must be driven by policy mandates, quotas, and innovative market mechanisms. Combining such mandates with joint public-private R&D will help improve material durability, infrastructural compatibility, and connectivity, and maximise energy-efficiency of hydrogen inputs.[228] The joint institution of interoperability standards would facilitate the scaling of pilots into larger trade corridors as technologies mature.

Table 6: Challenges of Hydrogen Infrastructure

Technical	Advancements in blue hydrogen may limit willingness to transition to green hydrogen, since infrastructure between the two are not interoperable. Regarding transport, existing hydrogen pipeline infrastructure remains limited, while retrofitting natural gas pipelines or constructing new dedicated networks requires significant capital investment. Moreover, liquid hydrogen must be maintained at cryogenic temperatures throughout transport and storage, requiring specialised cold-chain infrastructure that substantially increases transportation costs over long distances.
Economic	Low-carbon hydrogen must achieve cost-competitiveness against grey hydrogen, mature oil, natural gas, and LNG value chains. However, hydrogen cost-competitiveness is influenced by economic or geopolitical situations. For example, the US-Israel-Iran conflict may temporarily raise the cost-competitiveness of green hydrogen over grey hydrogen by emphasising the rational to accelerate green hydrogen development for energy security. Overall, a consistent lack of binding off-take contracts limits infrastructure progress and connectivity.
Security	High-pressure hydrogen can cause the cracking and weakening of pipelines and tanks, increasing the risk of infrastructural failure and gas loss. Hydrogen is also highly flammable, creating operational security concerns for workers and nearby infrastructure.
Geopolitical	China dominates electrolyser manufacturing, creating risks of dependency for raw materials. Retrofitting gas pipelines also creates a concern of replicating historic energy dependencies.
Regulatory	A lack of unified and globally recognised infrastructure standards across the supply chain and for green products inhibits interoperability for hydrogen exports. Moreover, there is a lack of alignment between local hydrogen regulations and certifications with regional and global standards and overall internationally-established regulatory framework. Currently, the EU leads in the creation of regulatory standards for hydrogen, but these are subject to change and revision, resulting in policy uncertainty for first-movers.
Socio-Environmental	Hydrogen development is highly energy-intensive, risking the redirection of renewable energy away from domestic use to hydrogen production for export. It is also highly water-intensive, increasing pressures on water-scarce countries such as Morocco. For desalination-dependent countries such as the UAE and Saudi Arabia, increased brine production will create risks for marine ecosystems. Lastly, unclear or unequitable land allocation for hydrogen development can infringe on the well-being of local communities.

Source: Authors' own

4

Natural Gas

COMPOUNDING CRISES IN the twenty-first century have placed pressure on natural gas infrastructure and supply, creating volatility in the Gulf regional and global market. Liquefied natural gas (LNG) production is concentrated between a few key suppliers. Many of these nations are in the middle of conflicts, including Russia, Iran, and Qatar, that account for more than half of global natural gas reserves.

The Russia-Ukraine war, ongoing since 2022, has resulted in infrastructural damage to Russian gas processing plants,[229] disruptions to the Nord Stream 2 pipeline linking Russia to Germany, and European Union (EU) sanctions on Russian gas supply.[230] This led to a 15-percent decline in globally traded gas between 2021 and 2023.[231] Since the war's effects were regionally concentrated and primarily impacted piped gas supply to the EU, the EU was able to mitigate shortages through LNG purchases from the United States (US), demand reduction, and pipeline supplies from Norway, North Africa, and the Caspian basin.[232]

Similarly, the 2026 Middle East conflict inflicted physical damage across critical gas infrastructure in the United Arab Emirates (UAE) and Qatar and disrupted LNG supply through the Strait of Hormuz, through which 20 percent of global gas supply transits.[233] Kinetic attacks on Qatar's Ras Laffan complex, the world's

largest LNG export hub, resulted in Qatar declaring *force majeure* on some LNG contracts for up to five years, reducing the country's export capacity by 17 percent.[c] Damage to the UAE's Habshan gas facility compromised its internal gas supplies, while shipping blockades caused the nation to halt 5.8 million tonnes per annum (mtpa) of production from its LNG plant on Das Island.[234]

In response, countries have sought to diversify LNG import sources, in addition to implementing demand-side adjustments, such as gas rationing. Unlike oil, only a fraction of global gas production is traded globally, and substitution remains more feasible in gas-consuming sectors. By nature, LNG can be transported through ship cargoes in addition to pipelines, giving producers and consumers more flexibility. Thus, these conflicts have spurred investments in projects beyond the US and Qatar while incentivising long-term procurement contracts outside of conflict zones to ensure energy security.[235]

Infrastructure

a. The IMEC Route

The traditional India-Middle East-Europe Economic Corridor (IMEC) corridor envisions the construction of a new integrated gas pipeline linking the Middle East to Europe. Theoretically, natural gas produced in the UAE and Saudi Arabia would be transferred first to Israel and Jordan, and then Europe.[236] However, given the prospect of a prolonged Strait of Hormuz closure and long recovery period for Qatari and UAE LNG facilities, an expanded IMEC corridor offers opportunities to integrate LNG terminal expansion, particularly in the Mediterranean, alongside alternative supply routes.

Among the IMEC countries and aside from the US, Saudi Arabia, India, and the UAE have the largest natural gas reserves.[237] Prior to the conflict, the UAE and Qatar were expected to contribute to a 40 million tonne (56 bcm) LNG surplus in 2026. Following the conflict, these projects, including the start-up of Qatar's North Field East expansion project, are likely to be delayed by at least a year from its earlier end-2026 target date.[238] Saudi Arabia's Aramco is still actively developing the Jafurah Gas Field, which is expected to produce two billion standard cubic feet of gas per day.[239] However, outputs are largely projected to go towards meeting domestic electricity demand, freeing up crude oil for international markets.

c A force majeure refers to a temporary contract suspension due to unexpected or uncontrollable external events.

