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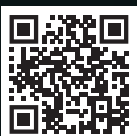
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Chairman's Message

Dear Readers,

Oman's historic green hydrogen journey is officially and resolutely underway, bolstered by some momentous developments, most notably the Royal pronouncements of His Majesty Sultan Haitham bin Tarik championing green energy as a sustainable alternative to Oman's hydrocarbon-fuelled economy. Indeed, all of Oman's policymaking and regulatory apparatuses are now working in concert to herald the emergence of a decarbonized economy powered by renewables and green hydrogen.

Boding well for this promising future is the recent elevation of HE Eng. Salim bin Nasser Al Aufi as Minister of Energy and Minerals. As Under-Secretary until recently, HE Al Aufi strongly advocated for green hydrogen and helped build a robust coalition of like-minded energy companies and public sector stakeholders to help germinate this new vision. He takes the baton from HE Dr Mohammed bin Hamad Al Rumhy, a towering personality who helped navigate Oman's Oil & Gas industry through a succession of upheavals wracking the global energy industry over the past 25 years.

A broad canvas of these important developments in green hydrogen is documented in this edition of *Energy Oman*, which makes essentially reading for those looking to stay up to date on happenings in the green energy space in Oman. Check out also the latest update on the Green Hydrogen Summit Oman 2022, organised by *Energy Oman's* parent organization Birba Energy with the support of the Ministry of Energy & Minerals. Leading local and international energy institutions are also backing the event, reinforcing Oman's emerging stature as a global-scale green energy hub.

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Abdullah Al Harthy



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SOUNDING BOARD

Members of the Editorial Advisory Board of Energy Oman share their thoughts on what promises to be an exciting energy future for the Sultanate of Oman, shaped by green hydrogen.

As Oman green energy plans go mega-scale, let's not give up on rooftop solar systems

On the one hand, it is indeed heartening to see that the Omani government now has its sights firmly on the strategic goal of weaning the country away from hydrocarbons and into greener energy resources. This is indispensable to our national commitments under the Paris Agreement to reduce our carbon footprint and pursue planet-friendly fuel resources.

But on the other, the momentum that was seen until recently in the uptake of rooftop-based solar PV systems by individual homeowners, businesses and organisations seems to be losing steam. It's true that the global economic downturn, compounded by the pandemic, is largely to blame for the apparent cooling of interest in small-scale rooftop solar installations.

But with subsidy on power supply having been for the majority of consumers, there still exists a strong incentive for owners of buildings, as well as private corporations, to install solar PV systems on their rooftops or car parks and thereby reduce their monthly bills quite dramatically.

The Sahim initiative of the Authority for Public Services Regulation (APSR), first unveiled several years ago, provides the most effective delivery platform for the large-scale roll-out of rooftop solar capacity. By roping in investment funds and private developers, Sahim can make it cost-effective for homeowners to sign up to the programme and ultimately enable the large-scale deployment of rooftop solar capacity in major cities of Oman.



Eng Saif Al Salmani, Technical Director – CC Energy Development (CCED)

Unlocking manufacturing opportunities

Oman's maiden solar PV panel manufacturing project is coming up at Salalah Free Zone, based on agreements signed recently by a group of investors with the free zone authority. Although a modest-scale 200MW capacity plant catering mainly to the requirements of small-scale residential and commercial customers, this project points to a much larger strategic national objective. With billions of dollars' worth of investments expected to flow into Oman's green energy industry in the coming decades, it's imperative that we harness the significant local manufacturing potential linked to this future industry.

Green hydrogen projects will be powered by solar and wind farms that will cover potentially hundreds of square kilometres of desert and windswept land in the central and southern parts of the country. Imagine the investment and job generation potential if some of the hardware required for these farms can be locally manufactured! Prepping Oman for manufacturing opportunities linked to this emerging industry is broadly in line with the country's longstanding In-Country Value (ICV) and localization strategies.



Dr Anwar Al Kharusi, Vice President – Upstream Business Development, OQ Upstream Business Unit



Climate Change: A clear and present danger

Climate scientists have been watching with some trepidation developments in Europe as the Ukraine-Russia War, and the energy crisis it has unleashed, has prompted some countries to revive coal plants to mitigate energy shortages. Clearly, the war, while being incredibly tragic at many levels, is also threatening to upend hard-fought global plans to attempt to heal our rapidly warming planet. World leaders should stay resolute in keeping collective pledges made under the Paris Accord to limit and ultimately roll back global warming. The unprecedented heatwaves sweeping across Europe and North America, coupled with the devastating floods wreaking havoc in South Asia, are evidence of climate change being a clear and present danger.

Dr Aisha Al-Sarihi, Research Fellow, Middle East Institute, National University of Singapore; Non-Resident Fellow, The Arab Gulf States Institute in Washington



Making the most of COP27

As Egypt prepares to host the UN Climate Change Conference (COP27) at Sharm el-Sheikh later this year, I think there's a big opportunity for the Sultanate of Oman to showcase its own decarbonization goals, as well as green energy strategies, at this prestigious event.

It's true that Oman has yet to articulate its Net Zero pledge – something that 2022 has potentially in store. But regardless, the Sultanate's green hydrogen ambitions in particular could go a long way in offsetting its carbon emissions. After all, Oman plans to produce enough zero-carbon green hydrogen not only for the country's domestic energy requirements, but potentially also for markets in Europe and the Far East. COP27 will be a powerful platform that Oman should consider exploiting to showcase its green energy ambitions.

Dr Zakiya Al Azri, Corporate Research and Development Adviser, Petroleum Development Oman (PDO)

Challenges of delivering green hydrogen projects

As green hydrogen projects are being developed for implementation in Oman, I think it's imperative to look at the challenges of delivering projects in today's business environment. One such potential challenge that comes to mind relates to global supply chain disruptions of the kind that we witnessed during the covid pandemic and its aftermath. Somewhat tied to that are concerns the cost due to supply chain constraints. Solar projects costs, for example, saw a steep increase of up to 50%, due to raw material price hikes and cost of logistics.

Given these challenges, and the very dynamic environment we need to look at capex efficiencies. There is still so much uncertainty looming around these giga-watt projects including timeframes to develop the electrolyser technologies and downstream processes. There definitely will be a steep learning curve in delivering these projects. We also need to keep in mind the lengthy timeframe associated in the delivery of any giga-watt scale project to define the right projects and delivering those projects right.

In the circumstances, we will have to ask ourselves – and indeed challenge ourselves -- with some key questions: What are the enablers, and how can we get some early wins in the implementation of our National Green Hydrogen Strategy? What is the scale of the projects that we can deliver here? And given some of the ambitious targets that we have, are we likely to face supply chain constraints in the delivery of, for example, the electrolyzers that we need for these giga-scale projects? One of the main questions would be how do we build capability across the entire phases of project delivery. With 70% or more of initial capex being associated upstream assets of wind, solar and associated infrastructure and networks, how do we speed up our capability building and improve our project delivery and economic value?

Clearly, we need a coherent pathway given these immense challenges -- a master-plan that breaks down these barriers and brings together all of the different elements of a comprehensive strategy at the Oman Inc. level.



Dr Salim Saif Al Huthaili, Chief Executive Officer of Solar Wadi

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NAVIGATING
A NEW NORMAL
IN OMAN'S
ENERGY SECTOR

FEATURED TOPICS
CAREER PROSPECTS
IN THE ENERGY
INDUSTRY
ANALYZING ENERGY MARKETS
IN THE MIDDLE EAST
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"We would like to take this opportunity to extend our sincere appreciation to Dr. Mohammed bin Hamad Al Rumhy for his efforts in developing the Energy and Minerals sector": OO Group



We are beyond grateful, HE Dr Rumhy. ■

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Crowning a distinguished career in energy affairs



Oman's energy sector, on the cusp of a major transition to a green-energy based future, joyfully received news of the elevation of HE Eng Salim bin Nasser Al Aufi to the post of Minister of Energy and Minerals on 16th June 2022.

That announcement came via a Royal Decree issued by His Majesty Sultan Haitham bin Tarik naming HE Salim Al Aufi, then Undersecretary, in place of HE Dr Mohammed bin Hamad Al Rumhy, who retired as Oman's longstanding Minister of Energy and Minerals at the end of an illustrious career spanning around a quarter of a century.

With his appointment as Minister, HE Salim ensures seamless continuity with the existing policies of the Ministry encompassing not only fossil fuels – a critical mainstay of the Omani economy presently – but also renewables / green hydrogen, electricity and minerals.

As an avowed proponent of green hydrogen, HE Salim Al Aufi is set to impart added momentum and vitality to Oman's pivot to green energy. From the outset, he has been a central figure in Oman's nascent green hydrogen journey which began just over three years ago. Throughout this period, he has vigorously advocated for renewables and low-carbon energy

resources as an alternative to greenhouse-gas causing fossil fuels.

His elevation to the position of Minister in the cabinet of His Majesty Sultan Haitham bin Tarik crowns a distinguished professional career that began with Petroleum Development Oman (PDO) in 1992 shortly before he obtained his Master's degree in Petroleum Engineering from

“Oman’s vibrant energy and minerals community heartily congratulates HE Salim Al Aufi on his appointment as Minister of Energy and Minerals, and pledges continued support to his official and professional endeavours in strengthening the Omani economy.”

Heriot-Watt University. He progressed within PDO in different technical and leadership roles, which culminated in him becoming the Oil North Director in 2010. This executive level position is responsible for all operations of Oil North Asset of PDO.

In his career spanning well over 28 years, HE Salim held different local and international positions, including PDO's Head of Corporate Planning, Chief Petroleum Engineering and Operations Manager. During his tenure in PDO, HE Salim was posted to Shell Nigeria as Petroleum Engineer and Asset Planner, and to Shell Canada as the Vice President of Production.

In May 2012, the late Sultan Qaboos bin Said appointed HE Salim Al Aufi as the Chief Executive Officer of the Public Authority for Civil Aviation and in December 2013, he was appointed as the Undersecretary for the Ministry of Oil & Gas (now Ministry of Energy and Minerals) in Oman. As Undersecretary, HE Salim's portfolio included Exploration and Production of hydrocarbons, and Electricity and Mining Regulatory responsibilities in the Sultanate of Oman. ■





Powering up Oman's decarbonisation journey

Lingering doubts, if any, of Oman's intent to transition resolutely towards a low-carbon energy future were swiftly and comprehensively quelled by HE Eng. Salim bin Nasser al Aufi, Minister of Energy and Minerals, during a webinar organised by the International Energy Agency (IEA) recently.

For energy industry professionals tuning in to an online forum hosted by the International Energy Agency (IEA) recently, the overarching message from the Sultanate of Oman was unambiguous: That the nation's green hydrogen journey is well and truly underway, and forging ahead at a rapid clip.

Addressing the forum, HE Eng Salim bin Nasser al Aufi, then Under-Secretary of the Ministry of Energy and Minerals (who has since assumed charge as Minister) left no one in doubt about Oman's ambitions to emerge as a green energy powerhouse in the region.

"Suffice to say that there is a very strong belief and momentum in the country that transitioning to low carbon energy and ultimately green and clean energy is an underlying objective; It is something that we have to do," he declared.

HE Al Aufi's comments, articulated during an online forum organised by the Paris-based intergovernmental organization, were an unequivocal reaffirmation of Oman's commitment to transitioning to low-carbon and green energy resources, chiefly green hydrogen, as a strategic national priority.

More than 100 policymakers and energy executives - from Oman and countries of Europe - participated in the virtual proceed-

ings, which focused on the theme, 'Scaling-up Low-Carbon Hydrogen to Decarbonise the Energy Sector in Oman'. Also in attendance were representatives of the organizations that together constitute the National Hydrogen Alliance (Hy-Fly) of Oman.

Co-hosted by Oman LNG, the webinar was moderated by Dr. Abdullah Al Abri who, until recently, headed the Energy Renewal Unit of Petroleum Development Oman (PDO),

“HE Al Aufi pointed out that Oman's transition to low-carbon energy resources starts from a good baseline in the electricity sector. With coal having no role to play in the country's power sector, and diesel a very minor part, fuel efficient natural gas is the dominant feedstock for electricity generation.”

but has since begun a two-year stint at the IEA as a Consultant on deputation from the Sultanate of Oman.

In his keynote address, HE Al Aufi pointed out that Oman's transition to low-carbon energy resources starts from a good



“In his address, Al Aufi called for greater attention to the certification process. “I’m pleased to see that there is a lot of movement happening in that area because that could potentially be a showstopper to some of the work that we’re doing if certification is not handled in a pragmatic manner,” he cautioned.”

baseline in the electricity sector. With coal having no role to play in the country’s power sector, and diesel a very minor part, fuel efficient natural gas is the dominant feedstock for electricity generation, he said.

At the same time, Oman is moving steady-

ly towards renewables-based power generation, mainly solar and wind based, said HE Al Aufi. “We have commissioned a number of renewable projects, and are trying to meet our objectives of a 30% share by 2030 and 40% by 2040,” he pointed out.

Output from renewables will primarily supply the grid, but is also envisioned to produce green hydrogen in the future for local consumption, as well as for export to Europe, the Far East and other international markets, he stated.

Oman’s hydrogen journey, while still nascent, is progressing quite well, stressed Al Aufi. “Some may argue that we are a little slow, but I think, considering where the world is with regards to low carbon energy and green energy today, we are moving very fast indeed. We still need to establish, of course, quite a number of regulations and policies, but these are going in parallel with

activities on the ground, and our discussions with the investors.”

Some underlying issues, he acknowledged, are still unclear at this stage, such as, for example, the price of hydrogen, the tax breaks and other incentives that should be extended to developers, and so on – issues that will be discussed at the appropriate time.

“But that doesn’t change the fact that we are still moving forward with as much decarbonisation as possible of the different industries, depending on which industry is ready to be decarbonized, what prices are suitable, and so on. Even though we haven’t written all of this on a piece of paper, our current green strategy is that we move ahead immediately,” he affirmed.

That strategy, HE Al Aufi further explained, will initially focus on easier-to-decarbonise industries, such as methanol, fertilizer, ammonia and grey hydrogen used in the refinery business, for example. Progressively, the focus will shift to difficult-to-abate industries, such as cement steel, aluminium and others. Eventually, the price of green hydrogen would ease to a point where the transition to greener energy in these industries will become cost-effective, he noted.

Also boding well for Oman’s decarbonisation journey, said HE Al Aufi, is the “strong support” extended by the different government stakeholder entities to the Ministry of Energy and Minerals, which is spearheading the overall national strategy. In this regard, he appealed for more robust support from international bodies, notably the IEA.

In his address, Al Aufi called for greater attention to the certification process. “I’m pleased to see that there is a lot of movement happening in that area because that could potentially be a showstopper to some of the work that we’re doing if certification is not handled in a pragmatic manner,” he cautioned.

Furthermore, with part of the green hydrogen output planned to be consumed in-country, the beneficial ramifications for new investments in low-carbon industries is huge, he pointed out. Access to adequate capacities of green energy will not



“ More than 100 policymakers and energy executives - from Oman and countries of Europe - participated in the virtual proceedings, which focused on the theme, ‘Scaling-up Low-Carbon Hydrogen to Decarbonise the Energy Sector in Oman’. Also in attendance were representatives of the organizations that together constitute the National Hydrogen Alliance (Hy-Fly) of Oman. ”

only enable existing industries to expand, but also has the potential to spark the growth of new energy-efficient industrial sectors in Oman, he said.

Concluding, HE Al Aufi added: “I think this webinar is timely and we need more of these discussions in order to raise the profile and push this agenda forward. I’m glad to see that there is that a lot of contribution and participation from different local as well as European agencies into this webinar.”

Conrad Prabhu

IEA Webinar

‘Scaling-up Low-Carbon Hydrogen to Decarbonise the Energy Sector in Oman’



A virtual webinar, co-hosted by the International Energy Agency (IEA) and Oman LNG, explored the opportunities and challenges associated with demand creation for low carbon hydrogen for: (1) domestic consumption, growth, and decarbonisation drivers, and (2) cross border partnerships and trade.

A number of prominent speakers representing governments, industry, financial sector, inter-governmental organisations, and experts from the IEA participated in the event. In all, around 100 policy makers, executives, technical

experts, and financial advisors from Oman (with representatives from all Hy-Fly organisations) and globally (predominantly Europe), were in attendance.

Distinguished speakers and attendees:

- **Keynote speakers:** HE Salim Al Auft (then Undersecretary and currently Minister of Energy and Minerals) and Ms. Mary Warlick (Deputy Executive Director, IEA)
- **Special guest:** Dr. Muna Al Baiti (Deputy Head of Mission, Embassy of the Sultanate of Oman)

- **Representatives from Hy-Fly PMO:**
Dr Khalil Al Hanashi and Sulaiman Tobli.

Panellists:

- **Session 1** – Najla Al Jamali (Alternative Energy CEO, OQ); Muhammad Abdul Qyyum (Sustainable Energy Research Center, Sultan Qaboos University); Jose Bermudez Menendez (Energy Analysts, IEA); and Susanne Moreira (Senior Gas Specialist, World Bank).
- **Session 2:** Dr Hamed Al Naamany (CEO, Oman LNG); An Stroobandt (Deputy Head of Cabinet, Ministry of Energy, Belgium); Isabelle Capaldi-Lureau (Global Lead Originator, Total Energies); and Noé van Hulst, Chair (International Partnership for Hydrogen and Fuel Cells in the Economy).
- **Moderated by** Dr. Abdullah Al-Abri (IEA Consultant) and Per-Anders Widell, International Energy Agency.

Key takeaways from the keynote speeches:

- Oman takes transition to low-carbon and green energy as an underlining priority: (a) starting from a good baseline in the electricity sector (no diesel, no coal – predominantly efficient gas based with increasing share of renewables). (b) Building focus is now on easier to decarbonise industries (methanol, ammonia, etc). (c) then move to the difficult to abate industries (steel, Aluminium, and other hard to abate industries).
- Oman is working on developing renewables concessions to allocate locations for additional renewables for power, and for hydrogen (hydrogen will be for local market as well as for export).
- Oman continues to engage with relevant stakeholders on standard and certification schemes setting.
- IEA continues to work with governments to share data, best practices and expertise on the role of hydrogen in energy transition, transition technologies – and wider aspects related to transition roadmaps and national strategies
- IEA sees that the advancement of clean energy technologies is essential – and we probably have the technologies to reach the set decarbonisation goals by 2030, but the world and governments in particular have to work harder to mature and develop other solutions to reach the 2050 targets.
- IEA and Oman would like to keep the dialogue on the transition agenda.

Key takeaways from the two plenary sessions:

- A) Oman is well placed for the production of low-carbon hydrogen capitalizing upon: (1) existing oil and gas expertise, infrastructure and trade partnerships, (2) successful international investment models, (3) existence of industrial ports, (4) existence of the national hydrogen alliance (Hy-Fly), (5) existing experiences on the production of grey hydrogen in the region, (5) geographical and meteorological benefits to produce low carbon hydrogen – all of this can: a. stimulate and provide benefits for first movers (announced projects);
- B) stimulate the domestic transition to low-carbon industries that use hydrogen in their feedstocks and/or in the creation of products (steel, aluminium, and other hard to abate industries);
- C) facilitate the establishment of low-carbon clusters. Clustering helps in establishing shared vision and shared P&L from an industry and



investment perspective. Clustering will require evaluation of the possible integration and applications for using the CO₂ in existing and/or new industries;

- D) attract investments and opportunities to establish local manufacturing and services.
- Given the aspiration and the announcement of sizeable projects for low-carbon hydrogen in Oman (more than 30 GW of renewables for Hydrogen announced), it is important to: a. Tailor-make support to those flagship projects;
- b. Since low-carbon hydrogen projects are new to the whole world, it is important to: i. Exchange the experiences with others who are developing similar projects around the world on how to manage supply chains and operations;
- ii. Involve multilateral development banks and concessional financing

[Courtesy: IEA]

into the journey;

- iii. Important to look into the supply chain aspects to realise the announced projects and also to look into the transferability aspects from traditional hydrocarbon-based supply chains to ones that cover renewables and hydrogen.
- 3. It is important to strengthen Oman's position on the global roadmap and boost stakeholder confidence through: a. Announcement of National Hydrogen Strategy - with targets and roadmaps;
- b. Establishment of relevant policies and frameworks (National Energy Policy, National Decarbonisation Policy, Legal Frameworks,). These policies shall include critical items like carbon tax and incentives, carbon market, infrastructure and retrofitting, additional investments.
- 4. The importance of having long-term offtake partnerships with the global community. This shall make the overall economics more appealing. These partnerships shall be stimulated through working closely with the identified markets to align on the technicalities, commercialities, and other aspects.
- 5. The importance of continuing to work with other national and multinational organisations on emissions calculation structures, standards, and certification schemes. a. Take learnings and experiences from the certification of ACME project (by TÜV Rhineland) in Oman.
- 6. The importance of looking into the size of renewables that will be connected to the system and how can the overall energy system (natural gas, renewables for power, renewables for hydrogen, storage) be optimised. ■

Oman, Germany ink landmark pact in energy field

The Sultanate of Oman and the Federal Republic of Germany signed a Declaration of Intent for cooperation in the field of energy, encompassing the exchange of technical knowhow, related integrated systems and smart networks.

