Report

Roland Berger

Unlocking Hydrogen Growth in the Middle East

KEY ENABLERS FOR THE CREATION OF A LOW-CARBON HYDROGEN ECONOMY

Roland Berger

SUMMARY

The **Middle East** is **uniquely positioned** to become a **frontrunner region** in the **future low-carbon hydrogen economy. Investing** in the creation and development of a **sustainable hydrogen ecosystem** can make the Middle East a **leading producer of low-carbon hydrogen** and a **major exporter** to Europe and North-East Asia.

Nonetheless, **several challenges still stand in the way** of achieving these ambitions, many of them related to the lack of infrastructure, strategies, and regulations. This publication outlines the **key challenges** and identifies **enablers** to drive the low-carbon hydrogen ecosystem forward.

CONTENTS

Cover photo Petmal/iStock

1 / Hydrogen – An opportunity for Middle Eastern Countries

The Middle East is **uniquely positioned** to become a future export hub of low-carbon hydrogen. Not only does it benefit from **abundant resources to produce low- carbon hydrogen** at a **large scale**, it is also **well located** to **export hydrogen to major demand centers** in Western Europe and North-East Asia.

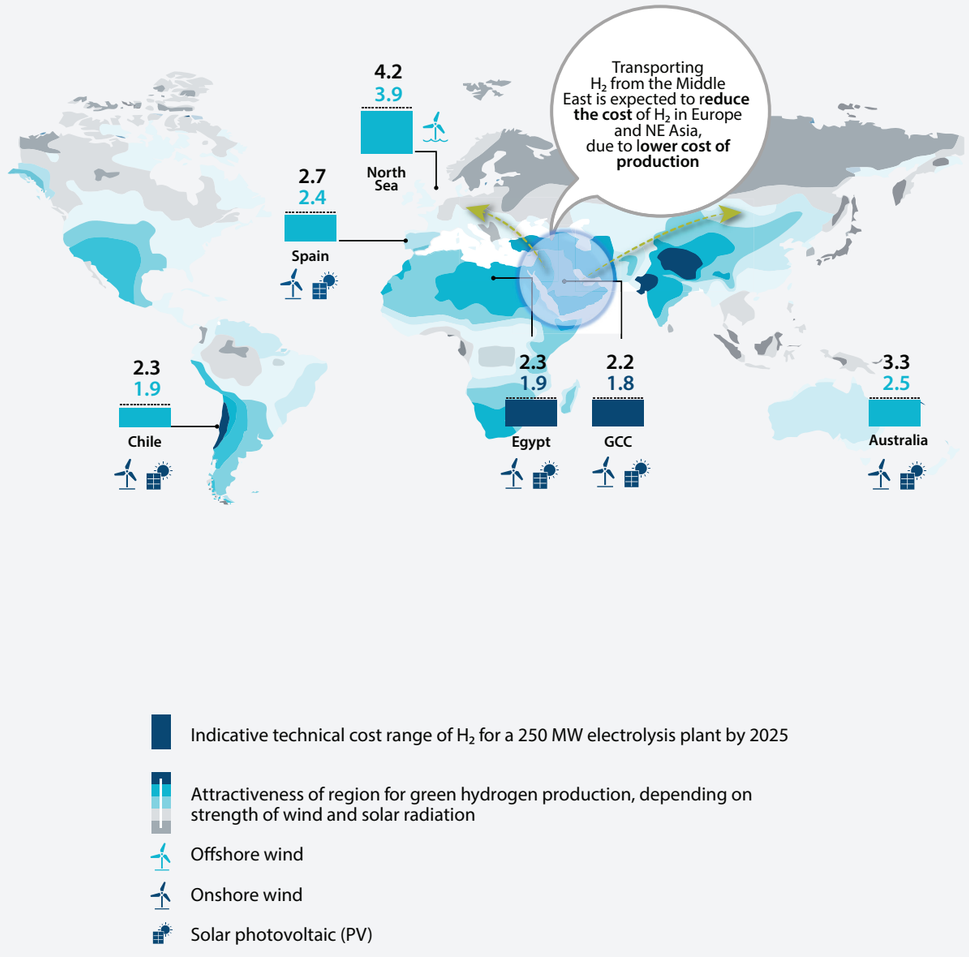
The hydrogen potential in the Middle East

