

JULY 2024

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OMAN: Building a Low Carbon Future

Corrosion • Mining • Industry Interviews



OMAN'S ENERGY SECTOR FUELS ECONOMIC GROWTH

The Sultanate's oil and gas sector is vital, contributing 72 per cent to GDP and achieving a 90 per cent Omanisation rate. Meanwhile, investments by OQ have increased reserves and production, driving economic stability and growth

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Oman's oil and gas sector drives GDP growth

By **ABDULAZIZ KHATTAK**

OMAN'S oil and gas industry is a cornerstone of the country's economy, contributing 72 per cent to its GDP. It not only drives economic growth but also fosters development stability and finances numerous government programmes.

The industry has a 90 per cent Omanisation rate among its operating companies, while small and medium enterprises (SMEs) benefit from the sector's procurement spending, with approximately 16 per cent of the total value of purchases and tenders allocated to SMEs.

Investments in exploration and enhancing reserves are ongoing, with Oman's oil reserves increasing by 1 per cent to 4,971.1 million barrels and natural gas reserves standing at approximately 23.1 trillion cubic feet by the end of 2023.

Oman's crude oil reserves reached 4.971 billion barrels by the end of 2023, with 309.4 million barrels added through 15 development and 39 exploratory wells.

The Sultanate produced approximately 388.8 million barrels of crude oil and condensates, achieving an average daily production of 1.064 million barrels.

Oman's gas sector produced 48.553 million cu m of non-associated natural gas in 2023, up by 2.4 per cent from 2022.

Total gas production and imports increased by 1.3 per cent to 49.703 million cu m. The country has substantial gas reserves, with 23.114 trillion cu ft of non-associated gas and 1.354 trillion cu ft of associated gas.

Leading that energy drive is OQ, the global integrated energy group, which plays a pivotal role in advancing Oman's oil and gas sector through strategic investments, innovative technologies, and sustainable practices.

OQ's efforts have been instrumental in enhancing exploration activities, increas-

ing reserves, and optimising production processes, thereby ensuring the stability and growth of the industry.

GROWTH MILESTONES & OPERATIONAL EXCELLENCE

Following OQ's remarkable financial results in 2022, the group continued to showcase resilience and strategic growth throughout 2023, particularly in the face of challenging and volatile markets experienced during the second quarter.

This steadfast performance is evident in its earnings before interest, taxes, depreciation and amortisation (EBITDA) of \$5.137 billion and a net profit of \$2.518 billion for the year.

In 2023, OQ marked the third consecutive year of strong financial performance. The group's solid operational performance and commitment to financial discipline were crucial in navigating turbulent market conditions.

The impressive financial results were further bolstered by proceeds from key privatisation initiatives, including attracting foreign investors to Blocks 48 and 60, and divesting Gulf Energy Maritime (GEM).

The increased oil production, supported by high Oman Export Blend (OEB) prices, consistent operational performance, and cost optimisation across business units, played a significant role in these achievements.

Moreover, OQ's divestment milestones, such as selling its 30 per cent stake in Vale Oman, which became a 100 per cent foreign-owned company, were instrumental in driving financial success.

In line with Oman Vision 2040, which aims to empower the private sector and attract foreign direct investment, OQ achieved several significant divestment milestones.

The successful IPO of Abraj Energy Services in February 2023, resulting in an 8.7x oversubscription, and the IPO of OQ

Gas Networks (OQGN) in October, which became the largest IPO listing in the history of Muscat Bourse, highlighted OQ's focus on asset rationalisation and partnership development.

These divestments and IPOs are part of OQ's strategic efforts to attract international expertise and contribute to the development of the Omani capital markets.

OQ maintained its growth trajectory by achieving several landmark milestones in 2023. The inaugurations of the OQ Ammonia Plant in Salalah and the Bisat Oil Field within Block 60 in January enabled OQ to achieve an 11 per cent increase in daily production compared to 2022, reaching an average of 246,000 barrel of oil equivalent per day (boe/d) in 2023.

The group also progressed several growth projects from the construction phase to operational phases.

The Oman Tank Terminal Company (OTTCO) in Duqm completed 19 shipments and transferred 26.6 million barrels of oil through its pipeline to OQ8 in 2023.

Additionally, OQ Alternative Energy advanced several projects, including signing project development agreements with Hydrom for the Hyport and Green Energy Oman (GEO) projects.

OQ's emphasis on operational excellence was highlighted in the upstream sector, with the early on-stream of Block 10 and the consistent performance from OQ Exploration and Production (OQ EP)'s existing blocks, leading to an annual production target exceedance.

On the commercial and downstream front, the Duqm refinery achieved its first on-spec diesel production in 2023, ahead of the 2024 opening.

Called, OQ8 – a 50:50 partnership of OQ Group and Kuwait Petroleum International – commenced commercial operations in February this year after six years of development.

