July 2016

OML 11 (inc. Ogoniland)

Key facts

Onstream			**On/Offshore**
Location		**Timetable**	
Sector, Basin: Onshore, Niger Delta		Discovery Date	Dec 1956
Block: OML 11, Area: 3,097 km^2		Production Started	Jan 1958
Water Depth: 30m		Issue Date	Jan 1960
		Peak Oil Production (234,010 b/d)	1973
		Peak Gas Production (519 mmcfd)	2007
		Final Expiry	Jun 2019
Operator		**Participants**	**%**
Shell		NNPC	55.00
		Shell	30.00
		Total	10.00
		Eni	5.00
Primary Reservoir(s):			
Neogene\Miocene\Aquitanian\Agbada			
Neogene\Pliocene\Zanclean\Agbada			
Recoverable Reserves (p+p)		**Hydrocarbon Quality**	
1,755 mmbbl Oil		Gravity (°API)	21.2 - 50
4,407 bcf Sales Gas			
Remaining Reserves at 01/01/2017			
73 mmbbl Oil			
1,638 bcf Sales Gas			
Contract		**Financial Summary**	
Concession		Capital costs (2017 terms)	US$18,584M
		Capital costs per boe (2017 terms)	US$7.34/boe
		Operating costs (2017 terms)	US$14,141M
		Operating costs per boe (2017 terms)	US$5.59/boe
		Remaining PV (10.0% nominal)	US$1,401M
		Remaining PV per boe (10.0% nominal)	US$3.88/boe
		Rate of return	15.7%

Source: Wood Mackenzie

Summary and key issues

Summary

OML 11 lies in the southeastern Niger Delta and contains 33 oil and gas fields. This makes it one of the most important blocks in Nigeria. The terrain is swamp to the south with numerous rivers and creeks. Port Harcourt is located in the northwest of the block, while the major yard and logistics base at Onne is located by the Bonny River. The Bonny oil terminal - the largest in Nigeria - and Nigeria LNG (NLNG) are both at Bonny Island within OML 11. These terminals are supplied with oil and gas from all over the delta as well as offshore fields. A high density of inter-field flowlines and strategic trunklines traverse OML 11.

In the central part of the block - and comprising about 30% of its area - lies the region of Ogoniland. In the late 1980s, concerns over the environmental impact of oil operations resulted in organised protests by the Ogoni people. Infrastructure was vandalised and increasing hostility towards oil operations made the region off-limits. In 1993, intervention by the Nigerian military followed by the execution of leading campaigners for the Ogonis in 1995, effectively ended all operations by Shell. All production in Ogoniland has been shut-in since. However, Ogoniland is still a transit route for a major pipeline transporting crude from other parts of the onshore delta.

Production from OML 11 is from six fields, outwith the Ogoni region. OML 11 also contributes substantial volumes of gas to NLNG, primarily from the Bonny field in the south of the block. Shell also operates the Afam VI gas-fired power station, which is supplied from the Afam field in the north of the block.

Key issues

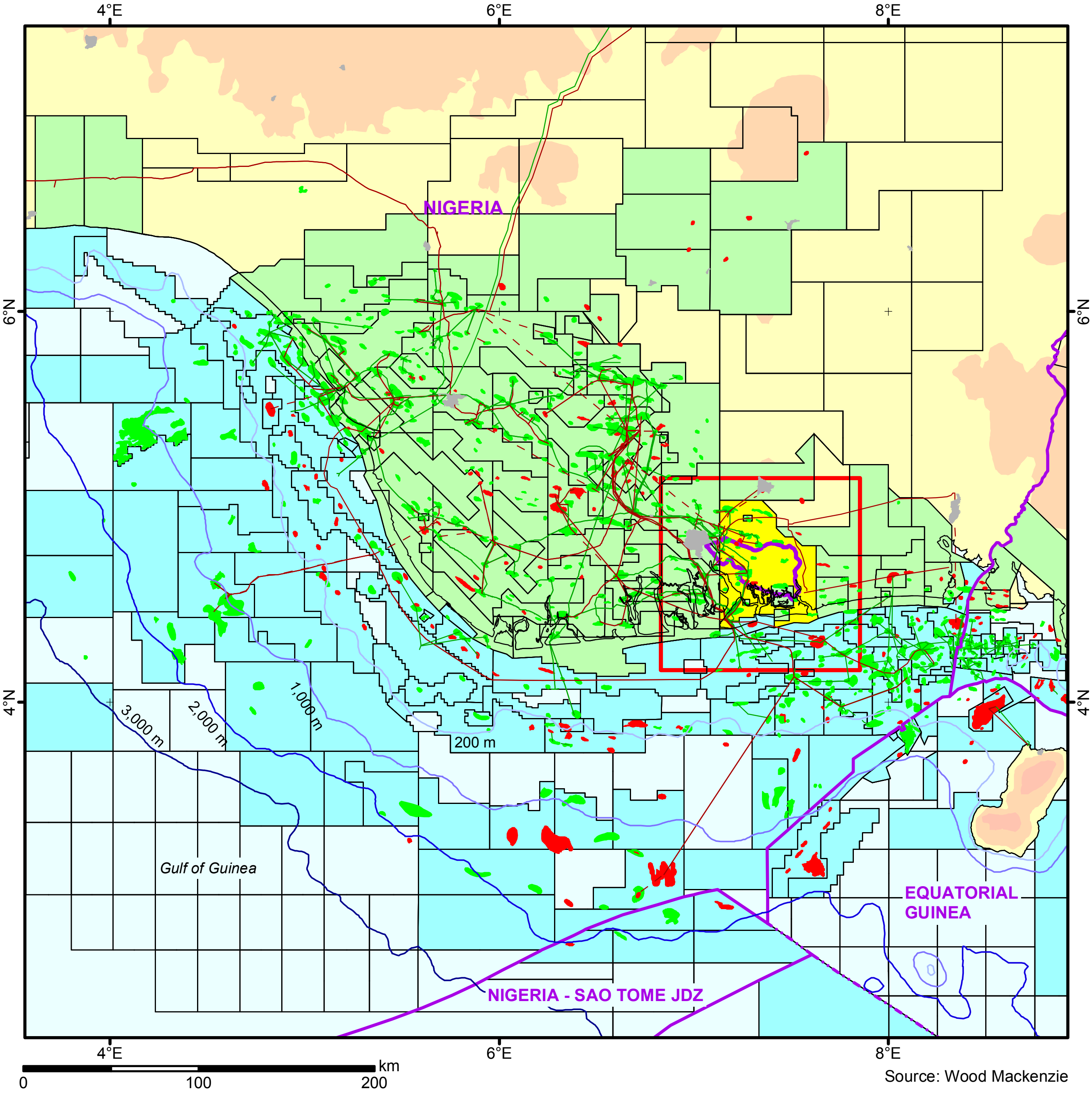
In 2008 the UN was invited to carry out a comprehensive study on the environmental impacts of oil activities in Ogoniland. It was funded by the NNPC/Shell JV partners and the final report in 2011 recommended among other things, the funding of bodies to oversee the monitoring and rehabilitation of areas impacted by pollution. It was estimated that US$1 billion would be initially needed, although long-term rehabilitation will cost many billions of dollars. Shell accepted the recommendations, including improvements to its pollution clean-up processes. A clean up also depended on the political will to implement the recommendations at the federal, state, and local government level, as well as the support of local communities. At these levels, no tangible progress has been made since, and the task now falls to the Buhari administration. However, with low oil prices there is no spare money to support this vital work.