The declaration of intent was signed from the Sultanate of Oman's side by HE Eng. Salim Nasser Al Aufi, Minister of Energy and Minerals whilst it was signed from the German side by HE Dr. Patrick Graichen, State Secretary at the Federal Ministry for Economic Affairs and Climate Action.

The declaration was signed within the framework of the official three-day visit of His Majesty Sultan Haitham bin Tarik to the Federal Republic of Germany during 13 – 15 July 2022.

The signing of this declaration fulfills the desire of the two countries to continue promoting their cooperation in the field of energy on the basis of mutual benefit, as the two countries are parties to the United Nations Framework Convention on Climate Change, as well as fulfilling their desire to establish a framework for the exchange of technical knowledge and advice, skills and expertise related to the field of energy.

The two sides reached an understanding on a number of topics that include encouraging cooperation in the fields of renewable energy technologies, their integrated systems and smart networks and energy efficiency, such as industry, buildings and transportation, green hydrogen and its derivatives, energy regulatory frameworks, research and market planning, with the aim of creating an attractive milieu to invest in energy transition technologies

The two sides also held a meeting



touching on the existing friendship and constructive cooperation between the Sultanate of Oman and the Federal Republic of Germany. The two sides also discussed the major joint projects that the two countries aspire to achieve in the fields of energy, green hydrogen and its lucrative feasible derivatives in a manner that brings mutual benefits to them.

The meeting was attended by HE Khalid Hashel Al Muselhi, Head of the Foreign Minister's Office Department, HE Thomas Schneider, German Ambassador to the Sultanate of Oman, and officials from both sides. ■

Omani-German Joint Declaration of Intent:

A true win-win in green energy cooperation

A landmark Joint Declaration of Intent (JDol), signed by Oman and Germany during the visit of His Majesty Sultan Haitham bin Tariq to Berlin recently, unlocks immense opportunities for cooperation between the two countries in the green energy space, says HE Thomas Schneider, German Ambassador to the Sultanate of Oman.



HE Thomas Schneider,
German Ambassador to the Sultanate of Oman.

For German Ambassador HE Thomas Schneider, a modest quest that began three years ago to explore energy cooperation between Oman and Germany culminated on a historic note in Berlin last month. There, on the margins of His Majesty Sultan Haitham bin Tarik's official visit to Germany, both sides affixed signatures to a Joint Declaration of Intent (JDol), affirming a mutual desire to work in partnership to develop the sustainable energy sector of the future.

HE Eng. Salim Nasser Al Aufi, Minister of Energy and Minerals, signed the landmark pact on behalf of the Sultanate of Oman, while the German side was represented by HE Dr. Patrick Graichen, State Secretary at the Federal Ministry for Economic



“ Germany has embarked on a journey to fundamentally restructure its entire energy sector in order to make it as green as possible. For this purpose, sufficient supply of green hydrogen is an essential ingredient to future green energy solutions. ”

Affairs and Climate Action.

For Ambassador Schneider, the JDoI marked the crystallisation of a multi-year effort to get the two friendly countries to recognise the enormous contribution that either can make to the other's decarbonisation goals.

Recalling the genesis of this green energy-centric journey, the Ambassador explains: “I remember very well the first time I heard about green hydrogen almost four years ago. A little later I was invited to deliver a welcome address to the first Oman

Hydrogen Initiative Symposium held at the German University of Technology in Muscat in cooperation with the German company Hydrogen Rise. You need not be an energy expert to realise the potential of cooperation between two countries like Oman and Germany.”

Mutual benefits

In essence, the JDoI enshrines a commitment by the two countries to capitalise on natural synergies in advancing their respective green energy goals. “There is an obvious match of mutually beneficial interests,” the German Ambassador noted. “Germany has embarked on a journey to fundamentally restructure its entire energy sector in order to make it as green as possible. For this purpose, sufficient supply of green hydrogen is an essential ingredient to future green energy solutions. Since Germany will not be in a position to produce the amount of green hydrogen needed we are looking for reliable long-term supply partners. The Sultanate of Oman is blessed



“The Sultanate of Oman is blessed with abundant sun, wind and space and thus has excellent conditions for producing green energy. Its geostrategic position facing the Indian Ocean and its political stability are further assets which support the case of making the Sultanate a significant producer of green energy.”

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green energy. Its geostrategic position facing the Indian Ocean and its political stability are further assets which support the case of making the Sultanate a significant producer of green energy.”

According to Ambassador Schneider, the potential for energy cooperation between the two countries is huge, more so as both sides join hands to make a contribution to shaping the energy market of the future. The scope of the Joint Declaration of Intent is broad and far-reaching. Areas of cooperation range from renewable energy technologies to energy efficiency and the use of green hydrogen, from establishing compatible regulatory frameworks to promoting investment opportunities in



energy transition projects, he said.

The JDoI, Ambassador Schneider points out, grew out of an ongoing dialogue on energy cooperation between the governments of Oman and Germany – a process that will continue to yield dividends going forward.

“During the year 2020 it became clear that both sides were serious in promoting and developing cooperation in the field of energy on the basis of mutual benefit. From there it was a natural move to define a common understanding on scope and content of this cooperation and put these ideas down in writing. The JDoI signed in Berlin now provides a powerful framework to take this dialogue to the next level, he said.”

Technological prowess

Significantly, the JDoI envisions a potential role for Oman in the supply of green hydrogen and other energy derivatives to the German market. Germany, for its part, has pledged to reciprocate by opening up its prodigious capabilities as a technology powerhouse in support of the Sultanate's nascent green hydrogen industry.

German expertise in green energy is unsurpassed globally, he asserts. “In Germany you find a unique cluster of know-how, to which not only some well-known global brands contribute but also the innovative power of numerous SMEs. Secondly, we are interested in sustainable cooperation and development. To this end the German government is funding the post of a special adviser on hydrogen attached to the German Industry and Commerce Office in Muscat and I am very happy about the added value which this brings to our support for businesses to engage in Oman. Thirdly, I would like to emphasize that Germany is already providing incentives for businesses to engage in bilateral projects.”

One such incentive is a fund worth two billion euros for supporting international green hydrogen projects, which has been set up by the Federal government within the framework of Germany's National Hydrogen Strategy.

“As we speak, applications for funding support are being evaluated by the German Ministry of Economic Affairs and Climate Action and I am optimistic that soon we will see more than one German-Omani project benefit from this possibility. We invite our Omani partners to think about ways of complementing our efforts by developing their own support mechanisms,” he stressed.

Germany, with its superior technological prowess in green energy and related fields, is well-placed to support the Sultanate of Oman in the delivery of its green hydrogen strategy, said the Ambassador.

“A lot of players in Germany are closely watching what is going on here in Oman and are thinking of being part of this process. Some of them have already entered into a pilot or other project in Oman. We have seen in some of these projects that there is also

*His Majesty Sultan Haitham bin Tariq
with German Chancellor Olaf Scholz.*



a chance for the Sultanate to use hydrogen in diversifying its downstream sector. The idea that, at some stage, green steel or green cement will be produced in Oman is a very exciting perspective and really adds value to this country. So I think there is much to gain for both sides.”

“**Notably, the JDoI does not envision the establishment of any new institutions since the ongoing German-Omani energy dialogue has already produced a reliable network of contacts between stakeholders.**”

Notably, the JDoI does not envision the establishment of any new institutions since the ongoing German-Omani energy dialogue has already produced a reliable network of contacts between stakeholders. Both sides have however decided to appoint high-level focal points for overseeing the bilateral cooperation, Ambassador Schneider noted.

“This will help to streamline our cooperation and keep it focussed and efficient. Our Embassy has also been active in bringing interested parties together and we are looking into ways of enhancing networking and creating synergies,” he said.

Royal imprimatur

Adding political heft and significance to the JDoI is its signing within the framework of His Majesty Sultan Haitham’s ground-breaking visit to Germany, according to the Ambassador. “It is important to note that this Joint Declaration of Intent was signed in Berlin during His Majesty’s historic official visit to Germany and this sheds a clear light on the significance of the document,” he said, noting that both sides greeted the signing with great enthusiasm, reflecting a mutual resolve to make it a success.

He also voiced hope that the JDoI would open a new page of German-Omani relations. “While in the past Germany has not imported fossil energy from Oman there



is now a good and real chance of establishing a close and significant strategic cooperation in the field of green energy. This is a true win-win-situation for both countries. There is a lot to gain. Let us not forget that both Germany and Oman are Parties to the UN Framework Convention on Climate Change and that we are committed to achieving the goals of the Paris Agreement. Germany and Oman may make a difference and become a role model for others,” HE Ambassador Schneider added in conclusion.

Conrad Prabhu

PIONEERING GREEN STEEL PRODUCTION IN OMAN

Hydrogen Rise sets out its vision for a Green Hydrogen economy in Oman

By Olav Carlsen, CEO Hydrogen Rise (Oman) LLC



When Munich-based Hydrogen Rise AG began to focus on Oman in 2018, we did this with a clear vision: To develop a Green Hydrogen Economy in Oman. We strongly believed that green hydrogen would play a leading role in the global energy transition and offer enormous opportunities also to the Sultanate.

We also believed early in the significance that green hydrogen is holding to achieve reach Oman's Vision 2040 goals: The diversification of the national economy and specifically within the energy sector. The

creation of plenty new job opportunities for young people in cutting-edge technology fields. Involving local academics in meaningful global research opportunities. And putting Oman in the path of the right now evolving new trading systems of renewable energy and decarbonized products.

Over the past 4 years we carefully studied the application of green hydrogen for the decarbonization of local industrial processes, especially in hard-to-abate sectors such as steel production, and the saving of natural gas as a result. We saw a longer-term development of considerable new green hydrogen-based export industries. Therefore, in 2019, together with the German University of Technology in Oman ("GUTech") and under the auspices of the Ministry of Energy and Minerals, we organized the first hydrogen symposium in the country and later established our project development company Hydrogen Rise LLC in Oman as a joint venture between the German company and our local partner Oman Educational Services.

It is reassuring to observe today's commitment to the development of a local hydrogen economy by all stakeholders in Oman - in industry, academia and authorities of the highest levels. We see our early vision taking shape. Now the time has come to bring the technology onto the ground and to develop projects that deliver the most relevant immediate goals: a bankable business model to accomplish the goals of the national Oman Vision 2040.

Compared to other previous major technology or industrial changes the worldwide transition towards renewable energy sources and green hydrogen is an



epic exercise. The entire global private and industrial concept of generating and consuming energy needs to transform. No single company, technology, industry or government can solve this challenge alone. It requires a dedicated international and cross-disciplinary team effort to develop projects that overcome that (challenge for all newly developing industries and technologies: early economic feasibility and scaling. Green hydrogen is still expensive when compared to its fossil-based alternatives, grey hydrogen or natural gas. In 10 years from now we will have overcome this early challenge and so the main question remains: “How do we get there?”

Many countries face, in varying degrees, similar challenges developing a large-scale green hydrogen industry: Land availability for the generation of sufficient renewable energy. Water availability and management for the electrolysis process. And the development and management of the energy grid to store and transmit renewable power for a 24-hour operation of the electrolysis process – at least solar power is not available day and night. There are technical solutions for all these challenges – some in currently just in theory, some already applied. Over the coming years, green hydrogen will become without doubt a natural and exclusively market-driven business choice. Economies of scale, further technology advancements in efficiency,

widening regulations for consumption and trading of fossil-based products and overall global consumer demand for decarbonized products will make green hydrogen a trillion-dollar business opportunity. Until then, during the ramp-up phase we find ourselves in, the focus must be on how we design the early green hydrogen projects to address the immediate issue of economic feasibility.

Let us look at one of the several Hydrogen Rise projects for that: Three partners, Hydrogen Rise LLC, Jindal Shadeed Iron & Steel LLC and Sohar Industrial Port Company SAOC recently announced that they are evaluating the greening of the steel production at Jindal’s state-of-the-art steel plant in Sohar. Let me use this green steel project to discuss our green hydrogen vision for Oman in more detail.

Building a bankable business

This is the game changer in the project planning and development process. Fact is that green hydrogen - today – per kg or per mmbtu is (in general still more expensive than the fossil fuel alternatives natural gas or grey hydrogen. The markets for green hydrogen-based products, such as green ammonia, methanol or steel are just evolving, as are the corresponding global government policies and regulations or mandates for trading and consuming fossil-based products. These



*Jindal Shaded Iron & Steel,
Sohar.*

three factors represent uncertainties for investors. The global steel market is already subject to carbon credit pricing established in many countries. Spot market prices for these required credits upon import into the European Union have recently soared to over €80 per ton of CO₂ and are expected to increase further in the future, some suggest to €200 in the future. When considering export opportunities to markets that are subject to such a stiff carbon taxing at its border, it gives green steel with its higher production cost already today a competitive edge towards a bankable business model.

Bankability also depends on the right project size. The investments made today in the green hydrogen production and/or renewable energy generation assets lock in a significant part – up to 80% - of the production cost of hydrogen for the long life of these assets. Once locked in by the initial investments, little can be done to benefit from future cost declines. We should see a decline of electrolyser cost per MW capacity of 50% or more over the next years. The Jindal Green Steel project has the potential capacity for a 500 MW green hydrogen generation to decarbonize a significant portion of the production within technical possibilities. The project partners opted for a realizable kick-off size of up to 50 MW. This also better aligns with the still limited global supply of electrolyser capacity today. By scaling the project step-by-step afterwards, it will

benefit from future cost declines and from the learning and technical synergies in the first step. This approach delivers a manageable risk in the ramp-up business model and offers long-term investors perspectives through a reasonable and carefully managed scaling plan. It requires a project plan that integrates a modular technical scaling ability and considers up-front all related logistical scaling challenges.

A project's economic feasibility must be further improved through modeling an optimal use of the production assets: Maximizing the output of kg of hydrogen per \$ investment. The more hours per day an electrolyser is operating, the lower the levelised cost of hydrogen. How can electrolyser investments be used to their maximum production output in a 24h operation when solar power is only available for part of that. A mix of wind and solar power is helpful for this challenge. More importantly innovative renewable power storage solutions are needed to store excess renewable power generated during the day to enable running electrolyzers during non-daylight hours. Regular battery solutions do not offer the answer. For the green steel project at Jindal, we will evaluate the replacement of gas-powered grid electricity by use of excess solar power generated during the day in the existing steel production process and subsequently using the same amount of replaced power from the grid for the electrolyser operation during nighttime. This concept is complex and meets many regulatory, grid capacity, industrial and green certification challenges. And it is a valuable concept to be analysed and lobbied for when building competitive business models. Here, government agencies, industry and the green certification agencies have to work hand in hand.

The cost gap between green hydrogen and the fossil fuel-based alternatives will still be a challenge for bankable business models, even though we see the gap closing recently because of the price hike of natural gas especially for fossil fuel importing countries. The nascent green hydrogen industry and business community, especially the financial community is looking for government support incentives to get comfortable with the risk,

especially for the first generation of projects. In Oman, an innovative support mechanism could consider the higher commercial value from an alternative use of natural gas saved by decarbonization projects. Applying the monetary gain from the alternative use as direct project incentive will help de-risking the investment decisions, a possible win-win for all. Many countries have assumed different financial support models to help early adopters to bridge the initial cost gap, but few have the advantage of applying a direct monetary gain from an alternative use of gas to support the energy transition itself, like Oman.

Align the project development with the Oman Vision 2040 goals

The economic diversification of the industry in the Sultanate depends on an efficient long-term use of its today's fossil and future renewable power capacity. This begins with short-term opportunities to decarbonize existing industrial processes, such as steel production. It saves natural gas today to either prolong the availability of national gas reserves or free up natural gas reserves for the above-mentioned alternative use with higher economic value, for example the global LNG spot market. In parallel to this short-term strategy, a longer-term economic diversification process will include large-scale green hydrogen projects adding additional national production capacity of decarbonized products. Because of their much higher investment size and the still existing uncertainty in today's markets their risk profiles of course differ significantly from the short-term options.

We believe that large-scale projects will become the standard in developed hydrogen economies. For the early adoption phase however, Hydrogen Rise focuses on immediate decarbonization opportunities to enable the green hydrogen applications and contribute to the Vision 2040 goals as early as possible. Greening the existing steel production process is such an opportunity. The global steel production is responsible for a significant part – bordering 10% - of the global CO₂ emission. Jindal Shadeed with its Direct Reduction Iron plant using natural gas and its Electric Arc



“Our green steel project plan with Jindal Shadeed in Sohar is just the beginning”

Furnace in Sohar is already way ahead in terms of the CO₂ footprint per ton of steel compared to other international coal- or coke-based traditional steel manufacturing plants. Applying green hydrogen to the reduction process of iron ore instead of NG to produce Direct Reduced Iron “DRI” will make Jindal steel ultimately almost carbon-free.

Aligning with the Oman Vision 2040 the green steel project partners prioritized the following project outcome: The immediate saving of natural gas as a result of the replacement with green hydrogen. Securing the local steel industry by increasingly reducing dependence on fossil fuels and by opening an important access to the evolving new global green steel market. Providing an early base for acquiring know-how and building local experience with green hydrogen technologies – not only for the project partners - but also the broader academic base in Oman. If we want to continue to attract energy intensive industries to Oman in the future, access to a stable and sufficient supply



MoU with Hydrogen Rise establishing the Oman Hydrogen Center.

of cost competitive renewable energy, a sufficient green hydrogen production capacity and a high level of local green hydrogen experience and engineering know-how are key. This leads to the third element of our vision:

- Integration of decarbonization projects in global market developments downstream.
- Through the increasing pressure of carbon pricing tariffs at international borders for most products currently being produced mostly with fossil fuels, the burden of decarbonisation is increasingly shifted onto the oil and gas sector and industries in high emission sectors such as steel, cement, ammonia and methanol.

More, the “Net Zero Emission” goals lead to global pressure on most international supply chains to decarbonize any aspect of industrial production. An example is the German automotive industry currently requesting from their global steel component suppliers to decarbonize all car component production beginning in 2025 leading to an extensive international search by these suppliers for supply of green steel or green Direct Reduced Iron feedstock. The economics of global steel production will shift from the current combination of cost-efficient access to raw materials, inexpensive fossil fuels and proximity to steel demand to a mix of new vectors including most certainly also the ability to green the DRI or the entire steel

production at the globally most competitive cost. New steel trading production routes will evolve and present an enormous opportunity for Oman: With renewable energy generation costs that are amongst the lowest in the world and geographically well positioned with deep-sea port infrastructure at the highest level to support the future trading routes. This is a good segue into the fourth element of our vision:

Projects require complete value chains from renewable energy to green product off-take

A successful project includes the most efficient management of greening the entire green hydrogen value chain. This again includes the captive generation or wheeling-in of renewable energy, finding the above mentioned cost efficient innovative energy storage or supply solutions for enabling the 24-hour run-time of electrolyzers, managing the most cost effective integration of possibly varying quantities of hydrogen supply into an industrial process, adapt the industrial process, designing the project around the most beneficial logistical requirements for land, transmission of energy and/or transport and storage of hydrogen as well as providing competitive advantages of export logistics for the finished product. While Hydrogen Rise plans to operate a Build-Own-Operate business model, this can only be achieved by partnering with a wide range of hydrogen technology providers, engineering experts, steel experts and researchers as well as logistics partners. Including the Port of Sohar with its own strong focus on a renewable and green hydrogen strategy as a project partner was therefore a logical move by Hydrogen Rise and Jindal. Many of the above-mentioned logistics requirements are best addressed together with an expert partner like Port of Sohar focusing on providing such solutions to all their port tenants.

Our green steel project value chain further extends to involving early potential green steel off-takers, especially in Germany, who contribute to the economic feasibility study and add insight into future demand for green steel, thus helping to de-risk some investment decisions. To avoid surprises late in the

process - as another significant task to de-risk important investment decisions - we involve international green certification agencies and experts early in the project development process because of the complexity in industrial scaling decarbonization processes.

Scouting for and requesting international project funding is another important element of a successful management of a complete hydrogen value chain. In our green steel project case, we applied for a potentially substantial amount from the German National Hydrogen Strategy that will have a game chaining impact on the green hydrogen and ultimately green steel production cost.

The complexity of managing all relevant elements of a green hydrogen value chain requires new and disruptive business concepts – more companies like Hydrogen Rise will evolve that focus on filling the gap that individual hydrogen components specialists face when success of a project depends on the successful management of the entire chain. These new project developers and operators will build strong and long-lasting relationships with “best-of-class” component experts and create strong consortia that execute the first successful green hydrogen projects together. For the Jindal project specifically, Hydrogen Rise has built a network of over 40 individual industry, academic and financial experts and companies that “connect the dots” and contribute individually to all project steps which are to follow.

