

# THE ASSOCIATION FOR THE STUDY OF PEAK OIL AND GAS “ASPO”

## NEWSLETTER No 39 – MARCH 2004

**ASPO is a network of scientists, affiliated with European institutions and universities, having an interest in determining the date and impact of the peak and decline of the world's production of oil and gas, due to resource constraints.**

**The following countries are represented: Austria, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.**

***Missions:***

- 1. To evaluate the world's endowment and definition of oil and gas;***
- 2. To study depletion, taking due account of economics, demand, technology and politics;***
- 3. To raise awareness of the serious consequences for Mankind.***

***Newsletters:*** This and past newsletters issues can be seen on the following websites:

<http://www.asponews.org>

<http://www.energiekrise.de> (Press the ASPONews icon at the top of the page)

<http://www.isv.uu.se/iwood2002>

<http://www.peakoil.net>

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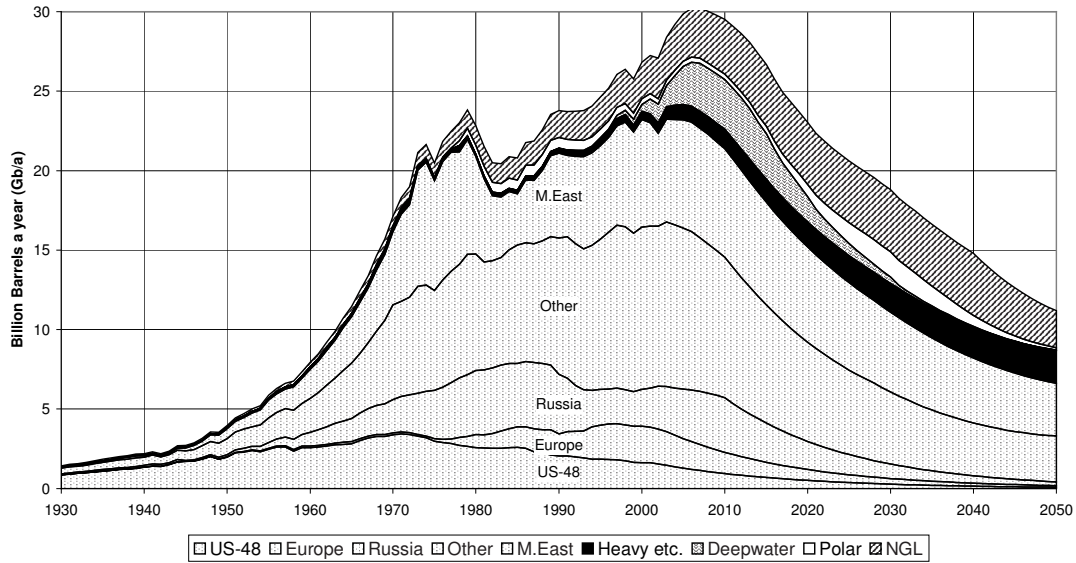
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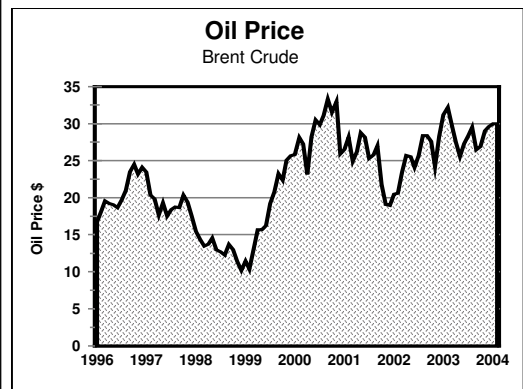
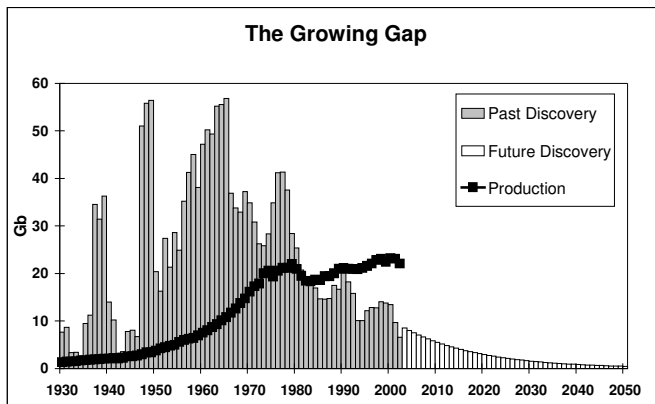
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## The General Depletion Picture