The Trans Niger Pipeline (TNP) carries oil produced from the Shell JV to Bonny. However, the TNP, which has a capacity of 150,000 b/d, has been severely affected by crude thefts. *Force majeure* on exports from Bonny are regular due to pipeline damage cause by thefts. In 2013, Shell sanctioned the US$1.5 billion Trans Niger Pipeline Loopline (TNPL). The loopline will offer an alternative route for crude transported to Bonny Terminal, avoiding Ogoniland. The looping of the line should allow for fewer outages, however, we expect it will still be vulnerable to damage.

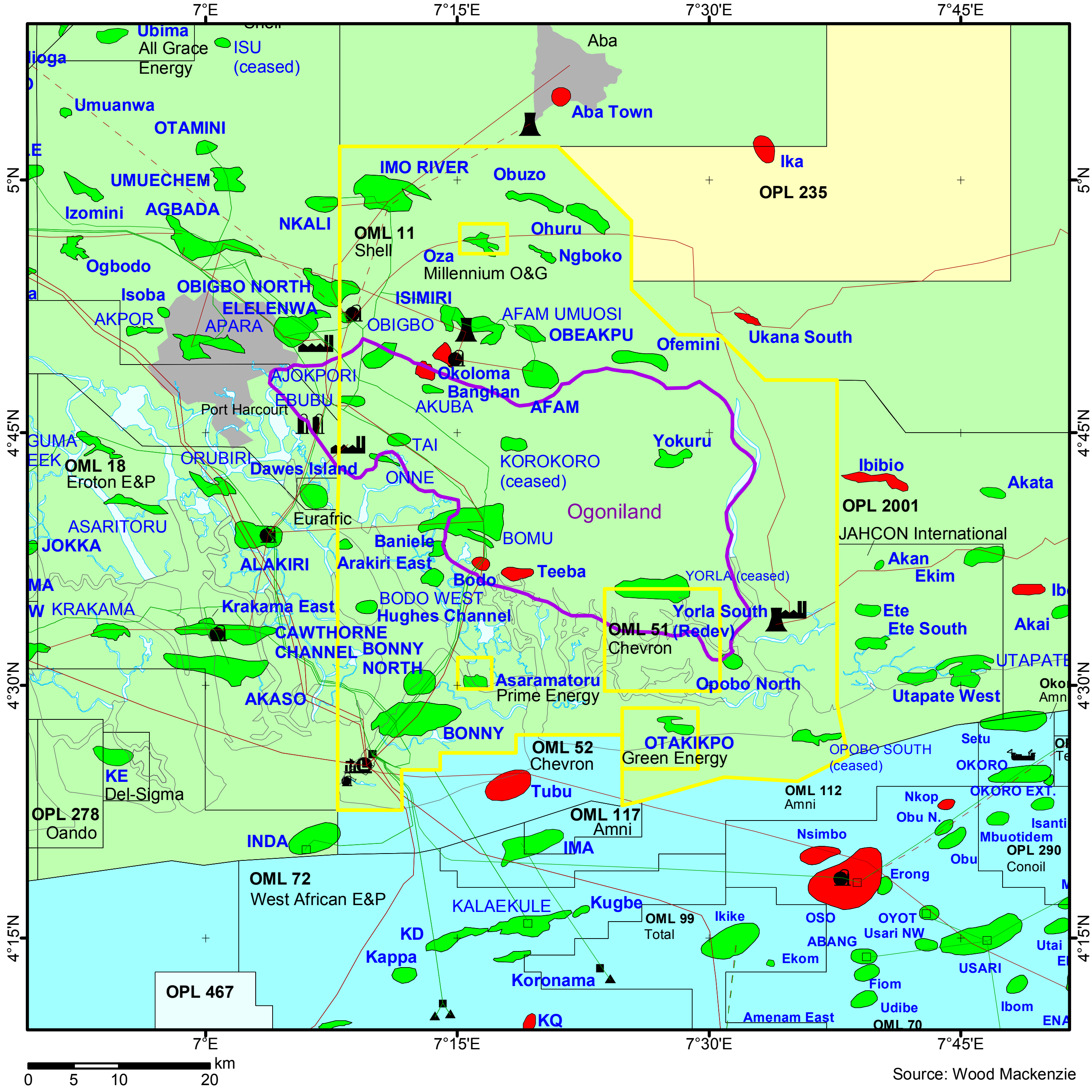
In 2016, militancy returned to the Niger Delta. While this was concentrated in the western delta, there have been multiple incidents on the pipelines that feed Bonny. We have adjusted our forecast for 2016 production to reflect this. However there are further downside risks should militancy continue throughout the year and beyond.

Location maps

Index Map



OML 11, showing Ogoniland boundary



Participation

Participation

Company	(%)
NNPC	55.00
Shell	30.00*
Total	10.00
Eni	5.00
Total	**100.00**

Source: Wood Mackenzie

** Operator*

In 2008, the Federal Government announced it would replace Shell as the operator in Ogoniland to allow oil operations to resume. NNPC's subsidiary, NPDC, would most likely assume the role, although the change has not yet been implemented. Given this situation, we expect minimal investments on the fields. OML 11 expires in 2019 and we expect at this point it will be awarded to a new set of indigenous investors.

Geology

The Tertiary Niger Delta covers an area of 75,000 square kilometres and has a sedimentary thickness of up to 9,000 metres. Hydrocarbons have been found generally in Tertiary rocks. The majority of these reservoirs are of the Paleocene and Pliocene age. Shell's fields are concentrated along the updip or proximal edge of successive depocentres generated through the Paleocene and Pliocene. The structural traps found in the fields are as follows:

- Simple rollover structures with landward dips are associated with a structure building fault. These therefore are the most northernmost fault blocks in the basin. They are generally bounded to the south by a crestal fault. Where these fault blocks are extremely large, they tend to be bounded down dip by another structure building fault.

- Simple rollover structures with anticlinal dips are also known as crestal fault blocks due to their symmetrical dips emphasising the crest of the structure.

The JV's fields produce from the Tertiary, Agbada Formation. Most of the main Niger Delta fields produce from this horizon. Sampled source rocks have been of generally poor quality. The organic content is low and it is gassy or light oil prone. The marine shales are the most effective source rocks. The main marine shale, which has been identified as a source of oil generation in the Niger Delta, is called the Akata Formation. Many reservoirs are gas-cap driven with aquifer support. The fields are characterised by high gas-oil-ratios and flaring is widespread.

Bonny Light

The Bonny Light blend has a gravity of 33-35°API and a sulphur content of 0.16-0.20%. Its pour point is approximately 19°F, and the total acid number (TAN) is 0.28 mg KOH/g.

