OMAN SPECIAL REPORT

A TECHNOLOGICAL REVOLUTION:

THE OIL & GAS INDUSTRY

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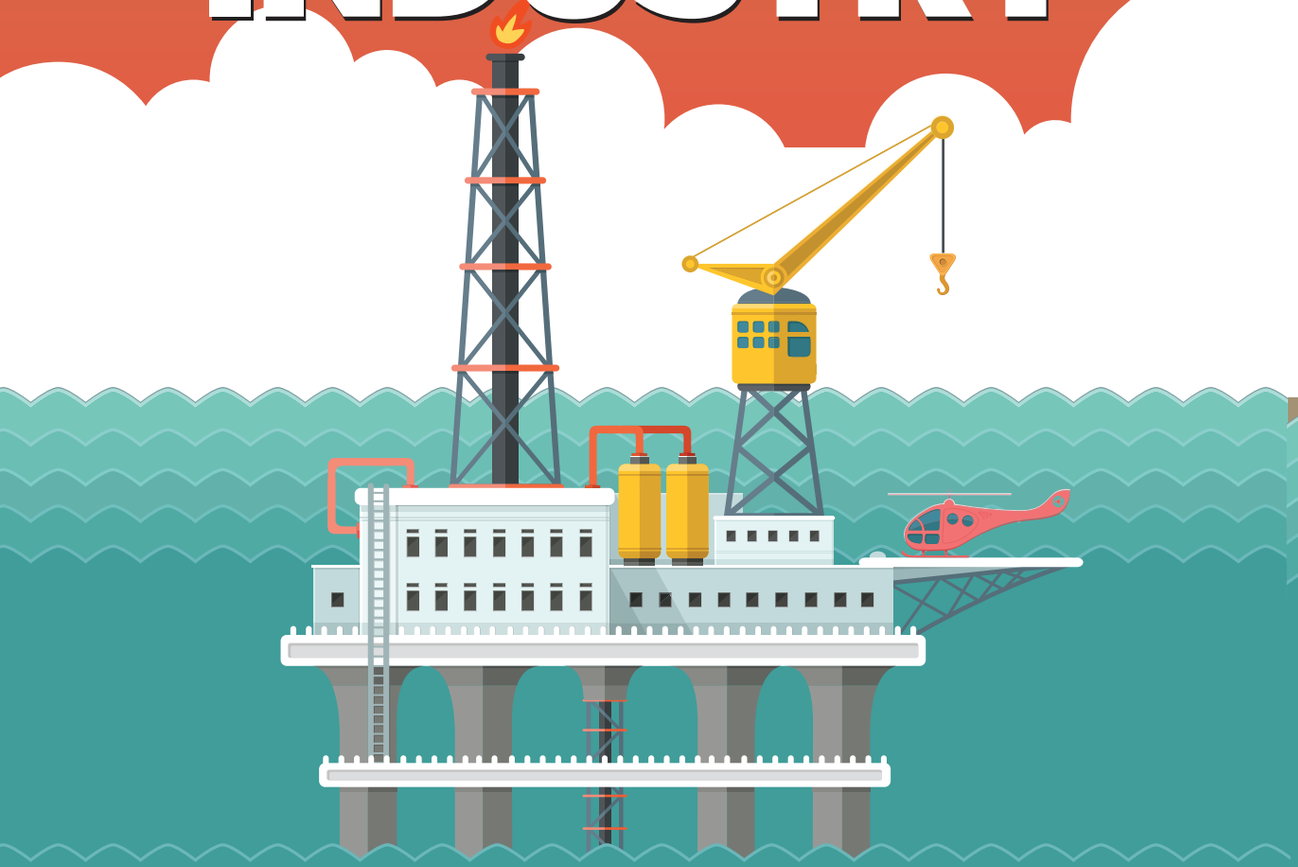
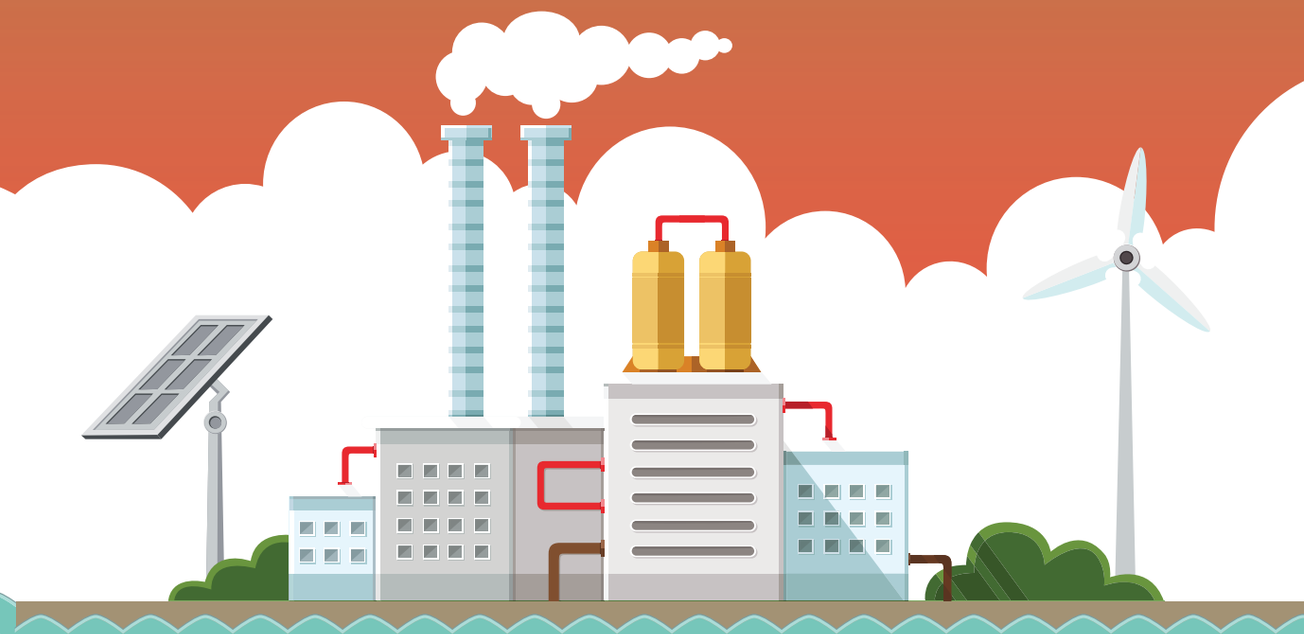
In the global landscape of oil and gas markets, Oman is dwarfed by its Middle Eastern neighbours. This is hardly surprising given that its proven oil and gas reserves are a tiny fraction of those of its peers. However, the country's long-standing investment-friendly policy means it has been able to deploy the latest technologies and not only reverse its oil production decline, but also reach record high production levels. Oman has also been able to tap its unconventional resources, which are trapped in some of the most complex and deepest geological formations known in the global industry.