Despite these dynamics, Gulf countries can continue to capitalise on existing energy trade relationships with India.[240] India and the UAE established a US$20-billion agreement where ADNOC would supply the Hindustan Petroleum Corporation with 0.5 mtpa of LNG. European countries, on the other hand, might look towards their Mediterranean and US counterparts to secure their LNG supply.[241]

Since the early 2000s, pipelines separate from the IMEC corridor have emerged with moderate success in the Middle East,[242] namely, the Arab Gas Pipeline (running from Egypt to Jordan, Syria, and Lebanon), the Dolphin Pipeline (running from Qatar to the UAE), and the East Mediterranean Gas Pipeline (planned to link Israel to Europe via Cyprus and Greece). Although the Arab Gas Pipeline has been partially operational, it has been considerably underutilised due to gas shortages from Egypt and kinetic damage to the construction. Qatar was initially excluded from the original IMEC corridor due to competitive regional dynamics. However, with the Hormuz strait under pressure, Qatar's only gas exports are through the Dolphin pipeline to the UAE and Oman, at a little over 20 billion cubic metres per year of gas.[243] Given these pressures, Qatar may be incentivised to extend renewal of the Dolphin pipeline contract beyond 2032, tying its integration with IMEC countries. Funded jointly by Italy's Edison and Greece's DEPA, the EastMed Gas Pipeline aims to transport Israeli and Cypriot natural gas to Greece and then Italy.[244] However, construction has been delayed due to high capital costs, technical difficulties stemming from passing through difficult geographical terrains, and the ongoing regional conflict.[245]

Given the concurrence of established alternative trade routes and Europe's increase in gas imports from the US, constructing an entirely new pipeline would be expensive and detract from Europe's ambitious decarbonisation goals. The estimated cost of building a new gas pipeline stands between US$2-US$5 billion.[246] One way to overcome this issue would be for the IMEC corridor to incorporate the standalone East Mediterranean Pipeline as a 'transition pipeline' with the capacity to transport blended natural gas and hydrogen fuels. Incorporating the 2,000-km pipeline to complement the corridor would achieve two goals: 1) support Europe's decarbonisation progress and 2) accept exports from the Gulf states that have high investments in low-carbon hydrogen.[247] Challenges inhibiting this effort include delayed investment take-off due to the ongoing Middle East conflict.

LNG terminals are increasingly gaining recognition as an alternative to transnational pipelines, due to their ability to provide operational flexibility and destination diversification through on-demand regasification capacity, grid backup, and the emergence of floating storage and regasification units which can be constructed faster. Modern energy corridors are looking at establishing Floating Storage and Regasification Units (FSRUs), which offer structural advantages, including faster planning and implementation, dynamic asset redeployment, and lower capital expenditure (CapEx) requirements.[248]

b. Alternate Route #1: Via Egypt

Europe is expected to receive natural gas from Cronos through existing infrastructure managed by Italy's Eni and France's TotalEnergies as early as 2027.[249] The gas would be processed and liquefied in Egypt's Damietta Port prior to being exported to Europe. There is also a likelihood of Europe obtaining gas from Cyprus' Aphrodite and processing it in Egypt's Port Said for domestic consumption or European export. Israel has similarly signed a US$35 billion deal to double gas exports from Israel's Leviathan natural gas field to Egypt starting in early 2026 through 2040.[250] Pursuing this route could be a smart diversification tactic for Europe, since increasing pressures to import LNG from the US could create a new system of dependency, with America already projected to supply up to 80 percent of the EU's LNG imports by 2030.[251]

c. Alternate Route #2: Via Iraq and Syria

Another nascent yet conceivable alternative route may emerge through Iraq and Syria. As the EU seeks to diversify its exports and the UAE and Saudi Arabia vie for new export markets, Syria offers untapped opportunities for infrastructure development. The Arab Gas Pipeline, for instance, is reportedly operational within Syria, pending a formalised commercial agreement between Lebanon and Egypt. Additionally, the Islamic-Iranian Gas Pipeline envisions the flow of natural gas from southern Iran through Iraq and Syria to Europe.[252] Lastly, the 2009 planned Iraq-Europe Gas Pipeline aimed to connect the Akkas gas field to European markets through Turkey[253] and was also expected to connect with Syria's Arab Gas Pipeline, but operations were suspended after the escalating conflict in Syria and Iraq in 2014. With these conflicts subsiding, the pipeline could be revived.

The feasibility of incorporating the Iraq-Syria route under the IMEC corridor depends on the UAE's and Saudi Arabia's keenness to act as first movers and ramp up investments in Syria's infrastructure development. In November 2025, the UAE's Dana Gas signed a preliminary agreement with the Syrian Petroleum Company to redevelop existing gas fields,[254] and Saudi Arabia quickly followed in December 2025, signing four agreements to develop Syrian oil and gas fields.[255] These efforts, however, pale in comparison to Turkey, which has secured more than US$11 billion in deals for a new power plant and gas pipeline construction in Syria.[256] The Kilis-Aleppo Natural Gas pipeline, for instance, became operational in August 2025, delivering gas at a capacity of 6 million cubic metres per day. Additionally, the revival of the Aleppo-Damascus-Nasib corridor now links Turkey to Jordan and Saudi Arabia, cutting high costs and transit times from shipments that formerly traversed through the Suez Canal.[257] Nevertheless, all investors must face potential challenges that would hinder project implementation in Syria, such as the costly rehabilitation of deteriorated infrastructure, lingering economic sanctions, and geopolitical instability in the region.[258]

Table 7: Natural Gas Challenges

Technical	Natural gas supply chains face technical risks, including that of methane leakage. Retrofitting existing gas pipelines may yield limited economic and operational value, since hydrogen blending may not produce high volumes.
Economic	Developers of new natural gas pipelines face projected risks of stranded assets as the global energy transition increasingly emphasises zero- or low-carbon alternatives. Moreover, increasingly strict green finance mandates and environmental, social and governance (ESG) criteria make it difficult to secure capital for new fossil fuel infrastructure.
Security	Energy trade routes face heightened vulnerability to maritime conflicts and blockades. Gas fields and long-distance cross-border pipelines remain exposed and vulnerable to geopolitical sabotage or targeted disruption.
Geopolitical	Geopolitical misalignment and stalled diplomatic normalisation between trading partners can disrupt cross-border energy cooperation, partnerships, and market integration.
Regulatory	An absence of interoperable energy efficiency standards for gas creates regulatory friction and trade barriers.
Socio-Environmental	Uncontrolled methane leakage poses environmental risks, driving up emissions.