Hydrocarbon and Reservoir Characteristics

Field	Gravity	GOR	Gross Thickness	Net Pay	Reservoir Depth	Initial Pressure	Temperature	Permeability	Porosity
	°API	scf/bbl	m	m	m	psi	°C	mD	%
OML 11	35.6	762.1	521.5	20.8	2,166.5	3,729.5	60.5	2,475	27

Source: Wood Mackenzie

Well data

OML 11 discovery wells

Well Name Type	Operator	Spudded Completed	TMD(m) WD(m)	Result	Discovery Field	Comment
Afam-1 Exploration	Shell	06 Sep 1956 08 Dec 1956	3,111	+ Oil	Afam	
Afam Umu-5 Exploration	Shell	12 Sep 1957 25 Nov 1957	3,099	+ Oil	Afam Umuosi	Afam Umu discovery well.
Bomu-1 Exploration	Shell	23 Feb 1958 08 May 1958	3,130	+ Oil	Bomu	
Obigbo-1 Exploration	Shell	28 Apr 1958 29 Jul 1958	3,489	+ Oil	Obigbo	
Ohuru-1 Exploration	Shell	11 May 1958 10 Sep 1958	3,102	* Oil	Ohuru	
Ebubu-1 Exploration	Shell	05 Aug 1958 13 Oct 1958	3,641	+ Oil	Ebubu	
Imo River-1 Exploration	Shell	14 Jan 1959 13 Apr 1959	2,942	+ Oil	Imo River	
Korokoro-1 Exploration	Shell	19 Jan 1959 26 Nov 1959	3,200	+ Oil	Korokoro	

Bonny-4 Appraisal	Shell	22 Jun 1962 14 Jul 1962	3,231		Oil		
Ngboko-1 Exploration	Shell	28 May 1964 25 Jun 1964	2,761	*	Oil	Ngboko	
Onne-1 Exploration	Shell	21 Mar 1965 06 Apr 1965	3,165	+	Oil	Onne	
Tai-1 Exploration	Shell	20 Oct 1965 03 Nov 1965	3,048	+	Oil	Tai	
Ofemini-1 Exploration	Shell	29 Dec 1966 12 Jan 1967	2,663	*	Oil	Ofemini	
Akuba-1 Exploration	Shell	01 Feb 1967 16 Feb 1967	3,180	+	Oil	Akuba	
Ajokpori-1 Exploration	Shell	18 Feb 1967 09 Mar 1967	3,431	+	Oil	Ajokpori	
Yorla-1 Exploration	Shell	01 Nov 1970 27 Nov 1970	3,632	+	Oil	Yorla	
Obuzo-1 Exploration	Shell	10 Oct 1971 03 Nov 1971	3,185	*	Oil	Obuzo	
Opobo South-2 Exploration	Shell	01 Apr 1974 15 Jun 1974	3,509 33	+	Oil	Opobo South	Opobo South discovery well.

Obeakpu-1 Exploration	Shell	11 Oct 1975 30 Oct 1975	2,530 +	Oil	Obeakpu	
Obeakpu-2 Appraisal	Shell	30 Sep 1976 03 Nov 1976		Oil & Gas		
Alakiri East-1 Exploration	Shell	06 Nov 1977 18 Dec 1977	3,730 *	Oil	Alakiri East	
Onne-3 Appraisal	Shell	01 Dec 1977 13 Dec 1977		Oil		
Obeakpu-5 Appraisal	Shell	12 Aug 1981 01 Sep 1981		Gas Shows		
Opbo North-1 Exploration	Shell	26 Oct 1981 23 Dec 1981	3,708 *	Oil	Opobo North	
Baniele-1 Exploration	Shell	13 Dec 1988 22 Feb 1989	3,987 *	Oil & Gas	Baniele	
Bonny North-2 Exploration	Shell	31 Dec 2002 05 Mar 2003	3,862 +	Oil & Gas	Bonny North	Bonny North discovery well.
Obeakpu-7ST Appraisal	Shell	01 May 2007 30 May 2007	2,784	Tight Hole		
Bonny North-4 Appraisal	Shell	01 Jun 2014 30 Jun 2014		Oil		

Source: Wood Mackenzie

** Technical Discovery*

+ Commercial Discovery

Exploration

OML 11 is extensively covered by 2D seismic and is well explored particularly in the west of the block. Around 250 E&A wells have been drilled since the Afam discovery in 1956. Of the 55 exploration wells drilled, 33 were discoveries with approximately half proving commercial. OML 11 has proved to be one of the most prospective blocks in the NNPC/Shell JV portfolio. Almost all E&A wells are located onshore, although in the mangrove swamps and numerous waterways floating swamp-barges are used. The first offshore discovery was Opobo South in 1974. Given the number of undeveloped discoveries on the block, no further exploration is expected.

Reserves and resources

Estimated recoverable and remaining commercial reserves for OML 11 are shown in the accompanying table. Because of a lack of investment and the shut-in of many fields since 1992, recovery factors are often below 30%. There are substantial reserves that we therefore class as technical.

Commercial Recoverable Reserves (p+p)

(Remaining Reserves at 01/01/2017)

	Init Oil (mmbbl)	Init Gas (bcf)	Rem Oil (mmbbl)	Rem Gas (bcf)
Afam	80	545	16	331
Ajokpori	5	-	0	-
Akuba	4	-	0	-
Bodo West	79	-	0	-
Bomu	286	52	0	0
Bonny	122	2,594	3	1,200
Bonny North	13	16	0	0
Ebubu	19	-	0	-
Imo River	713	388	34	0
Isimiri	73	4	2	0
Korokoro	76	-	0	-
Obeakpu	50	162	12	107
Obigbo	0	-	0	-
Obigbo North (OML 11)	126	647	7	1
Onne	10	-	0	-
Opobo South	16	-	0	-
Tai	4	-	0	-
Yorla	63	-	0	-
Total	**1,739**	**4,408**	**74**	**1,639**

Source: Wood Mackenzie

Technical Recoverable Reserves

(Remaining Reserves at 01/01/2017)

	Init Oil (mmbbl)	Init Cond. (mmbbl)	Init Gas (bcf)	Rem Oil (mmbbl)	Rem Cond. (mmbbl)	Rem Gas (bcf)
Afam	-	-	800	-	-	800
Afam Umuosi	50	-	134	50	-	134
Ajokpori	20	-	404	20	-	404
Akuba	7	-	60	7	-	60
Alakiri East	51	-	157	51	-	157
Banghan	1	-	70	1	-	70
Baniele	7	-	50	7	-	50
Bodo	-	-	1	-	-	1
Bodo West	120	-	209	120	-	209
Bomu	-	590	1,520	-	590	1,520
Bonny	-	100	-	-	100	-
Bonny North	250	-	2,000	250	-	2,000
Ebubu	35	-	40	35	-	40
Hughes Channel	2	-	8	2	-	8
Imo River	300	-	900	300	-	900
Isimiri	-	-	110	-	-	110
Korokoro	30	-	300	30	-	300
Ngboko	15	-	400	15	-	400
Obeakpu	50	-	450	50	-	450
Obigbo	4	-	30	4	-	30
Obigbo North (OML 11)	-	-	600	-	-	600
Obuzo	42	-	-	42	-	-
Ofemini	5	-	40	5	-	40
Ohuru	150	-	-	150	-	-
Okoloma	1	-	220	1	-	220
Onne	20	-	26	20	-	26
Opobo North	12	-	180	12	-	180
Opobo South	70	-	125	70	-	125
Tai	12	-	25	12	-	25
Teeba	-	2	75	-	2	75
Yokuru	5	-	5	5	-	5
Yorla	150	-	490	150	-	490
Total	**1,409**	**692**	**9,429**	**1,409**	**692**	**9,429**

Source: Wood Mackenzie

40% of the Obigbo North reserves are estimated to lie on OML 11.

