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OIL & GAS NEWS

# OMAN REVIEW



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The Sultanate has made significant progress in oil and gas exploration and production, with successful award of contracts even during the pandemic while at the same extending its gains from renewables, writes Abdulaziz Khattak

# OMAN RIDES ON WAVE OF JUMP IN OIL OUTPUT

OMAN has seen a substantial jump in both its overall hydrocarbons output and its consumption thereof. The Sultanate's oil production stood at 347.94 million barrels until the end of December 2020, compared with 354.39 million barrels a year earlier.

Condensate production rose by 45.2 per cent to touch 69.10 million barrels. However, crude oil production was down by 9.1 per cent at 278.84 million barrels, according to the National Centre for Statistics & Information (NCSI).

Last year, Oman's production averaged 950,700 barrels per day (bpd) of crude oil until December-end, compared to 970,900 barrels in 2019. Meanwhile, its exports during the period stood at 287.04 million barrels of crude compared to 310.33 million barrels in 2019, representing a 7.5 per cent fall.

The Sultanate is the Middle East's largest non-Opec oil and natural gas producer, and is economically greatly dependent on hydrocarbons just like its neighbours. As such, the country recorded a budget deficit of OR751 million ($2 billion) in Q1 2021 ($2 billion), due to a 30 per cent decline in revenues caused by the dual shock of the Covid-19 pandemic and oil price slump.

Oil activities in the quarter contracted by 20.6 per cent, reaching OR1.9 billion, while natural gas activities decreased by 10.4 per cent to reach OR320.8 million.

In 2021, oil exports accounted for the bulk (57 per cent) of total export revenues. Exports most wen to Asia, with China being the largest importer, followed by Japan, India and South Korea.

And although the Sultanate has a long-term goal of creating a more diversified economy as set out in its Vision 2040), oil and gas's share of revenues is forecast to grow 14 per cent during the period of 2020 to 2027.

In recent years, Oman has attracted several international majors, including Shell, BP, Thailand's PTTEP and Malaysia's Petronas to invest in upstream projects, mostly natural gas. Others like Occidental, Total and Partex are also undertaking oil and gas activities in Oman.

Most of Oman's oil and gas activity is onshore with some offshore as well.

Enhanced oil recovery (EOR) techniques, using natural gas, have been fundamental in driving the recent increases in crude production.

The country's fuel consumption has grown at an annual 10 per cent over the last five years, driven by higher demand from the industrial sector and power producers. Although the country currently enjoys surplus gas, it's still beefing up supplies through award of new exploration contracts.

Oman also hopes to see a new pipeline project with Iran go ahead if talks between the US and Iran to ease sanction succeed. The proposed pipeline will run from the giant South Pars gas field in Iran to Sohar in the north of Oman.

OQ8, previously called Duqm Refinery, stands more than 83 per cent complete

Although the country has held steady in the face of the pandemic, it has had some setbacks. Both the pandemic and falling prices have forced the delay of several ongoing downstream projects, including, the Liwa petrochemical plant project, its ammonia plant expansion and an LPG extraction project at Salalah, each of which was originally due for production start-up in 2021, state-owned integrated hydrocarbon firm OQ said

## OIL

Oman has made steady headway in several crude oil projects, both in exploration and refining.

A significant progress was reported on Oman's 230,000 bpd Duqm refinery project, where construction work crossed 83.4pc by the end of May 2021.

The refinery, which will produce primarily diesel, jet fuel, naphtha and LPG, is said to be on track for commissioning in late 2021 or early 2022. However, a slowdown cannot be ruled out in the event of a future drop in oil prices.

With regard to production, a key milestone in production was reached in May in the delivery of the Yibal Khuff project, which is being developed by Petroleum Development Oman (PDO), the country's main oil and gas producer.

When complete, it will produce around 21,900 bpd, the contractor, Petrofac said, more than double the previously estimated 10,000 bpd, in addition to 6.1 million cu m per day of gas.

Petrofac said hydrocarbons had begun flowing into the $1-billion mega project's central processing facilities, an Oman Observer report said.

Meanwhile, Oman's Ministry of Energy and Minerals signed a new exploration and production with Majan Energy to develop Block 71, which covers 282 sq km. The company will conduct geological and geophysical studies, drill appraisal and pilot wells and use EOR to evaluate and produce the ultra-heavy crude in Habhab field.

And at Mafraq Block 70 oil field, contractor Maha Energy announced the recovery of up to 25 million barrels of oil. The onshore block covers 639 sq km and includes the shallow undeveloped Mafraq heavy oil field.

