Oman sets off to become a hydrogen society

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Oman's Public Authority for Special Economic Zones and Free Zones (OPAZ) has announced the designation of a 150 km2 (15x10 km) area, the equivalent of around 21K football fields, in Duqm to generate solar power for the production of green hydrogen. This follows the announcement made previously by Sohar Port to transform the industrial port into a global supplier of green hydrogen using solar energy and electrolysis technology.

The Duqm project area size, as big as it may seem, represents a small fraction of Oman's vast deserts, which expands to more than 250K km2 in size. Having vast unoccupied areas with high solar irradiance, Oman is well positioned to become a global leader in exporting green hydrogen and help the world transition to a sustainable future. Oman's daily solar insolation rate reaches as high as 6.5 Kwh/m2 in certain locations, such as Manah-Adam region, which is more than double the average rate found in Europe. As such, in a 150 km2 area, Oman could produce as much as 45k GWh per year of solar electricity. With this value, Oman could produce enough power to run electrolyzers that would generate 60% of the hydrogen it consumes today. The green hydrogen energy produced would thus be equivalent to approximately 10% the local natural gas demand and around 16% of the natural gas annual exports. This could potentially offset 5MM metric tons of carbon emissions per year, the equivalent of 1MM passenger vehicles driven for 1 year.

Nevertheless, the establishment of massive green hydrogen projects, such as the one in Duqm, will accumulatively require vast quantities of desalinated water to produce hydrogen via electrolysis technology. The Duqm green hydrogen project alone will consume around 2% of the annual water production in Oman.

> Investing in green hydrogen will not only move Oman to an environmentally sustainable future but will also create economic diversification opportunities.

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Large-scale green hydrogen projects also require developing production, storage and distribution infrastructures, as well as acquiring technological know-how. The interest shown by numerous local and international investors to invest in green hydrogen, the establishment of center-of-excellence institutions, such as the Oman Hydrogen Centre at GUtech university, as well as Oman's geostrategic location and vast experience in the energy sector create a strong market edge for the country to overcome the associated challenges of tapping into emerging energy markets and expand its energy portfolio.

Hydrogen, which is the most abundant element in the universe, has over the past decades developed into a major global market, and is expected to play an ever more important economic role in the next decades. Hydrogen demand has tripled since 1975 and is expected to quadruple by 2050, reaching a record high of 287Mt.

Today, almost 96% of the global hydrogen production comes from fossil fuels, which is known as grey hydrogen, and is majorly used as feedstock by the refining and ammonia industries. Hydrogen alone consumes presently around 6% of the global natural gas supply, and accordingly is a major contributor to GHG emissions. The idea, however, is not only to green today's hydrogen markets but to also expand this market to previously untapped industries. Green hydrogen is globally gaining traction as a key element to transition towards a sustainable future. Replacing fossil fuels with renewables in the electricity sector alone will not be enough to decarbonize hard-to-abate energy intensive sectors and prevent the undesired outcomes of climate change. With its versatile power-to-x advantage, green hydrogen could play an important role in storing utility-scale clean energy and replace fossil fuels in certain chemical, manufacturing, power

and transportation industries. Green hydrogen has the potential to be utilized as feedstock to produce inorganic fertilizers, steel, methanol as well as other chemicals and manufactured products. By utilizing fuel cell technology to produce electricity, green hydrogen could also be used as fuel for heavy vehicles, including: trucks, ships and airplanes, as well as contribute to balancing electric grids. Currently, the cost of producing green hydrogen remains relatively higher than conventional grey hydrogen. Nevertheless, as green hydrogen investments begin to significantly pour-in, the enhancement of technology efficiency as well as economies-of-scale will make green hydrogen an internationally competitive product.

Globally, there are at present 9 states that have passed a national hydrogen strategy, including: Germany, Japan, Australia and Spain, and an additional 11 states that are working towards finalizing one. Together these states account for more than 40% of the global GDP. The share of global GDP represented by countries with national hydrogen strategies is expected to increase to 80% by 2025. Many countries have in fact started implementing green hydrogen projects. At technology level, Germany for example is currently running an intercity hydrogen-powered train on a 100km railway and is planning to have 14 of such trains by 2021. In Australia, plans are being set to replace grey hydrogen with green hydrogen as feedstock to produce fertilizers at Pilbara ammonia plant. At policy level, Japan and Australia have signed a joint statement of cooperation that entails the development of green hydrogen technology as well as the creation of green hydrogen trade routes between the two countries. The Netherlands has set a 500MW by 2025 and 3-4GW by 2030 target of installed electrolysis capacity

to produce hydrogen, as well as other hydrogen-based mobility targets. Investing in green hydrogen will not only move Oman to an environmentally sustainable future but will also create economic diversification opportunities. The interlink between green hydrogen production and renewable technologies creates opportunities for startups to emerge as well as mobilize greater segments of society to participate in carrying out an energy transition across the hydrogen value chain. Nevertheless, emerging markets, including green hydrogen, require careful technological incubation at their early stages as well as strong policy support. Energy policies should create demand pull for local development of green hydrogen technology (e.g., subsidizing green hydrogen production and enacting a scheme for the injection of green hydrogen into natural gas networks) as well as supply push by way of developing necessary green hydrogen infrastructures, enhancing local community involvement, supporting SMEs, establishing joint cooperation agreements with international actors and boosting R&D spending.

In alignment with Oman's 2040 vision, Oman should also aim at reducing the barrier-to-entry for local actors to participate in carrying out the energy transition to green hydrogen, and thus have economic, technological, knowledge and social capital permeate further into society. Collaboration between government, research institutions, businesses, civil society and center-of-excellence organizations is essential to ensure a successful diffusion of green hydrogen. This is a golden opportunity for Oman to carry a deep energy transition that would bring about a positive impact at the economic, environmental and social levels. ■