Production

Production on OML 11 began in 1958 from the Afam field. Output peaked in 1973 at 233,000 b/d. When the major civil unrest resulted in the shut-in of many fields, OML 11 was producing around 88,000 b/d. We estimate that up to half of total liquids production liquids production is NGLs from the Afam and Bonny fields. The key fields on the block are Imo River, Obigbo North and Afam to the north, and the Bonny oil and gas field to the south.

Production (2006-2015)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Afam	-	-	-	2	5	4	4	4	4	4
Bonny	4	4	3	3	3	2	2	1	2	1
Bonny North	6	6	-	3	5	3	2	1	1	0
Imo River	22	18	15	10	15	10	-	5	10	13
Isimiri	3	3	3	3	2	1	-	1	1	1
Obeakpu	-	-	-	-	-	-	3	3	3	3
Obigbo North	7	7	6	4	4	4	1	2	2	4
Total Liquid ('000 b/d)	**42**	**38**	**27**	**25**	**34**	**24**	**12**	**17**	**23**	**26**
Domestic gas	4	9	9	7	64	64	152	112	93	72
NLNG	250	510	425	399	380	238	252	262	142	150
Total Sales Gas (mmcfd)	**254**	**519**	**434**	**406**	**444**	**302**	**404**	**374**	**235**	**222**

Source: Wood Mackenzie

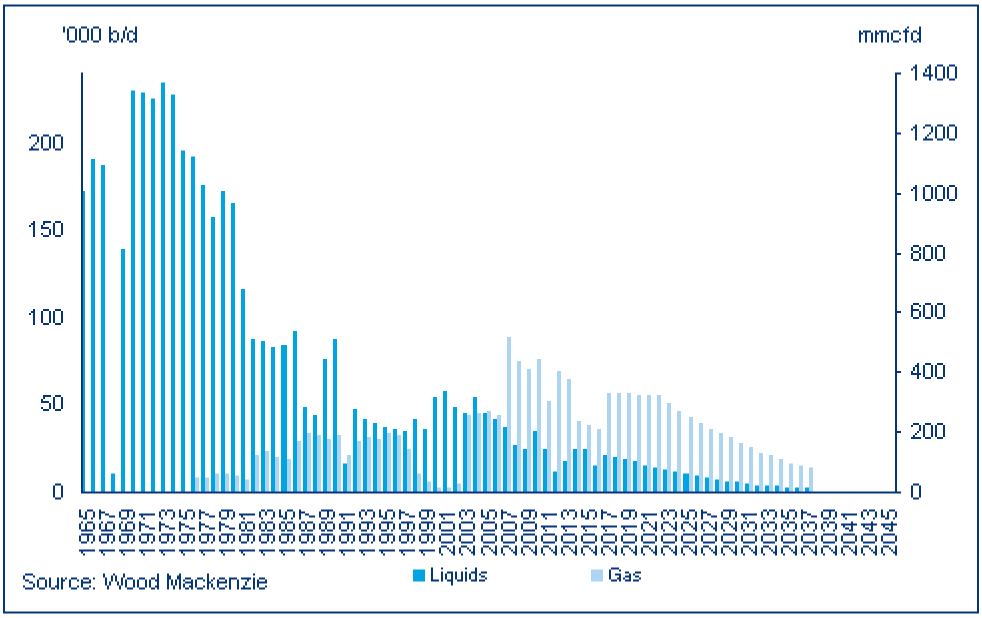
Production (2016-2025)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Afam	2	3	4	4	4	4	3	3	3	3
Bonny	1	1	1	1	1	1	1	0	0	0
Bonny North	-	-	-	-	-	-	-	-	-	-
Imo River	8	11	9	9	8	7	6	6	5	5
Isimiri	1	1	1	1	1	1	0	0	0	0
Obeakpu	2	3	3	2	2	2	2	2	2	2
Obigbo North	1	3	2	2	2	2	2	1	1	1
Total Liquid ('000 b/d)	**14**	**21**	**20**	**19**	**17**	**15**	**14**	**13**	**12**	**11**
Domestic gas	65	81	81	77	74	72	70	68	66	64
NLNG	145	250	250	250	250	250	250	225	203	182
Total Sales Gas (mmcfd)	**210**	**331**	**331**	**327**	**324**	**322**	**320**	**293**	**268**	**247**

Source: Wood Mackenzie

Please refer to our Upstream Data Tool (UDT) for life of field production data.

OML 11 Production Profile



Development

Oil infrastructure

Most of the oil infrastructure in OML 11 was constructed between the late 1950s and late 1970s. There are seven working flow-stations on OML 11: Afam, Bonny, Imo River (3), Isimiri and Obigbo North. Apart from oil and gas separators, the only water treatment facilities are basic gravimetric separators that skim oil from the surface and discharge waste water into trenches, water channels or pits. Associated gas is flared from the flow stations. The only offshore development on OML 11 was Opobo South, which produced 16 million barrels from a fixed platform between 1980 and 1990.

Trans Niger Pipeline Loopline

In 2013, Final Investment Decision (FID) was taken for the construction of the Trans Niger Pipeline Loopline (TNPL). The contract for the first phase of the project was finalised in July 2013, with Kaztec Engineering. The loopline will run from Ogale to the Bonny Terminal. It will consist of three parts - a 12.5 kilometre, 30 inch pipeline from Ogale to Eleme, a 22.5 kilometre 30 inch pipeline from Eleme to Ogo Bolo and a 20 kilometre 30 inch pipeline from the Cawthorne Junction Manifold to the Bonny Terminal. The loopline will offer an alternative route for crude transported to the Bonny Terminal and will reduce the crude losses and disruption associated from Bomu to Bonny. The total cost of the line is US$1.5 billion.

Gas infrastructure

The Okoloma gas processing plant is located at the Afam field and has a capacity of 240 mmcfd. Five eight-inch flowlines from non-associated gas wells on Afam are tied into a manifold. From here, a 12-inch 11 kilometre-long bulkline supplies Okoloma. Okoloma supplies the Afam VI power plant, but gas is also sold to the Nigerian Gas Company (NGC), which manages the domestic gas network and supplies industrial users. This includes up to 50 mmcfd of swing supply to the aluminium smelter at Ikot Abasi. German firm Impac was awarded the US$875 million contract for the construction of the Okoloma plant and pipelines.