Separately, international energy firm Tethys Oil announced investments worth $47 million this year in expanding its upstream oil and gas assets in the Sultanate. The company has licenses to several blocks including 3, 4, 49, 56 and 58, making Tethys Oil one of the largest concession holders in the Sultanate in terms of acreage (55,000 sq km).

Furthermore, Italian company Eni is preparing to drill a second well in the offshore Block 52 after the first returned dry. The company also has interests in Blocks 47 and 77.

## GAS

Oman has recorded a substantial increase in

*Continued on Page 6*

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gas production from Block 61. Operator bp said production reached 1.5 billion cu ft per day from the 1 billion cu ft per day. The company also plans to increase gas condensate output from Block 61's two main reservoirs, Khazzan and Ghazeer.

With an estimated 10.5 trillion cu ft of recoverable gas resources, Block 61 is one of the Middle East's largest tight gas developments and has the potential to deliver 35 per cent of Oman's total gas demand.

Additionally, bp said a 500 million cu ft gas project at Ghazeer field is near completion, adding installations are 99 per cent ready for the start of production.

Oman currently consumes over 470 million boepd of natural gas. The use of gas in industrial projects, such as the Oman LNG and Qalhat LNG projects, rose by 3.6 per cent over 2018 to reach 28,751 million standard cu m (MSCM) at the end of December 2019.

The country's LNG exports have been at full capacity from 2018-2020, averaging about 12 bcm per year. After de-bottlenecking, this is expected to increase to 14 bcm per year.

Oman exports LNG through liquefaction facilities based near Sur, a coastal town about 200 km south east of Muscat, with the majority of exports going to Japan and South Korea.

South Korea's Korea Gas Corporation (KOGAS) has a 25-year contract with Oman LNG for 4 million tonnes per year. The contract is due to expire in 2025.

In June, OQ announced the commissioning of one of the country's vital energy extraction projects, the OQ Liquefied Petroleum Gas (OQ LPG) facility, at Salalah Free Zone in the Dhofar Governorate.

Built with a total investment of $826 million, OQ LPG is the first of its kind gas treatment project in Oman to extract LPG and condensate from OQ's Gas network.

Block 61 gas field has reached full production capacity

The plant will process approximately 8 MSCM per day of lean gas to produce 304 kilotons per annum (KTA) of LPG products composed of 155 KTA of Propane (C3), 111 KTA of Butane (C4), and 38KTA of Condensate (C5+).

In other developments, OQ subsidiary OQ Gas Networks signed an assets transfer agreement with the Public Establishment for Industrial Estates (Madayn). Accordingly, Madayn will transfer the ownership and operations of its gas distribution networks to OQ Gas Networks.

The agreement is in line with Oman's Vision 2040 aimed at unifying national efforts and in-country assets to boost the efficiency of the service sector.

OQ Gas is the largest firm of its kind in the Sultanate, with supply pipelines stretching over an area of more than 4,000 sq km, including to five key industrial estates in Sur, Sohar, Rusayl, Nizwa and Raysut.

## RENEWABLES

In its Vision 2040 roadmap, Oman has stressed that the "national economy and society must no longer rely on non-renewable resources", while the National Energy Strategy aims to derive 30 per cent of electricity from renewable sources by 2030.

In line with these goal, Oman has embarked on several projects to generate electricity from renewables. These include a wind farm in Dhofar; two solar IPPs in Manah; 11 solar-diesel hybrid facilities; and the Sahim initiative to install small-scale solar panels on residential and commercial buildings, among others.

Last month, the 100-MW Amin Solar Photovoltaic Power Plant, Oman's first utility-scale PV power plant with one of the lowest tariffs in the world, kicked off commercial operations three months ahead of schedule.

The $94-million plant is located 210 km northeast of Thumrait and will operate under a 23-year power purchase agreement (PPA) with PDO. It is expected to generate electricity enough to supply 15,000 homes per year and offset over 225,000 tonnes of carbon dioxide (CO2) emissions.

PDO is also planning a new 100-MW renewables-based independent power project (IPP) in the northern Block 6 concession.

The proposed solar plant will feature a country-first large-scale battery storage component (30 MW) designed to ensure consistent and sustained power supply overcoming intermittency challenges typically associated with solar or wind based generation.

Once operational, the plant will save up to 300,000 tonnes of CO2 emissions annually.

Separately, OQ and EnerTech, a Kuwait government-backed clean energy investor and developer, has announced the development of an integrated green fuels mega project in the country.

