

# Oil and natural gas extraction data

Richard Heede  
 Climate Mitigation Services  
 File started: 11 January 2005  
 Last modified: April 2013

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## Petroleum Development Oman

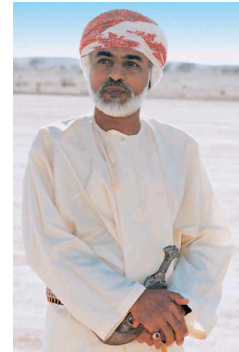
yellow column indicates original reported units

60% SOE

www.pdo.co.om Muscat Ministry of Petroleum and Minerals

## Production / Extraction data

Year	Crude Oil & NGL			Natural Gas		
	Gross production	Gross production	Gross production	Gross production	Gross production	Gross production
	Thousand bbl /d	Million bbl /yr	Million bbl /yr	Trillion cf/yr	Billion cf/yr	Billion cf/yr
	PD Oman	PD Oman	PD Oman	PD Oman	PD Oman	PD Oman



His Majesty Sultan Qaboos bin Said  
 Oman AR2011.

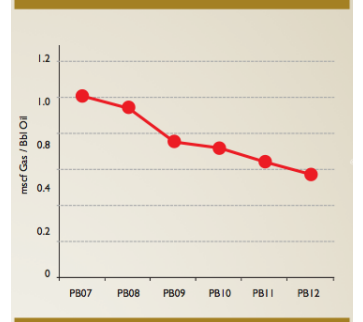
U.S. Bureau of Mines Minerals Yearbook 1976, page 888. Lists marketed and gross production of natural gas by country.

Year	Allocated PDO			PDO %	Oman		PDO Billion cf /yr	Utiliz. rate
	60% of Oman	PDO oil prod'n from PDO AnnRpts	Oil starts Aug67		gross production	marketed prod		
	million bbl /yr	million bbl /yr	million bbl /yr	Bcf/yr	Bcf/yr			
1964		23	2.3	10%				
1965		88	8.8	10%	14	na	1.5	100%
1966		120	12.0	10%	20	na	1.5	100%
1967		121	10.7	10%	20	na	1.5	100%
1968	121	107	10.7	10%	90	1.5	1.5	100%
1969	107	103	10.3	10%	90	1.5	1.5	100%
1970	107	107	64.2	60%	90	1.5	1.5	100%
1971	106	106	63.7	60%	36.0	1.5	1.5	100%
1972	125	125	84.5	60%	42.0	1.7	1.7	100%
1973	134	134	79.5	60%	45.0	2.0	2.0	100%
1974	124	124	74.5	60%	interpolated	8.5	8.5	100%
1975	115	115	68.8	60%	interpolated	15.0	15.0	100%
1976	108	108	64.6	60%	interpolated	21.5	21.5	100%
1977	104	104	61.8	60%	NA	28.0	28.0	100%
1978	117	117	69.4	60%	NA	33.0	33.0	100%
1979	119	119	71.1	60%	NA	41.0	41.0	100%
1980	138	138	82.5	60%	NA	51.0	72.2	100%
1981	152	152	89.2	60%	NA	47.0	82.5	100%
1982	183	183	107.1	60%	NA	55.0	92.8	100%
1983	206	206	120.7	60%	NA	70.0	103.1	100%
1984	215	212	125.0	60%	NA	79.8	122.5	0.80 actual utiliz. rate
1985	227	221	131.6	60%	NA	73.1	92.5	0.78 actual utiliz. rate
1986	238	224	134.9	60%	NA	98.5	95.8	
1987	254	252	142.8	60%	186	215.4	134.1	
1988	258	259	145.6	60%	237	218.6	127.6	
1989	272	271	151.5	60%	215	122.3	145.7	
1990	285	284	160.5	60%	227	125.4	166.3	
1991	298	278	175.4	60%	237	163.7	163.7	
1992	314	293	184.8	60%	268	161.1	161.1	
1993	326	303	191.0	60%	251	163.7	163.7	
1994	332	309	196.0	60%	363	174.5	174.5	
1995	331	305	194.7	60%	370	200.0	176.1	
1996	334	304	195.1	60%	408	164.0	129.2	from column "AA"
1997	356	331	198.2	60%	484	122.8	280.3	
1998	335	330	198.0	60%	730	139.2	459.9	
1999	329	281	184.6	60%	765	482.2	525.6	0.92 actual utiliz. rate
2000	301	256	166.9	60%	879	518.3	547.5	
2001	276	241	155.5	60%	971	543.8	628.5	
2002	286	230	151.1	60%	848	555.5	632.9	
2003	272	215	140.4	60%	1,052	768.5	823.4	
2004	261	205	132.9	60%	1,070	813.5	871.6	
2005	278	203	138.6	60%	1,068	797.2	854.1	from column "I"
2006	298	202	141.9	60%	1,097	838.0	838.0	
2007	317	202	141.9	60%	1,176	981.0	981.0	
2008								
2009								
2010								
<b>Total</b>	na	7,353	5,037		na	4,146	9,806	

