

This is the Eleventh Edition of our Report on Iraq's oil and gas Industry. This report contains 921 pages and includes data on 127 fields



# Iraq Oil and Gas Industry Strategic Report

By

Introduction, Field Assessment Sample,  
Contents, List of Figures and Index only



## Eleventh Edition July 2017



## Our Product Clients



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## **Introduction.**

Our Iraq Oil and Gas Industry Strategic Report, 11<sup>th</sup> Edition provides a comprehensive analysis of the entirety of Iraq's Oil and Gas Industry - encompassing its upstream, midstream, downstream and infrastructure elements.

The primary focus of the report is Iraq's upstream sector. This sector is analysed on a basin by basin format, providing basin and overall resource inventories, data sets for oil and gas fields (both developed and undeveloped) and an assessment of exploration potential.

Iraq is regarded as the most prospective oil and gas acreage available in the world today, with the status of its Oil and Gas licensing continually evolving and developing through more bidding rounds.

## **Highlights of the 11th Edition.**

The 11<sup>th</sup> Edition of the Iraq Strategic Report is a significant expansion of data when compared to the 10<sup>th</sup> Edition. It is the result of a comprehensive re-assessment of the Oil and Gas Industry in Iraq up to 2017. The latest Edition includes the following:

- 921 page hard copy Iraq Strategic Report
- A Total of 127 individual field reviews
  - Details of the exploration history and past developments carried out for each field in Iraq
  - Resource auditing for each field using PRMS standards
  - Outline Field Development Plans and costs estimates for each field in Iraq
  - Operation cost estimates for each field in Iraq
  - Complete historical production volumes for all fields in Iraq
- There are 18 new fields added to the 11<sup>th</sup> Edition Iraq Strategic Report:

Ain al Safra	Banan	Bastora	Bazian
Ber Bahr	Eridu	Faihaa	Jisik
Mil Qasim	Miran West	Mirawa	Peshkabir
Qara Dagh	Rovi	Sarta	Sheikh Adi
Shewashan	Zey Gawra		

The 11<sup>th</sup> Edition of the Iraq Strategic Report also includes a hard copy of our Iraq Exploration and Production Map Set. These maps are the result of a complete assessment of the 2017 statuses of licensing agreements, exploration trends and infrastructure available in Iraq. The maps include:

- A fully up-to-date Iraq map detailing the locations of Iraqi oil and gas fields and industry infrastructure.
- A 2017 License Block Map for the whole of Iraq including:
  - Iraq Licensing Round 1, 2, 3 & 4 Blocks
  - Kurdistan Blocks

In addition to this major update, the costs for all fields within the report have been reassessed and updated to reflect price changes within the Iraq Oil and Gas Industry. The economic consequences of these changes are further analysed in our **Iraq Fields Financial Report**.

## **Report Structure.**

Our report and map products offer our clients an accessible way to track these developments and provide comprehensive information on Iraq's licensing and Oil and Gas infrastructure.

The 11<sup>th</sup> Edition of Bayphase's Iraq Oil and Gas Industry Strategic Report provides a comprehensive review of Iraq's Oil and Gas Industry, which encompasses the following elements:

- **Upstream:** Oil and Non-associated Gas Fields and Production Facilities
- **Midstream:** Pipelines, Terminals
- **Downstream:** Refineries, Petrochemical Plants, Gas Processing Plants
- **Infrastructure:** Power Generation, Transportation

Our Iraq Strategic Report categorises the report into the following three main sedimentary basins:

- **Northern Folded Zone**
- **Mesopotamian Basin**
- **Western and Southwestern Deserts**

Analysis and detailed data sets for a total of **127** oil and non-associated gas fields is provided, including those fields which are currently in production and others which are undeveloped and awaiting investment.