Obigbo North has two gas compressors, one for associated gas, one for non-associated gas. Both send gas to a manifold at Obigbo from where it enters the NGC grid. A pipeline owned by the Shell Gas Company, supplies local consumers in the town of Aba, 40 kilometres to the northeast.

Imo River has a single compressor for associated gas that also ties into the manifold at Obigbo. To the south of the block, a compressor for non-associated gas at the Bonny field is connected by pipeline to the NLNG plant at Bonny.

Shut-in Ogoniland infrastructure

Ten oil fields have been shut-in since the early 1990s. They are: Ajokpori, Akuba, Bodo West, Bomu, Ebubu, Korokoro, Onno, Opobo South, Tai and Yorla. This includes over 100 wells, and five flowstations with a total capacity of 185,000 b/d which were abandoned *in-situ*. The flowstations are: Bomu, Ebubu, Korokoro and Yorla. A second flow station at Bomu was destroyed in the Biafran war and another flow station at Onne had already been decommissioned by the time of the unrest. While no oil production has taken place in Ogoniland for 20 years, the facilities themselves have never been decommissioned. At the time of shut-in, the fields were producing around 30,000 b/d.

Some trunk pipelines pass through Ogoniland but because the area is off limits, they have not been maintained adequately. Consequently, the infrastructure has gradually deteriorated, while vandalism has caused further pollution. Because of the length of time since the fields were shut-in, it is likely that any attempt to re-start production would require major new investment to replace the old infrastructure and drill new wells.

Afam VI power plant

A gas-fired power station at Afam in OML 11 was originally commissioned by government in 1962. It shut down in 1997, and at the time, it consisted of several trains (Afam I-III, Afam IV and Afam V) with a total installed capacity of over 1,000 MW. Since then, the gas processing plants at Obigbo North and Afam that supplied the station (combined capacity of 165 mmcfd) have been idle.

To address the power sector crisis and reduce flaring, in 2003, the state-owned Power Holding Company of Nigeria (PHCN) selected the NNPC/Shell JV consortium to enter into a lease, operate and transfer (LOT) agreement for Afam V; and a restore, operate and transfer (ROT) agreement for Afam I-IV. After assessing the condition of the plant, it was agreed that Afam I-IV should be replaced with a new unit known as Afam VI.

Afam VI is a combined-cycle gas turbine (CCGT) plant with an installed capacity of 650 MW and consists of three 150 MW gas generators and one 200 MW steam generator. The gas turbines were fully commissioned in July 2009, and the steam turbine was commissioned in December 2010. Shell is the operator on a 15-year lease. Afam VI receives gas from Okoloma and requires a feedstock of around 114 mmcfd to operate at the installed capacity. Afam VI accounts for about 20% of Nigeria's power generation capacity.

Infrastructure

There is a dense network of pipelines and flow lines that traverse OML 11. Because OML 11 hosts the Bonny Oil Terminal, and the NLNG plant, significant volumes of oil and gas transit the block from from other parts of the delta. In addition to the main inter-field pipelines, the key strategic trunk-lines which feed into the Bonny Oil Terminal, are the Trans-Niger-Pipeline (TNP), the Nembe Creek Trunk Line (NCTL). Key gas pipelines such as GTS-1, GTS-2, GTS-3 and GTS-4 also traverse OML 11 en-route to NLNG.

Costs

Capital costs

Estimated capital costs for OML 11 are shown in the accompanying table. Since the 1990s, upstream investments have been capital constrained with NNPC increasingly unable to meet its JV cash calls. Combined with the difficulties in Ogoniland where IOC activity is off-limits, OML 11 has seen limited investments, particularly for oil.

Capital Costs Pre-2007 to 2015 (US$ million)

	Pre-2007	2007	2008	2009	2010	2011	2012	2013	2014	2015
Production facilities	1,873	154	93	187	209	167	161	125	97	62
Processing equipment	623	51	31	64	103	80	30	30	19	5
Development drilling	1,454	120	72	126	160	98	65	95	45	-
Pipelines	208	17	10	18	18	27	22	375	375	250
Abandon. Costs	0	-	-	-	-	-	-	-	-	-
Total	**4,158**	**342**	**206**	**395**	**490**	**372**	**278**	**625**	**536**	**317**

Source: Wood Mackenzie

Nominal to 2016 and real (in 2016 terms) thereafter.

Capital Costs 2016 to Post-2024 (US$ million)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	Post-2024
Production facilities	20	47	107	2	107	2	50	-	50	-
Processing equipment	-	11	26	51	26	26	26	-	-	-
Development drilling	-	25	-	65	-	45	-	-	-	-
Pipelines	250	400	-	-	-	-	-	-	-	-
Abandon. Costs	-	-	-	-	-	-	-	-	-	1,139
Total	**270**	**483**	**133**	**118**	**133**	**73**	**76**	**-**	**50**	**1,139**

Source: Wood Mackenzie

Nominal to 2016 and real (in 2016 terms) thereafter.

Please refer to our Upstream Data Tool (UDT) for life of field capital expenditure data.

Operating costs

At pre-2006 production levels, Shell was one of Nigeria's lowest cost operators on a unit basis at around US$2.50/barrel, in nominal terms. The increased cost of security and general cost inflation since 2006 has substantially increased operating costs. Wood Mackenzie's estimate of annual operating costs for OML 11 shown below.

Operating Costs 2016 to 2025 (US$ million)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Fixed costs	164	175	185	185	181	181	181	166	166	156
Variable costs	23	34	32	31	29	27	26	24	22	20
Total	**187**	**209**	**217**	**216**	**210**	**208**	**207**	**190**	**188**	**176**

Source: Wood Mackenzie

Nominal to 2016 and real (in 2016 terms) thereafter.

Sales contracts

LNG Feedstock

Gas from OML 11 forms part of the JV's contractual supply to NLNG. Each of the six trains is covered by long term supply contracts. Shell is required to provide 55.8% of feedstock gas and this overall supply commitment amounts to approximately 1,950 mmcfd, which includes its JV assets, the offshore EA field and the deepwater Bonga field. We expect that new supply contracts will be agreed when the current ones expire, and that supply to NLNG will continue in the long term. Feedstock prices are 26% of the LNG sales price.

Annual LNG Feedstock Prices

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Price per Mcf (US$)	2.29	2.33	2.34	2.37	2.43	2.44	2.19	2.23	2.28	2.32

Source: Wood Mackenzie

Domestic gas supply

Significant volumes of gas from OML 11 are also used to supply industrial users around Port Harcourt. Shell also sells gas directly to industrial consumers in Aba town, via its own pipeline from Obigbo North.

Annual Domestic Gas Prices

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Price per Mcf (US$)	2.53	2.58	2.96	3.02	3.08	3.15	3.21	3.27	3.34	3.41

Source: Wood Mackenzie

Fiscal and regulatory

The NNPC/Shell JV is subject to the Shell JV concession terms. This includes a 20% royalty and Petroleum Profits Tax (PPT) of 85%. Please refer to the Fiscal Terms section of the **Nigeria Upstream Summary** for details.

Economic assumptions

The cash flow for this asset has been run on a stand-alone basis using Wood Mackenzie's **Global Economic Model** (GEM). It does not reflect corporate synergies. These are included in the company valuations which can be produced in GEM and also in Wood Mackenzie's **Upstream Data Tool** (UDT).