Adverse Geology

Oman has thrived, despite lacking the geological fortune of its Gulf neighbors.

40
It took almost four decades to strike oil in the sultanate.

1956
The first exploration license was granted in the early 1920s, but oil was not discovered until 1956.

22nd
Oman's proven oil reserves rank 22nd in the world, which is the equivalent to 2% of Saudi Arabia's reserves.

26th
Oman's proven gas reserves rank 26th worldwide, which is equivalent to 3% of Qatar's reserves.

ENHANCED OIL RECOVERY

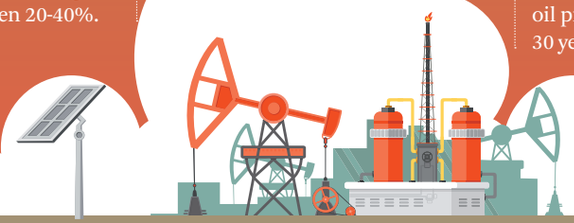
Oman has recovered its oil production trajectory to exceed all expectations in recent years – an impressive turnaround. The government's welcoming attitude to both domestic and foreign investors has encouraged the application of the latest technologies, especially when it comes to squeezing more oil out of older fields.

Subsequently, Oman has been a global leader in the application of enhanced oil recovery (EOR) technologies. Typically, production from a conventional oil field first increases rapidly but then, as the natural pressure inside the reservoir gradually drops, less and less oil can be extracted. In the end, a significant fraction of the original oil is left in place. Although the figures vary from one region to another, the average recovery factor is between 20-40%. This means that between 60-80% of the oil in a reservoir is left stranded.