1.24 million BOE/day (2012)

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	Total PDO Hydrocarbon Production (kboe/d)														
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31	Petroleum Development Oman: Annual Reports 1967-2010														
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PDO Oil Production Efficiency



Oman AnnRpt 2011, page 15.

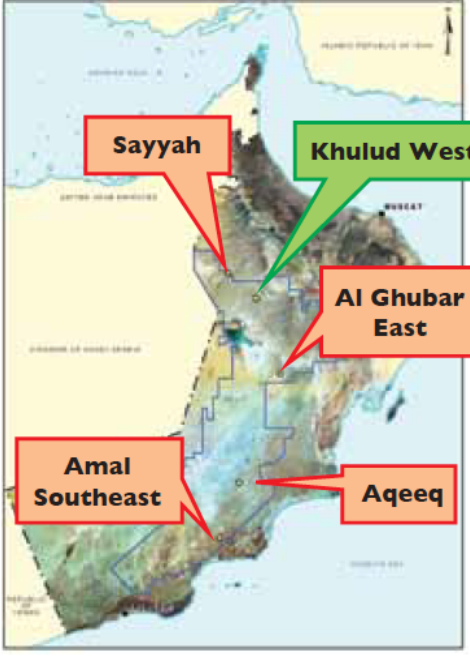

assume 6000 cf/BOEq

PDO data

gas delivered	gas	gas
million CM /day	billion CM /yr	billion cf/yr
70 to 92% utilis.		
5.6	2.0	72.2
6.4	2.3	82.5
7.2	2.6	92.8
8.0	2.9	103.1
9.5	3.5	122.5
7.2	2.6	92.5
7.4	2.7	95.8
10.4	3.8	134.1
9.9	3.6	127.6
11.3	4.1	145.7
12.9	4.7	166.3
12.7	4.6	163.7
12.7	4.6	163.7
13.5	4.9	174.5
13.7	5.0	176.1
13.8	5.0	177.8
19.7	7.2	253.9
34.3	12.5	442.1
37.4	13.7	482.1
	14.7	519.1
	15.4	543.8

Bcf/yr  
Gas prod column "T" convert to Bcf/yr

129
280
460
526
548
629
633
823
872
854
911
977

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28	<p>Oil and Gas Discoveries</p>														
29	<p>Oman PDO Annual Rpt 2010 p. 22.</p>														
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	Oman	Oman	US Energy Information Administration, International Energy Statistics				Oman	Oman
	Crude oil, condensate, & NGPL	Crude oil, condensate, & NGPL	www.eia.gov/emeu/internationalenergy.html				Reinjected	Gross Prod'n
	k bbl per day	million bbl per yr	Updated April 2013	Oman	Oman	Oman	Bcf per year	Bcf per year
			Prod Marketed Gas	Dry natural gas	Vented & Flared	Flaring of gross		
			Bcf per year	Bcf per year	Bcf per year	gas prod'n, %		
1970	332	121	NA	28	-		NA	NA
1971	294	107	NA	33	-		NA	NA
1972	282	103	NA	41	-		NA	NA
1973	293	107	NA	51	-		NA	NA
1974	290	106	NA	47	32		NA	NA
1975	343	125	NA	55	3		NA	NA
1976	366	134	NA	70	10		NA	NA
1977	341	124	NA	80	11		NA	NA
1978	315	115	NA	73	4		NA	NA
1979	295	108	NA	99	6		NA	NA
1980	284	104	109	99	25	13%	53	186
1981	321	117	136	124	31	13%	71	237
1982	326	119	131	117	22	10%	62	215
1983	377	138	151	140	22	9%	55	227
1984	417	152	162	150	16	7%	59	237
1985	502	183	160	147	8	3%	100	268
1986	564	206	158	145	8	3%	86	251
1987	588	215	205	176	34	9%	124	363
1988	623	227	289	248	29	8%	53	370
1989	651	238	242	197	47	12%	119	408
1990	695	254	392	322	32	7%	60	484
1991	708	258	582	493	34	5%	114	730
1992	746	272	625	530	32	4%	108	765
1993	781	285	653	558	28	3%	198	879
1994	816	298	703	607	28	3%	240	971
1995	861	314	748	699	35	4%	64	848
1996	893	326	906	837	51	5%	95	1,052
1997	910	332	921	849	49	5%	99	1,070
1998	906	331	917	850	50	5%	102	1,068
1999	916	334	953	875	51	5%	93	1,097
2000	974	356	1,035	957	46	4%	95	1,176
2001	917	335	1,020	937	32	3%	105	1,157
2002	902	329						
2003	825	301						
2004	756	276						
2005	782	286						
2006	746	272						
2007	716	261						
2008	763	278						
2009	818	298						
2010	869	317						
2011	891	325						
2012	923	337						
	1990-2011 totals		11,198	10,057	709	5.0%	2,154	14,060