### **Report History**

- 11<sup>th</sup> Edition July 2017 – 921 pages
- 10<sup>th</sup> Edition January 2016 – 835 pages
- 9<sup>th</sup> Edition January 2015 – 833 pages
- 8<sup>th</sup> Edition December 2013 – 792 pages
- 7<sup>th</sup> Edition November 2012 - 786 pages
- 6<sup>th</sup> Edition November 2011 - 786 pages
- 5<sup>th</sup> Edition July 2010 - 733 pages
- 4<sup>th</sup> Edition February 2009 - 632 pages
- 3<sup>rd</sup> Edition July 2007 - 484 pages
- 2<sup>nd</sup> Edition October 2005 - 290 pages
- 1<sup>st</sup> Edition March 2003 - 250 pages

### **Included With Each Purchase**

- A Hard Copy of our current **Iraq Oil and Gas Industry Strategic Report**
- A Free Searchable CD-ROM of our current **Iraq Oil and Gas Industry Strategic Report**
- A Hard Copy of our current **Iraq Fields Database**
- Excel Data Base of our current **Iraq Fields Database**

Our report is supplied in both electronic format and as a hard copy. The electronic version is provided as a PDF document on a CD-ROM, and the hard copy is supplied as a sure-bound document. Both copies of the report will be delivered via FEDEX.

Clients who order the Eleventh Edition of our Iraq Strategic Report will receive electronic updates to the report as they are issued. These clients will also receive a hard copy of the 12<sup>th</sup> Edition of the Report upon its scheduled release date of January 2018.

Provided below is the Bayphase analysis performed on the Tawke Field as an example of the work done for the Iraq Strategic Report. This is typical of the level of detail conducted for each hydrocarbon bearing field in the country whether producing or non-producing for the Report.

Our analysis covers the following technical information:

- G&G overview, Reserves Engineering, Facilities Engineering
- Current Development Status and Historical Production Figures
  - Resource Assessment of each field using PRMS standards
  - Value judgement of the future development and OPEX costs

## Tawke

The Tawke oilfield is located in northern Kurdistan, close to the border with Turkey in the High Folded Zone of the Zagros Fold Belt. It covers an area of approximately 25x3 kilometres and is contained in a detached fold-thrust anticline structure which is well defined on 3D seismic. To date, approximately 35 wells have been drilled, and in general production has been growing positively in recent years.

Oil is produced from multiple reservoirs in the structure including the Late Eocene aged Pila Spi Formation, the Campanian-Maastrichtian Shiranish Formation and the Aptian-Albian Qamchuqa Formation and most recently (since 2016) the Mio-Pliocene Jeribe Formation. All of them are carbonate reservoirs. Also reported from one well (Tawke-17) is hydrocarbon encountered in the Mid Jurassic Sargelu Formation but as of 2017 it is not thought that this horizon is a major producer at all. In any case, the vast majority of the production is from the Cretaceous reservoir systems in fractured carbonates. The gross thickness of the Cenozoic reservoir is 180m and the gross thickness of the Cretaceous reservoirs in 900m. Both Cenozoic and Cretaceous reservoirs flow 24° – 27° API oil with a very low gas content.

In terms of reserve volumes, DNO released 2P figures in February 2017 of 504mmbbls of which 348 mmbbls was classed as 1P. They also announced that Tawke contains 2C contingent resources of 100 mmbbls.

### *Key Field Data*

DNO was the first western company to drill for oil in post war Iraq, under a 2004 deal with the Kurdistan Regional Government. In April 2006 twin wells Tawke-1 and Tawke-1A (just 20 metres apart) drilled in the crest of the structure and tested approximately 5,000 bopd from shallow Eocene Jeribe Formation carbonates. Tawke-1 also encountered deeper Cretaceous hydrocarbons but did not carry out a full test on them. In June 2006 located 2km further west, Tawke-2 tested 3,840 bopd from the Jeribe Formation. These results were used as the basis for an early production plan, which was approved by the Kurdistan Regional Government. The Tawke-2 appraisal well confirmed the western extension of the Tawke structure.

Tawke-3 tested the deeper Cretaceous reservoirs which were encountered in Tawke-1 and recovered an aggregate 9,000 bopd.

In January 2007 Tawke-4 located 800m northeast of Tawke-1 tested 8,500 bopd from a 2" choke.

Tawke-5 located 1.1km east of Tawke-4 recovered a maximum of 9,860bopd and a EWT average of 4,500 bopd over two days.

Tawke-6 located 2.7km southwest of Tawke-5 was completed as a producer and not as a water injection well as originally envisioned.