Source: Authors' own

5

Nuclear Energy

IN THE WAKE of the unprecedented disruptions to hydrocarbon value chains due to the Strait of Hormuz blockade, there is potential for nuclear energy to emerge as a more indigenised form of electricity. Shorter supply chains and comparatively lesser exposure to repeated supply-chain risks increases its inherent value for IMEC countries that seek greater diversification and resilience in their energy and economic security formulations.

However, unlike trade in other forms of energy, nuclear energy's value proposition to the web-of-networks concept is not based on transporting generated electricity across the corridor. Instead, it is about its ability to serve as a supplemental baseload form that could provide the necessary grid stability for the integration of renewable energy into national energy ecosystems along the corridor and with providing captive energy for industrial clusters. The low-carbon, high-density, and baseload features of nuclear energy favour it for the decarbonisation, energy transition, industrialisation and digitisation ambitions and pursuits of states along the IMEC corridor.[259] With an emissions marker of 12-110gms of carbon dioxide equivalent per kWh,[260] civilian nuclear energy could underwrite many of the IMEC's clean-energy value chain's ambitions and agendas, while offering a relatively higher degree of insulation from the common vagaries of supply-chain volatility tied to

hydrocarbons. In addition to electricity generation, nuclear energy offers a viable answer to multiple priorities and needs across the IMEC corridor, such as seawater desalination, and district and process heating for hard-to-abate sectors such as cement manufacturing and aluminium smelting.[261]

The Value of Nuclear Energy for Energy Security and Industrial Growth

Appeal to Industrial Co-Location Models

Nuclear energy's baseload feature would help in the development of special industrial or economic zones along the IMEC corridor, if countries along the corridor consider co-locating nuclear facilities, including the small modular reactor (SMR) variants, within these industrial clusters. This could address the need for reliable baseload energy that can generate process heat at scale to meet the needs of large industrial units within dedicated industrial clusters and zones. Green hydrogen production, green steel and aluminium production, data centres, and desalination plants could also be co-located alongside. This model of industrial co-location could reduce costs while ingraining more resilience.

Appeal to Data Centres

Nuclear energy also offers unique advantages in the functioning of data centres, which, by virtue of their very structure and functioning, tend to be energy intensive. By installing nuclear reactors (SMRs included) for captive power generation for data centres alone, the countries along the corridor could gain an advantage in their efforts to establish themselves as important players in the fourth Industrial Revolution being underwritten by and in these data centres.

Appeal to Hydrogen Economy and Aluminium Smelters

Nuclear energy can also prove complementary to other agendas of decarbonisation along the IMEC route by providing the energy required to produce green hydrogen projects at scale along the corridor, for instance. This benefit could also be expected to pass into other industrial pathways along the corridor through the creation of industrial clusters. An ancillary industry that could flourish is the aluminium industry. Nuclear energy could lead to the production of decarbonised primary aluminium production[262] as well serve as the required industrial raw material for the SMRs and micro-reactors to be built at scale across the corridor.[263]

Table 8: Overview of Nuclear Capacity and Programmes, IMEC Countries

Country	India	UAE	Saudi Arabia	France	Italy
Installed nuclear power capacity	8780 MW 8.78GW	5600MW /5.6GW	NA	63GW	NA (working on legislation to reconsider SMRs
Percentage of electricity generated from nuclear power	3.1 percent	25 percent		65 percent	NA
Number of nuclear plants under operation	24	1		55	NA
Number under development/ plans	8 reactors of 6,600 MW total	1		14 EPR2 discussions and development of SMR technology and deployment	
Instructive Vision/Policy frameworks	100GW by 2047	ADVANCE Programme	Saudi National Atomic Energy Project Saudi Arabia has also signed agreements to acquire 17 GWe nuclear capacity by 2040 (16 plants)	Continue and enhance the life cycle of existing plants and focus on EPR2 development	Bill proposing the National Programme for Sustainable Nuclear Power and the establishment of an independent Nuclear Safety Authority has been approved by the Italian Parliament

Strategic Objectives	Sees nuclear energy as part of its strategic autonomy through reduced dependence on hydrocarbon imports; this aligns with the country's decarbonisation agenda; Aims to harness the considerable domestic capacity that the country has developed to share through nuclear commerce with countries that seek to develop their capacity for the peaceful use of nuclear power	Long-term clean energy objective and the guaranteeing of indigenously harnessed energy security; it also feeds into the growing energy needs of the country from the deployment of data centres. UAE is also open to the idea of nuclear commerce to share with countries its best practices	The uranium reserves that the Saudis have in the sector has been seen as being commercially viable and could also help the Kingdom move up the nuclear value chain through the partnerships it builds to better harness the full potential of its reserves.	Energy security and expanding its role in global nuclear commerce	Resumption of nuclear energy comprehensively to regulate the introduction of 'sustainable' nuclear power within the framework of European decarbonisation policies by 2050 and energy security objectives

Source: Authors' own

Ongoing Partnerships in Civilian Nuclear Energy

An important element of synergy on nuclear energy along the corridor could be its appeal to countries like India, the UAE, Saudi Arabia, and France, all of which have declared their intent and ambition to develop as data-centre hubs. Countries along the IMEC have been cooperating in the field of civilian nuclear energy already, in segments such as components manufacturing and sharing of reactor technology and best practices. Ongoing cooperation in this regard is reflected in the following initiatives, as noted in Table 9.