Connecting the project to In-Country-Value

When expecting government support on certain angles of the development of successful green hydrogen projects, questions arise what these projects deliver in return as In-Country-Value. All of our projects consider an integration with local academia and applied research as an opportunity for young engineers to learn. The future Oman hydrogen economy and all possible projects depend on the broad availability of well-trained hydrogen engineers and early projects must serve as a tool to achieve this. It becomes a self-serving prerequisite for a long-term development of a successful pipeline of green hydrogen projects for companies



like Hydrogen Rise. Our green steel project partners Jindal Shadeed and Port of Sohar are also recognizing this as an important value of our project. Based on this belief Hydrogen Rise in 2020 participated in the founding of the Oman Hydrogen Centre at GUTech as part of a strategy to develop and then accelerate hydrogen knowledge and experience in the country.

There are many project opportunities in Oman like the green steel project and we have met many stakeholders that share our vision. Cement and associated methanol production, shipping and aviation are a few examples for hard-to-abate sectors that offer significant potential for reasonable ramp-up projects. We are very pleased with the support we have received, especially from the Ministry of Minerals and Energy, the Vision 2040 team and entities like EDO that are adopting an increasingly important role in the development of the green hydrogen future of the country. The latest directives by His Majesty Sultan Haitham bin Tarik directed at the most important green hydrogen topics are a very decisive step towards a successful energy transition. No doubt that it will be achieved as alternatives do not really exist. It will be a global and inter-disciplinary team effort and the success is in managing the complexity of the process with constantly integrating the learnings along the way. I cannot wait to see that future starting with the first opening of a green hydrogen plant in the Sultanate. ■

Dr Bernd Wiemann, Hydrogen Rise CEO, with Dr Hussain Al Salmi of GUTech.

8 Green Energy Projects to Watch in Oman

A burgeoning pipeline of green energy projects, coupled with government-led efforts to put in place an effective regulatory framework, has buoyed the outlook for Oman's transition to a low carbon energy future.



Oman is walking the talk on green hydrogen!

Having spent the better part of three years debating the merits, indeed the imperatives, of transitioning towards low carbon energy resources, the Sultanate is now ratcheting up the pace to deliver on the government's vision for a sustainable energy future. This is evident from the ballooning pipeline of renewables and green hydrogen projects being prepped for implementation over the coming decade and beyond.

Leading this transformation is the Ministry

of Energy and Minerals which, besides creating a dedicated department focused on green energy development, has also commenced the task of putting in place effective policies and regulatory frameworks to underpin the growth of a green hydrogen-based economic future for Oman.

In parallel, a number of energy companies – local and international – are progressing their plans to implement a broad array of pilot, as well as mega-scale, green energy projects in the country. Their goal is to capitalize on Oman's optimal solar and wind

energy resources, vast swathes of desert land for upstream solar farms, extensive and modern port infrastructure, advantageous geographical location, and tranquil political environment – factors that are indispensable to large-scale green energy production.

Also auguring well for green energy investments to take root in Oman – sooner than later – are pronouncements expressing the government's unambiguous support for a strategic pivot towards a low-carbon energy future for Oman. That affirmation has come from no less than His Majesty Sultan Haitham bin Tarik who, at a recent cabinet meeting, gave his royal imprimatur to national efforts to ignite the growth of a hydrogen-based energy sector in Oman. He issued directives for the establishment, of among other things, a new department within the Ministry of Energy and Minerals to oversee the development of this new sector. Furthermore, His Majesty proposed the setting up of a national hydrogen-centric company to invest in green energy projects, as well for the formulation of effective institutional and regulatory foundations to support the growth of a future green hydrogen economy in the Sultanate of Oman.

The first half of 2022 has been momentous indeed for Oman's nascent green energy sector. Several new administrative, policy and regulatory initiatives – mandated by His Majesty Sultan Haitham bin Tarik – are currently under way.

Notable is the establishment of a new Directorate General of Renewable Energy and Hydrogen at the Ministry of Energy and Minerals. Headed by Eng Abdulaziz Said al Shidhani, the new department oversees policy guidance and framing of regulations – an exercise it is currently undertaking in collaboration with a number of government ministries and stakeholder institutions, including the Authority for Public Services Regulation (APSR), Ministry of Housing and Urban Planning, Environment Authority, Public Authority for Special Economic Zones and Free Zones (OPAZ) and Oman Investment Authority.

In this regard, the Ministry is targeting, by the end of this year, the roll-out of a broad policy framework underpinning the development of a renewables-based green energy industry in Oman. The initiative,



supported by a number of government and public sector stakeholder entities, aims to provide the country with a clear direction in its transition to a green energy future.

Additionally, the Ministry is formulating a new National Energy Transition Policy for the country. Eng. Abdulaziz Al Shidhani explained: "We will need to have an overarching Energy Transition Policy which will then be cascaded down to the following four specific energy policies: Energy Efficiency Policy, Renewable Energy Policy, Hydrogen Policy, and Carbon Capture Utilisation & Storage (CCUS) Policy. We will also need to make sure that cross-cutting policies that capture In-Country Value (ICV), R&D, capacity building and innovation are also embedded within these four policies."

In line with His Majesty the Sultan's directives, a new national hydrogen-centric energy company has been established. Hydrogen Development Oman (HDO) is a wholly-owned subsidiary of Energy Development Oman (EDO), the state-owned holding company set up by Royal Decree in December 2020 to represent the government's stake in Petroleum Development Oman (PDO), as well as champion the country's energy transition.

As the national company for hydrogen projects, HDO is expected to partner with local and international investors in the

**Eng Abdulaziz Said**

Head of Directorate General of
Renewable Energy and Hydrogen
at the Ministry of Energy and
Minerals.

implementation of green hydrogen projects. Its equity in any project will also include the vast tracts of land that will be required for the upstream green electricity generation component of the project, it is learnt.

Bountiful pipeline of green energy projects:

Energy Oman provides an overview of the mega-scale green energy projects lined up for implementation in Oman over the coming years, in addition to a number of landmark initiatives currently at a conceptual stage. Together, they underscore Oman's potential as a global-scale producer of green hydrogen and green ammonia for local and international consumption.

1. ACME – Scatec JV:

Green energy pathbreaker

While Oman's green energy project pipeline continues to swell, first off the starting blocks is expected to be Green Hydrogen and Chemicals Company (GHC), a 50:50 joint venture between the UK entity of India's ACME Company and Scatec ASA, a leading renewable power producer based in Norway.

Recently, the JV signed usufruct agreement with the Public Authority for Special Economic Zones and Free Zones (OPAZ) covering a 12 sq kilometer parcel of land in Duqm SEZ for the development of the first phase of a major green hydrogen and ammonia project. Phase 1 will contribute to the production of around 100,000 metric tonnes of green ammonia annually, eventually rising to 1.2 million tonnes in subsequent phases.

India-based ACME Group is a pioneer in cleantech sectors such as solar, green hydrogen and ammonia and sustainable green protein development. The company is one of the leading solar power developers in India with a portfolio of projects under development and operation aggregating around 8.5 GW. In the field of Green Hydrogen & Ammonia, ACME has already set up the world's first single location integrated solar power to green ammonia facility at Bikaner in the western Indian state of Rajasthan.

Its JV partner, Scatec ASA, is a leading renewable power producer, delivering affordable and clean energy worldwide. As a long-term player, Scatec develops, builds, owns and operates solar, wind and hydro power plants and storage solutions. The Oslo-headquartered company has more than 3.5 GW in operation and under construction on four continents, and is targeting 15 GW of capacity by the end of 2025.

ACME Group was represented at the latest signing in Oman by Mr. Manoj Upadhyay, Chairman & Founder. Signing on behalf of OPAZ was its Chairman, HE Dr. Ali bin Masoud Al Sunaidy.

Mr. Rajat Seksaria, CEO, ACME Group, said the project would be the first green hydrogen venture to materialize in the Sultanate. "The signing of the usufruct agreement is an important milestone in setting up this green hydrogen and green ammonia project. We will start the construction activities soon and build one of the most advanced technologies and create a state-of-the-art facility. This project helps opening a new chapter of business cooperation between our countries – India, the UK and Oman. We extend our gratitude to the Sultanate of Oman for



ACME scatec OPAZ signing ceremony held on 22 June 2022.

helping us contribute to the journey of innovation and transition to clean energy sources,” he stated.

Scatec’s CEO Terje Pilskog underlined the importance of the project to global climate mitigation goals. “Green hydrogen and green ammonia are vital if we are to get on track to limit global warming to only 1.5 degrees Celsius. We want to produce a strong supply of green hydrogen to help create energy security and a pathway to net zero,” he noted.

Mr. Gursharan Jassal, Country Head - Oman, Green Hydrogen & Chemicals, said the joint venture partners are committed to bringing the project on stream in a time-bound manner. “This project will further contribute to the Sultanate of Oman’s green energy vision and position Oman as the global export hub for green fuel,” he added.

The JV has also signed an MoU with Marafiq – Oman’s first centralized utilities provider – for the supply of electricity during non-solar hours for plant utilities. Marafiq, the exclusive provider of utilities in the Duqm SEZ, is expected to shortly sign an agreement to supply and other utilities to Green Hydrogen & Chemicals Company.

2. Hyport Duqm:

The Belgian route to Europe

Just a week earlier on 18th June 2022, the Public Authority for Special Economic Zones and Free Zones (OPAZ) signed a land lease agreement with the promoters of the prestigious Hyport Duqm project – an ambitious green hydrogen and ammonia venture backed by the partnership of OQ’s Alternative Energy Unit and DEME Group of Belgium.

It was the second of two land lease pacts: the first was signed last September for the upstream component of the project, which enabled the start of preliminary engineering studies and site data collection at Duqm SEZ. The more recent agreement covered the downstream component centring on green hydrogen and ammonia production.

Hyport Duqm was represented by Ms. Najla bint Zuhair al Jamali, Chairperson – Hyport Duqm (who is also CEO of OQ’s Alternative Energy Unit), and Mr. Martin D, Vice Chairman and General Manager of DEME Group (Belgium).

Based on the land lease agreement, Hyport Duqm will develop a green hydrogen production facility with a capacity of 500 MW



OPAZ Hyport Duqm signing ceremony.

on a 793,000 sq metre site near Port of Duqm. At the upstream end of the project, covering an area of 200 sq kilometres, a number of solar and wind farms will be developed to provide green electricity for the venture.

Hyport Duqm will consist of three distinct components: A solar and wind based renewable energy generation component; A green hydrogen production plant consisting of electrolyzers, ammonia synthesis plant and storage facilities; and a high voltage transmission line linking the upstream and downstream components.

According to Belgium-based DEME Group, Hyport Duqm will contribute Oman's goal to become a global hub for green hydrogen production. Green ammonia output will be exported from Duqm to customers in multiple European destinations and other global markets where the demand for low carbon energy resources is strong.

Green hydrogen from the project also has the potential to pave the way for investments

in a number of green heavy industries, including green iron and steel and green aluminium elsewhere in the Duqm SEZ.

3. SalalahH2

New green energy hub on the Indian Ocean

Earlier in May, a consortium comprising leading industrial gases company Air Products, integrated Omani energy group OQ and Saudi-based energy developer ACWA Power signed a joint development agreement (JDA) for a multibillion-dollar investment in a world-scale green hydrogen-based ammonia production facility powered by renewable energy in the south of the country. The JDA, signed on May 26, 2022, follows a memorandum of understanding signed in December 2021.

Signing the pact were Air Products Chairman, President and CEO Seifi Ghasemi, OQ Chairman Mulham Al Jarf and ACWA Power Chairman Mohammad A Abunayyan.

Envisioned for development in Salalah Free Zone, the joint venture project would be based on proven, world-class technology and include: the innovative integration of renewable power from solar, wind and storage; production of hydrogen by electrolysis; production of nitrogen by air separation; and production of green ammonia. It is anticipated that the green hydrogen-based ammonia production facility would be equally owned by the project partners.

Air Products Chairman, President and Chief Executive Officer Seifi Ghasemi, said, "We are delighted and honored to work with the government of Oman to develop this multibillion-dollar project, which would be similar to the world-scale green hydrogen project we are implementing with our partners in NEOM in the Kingdom of Saudi Arabia. We look forward to applying our know-how, technology and more than 60 years of experience in hydrogen to help move this project forward and take another significant step in decarbonizing the world."

Commenting on this venture, OQ Chairman Mulham Al Jarf said, "This project positions OQ as an energy transition

International consortium - Salalah green ammonia project.



enabler, while playing on our strengths and leveraging our expertise in the downstream chemicals business, particularly in Salalah where we have extensive operations, and our demonstrated ability to off-take products and competitively deliver them to global customers. The project fits well with the Sultanates' renewable energy strategy and fosters investments in alternative energy resources, both of which contribute to Oman Vision 2040."

ACWA Power Chairman Mohammad A Abunayyan said, "Oman continues to be a key market for ACWA Power for its potential, resources and location, making it a tremendous enabler for the production of green hydrogen. The signing of the joint development agreement is another milestone and signifies the continued trust being placed in ACWA Power by all our partners in bringing this ambitious project to life. We aim to leverage our proven track record, knowledge and expertise in developing sustainable global scale green projects including NEOM – a pioneering at-scale green hydrogen and ammonia facility, and we are confident of leading green hydrogen development globally through partnership and collaboration."

4. Waste-to-Energy project

Fuelling the circular economy

After languishing on a back-burner for a couple of years, Oman's first Waste-to-Energy (WTE) project is being revived for development. In March this year, Oman Environment Services Holding Company (be'ah), which operates and manages the country's municipal waste sector, signed an agreement with Oman Power and Water Procurement Company (OPWP), the sole procurer of new power generation capacity, to work together to ensure the successful delivery of the long-stalled venture.

This time around, OPWP and be'ah are looking at a significantly ramped up 130 – 150 MW capacity plant, up from the approximately 50 MW scheme envisaged earlier.

For state-run be'ah – part of Oman Investment Authority (OIA) – the WTE project will also contribute significantly to its



Waste-to-Energy project.

circular economy strategy. By contributing around 4,500 tons per day of municipal waste as feedstock for the project, be'ah hopes to reduce the carbon footprint associated with its landfills. Over the roughly 35-year operational life of the project, an estimated 50 million tons of municipal waste are expected to be channelized towards the WTE project, thereby contributing to Oman's carbon abatement targets as well.

5. BP Green Energy Scheme

Genesis of a giga-scale venture

The year began with BP and the Omani Ministry of Energy and Minerals signing a Strategic Framework Agreement (SFA) and a Renewables Data Collection Agreement to support the potential development of a



multiple gigawatt, world-class renewable energy and green hydrogen development in Oman by 2030.

As part of the agreement, BP will capture and evaluate solar and wind data from 8,000km² of land – an area more than five times the size of Greater London. The evaluation will then support the Omani

government in approving the future developments of renewable energy hubs at suitable locations within this area to take advantage of these resources. The renewable energy resources could also supply renewable power for the development of green hydrogen, targeting both domestic and global export markets.

BP Chief Executive Bernard Looney said: "Today's agreement represents what bp is able to offer as an integrated energy company. These projects will build on our gas business, and bring wind, solar and green hydrogen together in a distinctive and integrated way supporting Oman's low carbon energy goals. And we're not just investing in energy. We are investing in Oman to create and develop infrastructure, support local supply chains and cultivate the skills and talent needed to usher in this next generation of energy leaders. We look forward to working closely with the Omani government to take this forward."

Under the SFA, BP and Oman will also consider ways to collaborate in a number of areas, including a renewables strategy, regulation, the establishment of a renewable energy hub and the development and reskilling of the local workforce.

6. Oman Shell – PDO CCUS Study

Exploring the potential for a new CCUS industry for Oman

Shell Development Oman LLC (Oman Shell) and Petroleum Development Oman (PDO) have agreed to jointly study Carbon Capture Utilisation and Storage (CCUS) opportunities in Oman. Under an MoU signed in May, both sides have pledged to assess all aspects related to reinjecting and storing CO₂ in Oman.

Through this collaboration, Petroleum Development Oman and Oman Shell seek to leverage joint capabilities and economies of scale to initiate the CCUS industry in Oman, and to facilitate the inception of a Low Carbon Hydrogen value chain in Oman.

PDO is the operator of Block 6 and in line with Oman Vision 2040 has clear commitments towards achieving Net Zero Emissions by 2050. PDO is therefore progressing opportunities to grow its core hydrocarbon business whilst also reducing

GHG emissions from its operations, including the use of CCUS for enhanced oil recovery and long-term CO₂ storage.

Oman Shell is the operator of Block 10 and is maturing options for an associated downstream project based on Low Carbon Hydrogen value chains with CCUS.

Commenting on this agreement, Walid Hadi, Oman Shell's VP and Country Chairman, said, "The intent of this collaboration is to progress CCUS opportunities in Oman, making the best use of PDO's knowledge of the subsurface/surface and its long-standing experience of operating assets in Oman, together with Shell's global knowledge and experience in Carbon Capture Utilisation and Storage. The initial study may well result in further collaboration involving additional projects in the future."

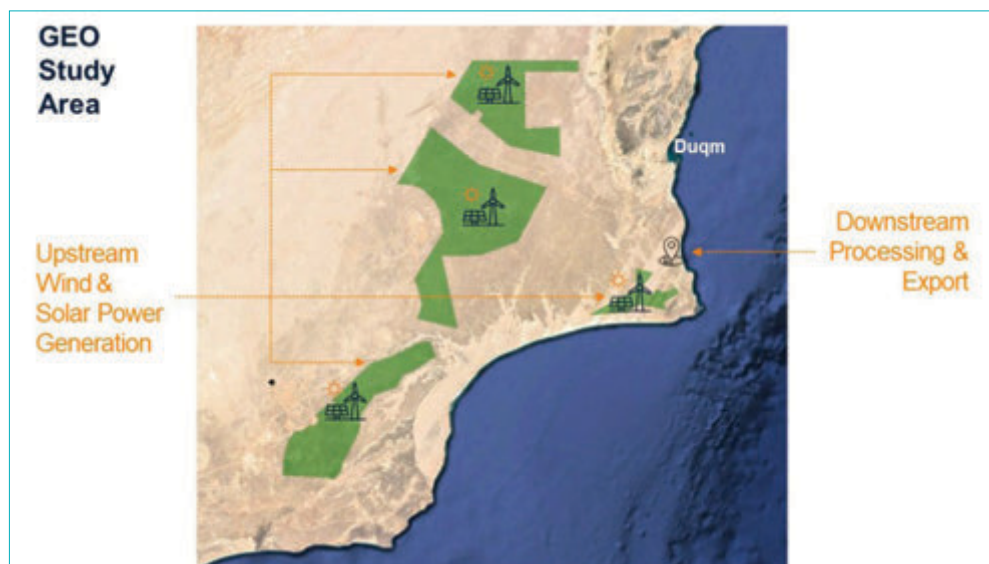
Steve Phimister, Managing Director of PDO stated: "In line with PDO's commitments to Oman Vision 2040 and our role in the energy transition, this collaboration lays the foundation for PDO to reduce emissions from our operations as well as helping to progress Oman's national energy agenda, via large scale CCUS."

7. Green Energy Oman (GEO)

Global-scale behemoth

The world-scale Green Energy Oman (GEO) project, currently ranked among the largest green energy ventures on the anvil for development globally, is backed by an international consortium comprising OQ Group, leading green fuels developer InterContinental Energy, and EnerTech, a Kuwait government backed clean energy investor and developer.

At full capacity, GEO encompasses 25 GW of renewable solar and wind energy to produce over 1.8 million tonnes of zero-carbon green hydrogen per annum. When fully completed across multiple phases, the project's geographical footprint will cover 6,500 sq kilometres across vast swathes of Al Wusta and Dhofar Governorates. A Final Investment Decision (FID), slated sometime in early 2026, will pave the way for construction work on Green Energy Oman to commence in 2027.



8. New solar PV and wind projects

Expanding renewables-based portfolio

A raft of new solar and wind-based power generation projects is being lined up for procurement to help meet electricity demand growth in Oman over the next six years. This is in addition to the pair of new solar PV based Independent Power Projects, each of 500 MW capacity, and planned for implementation at Manah in Al Dakhiliyah Governorate. The long-stalled procurement process covering the pair, dubbed Manah-1 Solar IPP and Manah-2 Solar IPP, is expected to be revived before the end of this year.



According to details shared by OPWP, a new solar-based scheme, dubbed 'MIS Solar IPP 2025', is also proposed to come up in Al Dakhiliya Governorate. Candidate sites include a previously defined site at Adam and a number of sites in other locations. This project is expected to use PV technology, with capacity around 500 MW.

Significantly, a fifth utility-scale solar PV project, tentatively slated for commercial launch in 2027, is envisioned in Al Wusta Governorate. Dubbed 'Solar PV 2027', the project will have a capacity of around 600 MW. Additionally, a first-ever Concentrated Solar Power (CSP) project with thermal storage is proposed to be set up near Duqm, according to OPWP. A feasibility study is currently underway in this regard.

At least three wind-based projects are also planned for procurement over the 2021 – 2027 timeframe, according to OPWP. Within the Main Interconnected System, a wind farm of around 100 MW is planned in the Wilayat of Jaalan Bani Bu Ali in North Al Sharqiyah Governorate.