Continued on page 3

The green hydrogen-based green molecule is chemically identical to natural gas and can be immediately used in the existing gas infrastructure for liquefaction, regasification, transportation and storage

OQ, TES agree to study e-NG project in Oman

TREE Energy Solutions (TES) and OQ Alternative Energy have entered a joint study agreement to assess the development of an e-NG (electric natural gas) facility in Oman.

Oman has been at the forefront in the development of a green hydrogen economy where the country aims to produce in excess of 1 million tonnes annum of green hydrogen by 2030.

Its strong renewable resources, in particular wind and solar, combined with a one stop-shop implementation framework under Hydrom's directive, has been promoting the Sultanate to be amongst the most interesting hubs to produce green hydrogen.

e-NG is a green hydrogen-based green molecule chemically identical to natural gas (on a molecular level) and obtained by combining, through a methanation process (called Sabatier), green H₂ with CO₂, producing green CH₄.

As such, it can immediately be used in the existing gas infrastructure for liquefaction, regasification, transportation and importantly storage and be a drop-in solution for industrial usage gradually replacing natural gas.

"This agreement with OQAE underscores our dedication to advancing the global energy transition and strengthens our commitment and ongoing activities in the Middle East. By harnessing the expertise of OQAE, a global leader in the energy industry, we are enabling the production of green hydrogen at an industrial scale, making e-fuels accessible and cost-effective," said Marco Alvera, CEO and



Alvera and Al Jamali (right) sign the agreement in the presence of senior Omani officials

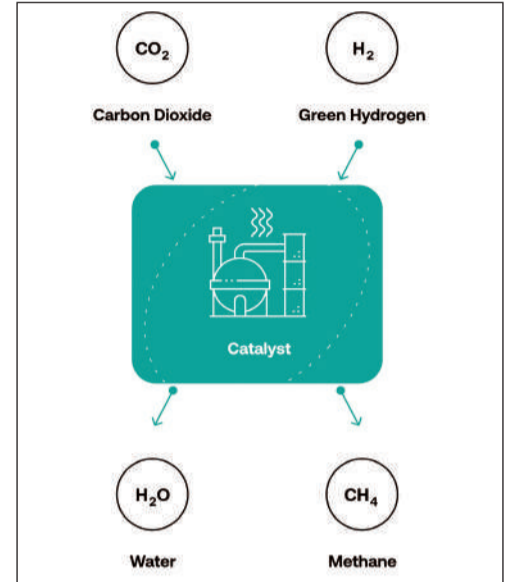
Co-Founder of TES.

Najla Al Jamali, CEO of OQ Alternative Energy, said: "At OQ, we are committed to advancing Oman's energy transition through building partnerships, creating innovative solutions, and implementing sustainable practices. This collaboration marks our dedication to innovation, sustainability, and shaping the future of energy. Collaborating on the study helps us move forward to identify additional downstream opportunities and vectors to diversify

markets for green hydrogen."

Headquartered in Europe, TES is a global green energy company leading the way in the production of e-NG.

The company's green hydrogen model uses solar and wind energy in low-cost areas with abundant sunlight or wind to create green hydrogen, which is then combined with recycled CO₂ from industrial emissions, CO₂ from Direct Air Capture and biogenic CO₂, to create "synthetic methane" or "green gas".



The e-NG making process

e-NG is easy to transport and store using existing infrastructure.

By 2030, TES plans to produce about 15 TWh of e-NG annually, equivalent to 0.4 megatons of green hydrogen, thus avoiding CO₂ emissions of 2.5 million tons annually by 2030.

TES also co-founded the global e-NG Coalition in March 2024 with industry leaders TotalEnergies, Engie, Sempra Infrastructure, Mitsubishi Corporation, Tokyo Gas, Osaka Gas and Toho Gas.

Continued from page 2

With a production capacity of 230,000 barrels per day, the refinery focuses on middle distillates, including jet fuel, gasoil, and diesel, and will significantly boost Oman's diesel export capabilities, leveraging its strategic location to serve markets in both the East and West, particularly the emerging African market.

ALTERNATIVE ENERGY & SUSTAINABILITY INITIATIVES

Oman is committed to reducing carbon emissions and achieving net zero emissions by 2050. The country has implemented sustainable initiatives and comprehensive environmental legislations, including protecting groundwater wells and safeguarding oil production sites.

Oman has signed international initiatives to reduce emissions in the oil and gas industry, including the World Bank's "Zero Routine Flaring by 2030" initiative.

OQ is committed to achieving net-zero emissions by 2050. By 2030, OQ targets a 25 per cent reduction in absolute/intensity emissions from the 2021 baseline.

The OQ Alternative Energy (OQAE) is leading the group's sustainability and decarbonisation efforts, focusing on energy efficiency, clean energy, and low carbon molecules (LCM).

