EGYPT
OIL&GAS
NEWSPAPER

ONSHORE IWELLS IN EGYPT:

PAST, PRESENT, AND FUTURE

INSIGHTS

Research & analysis

Tracking Egypt's Hydrocarbon Production through FY 2017/18

Light Crude vs. Heavy Crude: A Continuously Narrowing Gap

Containing Truck Incidents: A Major Safety Threat in the Oil Industry

Oil Shale: The Forgotten Energy Source

IHS Markit

the BullWhip Effect in the Oil and Gas Industry

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Minister of Petroleum & Mineral Resources - Arab Republic of Egypt

Under the Egyptian Oil and Gas Sector Modernization Program

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EDITOR'S NOTE

Although the Mediterranean has been in the spotlight of the Egyptian oil and gas sector lately, the solid ground still remains the gem of the sector's history. In order to bring some light onshore, Egypt Oil & Gas has dedicated this issue to the diversity of activities, prospects, and challenges within the onshore upstream operations in Egypt, among other topics.

Bringing insights on the security of these operations, we found out truck accidents are, surprisingly, the biggest cause of death in the sector, and we provide you with an article with valuable comments on this hazard. Additionally, following Eni's recent light crude oil discovery in the Western Desert, we bring you an article comparing the economics and the presence of light and heavy crude oil in the country. You can also learn more about oil shale in Egypt and understand the challenges of making oil shale projects feasible, in addition to the ongoing process to tap unconventional resources in Egypt, as well as the technical aspects of iWells.

As the fluctuation of oil prices has been affecting the petroleum sector in different ways in the past years, we bring you the possibility of looking into the duality of this fluctuation and its implications – positive and negative. Our Research & Analysis department also contributes in this issue with a report on Egypt's oil, gas, and condensates production during fiscal year 2017/18.

We hope you enjoy reading this issue as much as we have enjoyed preparing it. As always, thank you for your support and readership.

EDITOR IN CHIEF

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EGYPT'S LEADING OIL AND GAS MONTHLY PUBLICATION

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OIL MINISTRY SIGNS THREE EXPLORATION AGREEMENTS WORTH $139.2M

Oil minister Tarek El Molla signed three new exploration contracts to drill 15 wells in the Mediterranean and the Western Desert with an investment budget of $139.2 million and a $55 million signing grant. The first agreement was signed with EGAS, Tharwa Petroleum, and Italy's Eni to drill two wells in Noor concession in the Mediterranean with a total investment of $105 million.

OIL, FINANCE MINISTRIES CHOOSE WINNER OF OIL HEDGING BID

The oil and finance ministries have chosen a firm to sign fuel hedging contracts with the government, anonymous sources told Amwal Al Ghad. The fuel hedging solutions were proposed by the two ministries to stop the effect of oil price fluctuations on the state public budget, which assumes an average price of $67 per barrel. The winning company will help Egypt hedge against any oil price increase above $73 for a barrel. Sources told Enterprise that oil prices are expected to stand at $70 per barrel by the end of 2018.

EGYPT TO PROVIDE 10% OF JORDAN'S GAS CONSUMPTION

Oil minister Tarek El Molla and his Jordanian counterpart Hala Zawati have renewed an agreement that will allow Jordan to receive 10% of its gas needs from Egypt. An anonymous Jordanian official said in late July that Egypt will start exporting oil to Jordan by January 2019. El Molla and Zawati did not state the starting date however. The two ministers also discussed issues related to electricity exchange and cooperation in the mineral resources field, mainly those pertaining to phosphate. Egypt used to provide Jordan with 250 million cubic feet (mcf) of natural gas daily since 2004, but these amounts started decreasing at the end of 2009 until they were completely halted in 2011 after attacks on the Arab Gas Pipeline.

BALTEEM FIELD TO PRODUCE 500 MCF/D OF GAS BY MID-2019

Belayim Petroleum Company (Petrobel) is planning to produce 500 million cubic feet per day (mcf/d) of natural gas from its south west Balteem project by mid-2019, according to the company's head Atef Hasan. The company aims to drill six wells and build an offshore oil platform in the project. It also aims to build an undersea pipeline to transmit the project output to the shore. The gas will continue its journey to Abu Madi's through another onshore pipeline that the company is planning to build. The two pipelines will cost $380 million to construct.

EL MOLLA REVIEWS MODERNIZATION PROGRAM

Oil minister Tarek El Molla asserted the importance of the sector's modernization program in turning Egypt into an energy hub. He added that structural reforms of the sector and decision-making support are the most two important steps of the seven-division modernization strategy adopted by the ministry.

NEGOTIATIONS BEGIN TO ESTABLISH ENERGY ORIENTED EXCHANGE MARKET

The petroleum ministry and the Egyptian Exchange started negotiations regarding setting natural gas exchange market, banking sources told Al Mal. The talks aim to establish an energy-oriented futures exchange. The plan is to start with a natural gas exchange, which will be the main platform used for striking gas sale and purchase agreements and determining prices, quantities, and delivery dates, the source added.

EGYPT, CYPRUS TAKING STEP CLOSER TOWARDS CONNECTING PIPELINE

Egypt reached an agreement with Cyprus on a pipeline connecting the latter's Aphrodite gas field in block 12 to Egypt, Cypriot state TV announced. The agreement will be signed in the autumn, and has already been given the green light by the EU and it is being scrutinized for the final touches, CYBC added citing diplomatic sources.

GOVERNMENT TO CHARGE GAS COMPANIES FOR USING NATIONAL GRID

The Gas Regulatory Authority has set a tariff of $0.38 per million British thermal units (MMBtu) for companies aiming to transfer natural gas through Egypt's national gas grid, the newly established authority announced. The tariff will allow companies to use the national gas network for private imports. This rate is for the first year only and will be revised after the initial trial period.

MINISTRY OF PETROLEUM TO OFFER NEW EXPLORATION TENDERS

Minister of Petroleum Tarek El Molla announced on July 31 that the ministry is planning to increase investment opportunities for oil and gas exploration by offering new tenders for exploration in the Red Sea and West Mediterranean areas. El Molla stated that the ministry will offer an international exploration tender for the Red Sea depending on the results of an upcoming seismic survey project slated to take place in December 2018.

SISI: EGYPT TO ACHIEVE NATURAL GAS SELF-SUFFICIENCY BY 2020

President Abdel Fattah El-Sisi affirmed on July 29 that Egypt would achieve natural gas self-sufficiency and surplus by June 30, 2020. The president's remarks came during the closing session of the 6th National Youth Conference held at Cairo University. During the "Ask the President" session, Sisi also stated that Egypt's foreign reserves have reached $45 billion.

EGYPT CLOSE TO SETTLING FOREIGN PETROLEUM DEBTS

Egypt is edging closer to repaying its debts to foreign petroleum companies after paying $1.2 billion to international oil companies (IOCs) operating in Egypt with plans to repay the remaining $1.2 billion owed before the end of 2019. "We are also committed to repaying all remaining debts to show that we are keen on long-term relations with these companies," said petroleum ministry spokesman Hamdi Abdel Aziz. "We are doing everything we can to settle all debts soon."

ENI: ZOHR GAS FIELD CAPACITY TO REACH 2 BCF/D BY SEPT

The production capacity of Zohr gas field, which currently stands at 1.6 billion cubic feet per day (bcf/d), is slated to reach 2 bcf/d by September, according to operator Eni. Eni amassed a $58 million advance on future gas supplies to Egyptian state-owned partners in order to finance Zohr, Eni said in a statement. Zohr holds estimated reserves of 30 trillion cubic feet of gas, and is located in the Shorouk concession roughly 190 km north of Port Said.

ENERGY RECOVERY AWARDED $3.3M FOR EGYPT DESALINATION PROJECT

Energy Recovery has announced a $3.3 million order to supply its PX Pressure Exchanger for a water desalination project in Egypt, expected to ship in Q4 2018. The Energy Recovery PX-Q300 Pressure Exchangers will produce up to 106,560 cubic meters of water per day, and estimates show a potential power usage reduction of 16 MW per day at the facilities, as well as helping the facility avoid over 83,500 tons of CO2 emissions per year.

GOVERNMENT CALLS ON HOMEOWNERS TO SUBMIT PAPERS FOR GAS CONNECTION

The government is encouraging citizens to complete the required papers in order to connect their houses to the natural gas grid, a source told Amwal Al Ghad. Citizens will reportedly pay interest free payments of EGP 30 over a period of six years. Customers who want to connect their residential buildings to the natural gas grid should complete and submit their licences in order to benefit from the decision of paying the total value of gas delivery throughout six years, according to an EGAS source.

EGYPT'S BUDGET DEFICIT FALLS TO 9.8% IN FY 2017/18

The Egyptian budget deficit for fiscal year (FY) 2017/18 was 9.8% of gross domestic product (GDP), a decrease from 10.9% the previous year, achieving a primary fiscal surplus for the first time in 15 years, Deputy Finance Minister Ahmed Kouchouk stated on July 26. Tax revenues increased by 36% for FY 2017/18 to EGP 628 billion and the fiscal surplus resulted in an additional revenue of EGP 4 billion ($224 million), Kouchouk added.

EL MOLLA DISCUSSES OIL, GAS COOPERATION WITH BRITISH TRADE REPRESENTATIVE

Minister of Petroleum Tarek El Molla met with British trade representative Sir Jeffrey Donaldson and his accompanying delegation in the presence of British Ambassador John Casson to discuss ways of boosting cooperation between the two nations over oil, gas, and petrochemicals. British companies have contributed to the implementation of a number of Egyptian gas projects in the Mediterranean Sea, the press release read. It added that there are promising investment opportunities in the oil and gas exploration for British companies and some bids have already been put forward.

EL MOLLA: PETROLEUM SECTOR ATTRACTS $10B FDI IN FY 2017/18

Foreign direct investment (FDI) in Egypt's oil and gas sector reached $10 billion in fiscal year (FY) 2017/18, Minister of Petroleum Tarek El Molla announced. El Molla stated that he expects the same amount of investment for the current fiscal year, which runs from July to June in Egypt. In comparison, Egypt's petroleum sector received $8.1 billion of foreign investment in FY 2016/17.

CYPRUS TO SHIP GAS TO EGYPT IN 2022

Cyprus is hoping to ship gas from its 4.5 trillion cubic feet Aphrodite offshore gas field to Egypt by 2022, Cyprus energy minister Giorgos Lakkotrypis said. The field is operated by a consortium of companies including Texas-based Noble Energy, Israel's Delek, and Royal Dutch Shell. The consortium has a preliminary agreement with Shell to sell gas to the company to be processed at its LNG terminal in Egypt. However, the consortium has warned that the project may not be viable because of low oil prices, and has asked to renegotiate the current agreement.

EL MOLLA SIGNS TWO E&P DEALS WORTH $65M

Oil minister Tarek El Molla has signed two oil and gas exploration and production (E&P) agreements in Sinai and the Gulf of Suez with investments of $65 million and $3.5 signature grant. The first agreement was signed with the General Petroleum Company (GPC) in Sinai to improve its production. The second agreement was signed between the Egyptian General Petroleum Corporation (EGPC), PICO Group's Cheiron, Oceaneer, and Sahara Petroleum Services Company (SAPESCO) to conduct E&P in the Zaafarana area in the Gulf of Suez.

SAUDI ARABIA

Saudi Arabia's global petroleum exports will not be affected by the ongoing diplomatic dispute between the kingdom and Canada, Energy Minister Khalid Al-Falih affirmed. Al-Falih stated that Saudi petroleum supplies will not be affected by political considerations. **He reiterated political circumstances does not influence this longstanding policy, the Saudi Press Agency reported.**

Saudi Arabia was forced to cut oil production by more than 200,000 barrels per day (b/d) last month after OPEC's demand forecasts were lower than expected, raising concerns about oversupply. OPEC's total daily output for July rose by 41,000 b/d despite the Saudi cuts, as production from Nigeria, Kuwait, and the UAE increased production enough to offset the kingdom's lower output. **OPEC's demand growth forecasts fell by 20,000 b/d month-on-month to a total of 1.64 million b/d for this year.**

Saudi Arabia announced a "temporary halt" on all oil shipments passing through the Red Sea due to an attack on two oil tankers by Yemen's Houthi movement. Two very large crude carriers (VLCCs), each with a capacity of 2 million barrels, were attacked on the morning of July 25 while passing through the Bab al-Mandeb strait. **The shipping lane was reopened on August 4 after "necessary measures to protect the ships" were taken, al-Falih stated.** Bab al-Mandeb is the main transit route for exports from the Gulf going through the Suez Canal. In 2016, an estimated 4.8 million b/d passed through the strait heading towards Europe, Asia and the US.

Rowan Companies jack-up rigs joint-venture ARO Drilling has been awarded six three-year contracts by Saudi Aramco for Rowan rigs. Rowan will commence the new contract work when existing agreements for the rigs expire later this year. **Rowan Middletown, Charles Rowan, and Arch Rowan rigs are expected to be leased to ARO Drilling in September with the Rowan Mississippi to be leased in December for the completion of these contracts.** The Scooter Yeargain and Kank Boswell rigs, planned to be sold to ARO Drilling in September, will immediately be used for the new contracts upon their transfer to the joint-venture.

Saudi Aramco Technologies Company, alongside Mazda and the National Institute of Advanced Industrial Science and Technology (AIST), **has launched a research program to develop advanced engine/fuel combinations for greater efficiency and CO2 reduction.** For the project, Saudi Aramco will provide low carbon fuels and Mazda will provide a prototype high-efficiency engine.

IRAN

Iran is preparing to bring two new gas refineries online, covering phases 13, 22, and 24 of the South Pars gas field. The field currently feeds 10 refineries. Once phase 13 is operational, the field will produce a further daily 56.6 million cubic meters of rich gas, 75,000 barrels of gas condensates and 400 tons of sulfur, as well as an additional 1.05 million tons of LPG and 1 million tons of ethane annually.