In the Wilayat of Duqm, OPWP has plans to procure at least two wind projects of capacities ranging from 160 – 200 MW. The 'Duqm Wind IPP 2025' project, with an installed capacity of around 200 MW, is envisioned on a site within the SEZ at Duqm. Another utility-scale wind power project, Duqm II Wind IPP 2027, is proposed to be developed at a site approximately 60 kilometres from Duqm City with a capacity of at least 160 MW.

In Dhofar Governorate, OPWP aims to develop a second wind energy farm, adjoining the country's first wind project – Dhofar 1 Wind IPP – at Harweel. The new scheme, dubbed 'Dhofar II Wind IPP', is sized at around 100 MW of capacity. ■



PDO's Decarbonisation Strategy Targets Net-Zero Carbon Emissions by 2050



Petroleum Development Oman's (PDO) Decarbonisation Strategy, which lays out a roadmap for achieving net-zero carbon emissions by 2050 and halving them by 2030, was recently recognised with the Chairman's Award for Excellence (CAE) in the Non-Technical Category. The Corporate Planning Manager collected the prestigious award for developing and embedding the company's Decarbonisation Strategy.

As many as 466 Technical and Non-Technical projects were nominated for this year's CAE awards from 17 PDO directorates and departments. First established in 2004, the Chairman's Award for Excellence (CAE) acknowledges and rewards project teams who have implemented business improvements and displayed role model behaviours. Limited initially to exemplary projects in the technical category, the scope of the awards was widened in 2012 to cover additional efforts in process and work enhancements, commercialisation and strategy development under the non-technical category.

PDO's Decarbonisation Strategy is an integral part of the company's goal to build a sustainable energy future. It recognises that climate change is a clear and present peril, as is evident across the globe from the extreme weather patterns that contribute to heatwaves, wildfires, droughts, huge floods, storms and cyclones. The company's decarbonisation efforts will also make a tangible contribution to the climate abatement goals of Oman and the wider world.

The strategy is the product of months of engagement and alignment sessions with shareholders. Several collaboration areas were identified and an integrated work plan was developed with shareholders to address different topics including, for example, Flaring and Methane Reduction, Carbon Capture Utilisation and Storage, Energy Efficiency and Transition to Renewables.

The Project Team conducted as many as 15 sessions with shareholders to understand best practices across the industry and to embed them within PDO. The exercise required a great deal of ideation and innovation, culminating in the achievement of the following: GHG allocated to steam



“ With PDO staff as change agents, the broad objectives of the Decarbonisation Strategy were disseminated across the company through the adoption of a four-point process including promoting awareness, following standardised processes, replicating best practices, and monitoring Energy Management performance. ”

generation; GHG in competitive scoping; Energy Efficiency Surveillance tools for wells; Permanent Magnetic Motors; and fugitive leak detection through satellites/drones. Target areas for decarbonisation were expanded to also include carbon competences in Job Competence Profiles, wind energy, electromagnetic gearboxes, Hydrogen and Steam storage pilots.

With PDO staff as change agents, the broad objectives of the Decarbonisation

Strategy were disseminated across the company through the adoption of a four-point process including promoting awareness, following standardised processes, replicating best practices, and monitoring Energy Management performance.

PDO's decarbonisation roadmap was significantly enhanced in 2021 based on a shared vision to achieve the following (i) step reductions in GHG emissions by 2030, (ii) cascade targets per GHG sources, (iii) define 160 focus areas, (iv) strengthen organisation and streamline support, (v) enhance integration through progress meetings and detailed short term and long term strategy, (vi) launch of asset catalogue to create more opportunities, and (vii) set GHG intensity targets for hydrocarbon projects.

As a result, a structured approach to identifying opportunities was created which, this year, has enabled the company to reduce 2030 emissions by 15%.

The CAE Awards were presented on 12 May 2022 as part of celebrations marking the annual PDO Day, which commemorates the anniversary of late His Majesty Sultan



Qaboos bin Said's historic official visit to the company's Bait Mina al Fahal headquarters building in 2013.

The event, which was held under the auspices of His Excellency Eng. Salim Bin Nasser Al Aufi, (then Undersecretary of the Ministry of Energy and Minerals), recognised the achievements and contributions of staff in both technical and non-technical fields and this year also marked the 85th anniversary of PDO's foundation.

Managing Director Steve Phimister said: "PDO has an illustrious history and I know we will build on those solid foundations as we enter a new era and capture the opportunities that come with the Energy Transition.

"There is much to celebrate in our history and there are also exciting times ahead, as we leverage technology and our own capabilities to evolve into a fully integrated energy company. In full alignment with the Oman Vision 2040, we will grow our core hydrocarbon business and develop new low-Carbon value-chains, thereby sustaining our contribution to Oman for decades to come."

During the event, PDO revealed its 85th anniversary logo to celebrate its continuous

development and evolution as it embarks on its decarbonisation journey with a greater emphasis on renewables, such as solar and wind.

As part of the festivities, the winners of the Chairman's Award For Excellence (CAE) and the Dr Abdullah Al Lamki Award for Developing Talent (DALTA) were celebrated.

The Oil North Directorate, Gas Directorate and Project Delivery team won the Gold Technical Award for completing the Yibal Kuff mega project, the most technically complex in PDO history. The scheme will provide a major revenue boost for the nation with a daily production of 20,000 barrels of oil, 5.4 million cubic metres of gas and 230 tonnes of sulphur.

The Non-Technical Gold went to the Corporate Planning Directorate for developing and embedding the Company's Decarbonisation Strategy, which lays out a roadmap for achieving net-zero carbon emissions by 2050 and halving them by 2030.

The winner of the DALTA was Functional Maintenance and Integrity Manager Nasser Said Abdulla Al Toqi for his work mentoring young colleagues. ■

PDO's Steve Phimister named among Forbes Middle East's Top 100 CEOs - 2022



Steve Phimister, Managing Director – Petroleum Development Oman (PDO), has been featured in Forbes Lists' Top 100 CEOs in the Middle -- a prestigious ranking of C-suite executives making significant contributions to the region's economies.

Mr. Phimister, who joined PDO in April 2021, was ranked 19th among 100 listees credited with managing revenues in excess of 1 trillion dollars in 2021.

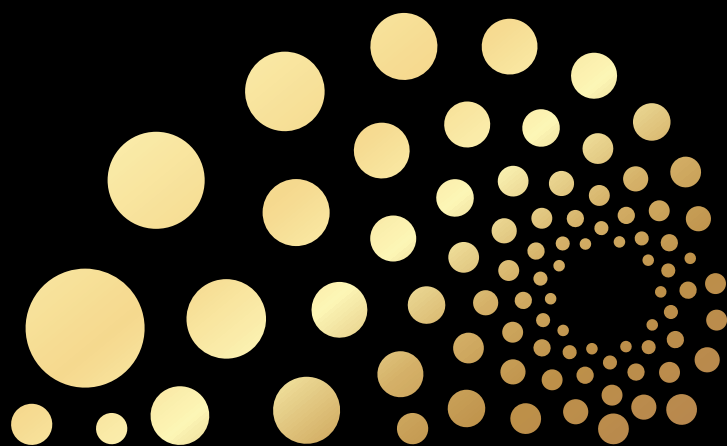
PDO delivers 70% of Oman's oil and nearly all of its gas. The company employs 8,900 people and more than 70,000 contractors as of 2020. The company

is working with Oman Shell to study Carbon Capture Utilisation and Storage opportunities in Oman to support Oman Vision 2040's goal of energy transition. Mr. Phimister previously worked with U.K. oil and gas company Shell for 30 years.

Four other Omanis made the cut as well: Eng. Abdulrahman al Hatmy – Group CEO, Asyad Group Oman (ranked 25th); Talal Said al Maamari, CEO – Omantel (ranked 42nd); Waleed Khamis al Hashar, CEO – BankMuscat (ranked 66th); and Abdulaziz Al Balushi, Group CEO – Ominvest. Overall, the firms of the 100 listees are currently collectively worth more than \$5 trillion.

Topping Forbes Middle East's 2022 list was Saudi Aramco's Amin H Nasser, who led the company to become the world's most valuable by market value again, surpassing Apple. ADNOC's Sultan Ahmed Al Jaber placed second as the firm took three of its subsidiaries – ADNOC Drilling, Fertigllobe, and Borouge – public, with Borouge's \$2 billion IPO becoming Abu Dhabi's largest-ever IPO. Rounding up the top three is Ahmed bin Saeed Al Maktoum of Emirates Group. All three maintained their rankings for the second consecutive year.

The 2022 cohort represent leaders from 26 nationalities. Emiratis dominated with 19 entries, followed by Egyptians with 16, and Saudis with 15. Combined, these three groups make up 50% of the ranking. With 27 CEOs, banking and financial services is the most represented sector. Eight entrants work in telecom, and seven head energy and logistics companies. Four of the top five leaders work in energy. ■



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TOWARDS A PROMISING FUTURE SHAPED BY GREEN HYDROGEN

By Nasser Al Rizeiqi, Director of Hydrogen Policies and Strategies Department, Ministry of Energy and Minerals



Hydrogen is widely used in different applications including ammonia production, petroleum refining and other energy-related areas. Today, hydrogen technologies are rapidly advancing in line with the world's shift towards cleaner energy on the road to Net Zero Emission targets, and perhaps more importantly, to meet global energy demand growth as well.

Among the frontrunners in the emerging hydrogen space is the Sultanate of Oman where a number of strategic hydrogen projects are under early development as they seek to capitalize on the country's outstanding geographical location. Developing a competitive and large-scale green hydrogen industry is critical to the Sultanate of Oman's goal to diversify the

economy and achieve its 2040 Vision.

A roundtable session held recently in conjunction with the Oman Petroleum & Energy Show (OPES) highlighted the importance of a large-scale hydrogen industry to the future of the Omani economy, the beneficial impacts of new technologies for young Omanis particularly in the form of employment opportunities, and the role of academia in this emerging space..

At the roundtable, I had the honour to be part of a panel of distinguished experts who were unanimous in your espousal of hydrogen as the fuel of future. There was also broad consensus that hydrogen can be the most effective in helping countries around the world achieve their decarbonisation goals in line with their commitments under the Paris Accords on climate mitigation.

The panel of experts underlined hydrogen's potential as an energy carrier. They shared their perspectives on the different types of hydrogen – Grey, Blue and Green – and the respective technologies that can be deployed to produce them in commercial quantities. Their respective carbon footprints were compared as well, with the panelists unanimous in their assertion that the green version of hydrogen has all of the hallmarks of an effective antidote to global warming, while also serving as a sustainable, low-carbon energy alternative to planet-warming resources.

Deliberations at the outset of the roundtable focused on the importance of R&D around hydrogen technologies. Advancements in electrolyzer technology at the heart of any commercially viable

green hydrogen project are driving the pace of large-scale green hydrogen adoption globally. The IEA predicts the uptake of renewables to hit a new peak by 2030 with hydrogen as a key enabler. It envisions the potential for hydrogen to be introduced into the energy sector by utilizing the existing infrastructure which is already in place for natural gas. Originally slated to become a reality by around 2040, hydrogen as an alternative to natural gas is set to become commonplace by 2030, which goes to show that technology alone is driving the pace of change in this space.

Producing green hydrogen cost-competitively is still a significant constraint. Of course, there are cheaper methods to produce hydrogen, but these can have a severe environmental impact. Mitigating that impact will lead to phasing out grey hydrogen while low carbon hydrogen steps in as a transitional option in the hydrogen market that needs to address the amount of emissions with approved methods of carbon capture. However, the ultimate target is to have a green process to leverage the green economy, which can't be achieved without the adoption of green hydrogen. Establishing this economy needs first to phase out the heavy emitters of harmful gases with cleaner energy resources while considering the economic impact of such initiatives, and then it can be followed by smaller scale projects that can raise the learning curve to support the local industry to establish green energy hubs.

A future green hydrogen economy will also need to look at hydrogen storage options in Oman. I quote here Michael Liebreich, founder of BloombergNEF, who said: "Oman is one of the places in the world that I've called the 'future renewable superpower' because what we really want is to produce green hydrogen with natural energy resources solar and wind. Oman is blessed with these two options making it one of biggest future dominants of this new market."

But energy storage still remains a challenge. Available options include salt domes, the use of green ammonia as an energy storage method, and utilizing

chemical hydrates for different applications, among others. Speaking generally, the development curve of global energy storage markets – the United States, UK, Germany and Ireland -- are seen as leaders in storage technologies which have enabled them to reach the stage of mass deployment. The Middle East, however, is still at the conceptual and planning stage.

“Producing green hydrogen cost-competitively is still a significant constraint. Of course, there are cheaper methods to produce hydrogen, but these can have a severe environmental impact. Mitigating that impact will lead to phasing out grey hydrogen while low carbon hydrogen steps in as a transitional option in the hydrogen market that needs to address the amount of emissions with approved methods of carbon capture.”

We also deliberated on the role that academia can play in addressing evolving market challenges through research. We agreed that research centers can also raise social awareness of the importance of green energy, thereby encouraging youngsters to explore career opportunities in the new hydrogen economy.

The discussion concluded with an overview of green hydrogen's potential to spark the growth of a new low-carbon economy for the Sultanate of Oman, supplanting oil and natural gas which has sustained the nation's socioeconomic development for well over half a century. Hydrogen's potential to fuel the emergence of green industries powered by a carbon-neutral energy resource was explored as well. ■

GHSO 2022: Plugging Oman into the global green hydrogen ecosystem

As Oman's signature platform for green hydrogen, the GHSO 2022 Conference & Exhibition will focus primarily on the nation's strategy to develop a world-class industry that, on the one hand, meets the energy requirements of the Sultanate's future low-carbon economy, and on the other, serve as a major global supplier of the carbon-neutral fuel.



Backed by Oman 2040 and the Ministry of Energy and Minerals, the Green Hydrogen Summit Oman (GHSO) Exhibition and Conference 2022 is garnering huge interest across the board: from investors and technology providers, at one end of the spectrum, to scientists and young researchers, at the other. In-between are those who foresee a significant stake in the new green energy industry, including players in the upstream, midstream and downstream segments of the value chain – from within the region and internationally.

Representative elements of this expansive and diverse ecosystem, centring around green hydrogen, are expected to take part in sizable numbers in this year's edition of GHSO 2022, which will take place at Oman Convention and Exhibition Centre during 5 – 7 December 2022.

Delegates and visitors can look forward to an impactful conference – the agenda for which is being drafted by a high-level team of energy sector executives. Their goal is to come up with an agenda that aligns perfectly with the broad objectives of Oman's future green energy-focused economy.

In May, the broad contours of the summit proceedings were sketched by members of the GHSO Technical Committee who gathered amid the spectacular settings of Jabal Akhdar, one of Oman's most popular tourist hotspots, for two days of deliberations. The mountaintop conclave was made possible courtesy of generous funding support from United Finance, a leading non-banking financial institution in the Sultanate of Oman.

Taking part in the discussions were: Prof Dr Ing Michael Modigell, former rector of GUTech (Chairman), Dr. Khalil Al Hanashi, Energy Technology Lead – Energy Renewal Unit (PDO); Basil El Zein – Integration Manager, Shell; Olav Carlsen, CEO – Hydrogen Rise; Dr. Rashid Al Abri – Head of Sustainable Renewable Energy Center SQU; Talal Al Wahaibi, Associate Professor at Engineering Department, Al Sharqiah university; Dr. Ruth Prelicz, Geostrategic Advisor – AHK; Cédric Roux, Green Hydrogen Technical Manager – TotalEnergies; Eng Faiza Al Harthy, Energy Sector Head, Oman Vision

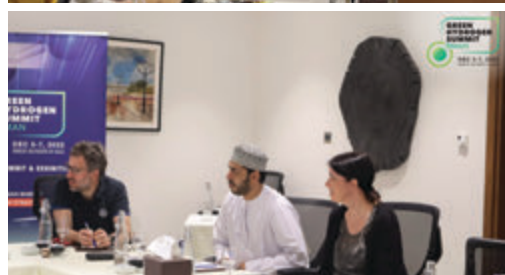
2040 Implementation & Follow-up Unit; and Nasser Al Rizeiqi, Director of Hydrogen Policies & Strategies Department – Ministry of Energy and Minerals.

“ As Oman's signature platform for green hydrogen, the GHSO 2022 Conference & Exhibition will focus primarily on the nation's strategy to develop a world-class industry that, on the one hand, meets the energy requirements of the Sultanate's future low-carbon economy, and on the other, serve as a major global supplier of the carbon-neutral fuel. ”

More recently, the Executive Committee, chaired by Mazin Al Lamki, CEO – Energy Development Oman (EDO), met to review and finetune the conference agenda. Also in attendance were: Abdulrahman Al Yahyaei, CEO – Oman Society for Petroleum Services (OPAL); Nasser Al Rizeiqi, Director of Hydrogen Policies and Strategies Development - Ministry of Energy and Minerals; Almunther Abdullatif, Balance Sheet Optimization and Corporate Strategy at OQ (on behalf of Najla Al Jamali, Chief Executive - Alternative Energy, OQ); Mohammed Al Mukhaini, Oman LNG; and Abdullah Al Harthy, Chairman - Birba Energy. [We are pleased to announce that Dr. Abdullah Al Abri, Energy & Investment Consultant at the International Energy Agency (IEA), has recently joined the Executive Committee as Vice-Chairman].

As Oman's signature platform for green hydrogen, the GHSO 2022 Conference & Exhibition will focus primarily on the nation's strategy to develop a world-class industry that, on the one hand, meets the energy requirements of the Sultanate's future low-carbon economy, and on the other, serve as a major global supplier of the carbon-neutral fuel.

While the broad theme of this year's summit is "Towards A Clean Energy



Economy', there will be focused sessions on the following topics: Green Hydrogen Potentials, Opportunities & Challenges; Regulations and Policies, Certification; Emerging Technologies; Storage and Transportation Challenges; Green Hydrogen Financing and Projects/Investments Partnership; Renewable Energies at the Heart of Green Hydrogen Production; Water Resources for Green Hydrogen; and the

Transition to a Green Hydrogen Society.

Expert presentations spread over the two-day Summit will offer high-level perspectives on, among other themes, Oman's energy transition, underlying policies and regulatory frameworks, the vision of a green hydrogen hub in the Sultanate, current and future renewable/green hydrogen projects, ICV and localisation opportunities, technological developments and R&D prospects. For the



“ While the broad theme of this year’s summit is ‘Towards A Clean Energy Economy’, there will be focused sessions on the following topics: **Green Hydrogen Potentials, Opportunities & Challenges; Regulations and Policies, Certification; Emerging Technologies; Storage and Transportation Challenges; Green Hydrogen Financing and Projects/Investments Partnership; Renewable Energies at the Heart of Green Hydrogen Production; Water Resources for Green Hydrogen; and the Transition to a Green Hydrogen Society.** ”

first time, a session dedicated to student research in the green energy space will be one of the highlights of the summit.

Organised by Birba Energy in cooperation

with the Ministry of Energy and Minerals, the forum has already receiving sponsorship support from a number of leading energy companies, developers and technology providers. Oman Society for Petroleum Services (OPAL is a Strategic Partner.

Leading sponsors include: Energy Development Oman (Host Sponsor); Petroleum Development Oman (Main Sponsor); Worley, Thyssenkrupp and Technip Energy (Platinum Sponsors); Sohar Aluminium and TUV SUD Middle East (Silver Sponsors), and STS (Session Sponsor).

Also backing the event are leading global organisations notably the International Energy Agency (IEA), Green Hydrogen Lab, Arab- German Chamber of Commerce and Industry, AKH German Industry and Commerce, and World Hydrogen Leaders.

For further details regarding registration, sponsorship, partnership and exhibition space, check out the dedicated website: greenhydrogensummitoman.com. ■

Entries open for GHSO 2022 Energy Future Leaders Programme



The Energy Future Leaders Programme – organised as part of the 2022 edition of the Green Hydrogen Summit Oman (GHSO) Global Conference & Exhibition – formally kicked off from July 1, 2022.

The novel initiative, kindly sponsored by Oman LNG, and SOHAR Port, will open the way for young energy researchers – from and abroad – to be part of Oman’s premier green energy forum set to take place at the Oman Convention and Exhibition Centre in Muscat from 5 – 7 December 2022.

Announcing the start of the Energy

Future Leaders Programme, Dr Intisar Al Busaidi – Team Leader, said: “For a limited period only, interested college and university students from Oman and abroad can register to be part of this exciting opportunity to showcase their research work on green hydrogen at this year’s GHSO 2022 Global Summit and Exhibition. The winning submissions will be invited on stage to speak about their research work and receive prestigious awards as well. For details about eligibility and registration criteria, interested students are requested to check out our dedicated page: www.

greenhydrogensummitoman.com.”

As many as 120-plus leading universities from around the world, including all of the universities in the Sultanate of Oman, are expected to participate in the Energy Future Leaders Programme, says Dr Al Busaidi, a well-known Omani Petroleum Engineer.

“We expect interest to be strong primarily because green energy is an emerging discipline with huge potential across the world. Participants will have the opportunity to network with industry professionals and peers, giving them valuable exposure to this exciting industry.”

