

THE WESTERN DESERT: EGYPT'S GIANT PETROLEUM RESERVOIR

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The Western Desert is enriched by the potential it has for oil and gas exploration as it is the main crude oil producer among other Egyptian regions. This can be demonstrated in the presence of crude oil in large quantities and high production rates in the deep layers of the oil concession areas in the region. The region's production represented 37% and 32.4% of Egypt's total production in Fiscal Years (FYs) 2017/18 and 2018/19, respectively, according to the Egyptian General Petroleum Corporation (EGPC) and Egyptian Natural Gas Holding Company (EGAS) data.

Bid Rounds

In May 2018, EGPC announced an international bid round, offering 11 concessions; five of which were located in the Western Desert. The offered blocks covered a total area of 12,562 km^2, according to a statement by EGPC..

The bid round results were announced in February 2019, on the sidelines of the Egypt Petroleum Show (EGYPS 2019). Seven blocks were awarded to major companies; four of which are located in the Western Desert. Three of these blocks were awarded for Shell, while one was awarded for Eni, according to the statement.

The signature bonus of the four concessions totaled $52.15 million. In addition, the total financial commitments recorded $74 million to drill 18 exploratory wells, the statement further mentioned..

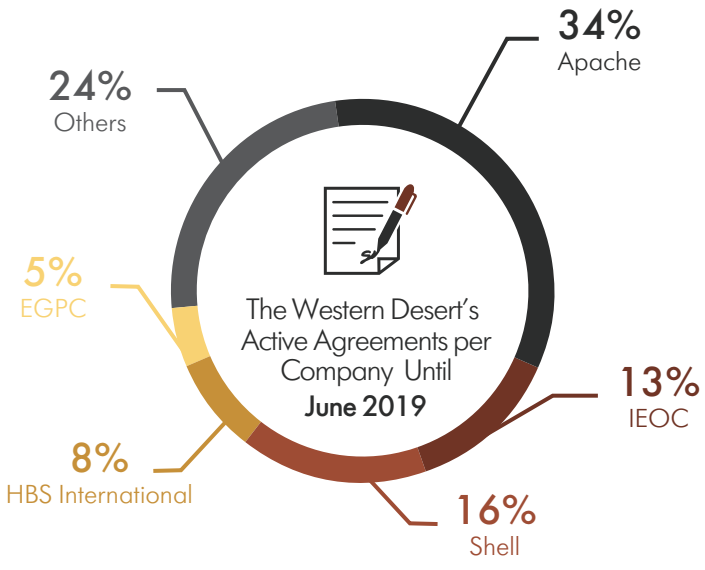
Active Agreements

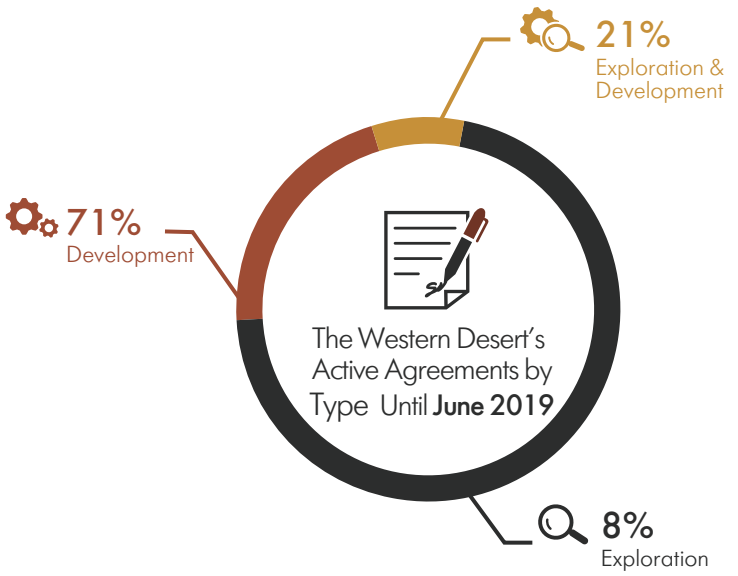
From the 1970s to June 2019, over 15 international oil companies (IOCs) have signed 62 agreements to exploit different concessions in the Western Desert. The most active operating company in the region is Apache, where it was awarded 21 concessions with a share of 34% of the signed agreements.