In 2023, OQAE expanded partnerships to de-risk existing green hydrogen projects, aligning with Oman's and OQ's ambitious net-zero goals.

Significant milestones were achieved in decarbonisation. A digital greenhouse gas inventory covering OQ's entire portfolio was implemented, laying the groundwork for future automation and enabling transparent reporting and proactive emissions reduction planning.

OQ surpassed its energy intensity reduction target in 2023, achieving a year-to-date score of 96.2 against the set target of 97.2 in its refineries, resulting in savings of \$8.5 million from enhanced energy efficiency across assets.



OQ8 will significantly boost Oman's diesel export capabilities

OQ outlined an energy efficiency roadmap for 2024 and beyond, aiming to further reduce the Energy Intensity Index (EII) of its assets.

The Group is developing a pipeline of projects targeting over 5 GW growth by 2030, with more than 400 MW of renewable power projected to reach Final Investment Decision (FID) within 2024.

OQAE made significant progress in the green hydrogen sector, signing project development agreements with Hydrom for Hyport Duqm, Green Energy Oman (GEO), and SalalaH2.

A concept study for a green hydrogen refueling station (GHRs) pilot project was concluded, aiming to test technologies and develop green hydrogen project experience.

Sustainability is central to OQ's strategic and investment decisions. In 2023, the group selected top ESG priorities, including decarbonisation, responsible procurement practice, responsible water management, occupational health and safety, diversity, equity, and inclusion, and impactful corporate social investment (CSI).

These priorities serve as a roadmap for sustainability efforts, ensuring a positive impact on the environment and the communities

where OQ operates.

OQ commits to robust water conservation and optimisation strategies, guided by a central data hub for water-related information across all operational assets, in alignment with Oman's Vision 2040 and sustainable development goals (SDGs).

LOCAL DEVELOPMENT

Oman's oil and gas companies are dedicated to maximising commitment to in-country value (ICV) by ensuring a sustainable supply chain, nurturing local talent, and supporting the growth of SMEs. These efforts align with Oman's Vision 2040, aiming to build a sustainable economy and enhance the oil and gas sector's contribution to the national economy.

OQ's commitment to supporting local businesses in Oman was evident in 2023, with the Group's local spend value exceeding \$1 billion, amounting to 77 per cent of its total procurement spend.

OQ RPI signed nine agreements worth \$88 million for industrial projects within the Ladayn Polymer Park in Sohar, further anchoring the Group's dedication to developing local

markets and products.

OQ's procurement procedures and practices enhance opportunities for local SMEs, contributing to the growth of the local economy. The total procurement spend was \$1.371 billion, with a local spend of \$1.059 billion. The ICV retained value was 31.9 per cent, amounting to \$437.4 million, with \$245.4 million allocated to SME spend.

COMMITMENT TO EMPLOYEE WELFARE

OQ places a high value on the welfare of its staff, considering employee satisfaction and motivation as key factors for performance and contribution to the group's success.

In 2023, OQ achieved 83 per cent Omanisation, representing over 50 nationalities, with 86 per cent male and 14 per cent female employees.

The Group aims to enhance the visibility of women in leadership roles through initiatives such as the Women@OQ platform.

More than 200 employees completed OQ's two-year graduate programme, over 300 were enrolled in the Masar leadership development programme, and about 900 interns were hosted.

Oman is leading an ambitious green hydrogen strategy, targeting substantial production increases and economic diversification by leveraging its renewable resources, strategic location, and significant investments

Oman poised to lead with green hydrogen ambitions

OMAN is setting a robust example in the global transition to renewable energy with its ambitious green hydrogen strategy.

The country is poised to become a leading global hub for green hydrogen, leveraging its abundant renewable energy resources, strategic geographic location, and clear, actionable plans.

This comprehensive approach aims to diversify the economy, ensure energy security, and contribute significantly to global decarbonisation efforts.

Oman's Green Hydrogen Strategy delineates a path toward significant contributions to both local and global hydrogen markets.

By 2030, Oman targets an impressive production capacity of 1 to 1.5 million tonnes per annum (mtpa) of green hydrogen, scaling up to 8-15 mtpa by 2040 and eventually reaching 35-40 mtpa by 2050.

These ambitious targets are underpinned by investments exceeding \$38 billion, aimed at building infrastructure, developing shared facilities, and ensuring a competitive levelised cost of hydrogen (LCOH) for export markets.

RENEWABLE RESOURCES & INFRASTRUCTURE

Oman is endowed with some of the world's best renewable resources. The country has allocated around 50,000 sq km of land specifically for green hydrogen projects, with regions like Duqm, Sohar, and Dhofar earmarked for extensive renewable energy development.

Wind and solar resources in these areas are exceptionally favorable, with wind speeds up to 11 m per second and solar irradiation exceeding 2,400 kWh/sq m.