But the programme will have broader spinoffs for the goal of human capacity building and R&D, Dr Al Busaidi adds.

“We envision the potential for this programme to prepare a new cadre of young professionals for jobs in the future green hydrogen industry, as well as enhance R&D opportunities in the green energy space.”

Abstracts of student research work must be submitted in the prescribed format latest by August 15, 2022 to be eligible to enter the programme. Following an evaluation phase by an eminent jury, a shortlist of merit-worthy candidates will be invited to submit a detailed paper on their work. While all of the finalists will be provided space in the exhibition area to showcase their work, three of them will receive the distinct honour to present their work during the Summit.

“We look forward to working closely with Dr Intisar and her all-Omani team in delivering an impactful Energy Future Leaders Programme as part of GHSO 2022,” said Mr. Abdullah Al Harthy, Chairman – Birba Energy, the lead organisers of the Green Hydrogen Summit Oman event. “By opening up the programme to participants from both Oman and abroad, we envision the potential for cross-border collaboration in R&D and Academia, knowledge sharing and skills development in new cutting-edge disciplines.”

Organised by Birba Energy in cooperation with the Ministry of Energy and Minerals, the 3-day Summit & Exhibition will focus on Oman’s strategy to develop a world-class industry that, on the one hand, meets the



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energy requirements of the Sultanate’s future low-carbon economy, and on the other, serve as a major global supplier of the carbon-neutral fuel.

Given the strategic national significance of this forum, GHSO 2022 has received strong sponsorship support from a number of leading energy companies, developers and technology providers. Oman Society for Petroleum Services (OPAL), Petroleum Development Oman (PDO) have signed up as Main Sponsor. Also backing the event are leading global organisations notably the International Energy Agency (IEA), Green Hydrogen Lab, Arab- German Chamber of Commerce and Industry, AKH German Industry and Commerce, and World Hydrogen Leaders.

For further details regarding registration, sponsorship, partnership and exhibition space, check out the dedicated website: greenhydrogensummitoman.com. ■

DISRUPTION IS NOW

Arthur D. Little's report, *Disruption Is Now*, reveals how decarbonization, decentralization, and digitalization are transforming the energy and resources sector.



Adnan Merhaba

Partner, Energy & Utilities Practice
Lead, Arthur D. Little Middle East



Carlo Stella

Partner, Energy & Utilities Practice,
Arthur D. Little Middle East

The next decade will witness some of the most exciting and transformative years in the energy and resources industry's history. In their 2022 energy flagship report, *Disruption Is Now*, Arthur D. Little (ADL), the world's first management consulting firm, draws attention to key trends that are currently shaping the energy and resources industry as it transitions with great ambitions toward net-zero.

Below are the three trends listed in the report:

- Decarbonization will be the most important overarching trend for all sectors and the world in general. It is already having a fundamental impact on the strategic thinking and future investment decisions of companies in all sectors.
- Decentralization for a far more localized solution in favor of service delivery rather than a reliance on a much wider national or regional infrastructure. The mission then for energy grid firms is to create future-proof energy infrastructures that can accommodate technologies such as intermittent and decentralized generation.
- Digitization or the need to digitize operations to enhance efficiency, thereby reducing costs, increasing revenue stream by diversifying into



new products and services as well as improving customer experience are increasingly important for energy players and fundamental to their transformation.

As part of the analysis, Arthur D. Little has reviewed in detail the investments being made by traditional companies across many different sectors, including both upstream and downstream oil and gas (O&G), power generation, networks and infrastructure,

customer services and solutions, waste, water, and metals and mining.

Evidently the energy and resources sector will need to go through a period of unprecedented change if they are to be fit-for-purpose in an increasingly decarbonized, decentralized, and digitalized world. The research, trends and insights recorded in Arthur D. Little's report provide a toolkit to help energy and resources industry to start thinking through, and moving towards, their vision of future success, with a need for companies and governments to assess their day-to-day operations and longer-term strategic decisions.

The way in which energy and resources sector position themselves today in preparation for transformation, will determine their sustainability, and could make or break their competitive advantage over the next decade. The report brings to light key trends focused on effecting transformation to help companies start thinking differently and in a way that is often at odds with their traditional working methods.

Adnan Merhaba, Partner, Energy & Utilities Practice Lead, Arthur D. Little Middle East said: "No one-size strategy can fit all – for some energy players, the journey will mean thoroughly evaluating their global and regional assets to determine those that are at risk of being stranded, and then divesting accordingly. For others, the focus will be on diversification, building outward from their existing competencies by adding new capabilities, or creating risk-sharing partnerships that enable them to exploit new opportunities. For most, achieving greater operational efficiency by embracing digitization and significantly reducing its carbon footprint to meet increasing demands from investors and shareholders will be the only way forward to quickly adapt to changing market conditions."

One of the market segments touched upon in the report is Hydrogen economy that is touted to become a \$700 billion economy by 2050, with green hydrogen expected to take a dominant share. Within the region, governments have made progressive strides to support the transition toward a greener future in hard-to decarbonize sectors.

Recently, the UAE has joined forces with the Netherlands to boost its research and efforts on hydrogen energy. Such partnerships contribute to catalyzing the transition towards hydrogen energy and support the two countries' orientation in formulating projects and initiatives to support the Paris Agreement on Climate Change. Germany and KSA announced a strategic alliance on green hydrogen development to collaborate on the generation, processing, use, and transportation of clean hydrogen for the

“ No one-size strategy can fit all – for some energy players, the journey will mean thoroughly evaluating their global and regional assets to determine those that are at risk of being stranded, and then divesting accordingly. ”

benefit of both countries. This partnership will help Germany maintain its technology leadership as well as attain policy targets. As for KSA, the alliance will help bolster it as a global producer of green hydrogen.

"Hydrogen is decidedly playing a key role in the diversification of GCC economies and shows great promise for the region to become a hub of green energy as we accelerate into an energy transition in accordance with sustainable and development goals. The increasing number of advanced use cases makes clean hydrogen a key decarbonization measure and contributor to the realization of a circular economy at the benefit of all stakeholders involved in the value chain," commented Carlo Stella, Partner, Energy & Utilities Practice, Arthur D. Little Middle East.

Including insights from companies gathered over the last year, the report showcases Arthur D. Little's own research into global energy practices. These together give a sense of what progress is being made toward a decarbonized future, which challenges still lie ahead, and the impacts on energy and utility players along the entire value chain.

Upstream Oil & Gas: FINDING A WAY TO THE NET-ZERO FUTURE

By Trung Ghi, Rodolfo Guzman, and Prakasa Mulyo



As more and more countries set net-zero targets, the upstream O&G sector will be increasingly impacted by the accelerating pace of energy transition. This will particularly affect those in high carbon-intensive production that will either have to change and conform or risk being left behind.

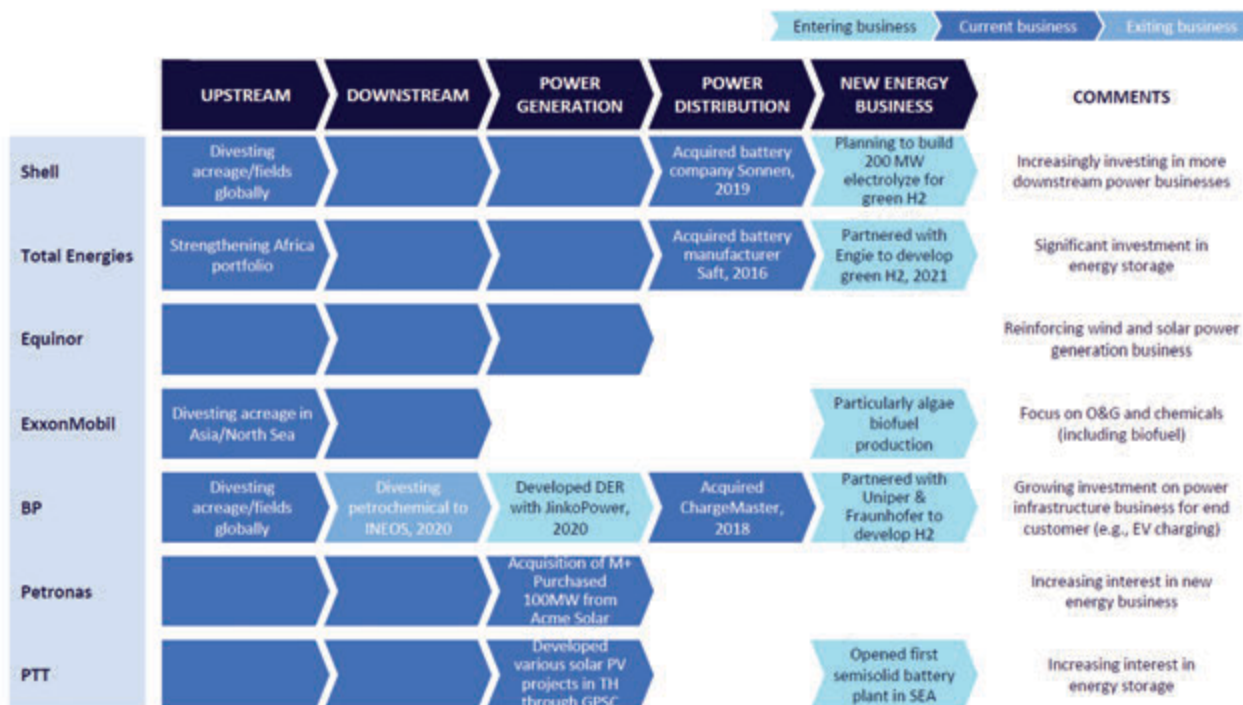
Many O&G companies now regard oil as their least favored portfolio play and consequently are shifting their investment to a more focused gas play and venturing into renewable energy generation, hydrogen, and other alternative energy, as well as EVs.

Some O&G companies are moving much more aggressively away from hydrocarbons and divesting from countries, regions, and portfolio plays to fund their transition into cleaner and greener energy. BP, for example, is moving out of Oman and Algeria; Exxon plans to exit Malaysia, Europe, and Equatorial Guinea; while Shell is saying goodbye to Mexico, Malaysia, and Egypt.

But others are taking a more gradual approach, maintaining their core production but refocusing on a combination of gas play and carbon capture, use, and storage (CCUS) technologies as seen in companies like Oxy. Those who haven't yet pursued this route are sure to come under increasing pressure to decarbonize from shareholders who are increasingly losing patience with the sector's slowness to do so. The value of energy companies on the S&P 500, for instance, is now less than 5% of the total index, well below its 11% of a decade ago.

The O&G service sector is quickly

Figure 13. O&G players are diversifying and decarbonizing their portfolio



adapting to sectoral shifts with players pushing the competitive boundaries in technologies, processes, and know-how. But to be among the success stories of this transformation, those in the service sector along with the O&G companies will need to work more closely than before, leveraging new partnerships and business models to ensure their survival. Looking forward, non-traditional partners will be required, which means anticipating new trends and identifying innovative models. As the industry converges, unlikely partnerships will develop.

WHO'S MOVING?

While the majors have the capacity to pursue a net-zero strategy more proactively, the pace of change for NOCs and Independents is determined more by shareholders, governmental agendas, and the need to meet national energy demands.

Following on from the 2021 UN Climate Change Conference (COP26), many O&G companies are taking steps to accelerate their decarbonization strategy




as well as diversifying into clean energy driven by regulators making changes to sustainability goals and targets. So we will see O&G companies adopting distinct decarbonization strategies.

Typically, NOCs and Independents (e.g., Oxy, ConocoPhillips) are focusing more on reducing the carbon footprint of O&G exploration and production operations through initiatives such as carbon capture solutions and integrating renewable energy as part of O&G exploration and production operations. Majors, on the other hand, are putting more attention into diversifying into power generation and expanding new energy businesses.

We are also witnessing the INOCs (international NOCs) taking a broader stance that involves protecting the national agenda of producing O&G with low-carbon techniques and venturing into new energy businesses.

Lockdowns in response to the COVID-19 pandemic significantly reduced demand for oil and gas and led to a reevaluation

Recommendations: Upstream O&G

MUST DO 	<ul style="list-style-type: none"> • Harvest existing portfolios with stronger focus on extracting value from existing assets while reducing exposure to frontier exploration or long lead developments. • Shift emphasis from liquids to natural gas. • Improve sustainability of existing operations: energy efficiency actions, renewable sources for internal consumption, reduction of methane leaks, etc. • Digitalization of key processes to reduce operating costs and improve resilience to oil price volatility. • Invest in CCUS and other carbon neutralization solutions as an option to decarbonize or offset carbon emissions from operations.
LARGE POTENTIAL 	<ul style="list-style-type: none"> • Low-cost E&P assets with near-term upside potential and modular flexibility (e.g., some low-cost shale oil operations). • Selective acquisitions of E&P independents in financial distress, particularly when operating synergies can be easily captured.
DIVEST 	<ul style="list-style-type: none"> • Exit high stranded risk assets such as tar sands or extra-heavy oil fields, and remote assets in sensitive environments with limited infrastructure (Arctic, jungle, etc.). • Limit investments in complex/high cost EOR (enhanced oil recovery) projects in mature assets (CO₂-EOR/EGR may be possible for decarbonization but recommend to divest out to achieve sustainability targets and energy mix shift). • Reduce exposure to frontier exploration blocks or some long-term developments with questionable economics (e.g., some deepwater discoveries).

of exploration and production activity. However, as local demand for oil and gas recovers, this should benefit the upstream sector. M&A activity in Q2 2021, for instance, surpassed 2020 by 70% and has been at the highest level for three years. In fact, about 56% of the deals made in 2021 were in gas portfolios (Source: S&P Global).

MAINTAINING CORE BUSINESS

Given that they are still the major energy source used globally and are relatively cheap, O&G will remain important in the short to medium term for O&G companies as a means to generate cash to fund decarbonization initiatives and provide stability.

Even for those strongly committed to emissions reduction, maintaining core business will be key to strategy with O&G companies focusing on core regions to improve cash flow and limit risk related to hydrocarbon price volatility.

So, while O&G companies will increase investment in decarbonization, oil and gas exploration and production will continue for the next decade. Equinor, for example, which aims to make low-carbon

solutions 50% of gross CAPEX, has recently declared its Bay du Nord oil field offshore of Newfoundland as a “key project.” Other O&G companies will continue to review and update their core portfolios to ensure their relevancy to company goals.

As in the power generation sector, O&G companies will implement innovative and digital decarbonization techniques while simultaneously moving their core business forward at a slower pace. But the core business will remain a “cash generator” for the next few decades, especially if they can introduce new operational efficiencies.

Major O&G companies are starting to put low-carbon CAPEX plans in place. During 2020, independent oil companies like Total and Repsol signaled their global net-zero ambitions by increasing their CAPEX on low-carbon initiatives to 5%, according to company reports. But while O&G companies like them will need to revisit their portfolios to fund such moves, it doesn’t mean that they will be abandoning their core business in the pursuit of net-zero any time soon.

Hydrogen Ecosystem: THE NEW GLOBAL FUEL

By Carlo Stella, Eddy Ghanem, Martijn Eikelenboom, Cedric Schemien, and Martin Dix

Ever since the Paris Agreement in 2015, there has been an increased focus on decarbonization globally. Green hydrogen has been identified as a key technology to meet decarbonization ambitions and, in particular, support the transition toward a greener future in hard-to-decarbonize sectors. To this end, more than 45 countries have enacted ambitious policies and plans to boost hydrogen use, which has generated myriad commercial leads across the globe and driven interest similar to the early days of solar PV.

The hydrogen economy is touted to become a \$700 billion economy by 2050, with green hydrogen expected to take a dominant share. A diverse set of players is currently repositioning and exploring opportunities in the green hydrogen paradigm, and many investments are underway with a plethora of projects announced each month across the globe.

Despite this momentum, the path to green hydrogen is not straightforward. Four conditions are necessary for successful deployment of hydrogen across four value chain elements:

- Steering policies and regulations.
- Competitiveness and reliability of supply.
- Availability of adequate transport infrastructure.
- Demand pull.

STEERING POLICIES AND REGULATIONS

Supranational, national, and regional

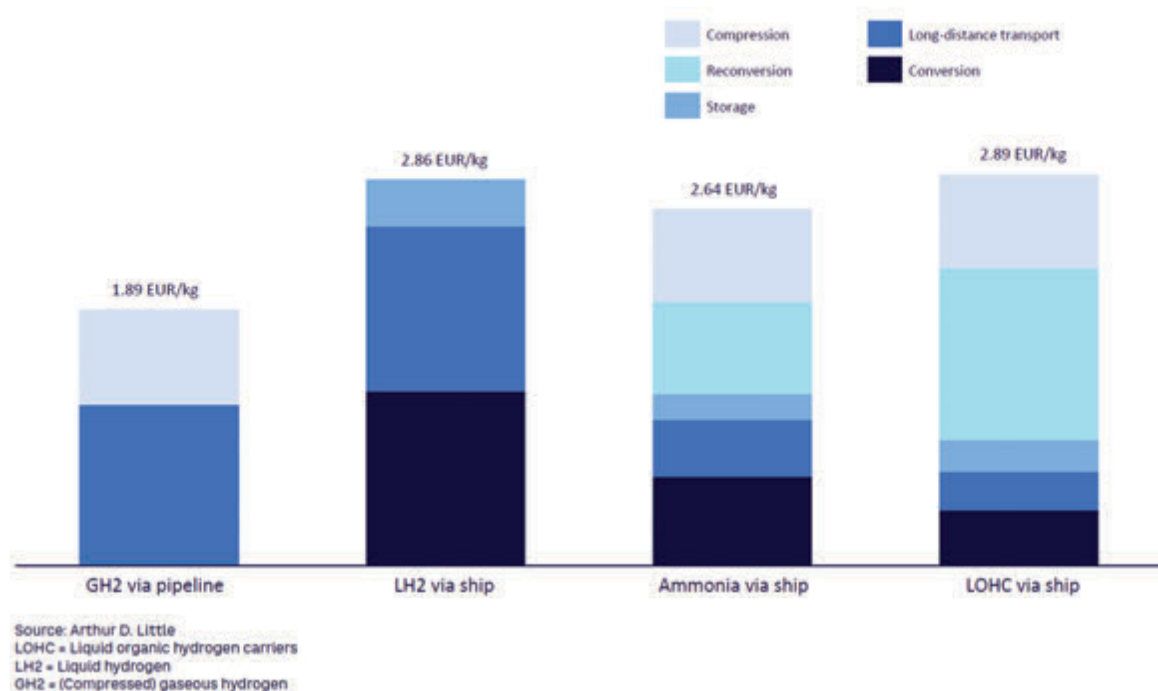
policies supported by adequate regulatory and incentive instruments are at the cornerstone of the green hydrogen economy and are imperative in the short to medium term to establish conditions for success and to fast-track deployment given the cross-sectorial nature of hydrogen applications and the need for economic-financial support initially.

In fact, while most supranational and national hydrogen policies initiated by the EU, Japan, Germany, Australia, and other countries are clearly targeting the decarbonization of their economies, there are at least two additional reasons why policymakers might advocate green hydrogen. First, it offers an opportunity for economic development and energy supply diversification; the Kingdom of Saudi Arabia (KSA) as well as UAE are examples of diversification away from hydrocarbon dependency. And second, is to maintain or achieve technological leadership with an associated positive GDP along with employment impact.

One such example is Germany, which might be willing to reaffirm its technological supremacy in the electrolyzer manufacturing business.

A key reinforcing element for the green hydrogen economy is foreign policy, and particularly, the formation of synergic, bilateral, or multilateral agreements, such as those observed recently. In 2021, for example, Germany and KSA announced a strategic alliance on green hydrogen development to collaborate on the generation, processing, use, and transportation of clean hydrogen for the benefit of both countries. This partnership will help Germany maintain its technology

Figure 21. Relative cost of transporting hydrogen in all forms



leadership as well as attain policy targets. As for KSA, the alliance will help bolster it as a global producer of green hydrogen. Another example is the Memorandum of Understanding signed last year between Singapore and Australia to share knowledge and collaborate on new low-emissions technology.

On top of traditional subsidies, demand-side measures, and green procurement policies, several regulatory/incentive instruments are available to enable the green hydrogen economy. These include the carbon tax and emissions trading system (ETS); research, development, and innovation (RDI) funding; green hydrogen certification; and contract for differences (CFDs).

Carbon taxes and ETS remain key levers for the deployment of green hydrogen, as these bridge the economic gap with gray hydrogen. As recently reported by S&P Global, the EU ETS carbon price surged to an all-time high of €90.75/mt (\$102.34/mt) on 8 December 2021 and EU allowance prices are expected to average €65.80/mt in 2022, compared with an average of just

under €53/mt in 2021. The EU also plans to bolster its current ETS mechanism with a carbon border adjustment mechanism to eliminate unfair competition outside Europe, creating more advantage for green hydrogen.