The IOCs are granted the rights to carry out different types of activities according to the type of the signed agreement. Until June 2019, the active agreements accounted for five, 44, and 13 for exploration, development and exploration & development activities, respectively.

4 AWARDED BLOCKS IN THE WESTERN DESERT IN 2019

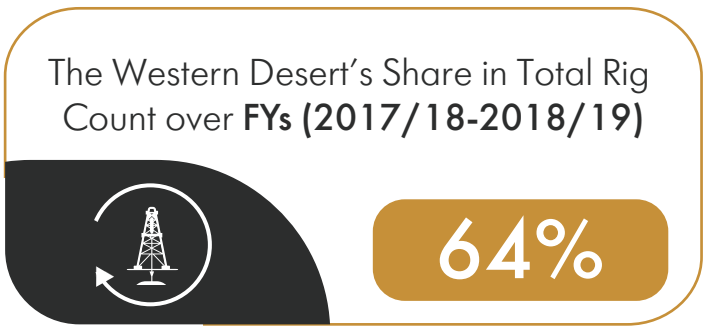
Company	Concession	Signature Bonus ($ million)	Minimum Financial Commitment ($ million)	Exploratory Wells	Area (km^2)
Eni	Southeast Siwa	1.15	17	4	3,013
Shell	Southeast Horus	23	24.5	5	2,508
	South Abu Sennan	1	7.8	3	2,481
	Abu Madi-El Gamil Pipeline	27	24.7	6	3,737





Drilling Activities

The average number of drilling rigs in the Western Desert fields in FYs 2017/18 and 2018/19 was almost the same with 65 rigs. The Western Desert has a share of 64%, which is the largest share in Egypt's total drilling rigs in the two referred years, according to EGPC.

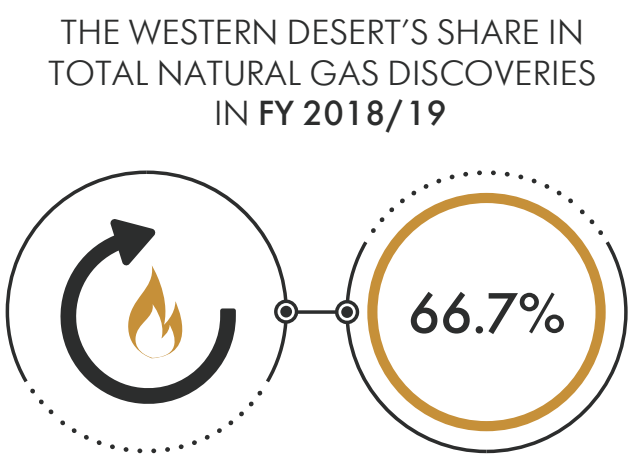


In FY 2017/18, the Western Desert witnessed 14 natural gas discoveries out of a total of 16 new natural gas discoveries made all over Egypt. The discovered resources in the Western Desert added reserves of 129.7 billion cubic feet (bcf) of natural gas, representing more than 70% of the total added natural gas reserves, according to the EGAS's annual report 2017/18.

In FY 2018/19, the drilling activities in the region resulted in achieving 10 out of 15 natural gas discoveries took place in Egypt. The Western Desert's new discoveries added natural gas reserves of 219 bcf, representing about 27% of the total added reserves of natural gas, according to EGAS's annual report 2018/19.