### OIL AND GAS LIQUIDS 2004 Scenario



ESTIMATED PRODUCTION TO 2075					End 2003					
Amount		Gb	Annual Rate - Regular				Gb	Peak		
Regular Oil			Mb/d				Total	Date		
Past	Future	Total	2005	2010	2020	2050				
Known Fields	New		US-48	3.6	2.6	1.4	0.2	195	1971	
919	757	123	1800	Europe	5.0	3.6	1.8	0.3	75	2000
All Liquids			Russia	9.1	10.0	5.5	0.9	210	1987	
1015	1685	2700	ME Gulf	19	19	16	9	650	2012	
2004 Base Scenario			Other	27	24	18	8	670	2003	
M.East over-reporting corrected			World	63	58	43	19	1800	2003	
M.East assumed to be producing at capacity			Annual Rate - Other							
Regular Oil includes condensate but excludes gasfield liquids			Heavy etc.	2.6	3	4	6	300	~	
			Deepwater	5.6	8	4	0	60	2009	
			Polar	0.9	1	2	0	60	2030	
			Gas Liquid	8.2	9	11	6	400	2027	
			<b>ALL</b>	<b>80.3</b>	<b>81</b>	<b>64</b>	<b>32</b>	<b>2700</b>	<b>2012</b>	

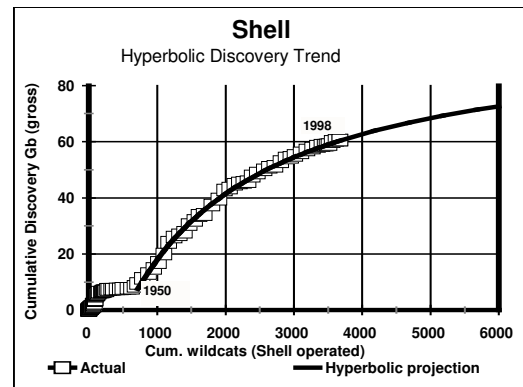


### 326 Reserve Reporting

The downgrading of Shell's reserves still interests the investment community, who continue to issue rather superficial analyses of its significance. One major bank has compared the reporting practices of the major companies listing the percentage of *Proved & Probable* deemed *Proved* as follows:

Total	70%	Eni	65%
BP	69%	Shell (revised)	59%
Chevron-Texaco	68%	Norsk Hydro	55%
Conoco-Phillips	68%	Statoil	50%
ExxonMobil	68%	British Gas	45%
Repsol	65%		

Although not clear from the text, the numbers probably refer to oil and gas combined, which perhaps explains the low values for British Gas, Statoil and Norsk Hydro as they may hold substantial undeveloped gas reserves that they have yet to book. The borderline between *Proved Undeveloped* and *Probable* must be very hazy. In a general sense, it looks as if oil reserves have been under-reported by about 30% to meet strict financial criteria, as indeed is confirmed by most major fields which have "grown" by this amount. The gap is likely to decline in the future as the size of finds falls. Gas reserves in remote places are probably under-reported by a greater amount, not qualifying as *Proved* until in commercial production. The practice seems perfectly satisfactory for financial purposes, comparing well with the declared assets of most other businesses that are themselves likely to become extraordinarily unrealistic in the face of the decline of oil supply in the years ahead. It is only when modelling depletion that we need the right numbers and the right dates. It would be useful to have an updated picture of Shell's actual discovery record to compare with the attached plot, which is now a few years out of date, but the Chairman declined to accede to a request for the same. It would not be surprising if it now falls below the theoretical curve. The investment community places great emphasis on so-called *Reserve Replacement* failing to grasp that it has not been achieved by new discovery for years. A genuine discovery record would tell much more, which probably explains why it is not released.