Indian company Reliance Industries Limited (RIL), operator of the world's largest single-location refinery processing about 1.4 million b/d, **announced that it will stop importing Iranian crude from November to comply with US sanctions on the Islamic Republic.** RIL's imports of Iranian crude rose by 45% between April 2016 and 2017, reaching 67,000 b/d. It imported roughly 96,000 b/d between January and April 2018.

Iranian e-consortium MAPNA Group has signed a contract with the National Iranian South Oil Company (NISOC) to develop the Paranj and Parsi oilfields in the Khuzestan Province in Iran. According to NISOC CEO, Bijan Alipour, MAPNA has previously carried out comprehensive studies on both fields, and the agreement hopes for a boost in output of 30,000-40,000 b/d from the fields. **"Both fields are among hydrocarbon reservoirs that require gas injection for enhanced oil recovery," Alipour added.**

British renewable energy investment company Quercus announced it will stop building a $570 million solar power plant in Iran due to the recently imposed sanctions on the Islamic Republic. The solar power plant was Quercus's first renewable energy investment outside of Europe, and was expected to be the sixth largest in the world.

Iran plans to sell discounted oil to the Asian market as a way to mitigate losses caused by US sanctions on the country. "The discount is part of the nature of the global markets being offered by all oil exporters," a source told the Islamic Republic News Agency, without giving details on the discount rate. Other reports also stated that the **state-run National Iranian Oil Company was preparing to reduce official sales prices sales of oil to Asia in September to their lowest levels in 14 years compared to Saudi crude prices.**

Turkey has rejected US pleas to curtail crude imports from Iran, telling US officials that it is under no obligation to implement Washington's sanctions regime against Tehran. "We do not have to adhere to the sanctions imposed on a country by another country. We don't find the sanctions right either," Foreign Minister Mevlut Cavusoglu stated.

Oil exports from the Shahid Bahonar port in southern Iran have risen by 40% over the past four months, state-run Mehr News Agency reported. Petroleum products exported through the terminal since March 21 marked a 40% increase in comparison to the same period last year. The port is responsible for nearly 5% of Iranian port activities and serves as a transit route and transportation hub due to its access to open water and the Persian Gulf.

ALGERIA

Algeria's Sonatrach has changed its senior leadership personnel in a bid to retain skilled workers within the state-run firm. Algerian President Abdelaziz Bouteflika appointed US-trained Abdelmoumen Ould Kaddour as head of Sonatrach to overhaul the company's management in March 2017. Years of fraud scandals, bureaucracy, and frequent CEO changes had dissuaded foreign investors from working with the company. **"We have lost thousands of experienced and talented people mainly because we can't give them a salary they get now in the Gulf and other countries," Kaddour stated.** Kaddour has appointed eight vice-presidents from within the firm.

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UAE

The UAE's Department of Energy (DoE) has issued a license for generating electricity to Barakah One Company, a key regulatory requirement for the operation of the Barakah nuclear facility at Al Dhafra, Abu Dhabi. The Electricity Generation License is an important milestone for the Emirates Nuclear Energy Corporation (ENEC) and Korea Electric Power Corporation (KEPCO) subsidiary Nawah to obtain an operating license from the Federal Authority for Nuclear Regulation (FANR). **The DoE assessment asserted that Barakah One Company is in compliance with the standards and requirements necessary to obtain the electricity generation license.**

Japan's crude imports from the UAE for June stood at 16.456 million barrels, 22.9% of the country's total crude imports. According to data released by the Agency of Energy and Natural resources in Tokyo, Japan's total crude imports for June stood at 71.860 million barrels, meaning the UAE imports represent nearly one quarter of Japanese crude for the month.

Oil industry services company Marsol International has become the first UAE company to be awarded the ISO 45001:2018 certification by Bureau Veritas, which recognizes the company's exceptional commitment to safety standards and employee safety. "We are passionate about the work we do and operational health and safety is a big part of that, which is why we have been so keen to embrace the new ISO standard. **Our services concentrate on enhancing operational integrity and cost efficiency, optimizing the lifetime of an asset, maximizing availability and reducing risk,**" Mike Young, director at Marsol, commented.

Japan's Jera Co announced it had signed a memorandum of understanding for a liquefied natural gas (LNG) supply from the Abu Dhabi Gas Liquefaction Company (ADNOC LNG). Jera, the world's largest buyer of LNG, is slated to purchase up to eight cargoes each year from ADNOC LNG for three years from April 2019. **"JERA believes this will contribute to its ability not only to respond to fluctuations in LNG demand, but also to optimize its LNG operations,"** the company said in a statement.

IRAQ

Norwegian oil and gas operator DNO ASA, announced it had beaten output targets after its fourth well at the Peshkabir field in Iraqi Kurdistan began production. "At around 35,000 barrels per day (b/d), Peshkabir has now leapfrogged into second place after Tawke among the Kurdistan fields operated by the international oil companies," said Bijan Mossavar-Rahmani, DNO's executive chairman. **The company had previously set a production target of 30,000 b/d.**

Iraq will develop its Mansuriya gas field near the Iranian border using state-run firms after the delay and failure of international oil companies (IOCs) to resume work at the field. The country also announced its plans to develop the Nasiriya oilfield in southern Iraq using local companies as well. Turkish company TPAO halted work at Mansuriya in 2014 due to security concerns over the foothold of Islamic State militants in the country. **"We need to start gas production from Mansuriya to feed the power stations and cope with electricity shortages," an oil ministry official stated.**

Siemens has been contracted to upgrade one of Iraq's largest gas-fired power plants. The company will increase the capacity of the Shatt Al Basra Gas Power Plant by 650 MW, taking it to a total 1,900 MW. Siemens will supply five of its steam turbines to ensure that the additional power generation comes at no extra fuel expense. The upgrade will convert the facility into a combined-cycle plant and increase efficiency by more than 50%. **Siemens stated that once upgrades are completed, the plant will supply roughly 1 million Iraqis with reliable and clean electricity.**

Iraq oil minister Jabar al-Luaibi stated that Iraq plans to raise oil production to more than 7.5 million b/d by 2023/24. He added that 6 million b/d would be exported, with 1.5 million b/d accounting for domestic consumption.

Genel Energy is likely to significantly increase oil production guidance for Kurdistan in 2019, chief financial officer Esa Ikaheimonen stated. The increased output is expected to come from 11 wells being drilled in the three fields in Kurdistan, eight of which are slated to begin production this year. Genel announced its crude production guidance for the first six months of 2018 stood at 32,800 b/d. **"There is a good chance that we enter the New Year with a significantly updated level of production," Ikaheimonen added.**

Iraq South Gas Company (SGC) has awarded a contract to Baker Hughes a contract for fast-track solutions to help the recovery of flared gases in Nasiriya and Al Gharraf oilfields. Advanced modular gas processing technology will be used for flare gas recovery, as well as using modular skid-mounted gas processing technology to build a gas-to-liquid (NGL) plant processing 200 million standard cubic feet per day. It is expected to come online by 2021, the company's statement added.

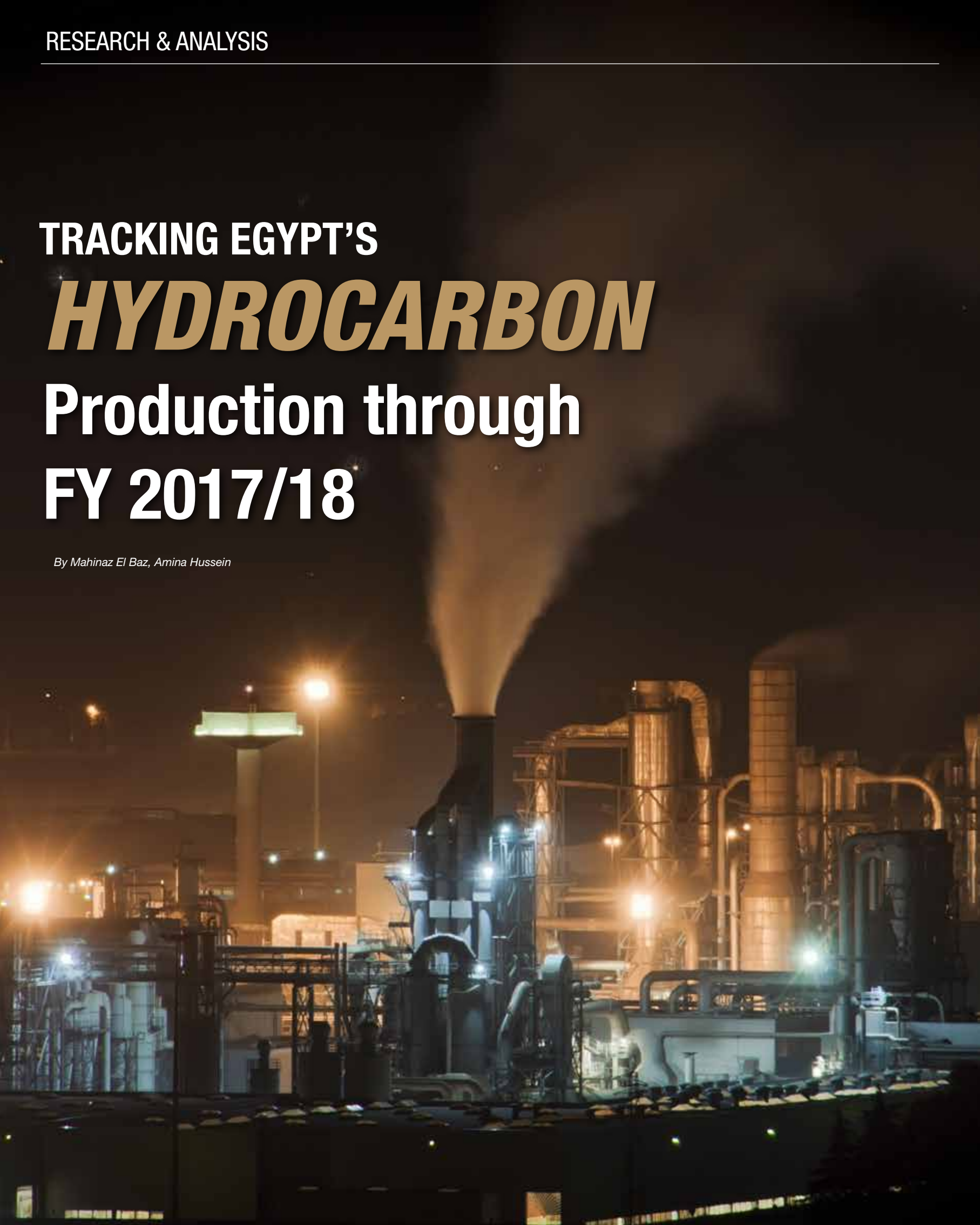
Iraq has signed a deal with Petrofac worth $369 million for the construction of a new crude-processing plant in the giant Majnoon oilfield. The plant, expected to have a capacity of 200,000 b/d, should be completed in 34 months, Ihsan Abdul Jabbar, head of the state-run Basra Oil Company, said. **The Majnoon field is currently producing 230,000 b/d, which is slated to rise to 450,000 b/d by the time the plant is operational.**

TUNISIA

The Tunisian government accepted a bid from the upstream company Upland Resources for an exclusive hydrocarbon exploration and appraisal license in onshore northern Tunisia. "The company believes there is the potential for very substantial quantities of recoverable gas within the permit area," Upland stated. Upland will act as an operator and hold a majority stake in the concession; however, in the event of a discovery, state oil company ETAP would retain the right as a joint-venture partner to control a minority stake. **An existing gas discovery made in the area 50 years ago as well as existing pipeline infrastructure connecting the field to the local market reduces the risk of Upland's exploration plans.**

TRACKING EGYPT'S *HYDROCARBON* Production through FY 2017/18

By Mahinaz El Baz, Amina Hussein



Egypt is a hydrocarbon production pioneer, as it is one of the oldest energy producers in the Middle East & North Africa (MENA) region. The country is considered the largest oil producer in Africa out of the Organization of the Petroleum Exporting Countries (OPEC) and the third-largest natural gas producer on the continent following Algeria and Nigeria, according to the Energy Information Administration (EIA). Egypt is also an active member of the Organization of Arab Petroleum Exporting Countries (OAPEC) since 1973.

Moreover, the country's developed infrastructure has allowed it to maintain sizeable liquefied natural gas (LNG) and crude oil export markets through shipped products and pipelines, as well as a sizeable downstream sector. Egypt used to be a net natural gas exporter before starting to import LNG in December 2012. In 2014, the country completely halted exports, turning into a net natural gas importer in fiscal year (FY) 2015/16. Egypt is aiming to reach natural gas self-sufficiency again, especially after the discovery of the Zohr field.

In FY 2017/18, Egypt crude oil and condensates production showed stable performance, while its natural gas production witnessed fluctuations. This report aims to highlight Egypt's hydrocarbon production from July 2017 to June 2018. It covers the performance of the country's production of crude oil, equivalent gas, and condensates.