The development of a green hydrogen certification scheme provides a guarantee of origin for hydrogen and its derivatives. Such certification is important as off-takers seek to develop zero-carbon products due to increased environmental awareness and regulatory pressures. Certification programs are being discussed at a policy level in Europe and Australia and are expected to roll out soon.

Besides RFI funding and hydrogen certification schemes, yet another tool that can accelerate the deployment of hydrogen supply facilities are CFDs, which were employed previously with wind farms. In Germany, this instrument is being discussed in conjunction with the concept of a market maker (MM), an entity that tenders long-term supply contracts on one side and demand contracts on the other. CFDs will then be used to compensate for

Recommendations: Hydrogen ecosystem

MUST DO 	<ul style="list-style-type: none"> • Ensure affordable, diversified, and abundant renewable supply to power electrolyzers. • Engage in consortiums to distribute risks, leverage capabilities, and influence policies. • Secure large demand early on through engaging large off-takers in the hydrogen consortiums or through other forms of long-term agreements. • Hedge technological risk by monitoring/investing in PEM, Alkaline, SOEC.
LARGE POTENTIAL 	<ul style="list-style-type: none"> • Investments in H₂ production and in renewable power facilities to supply electrolyzers. • Investments/localization in electrolyzer manufacturing. • Investments/localization of electrolyzer ancillary services. • Investments in hydrogen transport infrastructure.
DIVEST 	<ul style="list-style-type: none"> • Define clear strategy for grey hydrogen production assets to avoid the risk of stranded assets.

the difference between the two to help fast-track the creation of a global green hydrogen market.

COMPETITIVENESS AND RELIABILITY OF SUPPLY

While policy and regulation remain key considerations for successful deployment of green hydrogen, investing in green hydrogen supply is contingent on three critical factors:

- Cost-competitive production of green hydrogen.
- Willingness of investors to embrace the embryonic green hydrogen opportunity.
- The ability to deliver hydrogen to customers in a reliable manner.

One location that meets the requirements necessary for transition to green hydrogen is Saudi Arabia, where inexpensive renewable energy is abundant from both solar and wind. It is here that one of the world's largest GW-scale green hydrogen plants, when complete, is expected to have a combined electricity

cost of \$2-\$3 cents/kWh, with the total production cost of green hydrogen close to \$2 per kg.

The plant is being built in a collaborative project between Air Products, NEOM, and ACWA Power. This allows them to aggregate their capabilities and equity as well as leverage economies of scale. There are other examples of collective work, including the Smart Delta Resources consortium in the southwest Netherlands and the province of East-Flanders, Belgium; the cooperation agreement between Total and ENGIE to develop France's largest renewable hydrogen production site; and the recent alliance between Mubadala, ADNOC, and ADQ to grow the green hydrogen economy in Abu Dhabi. So, in many cases, a joint venture may be a good way forward as it limits risks and increases willingness to invest.

Another important condition for successful deployment of hydrogen is the reliability of supply (i.e., the ability to provide continuous, uninterrupted supply to customers). Many industries, like chemicals, petrochemicals, and steel, have a constant demand for a continuous



and uninterrupted supply of hydrogen. To ensure a continuous supply, it may be necessary to have a configuration of both electrolyzers and existing steam methane reformers, producing both green and blue hydrogen, or to develop and utilize storage facilities.

AVAILABILITY OF ADEQUATE TRANSPORT INFRASTRUCTURE

Irrespective of hydrogen's source, it needs to be transported and stored to balance supply and demand. In Europe, the caverns left after salt extraction would be an ideal location as here large quantities of

hydrogen could be stored at low cost.

Ships can carry hydrogen that has been liquified through compression and then cooled down to as low as -253°C , but this is a relatively wasteful process as there is an immediate 45% loss in volume with a further reduction of 0.2%-2% a day during transit.

So, as a more effective alternative, hydrogen can be carried as ammonia (NH_3) or in liquid organic hydrogen carriers (LOHC), both of which have high energy density and are easier to transport. LOHC, for example, have similar properties to oil products and can be shipped as a liquid without the need for refrigeration. However, both might still require conversion before transport and may also require reconversion at the destination, unless, as with ammonia, it is intended to be used as an end product.

Compared to shipping, pipeline transport may prove to be a more economical mode of transport. The downside is that the infrastructure takes time to build and may need scale, which means that shipping remains the convenient and necessary short-term solution even though it is more expensive.

Figure 21 illustrates the relative cost of transporting hydrogen in all forms from Saudi Arabia to Germany. The cost of transport in each case is under $\text{€}3/\text{Kg}$, with NH_3 having a slight cost advantage over LOHC, and both having a significant advantage over liquid hydrogen because of their higher density. However, this benefit is largely offset by the higher conversion and reconversion costs involved.

Pipeline transport can be achieved either by converting the existing natural gas network or by building new infrastructure. Even when new hydrogen pipelines are needed, it is more than 10 times cheaper to build them than to install an electrical infrastructure of the same capacity, which is why pipelines tend to be central to any integrated national hydrogen plan.

Though it will be necessary in many instances to construct some parts of a

pipeline network, existing natural gas networks often can be converted and repurposed, as is the case in Europe. The German Association of National Gas Transmission System Operators (FNB Gas), for example, is aiming to create a 1,293 km hydrogen transmission network in Germany by 2030. Similarly, Gasunie plans to build a 10-15 GW “hydrogen backbone” in the Netherlands by 2026. In both countries, it is technically feasible to convert about 80%-90% of the network to carry hydrogen by replacing compressors and other components.

Even without any conversion, it is still possible to carry as much as 10% hydrogen through an existing natural gas network without any adjustments.

DEMAND PULL

Based on a net-zero scenario, IEA forecasts suggest that hydrogen will comprise up to 35% of total demand by 2050, with long-term demand for hydrogen coming primarily from transport, power, heat, and especially industry, where the main use is as a carbon-neutral feedstock for syngas, bioethanol, steel production, and the like.

Using green hydrogen will be one of the few ways that many industries can comply with the Paris Agreement. Collectively, the iron and steel segment, for instance, could cut 2.4 Gt³ from the CO₂ emissions it emits worldwide using green hydrogen as the sole or auxiliary reducing agent during production. Some, like German steelmaker ThyssenKrupp, are already planning to use green hydrogen and as part of its emission reduction plans, RWE will supply ThyssenKrupp with green hydrogen made with offshore wind power.

In transport, green hydrogen is a real option where electrification is problematic, as in segments like shipping, heavy trucking, and aviation. And in the power and heat sector, hydrogen can be used for power generation and seasonal storage.

For heating buildings, green hydrogen is also an alternative. Micro combined heat

and power (mCHP), could replace natural gas boilers in private households, for instance.

However, if they are to ensure the long-term viability of large production facilities, green hydrogen producers will need significant and ongoing contracts from large off-takers in chemicals, petrochemicals, and steel.

“Another important condition for successful deployment of hydrogen is the reliability of supply (i.e., the ability to provide continuous, uninterrupted supply to customers).”

HOW WILL THE HYDROGEN ECONOMY DEVELOP?

The expectation is that a global green hydrogen economy will emerge, though not all producers will want to participate in it. Some may prefer to serve their domestic markets because these are less influenced by geopolitical factors and supply chain disruptions (e.g., the 2021 blocking of the Suez Canal), and there are also benefits from lower transport costs.

In any event, timescales will depend on investors making informed decisions about when, how, and where to move into what is still an embryonic market. This means they will have to consider not just current policies and regulations, but also the reliability and competitiveness of renewable energy supplies and the potential for scaling up to meet growing demand. Partnering with those with complementary skills, or a strong value proposition, is one way to remove risk from such investment decisions. ■

[Source:
Arthur D. Little's
‘Disruption Is Now’]

OPEC revises oil demand growth downwards

Oil demand growth in 2022 is projected to be slower at 2.8 mb/d, compared with 5.2 mb/d in 1Q22. Demand in 2022 is expected to be impacted by ongoing geopolitical developments in Eastern Europe, as well as COVID-19 pandemic restrictions.



Crude oil spot prices dropped in April after three-consecutive months of rises. The OPEC Reference Basket dropped by \$7.84, or 6.9%, to settle at \$105.64/b. Crude futures prices declined m-o-m in April, amid elevated market volatility, fuelled by persistent uncertainty regarding market outlook. The

ICE Brent front month fell \$6.54, or 5.8%, in April to average \$105.92/b and NYMEX WTI decreased by \$6.62, or 6.1%, to average \$101.64/b. Consequently, the Brent/WTI futures spread widened 8¢ to average \$4.28/b. The market structure of all three major crude benchmarks – ICE Brent, NYMEX WTI and DME Oman – softened significantly, but

remained in backwardation. Hedge funds and other money managers kept net long positions in WTI and Brent little changed after the previous month's sharp selloff.

World economy

World economic growth in 2022 is revised down to 3.5% from 3.9% in last month's assessment, following growth of 5.8% in 2021. US GDP growth for 2022 is revised down to 3.2% from 3.8%, after growth was reported at 5.7% for 2021. Euro-zone economic growth for 2022 is revised down to 3.1% from 3.5%, following growth of 5.4% in 2021. Japan's economic growth for 2022 is revised down to 1.8% from 1.9%, after growth of 1.7% in 2021. China's 2022 growth is revised down to 5.1% from 5.3%, after growth of 8.1% in 2021. India's 2022 GDP growth was revised down to 7.1% from 7.2%, after 2021 growth stood at 8.1%. Brazil's economic growth forecast for 2022 is revised down to 0.7% from 1.2%, following growth of 4.6% in 2021. For Russia, the 2022 GDP growth forecast is revised down to show a contraction of 6%, compared with a contraction of 2% expected in last month's assessment, which follows reported growth of 4.7% in 2021. Challenges related to ongoing geopolitical tensions, the continued pandemic, rising inflation, aggravated supply chain issues, high sovereign debt levels in many regions and expected monetary tightening by central banks in the US, the UK, Japan and the euro area require close monitoring.

World oil demand

World oil demand growth in 2021 remains broadly unchanged from the previous month's assessment at 5.7 mb/d. World oil demand growth in 2022 is expected to increase by 3.4 mb/d y-o-y, representing a downward revision of 0.3 mb/d from last month's report, with 1.8 mb/d in the OECD and 1.6 mb/d in the non-OECD. Oil demand growth in 2022 is projected to be slower at 2.8 mb/d, compared with 5.2 mb/d in 1Q22. Demand in 2022 is expected to be impacted by ongoing geopolitical developments in Eastern Europe, as well as COVID-19 pandemic restrictions.

World oil supply

Non-OPEC liquids supply growth y-o-y in 2021 is broadly unchanged at around 0.6 mb/d. Total US liquids production is estimated to have increased y-o-y by 0.15 mb/d. Non-OPEC supply growth for 2022 is revised down by 0.3 mb/d y-o-y to 2.4 mb/d. Russia's liquids production for 2022 is revised down by 0.36 mb/d. The US liquids supply growth forecast for 2022 is broadly unchanged at 1.29 mb/d. The main drivers of liquids supply growth for the year are expected to be the US, Canada, Brazil, Kazakhstan, Guyana and Norway. OPEC NGLs are forecast to grow by 0.1 mb/d both in 2021 and 2022 to average 5.1 mb/d and 5.3 mb/d, respectively. OPEC-13 crude oil production in April, increased by 153 tb/d m-o-m, to average 28.65 mb/d, according to available secondary sources.

Product markets and refining operations

Refinery margins on all main trading hubs continued to soar in April, amid a continued tightening in global product balances, and

“Favourable product demand-side dynamics, as the overall negative impact of Covid-19 further diminishes on a global level, strengthened fuel markets in general, including that of jet fuel, despite some mobility restrictions in a few Asian countries.”

lower crude prices. Favourable product demand-side dynamics, as the overall negative impact of Covid-19 further diminishes on a global level, strengthened fuel markets in general, including that of jet fuel, despite some mobility restrictions in a few Asian countries. Middle distillates were the main margin contributor over the month, while their margins spread widened further versus that of gasoline. Going forward, refinery intakes are expected to rise and that could provide partial relief to the global product

shortage, and potentially de-pressure product prices.

Tanker market

Suezmax and Aframax rates continued to outperform those in the VLCC class, with gains of 61% and 28% m-o-m. The Suezmax market was supported by a strong market in the Atlantic basin while Aframax saw from support from both the East and West markets. After a sluggish start to the year, VLCC rates finally saw a pickup of 24%. However, gains were short-lived dissipating by the end of the month amid ample availability. Clean rates continued to perform well, gaining a further 15%. The market has been supported by strength in the East and rising activity in tanker demand West of Suez, amid preparations ahead of the driving season in the Northern Hemisphere.

Crude and refined products trade

Preliminary data shows US crude imports declined to an 11-month low of 5.9 mb/d in April, while exports averaged 3.4 mb/d for a gain of 5% m-o-m. US product exports strengthened for the seventh month in a row, averaging 6.4 mb/d, supported by strong flows to Latin America and increasing flows

“Going forward, refinery intakes are expected to rise and that could provide partial relief to the global product shortage, and potentially de-pressure product prices.”

to Europe. In March, China's crude imports averaged 10.1 mb/d, recovering from the weak performance the month before. Recently released customs data shows China's crude imports increased to 10.5 mb/d in April, despite expectations that reduced demand due to COVID-19 lockdowns would weigh on imports. China's product imports declined 8%, while product exports rebounded, amid unexpectedly strong gasoil outflows. With domestic demand impacted by lockdowns, China's product outflows are likely to be higher than previously expected in April,

particularly for jet fuel. India's crude imports dipped in March, but remained near the strong performance seen over the previous four months, averaging 4.5 mb/d for the month. Product exports saw a robust increase of 26% or about 0.3 mb/d to average 1.7 mb/d in March, the highest since September 2013, as Europe sought alternatives to Russian oil product flows. Japan's crude imports have risen steadily since the start of the year, averaging 2.9 mb/d in March, amid healthy demand.

Commercial stock movements

Preliminary March data showed total OECD commercial oil stocks increasing m-o-m by 10.1 mb. At 2,621 mb, inventories were 298 mb lower than the same time a year ago, 304 mb lower than the latest five-year average, and 293 mb below the 2015–2019 average. Within the components, crude stocks rose m-o-m by 12.9 mb, while products stocks fell m-o-m by 2.8 mb. At 1,265 mb, OECD crude stocks were 189 mb lower than the latest five-year average and 198 mb below the 2015–2019 average. OECD product stocks stood at 1,356 mb, representing a deficit of 115 mb compared with the latest five-year average and 95 mb below the 2015–2019 average. In terms of days of forward cover, OECD commercial stocks fell m-o-m by 0.3 days in March to stand at 57.4 days. This is 8.8 days below March 2021 levels, 8.7 days less than the latest five-year average, and 5.0 days lower than the 2015–2019 average.

Balance of supply and demand

Demand for OPEC crude in 2021 was revised up by 0.1 mb/d from the previous month's assessment to stand at 28.2 mb/d, which is around 5.0 mb/d higher than in 2020. Demand for OPEC crude in 2022 was revised up by 0.1 mb/d from the previous month to stand at 29.0 mb/d, which is around 0.8 mb/d higher than in 2021. ■

Source: OPEC



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2022: Year of Green Hydrogen

In designating 2022 as the ‘Year of Green Hydrogen’, Oman Society for Petroleum Services (OPAL) has affirmed its robust support for the Omani government’s energy transition strategy and also envisions a significant role for itself in harnessing the potentially immense localization opportunities associated with the future green energy industry.



O PAL’s already weighty mandate as the sole representative organization of Oman’s energy sector – the cornerstone of the national economy – is set to expand even further.

The non-governmental organization, which only recently added mining and logistics, among other economic sectors to its ballooning ambit, is gearing up to play a pivotal role in the country’s future economy centred around green hydrogen.

“Our mandate, from the outset, has been aligned with that of our chief patron, the Ministry of Energy and Minerals. And with the Ministry pivoting strongly towards renewables and green energy, as an alternative to planet-warming fossil fuels, it’s only appropriate that OPAL embraces this new direction as well,” said Abdulrahman Al Yahyaei, CEO.

In affirmation of this new focus on green energy, OPAL designated 2022 as the Year of Green Hydrogen, underscoring its commitment to working closely with the Ministry, as well as the wider energy sector, in driving forward this ambitious vision for the Sultanate of Oman.

More recently, the Society signed an agreement with the organisers of the Green Hydrogen Summit Oman (GHSO) – the principal national platform showcasing Oman’s green energy aspirations – to support the 2022 edition of this important forum. Mr. Al Yahyaei signed the agreement with Mr.



Abdullah Al Harthy, CEO – Birba Energy, the principal organizer of GHSO.

The 2022 edition of the GHSO Summit & Exhibition will build on the stellar success of the maiden event held late last year, Mr. Al Yahyaei noted. “OPAL’s collaboration with Birba Energy aligns with His Majesty Sultan Haitham bin Tarik’s recent exhortations for the growth of a green hydrogen industry in Oman. Additionally, the transition to a green energy future is also a key goal of Oman’s 2040 Vision. Accordingly, OPAL will leverage its expansive reach within Oman and internationally to support the delivery of a truly world-class green hydrogen summit and exhibition later this year,” he stated.

Welcoming OPAL’s support, Birba Energy’s Abdullah Al Harthy stated: “OPAL’s endorsement of GHSO 2022, on top of the support already extended by the Ministry of Energy and Minerals, promises to elevate the event to world-class standards. Birba Energy looks forward to working closely with OPAL and its executive team in rolling out a conference and exhibition that Oman can be truly proud of.”

As Strategic Partner, OPAL has pledged to exhort its members to participate in the GHSO 2022 as exhibitors and delegates, “We will also reach out to the many

“ **OPAL’s collaboration with Birba Energy aligns with His Majesty Sultan Haitham bin Tarik’s recent exhortations for the growth of a green hydrogen industry in Oman. Additionally, the transition to a green energy future is also a key goal of Oman’s 2040 Vision. Accordingly, OPAL will leverage its expansive reach within Oman and internationally to support the delivery of a truly world-class green hydrogen summit and exhibition later this year.** ”

international energy-sector organisations and institutions that we have close ties with, to urge them to be part of this prestigious forum. We will encourage them to either depute high-level subject-matter experts as speakers or have a presence at the exhibition. OPAL is confident of making a substantive and impactful contribution to the overall success of this event,” Mr. Al Yahyaei stressed.

Robust support

OPAL envisions for itself a far more profound and concrete role in supporting the development of a thriving green energy production and export industry in the Sultanate of Oman. That role, says the CEO, encompasses primarily localization objectives, notably human capital and In-Country Value (ICV) development centring around a future green hydrogen economy.

In this regard, the Society plans to leverage its already considerable expertise in the development of national occupational standards (NOS) in a first for Oman's vocational training sector. Since it was awarded the mandate, in 2019, to host the country's first Sector Skills Unit for the Energy and Minerals economies, OPAL has successfully rolled out standards across a number of key disciplines, notably Electrical, Mechanical, Maintenance, Fabrication, Drilling and HSE.

“But it's not green energy alone that is preoccupying the energy industry's sole representative organization. In recent years, the Society has evolved and expanded to reflect the remit of the restructured and revamped Ministry of Energy and Minerals. As of mid-2022, there were more than 450 members and counting – the highest in the Society's history.”

“This year, the Sector Skills Unit has been tasked with developing National Occupational Standards for renewable energy related skills in line with our theme for 2022,” Mr. Al Yahyaei said. “As part of this broader effort, we will identify the skills necessary for this rapidly growing sector and the number of jobs that will be generated going forward, both at the upstream solar and wind based electricity generation end and the downstream green

hydrogen production ends as well.”

To this end, OPAL plans to partner with well-established training services providers to develop programme materials and curricula to help in the grooming of young Omanis for emerging jobs in the renewables and green energy industry. This initiative, set to be kicked off in the second half of this year, will also involve a reputable international institution to help in the formulation of National Occupational Standards for the sector, the CEO said.

In parallel with this objective, OPAL also plans to replicate its hugely successful ICV strategy for the Oil & Gas industry in the emerging renewables and green hydrogen space as well. The CEO sees significant opportunities for localization across many areas of the green energy value chain. Many of these opportunities have the potential to be unlocked in Duqm, where a sizable number of the mega-scale green hydrogen projects are planned for implementation, he points out.

Record performance

But it's not green energy alone that is preoccupying the energy industry's sole representative organization. In recent years, the Society has evolved and expanded to reflect the remit of the restructured and revamped Ministry of Energy and Minerals. As of mid-2022, there were more than 450 members and counting – the highest in the Society's history. Drawn by its positive intervention as a voice of the industry, companies operating outside of the energy space have been gravitating to OPAL and seeking membership. New members have included power generation and water desalination companies, and logistics businesses as well.

“This spike in our membership is a reflection of their trust in our commitment to addressing their concerns and working collaboratively in enhancing their growth objectives and that of the national economy,” said Mr. Al Yahyaei. “We also concluded our fiscal year with a very healthy balance sheet characterized by strong revenue growth – the highest in the Society's history.”