Shell's Chairman has announced that production is set to decline over the next two years. The Company's US gas production fell 9% last year, with the 4<sup>th</sup> Quarter being 18% down on last year's. There is surely a message here

### 327. Country assessment – Oman

Oman lies on the southern limit of the Arabian Peninsula, covering an area of some 300 000 km<sup>2</sup> and supporting a population of about three million. A coastal strip is separated from the great deserts of Arabia by mountain ranges rising to about 1500m. The coastal regions, which are fertile, have a hot and humid climate, watered by the SW monsoon.

Although the Oman formed part of tribal Arabia, it developed a particular maritime tradition. Its sailors and traders roamed far and wide, reaching China, the East Indies and East Africa. Some were in the slave trade. Although loosely under the Ottoman Empire, Oman was occupied at different times by both Portugal and Persia before securing a degree of independence partly with Britain's help. Rival factions supporting a coastal Sultan and an Imam in the interior vied for power. Britain, which had long been influential in the country, imposed a partial settlement of the disputes in 1920, although the

OMAN		Regular Oil
<b>Population M</b>		3.0
<b>Rates Mb/d</b>		
Consumption	2003	0.03?
per person b/a		2.0
Production	2003	0.82
	Forecast 2010	0.62
	Forecast 2020	0.41
Discovery 5-yr average Gb		0.01
<b>Amounts Gb</b>		
Past Production		7.3
Reported <i>Proved Reserves</i> *		5.5
Future Production - total		7.2
From Known Fields		7.0
From New Fields		0.2
Past and Future Production		14.5
Current Depletion Rate		3.9%
Depletion Midpoint Date		2003
Peak Discovery Date		1962
Peak Production Date		2001

\*Oil & Gas Journal

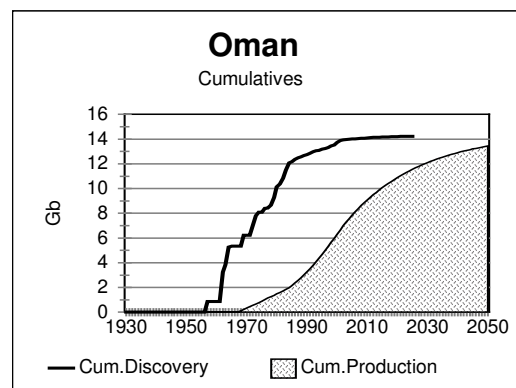
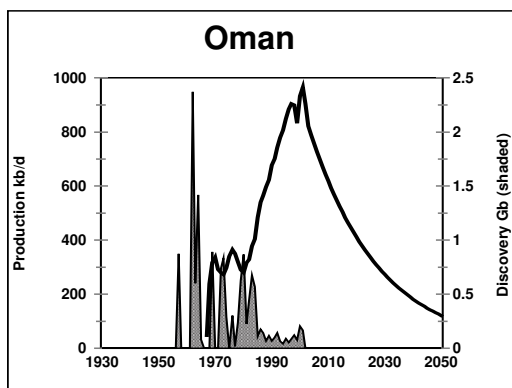
interior remained autonomous until 1954.

Insurrection however broke out again during the 1960s which was exploited by Communist elements with the support of China, the Soviet Union, Iraq and the adjoining Yemen. A palace coup in 1970 brought a new leader to power in the form of the Sultan Qabus, who had been trained in Britain's premier military college, and finally quelled the unrest in 1975 with British military help.

The country later assumed a new strategic importance in view of its location adjoining the Straits of Hormuz through which oil exports from the Middle East have to pass. It was neutral in the Iran-Iraq War, although it agreed to a Western military presence. It contributed a small force to the liberation of Kuwait during the Gulf War. Border disputes with Saudi Arabia and the Yemen were settled in the early 1990s, but certain difficulties with the United Arab Emirates remain. The country played a possibly significant role in recent events by allowing as many as 8000 British troops to undertake what were described as manoeuvres in preparation for the Afghan and Iraqi invasions.