To support this vast potential, Oman is developing a comprehensive infrastructure network. This includes the establishment of shared facilities such as electricity transmission lines, water pipelines, and hydrogen transport systems. Hydrom, Oman's dedicated entity for green hydrogen, plays a pivotal role as the central orchestrator, managing policies, auctions, and the development of this infrastructure.

Oman's strategy includes a transparent and competitive auction process to allocate land for green hydrogen projects.

The first auction round has already seen significant success, with six projects awarded, positioning Oman as a top contender in the global hydrogen market. These projects are expected to generate around 1.38 mtpa of hydrogen by 2030, supported by an installed renewable capacity of 34.8 GW and investments totaling \$49 billion.

The second round of auctions is already in progress, with additional projects being awarded to further bolster Oman's green hydrogen capabilities.

This competitive process ensures that only the most viable and innovative projects are selected, fostering a robust and efficient green hydrogen sector.

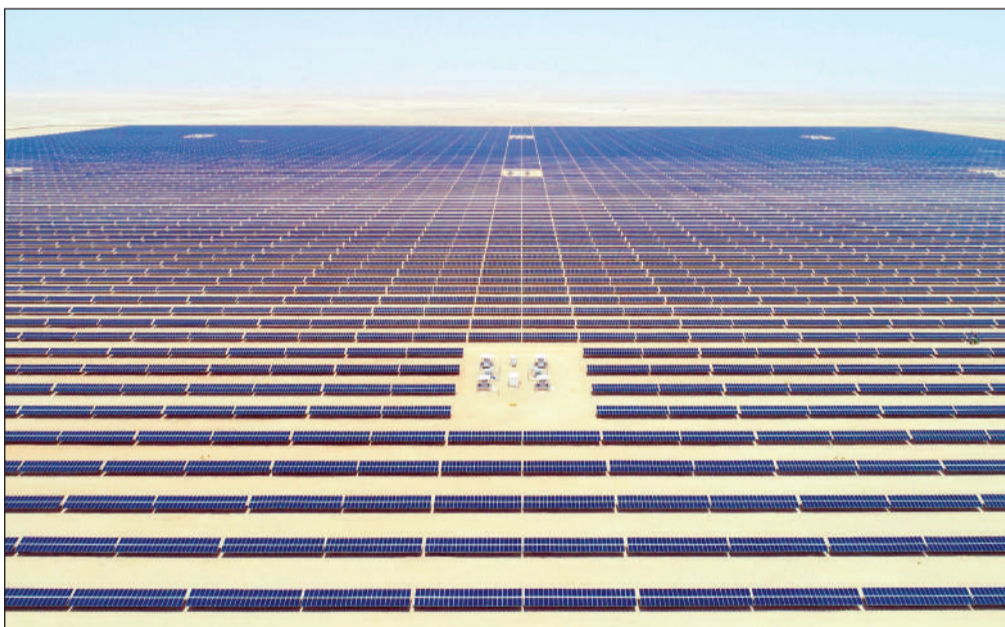
ECONOMIC DIVERSIFICATION & JOB CREATION

One of the core goals of Oman's green hydrogen strategy is economic diversification. By onshoring the supply chain and developing downstream industries, Oman aims to create long-term, sustainable jobs and reduce its reliance on oil and gas revenues.

The development of a green hydrogen sector is expected to spur growth in related industries such as green steel, ammonia production, and



Oman is driving green hydrogen production for net-zero



The Amin solar park in Oman ... 1,500 sq km of land has been earmarked for green hydrogen

renewable energy technology manufacturing.

Oman's commitment to localisation is evident in its strategy to integrate local content requirements and incentivise domestic sourcing.

This approach not only boosts the local economy but also ensures that the benefits of the green hydrogen transition are widely shared among Omani businesses and citizens.

ENVIRONMENTAL & GLOBAL IMPACT

Oman's foray into green hydrogen is a critical component of its broader strategy to achieve net-zero carbon emissions by 2050.

By replacing fossil fuels with green hydrogen in various sectors, Oman can significantly reduce its carbon footprint and contribute to global climate goals.

The hydrogen produced in Oman will primarily cater to export markets in Europe and Asia, regions that are keenly pursuing decarbonisation.

The potential for green hydrogen to transform industries such as transportation, shipping, and heavy manufacturing cannot be overstated.

Hydrogen's versatility as a clean energy carrier

makes it an ideal solution for sectors that are challenging to electrify, thus playing a crucial role in the global energy transition.

Oman recognises the importance of innovation and capability development in achieving its green hydrogen goals.

The country is investing in research and development to enhance the efficiency of hydrogen production technologies and to explore new applications for green hydrogen.

Education and training programmes are being developed to equip the local workforce with the skills needed to operate and maintain advanced hydrogen technologies.

Hydrom's role extends to coordinating with various stakeholders, including international developers, technology providers, and research institutions.

