PENSPEN

DEVELOPING HYDROGEN PROJECTS

in the MENA Region Depsite Higher Costs

Hydrogen is the most promising option for decarbonising fuel molecules in hard-to-abate sectors such as heavy industry and transport applications. Not only can it be readily developed from renewable sources, but hydrogen can be seamlessly integrated into our existing infrastructure.

Hydrogen Projects in the MENA Region

Governments across the Middle East and North Africa (MENA) region, especially within the Gulf Cooperation Council (GCC), seek to develop hydrogen hubs, eyeing energy leadership, economic sustainability, industrial diversification, and job creation. However, the green hydrogen agenda presents its own set of challenges and resolving them shall require innovation, not only in technology and its scaled-up deployment but also in policy, regulatory and investment frameworks.

The GCC countries are banking on centralised, cost-competitive export of green hydrogen given the availability of extensive land, solar and wind resources, as well as legacy infrastructure from the oil and gas sector. Hydrogen hubs in Oman, Saudi Arabia and the United Arab Emirates are ambitious endeavours and seek the establishment of major green hydrogen projects in return for an enabling environment providing abundant land, ready infrastructure and inexpensive utilities.

Within these hubs, however, hydrogen projects are often failing to achieve financial closure, given the prohibitive cost of green or blue hydrogen production and transmission. In particular, the transportation costs could be 2-3 times that of production costs, making green hydrogen more of a supply chain challenge than a production challenge.

Hydrogen Transportation: Costs and Feasibility

Governments Penspen, leveraging its knowledge and expertise in oil and gas transmission projects, investigated various hydrogen transportation scenarios inclusive of gas pipelines; compressed gas shipments via tube trailers; and marine shipments as Ammonia, Liquid Organic Hydrogen Carriers (LOHC) or cryogenic liquid hydrogen. Our analysis entails detailed designing, OEM consultation and accurate costing of these systems.

Based on our results, on a levelised cost of transmission basis, gaseous hydrogen pipelines remain the best possibility for hydrogen transportation, resulting in less than 1 USD/kgH2 levelised transportation cost, owing to the high transfer capacity and long pipeline lifetimes.

However, the high capital costs associated to pipelines and technical challenges in traversing ultra deep water between continents limit their usage to decentralised hydrogen applications where the source and sink of the gas are in close vicinity. On the other end of the cost spectrum, tube trailers are the most expensive mode of hydrogen transportation due to their high operational expenditure.

In the middle lie the marine shipment options, where Ammonia incurs substantial operational costs (for production and cracking of Ammonia back to hydrogen), and results in the highest transmission cost of 20-25 USD/kgH2. Liquefaction and LOHC could bring these transportation costs down to 5-15 USD/KgH2.

Cost Reduction Through Innovation

While intercontinental hydrogen exports still have merit, they are contingent on technological innovation which could result in further cost reductions. For instance, conventional air separation to produce nitrogen, and thereafter produce ammonia consumes considerable energy resulting in high operational costs. With membrane-based air separation, this energy penalty can be dramatically reduced. Similarly, process integration could provide further possibilities for cost reduction and additional revenues. Air separation can provide nitrogen for ammonia production and oxygen for combustion (in power, cement or other plants). Oxy-fuel combustion, without nitrogen, enables cost-effective carbon capture and storage and improved efficiencies for power or steam creation.

As an engineering consultancy, Penspen has been focusing on designing and costing of green hydrogen infrastructure as part of its energy transition service line, primarily in Europe. These exercises include consultation with OEMs; assessment of technology readiness levels, optioneering and routing of pipelines; process flow assurances; certification of existing equipment for hydrogen use; and quantitative risk assessments for hydrogen safety.

Hydrogen Future in the MENA Region

We would recommend project-based studies for hydrogen production, delivery, storage, and conversion systems at key hydrogen hubs in the GCC region. The results would identify the key steps of the local hydrogen value chain and the costs incurred. The identification of the cost barriers is the first step for resolving them. Such analysis shall become the basis of a collaborative discussion between industry, government and academia on optimising the value chain and reducing the overall costs.

Given the importance of the nascent hydrogen sector, collaboration is more important than competition. These studies could identify the technological, regulatory, and market barriers that limit the integration of hydrogen with conventional energy systems in MENA. The financial viability of hydrogen projects shall depend on their flexible use across different sectors, resulting in multiple sources of revenue. Overall, hydrogen feasibility studies, such as those delivered by Penspen, shall bring our collective hydrogen aspirations one step closer to reality.

About Penspen

Penspen is a global team of engineers who design, maintain, and optimise energy infrastructure to improve access to energy for communities worldwide. We help meet the world's evolving energy needs by providing consulting, project, and engineering solutions across the entire energy asset lifecycle.

For over 70 years, our teams have delivered more than 15,000 projects to in excess of 100 countries. By helping countries access lower carbon fuels and by extending the useful life of existing energy infrastructure, we help to bring cleaner energy to millions of people in thousands of communities across the Middle East, Africa, Asia, Europe, the UK, and the US.

Penspen is a proud member of SIDARA a leading, privately-owned professional services group with award-winning impact and global reach. As an engineering, architectural, and planning consultancy that values specialty expertise, Sidara is united by a commitment to providing clients with multidisciplinary solutions rooted in quality, innovation, collaboration, sustainability, and technology to deliver social and community impact.

CONTACT OUR ASSET INTEGRITY TEAM

Email: contact@penspen.com | Website: www.penspen.com