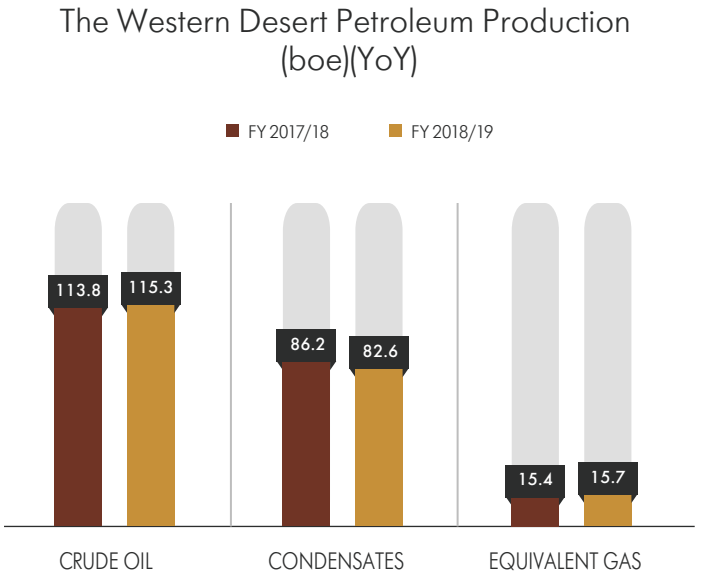
Remarkable oil discoveries were achieved in the Western Desert during FYs 2017/18-2018/19. In May 2018, Eni announced that Agiba Petroleum Co., a Joint Venture (JV) between Eni and EGPC, discovered new resources called A2-X in South West Meleiha license. The discovery was announced to have an initial production rate of 2,300 barrels per day (bbl/d) of crude oil, in addition to 0.4 million cubic feet (mmcf) of associated gas, according to a press release by Eni.

Two months later, Eni announced a second discovery in the same area. The new discovery, called B1-X, was drilled four miles off the A2-X discovery, to a total depth of 14,839 feet. The well has been opened to production with an initial rate of 5,130 bbl/d of light crude oil with low associated gas, Eni revealed in a press release.



Petroleum Production

In FY 2018/19, crude oil production represented 54.23% of the Western Desert's total petroleum production in comparison to 52.8% in FY 2017/18. Moreover, condensates production contributed 7.13% of the Western Desert's total production, compared to 7.38% in FY 2018/19. The equivalent gas share in the region's total production decreased from 40.05% in FY 2017/18 to 38.39% in FY 2018/19. It is worth noting that the decrease in equivalent gas' shares between the two mentioned years is offset with the increase in crude oil and condensates shares between the two years, according to EGPC and EGAS data.



Main Operators

The Western Desert is an attractive region for IOCs, as 16 companies have been awarded concessions and blocks in the region. Shell, Eni, Apache and HBS International (HBSI) are the most active IOCs in the region.

Apache

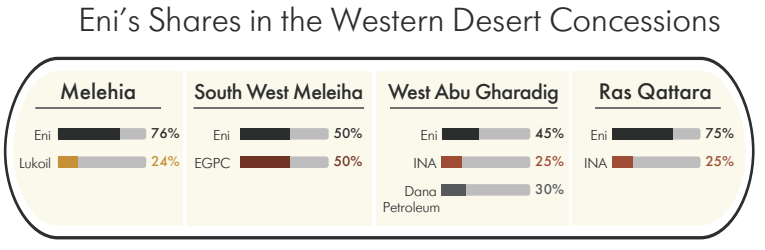
Apache started its activities in Egypt in 1994. In 2010, Apache acquired BP's total portfolio in the Western Desert. Since then, Apache became the main operator in the Western Desert and the most active driller among local companies in Egypt. The company is operating in the region, through its JVs, Khalda Petroleum Co. and Qarun Petroleum Co. In 2018, Apache drilled 70 development wells and 45 exploration wells with a success rate of 67%, according to the company's website.

In FY 2018/19, Qarun was able to drill 10 exploratory wells in the Western Desert. Moreover, the average production rate reached 31,700 barrels of oil equivalent per day (boe/d), according to a press release by Qarun.

On the other hand, in FY 2018/19, Khalda achieved 16 discoveries, with success rate of 88%. The company's crude oil production reached 49 million barrels (mmbbl), while the average natural gas production rate was 752 million cubic feet per day (mmcf/d), Apache revealed in a press release.