EQUIVALENT GAS PRODUCTION (JULY 2017-JUNE 2018)
(BARRELS)

MONTH	MEDITERRANEAN SEA	EASTERN DESERT	WESTERN DESERT	GULF OF SUEZ	DELTA	SINAI	UPPER EGYPT	TOTAL/MONTH
7\2017	15,684,326	23,000	8,600,941	918,295	8,322,598	8,365	0	33,557,525
8\2017	13,451,436	15,192	7,748,503	715,564	7,629,951	10,001	0	29,570,647
9\2017	12,071,252	13,964	6,933,889	655,273	7,159,726	5,344	0	26,839,448
10\2017	12,757,890	30,150	7,195,680	743,708	7,366,860	36,000	0	28,130,288
11\2017	12,332,627	29,145	6,955,824	770,269	7,121,298	34,800	0	27,243,963
12\2017	13,608,416	31,155	7,435,536	823,391	7,612,422	372	0	29,548,120
1\2018	14,809,727	0	7,193,845	670,614	7,499,661	839	0	30,174,686
2\2018	13,039,060	0	6,571,443	588,625	6,577,370	589	0	26,777,080
3\2018	14,536,197	0	6,332,665	600486	7,295,315	429	0	28,765,092
4\2018	14,023,105	0	7,015,160	574,589	7,054,960	554	0	28,668,368
5\2018	17,230,001	22,080	7,233,189	588,227	7,406,715	339	0	32,450,550
6\2018	17,131,583	35,009	7,046,406	535,010	7,143,314	446	0	31,891,768
Total/area	170,675,620	199,695	86,263,081	8,184,051	88,190,190	98,078	0	353,617,535

Source: EGPC & EGAS

CRUDE OIL PRODUCTION (JULY 2017-JUNE 2018) (BARRELS)

MONTH	MEDITERRANEAN SEA	EASTERN DESERT	WESTERN DESERT	GULF OF SUEZ	DELTA	SINAI	UPPER EGYPT	TOTAL/MONTH
7\2017	-	2,016,525	9,428,766	4,054,621	42,583	1,865,259	-	17,407,754
8\2017	-	1,986,523	9,385,426	4,135,487	44,321	1,738,859	-	17,290,616
9\2017	-	1,742,659	9,216,732	3,952,359	38,259	1,653,859	7,503	16,611,371
10\2017	59,550	1,837,050	9,708,630	3,895,950	36,900	1,537,680	15,690	17,091,450
11\2017	57,565	1,775,815	9,385,009	3,766,085	35,670	1,486,424	15,167	16,521,735
12\2017	25,000	1,780,000	9,500,000	3,900,000	30,000	1,500,000	6,000	16,680,000
1\2018	25,000	1,720,000	9,540,000	3,900,000	30,000	1,480,000	6,000	16,640,000
2\2018	15,000	1,660,000	8,700,000	3,380,000	20,000	1,340,000	5,000	15,080,000
3\2018	18,723	1,986,123	9,990,125	4178921	18,542	1,723,514	7,129	17,923,077
4\2018	16,000	1,866,000	9,477,000	3,715,000	135,000	1,395,000	5,000	16,453,000
5\2018	18,000	1,978,000	9,909,000	4,160,000	15,000	1,545,000	5,000	17,612,000
6\2018	19,000	1,790,000	9,542,000	3,494,000	16,000	1,489,000	3,000	16,315,000
Total/area	253,838	22,138,695	113,782,688	46,532,423	462,275	18,754,595	75,489	201,626,003

*Crude total excludes Upper Egypt production
Source: EGPC & EGAS

CRUDE OIL

Egypt produced 201,626,003 of crude oil barrels between July 2017 and June 2018, with a monthly average production of 16,802,166 barrels per month (b/m). Figures show that the Western Desert is the major crude oil production area in Egypt, representing around 56% of the country's production in FY 2017/18, with an average of 9,481,890 b/m. The Gulf of Suez is the second most productive area for crude oil production, while the Eastern Desert comes in at the third place. It is worth noting that Egypt produces mostly heavy crude oil.

In May, Eni announced an oil discovery in the Faghur Basin in the Western Desert. The exploratory well, has been drilled to a total depth of 5,090 meters and encountered 18 meters of light oil in the Paleozoic sandstones of Dessouky Formation of Carboniferous age. The well has also encountered other hydrocarbon levels in the Alam El Bueib sandstones of Cretaceous Age. This discovery gives hope of finding more crude oil either in the Western Desert or in any other onshore area in Egypt, according to Eni's press release.

EGYPT HAS MANY COMPETITIVE ADVANTAGES, AS IT BENEFITS FROM ITS LOW PRODUCTION COSTS AND A RELATIVELY LARGE VOLUME OF BOTH ONSHORE AND OFFSHORE OIL AND GAS FIELDS.

EQUIVALENT NATURAL GAS

Egypt's equivalent natural gas total production recorded 353,617,535 barrels in FY 2017/18, with an average monthly production of 29,468,128 barrels. Almost half of Egypt's gas production comes from offshore fields, as 48% of the country's equivalent gas production was extracted from the Mediterranean Sea, making 14,222,968 b/m on average.

In December 2017, natural gas production dynamics changed after Italy's Eni began producing from Zohr, the largest discovery of gas in the Mediterranean Sea. The first production unit of Zohr increased the natural gas production from the Mediterranean by around 1,201,311 b/d in January 2018 compared to December 2017, Eni's press release announced.

Four months later, the Italian company announced the start-up of the second production unit (T-1) of the Zohr project, which increased installed capacity by 400 million standard cubic feet per day (MMScfd). Accordingly, it subsequently increased the Mediterranean Sea's total natural gas production, as it reached 17,230,001 b/m in May compared to 14,023,105 b/m in April.

Achieving outstanding progress, Eni announced in May the start-up of the third production unit (T-2) of the Zohr project, increasing the installed capacity to 1.2 billion cubic feet per day (bcf/d). Zohr increased its production up to 1.1 bcf/d in ramp-up, equivalent to approximately 200,000 barrel of oil equivalent per day (boe/d), of which 75,000 boe/d net to Eni at working interest.

Eni recently revealed that the field's production capacity, which stood at 1.6 bcf/d in July, is slated to reach 2 bcf/d by September, Reuters reported.

The production of Zohr increased again after Eni brought the third unit online. Following this, Minister of Petroleum and Mineral Resources, Tarek El Molla, declared that recent production increases had pushed Egypt's total natural gas production to about 6 bcf/d, Reuters reported. Despite this, total equivalent natural gas production from the Mediterranean Sea slightly declined by 898,418 barrels in June compared to May.

In the mid-term, Egypt is planning to become a regional energy hub. President Abdel Fattah el-Sisi affirmed on July 29 that Egypt would achieve natural gas self-sufficiency and a surplus by the middle of 2020, Egypt Oil & Gas reported.

CONDENSATES PRODUCTION (JULY 2017-JUNE 2018) (BARRELS)

MONTH	MEDITERRANEAN SEA	EASTERN DESERT	WESTERN DESERT	GULF OF SUEZ	DELTA	SINAI	UPPER EGYPT	TOTAL/MONTH
7\2017	635,728	1,300	1,512,253	74,562	506,427	17,251	0	2,747,521
8\2017	583,814	2,001	1,520,214	73,569	449,568	19,542	0	2,648,708
9\2017	609,295	1,001	1,434,526	78,111	405,168	18,296	0	2,546,397
10\2017	684,480	15,030	1,178,884	105,630	345,268	19,992	0	2,349,284
11\2017	661,664	15,030	1,220,987	102,109	357599	20,706	0	2,378,095
12\2017	684,480	16,032	1,305,193	109,151	369,930	21,420	0	2,506,206
1\2018	853,040	0	1,247,010	75,227	468,358	17,517	0	2,661,152
2\2018	809,016	0	1,112,493	68,117	68,117	14,737	0	2,416,799
3\2018	921,627	0	1,157,163	76540	447,833	15,480	0	2,618,643
4\2018	883,700	0	1,192,909	74,938	425,452	14,580	0	2,591,579
5\2018	914,187	0	1,259,217	72,128	422,312	17,123	0	2,684,972
6\2018	891,733	0	1,227,377	64,786	407,814	17,260	0	2,608,970
Total/area	9,132,764	50,394	15,368,226	974,868	4,673,846	213,904	0	30,758,326

Source: EGPC & EGAS

From his side, El Molla said in 2017 that Zohr, North Alexandria, and Nooros gas fields are expected to increase Egypt's natural gas output by 50% in 2018 and 100% by 2020.

CONDENSATES

Egypt's production of condensates was stable through FY 2017/18 with a total production of 30,758,326 barrels. Half of this production came from the Western Desert, with a monthly average production of around 2,563,194693 b/m. The highest level of condensates production in the Western Desert came in the first quarter of FY 2017/18.

In addition, July 2017 recorded the highest level of total condensates production at around 2,747,521 barrels. Conversely, October 2017 saw the lowest output, producing 2,349,284 barrels.

Figures show that from October to December 2017, production from the Eastern Desert, the Gulf of Suez, and Sinai witnessed a remarkable increase, while the Delta's production sharply decreased in February 2018 by around 68% month-on-month.

New oil and gas discoveries have supported Egypt's hydrocarbon production in FY 2017/18, especially crude oil and condensates. As for equivalent natural gas, the current FY 2018/19 is expected to witness a significant increase in production, as more units will be put online in the Zohr field throughout this year. However, equivalent natural gas production recorded some decreases during the comparison period - it recorded the highest level of production by reaching a total of 353,617,535 barrels - while total crude oil production stood at 201,626,003 barrels, and total condensates production at 30,758,326 barrels.

ONSHORE iWELLS IN EGYPT: PAST, PRESENT, AND FUTURE INSIGHTS

Conventional oil and gas operations are becoming just one of many different options. In today's world of diverse technologies, the decision for each project needs more studies, comparisons, and long-term predictions. The varying parameters have changed to include the expected interventions, the duration of workover, zones' compatibilities, the selection of monitoring systems, as well as the subsurface structures. The compartmentalization strategy has been upgraded from adjacent wells into smart wells all over the field.

For instance, intelligent well completion has come up with competitive advantages to boost the integrity management for the projects. Egypt's onshore fields challenge the downhole tools with extreme conditions that impose intervention from time to time. Any error in the monitoring system can extend the workover time and cost the operator more money. However, differentiating between the relatively high initial cost and the long-term savings is what keeps executives awake at night. On the other hand, the future brings new advances to intelligent well completion telemetry systems using nanotechnology. The intervention tools have also witnessed break-through innovations that optimize the workover operation.

WHAT IS MEANT BY SMART WELLS?

Throughout the previous years, substantial attention has been paid to deploying smart well completion to boost the recovery, especially with the increasingly expansive opportunities in more challenging and rewarding assets. The term 'smart well' is relative to the current generic technology in wells. Hence, any updated technology that optimizes the performance and achieves long-term profits can be listed as a smart technology. In particular, intelligent well completion means the use of inflow control valves (ICVs) and autonomous inflow control devices (AICDs) in well completion to enable the remote control according to real-time measurements. It can be in multilaterals, injectors, and multiple zones applications.

Digitization is a more advanced stage that employs artificial intelligence and big data analysis to monitor, analyze, and control problems and their consequences. Smart wells can monitor and analyze, but actions are taken by authorized people through control lines.

There are two main smart controls: active control and proactive control. In active controls, valves are controlled remotely should water or gas break through. Proactive control wells are more advanced and need more feedback than active smart wells. Proactive controls adjust their zonal production before water or gas actually breaks through by monitoring the flow and optimizing the valve settings accordingly.

"The first successful operating intelligent well system was the surface-controlled reservoir analysis and management system (SCRAMS) installed at the Saga Snorre tension leg platform in the North Sea in 1997," a Halliburton paper entitled "Optimization of Recovery Using Intelligent Completions in Intelligent Fields" stated. SCRAMS operators could obtain real-

time pressure and temperature of each zone and could precisely control the flow by adjusting reservoir control valves of each zone. Later, more advanced smart wells became available for the industry.

The importance of reliable measurements was pointed out in Schlumberger's paper entitled "When Intelligent Wells Are Truly Intelligent, Reliable, and Cost Effective." The paper concludes that "measurements alone do not provide intelligence; interpretation tools are essential to provide accurate inversion to useful information. The combination of additional measurements, such as DTS, within an existing permanent monitoring infrastructure is a cost-effective method of improving the measurement value."

LESSONS LEARNED FROM EGYPT

Real-time surveillance has been a fast-emerging technology that affects the economics of projects. The quality of measurements and continual analysis can optimize and shorten the intervention duration. Egypt's onshore wells – such as the ER-5 well in the East Rabeh field - are showcasing the importance of zonal isolation and advanced telemetry systems. .

According to a research paper on real time operations surveillance at the ER-5 well, the lessons learned were to rely on the most recent data and to avoid mixed production for inflow performance. ER-5 produces oil from Nubia and Matulla formations, and was first completed and tested in January 2002. An electric submersible pump (ESP) was selected and the first system was installed in February 2004.

In January 2006, the fluid production rate dropped to 1,600 barrels per day (b/d) with a 98% water cut. The company decided to go ahead with a new well intervention and the well was worked-over to recomplete and produce from the Matulla and Nukhul zones. The well was put online in August 2006, producing around 950 b/d with a 20% water cut. However, the ESP failed electrically in January 2009. This last intervention showed the importance of deploying strong telemetry systems with ICVs.

The new ESP string was prepared to run through 139 stages. However, due to an electromechanical problem, the string was pulled before the targeted depth. The ESP was covered by crude oil as an indication of not killing the well properly. Knowing the total inside volume of the casing is 204 barrels, killing the well with 400 barrels of water provided clear evidence that the thief zone had swallowed the kill fluid. Moreover, they found out the pressure design was overestimated due to the absence of Nukhul production. That late conclusion came out after the ESP shutdown recorded lower pressure, so they pulled the string adding more stages.

The ER-5 intervention history proved by numbers the loss of intervention rig time due to a lack of real-time data and the cross flow among different zones causing production drops and water conformance problems.

HIGHLIGHT

IN ACTIVE CONTROLS, VALVES ARE CONTROLLED REMOTELY SHOULD WATER OR GAS BREAK THROUGH. PROACTIVE CONTROL WELLS ARE MORE ADVANCED AND NEED MORE FEEDBACK THAN ACTIVE SMART WELLS.

HIGHLIGHT

THE SMART WORKOVER STRATEGY AIMS TO REDUCE THE INTERVENTION OPPORTUNITIES AND THE DOWN-TIME, AS WELL AS PROVIDING REAL-TIME TELEMETRY SYSTEMS.