The project will consist of 25 GW of renewable solar and wind energy at full capacity to produce millions of tons annually of zero-carbon green hydrogen, which can be used locally, exported directly, or converted into green ammonia for international export.

# Petrofac leads in building ICV, investing in Omani youth

The commitment to nationalisation has been key to Petrofac's successful project delivery, while its training approach has accelerated the interest of Omani youth to work in the energy sector, key company officials tell ***OGN***

PETROFAC has a long and rich history in the Sultanate of Oman, which remains a key focus for the business and is one of the countries where the breadth of its service capabilities is employed in support of clients and industry.

Having launched in Texas 40 years ago with just 25 employees, Petrofac expanded to the Sultanate with its first international business in 1988.

Fast forward over three decades and Petrofac is now a global business with 9,400 employees engaged in the design and build of oil, gas, and renewable energy infrastructure. It also operates, maintains and manages assets, and trains personnel within the sector.

Al-Gheilani and Debattista ... leading Petrofac in Oman

### IN COUNTRY VALUE

During the 33 years Petrofac has been serving Oman's oil and gas industry, it has opened an engineering office in Muscat with a capacity of 400 people; invested $30 million in a technical training centre – Takatuf Petrofac Oman (TPO) - and developed a highly capable workforce with 30 per cent Omanisation in the Sultanate.

Faisal Al-Gheilani, Petrofac's In Country Value (ICV) Manager in Oman, says the support of the local economy and commitment to nationalisation has been key in successfully delivering on all of their projects, in the region and beyond.

"We have around 1,000 staff employed directly in Oman, 30 per cent of whom are nationals and have been successful in exceeding targets at the project level. Wherever Petrofac operates, we are committed to developing local capabilities, employing nationals, training the workforce of tomorrow, developing client and subcontractor skills, and investing in supply chain," he says.

According to Al-Gheilani, this approach has accelerated the interest of Omani youth to work in the sector. "Petrofac has well-established training and organisational facilities, along with development programmes for the graduates of our in-house clients through tools such as competency frameworks, development frameworks, and various agendas including talent management and succession planning.

"We also support graduate trainees from engineering streams of prominent universities with key strategic significance to our operating locations. This includes around 60 Omani engineers from our recent graduates' entry programmes who are all employees of Petrofac."

Al-Gheilani says this policy of deep engagement has resulted in "a deep understanding of industry needs, a collaborative and transparent approach to project development, and $2.5-billion in-country value generated from working with Omani suppliers and contractors".

With this solid base of local expertise, Petrofac has continued to achieve key milestones, despite the wider economic circumstances associated with the Covid-19 pandemic. Several major in-country projects have furthered its growth in the Sultanate. These include the provision of engineering, procurement and construction (EPC) and engineering, procurement and construction management (EPCM) projects, along with operations and maintenance support contracts and national workforce development, training and competence solutions, delivered through Petrofac's technical training facilities.

"A long-term framework agreement (FA) with Petroleum Development Oman (PDO) provides EPCM support services for major oil and gas projects in the Sultanate, says Al-Gheilani, adding, "Projects undertaken through the FA are supported by the Muscat office for technical delivery to ensure sustainable in-country value."

Other recent and ongoing projects include EPC and commissioning for the Phase Two central processing facility at Oman's Khazzan gas field development for BP. Petrofac has also constructed an LPG unit, with associated facilities and storage for the OQ LPG extraction project, together with jetty facilities in Salalah. And it is providing EPC, commissioning, training, and start-up operations for all utilities and offsites at Duqm refinery, located at the port town on Oman's central-eastern coast.

### SUSTAINABLE FUTURE

As Oman looks to boost its energy sector, its future projects market will hinge on foreign investment in its major industrial hubs in Sohar, Duqm and Salalah. Chinese investment will be key as part of its Belt and Road Initiative to benefit from Oman's position on the main East-West shipping alliance.

Petrofac ... 33 years of success in the Sultanate

Also critical will be the development of the Sultanate's Public Private Partnership (PPP) plans to obtain more private sector involvement in the funding, construction, and operation of future projects in the absence of major government capital expenditure.

Further ahead, the outlook is bright despite the current economic challenges. Oman continues to enhance its oil recovery techniques to boost oil production, while pursuing its 'Vision 2040' economic diversification plan, which includes investment in renewable energy infrastructure, to support the expansion of the industry well into the future.