To delay and decelerate the imminent production decline and squeeze more oil out of a reservoir, companies invest in EOR. This can improve the recovery factor by up to 60%, i.e., in some cases, 60% of oil can be recovered. This significantly boosts overall production. EOR involves different techniques, including the use of gas, chemicals and steam to improve the flow of oil in a reservoir and facilitate extraction.

Petroleum Development Oman (PDO), a joint venture majority-owned by the government of Oman (60%), the Shell Group (34%), Total (4%), and Partex (2%), is the only enterprise in the region that is simultaneously carrying out full-field projects using each of the three EOR methods. PDO accounts for around 70% of the country's crude oil production and nearly all its natural gas supply. By 2025, EOR is expected to account for approximately 25% of PDO's oil production.

One of PDO's oil fields, the Qarn Alam, is the world's first full-field steam injection EOR project and the largest of its kind. According to the engineering firm Mott Macdonald, after almost 40 years in operation, only 4% of oil in the Qarn Alam field had been recovered using conventional methods. The application of the steam injection technique is expected to increase its oil production 25-fold over the next 30 years.



40%
The average recovery factor from an oil reservoir is a maximum of 40%. Therefore, most of the oil (60%-80%) is not used.

60%
EOR can improve the recovery factor by up to 60%, i.e. 60% of oil can be recovered in some cases.

2025
EOR is expected to account for approximately 25% of PDO's oil production within the decade.

1st
One of PDO's oil fields, the Qarn Alam, is the world's first full-field steam injection EOR project and the largest of its kind.

X25
Engineering firm Mott Macdonald said that, after almost 40 years in operation, only 4% of oil in the Qarn Alam field has been recovered using conventional methods. Using steam injections could boost its oil production by 25x over the next 30 years.

2015
PDO partnered with US firm GlassPoint in 2015 to build Miraah, a 1,021 megawatt (MW) solar thermal energy facility at the Amal field. Miraah is the Middle East's first solar EOR and the world's largest solar project in terms of peak energy production.

GAS AND OIL PRODUCTION

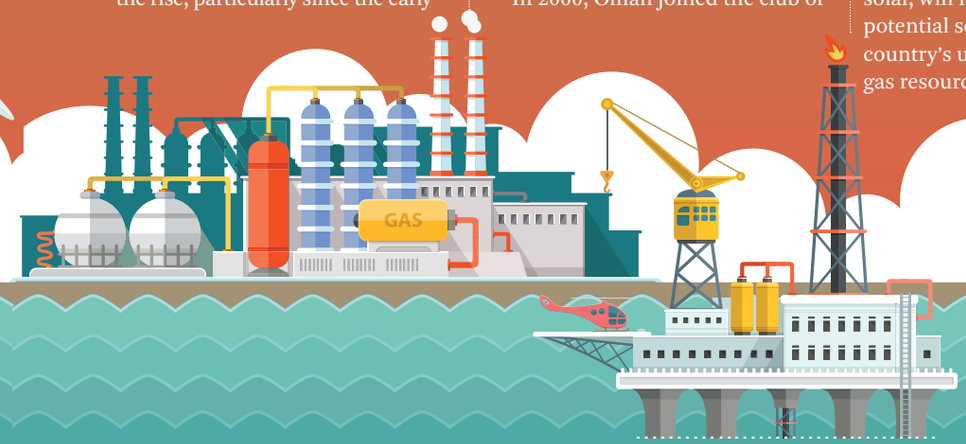
According to the US Energy Information Administration (EIA), Oman's oil production increased each year from approximately 716,000 b/d in 2007 to reach a new peak in 2016 of 1.01m b/d. This 36% increase made the sultanate the 20th largest oil producer in the world. Production could have been sustained at this level, but Oman, currently the largest non-OPEC producer in the Middle East, pledged to cut its oil output by 45,000 b/d as part of the OPEC+ deal in December 2016. The deal brought together the biggest alliance of OPEC and non-OPEC producers in the history of the oil market.