A SUCCESS STORY

The West Dikirnis field has had a successful history in deploying intelligent completion with horizontal wells. The field is located in the Nile Delta and is operated by Petroceltic and El-Mansoura Petroleum Company. It contains a thin oil rim with a thick gas cap and strong water aquifer. The field also showed lithological variations within short distances.

The development strategy was to drill horizontal wells completed with ICVs to overcome the geological and aquifer heterogeneities. According to a paper entitled "Challenging Field Management of the Thin Oil Rim Reservoir in the Nile Delta of Egypt," the first horizontal well drilled was WD-7-HW. Later, WD-10-HW became the first horizontal well to be completed with ICVs.

This well has a horizontal section of 2,200 feet, which is a very challenging record in the Delta. It produced initially about 2,300 standard cubic feet per day of oil and 4.6 million standard cubic feet per day of gas. This successful case proved the effectiveness of intelligent well completion in Egypt's onshore wells. In addition, the five horizontal wells drilled in the field have contributed with more than 45% of the cumulative oil production of the field, while the rest was produced from 10 vertical/deviated wells.

INTERVENTION, INNOVATION

Smart wells are not limited to include only the intelligent completions, but also the innovative intervention techniques. The smart workover strategy aims to reduce the intervention opportunities and the down-time, as well as providing real-time telemetry systems. The service providers were competitive to present innovative solutions. Halliburton, for instance, presents the Spectrum Fusion Real-Time Hybrid Coiled Tubing Service, which integrates among fiber optics, electric communication and power. Such a system is compatible with wireline and mechanical tools to help in diagnostic, design and delivery of operations. That enables real-time onsite decision-making with more optimized projects.

FUTURE INSIGHTS

Since the oil and gas industry adopted these new technologies, improvements have followed. One of the breakthrough research and development trends is 'nanocompletions'. This term refers to the adaptation of known applications of potentially viable nanostructures to the development of the components and functionality of well completion systems.

According to a paper entitled "Nanocompletions Versus Intelligent Well Completions, Investigating the Future of Nanotechnology in Well Completions," any known or potential application of nanotechnology in the modification and enhancement of two or more major components of a completions system can be defined as a nanocompletion. This definition would therefore clarify the possible misunderstanding of calling a completions system that incorporates one or two nanotechnology applications for its enhancement a nanocompletion system. For instance, the use of nanoparticles in 'smart' completion fluids or in transducers used for sensing would not be mistaken as nanocompletions.

The novel contributions of nanotechnology can be in the monitoring or the analyzing system. For example, if the polymer-supported nanoparticles (PSNPs) are properly engineered and tailored into a fibrous or a membranous configuration, it can be wound round the tubing and act as downhole flow-meter. Moreover, the nanoactuators can transmit the acquired information to a central station. In addition, carbon nanotubes can be engineered as electrical cables and wires of very high conductivity and as paper batteries with super capacitor functions. The analytic system can benefit from nanotechnology by employing nano-RAM, nanowires and nanoelectronics.

ECONOMIC FEASIBILITY

The decision to implement a smart well completion system instead of a regular one is a cost-to-revenue evaluation, because most of the smart wells are high-cost, deep-water wells. On occasions, mature oil fields could use smart wells to boost hydrocarbon recovery. A smart well has many benefits that offset the extra cost of implementing it. These benefits can be summarized as increasing production by controlling the production amount from different reservoir zones and increasing the productivity of wells and the total recovery by effectively managing water injection using zonal control.

The paper entitled "Optimization of Recovery Using Intelligent Completions in Intelligent Fields" contains two cases stressing the economic benefits of deploying smart systems. The first case was the installation of a dual machine tool valve system in offshore Vung Tau, Vietnam. That saved the investor more than 30 hours of rig time, which equivalently saved $360,000.

Another case studied the commerciality of completing the injector well by smart systems versus generic completions. The study included a reservoir model followed by a cash-flow model to simulate the same inputs into different scenarios. The results were promising for smart wells. Although the maximum capital outlay (MCO) was higher for the smart well completions, both the terminal cash surplus (TCS) and the net present value (NPV) were higher. For this model, the smart well completions indicated an incremental NPV of $42.47 million when compared to the generic well completions. The higher NPV was attributed to the lower water injection rates required to produce the same volume of oil in case of smart well completions.

Ten years later, the wells completed conventionally will be a burden upon the operators in comparison with the smart wells. The smart of today can be the conventional of tomorrow.

LIGHT CRUDE VS. HEAVY CRUDE: A CONTINUOUSLY NARROWING GAP

By Felix Fallon

The Western Desert contains Egypt's largest onshore crude deposits. In recent months, much of the attention given to the Egyptian energy sector has been focused on the giant offshore gas discovery of Zohr. However, while by no means as large as Egypt's Mediterranean gas find, the continued exploitation of the Western Desert for crude oil is a profitable endeavor for the Egyptian energy sector.

Egyptian oil production peaked in the 1990s at roughly 900,000 barrels per day (b/d). Since then, output has increasingly declined as fields matured, and the production has moved from the larger aging offshore fields in the Gulf of Suez to smaller fields in the Western Desert. Output currently stands at 560,000 b/d, the lowest in Egyptian history. Domestic consumption stands at 815,650 b/d, meaning imports are unavoidable.

The Western Desert is made up of clusters of small oil fields spanning different basins across the territory. In one of the largest, the Qarun field, operator Apache has estimated reserves of 75-80 million barrels of crude. However, after decades of production Egypt's total oil reserves have been depleted from 12 billion barrels to just under 2 billion barrels as of January 2011. Yet, much of the Western Desert remains unexploited - Apache has been operating in the

Western Desert since 1996 and says that 69% of its 5.6 million acres in the region is undeveloped.

The Faghur Basin, located onshore and spanning the Siwa and West Kalabsha blocks in the Western Desert, was discovered in 2006 with the Faghur-1 exploratory well. In 2018, Eni announced two new light crude discoveries in the basin, with a third exploratory well slated to be drilled before Q3 2018.

LIGHT CRUDE VS HEAVY CRUDE

Light crude is typically more valuable, easier to refine, and contains greater quantities of hydrocarbons than heavier variants. Whether a crude oil is light or heavy is determined by the impurities it contains and measured by its API Gravity; a standard measurement created by the American Petroleum Institute that compares the density of a given crude to the density of water. Pure petroleum by nature is less dense than water, so the API Gravity is a measure of how pure a particular oil is, and subsequently gives an indication of its ease and expense to both transport and refine.

API gravities don't have a unit of measurement, but are often talked about in degrees. The scale generally falls between 10 and 70, with the higher end results representing the lighter crudes as the formula for calculating API gravities creates an inverse result to the specific gravity of a crude. As a rule of thumb, a light crude would typically have an API of more than 31.1, a medium crude's API would fall between 22.3 and 31.1, a heavy crude will have an API below 22.3, and any measurement less than 10 is classified as extra-heavy (the oil would sink, rather than float in water). When attributing different crude blends with an API gravity, the figures are often typical of the area in which that blend falls rather than definitive measurements, because even within one particular blend, impurity levels vary.

However, the API gravity is not the only important factor affecting the value of a crude; the levels of sulfur in the oil, or how 'sweet' or 'sour' it is, has a big effect on how much it can be sold for. A sweet crude typically contains less than 0.5% sulfur, and can be refined into gasoline, kerosene, and high-quality diesel. For sour crude to be refined into gasoline, the impurities need to be removed, increasing the base cost in extracting the final product. Most sour crudes, therefore, are refined into heavy oils such as diesel and fuel oil, both less valuable than the gasoline products created from sweet crude.

Characteristically, heavier crudes also have higher viscosities, meaning they have a lower pump rate, and are harder to transport. Recovery techniques - such as waterflooding, which is used in the Western Desert - are not viable because of the high viscosity. Heavy crude fields require more wells to extract the oil than light crude fields, all factors that lower the profit margin for investment in heavier crude.

HIGHLIGHT

THE DISCOUNT AT WHICH HEAVY CRUDE HAS GENERALLY BEEN SOLD HAS BECOME SMALLER, BECAUSE OF BOTH A DECREASE IN HEAVY CRUDE PRODUCTION AND THE ADVENT OF MUCH IMPROVED REFINERIES ABLE TO PROCESS HEAVY CRUDE AT EASE.

DISTRIBUTION OF CRUDE TYPES IN EGYPT

Egypt has three main crude blends: the Suez Blend, the Belayim Blend, and the Western Desert Blend. The Suez Blend comes from declining offshore fields in the Gulf of Suez, and typically has an API gravity of 30.4 and a sulfur percentage of 1.65%, according to McKinsey data. The Suez Blend usually trades below Brent Crude, which has a both light API gravity (usually around 37.9), and a sulfur low percentage near the 0.45% mark. Most of the Suez Blend produced is refined domestically with only a small volume destined for export.

The Belayim Blend, as with the Suez Blend is domestically refined and not exported in great quantities. It is sourced from aging offshore fields in the Gulf of Suez. According to McQuilling Services, it has an API gravity of 27.5, making it a medium crude, but its value is decreased by its high sulfur percentage of 2.2%. It also trades at a lower price than Brent.

The Western Desert Blend, unlike the Belayim and Suez blends, is sourced from newer fields and not in decline. It has a typical API gravity of 41.1 and sulfur percentage of 0.34%, making it both light and sweet. Egypt's production of light and sweet crude has overtaken less valuable grades in the past eight years. Over the past 18 years, production has shifted from medium and sour grades towards light and sweet. In 2000, medium and sour crude accounted for 83% of Egypt's output. By 2016, this had fallen to just 37.8%, with light and sweet crude now making up 62.2% of the country's production.

Crude from the Eni's two exploratory wells drilled so far by Eni in the Faghur Basin - A2-X, drilled in May 2018, and B1-X, drilled in June 2018 - have encountered pockets of crude oil with API gravities of 32 and 37 respectively. Each are relatively small discoveries, but significant in showing the viability in the area. In July 2018, Apache announced their $9 billion agreement to explore and produce oil in the Western Desert, as well as drill seven wells in the area.

LIGHT-HEAVY PRICE DIFFERENTIAL

The price differential between heavy and light fuel products is no longer as stark as it once was. For example, in February 2017 the price difference between Louisiana Light Sweet crude and heavy Maya crude on the US Gulf Coast was almost $10 a barrel. Within the last month the price differential between the two grades has been less than $2 a barrel at some points.

The discount at which heavy crude has generally been sold has become smaller, because of both a decrease in heavy crude production and the advent of much improved refineries able to process heavy crude at ease, which are able to extract higher volumes of more valuable product such as gasoline than before.

There has also been an increase in light and sweet crude production. The OPEC-sanctioned production cuts exempted Nigeria and Libya (which mainly produce light and sweet crude) due to domestic volatility making output predictions unreliable, meaning both countries continued to produce high amounts. The two countries saw 18-month and four-year output highs of light sweet crude in 2017 respectively. In addition, the massive increase in US shale production in 2017 flooded the market with more light sweet oil, and again saw the premium of lighter grades fall.

Despite this, light crude remains more expensive than heavy crude, however by a relatively small margin - as of August 13 Iran Light stood at $71.24 a barrel and Iran Heavy stood at $67.8 a barrel, Basra Light and Basra Heavy saw prices of $73.31 and $69.08 respectively on the same date. Considering the balance of costs in transportation and refining, which were the reason for its premium, the value of light crude has fallen in comparison to its heavier counterpart. Demand for light crude may pick up if the price continues to fall comparatively, making it more competitive. Eklavya Gupte, Senior Editor at S&P Global Platts Oil News, stated that "one of the only avenues for these light sweet barrels to sell faster is for the price differentials of such crudes to fall even further, and make them more competitive with their sour counterparts."

FAGHUR BASIN NEW EXPLORATORY WELLS - ENI

SWM B1-X

Discovery: July 2018
Depth: 4,523 meters
Encounter: 35 meters net of light oil
Current Capacity: 5,130 b/d & low associated gas
API: 37

SWM A2-X

Discovery: May 2018
Depth: 5,090 meters
Encounter: 18 meters of light oil
Current Capacity: 2,300 b/d & 0.4 MMSCFD of associated gas
API: 32

KEEPING OIL STEADY IN THE WAKE OF ZOHR

Gas, rather than oil, is the future of the Egyptian energy sector. The country's crude reserves are simply not high enough for it to compete against the giants in the region. However, onshore Western Desert exploration shows promise. The new discoveries indicate that the Egyptian oil sector will remain stable for the foreseeable future, allowing it to maintain current levels of production while the focus of the industry shifts to Mediterranean gas.

The depletion of the offshore fields in the Gulf of Suez and the recent discoveries in the Western Desert have changed the Egyptian oil environment, which has been historically leaned towards heavy oil production. Light crude is now the dominant force in Egyptian oil. While traditionally more valuable, a mixture of geopolitics affecting supply, the boom in the US shale industry, and improvements in refining technology have decreased the demand for what once was definitively the more desirable grade of crude. However, the volatility of the market, with constantly ensuring geopolitical crises, continued price uncertainty, and further OPEC production cuts, the current state of light crude cannot be taken as reliable indicator for its future.

OIL SHALE: THE FORGOTTEN ENERGY SOURCE

By Matthew Hoare

At a time when the country is experiencing a boom in its natural gas production, it is understandable if exploring alternative, more expensive sources of energy is perhaps not a major priority of the Egyptian government.

This is not to say that the country's unconventional energy sector is suffering from a state of inertia. The past few years have seen the genesis of a number of projects seeking to capitalize on Egypt's shale gas potential. Other sources of energy – such as oil shale – have been neglected.

Egypt is not an anomaly when it comes to the underdevelopment of its oil shale resources - it follows a global trend. Oil shale remains a relatively untapped energy source whose potential is yet to be fully realized.

OIL SHALE AS AN ENERGY RESOURCE

It has been known for a number of years that Egypt possesses several known sites of oil shale. Oil shale – not to be confused with shale oil – is a source of petroleum found within shale rock.