In geological terms, the Oman lies at the southern end of the Persian Gulf Province, but in addition to the same prolific Jurassic reservoirs as found in the Emirates, it also has Palaeozoic reservoirs, charged by Precambrian source-rocks. Cambrian salt also plays an important part in the structural development. Shell was one of the pioneers in the country, where drilling commenced in 1955. As many as 600 wildcats have now been drilled, finding three giant fields (Yibal, 1962, with 2 Gb; Fahud, 1964, with 1 Gb, and Marmul, 1957, with about 600 Mb), as well as a large number of generally small to moderately sized fields. They follow a northerly trend through the central parts of the country extending into the Emirates.

In total, about 14 Gb have been discovered, of which half has been produced. Future discovery is here estimated at about 250 Mb, although there are some hopes of that a new deepwater play may be identified. Discovery peaked in 1962 delivering a corresponding peak of production in 2001. Production is now set to decline at a depletion rate of about 4% a year from its present level of 822 kb/d to about 600 kb/d by 2010 and 400 kb/d by 2020. Information on local consumption is not available, but if it is about 50 kb/d, the Oman may remain a net exporter for many years to come. Gas reserves stand at about 42 Tcf, being consumed locally at about 320 Gcf a year, leaving ample supplies for the future. In short, the Omani are well provided for, and since their oil resources are both modest and in decline they do not form an obvious military target, unless control of the Gulf of Hormuz becomes a critical issue.



### 328 North American Gas Crisis

The Annual Report of ExxonMobil shows that its gas production was down 5% on the year in the USA and 8% in Canada. ChevronTexaco was down 7%. One may suppose that these results are representative. If so, they herald an energy crisis of unimaginable magnitude. Europe's indigenous supply is similar, with the UK in steep decline and Norway, like Canada, being drained to meet the hunger of the consumers to the south, who have yet to curb their appetites.

*(Reference furnished by Chris Skrebowski)*

### 329 Corrections: Items 312, 317 322

Three items in the last Newsletter call for correction. Item 312 contains some faulty mathematics. The offending sentences should read

*We hear a great deal about "Reserve Growth" but it appears to be matched by "Reserve Erosion". If we believed the Oil & Gas Journal reserve number of 1213 Gb for 2002, this year's should be*

the same less the 65.43 Mb/d produced plus the 7 Gb reported to have been discovered, namely 1196 Gb, instead of which 1266 Gb is reported. So, somehow 70 Gb has been added out of thin air  
 Item 317: the Tehran Newsletter covers items of general interest relating mainly to the Middle East and is not restricted to oil depletion. Item 322: the address for obtaining the Ethic of Zero Growth has changed to 1510 Park Glen Ct., Reston, VA 20190, USA.

### 330 Unreliable OPEC Reserves and Upgrading the Depletion Model

The spurious nature of the reserves reported by the major OPEC countries has long been obvious. The early numbers were evidently too low, having been inherited from the foreign companies before they were expropriated. Nothing particular happened in the oilfields in the late 1980s to justify the huge increase, and in any event the valid revisions should be backdated to the discovery of the fields concerned which had been found as much as fifty years before. The increases were almost certainly prompted by OPEC quota considerations, and have barely changed since, suggesting that subsequent production has not been deducted. This might have made good sense from the standpoint of setting quota, to avoid frequent re-negotiation based on production. Removing the subsequent production also has the effect of lifting the depletion rate to a more reasonable, although still low, level. Alternatively it could be argued that the countries were reporting total discovered (also known as Original Reserves) and not Remaining Reserves. Reported discovery in Kuwait amounts to 87 Gb, rather close the 90 Gb reported following the 50% increase in 1985. (see also Item 339 below)