**Cell:** I9

**Comment:** Rick Heede:

Wiki PDO history: Oman's growth into a successful oil- and gas-producing nation had humble beginnings — so humble, in fact, that it began with a dud. A geological survey of the country in 1925 found no conclusive evidence of oil. Twelve years later, however, when geologists began intensively searching for oil in neighbouring Saudi Arabia, Oman's Sultan Said bin Taimur granted a 75-year concession to the Iraq Petroleum Company (IPC). Pausing only for the Second World War, exploration for oil was underway in Oman.

The exploration and production operations were to be run on behalf of the IPC by Petroleum Development (Oman and Dhofar) Ltd. The operating company had four shareholders, each with an interest of 23.75%: the Royal Dutch/Shell Group, the Anglo-Persian Company (which would eventually become the British Petroleum Company, or BP), Compagnie Française des Pétroles (whose convoluted lineage would make it a predecessor of today's TotalFina-Elf) and the Near East Development Company (whose likewise convoluted lineage would make it a subsidiary of today's ExxonMobil). The remaining 5% stake was held by a fifth shareholder, Partex.

Having landed at Duqm in February 1954, IPC geologists were faced with tribal conflicts which made access to the most promising oil prospect, Jebel Fahud, difficult. They reached the jebel in October 1954 and began to survey the surrounding terrain. Supplies had to be transported from Duqm. In January 1956 the company started drilling its first well at Fahud but the hardships were all in vain: the well was dry. Later, when the supply line was switched to the Sumail Gap, warring tribes were able to disrupt convoys and bring operations to a halt. Further dry wells were drilled and this lack of success, combined with worsening logistical problems and a glut of oil on the world market, led most of the partners to withdraw from the venture in 1960. Only Shell and Partex opted to remain in Oman to continue the search for oil. Their optimism was soon to pay off, however: they struck oil at Yibal in 1962 — and from these inauspicious beginnings an oil-producing nation was born.

Emergence (1962–1970): The pipe laying was followed closely by the construction of an industrial complex at Saih al Maleh (later renamed Mina al Fahal), the building of a tank farm, the installation of single-buoy moorings for seagoing tankers and the erection of a 20-megawatt power plant. The whole development — including the pipeline, the coastal industrial area, the tank farm, the marine terminal, a chain of radio repeater stations and housing for staff at Ras al Hamra — cost \$70 million. The first export of Omani oil took place on 27 July 1967. The original debit note shows that the consignment consisted of 543,800 barrels (86,460 m<sup>3</sup>) of oil valued at \$1.42 a barrel. A month before, in June, the Compagnie Française des Pétroles rejoined the partnership by taking over two-thirds of Partex's equity share, resulting in the following shareholding in the company that by then had changed its name to Petroleum Development (Oman): Shell 85%, Compagnie Française des Pétroles 10% and Partex 5%.

On 23 July 1970 His Majesty Sultan Qaboos took over from his father as ruler of the country. He made his first visit to the PD(O) offices on 18 August 1970.