Hydrom was established in 2022 in response to a directive from His Majesty Haitham bin Tarik, Sultan and Prime Minister of Oman, aimed at structuring and expediting the development of Oman's green hydrogen sector. It is fully owned by Energy Development Oman.

This collaborative approach ensures that Oman stays at the forefront of green hydrogen

innovation and can adapt to evolving market and technological trends.

Oman's green hydrogen strategy is designed to attract foreign direct investment (FDI) and foster international partnerships.

The country's political and economic stability, coupled with its strategic location between Europe and Asia, makes it an attractive destination for global investors.

The transparent auction process and the clear regulatory framework further enhance Oman's appeal as a reliable partner in the green hydrogen sector.

International companies are encouraged to participate in Oman's green hydrogen projects, either as developers, financial partners, or technology providers.

These collaborations are expected to bring in advanced technologies, expertise, and capital, driving the rapid development of Oman's green hydrogen ecosystem.

COMMITMENT TO GREEN HYDROGEN

Oman's commitment to green hydrogen is a strategic component of its broader vision for economic and environmental sustainability.

Mohsen bin Hamed Al Hadhrami, the Under-Secretary of the Ministry of Energy and Minerals, emphasised the critical need for collective action to address the unprecedented challenges posed by climate change.

Oman has made significant strides in its green hydrogen journey. Over the past year, concepts discussed have matured, leading to the signing of landmark agreements, including one focused on exploring energy storage.

Storage is a vital component for making green hydrogen competitive and viable in the future. Additionally, Oman has signed its sixth green hydrogen project, bringing the total investment in the sector to an impressive \$38 billion.

To sustain this momentum, several key factors are essential. First, developing In-Country Value (ICV) is crucial.

Localising activities within the green hydrogen industry ensures sustainability and promotes social responsibility and business viability. Second, securing offtakers for Oman's

Continued on page 6

The importance of transportation for green hydrogen cannot be overstated



Oman to lead with green hydrogen ambitions

Continued from page 4

green hydrogen output is vital.

This requires collaboration with the global market to ensure that green hydrogen products are delivered reliably, sustainably, and at competitive prices.

PRACTICAL IMPLEMENTATION

The practical aspects of implementation are equally important. The manufacturing of equipment such as wind turbines, solar panels, and electrolyser modules needs to begin by 2027-2028.

This necessitates access to resources at scale and readiness from industry, government, and investors. Balancing green energy costs with affordability is a critical challenge.

Collaborative efforts between governments and industries are needed to address inefficiencies, waste, and policy shortcomings.

Technology plays a pivotal role in driving the transition, supported by access to critical minerals.

Oman has been modernising its mineral sector, focusing on digitalisation of data and introducing high standards for health, safety, and environment (HSE).

With the target of producing 1 million tonnes of green hydrogen per year by 2030, Oman faces potential challenges. The simultaneous progress of multiple projects could strain construction capabilities, labor resources, and logistical infrastructure.

To navigate these complexities, the Ministry is creating a dedicated project delivery unit. This unit will anticipate potential hurdles and implement pre-emptive solutions, ensuring adequate transportation infrastructure, skilled labor, and regulatory compliance.

ENERGY EFFICIENCY & MARKET LIBERALISATION

Energy efficiency is a low-hanging fruit that supports the decarbonisation drive. The regulatory framework governing the electricity market is being reviewed to enable greater renewable energy contributions.

The liberalisation of the market will facilitate the integration of renewable energy into the grid, supporting the decarbonisation journey.

Oman is exploring hydrogen production



Oman has made a total of \$38 billion investments in hydrogen projects

across green, blue, and white hydrogen. Governance structures for green hydrogen are mature, while blue hydrogen is being assessed as part of the CCUS framework.

The country is also exploring carbon capture, utilisation, and sequestration as a pathway in its orderly transition.

To ensure compliance across different energy verticals, Oman is formulating guidelines for certification standards.

This involves collaboration with government entities, private sector elements, and international organisations.

The Oman Sustainability Centre will oversee these efforts once established. Oman anticipates challenges related to supply, demand, and the intricacies of the supply chain.

Market regulations at the import end, such as the European Union's Carbon Border Adjustment Mechanisms (CBAM), set high standards. Alternatives like a "book and claim" system

could benefit landlocked nations, facilitating decarbonisation.

The Ministry of Energy and Minerals is working on an energy model that considers primary energy resources across Oman.

This model articulates and simulates different scenarios, including the impact of green hydrogen on job creation, the primary energy mix, and total greenhouse gas emissions.

Collaboration with key stakeholders has been crucial in formulating these scenarios. Securing ample land for green hydrogen development is a priority. Oman has obtained 65,000 sq km of solar and wind-rich acreage.

Offshore sites are also being examined for inclusion in renewable energy and green hydrogen projects. Collaboration with other entities, such as the Oman Investment Authority (OIA), supports these efforts.

Hydrom has witnessed significant progress in planning and orchestrating Oman's green hy-

drogen industry.