While shale gas and shale oil remain classified as unconventional energy sources, oil shale has in fact been seen as a conventional source since 2013, according to a research paper published by Suez University.

Oil shale is commonly defined as a fine-grained sedimentary rock that contains organic materials rich with kerogen: a substance made up of a mixture of paraffin hydrocarbons, sulfur and nitrogen out of which oil may be extracted. This is different to shale oil, which refers to refinable oil deposits trapped inside the rock, requiring no heating processes in order to extract them.

Kerogen is derived from different materials which determine the hydrocarbon that can be extracted. Type I and II kerogen mainly produce oil while gas can be extracted from type III kerogen. When the substance is subjected to a chemical heating process referred to as pyrolysis, hydrocarbons are released to produce a synthetic form of crude. In order to achieve this, kerogen must be heated to temperatures of between 350 and 400 degrees.

EXTRACTION METHODS

The methods of extraction largely depend on the depth at which the shale is located. Shale positioned close to the surface may be mined using conventional techniques applied in the mining of oil sands. Deeper deposits require the application of more complex processes, such as in-situ retorting and underground mining. Underground mining – usually using the room-and-pillar method – recovers around 60% of the shale from smaller seams. However, with larger, deeper deposits, this technique is incredibly inefficient, recovering as little as 10% of the shale.

In-situ retorting is a process by which the oil shale is heated in place, and the liquid material is extracted from the ground. The technique relies on conducting controlled explosions underground in order to break down the shale, and ensure adequate air supply for the combustion process. Although in-situ retorting was first developed back in the 1980s, more recently Shell has developed an alternative in-situ technique by which heaters are lowered into the ground, and the shale is heated to release the kerogen, before being pumped to the surface. Shell's technique makes use of an ice wall installed around the shale site, which prevents potentially harmful compounds from being released into the ground.

Surface retorting involves crushing the shale and sending it to surface retorts – large vessels in which the shale is heated. Unlike in-situ retorting, surface retorting has a history of use by countries including China and Brazil.

WORLD RESERVES

Producing an accurate estimate of global oil shale reserves is problematic for several reasons. Firstly, there is a large variance of kerogen content within shale, and without analyzing every single shale deposit it is impossible to come to a reliable estimate of how much oil lies within the planet's shale deposits. Secondly, many shale deposits are located deep beneath the Earth's surface, placing them physically out of reach or rendering them unfeasible from a financial standpoint.

The most reliable global estimates come from the International Energy Agency's (IEA) 2010 World Energy Outlook (WEO), which states that there may be up to 5 trillion barrels of oil contained within shale around the world. Of this, more than 1 trillion barrels can feasibly be extracted. In addition, the IEA estimates that there are around 350 billion barrels of oil contained in shale located at shallow depths. It is unknown how much of this it is possible to extract.

HIGHLIGHT

SHALE POSITIONED CLOSE TO THE SURFACE MAY BE MINED USING CONVENTIONAL TECHNIQUES APPLIED IN THE MINING OF OIL SANDS. DEEPER DEPOSITS REQUIRE THE APPLICATION OF MORE COMPLEX PROCESSES.

OIL SHALE IN EGYPT

A succession of geological studies over the past few years have sought to understand more about Egypt's oil shale reserves. Shale deposits have been found in all parts of the country: in the Western Desert, the Eastern Desert and the Sinai Peninsula. Studies into the geological composition of the known shale sites have led experts to estimate that Egypt has around 16.5 billion barrels of oil.

The largest shale deposit is located at Quseir-Safaga in the Eastern Desert. This reserve is estimated to hold around 9 billion tons of shale, from which it is thought that around 4.5 - 5 billion barrels of crude could be extracted.

HIGHLIGHT

STUDIES INTO THE GEOLOGICAL COMPOSITION OF THE KNOWN SHALE SITES HAVE LED EXPERTS TO ESTIMATE THAT EGYPT HAS AROUND 16.5 BILLION BARRELS OF OIL.

According to a study undertaken by a group of researchers from the Egyptian Petroleum Institute and the American University in Cairo in 2014, the Quseir-Safaga site has the potential to be a commercially viable site of oil shale production. "After conducting the oil shale experiments on different samples (Quseir, Abu Tartur, and Colorado) we reached different results that show that Quseir is a commercial field for oil shale production," they wrote.

Another major site is the Gabal Duwi range in the Eastern Desert, which is estimated to hold around 4.8 billion barrels of oil. Other locations include Abu Tartur in the Western Desert, thought to contain around 1.2 billion barrels, Zog El Behar (2.5 billion barrels), West Youns (2 billion barrels), and Abu Sheyala (1 billion barrels).

THE FUTURE OF OIL SHALE

No company has yet worked out how to turn large-scale oil shale production into a commercially viable operation. While there are countries that have produced crude from oil shale reserves, production takes place at a far smaller level compared to conventional petroleum sources.

Despite the fact that large shale deposits exist all over the world, companies are yet to develop an economical way of mining, retorting and refining the shale. The costs of production are so high that some estimates say that crude prices would have to rise to $100 per barrel before oil shale becomes viable commercially. Even in a country like the US – which has around 1 trillion barrels in technically recoverable oil shale deposits in shallow areas – there is yet to be a serious push to develop it on a large scale.

Before oil shale becomes a realistic prospect in Egypt, advances will need to be made at the global level to turn it into a feasible source of energy; either technological breakthroughs, a dramatic rise in the price of oil, or a concerted investment drive by national governments. In addition to this, further exploratory drilling and geological analysis should be conducted before Egypt can think about capitalizing on its oil shale resources.

CONTAINING TRUCK INCIDENTS: A MAJOR SAFETY THREAT IN THE OIL INDUSTRY

By Omnia Farrag

The oil and gas industry holds some of the biggest hazards in operations. Its workers are often exposed to tough working conditions, in addition to heavy and sensitive materials and machines. Yet, most fatalities in the industry are not caused by heavy equipment or errors in complicated processes. Instead and surprisingly, they are mainly caused by driving mistakes.

"Most of the fatalities happening in the onshore oil and gas fields happen because of driving mistakes. We can secure complicated activities, such as drilling wells without any technical incidents, but we have no technique to prevent car accidents," Emad Elewa, HSE manager at Apex International Energy, told Egypt Oil & Gas.

DRIVING ERRORS EXPLAINED

Most of the death accidents in the petroleum industry are caused by highway accidents as workers and equipment have to be transported for long distances to and from the remote areas where the wells are located. While there is no data about fatalities caused by road accidents in the Egyptian oil and gas industry, the American Bureau of Labor Statistics (BLS) found that around four out of 10 American workers killed on duty in the petroleum industry are killed as a result of a highway vehicle incident – this number refers to accidents during the transportation of equipment to the oil rigs.

Driving mistakes within the oil field itself is another deadly threat as they are one of the reasons behind struck-by, caught-in, and caught-between incidents. Such incidents lead to three out of each five deaths in the industry, the BLS wrote. These incidents are also caused by moving equipment, falling equipment, and high-pressure lines.

TRUCKS IN THE PETROLEUM INDUSTRY

Beside transporting people and material to the fields, the petroleum upstream industry uses many specialized trucks to carry on operations such as the swab rig trucks. These oil specialized trucks are used to kick off the well through lowering a cable and winch down into a well in a way that releases pressure in the hole. Vacuum trucks are also commonly used in the fields as they suck water, mud, and other materials resulted from drilling and fracking.

Hot oil trucks are also used to carry on treatments needed for operations such as heating the flow of lines and cleaning equipment blockages. Frac water heater trucks are another type of specialized trucks used for heating the water for the hydraulic fracturing process, a well stimulation technique.

REASONS BEHIND DRIVING ERRORS

Elewa believes that controlling road accidents in Egypt is more challenging than it would be in some other places worldwide, since driving standards in Egypt are not as good as in other countries. "It does not meet the international standards. It is the most significant risk we consider in Egypt," Elewa added.

Driving fatigue is a common issue that truck drivers face in any industry all over the world. Over 750 people die and over 20,000 are injured each year because of fatigued commercial drivers in the US, according to the American Federal Motor Carrier Safety Administration (FMCSA). These accidents account to 40% of all heavy truck crashes, the American National Highway Traffic Safety Administration reported. These numbers show the deadly effect of having truck drivers to work for long shifts without proper breaks.

"Drug abuse is common among truck drivers to manage driving long trips and staying away from home," Elewa added. Drugs allow drivers to stay awake for long hours; however, they significantly decrease their concentration causing more accidents. Around 40% of truck drivers who were subject to the Egyptian Ministry of Interior campaign in 2014 were under drugs influence, local newspapers reported citing officials. While the traffic law obliges drivers to carry out drug tests as a prerequisite for driving license, drivers can still get away when caught under drugs influence. They can only be prosecuted if drugs were actually found with them, according to article 30 of the Egyptian traffic law.

In some accidents, route changes become the reason behind fatalities, as there are landmine fields in specific areas in the Western Desert, including Quattara Depression, Alamein, and the cities of Marsa Matruh, and Sallum. The country has approximately 23 million landmines covering 22% of its area. "It [truck drivers changing route] happened in the Western Desert and they went through a road that had landmines," Elewa elaborated.

SOME RECOMMENDATIONS

To decrease road accidents, which are proven to be a major cause for industry fatalities, Elewa advised oil companies to have their own oil transportation monitor system. He also recommended to have a clear driving policy and procedures to minimize the risk of driving accidents in the sector.

Experts also advise companies to guarantee drivers the right to take at least a 30-minute break after eight hours of their shifts as the risk of crash doubles from the eighth to the tenth hour of driving and doubles again from the tenth to the eleventh hour.

To avoid incidents, companies are not only advised to train their new employees, but also do refresher training to their old employees. Finally, new roads should be studied before taking any new route – the HSE department should study the risks affiliated with applying new procedures, which includes route changes.

TAPPING HARD-TO-ACCESS ONSHORE RESOURCES

By Sarah Samir

Oil and natural gas have been among Egypt's profitable resources for years. The North African country started by tapping fields on land rather than those in its territorial waters. Now, these onshore wells are starting to reach maturity, and industry leaders have begun to use previously unprecedented technologies to tap Egypt's riches. Companies are now adopting innovative means to produce tight oil and gas, revive onshore brownfields, and maximize the production rates from these resources.

DIGGING DEEPER

Egypt has been tapping unconventional hydrocarbon resources located in deeper strata that are difficult to be reached using normal techniques. "The demand for oil and gas in Egypt is growing every day, which drives Egypt to keep looking for more oil and gas reserves. This high demand led to the exploration for unconventional reservoirs," Senior Advisor Reservoir Engineer at Apache Corporation, Dr. Mazher Ibrahim, told Egypt Oil & Gas.

In addition, the growing energy demand builds a local market that encourages international oil companies (IOCs) to invest and share their technologies in the Egyptian unconventional exploration fields. In order to extract oil and natural gas from deep strata, the operators need to use highly efficient advanced techniques throughout all the phases of any unconventional project in order to address the "very low permeability" nature of the fields, which requires "drilling horizontal wells with long horizontal section, increasing the contact area with

the reservoir, and creating a stimulated reservoir volume (SRV) with acceptable conductivity, which can deliver hydrocarbons by conducting multi-stages hydraulic fracture jobs," Mohamed Adel Gabry, Senior Petroleum Engineer at Khalda Petroleum Company told Egypt Oil & Gas.

One of the successful techniques implemented in unconventional drilling is geosteering, Senior Production Engineer at Apache Corporation, El Sayed Elshazly, told us. Geosteering consists in a way to control the wells according to downhole geological logging measurements, as defined by Schlumberger website. Geosteering is "used to keep the wellbore within a particular section of the fractured reservoir and maximize economic production from the well," Elshazly explained.

However, the idea of what is considered an unconventional hydrocarbon resource changes as time passes and as new technologies are invented. "What we consider a conventional field today was considered unconventional or even sort of science fiction 25 years ago," Elshazly said. Back in 1960, the list of unconventional hydrocarbon resources included tight gas sandstones; shale oil; oil shale; shale gas; heavy oil; tar sands; coal to gas; bitumen; coal bed methane (CBM); and gas to liquids, according to a research entitled 'Unconventional Reservoir: Definitions, Types and Egypt's Potential' by Suez University scholars. By 2013, unconventional hydrocarbon resources had been narrowed down to just coal seam gas and gas hydrates, according to the study.

UNCONVENTIONAL NATURAL GAS

In 2008, Royal Dutch Shell discovered Egypt's first commercially-viable unconventional natural gas reservoir - the Apollonia play. Yet, the vertical production from the field proved uneconomical. Therefore, investors teamed-up to start producing tight-gas from horizontal wells. The Apollonia reservoir is a concession operated by Bapetco along with shareholders: Apache, Shell, and EGPC.

The development and growth of the Apollonia field is ongoing. "Egypt started producing the first unconventional gas in 2016, the project is still in the early stage of development and more wells are yet to come," Elshazly commented. The companies planned to start the project by drilling three horizontal wells in the reservoir. "Two of the three planned pilot horizontal wells have been drilled and completed with eight stages of fracture stimulation," according to the Journal of Petroleum Technology's (JPT) article 'Unlocking Egypt's Unconventional Resource Potential'. The first horizontal well was drilled in Q2 2016, while the second well's drilling took place in Q4 2016 and production commenced early 2017, the article points out.

The operating companies in the reservoir adapted several techniques to enhance the wells. "Bapetco has performed large-scale foam fracturing operations to maximize the well productivity," stated the Society of Petroleum Engineers (SPE) in the article entitled 'Critical Success Factors Identification to Develop Unconventional High Porosity Low Permeability Shallow Limestone Reservoir of Apollonia Formation, Western Desert, Egypt. With this, the company conducted the first accomplished foam fracturing process in North Africa, according to the article.