Consolidation (1970–1979): The oil price hike in 1973 greatly improved the economics of producing oil in remote locations. As a consequence, the focus of exploration activity was moved to the eastern flank of the south Oman geological basin. Wells soon revealed the Amal and Amin fields, amongst others. The Marmul field, considered uneconomic to develop when it was discovered in 1957, was now shown to be commercially viable upon reappraisal. The high oil prices compensated for the fact that the Marmul crude oil was heavy and viscous. These and other oil fields in south Oman would play a significant role in the growth of reserves and production in the coming years. The first half of the 1970s was important for other reasons as well. On 1 January 1974 the Government of Oman acquired a 25% shareholding in the Petroleum Development (Oman); six months later the shareholding was increased to 60%, backdated to the beginning of the year. As a result, the foreign interest in PD(O) was now made up of the Shell (34%), Compagnie Française des Pétroles (4%) and Partex (2%). These shareholdings have remained unchanged to the present day. (The Company, however, underwent a change six years later. On 15 May 1980, it was registered by Royal Decree as a limited liability company under the name Petroleum Development Oman — now without parentheses in its name.

Growth (1979–1994): In the early 1980s production rose to new record levels, dispelling, it seemed, any doubts about the future of Oman's oil and gas industry. By the end of 1984 average daily production had risen to 400,000 barrels per day (64,000 m<sup>3</sup>/d) and reserves stood at 3.8 billion barrels (600,000,000 m<sup>3</sup>)."  
en.wikipedia.org/wiki/Petroleum\_Development\_Oman

About PDO: Petroleum Development Oman (PDO) is the foremost exploration and production company in the Sultanate. It accounts for more than 70% of the country's crude oil production and nearly all of its natural gas supply. The Company is owned by the Government of Oman (with a 60% interest), Royal Dutch Shell (34%), Total (4%) and Partex (2%). The first economic oil find was made in 1962, and the first oil consignment was exported in 1967.

PDO operates in a concession area of about 100,000 km<sup>2</sup> (one third of Oman's geographical area), has more than 126 producing fields, more than 5,000 producing wells and a workforce of about 6,000 PDO staff and more than 35,000 contractors.

The objective of PDO is to engage efficiently, responsibly and safely in the exploration, production, development, storage and transportation of hydrocarbons in the Sultanate of Oman. The Company seeks a high standard of performance with the aim of furthering the long-term benefits of its shareholders, its employees and the society of Oman in line with our core values of honesty, integrity and respect. <http://pdointernet.pdo.co.om/Pages/AboutUs.aspx> accessed April 2013.

**Cell:** M9

**Comment:** Rick Heede:

PDO and other sources state a 60 percent share of Omani production by PDO, with 34 percent (PDO, 2013) to Royal Dutch Shell, Total SA 4 percent, and Partex 2 percent.

"In 1974 the Government of Oman acquired a 60% shareholding in PDO, the remaining interest in the Company being shared amongst Royal Dutch Shell (34%), Total (4%) and the Partex Corporation (2%). On 1 January 1980 PDO was registered by Royal Decree as a limited liability company in the Sultanate. The company is controlled by the state through Oman's oil ministry." World Bank (2008b) A Citizen's Guide to National Oil Companies, Part B: Data Directory, World Bank, Washington, & Center for Energy Economics, Bureau of Economic Geology Jackson School of Geosciences University of Texas, Austin, 764 pp. At page 480.

**Cell:** E12

**Comment:** Rick Heede:

Total net worldwide crude oil plus natural gas liquids produced by each company or state-owned enterprise. Where data is available, we list gross production (before royalty production is netted out). More often, however, oil companies report production net of royalty production. Crude production includes natural gas liquids (NGL) unless noted.

**Cell:** I12

**Comment:** Rick Heede:

Natural gas is typically reported as dry gas; natural gas liquids are reported under crude oil.

Carbon dioxide is normally removed from the gas flow at the production site (see "Vented Carbon Dioxide").

"SCM/d" = standard cubic meters per day. "cf/d" = cubic feet per day.

Net production typically excludes a number of diverted gas streams. Quantities and fractions vary; ExxonMobil's exclusions are probably typical of the industry: "Net production available for sale quantities are the volumes withdrawn from ... natural gas reserves, excluding royalties and volumes due to others when produced, and excluding gas purchased from others, gas consumed in producing operations, field processing plant losses, volumes used for gas lift, gas injections and cycling operations, quantities flared, and volume shrinkage due to the removal of condensate or natural gas liquids production."