Along with **strong political** commitment to create a foothold in the new hydrogen economy, countries of the Middle East have **abundant renewable** (solar and/or wind) and **natural gas resources** to produce low-carbon hydrogen at **among the lowest technical costs in the world.** In fact, low-carbon hydrogen imported from the Middle East to European and North-East Asian countries could have a lower overall price (including transport) than locally produced low-carbon hydrogen. → **A**

Most **Middle Eastern countries** have already started **claiming their space in clean hydrogen production,** with **over 60 hydrogen production projects** announced in recent years – mostly in Egypt, Oman, UAE and KSA. More than **80% of all announced projects** focus on the **production of green hydrogen,** with more than 20 projects in Egypt alone.

While there is **considerable potential for the Middle East** to become a hydrogen powerhouse and despite the high number of hydrogen projects and the opportunities available on the global market, an **overarching strategy direction is missing: no Middle Eastern country has yet defined a strategy** to support, with tangible steps, their hydrogen ambitions.

A / Levelized cost of of hydrogen production [EUR/kg H_2]



Source: Roland Berger

2/ Challenges and Enablers

Middle East countries, while well positioned, **must overcome challenges** in order to **ensure the development of a robust hydrogen economy.** Five main challenges, and possible enabling solutions, have been identified. → B

B / Key challenges in the development of the hydrogen ecosystem

1	2	3	4	5
Lack of strategy & institutional design	**Inadequate infrastructure**	**Low local demand for clean hydrogen**	**Lack of certification & standards**	**Insufficient tech. & human capital**
• Lack of a **national strategy** • Absence of efficient **governance mechanisms** • Lack of clarity on **roles and responsibilities** of different government departments	• **Insufficient infrastructure** (includes **solar PV plants, electrolyzers**, pipelines, storage units, etc.) • Unclear **regulatory** and **policy** regime to guide infra. development	• Lack of government-led **regional/national** and **project-specific** initiatives to **stimulate production and consumption** of low-carbon hydrogen	• Absence of a **local certification** scheme • Lack of **technical standards** covering the entire H_2 value chain	• Lack of **qualified domestic workforce** • Little emphasis on **local development** of technology

Source: Roland Berger

1) LACK OF STRATEGY AND INSTITUTIONAL DESIGN

To date, **no Middle Eastern country has defined a national hydrogen strategy** to support with tangible steps their low-carbon hydrogen goals.

National strategies play a **crucial role** in the setting of national targets and ambitions. They also help set clear **guidelines, governance**, and **roadmaps** and create a **central approach** to support hydrogen projects. This offers project developers the **clarity required to invest in a dynamic new industry**. A clear hydrogen strategy can answer the following questions:

- Who is leading the development of the hydrogen economy?
- Which local or regional government departments play a leading role?
- What is the current and future regulatory regime for hydrogen economy development?
- What are the infrastructure and regulatory requirements?
- Are there incentives in place that enhance willingness to pay low-carbon premium?
- What is the national framework for international trade?

In **most countries** (e.g., Chile), the **Ministry of Energy** (or its equivalent) leads the **development of the hydrogen economy**, with regulation development support from other relevant ministries. **Countries with a federal structure** (e.g., Germany) give **local/regional departments of energy the leading role**, with the federal ministry responsible for overall coordination and alignment with national goals. Also, when setting a national strategy, countries must take into consideration their net-zero strategies.

A **robust national strategy** can **further create councils or taskforces** that are **assigned advisory roles** for project developers. In addition to institutional design, creating a **government one-stop-shop** is essential to **provide bespoke support for hydrogen projects**. This would simplify and fast-track support to project developers and provide better visibility of the hydrogen ecosystem.

One-stop-shops can be made up of **multiple government entities**, each playing a different regulatory role. They can also identify exemptions to allow projects to thrive while the regulatory framework is being built and provide incentives for projects that need support in the form of tax exemptions or subsidies, among others.