SPURIOUS RESERVE REVISIONS								
	Abu Dhabi	Dubai	Iran	Iraq	Kuwait	Neutral Zone	Saudi Arabia	Venezuela
1980	28.0	1.4	58.0	31.0	65.4	6.1	163.4	17.9
1981	29.0	1.4	57.5	30.0	65.9	6.0	165.0	18.0
1982	30.6	1.3	57.0	<u>29.7</u>	64.5	5.9	164.6	20.3
1983	30.5	1.4	55.3	41.0	64.2	5.7	162.4	21.5
1984	30.4	1.4	51.0	43.0	<u>63.9</u>	5.6	166.0	24.9
1985	30.5	1.4	48.5	44.5	90.0	5.4	169.0	25.9
1986	30.0	1.4	47.9	44.1	89.8	5.4	168.8	25.6
1987	31.0	1.4	48.8	47.1	91.9	5.3	166.6	<u>25.0</u>
1988	92.2	4.0	92.9	100.0	91.9	5.2	167.0	56.3
1989	92.2	4.0	92.9	100.0	91.9	5.2	<u>170.0</u>	58.1
1990	92.2	4.0	92.9	100.0	91.9	5.0	257.5	59.1
1991	92.2	4.0	92.9	100.0	94.5	5.0	257.5	59.1
1992	92.2	4.0	92.9	100.0	94.0	5.0	257.9	62.7
1993	92.2	4.0	92.9	100.0	94.0	5.0	258.7	63.3
1994	92.2	4.3	89.3	100.0	94.0	5.0	258.7	64.5
1995	92.2	4.3	88.2	<u>100.0</u>	94.0	5.0	258.7	64.9
1996	92.2	4.0	93.0	112.0	94.0	5.0	259.0	64.9
1997	92.2	4.0	93.0	112.5	94.0	5.0	259.0	71.7
1998	92.2	4.0	89.7	112.5	94.0	5.0	259.0	72.6
1999	92.2	4.0	89.7	112.5	94.0	5.0	261.0	72.6
2000	92.2	4.0	89.7	112.5	94.0	5.0	259.2	76.9
2001	92.2	4.0	89.7	112.5	94.0	5.0	259.3	77.7
2002	92.2	4.0	89.7	112.5	94.0	5.0	259.3	77.8

Anomalous increase underlined. Note also implausible unchanged estimates.

It was relatively easy for the Middle East governments to report whatever they saw fit, because the oil industry was mainly in State hands, but Nigeria facing a similar problem had to persuade the foreign companies to increase their reported reserves. Investigation into Shell's recent reserve downgrading has unearthed the fact that during the 1990s the foreign companies in Nigeria were given tax inducements to over-book their reported reserves. The government for some reason is now trying to claw-back \$600 million attributable to the over-reporting.

(see <http://news.independent.co.uk/business/news/story.jsp?story=486913>)

Approximately 140 Gb have been produced by the OPEC countries since the late 1980s. Deducting this from the total reserves reported by the Oil & Gas Journal gives 730 Gb out of a total discovered of 1105 Gb. They are accordingly about 34% depleted, which sounds reasonable. It follows that their

swing role is coming to an end as their ability to offset decline elsewhere withers away. Indonesia is the most depleted of the OPEC countries, being already in terminal decline, and has no good reason to maintain its membership. The organisation itself will become redundant when the need to manage swing production disappears, as did the Texas Railroad Commission, on which it was modelled, when the United States reached peak production.

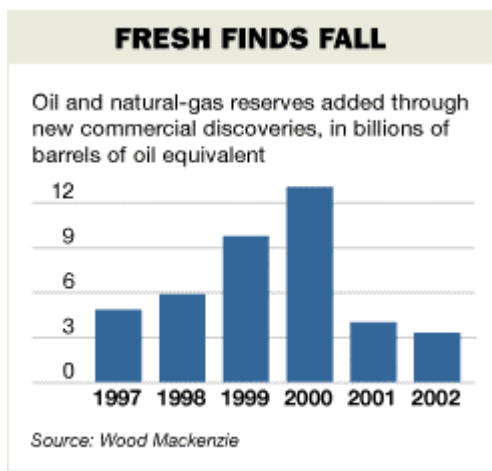
Work on upgrading the model proceeds, leading to a tentative revision of the figures and tables on Page 2. The emphasis is on *tentative* as much more work has to be done.