In August 2007 Tawke-8 tested the deeper Cretaceous reservoirs and recovered 8,000 bopd from its 'most productive horizon', and an aggregate of 17,000 bopd from all tested horizons.

A year later in September 2008 Tawke-9 and Tawke -10 were installed as a producer wells.

In April 2008 Tawke-11 and Tawke-12 were completed as Cretaceous producers. This completed the first phase of the field development plan, as the well capacity had exceeded 100,000 bopd.

In 2009 the Tawke Field was tied into Iraq's Northern Pipeline System and full scale production commenced in June of that year, although it was halted temporarily that September.

In 2010 hydrocarbons produced from Tawke were only sold to the domestic market. Extensive downhole pressure monitoring provided new insights into the Cretaceous reservoir properties. BeicipFranlab had completed a fractured carbonate reservoir study as well to help provide more accurate volumetrics for the Cretaceous reservoir and an improved reservoir model. By this stage DNO announced that the P50 STOIP for the Cretaceous was 1,536 mmbbls and the Cenozoic was 148 mmbbls.

In 2011 further work was done to enhance the reservoir model, seeing an increase in the estimated recoverable resources.

In 2012 wells Tawke-14, Tawke-14A, Tawke-18, Tawke-16 and Tawke-19 were drilled as Cretaceous producers and also helped to delineate the new areas of the field in the northern flank. At the end of that year Tawke-20 was spudded as the first horizontal well.

Well Tawke-16 was drilled with the objective to appraise the northern flank of the structure. The well reached a TD of 2,369m in early 2012 with gross oil column of more than 350m in the Cretaceous.

When Tawke-17 was completed in June 2013, it was the deepest well in the field at 4,775m TD. It tested the deeper prospective resources in the Jurassic and Triassic underlying the productive Cretaceous intervals. The well encountered a reservoir interval in the Jurassic Sargelu Formation which flowed 1,500 bopd of 26°- 28° API oil. The Triassic intervals that were tested proved to be either tight or water bearing.

In July 2013 Tawke-20 was completed and set the record for production at Tawke at 25,000 bopd, having flowed 8,000 bopd from each of the ten fracture corridors in the Cretaceous reservoir.

In September Tawke-23 (also horizontal) located 6km away from Tawke-20, encountered continuous oil shows through 930m of horizontal section in the Cretaceous and tested 32,500 bopd – a record for the field.

In 2014 five horizontal wells were drilled bringing the total number of wells to 28 with 26 producers. Tawke-24, Tawke-25, Tawke-26, Tawke-27 and Tawke-28. These wells flowed at a rate of about 9,000 bopd.

A second 3D seismic acquisition programme was also carried out over the field area in 2014.