Gas production has also been on the rise, particularly since the early 2000s. Oman is now the world's 24th largest natural gas producer and the 10th largest LNG exporter, with 88% of its gas exports going to the Asia Pacific region.

Natural gas is Oman's main source of primary energy, providing 63% of final consumption. The remaining 37% of consumption comes from oil. Domestic gas demand has been growing rapidly. Between 2000 and 2015, it increased by a staggering 213%. Oman is a net exporter of gas, but it imports around 2.1 bcm yearly through its only international gas pipeline – the Dolphin – which runs from Qatar to Oman via the UAE. This supply may not suffice for future needs.

In 2000, Oman joined the club of LNG exporters. Fifteen years later, Oman Liquefied Natural Gas (Oman LNG), owned by a consortium including the government, Shell and Total, which operates all LNG facilities in the country, announced that it would end exports and divert its entire output to domestic consumption by 2024. Since oil and gas are the backbone of the Omani economy, as in other Gulf states, such a scenario would have serious implications for the local economy if no alternative revenue sources are developed.

If Oman is to maintain its gas exports, it must curb local demand and increase supply. Applying alternative EOR techniques, such as solar, will help. Another promising potential source of supply is the country's unconventional gas resources.



213%
Oman's domestic gas demand has soared; it climbed by a staggering 213% between 2000 and 2015.

36%
Oman's oil production increased each year from approximately 716,000 b/d in 2007 to a record high of 1.01m b/d in 2016. This 36% increase made the sultanate the 20th largest oil producer in the world.

45,000 b/d
Oman, the largest non-OPEC producer in the Middle East, pledged to cut its oil output by 45,000 b/d as part of the deal between OPEC and non-OPEC members in December 2016. The deal marked the biggest such alliance in the history of the oil market.

1st
Oman is the first Middle Eastern country to join the very small club of unconventional oil and gas producers, currently led by the US. Production started at Oman's $16 billion Khazzan tight gas field last September and involved the largest-scale use of US-style fracking technology seen to date in the Middle East.

SOLAR FACTOR

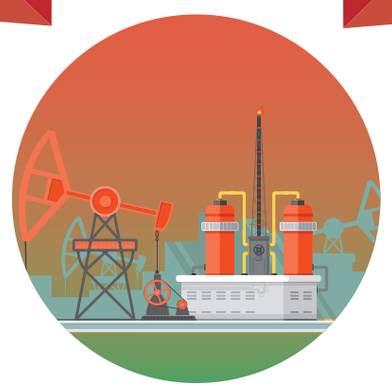
Although renewable energy has yet to make its way into Oman's primary energy consumption, it is being used in EOR. In 2015, PDO partnered with US firm GlassPoint to build Miraah, a 1,021 megawatt (MW) solar thermal energy facility at the Amal field. Miraah is the Middle East's first solar EOR and the world's largest solar project in terms of peak energy production. The project harnesses solar rays to produce steam, which in turn is used to improve the recovery factor from the Amal field. According to PDO, this landmark project points to the existence of a massive market for deploying solar in the oil and gas industry. The technology offers an alternative to burning natural gas for EOR, which currently accounts for nearly 20% of Oman's total gas use. By switching to solar, Oman can find a more lucrative use for its gas, such as meeting its rapidly growing local demand or/and expanding its liquefied natural gas (LNG) trade. Once complete, the Miraah project is expected to save 0.16 billion cubic meters (bcm) of natural gas each year – the amount of gas that could be used to provide electricity to nearly 5% of the sultanate's population.

US IMPACT

Oman recently became the first Middle Eastern country to join the very small club of unconventional oil and gas producers, currently led by the US.

In September 2017, production started at its $16 billion Khazzan tight gas field, involving the largest-scale use of US-style fracking technology seen to date in the Middle East. Like shale, tight gas is difficult to access due to the nature of the rock, making hydraulic fracking and horizontal drilling necessary to extract it. A combination of these ushered in the shale revolution in North America.

The Khazzan reservoir in Block 61 represents one of the Middle East's largest unconventional tight gas accumulations. According to BP, which operates it as a holder of 60% interest (the rest belongs to Oman Oil Company Exploration and Production), plateau production is expected to reach 42 mcm/d. This is the equivalent of a third of Oman's total domestic gas production.