Furthermore it seems that the Middle East is now running very close to capacity having to run ever faster to stand still to offset the natural decline in their giant fields where the water tables are inexorably rising as the oil is extracted. The size of new discovery has been small by comparison, meaning that it is difficult to compensate from new fields. Accordingly, production has been modelled as flat to the midpoint of depletion when it is assumed to decline at the then depletion rate. Depletion rates in these countries remain very low by world standards, even after downward revision, which is another argument against accepting the higher reports. Since the oil industry in these countries is mainly in State hands, investments have to be drawn from national budgets for which there are many other claims. Furthermore, the State entities do not have the huge advantage of the foreign companies of being able to take operating expense as a charge against taxable income. The countries have no particular incentive to make mammoth investments to increase production when a failure to do so may lead to increased revenues from the consequential higher prices. On the other hand, high prices may stifle demand to some degree, but as the North Sea declines and the Caspian disappoints, these countries face declining competition.

This revision has a major impact on the world position, calling for a reduction of the estimate of total production to 2075 (Ultimate) to be reduced from 1900 to 1800 Gb. This is a substantial downward revision that calls for much more detailed consideration. The resulting model shown on Page 2 shows the onset of a fairly volatile epoch, which seems more plausible than the flat scenario of the previous model. Much more work and thought is called for, and progress will be reported in successive newsletters

### ***331 Fall in Discovery Confirmed***

The Wall Street Journal of January 26<sup>th</sup> confirmed the fall in discovery by the ten largest companies over recent years, based on a study by Wood Mackenzie illustrated by the attached figure. It is



confusingly quoted in oil equivalent, but nevertheless gives the picture. The spikes of 1999 and 2000 relate mainly to two large exceptional finds or confirmations (Kashagan in Kazakhstan and Azedegan in Iran). Otherwise, discovery seems to be running at below 6 Gboe a year, with less for oil alone. The World finds less than one barrel for every four it consumes, having been in deficit since 1981. It should surprise only the flatest of the flat-earth economists that the peak and decline of corresponding production is now here or imminent. Perceptive analysts may reasonably conclude that this spells a deep and possibly permanent economic recession, given the World's dependence on cheap oil-based energy. The scale of this transition from growth to decline is monumental as the financial system depends on growth for survival, and everyone's mindset is

conditioned to the objective of earning, spending and consuming more. A recent survey revealed that the average child in oil-rich Norway possesses 500 toys. Others may speculate that it in turn means grave geopolitical tensions and resource wars by those determined to control what is left.

### ***332. The truth breaks in the United States***

Reports have been received of a presentation at the US National Energy Technology Laboratory by Robert L. Hirsch on peak oil, which was described as little short of a catastrophic event without obvious remedy. Evidently, senior officials from the Department of Energy were present and concurred with the findings. The limits to production in Saudi Arabia and Russia were stressed. ASPO analysts were mentioned. More details are awaited.

### 333 Canadian gas production declines

A Dow Jones Newswire of 3<sup>rd</sup> February reports that Canadian gas production is set to decline. The reserves of the Sable Island Fields off the East Coast have been seriously downgraded. Although giving only 3% of the country's production, it provides important swing exports to the US East Coast market. Canadian production was down about 3% overall last year, with net exports to the USA falling by 11%, according to Lehmann Brothers. A 5% decline in 2004 is forecast.

### 334. New roads and a tunnel in Switzerland

Switzerland operates a devolved form of government seeking to involve its citizens in major issues rather than impose decisions by parliamentarians under the iron grip of party machines, as practised in many so-called democracies. The decision now facing the Swiss people is whether or not to modernise the highway system and build a new tunnel under the Alps. Linear extrapolation of past trends of traffic and goods transport has no doubt been used to justify the mammoth undertaking, but it is meeting strong opposition, partly built on recognition of oil depletion. A cartoon has appeared depicting a future scene of a cyclist and an old man looking down on an empty highway with trees growing through the cracks. The old man comments "In my day we believed in all that" to which the cyclist replies "You still had petrol"

The Swiss Federal Office of Energy is holding a Workshop on oil and gas resources on February 27<sup>th</sup> which will be open to the public. ASPO will be represented by Campbell and Bauquis in a discussion with representatives of the IEA, IHS, Schlumberger and Chevron-Texaco. It remains to be seen if it will have any positive outcome, as the accompanying report commissioned by the Federal Office simply contrasts the views of so called "optimists" and "pessimists" to reach a neutral position, absolving the government from the need to take any firm action. The likely outcome is that the investments in roads and tunnels will be neither approved nor rejected but simply delayed – it might indeed be a good political response, given that impact of peak oil will soon be self-evident.