Discount rate and date

Wood Mackenzie's discount rate is 10% nominal. The discount date is 1 January 2017.

Inflation rate

Wood Mackenzie's inflation rate is 2% in 2017 and onward.

Oil price

Wood Mackenzie's Q1 2017 Brent oil price assumption (nominal terms) is US$52.00/bbl in 2017, US$54.00/bbl in 2018, US$59.00/bbl in 2019, and US$68.98/bbl in 2020, inflated at 2% per annum thereafter. This equates to a long-term Brent price assumption of US$65.00/bbl (real, 2017 terms) from 2020 onward.

Oil is sold as the Bonny Light blend which trades at a 2% premium to Brent.

Global Economic Model (GEM)

The corresponding GEM file name is **OML 11**.

Economic analysis

Cash flow

Year	Production		Gross	Op	Capital	Royalty	Taxes	State	State Equity	Company Cash	Total Field
	Liquids	Gas	Revenue	Costs	Costs			Carry	Cash Flow	Flow	Cash Flow
	000b/d	mmcfd	US$M	US$M	US$M	US$M	US$M	US$M	US$M	US$M	US$M
1965	172.1	0.0	109.7	25.1	182.9	21.6	0.0	0.0	-65.9	-54.0	-119.9
1966	190.1	0.0	123.1	19.0	157.0	23.7	0.8	0.0	-42.5	-34.8	-77.3
1967	186.7	0.0	122.5	22.5	132.4	23.0	1.0	0.0	-31.1	-25.4	-56.5
1968	10.8	0.0	6.9	4.5	16.2	0.6	0.0	0.0	-7.9	-6.5	-14.4
1969	138.4	0.0	88.2	19.6	38.4	16.8	0.9	0.0	6.9	5.7	12.6
1970	229.2	0.0	146.1	29.4	115.7	28.5	1.3	0.0	-15.8	-12.9	-28.7
1971	229.0	0.0	186.4	41.6	96.8	35.7	6.9	0.0	3.0	2.4	5.4
1972	225.5	0.0	209.0	75.4	89.1	39.0	7.4	0.0	-1.1	-0.9	-1.9
1973	234.0	0.0	285.0	75.9	89.7	53.8	16.2	0.0	27.2	22.2	49.4
1974	226.9	0.0	943.6	73.1	85.4	185.3	344.3	0.0	140.6	115.0	255.6
1975	194.9	0.0	807.4	80.2	93.3	158.4	403.6	0.0	39.5	32.3	71.9
1976	191.8	46.8	853.0	77.1	87.6	167.4	439.7	0.0	44.7	36.6	81.4
1977	175.6	46.6	840.3	73.5	81.8	164.7	436.0	0.0	46.4	38.0	84.4
1978	157.9	59.4	773.3	77.7	83.8	151.3	386.7	0.0	40.6	33.2	73.8
1979	172.6	59.5	1,848.8	71.0	77.9	366.3	1,127.5	0.0	113.4	92.8	206.1
1980	165.3	55.6	2,104.3	78.0	83.7	417.1	1,297.4	0.0	125.5	102.6	228.1
1981	116.1	42.1	1,423.6	90.3	103.2	281.0	815.7	0.0	73.4	60.0	133.4
1982	87.5	122.7	1,040.2	88.7	102.0	203.2	553.4	0.0	51.2	41.9	93.0
1983	86.1	133.1	930.8	89.6	104.3	181.0	475.6	0.0	44.2	36.1	80.3
1984	83.3	115.9	869.2	82.3	99.4	168.8	438.3	0.0	44.3	36.2	80.5
1985	84.2	107.8	845.9	80.0	99.2	164.0	422.6	0.0	44.1	36.1	80.1
1986	91.4	165.4	490.8	101.1	131.5	93.1	150.0	0.0	8.3	6.8	15.1
1987	48.3	195.6	337.6	86.0	110.1	62.5	61.9	0.0	9.4	7.7	17.2
1988	43.1	185.9	254.7	75.8	97.8	45.2	18.3	0.0	9.6	7.9	17.5
1989	75.6	171.2	516.7	71.0	93.4	97.0	203.4	0.0	28.6	23.4	51.9
1990	87.6	188.2	771.2	111.1	104.4	146.6	339.9	0.0	38.0	31.1	69.1
1991	15.6	120.0	147.9	39.8	36.5	21.8	10.3	0.0	21.8	17.8	39.6
1992	47.2	165.1	361.8	70.0	49.4	64.5	117.1	0.0	33.4	27.3	60.8
1993	41.1	179.3	283.5	65.0	53.7	49.4	78.3	0.0	20.3	16.6	37.0
1994	39.0	177.4	262.0	56.5	63.2	43.9	75.4	0.0	12.6	10.3	23.0
1995	37.0	194.2	282.2	66.3	79.6	45.0	89.2	0.0	1.2	1.0	2.1
1996	35.6	186.9	312.6	69.7	71.6	52.5	102.1	0.0	9.2	7.5	16.7
1997	34.2	140.2	280.9	57.1	61.8	47.9	90.5	0.0	13.0	10.6	23.6
1998	41.0	58.9	216.2	40.8	64.3	37.0	43.8	0.0	16.7	13.7	30.3
1999	35.8	36.2	257.7	36.1	43.9	45.2	91.8	0.0	22.4	18.3	40.7
2000	53.8	11.9	600.4	46.6	63.3	111.0	269.0	0.0	60.9	49.8	110.7
2001	57.0	12.8	548.5	39.3	102.3	100.6	228.7	0.0	42.7	34.9	77.6
2002	48.1	28.7	467.1	51.7	114.5	86.5	172.4	0.0	23.1	18.9	42.0