ExxonMobil Corporation (2004) 2003 Financial and Operating Review, www.exxonmobil.com, p. 55.

**Cell:** G31

**Comment:** Rick Heede:

PDO annual reports. See page 2 for PDO data. PDO annual production data are multiplied by PDO's ownership in Omani oil production, presumed constant at 60 percent from 1974 to 2010. WE also attribute 10 percent of oil production from 1967 to 1973 as presumed concession production.

**Cell:** E33

**Comment:** Rick Heede:

1967-1969 data from US Bureau of Mines (1971) International Petroleum Annual, p. 36.

**Cell:** AG33

**Comment:** Rick Heede:

Energy Information Administration International Energy Statistics, World Production of Crude Oil, lease condensate, plus NGPL, 1980-2010

Also Table 4.1c World Crude Oil Production (Including Lease Condensate), 1970-1979.

If needed, see U.S. Bureau of Mines (various years) Minerals Yearbook, Petroleum, 1950-

**Cell:** D34

**Comment:** Rick Heede:

Energy Information Administration International Energy Annual 2003, Table G.1 World Production of Crude Oil, NGPL, and Other Liquids, 1980-2003.  
Also Table 4.1c World Crude Oil Production (Including Lease Condensate), 1970-1979 (detailed in Columns L and M).  
1967-1969 data from US Bureau of Mines (1971) International Petroleum Annual, p. 36.

**Cell:** J35**Comment:** Rick Heede:

PDO gas reporting is spotty prior to 1984, and while most of the associated gas is vented or flared, and only re-injected later in the 1970s, CMS assumes that gas is used in field equipment and refineries, plus significant flaring. While PDO's natural gas utilization rate is historically low, CMS assumes low re-gasification rates (for EOR: thus "sequestered") and that 90 percent of produced gas is combusted (marketed, internal use, or flared).

Gas utilization is reported as 80 percent in 1986, increasing to 92 percent in 2002. This may be conservative. Also, it does not estimate the significant quantities of natural gas flared and vented in the fields.

Note: Also see PDO annual report for 1991, p. 8, North Oman Crude Stabilisation project at Mina al-Fihal tank farm, which extracts light hydrocarbons (methane and ethane, from the "live crude" to "improve safety, reduce flaring in the interior, and recover an additional 5,000 bbl per day of oil that would otherwise have been wasted."

We attribute 100 percent of gas production to PDO.

**Cell:** E36**Comment:** Rick Heede:

PDO crude production for 1970-1986 assumes all Omani production reported by EIA is attributed to PDO.

Note: This is curious, in view of our later comparison with PDO annual reports, since PDO is allocated 60 percent of all oil & gas produced, and foreign concessionaires receive 40 percent (per an agreement signed in ~1974).

**Cell:** I38**Comment:** Rick Heede:

U.S. Bureau of Mines Minerals Yearbook 1974, page 870. Lists marketed and gross production of natural gas by country.

**Cell:** I40**Comment:** Rick Heede:

U.S. Bureau of Mines Minerals Yearbook 1976, page 888. Lists marketed and gross production of natural gas by country.

**Cell:** R41**Comment:** Rick Heede:

Petroleum Development (Oman) Ltd annual report 1975 reports "total production from Oman," which is presumably total national crude oil production rather than PDO's 60 percent share, per the 1974 revised concession between Shell, Partex, and Compagnie Francaise des Petroles.

**Cell:** AA43**Comment:** Rick Heede:

"Reducing Energy Consumption : During the course of 2011, PDO continued to reduce the amount of energy used in its operations. Energy efficiency measures were implemented at many of PDO's locations and, as a result, the amount of gas used for energy fell from around 12 million cubic metres per day in 2005 to 8.4 million cubic metres per day in 2011."

PD Oman AnnRpt 2011, p. 15.

**Cell:** R44**Comment:** Rick Heede:

PDO annual report 1978

**Cell:** D46**Comment:** Rick Heede (Jan10):

Energy Information Administration International Energy Annual 2006, Table 2.2 World Crude Oil including Lease Condensate Production, 1980-2006 (Thousand Barrels per Day) for Oman.

**Cell:** H46**Comment:** Rick Heede:

Energy Information Administration International Energy Statistics, Dry Natural Gas Production, 1980-2010: Oman. See page 3 for details.

**Cell:** W46**Comment:** Rick Heede:

Gas reporting varies, but is typically net gas production (typically gas delivered to the Govt Gas System, and from 2000 fwd also delivered to the Oman LNG facility).