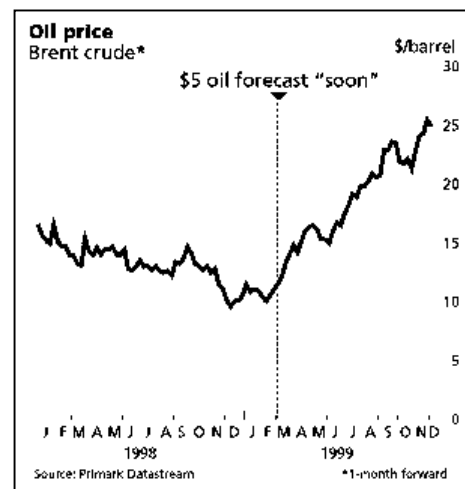
(Based on information from W.H.Ziegler)

### 335 The Economist confesses

A species known as the *flat-earth economist* has been often identified in these pages as a blinkered adherent of outdated economic theory. The Economist Magazine confirmed its membership to the species (or sect as it might be better described) when in March 6<sup>th</sup> 1999, it published an article entitled *Drowning in Oil*, predicting that prices would fall to \$5 a barrel. But to its credit, it did confess on December 19<sup>th</sup>, publishing the attached graph to show how wrong it had been.

The confession explained that the faulty forecast was based on an expected economic decline dampening the demand for oil, without considering the resources constraints. It also excused itself by a forgivable failure to read the minds of the Saudi government. It went on to discuss a self-adjusting phenomenon in forecasting, whereby forecasts alert decision-makers to the need to react, adding that many predictions carry the seeds of their own destruction for this reason. That however reflects a flat-earth mind-set, which sees everything to be within Man's power. Nature for her part is immutable, and is unlikely to deliver more oil because her limits have been identified. All the same, Confession is the first step to Redemption, and The Economist could now urge its readers to use less and find new economic principles to govern the World in its oil-based age of decline

(Reference furnished by Peter Salonijs)



### 336 Out of Gas by David Goodstein

An admirable new book on oil depletion by a distinguished scientist is reviewed by the New York Times as follows;

#### OUT OF GAS

The End of the Age of Oil. By David Goodstein.

Illustrated. 140 pp. New York: W. W. Norton & Company. \$21.95.

If all you knew about David Goodstein was the title of his book, you might imagine him to be one of those insufferably enthusiastic prophets of doom, the flannel-shirted, off-the-grid types who take too much

pleasure in letting us know that the environment is crumbling all around us. But Goodstein, a physicist, vice provost of the California Institute of Technology and an advocate of nuclear power, is no muddled idealist. And his argument is based on the immutable laws of physics.

The age of oil is ending, he says. The supply will soon begin to decline, precipitating a global crisis. Even if we substitute coal and natural gas for some of the oil, we will start to run out of fossil fuels by the end of the century. "And by the time we have burned up all that fuel," he writes, "we may well have rendered the planet unfit for human life. Even if human life does go on, civilization as we know it will not survive." He's talking about 100 years from now, far enough in the future, you might say, that we needn't worry for generations. Surely some technological fix will be in place by then, some new source of energy, some breakthrough. But with a little luck, many readers of these pages will live until 2030 or 2040, or longer. Their children may live until 2070 or 2080, and their grandchildren will easily survive into the 22nd century. We're talking about a time in the lives of our grandchildren, not some warp drive, Star Trek future.