But the Khazzan project is not for the fainthearted. BP notes that the reservoir's gas deposits lie at depths of up to five kilometers in narrow bands of extremely hard, dense rock. Specialized drilling equipment is necessary to access it. The company conducted the world's largest onshore seismic survey, covering the 2,800-square-kilometre block area, to understand where the gas is.

PDO is also investing in its first tight gas project – the Khulud field. It is one of the deepest tight gas accumulations in the world and requires capital-intensive, innovative and complex techniques to exploit. More unconventional projects should come on stream as Omanis master the technology.

THE RIGHT ATTITUDE

As the US shale experience demonstrates, a friendly regulatory environment is needed to encourage investment in unconventional technology. Although Oman could benefit from further reductions in red tape, compared with the rest of the region, the sultanate has honored a tradition of welcoming and supporting international investment.

According to the EIA, contract terms for international oil companies in Oman are more favorable than in other countries in the region; some allow significant equity stakes in the projects, for example. In 2013, the government amended the Khazzan contract to make the investment proposition more attractive for the foreign partner. The revised contract included a higher gas price and a reduction in the government's share of profit gas from 70% to 55%. Such an attitude has helped Oman compensate for its smaller oil and gas reserves, complex geology and higher exploitation costs. This highlights the importance of above-ground factors in hydrocarbon investments.

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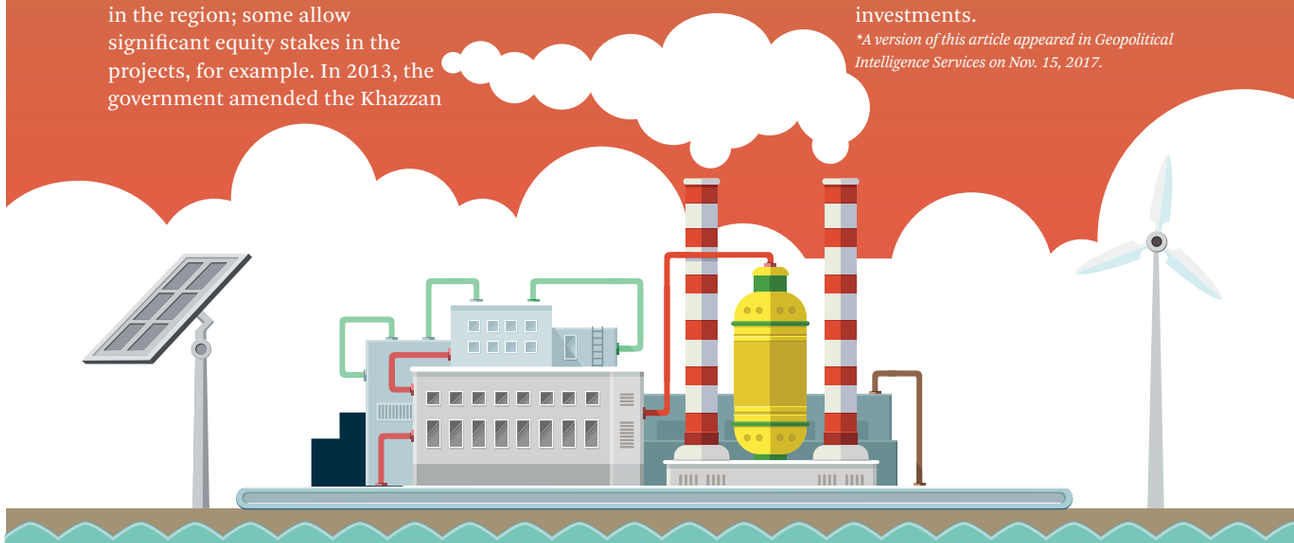

Oman Factbox

- *Since July 23, 1970, Oman has been ruled by Sultan Qaboos bin Said al Said.*
- *The state-owned Oman Oil Company (OOC) is responsible for energy investments both inside and outside Oman.*
- *Petroleum Development Oman (PDO) holds drilling rights to around 40% of the country's land area and produces over 75% of Oman's hydrocarbons from over 100 fields.*
- *In 2016, oil revenues accounted for 27% of Oman's GDP. The country's Vision 2020 development plan calls for reducing that share to 9% of GDP by the end of this decade.*