ENI

Eni has been operating in Egypt since 1954, where the company's portfolio includes high margin oil assets in Western Desert. Eni is operating through its subsidiary IEOC in eight concessions in the Western Desert, according to Eni's official website.



SHELL

Shell existed in Egypt since 1911, where the company's upstream activity, mostly focused in the Western Desert in 10 concessions. Shell acquired stakes distributed between 19 crude oil and natural gas producing development leases, existing in Badr El Din and Obaiyed concessions. The company's business portfolio consists

of four exploration concessions, which are in North East Abu El Gharadig, West Sitra, Bed 1 gas, and the West Alam El Shawish concessions, according to Shell's official website .

Shell has been operating since the 1980s through Badr El Din Petroleum Company (BAPETCO), a JV with EGPC. BAPETCO is in charge of developing Shell's fields in the Western Desert. In FY 2018/19, BAPETCO's production levels from the Western Desert fields reached over 124,000 boe/d. In addition, the company has seven active rigs, which supported the drilling of 53 wells in the same year, according to a press release by BAPETCO.

HBS INTERNATIONAL

HBSI has been operating in Egypt since 1997. The company acquires five concessions in the Western Desert. HBSI's asset portfolio includes development and production leases in the South Dabaa and Ghazalat concessions as well as three new exploration leases in North Ghazalat, South West Alamein, and Halif concessions, the Minister of Petroleum and Mineral Resources, Eng. Tarek El Molla, announced in January 2018.

Main Fields

Over the past decades, many productive crude oil and natural gas fields have been discovered in the Western Desert. Razzak field is considered one of the oldest oil fields in the Western Desert as its discovery dates back to the 1970s. On the other hand, Abu Gharadig field is marked as the first gas field in the Western Desert.

MAIN CRUDE OIL FIELDS

The Western Desert has many discovered oil fields such as: Khalda, El Rizzak, Sitra and Rosa North fields in addition to other significant fields.

1) THE MELEIHA

In 1972, the Meleiha field was discovered by Western Desert Operating Petroleum Co. (WEPCO) when the company drilled its first well Meleiha-1x. The field covers an area of about 100 km^2 and lies in the northern part of the Western Desert, about 60 km south off Matruh City.

In 1978, Agiba was granted the Meleiha concession which covers an area of 1600 km^2. In 2011, Agiba successfully drilled a new exploratory well, Zarif-1X, South Meleiha with an investment cost of $3 million. In 2018, Eni engaged in South West Meleiha oil discoveries, through its subsidiary IEOC, according to Eni's website.

2) THE QARUN

The Qarun field is located around 70 km southwest of Cairo. The Qarun field was brought on stream in November 1995, with an average initial production rate of 3,500 bbl/d. In May 1997, Qarun succeeded to complete the permanent facilities and put the field on production with an average production rate of 38,000 bbl/d. In 2010, production facilities in Qarun field were expanded to increase the field's capacity to 66,000 bbl/d. , according to Qarun's website.

3) BADR EL DIN

In 1986, Shell succeeded to discover an oil and gas accumulation called Badr El Din field (BED). BAPETCO was initially formed to develop and operate BED-1, Shell's first discovery in the field. The developments of the BED concession led to two significant natural gas discoveries at the BED-2 and BED-3 in the late 1980s, stated by BAPTCO's website.



In **H1 FY 2017/18**, the production from the Badr El Din fields reached **123,000 boe/d**.

4) THE SOUTH GHAZALAT

The South Ghazalat field is located in the Western Desert in the Abu Gharadig basin. In late 2018, the field was discovered through the drilling of the SGZ-6X. In May 2019, EGPC awarded TransGlobe Energy Corporation a 20-year development lease with an optional extension of five years. TransGlobe is the field's operator and targets to install early production facilities to achieve first oil production in Q4 2019, according to TranslGlobe's website.