REVIVING BROWNFIELDS

Egypt's oil consumption is growing relative to its production. In May 2018, the North African country consumed 2.935 million tons of petroleum products, while it produced 2.863 million tons of crude oil, condensates and butane, according to CAPMAS data. Accordingly, the government is working to boost crude oil production through new discoveries and the revitalization of brownfields.

Brownfields are oil and natural gas fields with declining production rates, and which are close to reaching maturity. Around 77% of Egypt's oil production comes from brownfields. Hydrocarbon industry leaders use several stimulation techniques in order to develop brownfields and maximize their lifespan. The techniques include "acid stimulation, hydraulic fracture stimulation techniques, [besides] the use of artificial lifts with maximum withdrawal rate to get maximum production from that wells," Mohamed Gabry told us.

In 2017, world oil leaders were increasing their conventional exploration, with almost 75% of the approved projects being brownfields, according to the Financial Times's article entitled 'Big Oil fights back'. "Not only are [brownfield] projects less risky than greenfield developments, they also tend to be less capital-intensive and are quicker to bring on stream, offering a quicker payback and better returns on development dollars," Angus Rodger, research director at Wood Mackenzie, told the Financial Times. Global oil prices have started growing up to reach over $70 a barrel. Yet, as an oil importer, Egypt should use economic exploration types and innovative unconventional technology to boost its output from these existing fields.

THE ECONOMIC IMPACT OF UNCONVENTIONAL ENERGY

One of the main challenges faced during unconventional exploration is the cost needed for technology and specialized personnel. Even the techniques carried over from conventional plays are required to be performed more intensely in unconventional plays. "Although horizontal drilling is sometimes used for conventional wells, the unconventional play pushes the limits of horizontal drilling reaching out to more than 3,500 feet," Elshazly explained, adding that the completion and production are further representing challenges for the currently used techniques in exploration and production (E&P) firms.

"As more E&P companies adopt new technologies, the advanced techniques [required for unconventional exploration] will be available at lower prices, and the national personnel will gain more experience using them," Elshazly continued. As the country's personnel gain experience, many people will find vacancies to work whether in engineering or technical positions.

Egypt has started implementing new methods and using novel technologies including tracer technology, which Elshazly says will "be of a great significance in the future" to both conventional and unconventional energy sources.

The cost of developing unconventional sources is a challenge. "From an economic point of view, the unconventional reservoirs differ from the conventional reservoir in the high capital cost of drilling horizontal wells with multi-stages hydraulic fracture," Gabry stated. However, "the operating cost will be low as the production performance problems are low," Gabry noted, adding that "the economic risk of unconventional reservoir are low because the unconventional reservoirs have a very wide areal extent."

Moreover, Dr. Mazher Ibrahim said that the cost "could be optimized by applying unconventional technology and using local resources." Adding to that, Elshazly noted that "the easy access to new technology and the readiness of local expertise can significantly reduce the cost of producing and developing unconventional fields. Ultimately, the return on investment will increase and the unconventional play will be favorable and profitable for more investors."

However, in order for unconventional exploration to be economically feasible in Egypt, global oil prices need to go higher to compensate for the costs. "The major problems facing Egypt have been the need of huge amount of freshwater and low oil price during the last few years," Ahmed Algarhy, PhD Assistant Professor at the Petroleum Engineering and Geology Department, Marietta College, told Egypt Oil & Gas. Algarhy explained that "organic shale development as major unconventional reservoirs may need oil prices near $90 [a barrel] to be feasible to be developed in Egypt."

Yet, Algarhy anticipated ways to minimize unconventional development costs to make it profitable for Egypt. He highlighted the existence of studies conducted on methods to "minimize the need for water in fracturing, like in using a plasma pulse to fracture the formation," which could decrease the costs of exploring unconventional resources.

Tapping hard-to-access hydrocarbon unconventional resources and reviving oil and natural gas brownfields are among ways to secure Egypt's growing energy demands. Hence, over the long term, it will save huge amounts of foreign currency that would otherwise be spent on importing oil and liquefied natural gas. With the use of the right technologies and local personnel, Egypt will be able to bolster its foreign currency reserves and support petroleum sector employment.

> *WHAT WE CONSIDER A CONVENTIONAL FIELD TODAY WAS CONSIDERED UNCONVENTIONAL OR EVEN SORT OF SCIENCE FICTION 25 YEARS AGO ... THE EASY ACCESS TO NEW TECHNOLOGY AND THE READINESS OF LOCAL EXPERTISE CAN SIGNIFICANTLY REDUCE THE COST OF PRODUCING AND DEVELOPING UNCONVENTIONAL FIELDS.*
>
> **EL SAYED ELSHAZLY, SENIOR PRODUCTION ENGINEER, APACHE CORPORATION**

> *THE MAJOR PROBLEMS FACING EGYPT HAVE BEEN THE NEED OF HUGE AMOUNT OF FRESHWATER AND LOW OIL PRICE DURING THE LAST FEW YEARS... MAJOR UNCONVENTIONAL RESERVOIRS MAY NEED OIL PRICES NEAR $90 [A BARREL] TO BE FEASIBLE TO BE DEVELOPED IN EGYPT.*
>
> **AHMED ALGARHY, PHD ASSISTANT PROFESSOR AT THE PETROLEUM ENGINEERING AND GEOLOGY DEPARTMENT, MARIETTA COLLEGE**

THE CLASH BETWEEN BENEFITS AND THREATS IN OIL PRICES

By Osama Radwan

The petroleum market dynamics have exhibited commodity price turbulence over the past few years. The 2014 oil-prices downturn allowed oil-importing countries to lower their expenses and fiscal deficits, while exporting countries suffered losses. The latest oil price rise has enabled the economies of exporting countries to recover, while hurting the economies of oil importers.

The market has been changing over the past five years, with large fluctuations of oil prices affecting businesses negatively. The giant producers were under pressure to cut production to increase commodity prices, but, instead, they continued to produce normally, which directly contributed to the surplus of production and the severe drop in oil prices. Recently, the coalescence of geopolitical issues in oil-producing countries have combined with the OPEC-sanctioned production cuts to force prices upwards.

MARKET POLITICS AND ECONOMICS

Before discussing the reasons for the 2014 downturn, it is important to examine the foundations for the oil boom. There has been a noticeable global increase in the demand for petroleum products. Simultaneously, technology used in production has evolved rapidly and hydraulic fracturing rose to become a dominant technique used in the industry. The US increased the production of unconventional reservoirs by employing the hydraulic fracturing in the Permian basin and other shale plays supported by the increase of the oil production in major oil-producing countries. This, then, created a situation of constant demand and increasing oil production, which affected the market dynamics and led the oil prices to crash.

THE 2014 PRICE DOWNTURN

The debates about the principal reasons for the 2014 downturn in oil prices were continuous. Dr. Riverson Oppong, the country director of Bay Kinetics Subsea Technology LLC, told Egypt Oil & Gas that "if you entertain such emotional conflict over oil prices you will surely get a heart attack. The dynamics of the disparity between crude prices and product prices are indeed deep."

Ralph Eads, vice chairman and global head of energy investment banking at Jefferies LLC, said in 2015 that "the Saudis have the will and the money to cut prices, there is political stability in all the bad actor countries and we have slack global demand." He continued stating that "Saudis want to increase their political clout and to hit other countries' pocketbooks to create uncertainty about long-term oil prices to cut projects and lower others' production."

It is obvious that Eads is against the Saudis' strategy and considers them responsible for engineering the price downturn. Others, however, see the US as being the primary actor due to the entrance of shale into the market.

The Energy Information Administration (EIA) reported on September 30, 2015, that the US crude oil inventories rose by 4.5 million barrels from the week before. Evan Tarver, an economics researcher, said that the country's oil inventories reached 80-year highs . "It was not only an oversupply, but also an increasing production," he said.

"The US implicitly initiated the oil prices drop by the actions in the downturn period. The US shale industry evolved rapidly contributing to the oil production increase," he stated. "Moreover, the surge in the US dollar in the second half of 2014 caused a sharp fall in the commodities indexes. The US nuclear deal with Iran allowed more Iranian oil exports. Market reacted to this news by decreasing the oil price," he added.

> *"THE COLLAPSE OF MAJOR PROJECTS, THE MERGERS, OPERATIONAL SHIFTS TO DIGITALIZATION AND THE BULK TERMINATIONS OF EMPLOYMENT CONTRACTS WERE SOME OF THE MAIN EVENTS THE OIL INDUSTRY HAS WITNESSED DURING THE FALL OF OIL PRICES."*
>
> **MOHAMED YOUSEF ALKLIH, RESERVOIR ENGINEER, ADNOC**

Abdelrahman El-Diasty, vice president of petroleum engineering at Prime Rock Energy Capital LLC, remarked at how the US shale industry benefited from the collapse in prices. "No one would give you an ear, four years ago, if you said that oil prices would be cut in more than a half, but that shale revolution would be that strong and continue to grow output," he said.

Mohamed Yousef Alklih, reservoir engineer at the Abu Dhabi National Oil Company (ADNOC), told Egypt Oil & Gas about the negative effects felt by oil companies.

"Watching events unfold over the past period of the downturn in the oil industry, driven by supply-demand disruption, has been shocking on some occasions, prompting oil companies to reform their portfolios and do cost optimization exercises intensely," he said.

"The collapse of major projects, the mergers, operational shifts to digitalization and the bulk terminations of employment contracts were some of the main events the oil industry has witnessed during the fall of oil prices," he added.

Through examining the differing experiences of the US shale industry and oil companies from other parts of the world, we can see that movements in the price of oil can be seen as beneficial for some parties and threatening to others.

RISING RISK, RISING PRICES

The recent rise in the oil price has been driven by a number of events and decisions. Although some countries have recently started increasing production, the prices went higher, affected by economic and political instability. The global demand for crude oil remains strong and geopolitical risks are rising.

When the American administration decided to unilaterally exit the nuclear deal with Iran, international oil companies (IOCs) operating in the country and buyers of Iranian crude were left in a delicate situation. Although Iran's exports have not significantly dropped, the speculation has been raised on the future of Iranian oil, which influences the dynamics of oil prices.

Additionally, Venezuela, the oil-rich South American country, has decreased its oil production due to its ageing conventional oilfields, alongside its economic and political crises. "Lots of oilfield employees in Venezuela resigned because of the law wages and weak safety policies," the EIA reported.

Iran and Venezuela are not the only sources for instability, with destabilizing situations in Iraq, Yemen, Syria, and Libya weighing on the oil markets.

In particular, it would be extraordinary - after last year's price rise - if these increases did not affect global demand. Statistically, the global demand growth went down from 1.5 million b/d to 1.4 million b/d, according to Watchdog in May. Moreover, the indicators show that the global market will receive an extra amount of refined petroleum products in the upcoming years, due to projects such as the Canada-US pipeline.

THE EGYPTIAN SCENARIO

Each country experiences oil price fluctuations in a different way. Among the financial problems imposed by oil prices was the increase of governmental allocations from the national budget in countries that subsidize the energy sector. As an oil importing country, Egypt is at risk of oil price fluctuations.

In the last fiscal year the government planned its finances assuming oil would average $55 a barrel. The oil price then hit $80 a barrel, then retreated to $77 a barrel, placing great pressure on government finances and increasing the budget deficit simultaneously. Fuel subsidy costs, one of the main burdens on Egyptian state finances, increased sharply, which led the government to implement the gradual cut of fuel subsidies in the country.

Now at over $70 per barrel, crude prices have already risen above the 2018/19 budget's benchmark price of $67. In response, the cabinet gave the go-ahead for the ministry to negotiate contracts with international financial institutions that would insure against the rising prices.

According to the Ministry of Petroleum and Mineral Resources, Egypt's oil production covers nearly 65% of the country's needs. Oil produced within Egypt is sold to the domestic market at the international rates and the government covers a portion of the price for public use, saving only the shipment costs.

As paying the country's debts to IOCs and moving forward with the subsidy reform remain as challenging steps in the new fiscal year, Egypt must keep its efforts to secure the existing fund and the foreign currency reserves. The government should continue to attract big investment opportunities, and liberalize their markets to encourage small, medium, and large investors to enter the Egyptian market – thus decreasing the negative impacts of the oil prices downturn in the past years.

THE BULLWHIP EFFECT
IN THE OIL AND GAS INDUSTRY

By Vinodkumar Raghothamarao, Director Consulting, Energy Wide Perspectives & Strategy, IHS Markit EMEA

Between the 1940's and the 1970's, the average annual price of oil fluctuated within a 6.5% band, but from the 1980's until the last few years, the variation leapt to almost 11 times that amount. A range of factors have contributed to the most recent volatility, including political crises, financial speculation, and a sharp increase/decrease in demand.

Regardless of the reason behind the initial shocks, the variation from a steady state historical demand induced the "bullwhip effect", in which small changes in demand cause oscillating and increasing reverberations in production, capacity, and inventory throughout the supply chain in markets for oil and gas field machinery and equipment, such as generator sets, motors, turbines and electrical equipment, among other equipment and supplies.

Small variations in demand at the retail end tend to dramatically amplify as they travel upstream across supply chains with the effect that order amounts are very unbalanced and can be exaggerated in one week and almost zero in following next week. This amplification of demand fluctuations from downstream to upstream in a supply-chain is called the bullwhip effect.

Variability also comes from changes and updates of the demand forecasts. After all we aware that the bullwhip effect is the tendency of small variations in demand to become larger as their implications are transmitted backward through the supply-chain.

This bullwhip effect has caused the following types of economic inefficiency at oil company equipment suppliers:

- Equipment manufacturers held excess inventory during the boom and took a long time to draw it down when the recession hit;
- Equipment manufacturers made excessive capacity investments near the peak and suffered a low or negative return on investment on it;
- Component and parts suppliers lost orders that they were not able to fulfill at the peak due to inadequate capacity and long lead times caused by large backlogs.