With two successful auction rounds of land blocks completed, Hydrom is also focusing on common infrastructure and localisation opportunities.

The creation of a dedicated entity, provisionally named 'InfraCo,' will oversee shared infrastructure, including transportation corridors and utilities. Hydrom is engaging national champions like OQ Gas Networks, Oman Electricity Transmission Company (OETC), and Nama Water Services to support the development of the green hydrogen industry. A three-phase strategy has been outlined to ensure the infrastructure is operational by mid-2029.

LOCALISATION & MANUFACTURING

Oman is keen on localising manufacturing, operations, and maintenance across the green hydrogen ecosystem. This includes potential partnerships with global energy technology giants like Siemens Energy to develop a domestic electrolyser manufacturing facility. Investors are encouraged to establish manufacturing facilities in Oman, leveraging the country's strategic advantages.

OQ Alternative Energy (AE) is a significant player in Oman's green hydrogen push, with stakes in three mega projects.

These projects, totaling over 30 GW of renewables, are expected to contribute significantly to Oman's hydrogen production targets by 2030. The company's focus is on achieving bankable offtake and addressing transportation challenges for green hydrogen derivatives.

CONCLUSION

Oman's strategic vision for green hydrogen production reflects a commitment to sustainability and economic growth.

Through collaboration, strategic planning, and leveraging its natural resources, Oman is poised to become a global leader in green hydrogen, driving the transition to a low-carbon future.

As Oman continues to implement its strategy and attract international collaboration, it sets a powerful example of how nations can effectively transition to a green economy while securing long-term economic and environmental benefits.

Reliable pipeline protection with J22 moisture analyzer

In comparison to traditional techniques of moisture measurement, the Endress+Hauser J22 moisture analyzer offers continuous, reliable moisture measurement for increased safety and asset integrity, Anand Jeevakaruniyam, Business Development Manager, Optical Analysis, tells **OGN**

ONE of the main reasons for pipeline explosions, when natural gas is transported through pipelines to downstream industries, is the presence of moisture.

When moisture condenses inside the pipeline, it may combine with hydrogen sulfide (H₂S) and carbon dioxide (CO₂) to become more acidic.

This causes pitting inside the pipeline, damaging it and other downstream equipment over a period. Hence, one of the critical processes before the natural gas is transported through pipelines is removal of moisture.

Figure 1 shows the internal corrosion in the pipeline which is mainly due to the water molecules combining with H₂S and CO₂.

The moisture in the pipeline is not only monitored for the protection of pipeline and assets, but also to maintain the quality of the natural gas being transported as the presence of moisture will always lower the heating value of natural gas.

Traditionally, the moisture content is monitored using various technologies, such as aluminum oxide, quartz crystal micro-balance, silicon sensors, etc. All these techniques have limitations in providing a reliable measurement.

In most of the cases, the moisture measurement using these technologies misleads the operator, ending in taking wrong decisions.

Another challenge while using the traditional techniques is the presence of the contaminants such as methanol, glycol, amines, H₂S, chlorides or mercury, which affects the measurement performances, as they are primarily a contact-based measurement, that is, natural gas along with the contaminants will be in contact with the sensor and the detector to provide the measurements.

Contact-based techniques usually results in drift, poisoning the sensor, requiring frequent calibration, sensor replacement, etc. Hence the traditional techniques are highly unreliable.

RELIABLE SOLUTION FOR MOISTURE MEASUREMENT

Endress+Hauser has been in the field for more than 20 years providing TDLAS (Tunable Diode Laser Absorption Spectroscopy) based Gas analyzers to measure the Moisture in Natural Gas. J22 Moisture analyzer is of extractive type, non-contact, continuous measurement, ensures the operational safety with high plant availability. These high-quality analyzers are best-in-class for meeting gas quality specifications. In doing so, J22 TDLAS gas analyzers



Jeevakaruniyam ... safety and asset integrity focus

increase human safety and asset integrity by helping to prevent pipeline corrosion, hydrate formation, and risk of explosion.

PRINCIPLE OF OPERATION

The design consists of the laser diode and a detector at one end in a compartment (Figure 2), which is completely isolated by a sapphire glass window.

The laser diode is tuned to produce a specific wavelength of light with a narrow bandwidth into the flow cell, which hits the flat mirror at the far end and goes back to the detector.

The photons emitted by the laser source interacts with the gas molecules to provide various absorption spectrum, which is detected by a detector.

The analyzer selects the interference-free absorption peak to provide the concentration of moisture.

The laser light travels fast and is continuous within the flow cell ensuring fast updates of measurement.

The pressure sensor employed in the flow cell compensates the measurements for the pressure variations.

The extracted sample gas with the fast loop line, from the pipeline, continuously flows through the flow cell to have the true representation of the sample in the process to provide real time moisture measurement.