Table 9: Partnerships for Nuclear Energy

Partners	Partnership Framework	Scope of Partnership
India-UAE	MoU[264] between Emirates Nuclear Energy Corporation (ENEC) and Nuclear Power Corporation of India Limited (NPCIL)	Knowledge sharing and enhancing potential cooperation in various fields, such as supply-chain development, human resource development, provision of nuclear consultancy services, future investment.
India-France	India-France Special Global Strategic Partnership[265]	R&D cooperation, skills development to align with industrial applications and demands; harmonisation across regulatory bodies
India-EU	India-Euratom Agreement[266]	Cooperation to explore the peaceful use of nuclear energy through joint R&D projects where a technology management plan (TMP) has been developed; exchanges, sharing and transfer of samples, materials, instruments and apparatus for experimental purposes; sharing of information on relevant practices, laws, regulations and programmes.
UAE-France	MOU[267] between Emirates Nuclear Energy Company, the UAE's Federal Authority for Nuclear Regulation, and leading French institutions, including Électricité de France, French Alternative Energies and Atomic Energy Commission (CEA), Framatome, Andra, and the French Authority for Nuclear Safety and Radiation Protection (ASNR)	The French Framatome has committed[268] to supplying complete nuclear fuel assemblies for the UAE's Barakah Nuclear plant.
Trilateral as part of the 28th United Nations Climate Change Conference (COP28) in 2023	Declaration committing to supporting the Tripling Nuclear Energy initiative[269]	In addition to exploring the use of peaceful nuclear energy to meet their decarbonisation and industrial goals, many of these countries are exploring future opportunities in advanced reactor technologies, SMRs, and nuclear fuel assurance.

Source: Authors' own

The US remains an integral part of the IMEC framework, particularly to the civilian nuclear energy interests/pursuits of countries such as India and the UAE, despite being outside the remit of the geographic scope being considered by this report in making the case for an integrated web of networks focused on energy. Saudi Arabia (Civil Nuclear Pact) and Jordan are also supposedly in discussions with the US regarding expanding the scope of their partnership in the nuclear sector.

Constraints to Expansion

Nuclear energy projects come with considerably long gestation periods. China's Hualong One was constructed in a record 5.5 years,[270] but it should be considered an exception. World Nuclear Association estimates suggest that the average time taken for construction based on 2024 figures still stands close to a decade.[271] It is necessary to factor this time consideration into any proposal that includes nuclear energy as a potential element to build cooperation and resilience frameworks. In the volatile strategic environment that the IMEC project is expected to operate in, changing dynamics and disjoints in the strategic trust matrix is another important element that would have to be factored into the discussion on something as sensitive as nuclear energy.

Furthermore, in the expansion of nuclear energy adoption across the IMEC corridor, the additional dependencies that countries may be taking on as part of the need to import uranium, as well as the technological inputs required by the nuclear facilities, should be considered. However, Saudi Arabia's uranium reserves to the tune of 90,000 tonnes could be important in reducing the IMEC corridor's dependence on suppliers globally. Within the IMEC route, only Saudi Arabia holds proven reserves of uranium. India's share of uranium is miniscule in comparison to what is commercially viable, yet it does hold reserves of thorium in the monazite salts of its coasts, which can be expected to emerge as a significant strategic asset if and when the technology to replace uranium with it in nuclear reactors acquires maturation.

While there have been proposals regarding the creation of a uranium enrichment consortium or fuel bank in the Middle East,[272] it may be difficult to implement this in the region presently due to concerns about countries having differing capabilities and allocation potential and transparency issues due to varying strategic concerns. Additionally, the growing momentum for the adoption of nuclear energy globally will also lead to increased competition for the scarce reserves of uranium.

Uranium supply chains, while more predictable than hydrocarbon forms, remain tightly controlled by a small number of actors. While the industrial and environmental logic for the integration of nuclear energy into the corridor's energy security pathways is valid,

there remain concerns regarding the resilience and adaptability of the nuclear fuel cycle to the complexities of the region. The nations that have active civilian nuclear programmes presently—India, the UAE and France—have been importing uranium from various countries (see Table 10).

Table 10: Uranium Sourcing by India, the UAE, and France

Country	Source of Uranium
India	Kazakhstan, Canada, Russia, Australia, Uzbekistan
UAE	Kazakhstan, Russia, Australia
France	Niger, Kazakhstan, Australia, Canada, Russia

Source: Authors' own, based on country profiles.[273]

Strategic Opportunities Across the Nuclear Value Chain

SMR development and the creation of a more transparent alternative supply chain across the nuclear value chain could be strategic opportunities for the IMEC.

There is a reasonable amount of convergence among the countries along the proposed IMEC route over the need to build resilient energy systems that could feed into decarbonisation plans as well as meet the industrial competitiveness that requires baseload energy. Nuclear energy fulfils these requirements. Additionally, nuclear energy also offers the baseload grid stability to better integrate intermittent renewable energy pathways into national energy baskets. Its effective harnessing through a cooperative regional model could create enduring synergies between countries along the IMEC corridor. In a strategic environment where China and Russia have been emerging as the most dominant global exporters of nuclear technology and hardware, particularly to countries of the Global South, partnerships forged between IMEC partners such as France, India, and the UAE, with the US's participation, could offer an alternative model bringing technical expertise, nuclear management, waste management expertise, and best practices in the sector to countries in the Middle East, Africa, and Europe. This could prove particularly salient in the domain of future developments in the field, such as the deployment of SMRs.