> *„As future major producers of low-carbon hydrogen, it is critical for Middle Eastern states to formulate key policies and regulations required to enable the local development of their respective hydrogen ecosystems“*
>
> **Vatche Kourkejian, Partner at Roland Berger**

2) INADEQUATE INFRASTRUCTURE

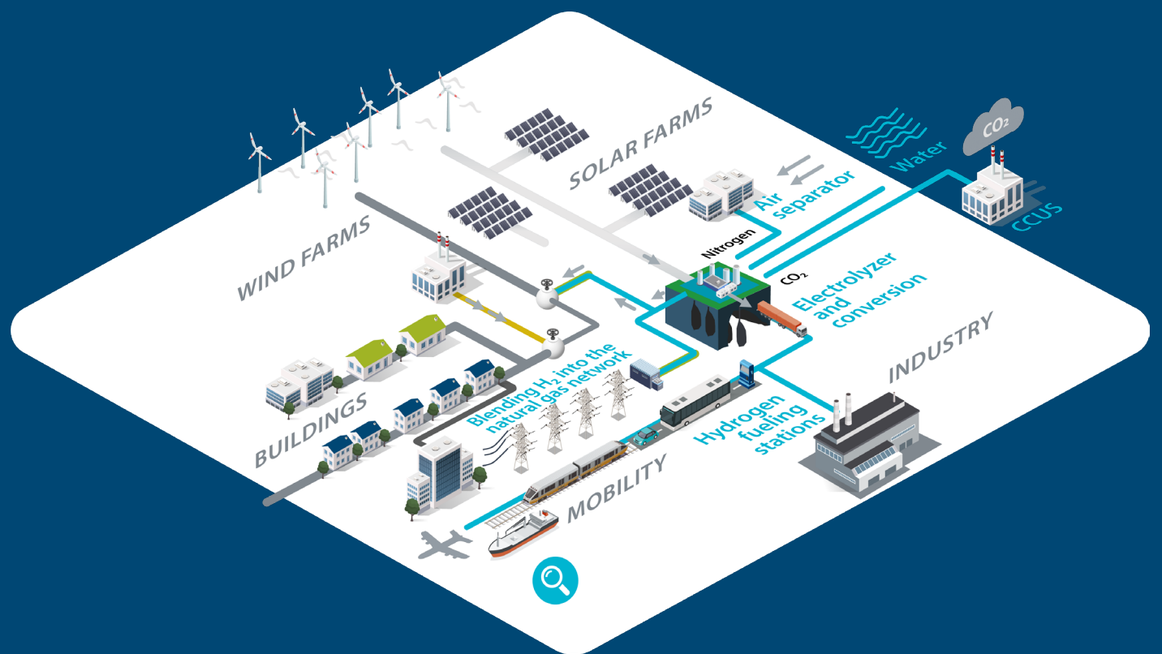
Insufficient infrastructure (including solar PV plants, electrolyzers, pipelines, storage units, etc.) coupled with **unclear regulation of policy regime to guide its development** is a **common barrier** faced by most countries in the development of their future hydrogen economy.

Provision of adequate infrastructure, especially during the early stages of development is a key foundation in the hydrogen economy creation.

A. One possible solution includes the introduction of hydrogen valleys

Hydrogen valleys are hubs of hydrogen production and consumption that lead to **system-wide synergies and reduce the overall infrastructure cost for players** through sharing mechanisms and incentives.

C / Hydrogen valley overview



Source: Roland Berger

Hydrogen valleys:

- Are large scale production and consumption hubs;
- Cover multiple steps of the hydrogen value chain;
- Supply low-carbon hydrogen to multiple sectors (showcasing the versatility of hydrogen);
- Are concentrated in a specific geographic area. → C

They hold **great potential of realizing economies of scale**, creating **additional revenue** sources, and **reinforcing synergy and knowledge sharing**. Furthermore, by bringing production and consumption together, hydrogen valleys can become **accelerators for low-carbon hydrogen supply/demand**.