The Sultanate's drive to diversify and develop alternative energies chimes with Petrofac's own ambitions is to become a net-zero company by 2030. "We want to ensure sustainability is fully integrated into our business," says Ian Debattista, Country Manager, Oman.

"To this end, we are implementing an energy transition strategy that supports our clients' lower carbon ambitions, while also working across our own projects to improve energy efficiency. We will continue to target more opportunities in renewable energy infrastructure."

Debattista says this process requires momentum to meet the challenges posed by Climate Change. "We have announced our own net zero targets, which support the principles of the Paris Agreement, and are also aligned with our clients' ambitions as the sector moves to a net zero future. It is the right thing to do, and it is also the key for long-term value creation."

However, he is also confident that the transition is part of a wider story that encapsulates Petrofac's progress since its founding.

"Our experience goes back to 2008, with offshore wind substations that allowed us to build a good position in the market. We are actively expanding our renewable energy portfolio in other areas, including carbon capture and storage (CCS).

"Last year we secured a support contract for the Acorn project, which is on track to establish low carbon energy and CCS infrastructure for the UK. And our focus is also on hydrogen, waste-to-energy, and emissions reduction. We are very much at the heart of the energy transition and well placed for the future, taking advantage of the whole skills base we have built up over 40 years across many different sectors including renewables," says Debattista.

### THE TECH TRANSITION

This forward-thinking approach is predicated on Petrofac's approach to the digital transformation of the entire energy sector. All Petrofac projects are driven by a recognition that industry conventions must be challenged in order to innovate, improve, and stay ahead. Deep know-how is being combined with the latest technology to deliver more efficient outcomes.

Digital initiatives that have propelled Petrofac into the future include a Computer Vision and Knowledge Mining system, which processes non-intelligent information through machine learning techniques, such as natural language processing and neural networks, allowing Petrofac to build models that power AI–based applications.

A Material Life Cycle Management and Supply Chain Control Tower system tracks the lifecycle of material from the engineering design stage, to supply chain, construction, until the handover of a completed facility, which is particularly useful in supply chain management.

Debattista says the ability to process information quickly through data management systems has enhanced efficiency and accuracy, providing useful insights for more effective decision making. "New technologies combined with data-driven insights can transform operations. Digital systems improve workforce productivity, boost efficiencies, and save costs in project deliveries. In addition, technology can boost health and safety performance and lower risks."

As technology continues to evolve, Petrofac's mission remains the same: enabling its clients to meet the world's evolving energy needs. Debattista says this makes him confident for the future of the energy industry both globally and in Oman.

"Looking forward, increased integration of technology will not only transform business operations in the region, but it will also enhance transparency and flexibility, giving way to newer business models," he concludes.

# Opal heralds era of professional sector associations in Oman

The industry's trust in Opal has grown manifold with the number of member companies having peaked a record high in its 24-year history, Abdulrahman Al-Yahyaei, CEO of Opal, tells ***OGN***

THE benefits of having sector associations far outweigh the downsides of not having any representation at all, something the Oman Society for Petroleum Services (Opal) has shown to be true when it lent support to oil and gas companies in the Sultanate of Oman at a time the world was reeling from a raging pandemic.

By sheer hard work, Opal has written an impressive history. Now other sectors in the country are approaching it to learn from its experience and initiate associations of their own.

The association, funded mostly by member companies and some support from the Ministries of Energy and Minerals, and Labour, has led the oil and gas industry in standardisation reforms, training and licensing, and industrial support. It's the oil and gas industry's strongest voice at all levels.

The industry's trust in Opal has grown manifold with the number of member companies having peaked a record high in its 24-year history.

Opal has announced it will soon be called the 'Oman Society for Energy and Minerals', representative of its growing scope that encompasses the mining sector. The name change is pending before the relevant authorities. However, the association has decided to keep the 'Opal' brand name.

Below are excerpts of a video interview, Abdulrahman Al-Yahyaei, CEO of Opal, gave Abdulaziz Khattak of ***OGN*** about the association's achievements and what lies ahead for it.

**What are the milestones Opal achieved during the pandemic in its support for the oil and gas industry?**

The year 2020 was a golden year for Opal. We saw how vital the role of professional associations is in societies, especially in times of crisis like this pandemic. During this course, we worked closely with the authorities and oil and gas companies to coordinate between each other, and initiate measures to ensure the safety of the workforce, while at the same ensuring the flow of oil and gas wasn't affected.