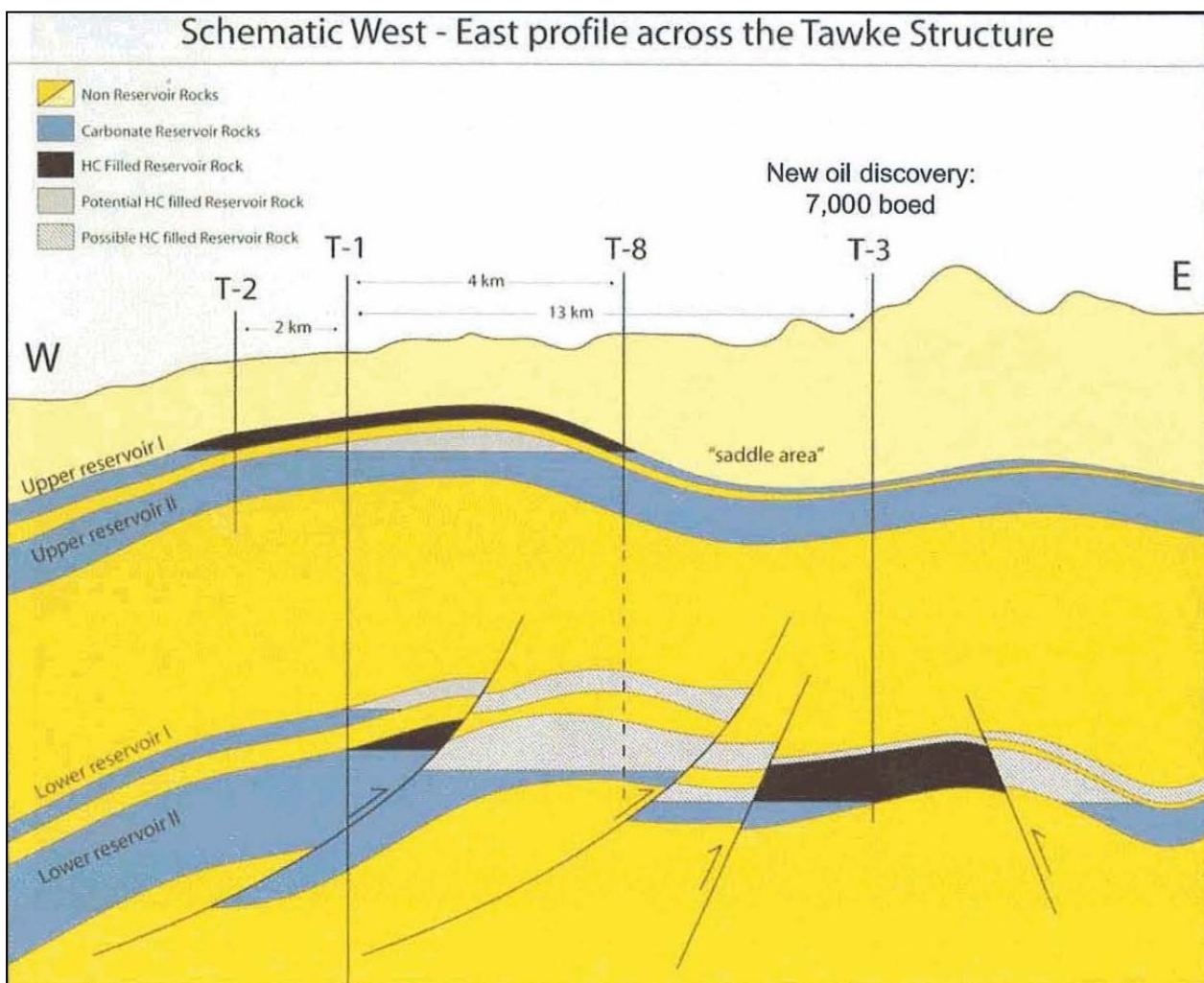
In 2015, 200,000 bopd wellhead, processing and pipeline capacity was reached at Tawke. There were 10 new horizontal wells drilled which doubled the capacity. Furthermore, 44km of 24" pipeline was completed as well as the construction of two new early production facilities to supplement the existing central processing facility which had a 120,000 bopd capacity.

In 2016 four production wells (Tawke-31, Tawke-33, and Tawke-34&Tawke-37) and one water injection well (Tawke-32) were drilled. The objective of Tawke-31 was to become a producer well from the Cretaceous reservoir like previously drilled wells. The four other wells were much shallower and far less expensive, as DNO began to target production from the Miocene Jeribe Formation, which is the formation where the discovery was made in 2006, but had never been developed. These four Jeribe wells were drilled for a cost of \$6 million and they helped to increase production at the field by 10% or approximately 10,000bopd. Overall however production was down in 2016 due to reduced drilling activity in 2015, which was a knock-on effect of the low oil price since 2014.

There are plans in 2017 to drill five additional Cretaceous producer wells (Tawke-35, Tawke -36, Tawke-41, Tawke-42, Tawke-43), two Miocene Jeribe producer wells (Tawke-38 and Tawke-39), and one water injection well into the Jeribe (Tawke-40).