Creating and regulating these hydrogen valleys requires **complex coordination between multiple stakeholders**, large amounts of financing and new business models. Policy and regulation development must be carefully considered to act as catalysts.

B. Policies and regulatory frameworks must be developed for these hydrogen valleys

To create hydrogen valleys, **clear regulatory frameworks need to be set** so that project developers have **clarity about the laws and licensing regulations along the hydrogen value chain**. These frameworks instill **confidence in the producers and consumers** of hydrogen.

In the **short term**, the frameworks should include limited regulations to **foster private infrastructure development** (both repurposing and creation of new infrastructure) and support the growth of infrastructure needed to accelerate low-carbon hydrogen and derivatives production.

In the **medium term**, the regulatory frameworks should expand to define boundaries **ensuring objective, transparent, and non-discriminatory third-party access.**

And finally, in the **long term**, a robust **TSO-managed backbone infrastructure should be developed**, including a tariff setting framework, ensuring minimization of infrastructure cost and avoiding underutilization of costly assets, in addition to fair tariff schemes and non-discrimination.

3) LOW LOCAL DEMAND FOR LOW-CARBON HYDROGEN

Due to the higher price of low-carbon hydrogen compared to more polluting sources of energy/fuels and the lack of regulations and incentives that support its adoption, the **demand for low-carbon hydrogen in Middle Eastern countries is currently low.**

Developing **initiatives** can **stimulate the production and consumption** of low- carbon hydrogen at the **macro and project-specific levels:**

- **Regional/country-level** initiatives can include quotas to foster the use of low-carbon hydrogen, ecolabels, sustainable procurement initiatives, decarbonization targets, etc.
- **Sector/project-level** initiatives can include direct funding, loan guarantees, export duty exemptions, production and investment tax credits, etc. → D

4) LACK OF CERTIFICATION & STANDARDS

A **lack of technical standards** for the production, distribution, storage and utilization of low-carbon hydrogen was observed in the Middle East, in addition to the **absence of local certification schemes**.

The establishment of **credible and transparent certification schemes is essential** to instill **confidence in buyers and stimulate local and export demand.** Such schemes would assure buyers of the **quality and type** of hydrogen, allow **full traceability** of hydrogen supply chains (from origin of renewable electricity to point of hydrogen supply) and **add legitimacy** to low-carbon claims.

D / Macro and sector-specific hydrogen initiatives

Regional/country-level initiatives (macro)	Introduce quotas and mandates for use of low-carbon H_2 — India	Drive sustainable procurement initiatives — Netherlands | US	Introduce ecolabelling for selected products — Germany	Introduce blending targets for H_2 in natural gas pipelines — UK
	Introduce carbon market — EU	Define decarbonization targets by each end-use sector — China | Germany	Phase out fossil fuel-based technologies for hard-to-abate sectors — France	
Sector/project-level initiatives (micro)	Introduce project-based Carbon-Contracts-for-Difference — UK | Germany | EU	Introduce direct funding for supporting deployment and use of H_2 technology	Introduce loan guarantee programs for H_2 projects — US	Provide provision of concessional loans for H_2 projects — South Africa
	Introduce export duty exemption for H_2 projects — UK | Russia	Introduce import duty waiver for critical inputs used in H_2 production	Introduce production tax credit for H_2 projects — US	Introduce investment tax credit for H_2 production — US

Source: Roland Berger

Ideally, the certification schemes should be **developed and monitored by a central organization**. A robust scheme should provide a consistent definition of "low-carbon" hydrogen, set renewable electricity certification as a prerequisite, and put in place tracking systems to ensure transparency . → E

E / Benefits of low-carbon hydrogen schemes

Low carbon hydrogen certification schemes

Critical to **assure buyers** of hydrogen **quality and type** (necessary prerequisite for reaching export ambitions)

Allow **full traceability** of hydrogen supply chains – from origin of renewable electricity to point of hydrogen supply

Offer legitimacy to "low-carbon" hydrogen claims

Examples of leading certification schemes

Currently, the EU leads the development in defining and preparing schemes for low-carbon hydrogen certification