To its credit, the successful rollout and implementation of a new Road Safety



Standard for the Oil & Gas sector has opened a new revenue stream for OPAL. Having been given the mandate to accredit all of the service providers that form part of the Road Safety Standard apparatus for the industry, OPAL is entitled to charge a set of fees and royalties for the smooth operation of this new standard. Included in this expansive ecosystem are Defensive Driving Training Service Providers, Defensive Driving Assessment Centres, Vehicle Inspection Centres, IVMS vendors and installers, and related service providers. Together, and with OPAL's overall supervision, this apparatus has enabled the issuance of over 22,000 defensive driving permits to date, as well as the installation of over 7,000 IVMS devices in vehicles licensed to operate in the oilfield areas of the country.

New standards

At the same time, work on new standards development continues apace at OPAL. In its sights is a new set of standards which, for the first time, will focus on the health and well-being of energy sector workers. Thus, in addition to the Occupational Health Standard that was rolled out last year, OPAL is now working on a new 'Fitness to Work' standard – an initiative that entails close collaboration

with fellow stakeholder agencies, including the Ministry of Labour.

In line with its broader localization commitments, OPAL continues to ramp up its employment generation efforts. To this end, the Society is working closely with the Ministry of Labour, as well as Ministry of Energy and Minerals, to help on the one hand, to unlock new employment creation opportunities for Omanis, and on the other, support the vocational training and upskilling of job-seekers.

One such notable initiative, wholly conceived by OPAL, will result in the creation of hundreds of new HSE advisory positions in organisations with sizable workforces. Under an MoU signed with the Ministry of Labour, OPAL has rolled out an apprenticeship programme that will help Omanis to acquire the requisite skills and qualifications to serve as HSE Advisors. On the same lines, OPAL is preparing the groundwork to support the training and qualification of Omanis for jobs as Lifting Inspectors – a move that will help replace expatriates currently dominating this discipline. Similar efforts are ongoing to help localize the positions of Fuel Station Managers and Fuel Truck Drivers – initiatives that will further open up rewarding job opportunities in key sectors. ■

ENERGY INVESTMENTS GROW DESPITE GLOBAL VOLATILITY: APICORP

The MENA region is well-positioned to supply around 10% to 20% of the global hydrogen market by 2050, with GCC and North Africa set to become global export hubs catering for demand in Europe and SE Asia, says APICORP in its latest 'MENA Energy Investment Outlook 2022-2026' report.

Although 2021 was a tumultuous year with bouts of volatility on the trifecta of the health, economic and financial fronts, we enter the year of 2022 expecting that it will be no less of a rollercoaster as several uncertainties loom. On the geopolitical front, the Russia-Ukraine conflict is triggering worldwide spillovers through commodity markets, trade, and financial channels. Fuel and food prices have increased rapidly, with vulnerable populations – particularly in low-income countries – most affected.

On the economic front, public debts and inflation rates are at a record high, with fiscal austerity measures anticipated to cool off the market overheating and restraint commodity prices. Interest rates are expected to rise as central banks tighten policy, exerting pressure on emerging market and developing economies. According to the IMF, inflation in 2022 is projected at 5.7% in advanced economies and 8.7% in emerging market and developing economies.

Worsening supply-demand imbalances and further increases in commodity prices could lead to persistently high inflation. Elevated inflation will complicate the trade-offs central banks face between containing price pressures

and protecting growth.

On the health front, new variants are expected to emerge as the virus mutates while the viral spread may be shifting from 'pandemic' to 'endemic'. Although many parts of the world appear to be moving past the acute phase of the

COVID-19 crisis, death rates remain high, especially among the unvaccinated. Moreover, recent lockdowns in key manufacturing and trade hubs in China will likely compound supply disruptions elsewhere.

The fear of stagflation looms, as fiscal stimulus packages are being withdrawn, asset purchasing programs are being tapered and interest rates are to be hiked. The economic recovery will slow down amid a vicious inflationary cycle that turned out not to be transitory after all.

Although the global growth momentum is experiencing a cyclical slowdown ahead, the outlook for the MENA region is relatively positive – compared to the past two years – driven by the energy exporters, particularly the GCC, Iraq and Algeria. MENA energy exporters are set to benefit from the spike in energy prices which will result in higher government and private energy sector revenues. Such revenues will activate higher



public capital spending and improve the general business sentiment in the private sector, thus facilitating longer-term expansion plans.

Several headwinds still pose a threat to the economic recovery in MENA, mainly: tighter monetary policies and higher interest rates which will drive FX outflows from emerging economies, commodities entering a super-cycle mode, prolonged Russia-Ukraine conflict into 2023, continued supply chain disruptions, food insecurity, and the threat of Covid variants causing key trade and manufacturing hubs in China to undergo lockdowns beyond Q2 2022.

Inflation in the GCC countries is expected to be on the lower side where the economy is supported by a strong windfall from oil & gas export revenues, currency pegs to the dollar and high forex reserves. As for the net-energy importers in North Africa and Levant regions, more suppressed growth rates are expected in 2022 as countries in these regions are more exposed to the macroeconomic risk imposed by the Russia-Ukraine conflict, food and commodity insecurity, higher inflation and less fiscal room for governments to withstand external shocks to their economies.

Both KSA and UAE warn of a mismatch between the ongoing energy needs and the IOCs' reluctance to spend on replenishing their hydrocarbon reserves base due to anti-fossil fuel pressures. This will compromise energy security and economic activity should triple-digit oil prices become a norm. For instance, the declines experienced in OPEC members Nigeria and Angola, led both countries to fall short of their OPEC quotas in 2022.

The ability of OPEC+ members to abide by the target increases to reach pre-pandemic levels by mid-year will be under the lens as SPR (strategic petroleum reserve) releases in the US, EU and SE Asia are not enough to compensate the loss of Russian supply oil. This is mainly due to lower overall output due to historically low upstream E&P investments over the past years and decline in Russian production due to sanctions/self-sanctions. Replenishing SPR stocks will be needed by Q3 2022 as huge withdrawals will leave these countries (US, EU, Japan and



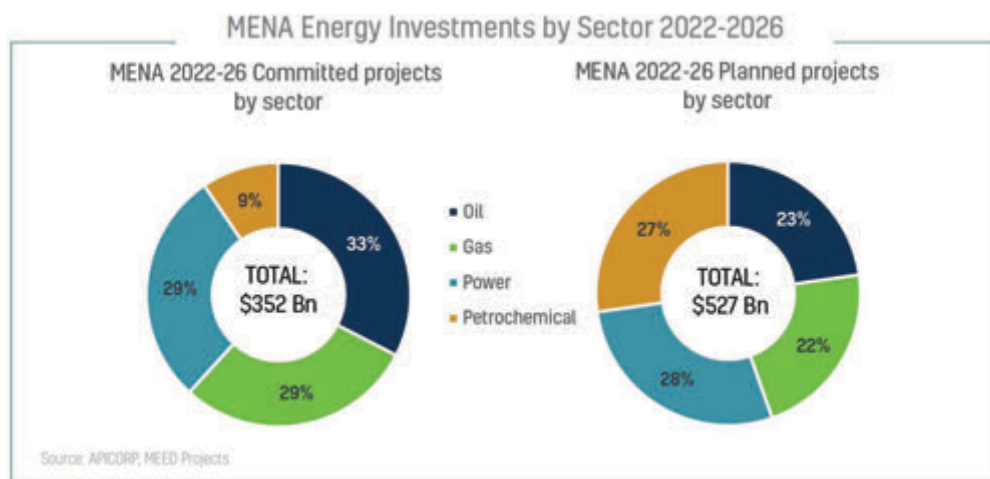
South Korea) exposed to very low storage levels, compromising energy security and further triggering an oil price spike by Q4 2022 / Q1 2023. The market is already taking this into account, and this is the reason oil futures remain elevated despite SPR releases.

Brent is expected to experience bouts of sharp volatility due to tight energy markets, before stabilizing at an average price revolving around USD 100/bbl. in 2022, as existing market fundamentals imply. As for natural gas, the JKM and TTF/NBP hub prices in Asia and Europe are expected to cool down during the summer season due to lower energy demand but remain poised to climb back near record high levels with the onset of winter in Q3 2022, since global gas markets will remain fundamentally under-supplied until late 2025.

Strong growth in MENA energy investments driven by O&G

Data compiled and analyzed in Q1 2022 shows that MENA's 5-yr forward-looking energy investments register a total of USD 879 Bn, a 9% increase over last year's 2021-2025 figure of USD 805 Bn. Of this total, committed projects (i.e. projects which have entered the execution stage) make up around 30%, while planned projects (i.e. projects still in the planning phase) constitute the remaining 70%.

The increase in project expenditure is spearheaded by the GCC, with committed



projects making up more than 45% of the Gulf states' total energy investments thanks to the windfall from oil and gas export revenues. As for North African countries, which skillfully managed to offset the decline in committed projects during the pandemic years (2020-2021) due to the resilience of their diversified economies, the strains of inflation and debt burdens are beginning to show and impact investments (with the exception of Algeria, buoyed by bumper O&G exports revenues).

On a YoY analysis (year-on-year) of the 2022-2026 outlook vs last year's outlook, crude oil –the region's main energy export commodity– sees a 3% increase, thanks to strong capacity increment targets in KSA, UAE, Kuwait and Iraq. Libyan planned projects remain uncertain as the country suffers political setbacks.

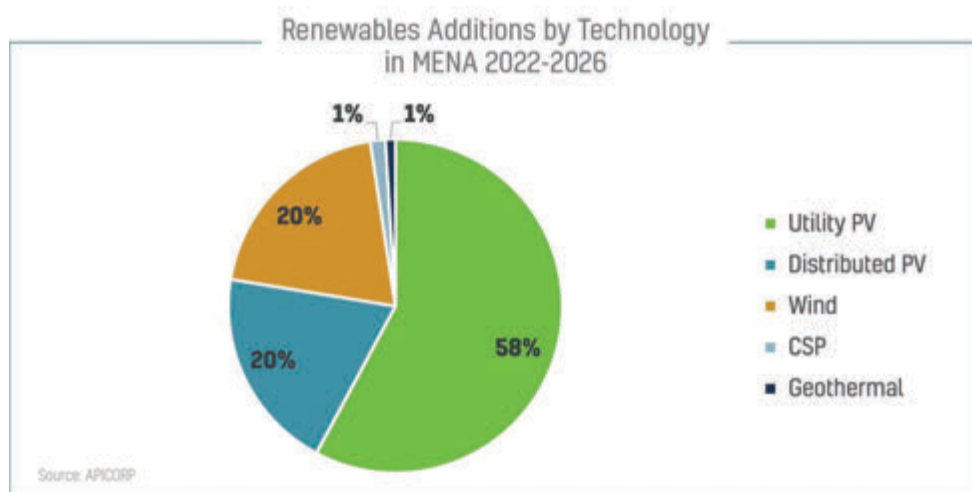
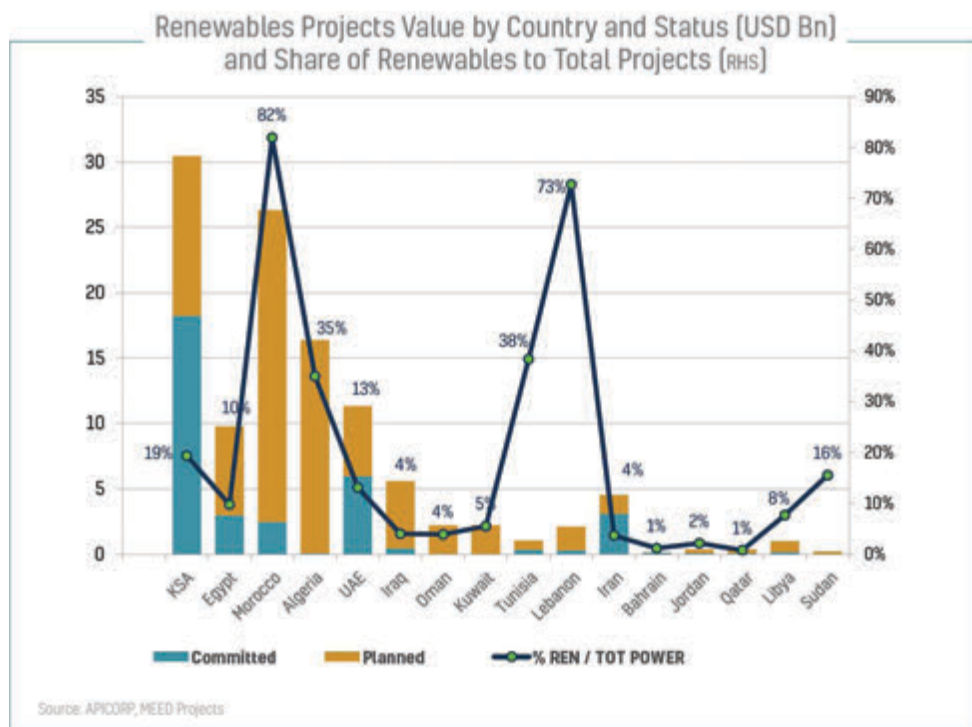
Natural gas investments are forecast to grow by 5% owed to Qatar LNG expansion projects, UAE sour gas developments (plus a newly planned LNG terminal on the Indian ocean straddling the Hormuz Strait chokepoint), and Iraq GTP projects. Committed projects in North Africa register a growth –especially in Algeria and Egypt– to stem gas exports in light of recent MOUs with EU countries to substitute part of the Russian gas imports.

Petrochemicals investments show the highest increase at 45% YoY –as several projects were put on hold in the last two years

due to the combined crises where the focus was more on power sector and maximizing oil & gas export revenue to support the squeezed state budgets.

The power sector investments remain almost unchanged as MENA countries carry on with investments across the power value chain –in generation and T&D. On the supply power mix, natural gas and renewables drive the power decarbonization momentum via switching to natural gas as a cleaner fuel and leveraging sizeable renewables capacities. Although few MENA countries have already pledged their net-zero targets by 2050 (UAE) and 2060 (KSA, Bahrain), electrification via renewable energy sources will be a key driver to reach those targets. However, due to the intermittency of renewable energy sources and the lack of utility-scale grid storage solutions to date, fossil fuels and nuclear will remain indispensable in the power supply mix in the foreseeable future.

The national renewable energy targets for 2030 –ranging between 15% and 50% of electricity generation– portray the governments' will to double down efforts and increase the share of renewables in the energy mix. As of 2021, the total renewables additions reached 3 GW across MENA, with almost 5.6 GW to be added during 2022. The MENA region is expected to add around 33 GW of renewables by 2026 (by installed capacity), with around 26 GW as utility and distributed solar PV.

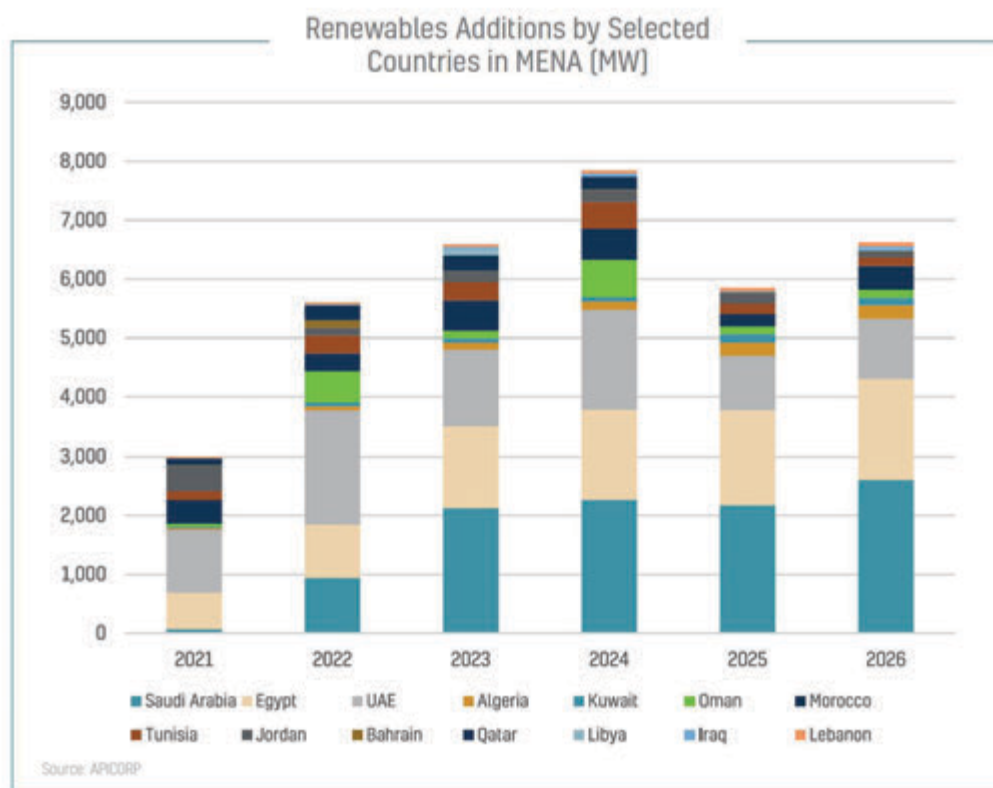


Hydrogen gains momentum among the traditional energy vectors in MENA

As for the energy vectors constituting the power mix in MENA, natural gas –which is already a dominant fuel for power generation– is expected to grow to maintain a power generation share of around 70% to 75% across MENA by 2024. Another positive sustainability signal is given by the region where oil-

fired power is set to drop from 24% of total generation to almost 20% by 2024.

The most remarkable addition to the MENA's downstream sector is hydrogen as the region targets capturing considerable future market share of this nascent commodity based on its strategic advantages. At the time of compiling this outlook, the MENA region has registered more than USD 26 Bn in hydrogen projects, mostly in the planned phase.



In light of the gradual energy transition towards a low-carbon future, hydrogen will play a central role due to its versatility as a clean energy vector. Hydrogen can be an energy carrier and/or an energy storage medium given its high energy content per mass. Hydrogen can also support the MENA countries' energy security by diversifying the energy mix and boosting the resilience of localized energy systems.

By leveraging its strong potential, the MENA region is well-positioned to supply around 10% to 20% of the global hydrogen market by 2050. It is expected that the hydrogen markets in MENA will pass through three phases before transforming into a fully established commodity market where several aspects need to be addressed to ensure an attractive investment environment.

The energy transition drive in MENA takes shape in equity and financial markets.

With decarbonization efforts growing across the globe to counter climate change,

O&G companies are facing tighter financing conditions and evolving regulatory frameworks while trying to keep contributing to socioeconomic development and providing affordable energy to stem economic activity.

MENA equity markets in 2021 witnessed the return to healthy deal flow volumes in both conventional and renewable energy given the region's dual approach to the energy transition. We expect the strong regional privatization drive to continue in 2022, with increased PPPs and IPOs to unlock value from world-class hydrocarbon assets, while targeting synergies through Public-Private-Partnerships.

MENA green and sustainability-linked bonds issued in 2021 more than tripled from 2016-2020 to USD 18.64 Bn with an increase of a staggering 123% from the previous 2020 record of USD 4.5 Bn. This includes APICORP's USD 750 Mn ICMA-aligned Green Bond (Sep 2021) —following the development of APICORP ESG policy. Green and Sustainable Sukuk issuances also continued their growth in 2021 with a 17.2% YoY increase, (Fitch).

MENA's most notable issuance for 2021 was Islamic Development Bank's (IsDB) USD 2.5 Bn Sustainability Sukuk in March, which is also its biggest USD public issuance to date.

2021 also witnessed MENA's First voluntary carbon trading scheme by Saudi Stock Exchange (Tadawul), paving the way for the development of a formal carbon market for trading credits and offsets. Under the recent net-zero pledges of the UAE, KSA, and Bahrain, carbon markets are expected to flourish in the region.

APICORP and IsDB kicked-off 2022 with the 'Infra Initiative' —a USD 1 Bn private sector-focused infrastructure financing initiative to identify and deliver structured finance facilities to utilities projects with limited access to international financing. Under this initiative, funds will be allocated to electricity generation and transmission projects which utilize renewable energy or natural gas, as well as water and waste management facilities. The involvement of the private sector at the local, regional, and international levels will also be a priority in the project selection process.

MENA private sector investments continue to grow

The share of private investments in MENA committed and planned projects for 2022-2026 increased from 27% (2021-2025) to 30%. In the GCC and North Africa, the percentage slightly increased from last year outlook: 22% for GCC and 36% for North Africa, while in the Levant countries —Iraq, Lebanon and Jordan— the figure goes down to 43% as compared to 52% in last year's outlook.

MENA to lead climate action in COP27 and COP28

After the COP26 summit held in Glasgow in November 2021, there was a global consensus that our future shall be low-carbon. Although the 'what' is well defined, the 'how' remains debatable. Every country will chart its path as a function of energy security, level of socioeconomic development, financial capabilities and inherent energy mix.

As a direct result of COP26, we expect the focus to shift to assuring a sustainable energy

transition for all nations ('SE4ALL') —with the UN SDGs in mind— and on how the required financing will be mobilized (the main task for the UN Glasgow Financial Alliance for Net Zero —'GFANZ'). We also expect the 'Emissions Trading Schemes' (ETS) and voluntary carbon trading to substantially increase in volume from 2022 and beyond, as a result of the activation of Article 6 of the Paris Agreement.