The PDO annual report for 1995, p. 14, shows gross production of 12.5 million cm per day, "a record level of 92 percent of this gas was used for fuel, electrical power generation, or added to the Government Gas System. The utilisation of produced gas has risen from around 70 percent ten years ago."

**Cell:** W49**Comment:** Rick Heede:

See note at 1986, below. PDO production and gas utilization is incomplete prior to 1986.

**Cell:** W51**Comment:** Rick Heede:

PDO is not clear about total gas production in its 1985 annual report, mentioning rapidly increasing investment in gas processing and utilization of associated gas (rising from 5 to 60 percent 1980-1985); non-associated gas production is not quantified either (but 2.2 million SCM/day from the Saih Nahayda gas treatment facility alone). CMS estimates total utilized gas production based on the more complete data for 1986 (8 million SCM per day) by assuming that 1983 = 70 percent of 1986, 1984 = 80 percent of 1986, and 1985 = 90 percent of 1986.

**Cell:** E53**Comment:** Rick Heede:

Oil & Gas Journal OGJ100 data for 1987-2004.

**Cell:** W54**Comment:** Rick Heede:

PDO annual report 1988, p. 14, "associated gas production amounted to 326 million cf/day (9.21 million cm/day) of which 78 percent was utilised." CMS reports the utilized gas (9.21 \* 0.78 = 7.18 million cm/day).

**Cell:** I56**Comment:** Rick Heede:

Data 1990-2004 from Oil & Gas Journal OGJ100, various years. Also see EI data 2000 and 2001, below.

**Cell:** R56

**Comment:** Rick Heede:

PDO annual report for 1991, p. 8, show crude oil production, no condensate reported (although certainly produced). Also mentions North Oman Crude Stabilisation project at Mina al-Fihal tank farm, which extracts light hydrocarbons (methane and ethane, from the "live crude" to "improve safety, reduce flaring in the interior, and recover an additional 5,000 bbl per day of oil that would otherwise have been wasted." Wasted, presumably to both flaring and direct venting (or, if all flared, safety is less of an issue).

**Cell:** W59

**Comment:** Rick Heede:

PDO annual report for 1993 reports (p. 10) 12.9 million cubic meters per day of "associated gas." However, in the next paragraph, the company states that of the 6.1 million cm/d delivered to the Govt Gsa System, some 77 percent was non-associated gas ..."

**Cell:** R61

**Comment:** Rick Heede:

PDO annual report 2004, "Oil & Gas Production," shows crude, condensate, and gas production (gas in BOE) for 1995-2004 in thousand bbl oil equiv per day.

**Cell:** W63

**Comment:** Rick Heede:

PDO 1997 annual report, p. 14, shows 13.54 million cm per day of associated gas production, plus 86 percent of 7.7 million cm per day of gas delivered to GGS is "non-associated gas." This implies (but not stated explicitly), that PDO gas production totals at least  $13.54 + 6.62 = 20.16$  million cm per day, or 222 Bcf/yr.

**Cell:** R65

**Comment:** Rick Heede (Jan10):

PDO (2009) Fact book (covers 1999-2008).

**Cell:** E66

**Comment:** Rick Heede:

Energy Intelligence reports 327.4 and 326.7 million bbl in 2000 and 2001, respectively.

**Cell:** I66

**Comment:** Rick Heede:

Energy Intelligence reports 276 Bcf and 411 Bcf for 2000 and 2001, respectively. EI is thus far closer to production reported by PDO than is OGJ.

**Cell:** I71

**Comment:** Rick Heede:

Oil & Gas Journal OGJ100, various years.

**Cell:** E74

**Comment:** Rick Heede:

OGJ100 6Sep2010 pg 69, and OGJ 3 Oct 2011 pg 49. We assume that Oil & Gas Journal reports PDO production without adjusting for the company's ownership share (60 percent), and we do this here. O&GJ reports 202.9 million bbl in 2008, 201.5 million bbl in 2009, and 201.8 million bbl in 2010.

**Cell:** I74

**Comment:** Rick Heede:

OGJ100 6Ssep2010 pg 69

**Cell:** L76

**Comment:** Rick Heede:

Petroleum Development Oman (2013) Fact File, May 2013. "Set a new production record of 1.24 million barrels of oil equivalent per day in 2012."