There is considerable interest among the IMEC corridor countries regarding the development and adoption of SMR and Advanced Modular Reactors (AMR) technologies. This has been explored through declarations[274] between the Indian and the French national atomic energy commissions regarding cooperation focused specifically on these. A similar intent has also been expressed in bilateral discussions between the UAE and France,[275] as well

as in the national energy policy pronouncements of countries such as Saudi Arabia and Italy.[276],[277] However, these remain future plans since the technology is still awaiting sufficient maturation to enable design standardisation. While India's Bharat Small Modular Reactors[278] could fulfil this requirement, since their size and effective modularity qualify them to do so, commercial deployment at scale remains a nascent discussion. Yet, once mature, the SMR model can prove apt for adoption in the industrial clusters, remote mining infrastructure, port infrastructure, and green hydrogen production infrastructure of the IMEC route. The potential deployment of an SMR value chain could also ensure that IMEC countries such as India, France, and the UAE become more natural partners to countries of the Middle East, Africa and Europe—which the corridor proposes to integrate into a clean energy network—in their pursuit of civilian nuclear energy.

Table 11: Nuclear Energy Challenges

Technical	While India and France have the capacity in segments, there are considerable gaps in the industrial and institutional capacity among IMEC countries to manufacture components required by the nuclear industry. Human resource and the specialised skills needed by the industry also pose a glaring challenge in nuclear energy adoption along the corridor.
Economic	Nuclear energy remains a capital-intensive option. This can prove to be particularly challenging, given the time the plants take to come online and that energy security concerns along the corridor have become an exigent and urgent issue today.
Security	The adoption and deployment of nuclear energy increase security complexity more than other forms of energy, in terms of concerns regarding proliferation and differing strategic perceptions.
Geopolitical	Nuclear energy would create dependencies that could impact the broader energy security angle in the event of any future disruptions by way of uranium supply guarantees, expertise with enrichment, management of nuclear waste, competition for the resources, and technical staff.

Socio-Environmental	Lack of public awareness around nuclear energy and the newly developed safety features of the form pose challenges towards its societal acceptance. Concerns regarding efficient and sustainable forms of waste management further complicate the potential for nuclear energy's integration and become particularly acute in a geopolitically volatile region.
Regulatory	The adoption of nuclear energy along the corridor should be preceded by a discussion on regulatory harmonisation, which will also need to concern itself with the end-of-life management of residue. This could prove challenging due to the differing abilities and objectives of each country in the domain. Additionally, liability clauses can be expected to pose an issue during implementation of nuclear energy projects along the corridor.

Source: Authors' own

6

Critical Minerals as an Enabler

The Green Industrial Corridor and Industrial Competitiveness

IMEC could potentially create a networked cluster of green industrial activity by harnessing the industrial and economic complementarities within its pool to develop critical-mineral refining and processing hubs. This would enable it to emerge as an important node of diversification from the Chinese dominance in the sector.

The disruptions to hydrocarbon supply chains experienced during the conflict in the Middle East and the blockade of the Strait of Hormuz, can be expected create greater impetus to transition to more localised and indigenously sourced forms of renewable energy, such as solar and wind. The infrastructure needed for this transition depends on a reliable and sustained supply of critical minerals such as copper, aluminium, gallium, chromium, selenium, neodymium, cobalt, lithium, boron, molybdenum, nickel, and dysprosium, at scale, to underwrite cleaner forms of energy. In addition to their salience to decarbonisation and energy transition pursuits, critical minerals are also central to many of the core agendas shared by countries across the IMEC corridor, such

as digitisation, industrial development, and infrastructural expansion. To realise the potential of the Green Industrial Corridor being proposed by this report, it is essential that countries along the IMEC corridor invest in developing their capabilities across the critical minerals value chain.

Due to their centrality to economic competitiveness, decarbonisation and national security considerations, the creation of critical minerals ecosystems along the corridor must be undertaken despite the challenges associated with the effort. Any efforts to break Chinese monopoly over the sector entirely in the short to medium term are not likely to succeed, given the country's unparalleled dominance across the value chain.[279] This holds particularly true in the midstream segment of processing and refining, where China controls nearly 90 percent of the value chain. Additionally, the development of critical minerals processing capacity is both time and capital intensive. Despite the compelling security rationale for building more localised supply chains of critical minerals, it is also important to consider whether the corridor itself could meet the heavy capital expenditure without the demand scale that would justify such high investments.

Yet, while China remains the principal supplier of these minerals to countries along the proposed IMEC corridor for the foreseeable future, it may be valuable to consider what, if any, capacity could these countries develop. The centrality of these minerals to the energy portfolios considered along this corridor—for the energy transition to nuclear and hydrogen, for instance—make this an effort worth pursuing.

The corridor is largely deficient in reserves of critical minerals in both the required composition as well as at scale. While India has the third-largest reserves of Rare Earth Elements (REEs) globally and Saudi Arabia's Arabian Shield also has substantial reserves of REEs,[280] the IMEC corridor is largely deficient in critical minerals resource endowments. While countries like Jordan[281] and Morocco[282] that are factored into the web of networks recommended by this report do have some mineral wealth, these reserves are not at the scale and variation required to become reliable feedstock for the industrial and energy transition agendas along the corridor.

What the IMEC countries lack in their geological reserves, they could make up for through their industrial and logistics capacity geared towards emerging as a low-carbon industrial processing hub of critical minerals. India's manufacturing scale and engineering expertise, the Gulf's abundant and economical energy resources and their logistics infrastructure, African interest in developing its participation along the value-chain, and European process engineering and advanced manufacturing expertise, could combine to create multiple complementarities in the domain along the route. The complementary position of each partner in such a hub could help create a reliable, friend-shored supply chain of critical

minerals that aligns with the positioning of the IMEC corridor as a web of networks focused on decarbonisation, digitisation, and industrial development, given the centrality of these minerals to each of these pursuits.

The corridor's advantage in the critical minerals sector lies in its points of access to and invested leverage in the minerals super-region of Africa and Middle East.[283] That the African continent could serve as a hinterland to both the upstream segment as well as a market for the downstream produce could prove to be an important value addition to the critical minerals capacity that could be developed along the IMEC corridor. Given these advantages, countries along the corridor could work towards developing joint processing capacity to offset the considerably high CapEx requirements as well as the lack of a sufficiently large talent pool in the sector.