Last year, when international travel came to a standstill, we ran more than 133 chartered flights. On one hand, we repatriated more than 27,000 expat workforce back to their countries, while on the other, we managed to secure approval for the return of more than 11,000 critical employees to Oman to support their organisational operations.

This was done at a time when many projects had either stalled or were completed, leaving behind a large idle force. Keeping this huge number in the country could have cost the companies dearly while being a health risk at the same time.

Through Opal's efforts, we saved the industry close to $60 million had each operating company arranged their own charter flights. More than 200 companies benefited from the scheme.

Through the formation of two Covid-19 committees, Opal aimed to mitigate the spread of Covid-19 in the concession areas and in the fields.

We met almost every week with operating companies to relay feedback from the Ministry of Health and the Supreme Committee, and vice versa. A major requirement by the Supreme Committee in Oman was to have 25 per cent of the camp population quarantined. This meant building capacities for quarantine and a financial burden on the companies at a time when business was low.

Upon the requests of our member companies, Opal was able to convince the authorities to reduce that to 15 per cent.

Additionally, a number of guidelines were developed to educate the workforce, including for working from home, and returning back to work. This step saved the sector companies from having to develop their own guidelines, effectively saving them time, effort and money.


Opal's new offices

Al-Yahyaei ... guiding the oil and gas sector

Another of Opal's key achievements was addressing the issues of employees facing layoff. A large number of the sector's workforce, including nationals and expats, was badly affected because of the downsizing of activities. The companies wanted to terminate their contracts.

But since the law bars the termination of national employees, we worked closely with the Ministry of Labour and asked them to give incentives to the private sector companies, including reducing the number of working hours and accordingly reducing salaries, and asking employees to consume their accumulated annual leaves, especially when there was no real work for them.

These measures saved many nationals from being terminated and it was a consolation for the companies as well. In fact, only a total of 7,000 Omani employees out of the 230,000 working in the private sector lost their jobs and which is really a small number considering the situation. For those terminated, we also helped in redeployment.

Furthermore, the Ministry of Labour last year established the Employment Security Fund for the Omani workforce to which employees and employers alike contribute 1 per cent of their salaries. In case of layoff, the individual gets 60 per cent of his average salary for several months.

• Covid-19 vaccination and testing: Opal is working closely with both the sector companies and the Ministry of Health to ensure there are enough testing capacities in the interior of the Sultanate. Many of Opal's member companies contributed financially or donated testing equipment to the ministry to mitigate the risk of the spread of the virus across the concession areas in the industry.

With regard to vaccination, we collected the demand of the number of doses required by the sector's workforce and their families and passed it on to the authorities.

**The number of Opal member companies has reached a record high. How did you manage to gain the trust of companies in the industry?**

A year back we were about 323 members; today we have 447 member companies. That's an increase of almost 35 per cent from last year.

We have hit a record high in terms of membership since the association's establishment 24 years ago. For the first time ever Opal reached 400. We have first-time members as well. Last year, 85 new members joined Opal for the first time. And since the beginning of this year, 38 new members have joined.

And I can assure you that this sudden increase in members is because of the trust they have in Opal.

**Training is one of Opal's core programmes? What is the role of the Sector Skills Unit in this regard?**

In late 2019, Opal was certified by the Ministry of Labour to establish the first Sector Skills Unit (SSU) in Oman. The role of such a unit is to develop national occupational standards and create training programmes revolving around the standards with the purpose of supplying the market with the right trained candidates.

There has always been a gap between graduates supplied and the market's requirements. National occupational standards will help a lot in closing this gap. The ultimate goal of the SSU is to start skill certification and competency cards. So whether you are an Omani or an expat, if you want to pursue a certain job in the oil and gas, you will need a competency card or you can't work there.

So 2019 was the foundation year for the unit. We have worked hard building the unit, and were able to develop eight national occupational standards. We also formed the governance board in addition to four advisory committees, including:

• Operator companies HR committee.
• Contractors HR committee.
• National occupational standards (NOS) committee.
• Training providers committee.

The unit is fully staffed. It has a manager and heads of research and developments, technical training, and NOS departments.

We will be kicking off activities, including skill certification and competency cards, before the yearend.

**What are Opal's achievements for standardisation?**

An important milestone we achieved last year was the implementation of the road safety standard.

In the past, every operating company in oil and gas had its own defensive driving (DD) permit, own DD training, and their own approved In-Vehicle Monitoring System (IVMS) devices. It was just a waste of money.

And despite Opal having developed an industry standard several years ago, it never went into effect. However, we were determined and in the beginning of 2020, we successfully implemented the road safety standard.