2003	44.5	253.0	545.2	70.2	138.2	96.1	194.2	0.0	25.6	21.0	46.6
2004	53.9	258.3	859.0	91.3	185.6	154.4	346.6	0.0	44.6	36.5	81.1
2005	44.9	265.8	1,045.2	95.5	181.3	187.0	453.0	0.0	70.6	57.8	128.4
2006	41.2	254.0	1,139.7	126.9	291.2	205.0	471.8	0.0	24.7	20.2	44.8
2007	36.6	518.6	1,193.1	288.0	342.7	209.6	322.3	0.0	16.8	13.7	30.5
2008	26.7	434.1	1,203.2	292.9	206.8	207.2	328.3	0.0	92.4	75.6	168.0
2009	23.9	405.7	771.9	306.4	395.1	121.3	84.0	0.0	-74.2	-60.7	-135.0
2010	34.0	444.1	1,262.6	267.5	489.3	214.6	163.6	0.0	70.2	57.4	127.6
2011	23.8	301.7	1,250.3	191.9	372.2	211.8	324.1	0.0	82.7	67.7	150.4
2012	11.4	404.1	858.4	300.3	277.4	118.6	116.2	0.0	25.2	20.6	45.9
2013	17.0	373.8	1,125.2	313.7	625.0	152.5	174.4	0.0	-77.3	-63.2	-140.5
2014	23.6	235.0	1,133.5	276.8	536.0	162.2	161.6	0.0	-1.7	-1.4	-3.1
2015	24.6	221.6	712.9	234.0	317.0	71.8	100.5	0.0	-5.7	-4.7	-10.4
2016	14.5	210.0	483.5	186.6	270.0	15.0	75.2	0.0	-34.9	-28.5	-63.4
2017	20.9	330.8	777.1	212.7	492.7	43.8	136.4	0.0	-59.6	-48.8	-108.4
2018	19.6	330.5	784.7	225.9	138.4	56.1	117.6	0.0	135.7	111.1	246.8
2019	18.5	327.3	797.7	229.0	125.2	71.7	110.2	0.0	143.9	117.7	261.6
2020	16.9	324.3	831.9	227.2	144.0	86.6	121.4	0.0	139.0	113.7	252.7
2021	15.4	321.9	801.2	229.9	80.6	89.8	107.3	0.0	161.4	132.1	293.5
2022	14.2	319.7	751.0	232.9	85.6	96.9	99.3	0.0	130.0	106.4	236.4
2023	12.9	292.7	704.9	217.7	0.0	90.2	89.1	0.0	169.3	138.6	307.9
2024	11.9	268.4	666.9	219.9	58.6	85.0	84.5	0.0	120.4	98.6	219.0
2025	10.7	246.6	621.2	209.8	0.0	78.0	75.1	0.0	142.1	116.2	258.3
2026	9.4	226.9	570.5	205.5	0.0	71.1	67.1	0.0	124.8	102.1	226.9
2027	8.2	209.3	522.6	206.7	0.0	64.3	58.4	0.0	106.3	86.9	193.2
2028	7.2	193.3	478.7	208.7	0.0	58.0	50.2	0.0	89.0	72.8	161.8
2029	6.2	179.0	438.2	207.7	0.0	52.2	43.1	0.0	74.4	60.9	135.3
2030	5.3	161.1	393.8	208.5	0.0	46.3	34.4	0.0	57.5	47.1	104.6
2031	4.4	145.0	348.3	206.6	0.0	40.0	26.0	0.0	41.6	34.1	75.7
2032	3.9	130.5	317.4	209.3	0.0	36.4	21.9	0.0	27.4	22.4	49.8
2033	3.5	117.4	288.0	212.3	0.0	33.1	33.8	0.0	4.8	4.0	8.8
2034	3.1	105.7	255.7	199.6	0.0	29.9	22.9	0.0	1.8	1.5	3.2
2035	2.8	95.1	232.4	173.5	0.0	27.2	25.0	0.0	3.7	3.0	6.8
2036	2.5	85.6	210.7	168.6	0.0	24.8	16.1	0.0	0.7	0.6	1.3
2037	2.2	77.1	191.8	155.9	0.0	22.6	13.3	0.0	-0.1	0.0	-0.1
2038	0.0	0.0	13.9	0.0	0.0	0.0	11.8	0.0	1.1	0.9	2.0
2039	0.0	0.0	12.1	0.0	0.0	0.0	10.3	0.0	1.0	0.8	1.8
2040	0.0	0.0	10.6	0.0	0.0	0.0	9.0	0.0	0.9	0.7	1.6
2041	0.0	0.0	8.8	0.0	0.0	0.0	7.5	0.0	0.7	0.6	1.3
2042	0.0	0.0	7.7	0.0	0.0	0.0	6.6	0.0	0.6	0.5	1.1
2043	0.0	0.0	6.8	0.0	0.0	0.0	5.8	0.0	0.6	0.5	1.0
2044	0.0	0.0	5.4	0.0	0.0	0.0	4.6	0.0	0.4	0.4	0.8
2045	0.0	0.0	0.0	0.0	2,023.0	0.0	60.7	0.0	-1,146.1	-937.7	-2,083.7
Totals:	**1,755.5**	**4,407.4**	**45,582.2**	**9,767.6**	**11,136.7**	**7,331.5**	**14,102.3**	**0.0**	**1,784.3**	**1,459.9**	**3,244.1**
PVs		Total PV	673,689.7	79,317.6	155,251.9	129,324.1	277,271.7	0.0	17,888.4	14,636.0	32,524.4

Rem PV	5,793.2	1,956.4	1,057.1	592.5	786.5	0.0	770.4	630.3	1,400.7

Source: Wood Mackenzie

Discounted at 10.0% from 01/01/2017

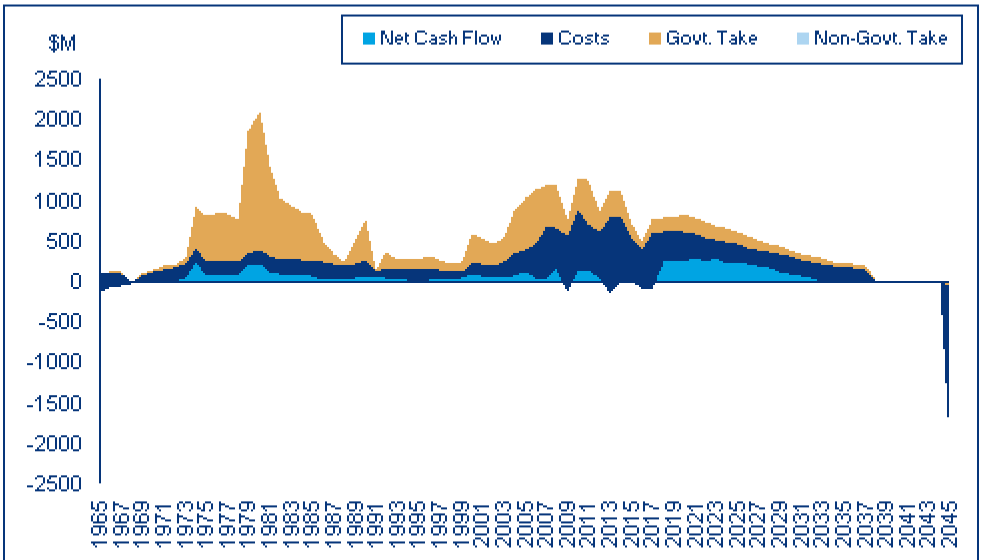
Discount Rate %	Total PV Post-Tax US$M	Total PV Pre-Tax US$M	Remaining PV Post-Tax US$M	Remaining PV Pre-Tax US$M	Remaining PV/boe Post-Tax US$	Remaining PV/boe Pre-Tax US$	Total Gov. Take US$M	Total Gov. Take %	Remaining Gov. Take US$M	Remaining Gov. Take %	P/I Ratio	Capex Boe US$	Opex Boe US$
0.0	3,244.1	24,678.0	860.8	3,534.2	2.38	9.79	21,433.8	86.9	2,673.3	75.6	1.3	4.40	3.86
5.0	10,779.0	92,846.0	1,563.1	3,405.0	4.33	9.43	82,067.0	88.4	1,841.8	54.1	1.4	11.26	7.64
7.0	17,101.8	170,490.5	1,532.8	3,159.9	4.24	8.75	153,388.7	90.0	1,627.1	51.5	1.3	20.96	12.61
8.0	21,445.9	233,008.2	1,495.7	3,031.6	4.14	8.39	211,562.3	90.8	1,535.9	50.7	1.3	29.55	16.79
9.0	26,633.9	319,540.2	1,450.6	2,904.2	4.02	8.04	292,906.4	91.7	1,453.6	50.1	1.3	42.32	22.77
10.0	32,524.4	439,120.2	1,400.7	2,779.7	3.88	7.70	406,595.8	92.6	1,379.0	49.6	1.2	61.34	31.34
11.0	38,661.1	604,054.1	1,348.3	2,659.5	3.73	7.36	565,392.9	93.6	1,311.2	49.3	1.2	89.69	43.61
12.0	44,018.2	831,045.7	1,295.0	2,544.4	3.59	7.04	787,027.5	94.7	1,249.4	49.1	1.1	132.00	61.23
15.0	25,899.8	2,151,935.6	1,139.6	2,232.5	3.16	6.18	2,126,035.8	98.8	1,092.9	49.0	1.0	430.18	175.21
25.0	-13,054,993.0	42,878,978.5	747.0	1,514.1	2.07	4.19	55,933,971.6	130.4	767.1	50.7	0.8	22,203.77	6,432.35