In the long term, this volatility costs the equivalent of 9% of the cost of producing a barrel of oil. Smoothing volatility in demand and prices would result in steadier and more profitable capital expansion, which means a higher return on assets. Steadier prices would translate to higher operating profits and lower operating costs as companies would go through fewer waves of layoffs and subsequent re-hiring. Perhaps most importantly, more stable research and development (R&D) investments would result in greater oilfield productivity.

The million-dollar question then becomes: what can oil companies and their equipment suppliers do? Passing all risk to suppliers is a win-lose strategy that only works well for buyers when demand is decreasing because buyers can drive prices lower. In contrast, "going long" minimizes the cost throughout the supply chain, especially if combined with collaborative supply chain management activities such as sharing production, marketing, and engineering information among exploration and production companies, refiners, and manufacturers; sharing of capital investment; and sharing of supply risk through price indexing and the use of options and futures contracts.

If you "go long," be sure to sign long enough agreements to bridge the up-and-down cycle. Many buyers think a long-term agreement lasts for 3-5 years in duration. Because this is shorter than it takes for an initial demand shock to reverberate through the supply chain, the contract has a significant risk of painful and premature failure. From the past consulting experience working with national oil companies (NOCs), international oil companies (IOCs), independents, and other oil field equipment suppliers, it indicates that if you are going to go long, you may need a much longer agreement in order to fully mitigate the impact of production-inventory- capacity cycles - and the optimal length varies according to the category of purchased equipment or services.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PRODUCTION AND EXPLOITATION COSTS OF SHALE GAS IN THE US

Shale gas production in the United States is concentrated in a few fields. The largest three fields, Haysville, Barnett (Texas), and Marcellus (West Virginia), accounted for 66% of the total gas production in mid-2012. The first three in terms of production are Fayetteville (Arkansas), Eagle Ford, and Woodford (Oklahoma). Their production accounts for 22% of total shale gas production, so the production of the six fields accounts for 88% of US shale gas production.

Shale gas wells take a sharper decline. For example, the production of Hinesville wells decreased by an average of 68% in the first year, and by 50% in the second, third and fourth years. This leads to a sharp decline in production unless wells are drilled continuously.

The share of shale gas in total US natural gas production rose from 1.6% in 1996 to about 10% in 2008. US shale gas reserves have made a huge jump in 2008, rising from 21.7 trillion cubic feet (tcf) in late 2007 to 32.8 tcf a year later. At the end of 2008, gas reserves represented 13.8% of the total proven US natural gas resources, up from 9.1% at the end of 2007. The unexpected success of the Texas Barnett Gas Project in particular has spurred other sources of shale gas all over the US.

In 2000, proven shale gas accounted for 1% of natural gas production in the US, and 20% by 2010. According to the Energy Information Administration (EIA) forecast, by 2035 shale gas will account for 46% of the US natural gas supply.

In the US, gas resources will keep natural gas prices relatively low for an extended period of time, and the longer the period, the greater the demand for natural gas in the transport and power generation sectors. The EIA predicts that shale gas will account for half of the total US gas production over the next two decades, compared to about one-third at the present time. This is likely to lead the US to energy self-sufficiency by 2020; not needing to import gas or oil to meet its energy demand.

The utilization rate of US reserves of shale gas has increased rapidly and is likely to continue at the same pace in the coming years, as technology and experience in this sector develop and lower production costs. The underlying causes of this boom include:

- Significant improvements in drilling, fracturing, and production techniques in general;
- Cumulative knowledge that led to further cost reductions and increased margins, which will ensure the continuation of the boom beyond the first easy production stages. Perhaps one of the most prominent examples that supports these expectations is what happened in the Marcellus fields, where the costs of the well decreased from $10 million to $4 million.

COSTS OF PRODUCING SHALE GAS

There is considerable debate about the cost of producing shale gas, with estimates for production cost in North America ranging from $4 to $8 per thousand cubic feet. On one hand, supporters of the low price hypothesis argue that the production of shale gas can remain at the very low level of the first three months of drilling. They also say that the ease with which water fracturing is done many times is a good reason to keep prices low in the future. On the other hand, the high price hypothesis advocates argue that the costs of current drilling are prohibitive and that they will continue to rise with laws protecting the environment. Costs of compensation for water and removal of chemical waste will be added to production costs. Typical shale gas wells cost between $5 million and $8 million for drilling and completion the work.

Accessibility, as well as environmental laws and proximity to the natural gas infrastructure generally determine the production cost of shale gas. In remote areas, prices will certainly be higher as a result of the need for processing plants and transport pipelines to market.

BY HASSAN SALEM
Reservoir Engineering Studies General Manager
Egyptian General Petroleum Corporation (EGPC)

UNCONVENTIONAL OIL AND GAS AGREEMENTS: NEW TRENDS

Economics is the key driver of business, especially in the oil and gas sector. The dynamic variation of oil prices is rapidly changing the field's economics, and strengthens the need to adapt new technical concepts to create the most cost-effective opportunities.

Unconventional and mature fields are one of the more challenging aspects of the oil and gas sector from an economic point of view. Creating effective opportunities for oil delivery from subsurface to sale will support the new techniques needed to explore and develop unconventional and mature fields, such as secondary and tertiary oil recovery. Such approaches will enable the continuity of these fields by reducing the barrel operating cost and well capex.

On the other hand, attractive and profitable agreements for exploring and developing such fields will open the door to building mutual trust between stakeholders, and assist decision-makers to increase investment.

Up until now, most upstream petroleum laws, regulations, contracts, and fiscal regimes were drafted with only conventional petroleum activity in mind. This ignores the specificities of unconventional petroleum, which was not of commercial interest at that time. The original production sharing contract (PSC) system of a fixed percentage of profit petroleum sharing is no longer used. It was replaced by a sliding scale based on different progressive systems such as: increments of daily production or cumulative production; the R-factor – a profitability criterion equal to the ratio between revenues and costs for the period from the contract signing date to each date of production sharinga; and the effective rate-of-return (ROR).

Over the last decade, the R-factor has become the most popular profitability criterion used for triggering progressive sharing mechanisms in the world. This is despite the attempts of some countries to modify its fiscal system to comply with these types of resources. Only exploration and production (E&P) contracts which are built with a reasonably progressive fiscal scheme can be sustainable, encourage fiscal stability, and foster the pursuit of new investments in such adventures. This is because they are designed to allow both the host country to receive a fair government take whatever the changing circumstances, and the international petroleum company to achieve its profitability criteria,

BY HANY SHAKER
General Manager, Feasibility Studies & Project Evaluation, Production Department (EGPC)

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Key Highlights of the IMF's Third Review on Egypt

Missed/ Delayed Targets

Missed Targets

Primary fiscal surplus
(By a dismal margin)

Indicative target on EGPC arrears
(Missed by USD 200 mn compared to a target of USD 400 mn)

Targets Met with Delay

Divestment of shares in public enterprises
(End-Jan. structural benchmark; announced in March)

Fuel price indexation mechanism
(End-Feb. structural benchmark; approved in June)

Likely Missed by June '18

Budget sector debt target
%
(Due to higher-than-expected interest payments)

Fuel subsidy bill
$
(Due to higher-than-expected international oil prices)

Key Risks

Global risk aversion
Resulting in pullback of investors from emerging markets

A sustained rise of international oil prices

Reform fatigue
(Loss of momentum on structural reforms)

Worsening of the security situation
(Would disrupt tourism recovery)

Structural Reforms

New industrial land allocation scheme

Strengthening public procurement & addressing corruption

Moving forward with government's IPO program

Better integration of women in the labor force

Further Pipeline Measures

Eliminating fuel subsidies excluding LPG by June 2019

Improving FX reserve management

Strengthening competition

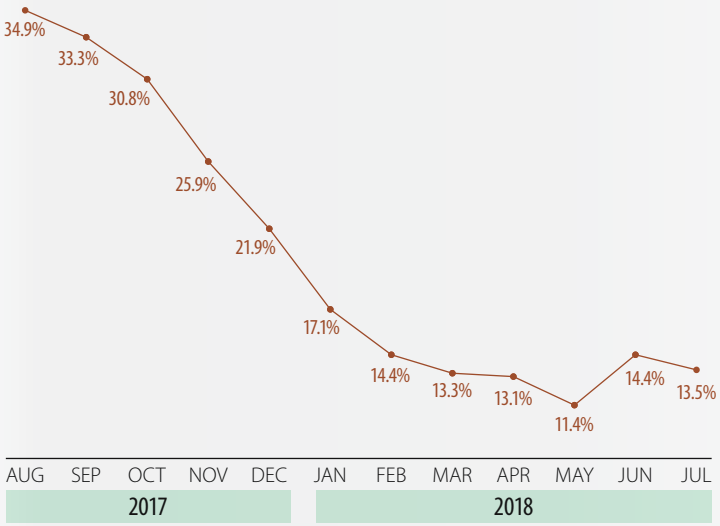
Developing capital markets

Improving public sector transparency

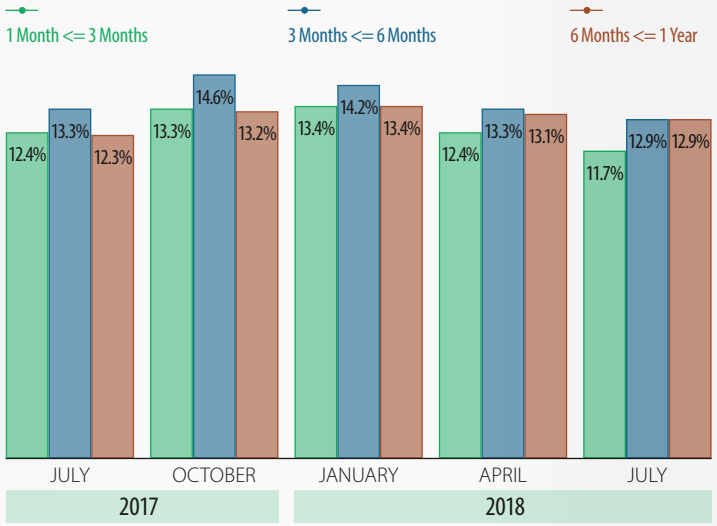
Remaining Disbursements

Date	Amount	Condition
Nov. 11, 2018	USD 2 bn	4th review and end-June 2018 performance criteria
Mar. 15, 2019	USD 2 bn	5th review and end-December 2018 performance criteria

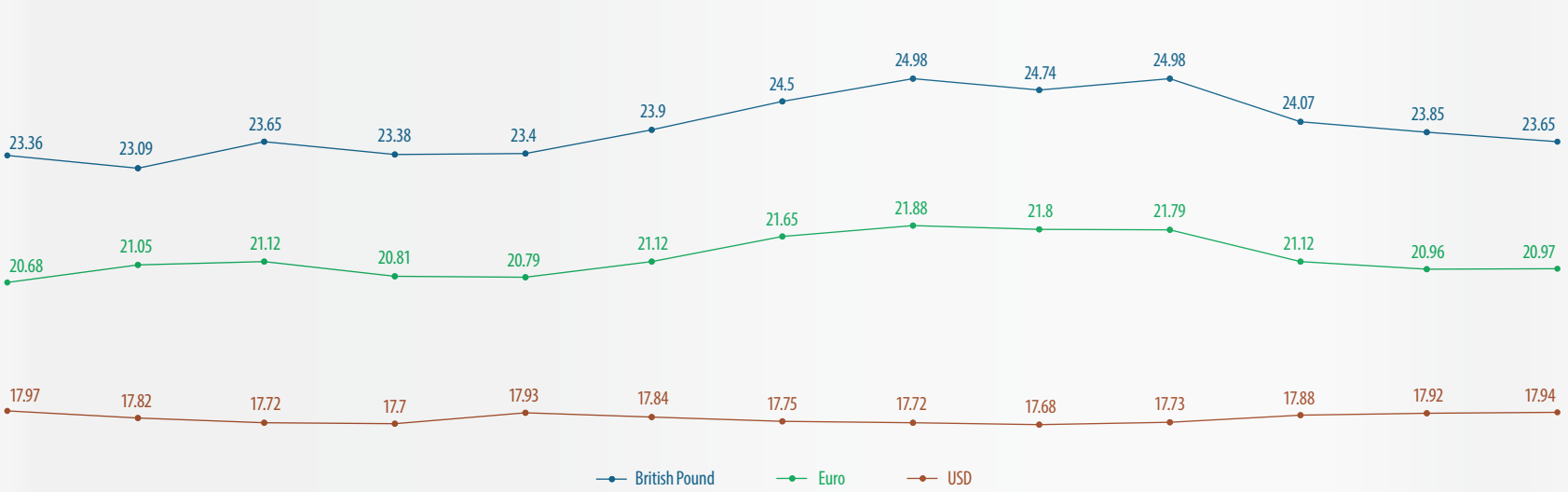
Egypt Annual Headline Inflation %



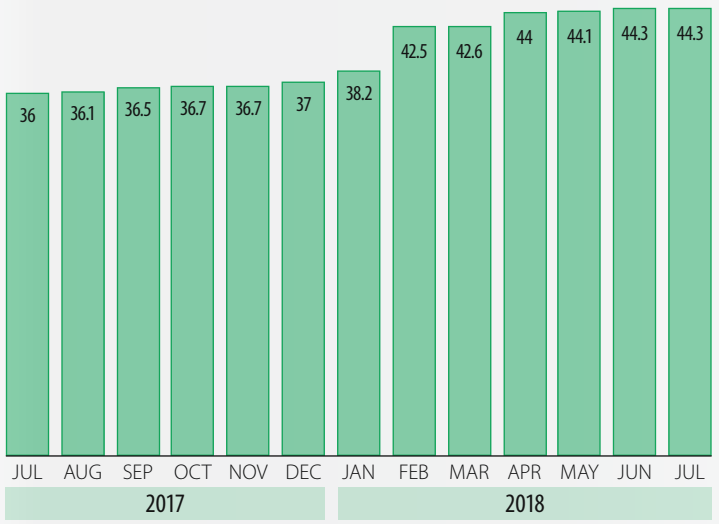
Average Interest Rates (EGP Deposits)



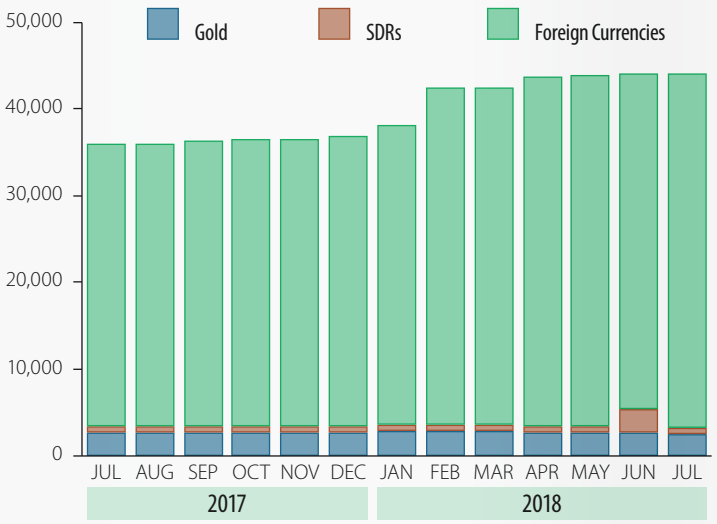
Exchange Rates



Net International Reserves (USD bn)



Gross Official Reserves (USD mn)



Sources of Raw Data: Central Bank of Egypt (CBE) and Central Agency for Public Mobilization and Statistics.