Now, there is only one DD permit, one DD driving programme, one roadworthiness assurance standard (RAS) inspection sticker – Opal – and a list of Opal-approved IVMS vendors and devices in Oman. All operating companies adhere to this guideline and standard.

This alone will save the country OR6 million ($15.6 million) every year

**Does Opal have initiatives in renewable energy?**

Yes we do. We are actually supporting a big forum in September this year on hydrogen.

We are also working closely with Ejaad on renewables and energy development – hydrogen in particular. We opened special account a couple of months ago to facilitate the R&D in the hydrogen sector.

**Do you have annual themes?**

We have a theme every year. Last year, it was 'Energy Efficiency'; this year, our theme is 'Duty of Care'.

Through this theme, we hope to create awareness in the workforce about one's responsibilities towards his colleagues, company, customers, country, and the environment.

We are doing this in collaboration with a number of our member companies, such as Shaleem Petroleum, Halliburton, Schlumberger and Abraj Energy Services.

**What is the level of Omanisation in the oil and gas industry? Are Omani women showing interest in joining the industry?**

We have 60,000 Omanis working in the oil and gas industry in various categories. So, for example, 17,000 Omanis work for the operating companies. That's close to 90 per cent Omanisation.

In the oilfield service companies, the total number of Omanis is about 8,000 with an Omanisation rate close to 90 per cent.

In the lead contractors' segment, the Omanisation percentage is between 40 to 50 per cent.

And similarly, we have locals working in other categories in oil and gas, such as construction, logistics, catering, supplies, etc.

With regard to Omani women, we are proud to say that we have many women on the technical side, including Omani women drillers, and senior well design engineers. Opal is itself 51 per cent females and 100 per cent Omani.

For full report, visit www.ognnews.com

The company has been engaged in a number of new investment opportunities in Oman including for the production and supply of green hydrogen, Martin Dworak of Linde Engineering Middle East, tells ***OGN***

# Sultanate excellent location for hydrogen development: Linde

REALISING the need in Oman for high value industrial gases and applications, Linde – the world's largest industrial gases firm in terms of market share and revenue – has built a solid base to serve the Sultanate.

In November 2020, Linde established and started a new operating company in Oman, Linde Gulf Industrial Gases, for the acquisition of air separation assets from Moon Steel Company (MISCO) and the supply of industrial gases to MISCO and the overall market.

"From then onwards, the company has been engaged in a number of new investment opportunities in Oman including for the production and supply of green hydrogen," Martin Dworak, Director Region MENA, Business Development Technology-EPC, Linde Engineering Middle East, tells ***OGN***.

Linde produces and supply gases to refineries, petrochemical and chemical facilities, steel manufacturing, glass manufacturing, electronic fab, etc. Pretty much most of the manufacturing processes requires some industrial gases in one form or another, which Linde typically makes available to the market. Linde also produces and supplies oxygen, a very critical resource in the current Covid-19 pandemic, and associated applications to hospitals.

Linde's unit in Oman

**HYDROGEN**

Linde is a global leader when it comes to technologies and solutions for the production of blue and green hydrogen. Dworak cites hydrogen's key role in decarbonisation and industrial activities including in oil and gas. Additionally, hydrogen is also an excellent gas for energy storage, he adds.

"In general, technologies and applications in industrial gases, including hydrogen, nitrogen and carbon dioxide have a key role to play in optimising processes and lowering the carbon footprint of the related activities."

To help businesses achieve a continuous, safe and reliable source hydrogen, Linde offers the full range of cost-effective and low-emission on-site hydrogen generators.

Offered at every scale, these generators include solutions on basis of steam reforming, partial oxidation, autothermal reforming for the production of green and, associated with carbon capture, blue hydrogen, as well as electrolysis for green hydrogen.

"Each technology has specific advantages and needs to be assessed with the market and specific project," Dworak says.

With regard to decarbonisation, Dworak says the region is committed and is seeing initiatives, partnerships and projects. He finds the Sultanate an excellent location for the development of green hydrogen projects.

**COLLABORATION**

Although gifted with many technologies along the value chain, Dworak believes in collaboration as the way forward in helping the world meet its net-zero goals.

"Partnerships are key as no one has 100 per cent knowhow along the full value chain. Also, financing of pilot and pre-commercial projects can be challenging," he says.

Linde has made public a number of key partnerships, especially in the area of technologies with other global companies, with the view to offer to the market best-in-class solutions to optimise efficiency and accelerate decarbonisation of the petrochemical industry.