The IMEC countries could coordinate and develop processing and refining hubs of industrial activity along the networked corridor by enhancing their domestic and regional capacity through processing, recycling, downstream manufacturing, and trading of commodities. There are instances of ongoing cooperation in the sector, such as the coordination between India-UAE, France, the US and Italy bilaterally and through minilateral arrangements, to develop capacity across the critical minerals value chain.[284,285,286,287] The UAE's Khalifa Economic Zone's Lithium Processing plant[288] could also serve as a model in this regard.

The Model of Co-Location

Mining is an energy-intensive industry. To harness the renewable energy potential along the IMEC corridor, the energy transition infrastructure should ideally be able to provide much of it. Additionally, the region will also need to focus on the growth of battery storage to make use of its renewable energy potential. An integrated model of development where critical minerals required across the clean energy value chain, including batteries for storage, could serve as a focal point of such a cooperative model. Ancillary benefits can be expected to flow, for instance, from this co-location model and the resultant 'localisation' of the critical minerals infrastructure to the region's aluminium industries. The Gulf's aluminium smelters have an important role to play in supporting the industrialisation agenda along the IMEC route through the building of factories. The aluminium manufacturers of the region—among the largest in the world—could benefit from the investments expected along the corridor in data centres, digital infrastructure, and connectivity, as well as the establishment of solar farms. Having green industrial hubs that process, refine, and recycle critical minerals co-located with these aluminium industries could help create a circular green architecture.

Table 12: Comparative Critical Mineral Advantages, IMEC Countries

Country	Comparative Advantage
India	Manufacturing capacity that can be scaled, high refining capabilities, mining and chemical processing expertise, a large pool of human resource including semiconductor design talent, and a robust demand-generating market.
UAE	Logistics networks forged to build connectivity corridors, the patient capital that its sovereign wealth fund seeks to deploy strategically to underwrite the heavy capital expenditure needed; robust and resilient infrastructural capabilities; potential to emerge as a global trading and financing hub for critical minerals.
Saudi Arabia	Critical mineral resources including 90,000 tonnes of proven uranium reserves; collaboration with MP Materials and the US DoD through Saudi Arabian Mining Company Maaden; patient capital; cheap and abundant energy; mining is the third pillar of its economy.
Jordan	Geological mapping indicates substantive reserves of copper, lead, lithium, gold, and zinc, in addition to the significant potash reserves of the country; REEs are also indicated to be present but the reserves remain to be verified.
France	Indications of geological mapping for previously known reserves of critical minerals; mining know-how; recycling technology
Italy	Indication of lithium and REE reserves in the Tuscany and Alps regions; advanced manufacturing and processing capabilities, particularly in the critical minerals used in the automotive and aeronautical sectors; recycling expertise; entry point into the larger European markets.

Source: Authors' own, based on country profiles.

While the creation of a joint Strategic Reserve of Critical Minerals may prove to be challenging, given each IMEC member's differing security considerations and industrial trajectories, countries along the corridor could coordinate to prioritise the recovery of critical minerals from recycling. Coordination between actors such as India, the UAE, Israel, Saudi Arabia, and the EU in the US-led Pax Silica and FORGE Initiatives[289,290] to enhance resilience along the critical minerals value chain while reducing dependence on the singular centres of influence, such as China, adds further impetus to developing capacity as processing hubs along IMEC and its hinterland. A successful iteration of such a critical minerals processing hub could initiate the long-term energy diversification to cleaner forms and integrate economic diversification goals with the strategic diversification sought by the countries along the corridor that seek to reduce their exposure to Chinese dominance. Given the implausibility of meaningfully challenging China's first-mover advantages in the domain of critical minerals, such industrial clusters will have to compete with the dominant Chinese supply chain on issues such as traceability, reliability, and on offering more value-addition capability locally.

7

Policy Recommendations

Governance: Build the Institutional Architecture

1. **Establish an Energy Connectivity Secretariat:** An infrastructure project, of the scale and ambition, as envisioned under IMEC and the suggested corollaries, must be underpinned by a strong institutional framework to guide and course-correct the agreed arrangements and commitments. A Secretariat, therefore, should be set up to add teeth and mettle to these ambitions. Given that the Eastern Corridor linking India with the Gulf is already operational, led by India and the UAE, a joint secretariat should be set up between the two countries to build momentum and track progress. Without such institutional anchoring, infrastructure ambition may outpace implementation capacity. Infrastructure alone will not determine the success of the connectivity project; it will equally be judged by how risks are managed in real time and how governance is institutionalised across jurisdictions. The inter-governmental/ inter-ministerial body could also help identify industrial opportunities and connect them to investors through a single-window model.

2. **Set Up Technical Councils:** The Secretariat should commission working groups or technical councils on the various themes and challenges that have been identified thus far. The objective of the technical council should be to bring together a series of government, private sector, and academic experts working on that particular sub-theme—for instance, grid interconnections—and undertake or commission feasibility studies The recommendations from the Council should be presented to the Secretariat which would be responsible for reviewing and elevation to the appropriate political and ministerial decision-making bodies. The Secretariat must also ensure cross-collaboration among the technical groups where synergies or overlaps exist. Other examples include a technical council on data-sharing regarding energy demand patterns across the participating countries or a dedicated cybersecurity platform that focuses on addressing integrated exposure across the energy trade and infrastructure units.

3. **Institutionalise South–South Knowledge Partnerships:** Given similar funding, technology, and infrastructure deficiency constraints across countries, establishing a forum for South-South exchange of lessons learned and research progress would help with establishing unified infrastructure standards, interoperability strategies, and safety protocols. Beyond formal intergovernmental cooperation, the initiative should actively promote greater participation from civil society, academia, universities, and research institutions through structured Track 2 engagement. Such platforms will help build wider ownership of the Energy Connectivity Initiative, facilitate the exchange of technical expertise and policy innovation, and ensure that momentum is sustained beyond political cycles through broader societal engagement.