RESEARCH BY HAGER MAGDY

HELD UNDER THE PATRONAGE OF H.E. JEFF RADEBE, MINISTER OF ENERGY
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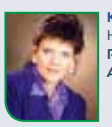

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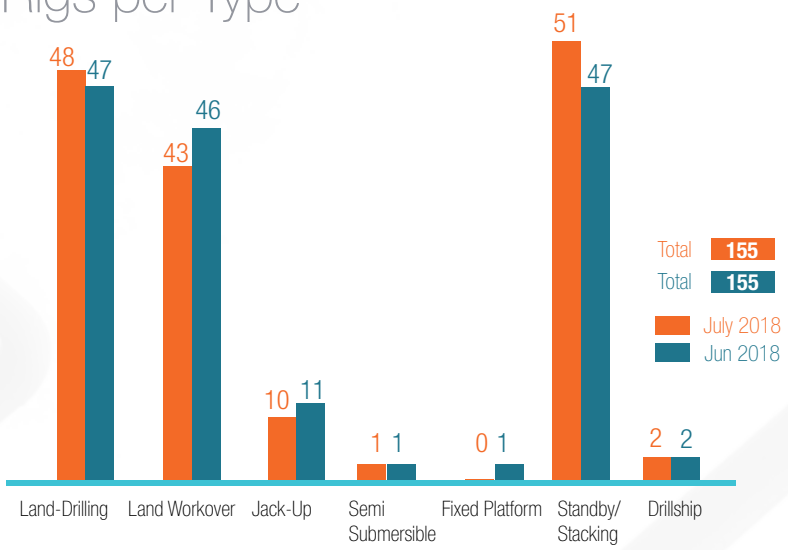
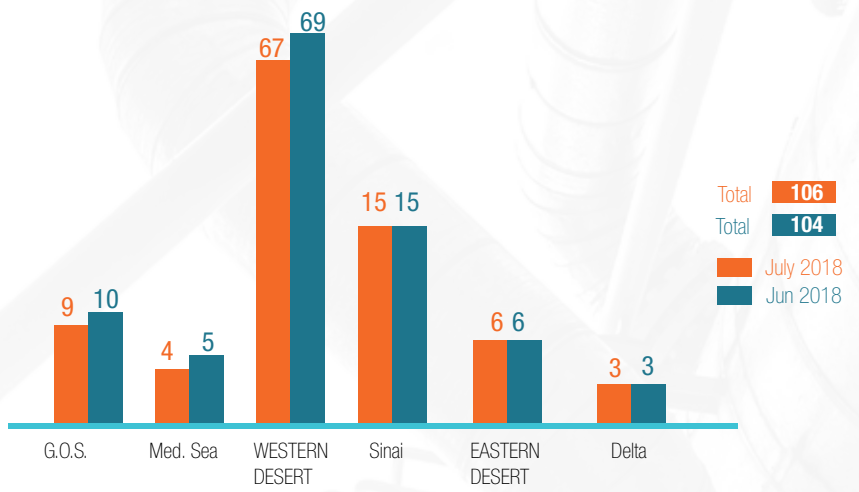
EGYPT STATS

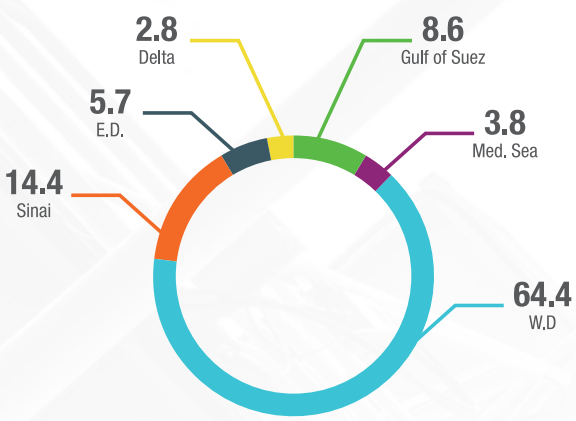
Rigs per Type



Rigs per Area

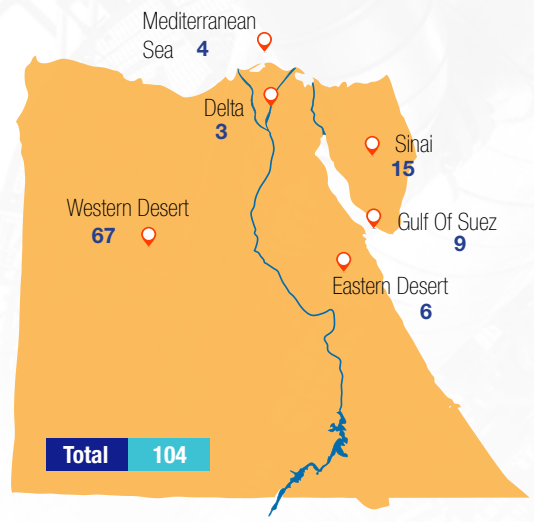


Distribution of Rigs - July 2018



Egypt's Rig Count per Area

July 2018



PRODUCTION

July 2018

TOTAL		
23,432,000	188.2825099	
Barrels	BCF	
183,186	2,693,835	
MCF	Barrels	

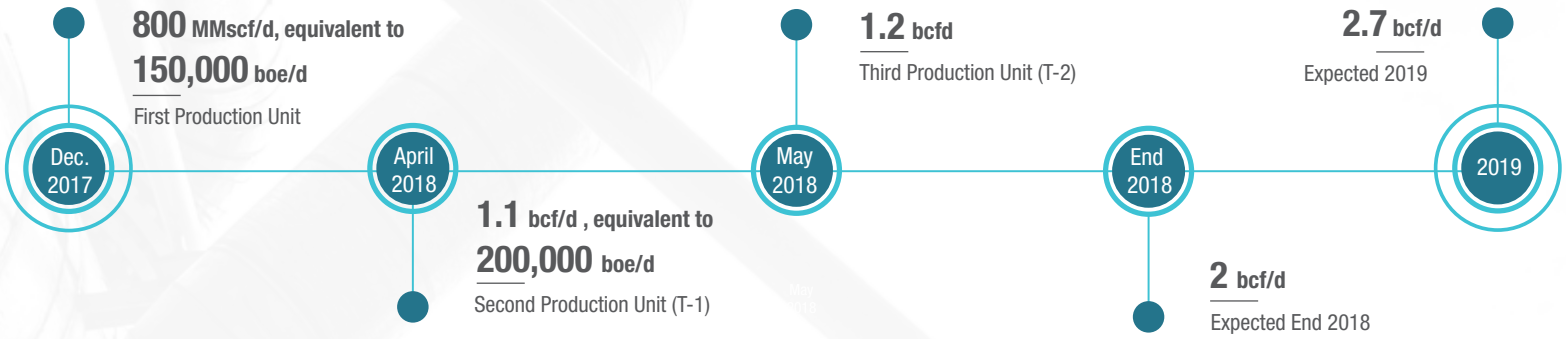
	CRUDE OIL	GAS	SOLD GAS	CONDENSATES
MEDITERRANEAN SEA	19,000	99.98607024	97,547	931,206
EASTERN DESERT	1,833,000	0.23337118	228	-
WESTERN DESERT	10,090,000	42.34490988	41,312	1,282,553
GULF OF SUEZ	3,911,000	3.738462	3,143	62,825
DELTA	17,000	41.97610914	40,952	399,727
SINAI	7,559,000	0.0035875	4	17,524
UPPER EGYPT	3,000	0	-	-

Drilling Updates

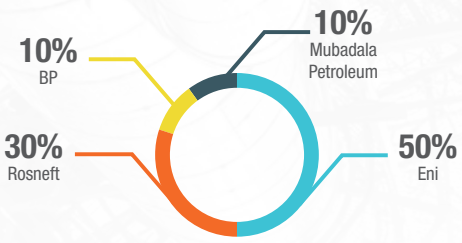
REGION	COMPANY	WELL	WELL TYPE	RIG	DEPTH	WELL INVESTMENTS
SINAI	PETROBEL	113-202K	Development	ST-1	10,745	$3.820 M
MEDITERRANEAN SEA	RASHPETCO	SCARAB DT	Development	N.GLOBE 1	5,276	$11.980 M
DELTA	SUCO	NSG 4-2	EXP	PDI-94	11,713	$5.730 M
WESTERN DESERT	AGIBA	AMAN-82	Development	EDC-64	6,500	$1.050 M
	KHALDA	ALYID G -1X_TUNA	EXP	EDC-61	8,500	$719,785
		MENES-4	Development	EDC-11	12,030	$1.165 M
		NRQ-12X	EXP	EDC-61	8,500	$1.021 M
		PTAH-30	Development	EDC-54	12,800	$1.812 M
		MRZK-166	Development	EDC-62	6,500	$1.134 M
		AG-141X	EXP	EDC-47	14,000	$2.231 M

*DRILLING is for July 2018.

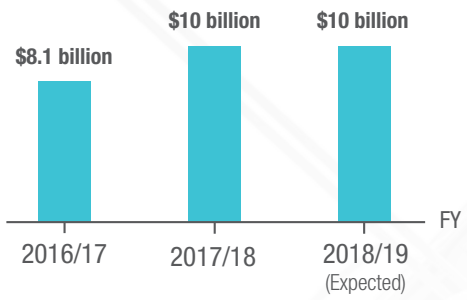
Zohr Developments



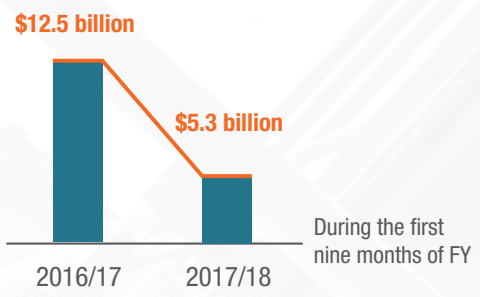
Stake in Shorouk Block



Foreign Direct Investment (FDI) in Egypt's Oil and Gas Sector

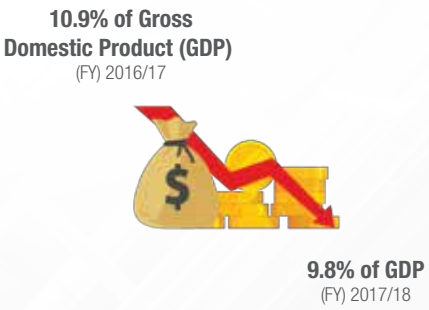


Egypt's Current Account Deficit

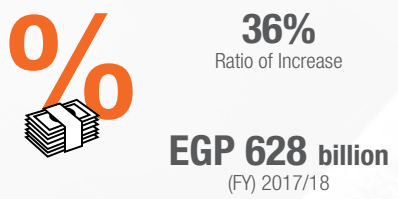


Natural Gas Production

The Egyptian Budget Deficit

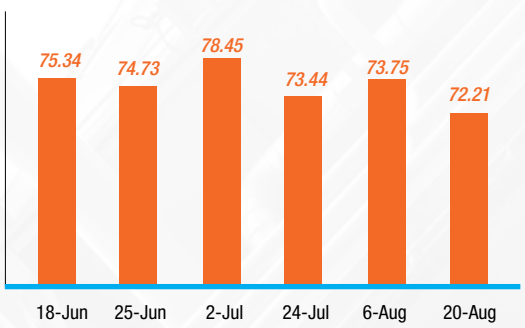


Egypt's Tax Revenues

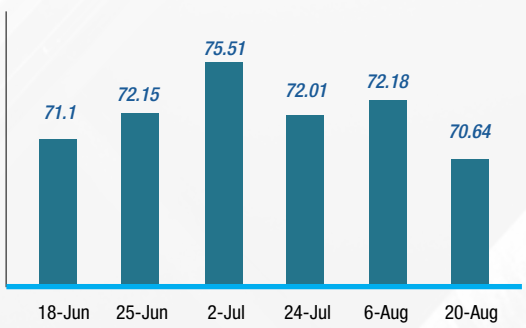


Sources of Raw Data: Ministry of Finance, Central Bank of Egypt, Ministry of Petroleum and Eni.

BRENT PRICES



OPEC BASKET PRICES



NATURAL GAS PRICES