The MENA region will take center stage in the ongoing global energy transition as all eyes shift to Egypt, which will host COP27 in November 2022, and UAE hosting COP28 in 2023. While the transition continues to steadily gain momentum, governments face the challenge of balancing imperatives which are oftentimes very difficult to align: energy security, energy affordability, emissions reduction, and maximizing gains from core competitive markets to fund socioeconomic development targets.

As for the upcoming COP27 summit, the work has already started as several key decisions that were supposed to be taken at COP26 were postponed. The COP26 produced substantial progress on cutting greenhouse gas emissions, but the national carbon targets laid out fell far short of the near-halving of emissions required to stay within 1.5°C of pre-industrial levels. Recognizing that, nations agreed to review their targets before they convene this November.

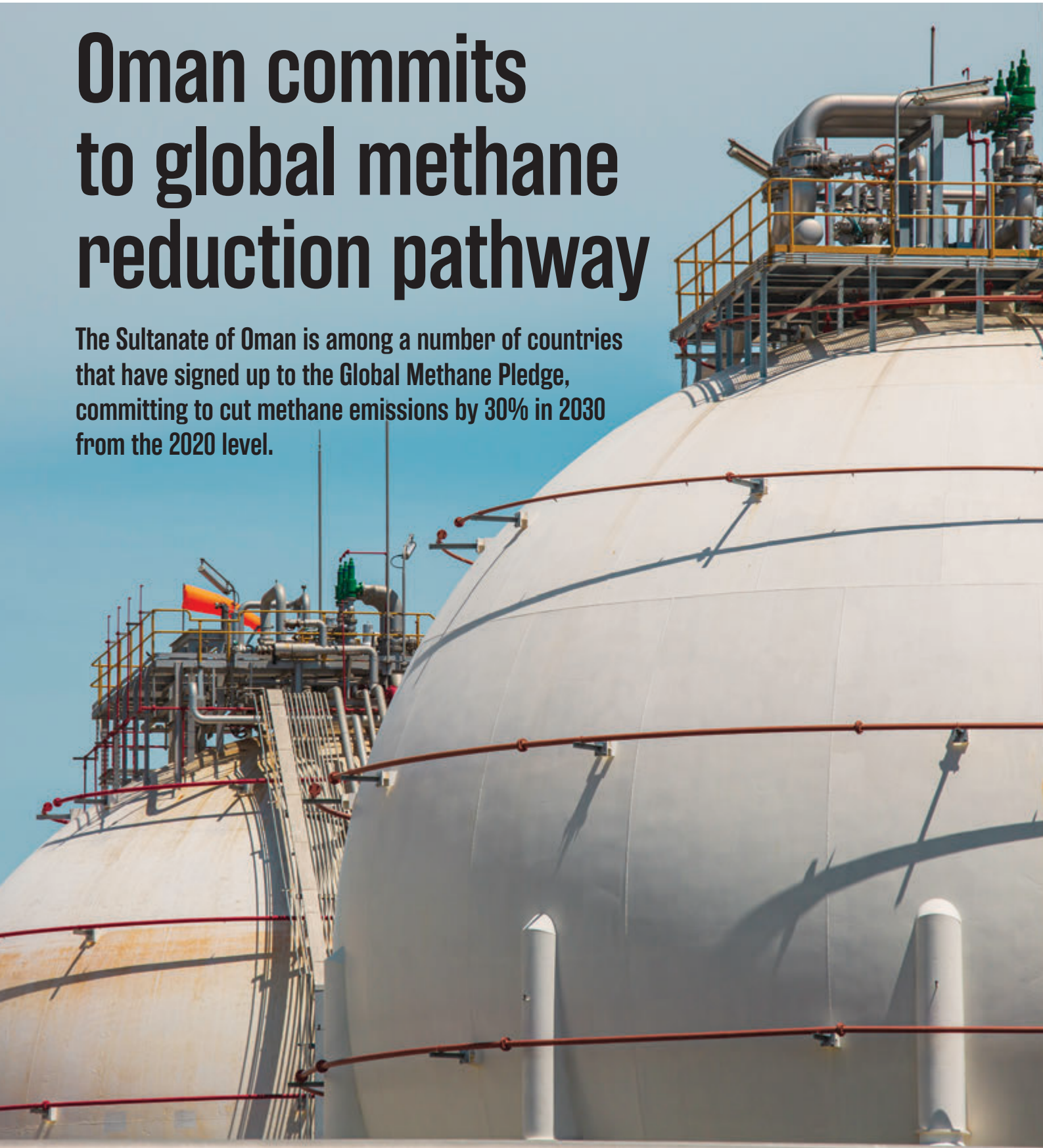
The COP27 summit will underscore the sustainability aspect of the energy transition from the developing nations' perspectives —including MENA— which have been calling for a more 'inclusive' energy transition.

We expect the focus at COP27 to be in areas such as climate financing, adaptation, and loss and damage, to keep pace with the progress that the world hopes to achieve in mitigation and carbon neutrality efforts. Governments will be under pressure to act on their pledges from COP26 as the momentum builds ahead of the summit next November. ■

[The Arab Petroleum Investments Corporation (APICORP) is an energy-focused multilateral financial institution established in 1975 by the ten Arab oil exporting countries. APICORP's mission is to support the sustainable development of the region's energy sector and related industries through a range of financing and direct equity solutions, as well as energy research and advisory services.]

Oman commits to global methane reduction pathway

The Sultanate of Oman is among a number of countries that have signed up to the Global Methane Pledge, committing to cut methane emissions by 30% in 2030 from the 2020 level.



Oman is now a full-fledged member of a global initiative to catalyze reductions in planet-warming methane emissions in the oil and gas sector, while advancing both climate progress and energy security as well.

The Sultanate was among a total of 11 countries that, on 18 June 2022, formally endorsed the Global Methane Pledge -- first unveiled by the United States and the European Union at the COP26 Summit in Glasgow last year.

Welcoming Oman's participation in the worldwide movement, the Bureau of Near Eastern Affairs at the US State Department, stated in a twitter post: "Oman's endorsement of the Global Methane Pledge is a great step! Reducing methane emissions, particularly in the Oil & Gas sector, is critical to keep global warming to 1.5 deg C and to avoid worst impacts of climate change."

Other countries that also endorsed the Global Methane Pledge on Saturday, along with the Sultanate of Oman, were Egypt, Kosovo, Moldova, Qatar, Saint Lucia, Trinidad and Tobago, and Uzbekistan. With their accession to the initiative, a total of 120 countries have so far endorsed the Pledge, representing half of global methane emissions and nearly three-quarters of the global economy.

To limit warming to 1.5 degrees C and avoid near-term tipping points, the world must rapidly reduce methane emissions in addition to decarbonizing the global energy sector. This is why the United States, the European Union, and more than 100 countries launched the Global Methane Pledge (GMP) at COP26 to reduce anthropogenic methane emissions at least 30 percent by 2030 from 2020 levels. With the recent additions, 120 countries have now endorsed the Pledge, representing half of global methane emissions and nearly three-quarters of the global economy.

Tackling methane emissions in the oil and gas sector is critical to achieving the Global Methane Pledge target—and will also bolster global energy security by preventing the

needless waste of valuable gas resources. The oil and gas sector contributes roughly one-quarter of all anthropogenic methane emissions due to flaring, venting, and leaking of methane, which is the principal component of natural gas.

Globally, more than 250 bcm of natural gas was flared, vented, or leaked in 2021—exceeding the annual output of the world's third-largest gas producer. Reducing flaring and methane emissions in the oil and gas sector is immediately cost-effective and has the triple benefit of acting on climate change, improving health outcomes, and enhancing global gas supply at existing levels of production—simply by capturing gas that would otherwise be wasted due to flaring or methane emissions.

The Energy Pathway is a critical implementation step of the Global Methane Pledge that will accelerate deployment of the fastest and most cost-effective methane mitigation solutions available today. The GMP Energy Pathway aims to encourage all nations to:

- Capture the maximum potential of cost-effective methane mitigation in the oil and gas sector, and
- Eliminate routine flaring as soon as possible, and no later than 2030.

Participating countries commit to support these efforts by providing new technical and financial resources and/or by enhancing domestic project and policy action.

According to an International Energy Agency report released this week, deploying all available abatement technologies to reduce methane emissions and flaring from the oil and gas sector can avoid nearly 0.1 degree C of warming by mid-century—the equivalent of immediately eliminating the greenhouse gas footprint of all cars, trucks, buses, and two- and three-wheelers in the world.

Countries and supporting organizations announced nearly \$60 million in dedicated funding to support implementation of the Pathway. These funds will be critical to improve methane measurements in the oil and gas sector, identify priority areas for methane mitigation, develop technical



assessments for project development, strengthen regulator and operator capacity, support policy development and enforcement, and other essential activities to achieve reductions in methane emissions.

In addition, the UNEP International Methane Emissions Observatory will work with partners to launch the first phase of an alert and response system for satellite-detected methane emissions by COP27. The EU has so far committed 17 million EUR to support the work of the UNEP International Methane Emissions Observatory and has envisaged further funding in the coming months.

The Climate and Clean Air Coalition will also support the goals of the Pathway through its Hub on Fossil Energy to reduce methane and other short-lived climate pollutant mitigation in this sector.

Global gas producers have also announced significant new commitments to develop projects and strengthen policies to cut methane emissions and ensure clean, secure gas supply. Additionally, major consumers

of natural gas have announced efforts to reduce the methane emissions associated with gas production and consumption

The EU and the Government of Japan will endeavor to reduce the methane emissions from the entire value chain of oil and gas production and consumption, including by promoting appropriate international monitoring, reporting, and verification standards; by providing technical assistance and investment for methane emissions reduction along the fossil fuel value chain; and by supporting lower-GHG emissions oil and gas production and consumption.

Methane mitigation in the oil and gas sector is a necessary complement to renewable energy expansion in advancing global climate progress and supporting energy security.

In addition to reducing the greenhouse gas emissions across the fossil fuel supply chain, the world must also accelerate renewables deployment and energy efficiency to reduce reliance on volatile fossil fuels. The clean energy transition is the ultimate energy security solution by reducing dependence on volatile fossil fuels.

Energy efficiency and energy saving has a vital role in addressing today's climate change crisis and spike in energy prices, while strengthening energy security by decreasing price and demand pressures on global energy markets. The International Energy Agency estimates that improvements in efficiency, accelerated deployment of renewables, and other clean energy solutions can free up 350 bcm of natural gas by 2025—exceeding the annual gas consumption of all of Africa and Central and South America.

Rapid renewables deployment can also help alleviate global gas supply shortages by offsetting gas consumption in sectors where alternatives are easily available. Specifically, in gas-producing countries, renewables expansion can reduce domestic gas consumption and free up gas for export at today's high market prices. ■



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Renewables take lion's share of global power additions in 2021: IRENA

An energy transition requires that the use of renewables expands by more than the growth in energy demand, so that less non-renewable energy needs to be used. Many countries still have not reached this point, despite dramatic increases in their use of renewables for generating electricity, the International Renewable Energy Agency (IRENA) has warned in a new report.

New data released by the International Renewable Energy Agency (IRENA) shows that renewable energy continued to grow and gain momentum despite global uncertainties. By the end of 2021, global renewable generation capacity amounted to 3,064 Gigawatt (GW), increasing the stock of renewable power by 9.1 per cent.

Although hydropower accounted for the largest share of the global total renewable generation capacity with 1,230 GW, IRENA's Renewable Capacity Statistics 2022 shows that solar and wind continued to dominate new generating capacity.

Together, both technologies contributed 88 per cent to the share of all new renewable capacity in 2021. Solar capacity led with 19

per cent increase, followed by wind energy, which increased its generating capacity by 13 per cent.

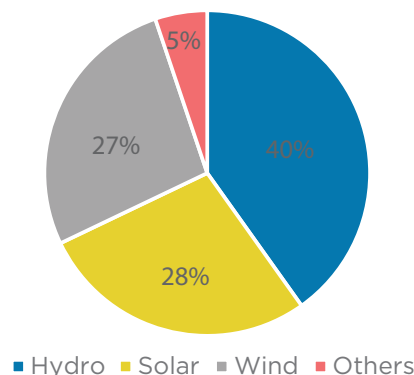
"This continued progress is another testament of renewable energy's resilience. Its strong performance last year represents more opportunities for countries to reap renewables' multiple socio-economic benefits. However, despite the encouraging global trend, our new World Energy Transitions Outlook shows that the energy transition is far from being fast or widespread enough to avert the dire consequences of climate change," says IRENA Director-General, Francesco La Camera.

"Our current energy crisis also adds to the evidence that the world can no longer rely on fossil fuels to meet its energy demand. Money directed to fossil fuel power plants yields unrewarding results, both for the survival of a nation and the planet. Renewable power should become the norm across the globe. We must mobilise the political will to accelerate the 1.5°C pathway."

To achieve climate goals, renewables must grow at a faster pace than energy demand. However, many countries have not reached this point yet, despite significantly increasing the use of renewables for electricity generation.

Sixty per cent of the new capacity in 2021 was added in Asia, resulting in a total of 1.46 Terawatt (TW) of renewable capacity by 2021.

Renewable generation capacity by energy source



China was the biggest contributor, adding 121 GW to the continent's new capacity. Europe and North America—led by the USA—took second and third places respectively, with the former adding 39 GW, and the latter 38 GW. Renewable energy capacity grew by 3.9 per cent in Africa and 3.3 per cent in Central America and the Caribbean. Despite representing steady growth, the pace in both regions is much slower than the global average, indicating the need for stronger international cooperation to optimise electricity markets and drive massive investments in those regions.

Renewable generation capacity by energy source

At the end of 2021, global renewable generation capacity amounted to 3,064 GW. Hydropower accounted for the largest share of the global total, with a capacity of 1 230 GW.

Solar and wind energy accounted for equal shares of the remainder, with capacities of 849 GW and 825 GW respectively. Other renewables included 143 GW of bioenergy and 16 GW of geothermal, plus 524 MW of marine energy.

Renewable generation capacity increased by 257 GW (+9.1%) in 2021. Solar energy continued to lead capacity expansion, with an increase of 133 GW (+19%), followed by wind energy with 93 GW (+13%). Hydropower capacity increased by 19 GW (+2%) and bioenergy by 10 GW (+8%). Geothermal energy increased by 1.6 GW.

Solar and wind energy continued to dominate renewable capacity expansion, jointly accounting for 88% of all net renewable additions in 2021. Along with the higher growth of geothermal, this growth in wind and solar led to a high annual increase in renewable generating capacity.

Asia accounted for 60% of new capacity in 2021, increasing its renewable capacity by 154.7 GW to reach 1.46 TW (48% of the global total). A huge part of this increase occurred in China (+121 GW). Capacity in Europe and North America expanded by 39 GW (+6.4%) and 38 GW (+9.0%) respectively, with a notably large expansion in the USA (+32 GW). Africa continued to expand steadily with an increase of 2.1 GW (+3.9%), slightly less than

in 2020.

Oceania is no longer the fastest growing region (+5.2%), although its share of global capacity is small and almost all of this expansion occurred in Australia.

Highlights by technology

Hydropower: Growth in hydro increased steadily in 2021, with the commissioning of several large projects delayed through 2021. China added 14.6 GW of capacity, followed by Canada with 1.3 GW.

Solar energy: With an increase in new capacity in all major world regions in previous years, total global solar capacity has now outgrown wind energy capacity. Expansion in Asia was 76 GW in 2021 (compared to +77 GW in 2020), with major capacity increases in China (+53.0 GW) and India (+10.3 GW). Japan also added 4.4 GW and Republic of Korea expanded solar capacity by almost 3.6 GW. Outside Asia, the United States added 19.6 GW of solar capacity in 2021, Brazil and Germany respectively added 5.2 GW and 4.7 GW and the Netherlands and Spain added more than 3 GW.

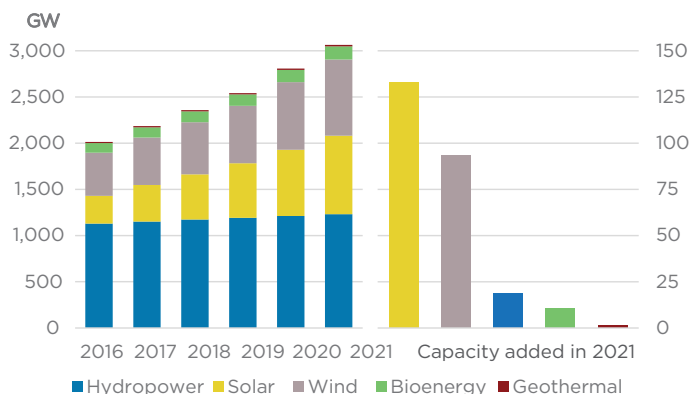
Wind energy: Wind expansion continued at a lower rate in 2021 compared to 2020 (+93 GW compared to +110 GW last year). China added 46.9 GW of new wind capacity, followed by the United States (+14.0 GW). Eleven other countries increased their wind capacity by more than 1 GW in 2021. While offshore wind remains a fairly small part of the sector, it continues to increase in importance each year and reached around 7% of total wind capacity in 2021.

Bioenergy: Net capacity expansion increased in 2021 (+10.3 GW compared to +9.1 GW in 2020). Bioenergy capacity in China expanded by 6.2 GW, leading net expansion in Asia and the world. North America was the only other region with significant expansion in 2021, adding 1.3 GW of bioenergy capacity.

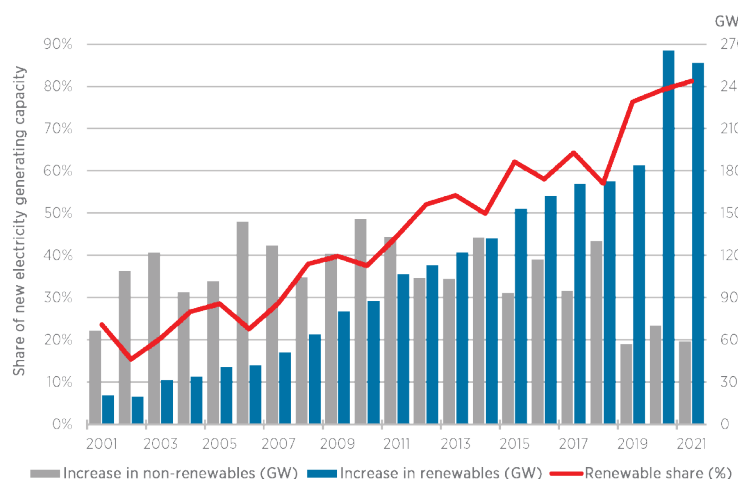
Geothermal energy: Geothermal capacity had an exceptional growth in 2021, with 1.6 GW added. The United States increased capacity by 1.3 GW in 2021, and other expansions occurred in Indonesia (+146 MW), Turkey (+63 MW), Italy (+30 MW) and Mexico (+25 MW).

Off-grid electricity: Off-grid capacity grew by 466 MW in 2021 (+4%) to reach 11.2

Renewable power capacity growth



Renewable share of annual power capacity expansion



GW. Solar expanded by 312 MW to reach 4.9 GW and hydro added 113 MW to reach 1.9 GW. Bioenergy and other capacity remained almost unchanged at about 4.5 GW.

Renewable Capacity Additions

In 2021, renewable generating capacity expansion slowed down slightly compared to 2020, while staying well above the long-term trend. Most of this expansion occurred in China and, to a lesser extent, the United States. Most other countries continued to increase renewable capacity at a similar rate to previous years.

The share of renewables in total capacity expansion reached 81% in 2021, compared to the figure of 79% in 2020. The renewable

share of total generation capacity rose by almost two percentage points from 36.6% in 2020 to 38.3% in 2021.

The upward trend in these shares reflects not only the rapid and increasing growth of the use of renewables but also the declining expansion of non-renewable capacity. At the global level, the latter is also affected by the large amount of net decommissioning that has occurred for many years in some regions.

In 2021, non-renewable capacity continued to expand in Asia, the Middle East and Africa (but with a much lower expansion in Middle East and Africa), while net decommissioning continued in Europe and Eurasia.

An energy transition requires that the use of renewables expands by more than the growth in energy demand, so that less non-renewable energy needs to be used. Many countries still have not reached this point, despite dramatic increases in their use of renewables for generating electricity.

Latest figures

Compared to the capacity statistics published in August 2021, the figures here have been revised upwards very slightly. Total renewable capacity in 2020 was reported as 2 802 GW last year and the new figure for 2020 is 2 807 GW (+0.18%).

As noted last year, most revisions can be explained by imprecise early reporting of distributed solar power generation in a few countries (which is often overstated). Upward revisions were also made this year for a few countries where data were not available and estimates were made last year.

The other main revision has been an increase in the time-series for off-grid generation, where new figures have been found. Given the importance of increasing energy access and the widespread use of solar power for this purpose, countries are encouraged to continue expanding the collection of off-grid data for monitoring their national energy goals and targets. ■

[Courtesy: IRENA]



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