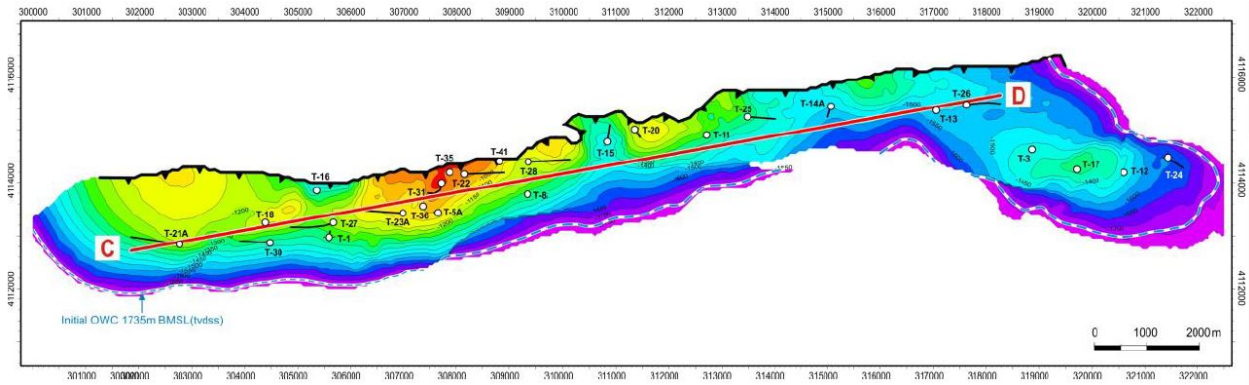
In terms of production targets DNO have stated in presentations that they hope to achieve 200,000 bopd at the Tawke Field.

**Figure. 1:** Schematic profile along strike of the Tawke Field

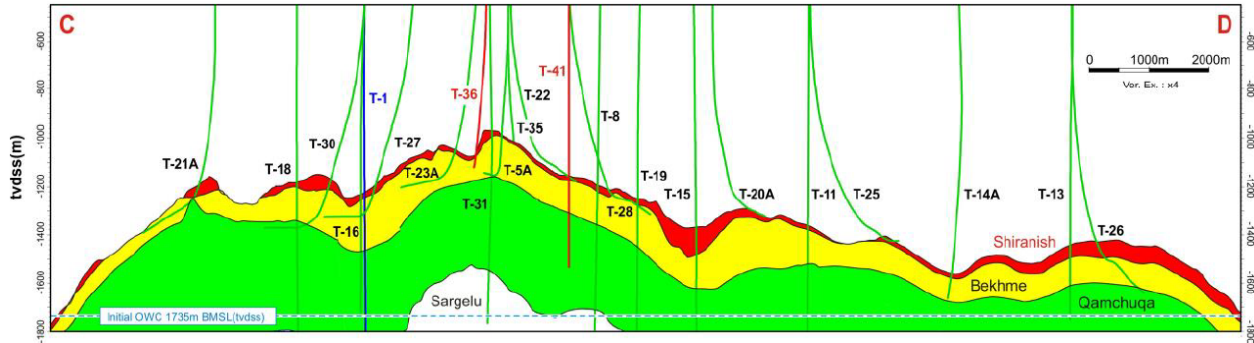




**Figure. 2:** Tawke Top Cretaceous map. Cross section C-D in next figure



**Figure. 3:** Tawke Cross Section C-D along the long axis of the structure.



Below we present the Key Field Data gathered for the Tawke Field

Table.1:Tawke Key Field Data			
Parameter			Value
Discovery Date			2004
On-stream Date			July 2009
Recoverable Reserves	Original	Oil (Million Barrels)	777
		Gas (Billion Cubic Feet)	35
	Remaining	Oil (Million Barrels)	503.8
		Gas (Billion Cubic Feet) <sup>1</sup>	34
Contingent Resources		Oil (Million Barrels)	100.2
		Gas (Billion Cubic Feet)	38
Prospective Resources		Oil (Million Barrels)	51
		Gas (Billion Cubic Feet)	10
Production	Current	Oil (Barrels per day)	113,876
		Gas (Million Standard Cubic Feet per day)	20.3 (estimate)
	Potential	Oil (Barrels per day) <sup>2</sup>	200,000
		Gas (Million Standard Cubic Feet per day)	30 (estimate)
Geology	Producing Horizon(s)		Jeribe (Mio-Pliocene)
			Pila Spi (late Eocene)
			Shiranish (Camp-Maas.)
			Qamchuqa(Apt-Albian)
	Rock Type(s)	Fractured Carbonates	
Reservoir Depth (Metres)	Lower Reservoir 2000-2500m		
Porosity (%)	Shiranish – 16		
	Qamchuqa - 14		
Permeability (mD)	Shiranish - 400		

<sup>1</sup>This is for all gas thought to be present and is based on statements reported to have been made by DNO.