5) THE BERENICE

In 2014, Khalda further discovered Berenice -1 in the Western Desert, which added reserves of about 8 mmbbl of crude oil, according to EGPC's annual report FY 2014/15. The Berenice field started producing light crude oil in November 2014. In March 2015, three wells were producing more than 9,500 bbl/d. The drilling depth in the field was approximately 12,000 feet with completed-well costs of $3 million on average, according to a press release by Apache.

6) THE PTAH

In 2014, Khalda announced the discovery of Ptah-1 in the Western Desert, with added reserves of 15 mmbbl of crude oil, according to EGPC's annual report FY 2014/15. The Ptah field started producing light oil in December 2014. The field well (Ptah-1X) has a production rate of 2,350 bbl/d, while the second well (Ptah-3X) started production in March 2015 at a rate of 2,000 bbl/d.

MAIN NATURAL GAS FIELDS

Most of the natural gas fields in the region that were discovered and operated by Khalda are: Sham, Salam, Um Baraka, and Tarek fields, in addition to other major fields. Further, the Western Desert embraces promising future gas fields such as Melaha Deep and Agiba fields.

1) THE ABU GHARADIG

The Abu Gharadig field was discovered in 1969 as the first large hydrocarbon discovery in the Abu Gharadig Basin. The first crude oil production was in 1973, while natural gas production started in 1975. In 2008, North East Abu El Gharadig (Neag) block started production, while during 2015, the crude oil production rates have been increased from the Neag 1 block reaching 15,000 bbl/d, according to EGAS's website and BAPETCO's Annual Report 2015/16.

2) THE OBAIYED

The Obaiyed gas field is operated by BAPETCO and is located in the Western Desert, 35 km southwest of Matruh. In 1989, Shell was awarded the Obaiyed exploration license, for an area of 4,275 km^2, then drilled the successful Obaiyed 1-1 well in 1991. The main Obaiyed field discovery took place in 1994 and started production in 1998 at a depth of about 4,000 m.

In 2017, the Obaiyed fields achieved a new increase in production, which amounted to 25 mmcf/d of natural gas and 1,200 bbl/d of condensates after the successful installation of the new compressor unit in the fields. Accordingly, this brought the total production to 515 mmcf/d of natural gas and 47,400 bbl/d of crude oil and condensates, according to a statement by Emad Hamdi, President of BAPETCO, in February 2017.

3) THE ABU SENNAN

The Abu Sennan fields are 10 km South East Neag area and were discovered by Kuwait Energy. In 2012, the field started its production when the first well was tested and drilled with an initial production of 835 boe/d. During H1 2017, Rockhopper Exploration PLC announced that its production from the Abu Sennan fields averaged 3,300 boe/d. The company is currently producing 5,100 boe/d from the field, the company declared in a statement in December 2019.

4) THE QASR

The Qasr Field is located in the northeastern portion of the Shushan basin in the northern part of the Western Desert. The field, discovered in 2003, is considered one of the largest gas fields in the region, with production rates of 670 mmcf/d of natural gas and 30 mmbbl of condensates.

5) THE ALAM EL SHAWISH

In 2012, Shell was granted the right to exploit Alam EL Shawish field. In late 2013, Shell signed an agreement with the Ministry of Petroleum and Mineral Resources (MoP) and EGPC to start its exploration activities within the field.

In 2016, Shell announced achieving a gas discovery in the North Alam EL Shawish concession where the production rates recorded 20 mmcf/d and reserves of 0.5 trillion cubic feet (tcf) of natural gas, which made it one of the largest discoveries during 2016, as stated by the MoP in a press release published in late 2016.

6) SOUTH DABAA

The South Dabaa Block is located north of Badr El Din fields and south of the Razzak field. The block's exploration activities started in early 1998 in the area by HBSI. Furthermore, HBSI made six discoveries before the expiry of the exploration license in mid-2004. In 2011, South Dabaa Petroleum Co. announced the drilling of a new exploratory well in the South Dabaa field with an average of 57.4 mmcf/d of natural gas.