Key recommendations for scheme development

1. Develop a **harmonized definition** of "low-carbon" hydrogen
2. Mandate a trusted and authoritative **central organization** to **implement the scheme**
3. Define **renewable electricity certification** as a prerequisite
4. **Assess existing schemes** to draw out best practices
5. Ensure that the **certificates contain sufficient information** for consumers and policymakers
6. Put in place **tracking systems** to avoid misuse/ double counting and ensure transparency

Source: Roland Berger

In addition to these schemes, countries would benefit from **adopting internationally recognized technical standards** for the production, distribution, storage, and use of hydrogen. These standards, set by a national and local regulatory authority, are essential to **enable the commercialization of hydrogen across all sectors.**

5) INSUFFICIENT HUMAN CAPITAL & TECHNOLOGY

The final challenge that could potentially hinder the growth of a low-carbon hydrogen economy in the Middle East is the **lack of a domestic workforce trained in the sector,** and **limited emphasis on local technology development.**

To enable **human capital development, educational programs and sector-specific trainings** to support skills and competencies development in the hydrogen market **need to be established**. Some countries have already instilled the first steps towards this effort. For instance, Oman has created a Hydrogen Center in collaboration with GUTech to support the training of future workforces and talents. In Germany, a multimillion-euro fund was created to attract international scientists for collaborative research and technology development.

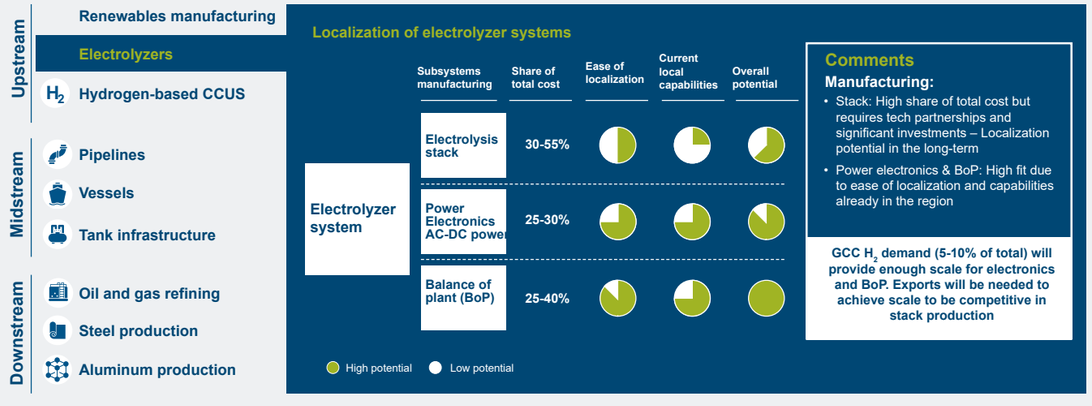
The **development of this new workforce** can then be **supplemented with R&D support** through funds and grants. Some R&D programs are already in place in the Middle East, but additional public funding would be required. Also, large scale proliferation of technology and commercial **partnerships between Middle Eastern and European countries** have been witnessed in recent years, but **further collaboration would be required to ensure efficient knowledge and technology transfer to the Middle East.**

Finally, steps should be taken to **assess localization opportunities across the hydrogen value chain.** While the hydrogen economy in itself is a tremendous opportunity, **gains can be multiplied if steps are taken to localize production of critical elements** of the hydrogen value chain. In upstream, **electrolyzers are a case in point:** only GCC hydrogen demand (5-10% of total global demand) will provide enough scale for electronics and balance of plant equipment, even in the short to medium terms. However, additional exports will be needed to achieve scale and competitiveness in stack production in the long-term. → F

3/ Implementation

Having identified challenges and enablers, it is vital for countries in the Middle East to **create integrated implementation roadmaps that ensure a phased roll-out of hydrogen economy enablers.**