<sup>2</sup> This is based on statements reported to have been made by DNO and represents their view of production potential.



Parameter		Value		
		Qamchuga - 40		
Fluid Properties	Oil	Gravity (° API)	Shiranish –24°-27° Qamchuga - 24°-27°	
		Sulphur Content (wt %)	2.6 - 3.0	
	Gas	Gas-Oil Ratio (standard cubic feet/ barrel)	150	
		Hydrogen Sulphide Content (mol %)		
		Carbon Dioxide Content (mol %)		
		Molecular Weight		
	Existing Facilities	Subsurface		<i>Total now</i>
Number of Producers			~37	44
Number of Gas Injectors			-	3
Number of Water Injectors			~3	3
Total Number of Wells		~40	50	
Surface		Separation Capacity (bpd)	200,000	
		Compression Capacity (MMscfd)		
	Acid Gas Treatment Capacity (MMscfd)	-		

A further piece of key data we have been able to establish based on in country research and production data gathered from a number of sources is the field's production history. This is presented in the table below on an average daily production basis; the table has been established largely on yearly reports released by DNO.

Year	Average Daily Oil Production (Barrels per day)	Year	Average Daily Oil Production (Barrels per day)
2007	7,012	2013	39,433
2008	7,224	2014	95,255
2009	15,342	2015	144,492
2010	11,780	2016	107,299
2011	51,664	2017 (est)	113,876
2012	45,477		

DNO's pipe export operations from Tawke started in June 2009 but were interrupted due to non-payment for oil exported from the field in September of that year. Between the years 2009 and 2013, oil production at Tawke was frequently lower than capacity due to issues with exportation licenses, costing operator DNO millions of dollars in lost potential export revenue. Currently the field output is transported along a 24-inch pipeline from Tawke's main processing facility to Faysh Khabur in northwest Iraq close to the Iraq-Syria-Turkey boundary tri-point. This line was completed in early 2014 to supplement an existing 12-inch line, and runs at a capacity of approximately 200,000 bopd.

Mean average production rates of about 107,299 bopd were achieved in 2016. Production volumes were higher in 2015 where DNO confirmed it had increased capacity at the Tawke field to 200,000 bopd and a record level of 186,000 bopd was achieved in May 2015. Overall production had a mean average of 135,000 bopd in 2015.

Recently DNO publish monthly announcements about what monies they have received for hydrocarbon deliveries from the Tawke Field from the Kurdish Regional Government.

This production is split between local sales (60%) and export via the main Kirkuk-Ceyhan pipeline (40%)

#### *Commercial Data*

DNO is the operator and has a 55% participating interest in the Tawke Block. Genel Energy has a 25% interest and the Kurdistan Regional Government (KRG) holds the remaining 20% as a Government interest.

Table.3: Tawke Key Commercial Data		
Parameter		Value
Contact Type		Revised Production Sharing Agreement
Contract Effective Date		March 2008
Operator		DNO
Equity (%)	DNO	55
	Genel Energy	25
	Kurdistan Regional Government	20
	<b>Total</b>	<b>100</b>

### Investment Opportunity

DNO's field development plan effectively targets mainly the Cretaceous oil containing reservoirs while also investigating the deeper targets, and develops the field through a series of steps:

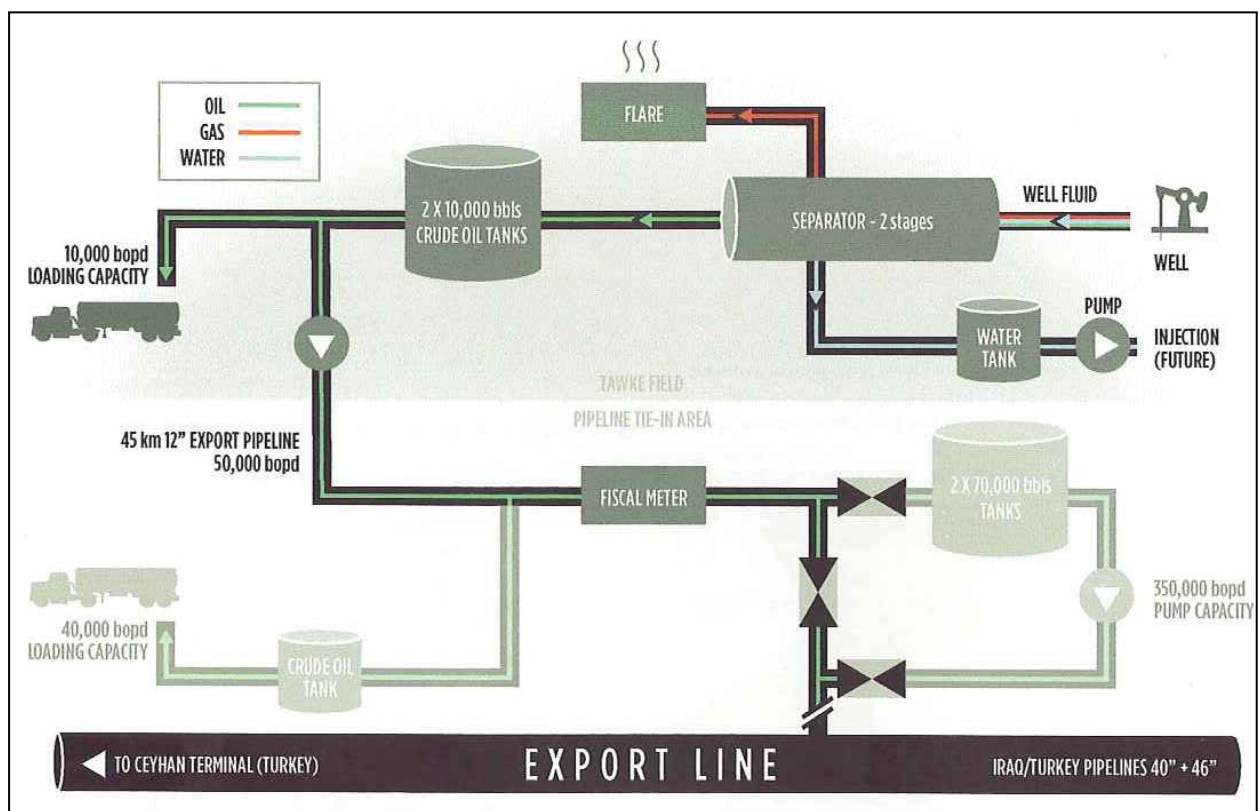
- Drilling of further deep appraisal wells to evaluate the Tawke-17, Jurassic discovery.
- Flaring of associated gas – although DNO state that this is not what they do.

To fully exploit the Tawke field we would expect a number of other steps to be executed:

- Drilling of around 8 wells to further target the shallow lying reservoir and the deep reservoir. This would include producers, water injectors and gas injectors.
- Implementation of a gas disposal scheme that recovers associated gas then compresses and re-injects it back into the Tawke reservoir.

DNO's field development plan is diagrammatically represented in the figure below Fig. 3.24, while the work scope we'd expect to be implemented to fully exploit the field along with associated costs is detailed further in the tables below.

**Figure. 4:** Tawke Project Development Plan



This work scope along with associated costs is detailed further in the table below.

Table. 4: Tawke Development Cost Summary				
Project	Rationale	Time Frame (Years) <sup>3</sup>	Cost Estimate (MillionUSD) <sup>4</sup>	
			Low	How
<b>Subsurface</b>				
Acquire 3D seismic data (Completed)	Acquisition may be warranted for the effective reservoir and production management of the shallow and deep lying reservoirs. Acquisition and Processing services will be needed, plus computing hardware and software plus interpretation. (Completed)	1-2	-	-
Appraisal drilling	Completed	2-4	-	-
DNO's early production drilling. (Already executed by DNO-Genel)	16 development wells targeting the shallow lying reservoir.	1 – 2	-	-
Drill new development wells	19 new development wells including production, water injection and gas reinjection; mixture of vertical and horizontal wells assumed completed by end of 2016. (Completed)	2 – 3	-	-
Other development wells	8 new wells expected to be drilled in 2017, consisting of five Cretaceous producers, two Miocene producers and a water injection well in the Miocene.	1-2	16.9	25.8
<b>Rounded Subtotal</b>			<b>16.9</b>	<b>25.8</b>
<b>Surface</b>				
DNO's early surface production facilities (Already executed by DNO-Genel)	Implement separation and storage system in two stages: 1 <sup>st</sup> stage - 30,000 barrel per day, 2 <sup>nd</sup> stage – 20,000 barrel per day giving a total production of 50,000 barrels per day.	1 – 2	-	-
Field Expansion (separation and pumping facilities have been executed)	3 <sup>rd</sup> Stage - Expand surface facilities to 200,000 bopd and focus on addition of water injection, and gas reinjection facilities expected to be completed by the end of 2020.	2 – 3	413.9	679.2
<b>Rounded Subtotal</b>			<b>413.9</b>	<b>679.2</b>
<b>Rounded Total</b>			<b>430.8</b>	<b>705.0</b>