Field Development Projects

Field Development Projects in the Western Desert

■ FY 2017/18 ■ FY 2018/19

Project	Operator	Initial Production Rate (mcf/d)	Cost ($ million)	Start Up
GAS COMPRESSOR	GPC	5	2	OCT. 2017
BTE	BAPETCO/ SHELL	30	5	JAN. 2018
NORTH UM BARAKA	BAPETCO/ SHELL	20	8	APR. 2018
KARIMA & HG PETROSANNAN	NAFTOGAS	5	6	MAY 2018
NORTH GHAZALAT (S.DABAA)	HBS INTERNATIONAL	5	-	JUL. 2018

Infrastructure

As the Western Desert is a major producer of both natural gas and crude oil, it has a robust infrastructure to serve the post-production process in the region.

NATURAL GAS INFRASTRUCTURE

The Western Desert has 13 natural gas pipelines. The northern part embraces seven natural gas pipelines. Meanwhile, the southern part has six natural gas pipelines mainly connecting Abu Sennan, Abu Gharadig, and Badr el Din Fields. General Petroleum Company (GPC) established a plant for gas and condensate processing in Abu Sennan with a capacity of about 85 mmcf/d of natural gas and 3,000 bbl/d of condensates, according to GPC's website. Hence, the southern fields' production is linked to a distribution center on the Mediterranean Coast through Abu Sennan field.

The Western Desert is the second largest petroleum production area in Egypt, representing 32.43% of the total petroleum production, following the Mediterranean Sea that contributed by 38.8% in FY 2018/19. The Western Desert has the potential that encourages the government to work on further developments and attract investors to operate more in them. New discoveries and agreements are capable to attract IOCs and intensify exploration and production (E&P) in the region. This will enhance crude oil and natural gas reserves, and open new horizons towards increasing opportunities in the Western Desert.

CRUDE OIL INFRASTRUCTURE

The Western Desert has four crude oil pipelines. Three pipelines transport crude oil from the production areas, specifically from Meleiha, Badr El Din, and Abu Gharadig concessions to El Hamra terminal. El Hamra terminal is operated by the WEPCO. The crude oil received by the terminal is controlled and monitored by metering stations, then is shipped by the fourth pipeline, El Hamra-Sidi Kerir, to refineries in Alexandria, according to WEPCO's official website.

Crude Oil Infrastructure in the Western Desert

Pipeline	From	To	Length (Km)	Diameter (Inches)	Capacity (bbl/d)
Meleiha-El Hamra	Meleiha Fields	El Hamra	167	16	90,000
Badr El Din-El Hamra	Badr El Din 1	El Hamra	128	12	60,000
Abu Gharadig-El Hamra	Abu Gharadig	El Hamra	140	12/16	60,000
El Hamra-Sidi Kerir-Alexandria	El Hamra	Alexandria	90	16	200,000



Natural Gas Infrastructure in the Western Desert

Pipeline	From	To	Length (Km)	Diameter (Inches)	Capacity (mmcf/d)
Tarek-Ameryia	Tarek	Ameryia	231	34	950
Obaiyed-Tarek	Obaiyed/Salam Connector	Tarek	49.5	32	600
Obaiyed Spurline	Obaiyed	Obaiyed/Salam Connector	41.5	26	480
Salam Spurline	Salam	Obaiyed/Salam Connector	35	22	250
Qasr-Shams	Qasr	Shams	40	24	350
Shams-Obaiyed	Shams	Obaiyed	42	18	240
Salam-Matruh Terminal	Salam	Matruh	75	10	22
BED/AS-Ameryia	BED/Abu Sennan connector	Ameryia	160	24	350
Badr El Din Spur (1)	Badr El Din Fields	BED/Abu Sennan connector	130	20	180
Badr El Din Spur (2)	Badr El Din Fields	BED/Abu Sennan connector	130	16	150
Abu Sennan Spur	GPT	BED/Abu Sennan connector	45	14	-
Abu Gharadig-Dashour (1)	Abu Gharadig	Dashour	260	24	150
Salam-Abu Gharadig	Salam	Abu Gharadig	212	18	187