The primary gaps along the corridor in the sector are in areas such as technology transfer, infrastructure building, component manufacturing, skills training, and management capabilities. The Secretariat could coordinate the integration of nuclear energy along the IMEC corridor through preferential training or access to the partners of the corridor for the required capacity-building in the sector. Similarly, it could focus on strengthening the research and development gap that exists in the critical minerals sector through coordination between countries along the corridor on the creation of training and skilling modules specially targeting the midstream and downstream segments. Enhancing value-addition in these segments would help with integrating the countries of the corridor into the global clean energy value-chain.

4. **Ensure Interoperability in Standards and Regulations:** In order to ensure seamless cooperation between the participating countries and long-term operational viability, it is critical to ensure harmonisation across digital platforms, customs integration, regulations across trade, safety standards, and environmental codes, and transparent monitoring frameworks, among others.

There must be a regulatory body created through equal representation from the countries of the IMEC corridor to harmonise regulatory frameworks and compliance requirements of the trade and distribution of earned value from critical minerals processing, to guard against the weaponisation of the supply chains thus created. Relatedly, the distinctive value of the IMEC green industrial corridor could be transparent systems that create value locally through cooperation between partners along the route. This could help it emerge as a viable alternative to the exclusively Chinese ecosystem through the inclusion of sustainability features.

Finance: Mobilise Capital at Scale

5. **Create a RD&D Fund:** While the cost of solar and wind have dropped remarkably, much of the upstream and downstream supply chain, particularly for modules, wafers, inverters, and rare-earth inputs, remains concentrated in China. The participating countries can pool resources and build an energy transition fund that finances research, development and demonstration (RD&D) across new and emerging frontier technologies that support both energy efficiency and advanced chemistries, including but not limited to solar efficiency improvements, offshore wind, advanced electrolysers, battery storage, and smart-grid optimisation. This will improve efficiency and reduce costs for electrolysers, fuel carriers, and end-use applications.

6. **Joint Investment Vehicle:** For the private sector and international institutions, the absence of a dedicated corpus fund aimed at IMEC-associated projects exclusively compounds the concerns inherent in the volatile security matrix along the corridor. Under the circumstances, a mechanism to connect capital to capacity along the route should be developed. Increases in annual investment will be necessary, supported by blended finance models, multilateral guarantees, and sovereign participation. Sovereign wealth funds, including the Public Investment Fund (PIF), Mubadala Investment Company, and Abu Dhabi

Developmental Holding Company (ADQ), are well positioned to anchor corridor financing. Through joint ventures with partners in Europe and Asia, they can structure politically risk-insured investment vehicles that crowd-in private capital while maintaining regional ownership of strategic infrastructure.

7. **Develop Integrated Risk-Mitigation Mechanisms**: Incentivising investment through the provision of longer licence terms, extended off-take agreements, targeted pricing structures, supportive banking and financial ecosystems, and tax exemptions could help create a more conducive environment to enhance project bankability and attract private players as well as institutional funders. For instance, establishing long-term power-purchase agreements or feed-in-tariffs to lower the cost for renewable energy. Sustainable finance mechanisms like green *sukuk*,[d] green bonds, and sustainability-linked bonds should also be leveraged to mitigate the cost of capital for large infrastructure projects. Cross-border payment settlements, potentially leveraging national digital payment platforms such as India's Unified Payments Interface (UPI), could reduce transaction friction within the corridor.

Incentivise private sector involvement in green industrial production through regulatory clarity and measures such as price floors, off-take agreements, and increased local content requirements that align with the IMEC's geographic sweep. Countries of the IMEC Corridor could consider the institution of a corpus fund to underwrite the building of regional industrial processing hubs.

Industry and Innovation: Accelerate Innovation, Industrial Competitiveness, and Market Access

8. **Build Regional Manufacturing Ecosystems/Green Economic Zones/Industrial Corridors:** Dedicated Green Economic Zones could be established to anchor renewable manufacturing ecosystems, including solar modules, wind components, electrolysers, battery storage systems, and grid technologies. These zones should integrate common-user infrastructure, shared logistics, digital monitoring

d A sukuk is a Sharia-compliant financial certificate that functions as an Islamic alternative to a conventional bond.

systems, and streamlined regulatory approvals to reduce production costs. Pilot initiatives such as NEOM (Saudi Arabia), Al Dhafra (UAE), and Khalifa Port (UAE) demonstrate scalable renewable and hydrogen-linked infrastructure connected to European and Indian demand centres. A coordinated industrial strategy combining Gulf capital, Indian manufacturing scale, and European technology partnerships could accelerate regional industrial transformation while reducing strategic dependency on single suppliers.

The development of Special Economic Zones with the option of adding Green Premiums for products that comply with the environmental/ emissions standards agreed to by the signatory countries could be a start and supplement the financial agency that the Gulf countries bring to the project. This could be further supplemented with coordinated mandates across the participating countries to offer preferential pricing for land and power use for companies that commit to the absorption of green products. The generation of employment in these green pathways could add an additional lever to the inter-regional efforts of decarbonisation.

Infrastructure: Develop Integrated Energy Infrastructure

9.

Grid Upgrade, Modernisation, and Digitisation: Grid infrastructure must be treated as the backbone of electrification. According to IRENA, hundreds of gigawatts of renewable capacity remain stalled globally due to inadequate grid integration. IRENA estimates that US$670 billion in annual investment between 2025 and 2030 will be required to modernise and expand electricity grids worldwide. Countries along the corridor must prioritise transmission expansion, cross-border synchronisation, and flexible grid management systems. Upgrading substations, deploying high-voltage transmission lines, and investing in battery energy storage systems (BESS) will be essential to manage renewable intermittency.