The entire design and measurement are of non-contact type, hence there is no drift and the requirement of field calibration is eliminated.



Figure 1 ... internal corrosion in a pipeline

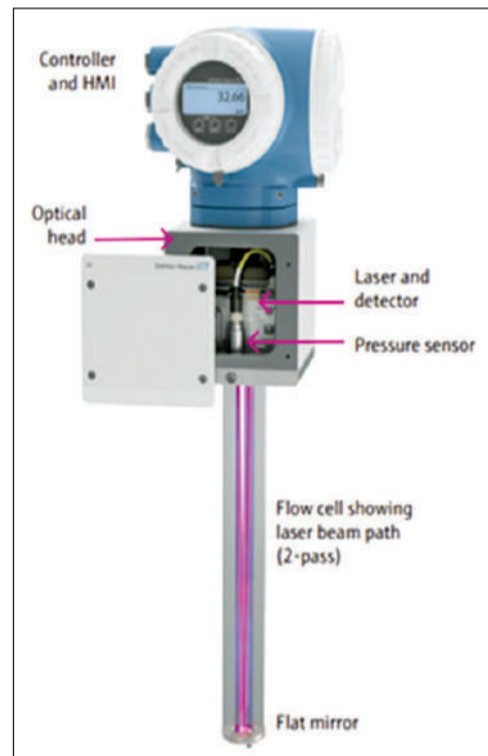


Figure 2 ... principles of operation of the J22

The TDLAS technology doesn't affect due to the presence of the contaminants.

The table in Figure 3 highlights the comparison of contaminants versus moisture measuring technologies.

It shows the J22 TDLAS moisture analyzer measurement is unaffected due to the presence of the contaminants in the natural gas.

FIELD INSTALLATION

Smaller in footprint (Figure 4), the J22 analyzer with the sampling system provides various options for field installations as the analyzer is certified for Zone 1, rated for 60 deg C ambient.

The analyzer can be installed on a field rack with a simple sunshade or on a flat surface in the field without requirement of any air-conditioning shelters or vortex cooler.

With no moving parts, less maintenance, minimal utilities, the analyzer ensures highest availability with lower Opex.

ADVANCED DIAGNOSTIC FEATURE

The J22 Analyzer employs Heartbeat technology (Figure 5), which continuously monitors the analyzer electronics and the spectroscopy for its functionalities.

It provides four levels of alarm category, for easy diagnostics. It also provides the verification report as and when required, containing valuable information for process optimisation and predictive maintenance.

CONCLUSION

The natural gas industries are looking for a reliable moisture measuring technique, to meet the needs of robust, reliable, drift free, fast response, ease of field installation, and less maintenance.

With immense experience in the field of providing TDLAS based analyzers for the natural gas industries, the Endress+Hauser J22 analyzer meets all the demands and offers quality measurement with maximum availability, ensures pipeline protection and asset integrity.

Gas phase contaminant	Al2O3	P2O5	Quartz Crystal	Chilled Mirror	TDL Sensor
Methanol	▶	▶	▶	▶	✓
Glycol	▶	▶	▶	▶	✓
Amine	▶	▶	▶	▶	✓
Mercury	●	✓	✓	✓	✓
Hydrogen Sulphide	●	▶	▶	●	✓
Hydrogen Chloride	●	▶	▶	●	✓
Chlorine	●	▶	●	●	✓
Ammonia	●	▶	●	●	✓

✓ = Analyser unaffected
 ● = Can cause permanent damage to sensor
 ▶ = Can cause slow or inaccurate readings

Figure 3 ... comparison between contaminants versus moisture measuring technologies



Figure 4 ... J22 installation with comparatively small footprint



Figure 5 ... Heartbeat Technology continuously monitors the analyzer electronics and spectroscopy

OQ's \$245m project to enhance South Gas Grid

OQ Gas Networks is enhancing Oman's South Gas Grid with a \$245 million project involving the installation of two loop lines to increase capacity and efficiency, with 90 per cent completion and a targeted finish by Q4 2024



The construction of new loop lines aims to boost capacity and will aid OQ Gas Networks in meeting future gas demands

By ABDULAZIZ KHATTAK

OQ Gas Networks, a leading gas infrastructure company in Oman, has embarked on a significant endeavour to enhance its South Gas Grid.

The project, dubbed the South Grid Debottlenecking, Phase 2, involves the installation of two extensive loop lines aimed at increasing the grid's capacity and efficiency.

This ambitious initiative, with a substantial revised budget of \$245 million, reflects OQ Gas Networks' commitment to strengthening Oman's energy infrastructure and meeting the growing demand for natural gas in the region.

PROJECT OVERVIEW

The main contractors tasked with the execution are Elecnor and Gulf Petrochemical Services, both renowned for their expertise in gas and pipeline infrastructure.

The project also involves several sub-contractors, including Larsen and Toubro for electrical and automation services, Intelc for LV and control systems, and Point B Services Engineering Technology for pipe coating services.