The minimum cost presented in the table above is based on the absolute minimum cost for developing this field. We have also used our cost estimating software - [NetCo\\$ter](#) to evaluate the work scope we believe will be required to achieve the production plateau targets associated with the service contract; our figures are presented as the maximum cost.

In addition to development cost the consortium will spend a very significant amount on operating costs. We have used our cost estimating software - [NetCo\\$ter](#) to estimate what these will be and these estimates are provided below.

<sup>3</sup>Time frame is our expectation of the time that will be required from making a decision to implement the full work scope through to completion. Fundamentally we have assumed that this follows a normal construction path without consideration of constraints - political, economic or other - that may act to restrain the schedule.

<sup>4</sup> The cost ranges reflect the uncertainty associated with the actual work scope that will have to be implemented. At this stage, not enough is known about the facilities to fully define the costs.

Table. 5: Tawke Operating Cost Summary				
Project	Rationale	Start Date (Year)	Cost Estimate (MillionUSD/year) <sup>5</sup>	
			Low	High
<b>Subsurface:</b>				
Work over existing wells	Maintenance and improved performance of 40 wells from 2017 onwards	2017	5.0	10.0
<b>Rounded Subtotal at Peak Production per Year</b>			<b>5.0</b>	<b>10.0</b>
<b>Surface:</b>				
Operation of Facilities	Operation of surface gathering, water injection, and gas reinjection facilities to a total capacity of 200,000 bpd to be completed end of 2017.	2017	38.0	46.0
<b>Rounded Subtotal at Peak Production per Year</b>			<b>38.0</b>	<b>46.0</b>
<b>General and Administration:</b>				
General and Administration	Operation of surface gathering, water injection, and gas reinjection facilities to a total capacity of 200,000 bopd to be completed end of 2017.	2017	20.0	25.0
<b>Rounded Subtotal at Peak Production per Year</b>			<b>20.0</b>	<b>25.0</b>
<b>Rounded Total at Peak Production per Year</b>			<b>63.0</b>	<b>81.0</b>

This then is the technical basis for installing production facilities at this field. We have also conducted a full economic assessment of this plan that can be found in our **Iraq Fields Financial Report**. This is the sister publication to this report and it uses these costs as the basis for its analysis.

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<sup>5</sup> The cost ranges reflect the uncertainty associated with the actual work scope that will have to be implemented. At this stage, not enough is known about the existing facilities to fully define the costs. Each element of operating cost is additive, so as units are brought into production their operating cost is added to the existing base.

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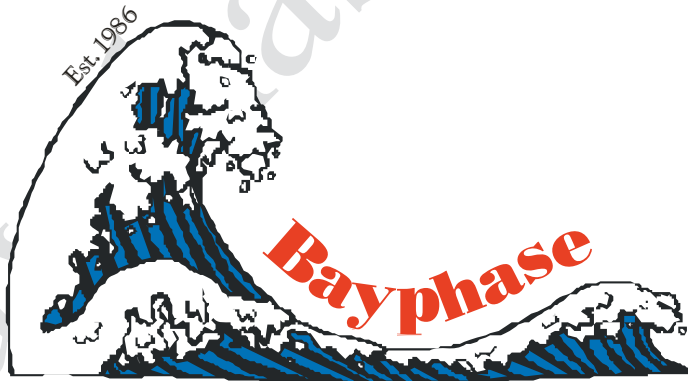


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