F / New sectors development potential

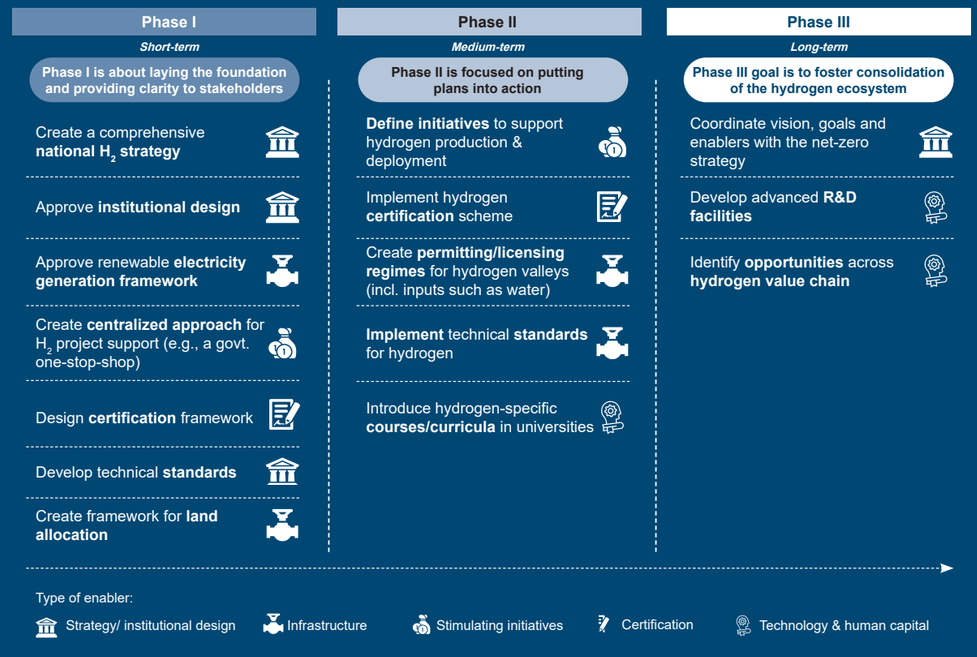


Source: Roland Berger

Phase I:
This **initial phase** is critical and must lay the **foundation for a strong hydrogen economy and provide clarity to stakeholders.** Focus should be on setting a national hydrogen strategy, clarifying and approving regulations and governance, and identifying a renewable electricity framework and a fair mechanism for land allocation.
Phase II:
The **medium-term phase** is focused on **putting plans into action,** by supporting hydrogen production and development with initiatives, launching certification schemes, setting standards and permission regimes and introducing hydrogen-specific trainings and curricula in formal higher education.
Phase III:
During the last phase, further opportunities and localization initiatives are identified, a wider ecosystem for R&D is fostered while **consolidating efforts towards enabling the net-zero strategy.**

The timely and deliberate implementation of enablers can ultimately lead to a robust hydrogen economy, knowledge sharing, and overcoming barriers. → G

G / A roadmap for implementing the identified enablers



Source: Roland Berger

4/ Conclusion

The Middle East has the **potential to be at the forefront of the global hydrogen economy.** It possesses the ideal natural resources, the geographic location, and the political willpower needed to capture the growth of a robust regional hydrogen market.

Five main barriers that Middle East countries must overcome to ensure a robust hydrogen economy, **have been identified along with potential solutions** to be implemented, in careful phases, on the national and local levels. These challenges include **lack of strategy and institutional design, inadequate infrastructure, low demand for low-carbon hydrogen, lack of certification & standards and insufficient human capital & technology.** → H

If **well-informed national strategies are set and executed,** the Middle East can see a **boom in large-scale hydrogen projects,** an **expansion of hydrogen valleys,** and a **decline in production costs.** It can further become a leader in advanced R&D activities and hydrogen innovations, and in setting international best practices and standards.