Digitisation will play a critical role in reducing technical losses, enabling demand response, strengthening cybersecurity, and generating auditable carbon data increasingly required by global investors and buyers. Modern grid infrastructure must integrate smart metering, predictive maintenance, advanced load forecasting, and real-time balancing mechanisms. Fibre-optic sensors capture data about real-time activity and strain on power lines which can be transformative for utilities to reduce wastage and manage supply, at a much lower cost.

The viability of the renewable energy pathways and grid integrations based on them would largely be determined by how its intermittency component could be mitigated. To address this, the development of Energy Storage solutions and CCUS technology must be made central in the investment and R&D focus models. At the same time, cost allocation mechanisms must be carefully designed. Transparent tariff design and benefit-sharing arrangements will be essential to preventing political resistance and ensuring long-term sustainability. Cooperation in the design, development, and deployment of Small Modular Reactors (SMRs) through the role that countries such as India and France, in particular, are playing in the sector could prove to be a valuable avenue for cooperation.

10. **Expand Strategic Port and Storage Infrastructure:** Investments and cooperation in expanding port and docking capacities around the region is essential if the transport of energy and the concomitant products is to be made sustainable and effective along the corridor. As the region evolves into a multimodal energy connectivity network, capacities should be built to handle diverse energy carriers, including LNG, hydrogen, ammonia, methanol, refined petroleum products, and critical minerals. Participating countries should therefore coordinate investments in deep-water ports, specialised docking facilities, LNG regasification terminals, hydrogen and ammonia export terminals, bunkering infrastructure, electricity cable landing stations, and dedicated logistics corridors connecting ports to inland industrial clusters. Expanding strategic storage capacity, not only for crude oil reserves and LNG storage but also hydrogen and BESS, would further enhance the corridor's resilience against supply disruptions.

11. **Develop a Regional Hydrogen Economy:** As India raises its ambitions from energy security to energy independence, the affordability of clean energy such as green hydrogen and its derivatives is critical to the long-term competitiveness of India's energy transition. Green ammonia is currently leading in the adoption of green hydrogen, with its strategic adoption advanced across regions such as the EU, India, and South Korea. Noteworthy examples include H2Global's tender of green ammonia under the EU's hydrogen import strategy, South Korea's

Clean Hydrogen Portfolio Standard (CHPS) tender for clean ammonia procurement as a bulk fuel, and the recent tender concluded by the Solar Energy Corporation of India (SECI) under the Strategic Interventions for Green Hydrogen Transition (SIGHT) programme of India's National Green Hydrogen Mission.

Implementing innovative market mechanisms where governments shoulder the price risk can facilitate access to debt finance for hydrogen projects. Adopting an auctions-based system, for instance, creates a competitive framework for allocating land, renewable resources, and infrastructure, attracting more private sector participation. Auctions can be "single-sided", which focus on stimulating the supply or demand side or "double-sided" which stimulate supply and demand. In double-sided auctions, green hydrogen suppliers offering the lowest price and off-takers with the highest willingness to pay are selected and an intermediary covers the difference between the supply and market price. When auction system design clarifies risk allocation, payment security, and off-take and pricing conditions, they have the potential to create a mutually beneficial framework for stakeholders.

In the immediate term, prioritise downstream end-use hydrogen applications through policy mandates, quotas, and green public procurement to encourage industry adoption. As an alternative to subsidies, governments can promote a green steel and green cement market by prioritising its implementation in government-funded construction projects. Pairing end-use application mandates with cohesive green product standards would also enable the creation of high-value industrial clusters. Furthermore, aggregating demand through common-user infrastructure or hydrogen valleys where multiple industrial off-takers are located nearby hydrogen and renewable energy production sources would mitigate transport issues, and improve utilisation and efficiency.

12. **Build a Regional Critical Minerals Hub:** The region has an advantage in the critical minerals sector by virtue of its points of access and invested leverage in the minerals 'super-region' of Africa and Central Asia. It also has the lowest costs of baseload as well as cleaner energy options, patient capital, and the process engineering expertise of the Gulf in the hydrocarbon sector and of India and France in mining. Given these advantages, countries along the corridor could work towards developing joint processing capacity to offset the considerably high CapEx requirements as well as the lack of a sufficiently large talent pool in the sector. While the creation of a joint Strategic Reserve of Critical Minerals may prove to be challenging given the differing security considerations and industrial trajectories of the countries, they could coordinate to prioritise the recovery of critical minerals from recycling. The integration of IMEC actors such as India, the UAE, Greece, Israel, Saudi Arabia, and the EU in the US-led Pax Silica and FORGE initiatives to enhance resilience along the critical minerals value chain, while reducing dependence on the singular centres of influence such as China, adds further impetus to developing capacity as processing hubs along IMEC and its hinterland.

8

Conclusion

THE VISION OUTLINED IN THIS REPORT may be ambitious, and the web of networks framework will take years, if not decades, to materialise in its entirety. Political realities, financial constraints, technological challenges, and differing national priorities mean that these corridors will emerge incrementally rather than simultaneously. Bilateral, trilateral, and minilateral alliances and partnerships will develop and likely precede a broader regional integration.

While the corridor development may be gradual, the imperative to build redundancies is immediate. The weaponisation of maritime chokepoints, across the Strait of Hormuz, the Bab el-Mandeb, the Red Sea, and other land corridors in the region reflect the increasing vulnerabilities of relying on limited trade routes, and the growing urgency to build alternative pathways. Countries in the Middle East will have to find ways to overcome their internal and regional tensions in the interest of long-term economy prosperity and political stability. Energy connectivity provides one such opportunity for sustained cooperation.

This report has presented a framework for an integrated web of networks that extends beyond transport infrastructure and IMEC alone and moves to a roadmap for cooperation that encompasses the systems likely to define the future of global energy. This includes not only oil and natural gas, but also cross-border electricity interconnections, hydrogen and its derivatives, civilian nuclear energy, and critical minerals. Together, these sectors form the foundations of a more resilient and diversified regional energy architecture.

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