Source: Wood Mackenzie

Discount Date	Jan-2017
Remaining Liquid Reserves (mmbbl)	72.9
Remaining Gas Reserves (bcf)	1638.2
Total Remaining Reserves (mmboe)	361.2
Total Reserves (mmboe)	2531.2
Project IRR (post tax)	15.72%
Pre-tax IRR	40.54%
Payback Period (years)	9.9
Reserve life at current production (years)	12.5

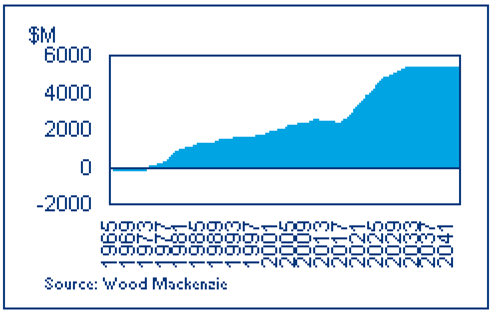
Source: Wood Mackenzie

Split of Revenues

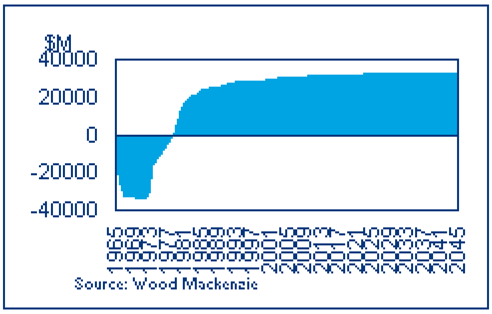


Source: Wood Mackenzie

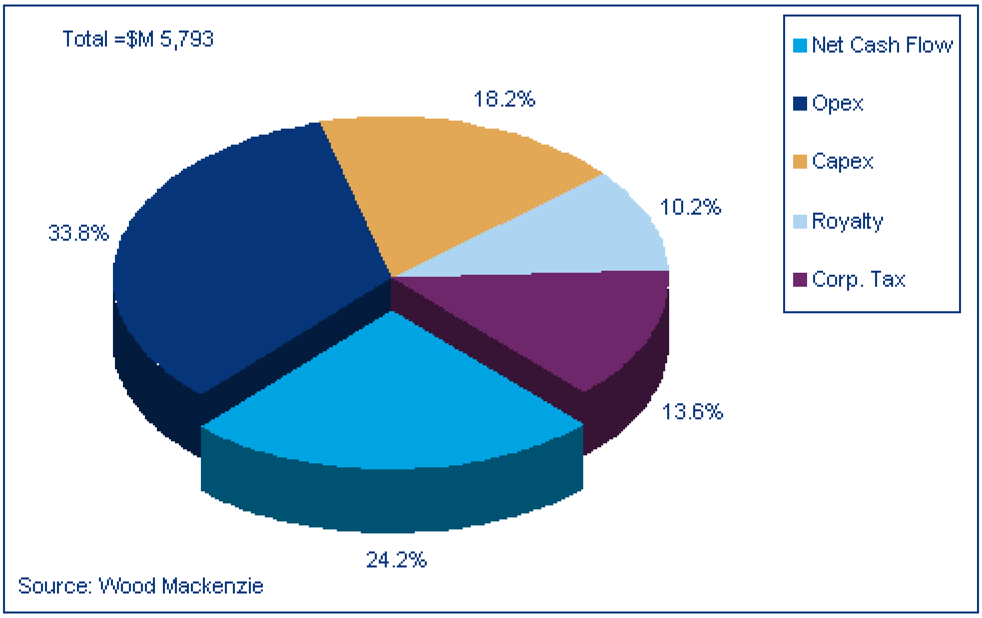
Cumulative Net Cash Flow - Undiscounted



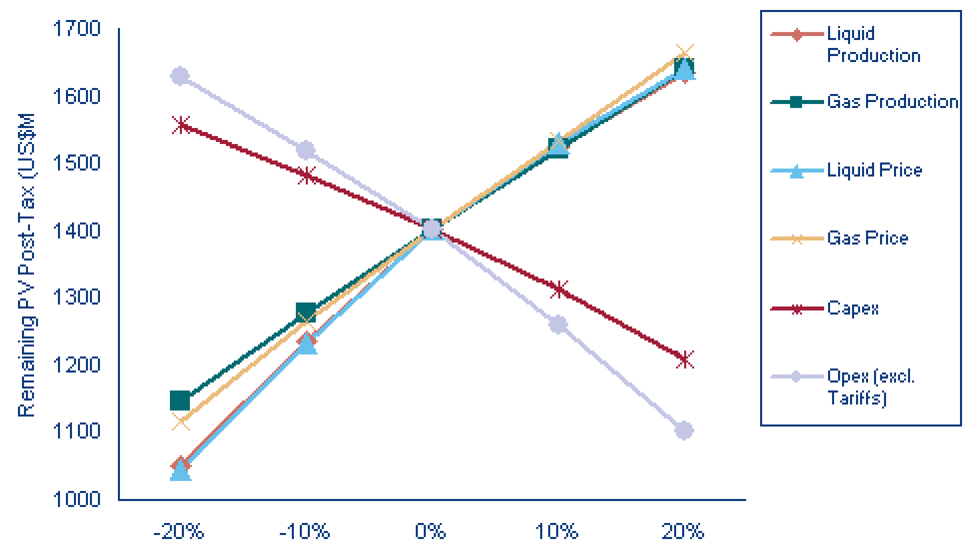
Cumulative Net Cash Flow - Discounted at 10% from 01/01/2017



Remaining Revenue Distribution (Discounted at 10% from 01/01/2017)



Remaining PV Price Sensitivities



Source: Wood Mackenzie

Client Helpdesk	Europe	Americas	Asia Pacific
support@woodmac.com	+44 131 243 4477	+1 713 470 1700	+65 6518 0888