# FLEXIM helps operators improve efficiency of EOR activities

Productivity highly depends on comprehensive and effective process control. Carolina Stopkoski and Jörg Sacher from FLEXIM explain how non-invasive ultrasonic flow measurement technology can be used to boost oil production

PRODUCING hydrocarbons requires absolute caution and competence; large quantities of material and energy have to be controlled in a completely safe manner. This makes safety the number one priority.

Safe and efficient operations rely on process control, which relies on effective and accurate measurements. In addition to safety and efficiency, sustainability is another driver for this demand for measurement and control. Environmental concerns mean there are strict regulations on the monitoring of plants and their operations.

According to Carolina Stopkoski, Head of Market Management for Oil and Gas, FLEXIM: "When mature field production starts to decline, operators are forced to re-think how they operate and use new and advanced technologies to extract every drop of their 'black gold' from the ground safely and economically.

"However, one important measure that is often overlooked is the condition and applicability of ageing instrumentation and how it can impact optimisation strategies that rely on real-time data acquisition, such as enhanced oil recovery (EOR)."

As assets mature and reach brownfield status, flowmeters and other process control instrumentation become obsolete and inaccurate. To optimise and validate empirical EOR calculations and models, asset managers and production teams are faced with the need to evaluate the performance, suitability, and applicability of existing instrumentation, identify new required measuring points and process conditions while avoiding process interruptions or defer production at all costs.

Gas flow measurement at remote wells can be challenging

### MEASURING FROM THE SAFE SIDE

Clamp-on ultrasonic technology has always been preferred when the medium being measured is reason enough to avoid opening the pipe, if at all possible. Therefore, it is the method of choice when it comes to measuring precious and hazardous media under the most challenging process conditions and in the harshest environments.

FLEXIM's clamp-on ultrasonic flowmeter system, FLUXUS, is therefore found throughout the entire value chain of the oil and gas industry, from the well to consumers, both in liquid and gas flow applications.

Measuring from the outside of the pipe means measuring from the safe side. Installation and commissioning of an ultrasonic flowmeter does not require opening of the pipe and, therefore, the availability of the plant is unaffected.

Since the transducers do not come in direct contact with the medium, they are not subject to wear and tear. This external measurement works independently of pressure changes in the pipe and does not cause any pressure loss or risk of leakage.

An additional advantage of the acoustic measurement lies in its extreme dynamic range, independent of the flow direction: ultrasonic flow measurement is inherently bidirectional and active even at very low flow conditions.

### DRAWBACKS OF CONVENTIONAL FLOW MEASURING TECHNOLOGIES

Although, nowadays, it is widely accepted that a modern, small smartphone is by far a more powerful tool for communication and information than a head secretary's impressive telephone in the 1970s, it seems that in many industries, the same insight hasn't taken place when it comes to process instrumentation.

In the oil and gas industry, differential pressure (DP) measurements such as orifice plates and venturi tubes are still standard measuring technologies. The first drawback of this kind of measurement is inherent to its measuring principle: It relies on a pressure difference, that is, a pressure loss affecting the efficiency of the plant.

Further, and even more significant disadvantages, are common to all wetted instrumentation: Its installation requires opening of the respective pipe and, therefore, interruption of operation. In addition, wetted instrumentation is subject to wear and tear through abrasion or scaling, leading to measuring drift and causing a high maintenance effort, also affecting the availability of the plant.

### ONSHORE AND OFFSHORE, PORTABLE AND STATIONARY

In many oil and gas applications worldwide, FLEXIM's clamp-on ultrasonic measuring systems have successfully proven their excellent suitability and demonstrated their advantages. Here are some examples:

Gas injection, gas lift metering and optimisation in remote onshore assets can be a challenging task. In most cases, some field instrumentation is available, but it is often outdated and inaccurate and, therefore, not trusted by the operators.

Traditional well testing packages, test and production separators only provide indication of the totalised gas coming out of the oil but provide very little indication of which well to optimise and at what specific gas injection rates net oil production is increased. Therefore, having the means to test injected gas lines during normal operations is imperative.

FLEXIM's hazardous area rated the FLUXUS G608 portable gas flowmeter as the perfect tool for the job for high well count in remote locations where operators are looking to test multiple wells within their gas injection/lift network without having to worry about power supply, weight limitations or having to deploy different pipe size meters to the field.

The FLUXUS G608 portable meter's ease of installation enables operators to start gathering accurate and reliable flow rate data at standard conditions in less than five minutes.