H / Outcomes of introducing enablers

Barriers	Short-term	Medium-term	Long-term
Lack of strategy & institutional design	Clarity on overall policy direction key roles and responsibilities of government departments Provision of bespoke support to hydrogen projects using a centralized approach	Use of a govt. backed one-stop shop to enable projects to smoothly scale up and achieve economies of scale	Proliferation of **independent, large-scale** hydrogen and derivatives projects
Inadequate infrastructure	Clarity on **regulations and governance** of H_2 valley, incl. access to low-cost renewable electricity for production	Proliferation of **H_2 valleys concentrated** in few centers in Abu Dhabi to unlock benefits such as lower cost of infrastructure	Rapidly **scaling H_2 valleys** with key infrastructure for production, conversion, transport and storage of H_2 and its derivatives in place
Lack of stimulating initiatives	Identification (and legislation) of policy instruments to increase uptake of H_2 across sectors; incl. setting of **sector-specific mandates** and **decarbonization targets**	Low-carbon and green H_2 **use increasing across sectors**, rapidly replacing fossil fuel-based legacy technologies	Increased scale of production leading to **decline in costs** – with green/blue H_2 in optimal conditions competitive with grey H_2
Lack of certification & standards	Identification/creation of **certifying bodies** Introduction of **certification mechanism** for low-carbon hydrogen	Alignment of **lifecycles emissions calculation** methodology for different green products (e.g., steel)	Internationally **approved/ adopted standards** being used for large scale commercial projects
Insufficient technology & human capital	Introduction of **H_2 technology-specific R&D support measures** (e.g., grants) and development of **university and vocational courses** tailored to H_2	Advancing **creation of working groups** to enable dynamic data and knowledge sharing	**Advanced R&D facilities** in an efficient knowledge sharing economy; presence of a locally trained workforce for H_2 ecosystem

Creation of a sustainable H2 ecosystem

Source: Roland Berger

AUTHORS

Vatche Kourkejian
Partner & Head of Energy, Roland Berger Middle East
vatche.kourkejian@rolandberger.com

Alejandro Longueira
Principal, Roland Berger Middle East
alejandro.longueira@rolandberger.com

Aeshwarya Jain
Consultant, Roland Berger Middle East
aeshwarya.jain@rolandberger.com

Celia Garcia Oliver
Senior Consultant, Roland Berger Middle East
celia.garciaoliver@rolandberger.com

Dmitriy Shnyakin
Business Analyst, Roland Berger Middle East
dmitriy.shnyakin@rolandberger.com

FURTHER CONTACTS

Uwe Weichenhain
Partner & Head of Global Hydrogen, Roland Berger Germany
uwe.weichenhain@rolandberger.com

Dan Gabaldon
Senior Partner, Roland Berger US
dan.gabaldon@rolandberger.com

Emmanuel Fages
Senior Partner & Head of Energy, Roland Berger France
emmanuel.fages@rolandberger.com

François Castelein
Partner & Head of Energy, Roland Berger Belgium
francois.castelein@rolandberger.com

Dieter Billen
Partner & Head of Energy, Roland Berger South East Asia
dieter.billen@rolandberger.com

Markus Kaufmann
Principal, Roland Berger Germany
markus.kaufmann@rolandberger.com

Bram Albers
Principal, Roland Berger Netherlands
bram.albers@rolandberger.com

Christopher Schmitt
Principal, Roland Berger Germany
christopher.schmitt@rolandberger.com

Thor Kristjansson
Project Manager, Roland Berger US
thor.kristjansson@rolandberger.com

We welcome your questions, comments and suggestions | **www.rolandberger.com**

01.2023

ROLAND BERGER is the only management consultancy of European heritage with a strong international footprint. As an independent firm, solely owned by our partners, we operate 51 offices in all major markets. Our 3000 employees offer a unique combination of an analytical approach and an empathic attitude. Driven by our values of entrepreneurship, excellence and empathy, we at Roland Berger are convinced that the world needs a new sustainable paradigm that takes the entire value cycle into account. Working in cross-competence teams across all relevant industries and business functions, we provide the best expertise to meet the profound challenges of today and tomorrow.

Publisher:
ROLAND BERGER Middle East
Innovation Hub Building 2B, 3rd Floor
P.O. Box 502254
Dubai, UAE
+971 4 446 4080

22_8006_REP