The South Grid Debottlenecking project is divided into two primary loop lines:

- **Loop 1:** A 32-km, 32-inch NPS natural gas pipeline situated in the Hubara area, stretching between BVS-09 and BVS-10.

- **Loop 2:** A more extensive 175-km, 32-inch NPS natural gas pipeline running from Thumrait to Salalah, connecting BVS-17 to the Raysut terminal.

The project involves comprehensive work, including pipeline installation, trenching, welding, coating, and integration with existing infrastructure.

The scope also covers the construction of new block valve stations, pressure control systems, a leak detection system, and various civil, electrical, and telecom works.

PROJECT TIMELINE & PROGRESS

The project was first announced in Q1 2020, with the tender for the engineering, procurement, and construction (EPC) contract issued shortly after.

The evaluation of technical and commercial proposals took place throughout 2020, leading to the awarding of the EPC contract to a joint venture of Elecnor and Gulf Petrochemical Services in February 2021.

In April 2021, ILS completed the transportation of the third pipes shipment, marking a crucial logistics milestone with a total of 4,452 pipes delivered to the project site.

Then in October 2021, pipe stringing works commenced, setting the stage for the subsequent phases of the project.

In February 2022, Point B Services Engineering Technology was awarded a contract to provide concrete weight coating for the pipeline, ensuring durability and stability.

Throughout 2022, significant progress was made. This included the transportation of all 32-inch line pipes in May 2022 to the project site, and pipeline fabrication was well underway.

In July 2022, pipeline installation progressed at full swing, with Elecnor handling fabrication and GPS managing valve supply and installation.

And in October 2022, Intelc successfully completed the Factory Acceptance Test (FAT) on LV Switchboards, and pipeline welding and lowering into the trench continued.

By 2023, the project had reached critical stages. In March 2023, Elecnor celebrated the completion of 200 km of automatic welding using the electore automatic welding system (EAWS), a testament to the project's technological sophistication.

In June 2023, Point B Services Engineering Technology completed over 12 km of concrete weight coating, further advancing the project's physical infrastructure.

As of June 2024, the project is 90 per cent complete, with Loop Line 1 fully finished. The final stages involve rigorous testing and quality assurance to ensure the new pipelines meet all safety and performance standards.

The project is on track for completion by Q4 2024, marking the end of a significant phase in Oman's energy infrastructure development.

CHALLENGES & ADAPTATIONS

Initially estimated at \$150 million, the project's budget was revised to \$245 million. This increase reflects the complexities and unforeseen challenges encountered during execution, including the need for additional resources, advanced technology, and extended timelines to ensure the highest standards of safety and efficiency.

The project faced several technical and logistical challenges, from transporting massive quantities of pipes to coordinating multiple contractors and sub-contractors.

The use of advanced technologies such as the EAWS for automatic welding and comprehensive testing procedures underscored the project's commitment to quality and innovation.

STRATEGIC IMPORTANCE

The South Grid Debottlenecking project is pivotal in enhancing the capacity and reliability of Oman's natural gas infrastructure.

By alleviating bottlenecks and expanding the grid's capacity, OQ Gas Networks aims to ensure a stable and efficient supply of natural gas, critical for both domestic consumption and industrial use.

This project is not only a technical and engineering achievement but also a strategic investment in Oman's economic growth.

By ensuring a reliable supply of natural gas, the project supports the development of various sectors, including manufacturing, power generation, and petrochemicals, driving economic diversification and sustainability.

OQ Gas Networks has placed significant emphasis

on environmental and safety considerations throughout the project's lifecycle.

The implementation of a pipeline leak detection system (LDS), advanced coating technologies, and rigorous testing procedures are all part of a comprehensive approach to minimizing environmental impact and ensuring the safety of both the infrastructure and the surrounding communities.

Upon completion, the South Grid Debottlenecking project will serve as a foundation for further expansions and upgrades.

OQ Gas Networks plans to continue enhancing its infrastructure to meet future demands and support Oman's long-term energy strategy.

The project has showcased the potential of technological innovations in pipeline construction and management.

The successful implementation of the EAWS and other advanced systems sets a precedent for future projects, highlighting the role of technology in achieving efficiency and reliability. By collaborating with international and local contractors, OQ Gas Networks has reinforced its commitment to regional cooperation and knowledge sharing.

This collaboration not only enhances the project's execution but also contributes to the overall development of expertise and capabilities within the region.

CONCLUSION

The South Grid Debottlenecking, Phase 2, project is a landmark initiative for OQ Gas Networks and Oman's energy sector.

With its completion on the horizon, the project stands as a testament to the company's dedication to excellence, innovation, and strategic growth.

As OQ Gas Networks continues to drive forward with its ambitious plans, the successful execution of this project marks a significant milestone in the journey towards a robust and sustainable energy future for Oman.