Equipped with two flow channels, inputs for pressure and temperature, an integrated data logger with a serial interface, and a battery life of up to 25 hours; the FLUXUS G608 portable gas flowmeter is the meter of choice for use in challenging environments.

### FLOW SURVEY AND RETROFITTED REPLACEMENT IN GAS LIFT NETWORK

At an offshore field in the South Chinese Sea, production started back in 1970 with 500 reservoirs, more than 300 well strings, 30 platforms/jackets, 5 production separation platform complexes, and 185 offshore pipelines.

Over the years, field reservoir pressure declined, meaning that nowadays upwards of 80 per cent of the existing producer wells are gas-lifted. Six compressors supply lift-gas to 260 gas-lifted wells and, therefore, gas balance and allocation is extremely important.

Historically, gas going into the lifting wells was controlled by the size of the orifices in the downhole operating valve. As the well conditions changed, inappropriate plate sizes caused lifting instability and field operators were not able to optimise the field or validate empirical models. The platforms did not have the means to evaluate the performance of the existing meters and balance gas volumes within the system. Well and field-wide gas-lift optimisation was, therefore, not possible.

"FLEXIM demonstrated the capability and accuracy of its FLUXUS ultrasonic clamp-on flowmeters in various field evaluation trials. Following the positive results obtained during testing, field operators decided to use the clamp-on meters to do a full flow audit of the gas lift network," says Jörg Sacher, Press and Public Relations, FLEXIM.

A list of more than 60 measurement points was drawn up between different platforms. Two sets of portable FLUXUS G608 flowmeters were deployed in conjunction with field technicians to enable simultaneous measurements.

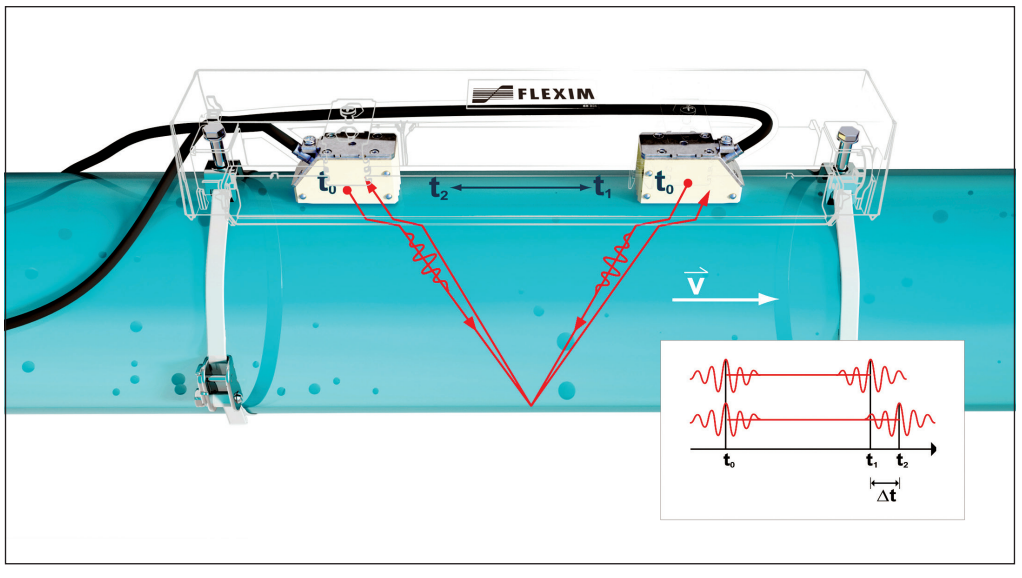
Based on the results of the survey, the operator had evidence that some DP flowmeters had drifted significantly over time causing process settings to be incorrect and resulting in over-injection.

With the new data collected from the flow audit, the operator was now able to better balance their gas lift system and carry out optimisation strategies in individual wells. With, the right dose of natural gas per well, excess gas was then exported for sale, increasing both net oil production and gas sales.

Based on the huge success of the flowmeter survey, the operator now equips the measurement points, previously served with differential pressure meters, with permanent FLUXUS clamp-on ultrasonic flowmeters.

### CONCLUSION

FLEXIM's non-invasive ultrasonic measuring technology delivers convincing solutions to effectively increase productivity. When safety is paramount and downtime is not an option, the best way is to measure from the outside of the pipe.




Non-invasive flow measurement with clamp-on ultrasonic technology according to the transit-time-difference (time-of-flight) principle

Permanent gas flow measurement on an offshore platform