And what about that technological fix? "There is no single magic bullet that will solve all our energy problems," Goodstein writes. "Most likely, progress will lie in incremental advances on many simultaneous fronts." We might finally learn to harness nuclear fusion, the energy that powers the sun, or to develop better nuclear reactors, or to improve the efficiency of the power grid. But those advances will require a "massive, focused commitment to scientific and technological research. That is a commitment we have not yet made." Drilling in the Alaska National Wildlife Refuge, and scouring the energy resources of national lands across the West might help the constituents of Senator Ted Stevens of Alaska and Vice President Dick Cheney's friends in the energy industry, but it won't solve the problem.

Goodstein's predictions are based on a sophisticated understanding of physics and thermodynamics, and on a simple observation about natural resources. The supply of any natural resource follows a bell curve, increasing rapidly at first, then more slowly, eventually peaking and beginning to decline. Oil will, too. It has already happened in the United States. In 1956, Marion King Hubbert, a geophysicist with the Shell Oil Company, predicted that oil production in the United States would peak sometime around 1970. His superiors at Shell dismissed the prediction, as did most others in the oil business. But he was right. Hubbert's peak occurred within a few years of when he said it would, and American oil production has been declining ever since. There was no crisis, because this country tapped the world's reserves, and the supply increased along with demand.

Now Goodstein and many others have shown that the same methods, when applied to global oil production and resources, predict a Hubbert's peak in world oil supplies within this decade, or, in the best-case scenarios, sometime in the next. Once that happens, the world supply of oil will begin to decline gradually, even though large quantities of oil will remain in the ground. The world demand for oil will continue to increase. The gap between supply and demand will grow. But this time the gap will be real; there will be no other source of oil (from the moon, Neptune or Pluto?) to flow into the system. When the supply falls and the demand rises, the price will go up. That's no problem, economists say. With the high price, companies will go after more costly oil, and the market will take care of things.

Maybe not, Goodstein replies. "In an orderly, rational world, it might be possible for the gradually increasing gap between supply and demand for oil to be filled by some substitute. But anyone who remembers the oil crisis of 1973 knows that we don't live in such a world, especially when it comes to an irreversible shortage of oil."

In the best-case scenario, he writes, we can squeak through a bumpy transition to a natural-gas economy while nuclear power plants are built to get us past the oil crisis. In the worst case, "runaway inflation and worldwide depression leave many billions of people with no alternative but to burn coal in vast quantities for warmth, cooking and primitive industry."

President Bush has pointed to hydrogen as the ultimate answer to our need for transportation fuels, but Goodstein correctly points out that hydrogen is not a source of energy. It is a fuel produced by using energy. We can use coal to produce it, or solar power, or something else, but it is only a way of converting energy into a form that can be used in vehicles; it doesn't do anything to ease the transition away from oil.

"Out of Gas" -- a book that is more powerful for being brief -- takes a detour to explain some of the basics of energy budgets, thermodynamics and entropy, and it does so with the clarity and gentle touch of a master teacher.

Then Goodstein gets back on message. Even nuclear power is only a short-term solution. Uranium, too, has a Hubbert's peak, and the current known reserves can supply the earth's energy needs for only 25 years at best. There are other nuclear fuels, and solar and wind power might help at the fringes. But "the best, most conservative bet for ameliorating the coming fuel crisis is the gradual improvement of existing technologies," he writes. We can improve the efficiency of lights, tap solar power with cheap photoelectric cells and turn to nuclear power. The problem is that we have not made a national or global commitment to do so. "Unfortunately, our present national and international leadership is reluctant even to acknowledge that there is a problem. The crisis will occur, and it will be painful."

I hope Goodstein is wrong. I wish we could dismiss him as an addled environmentalist, too much in love with his windmill to know which way the wind is blowing. On the strength of the evidence, and his argument, however, we can't. If he's right, I'm sorry for my kids. And I'm especially sorry for theirs.

### **337. ASPO Workshop Reminder**

ASPO's Third International Workshop on Oil and Gas Depletion will be held in Berlin on May 25<sup>th</sup> and 26<sup>th</sup>. The programme themes are as follows

Tuesday May 25<sup>th</sup>

Morning: Natural Gas – Our Future?

Afternoon: Oil – When will production Peak?

Wednesday May 26<sup>th</sup>

Morning: Renewables - What can we expect?

Afternoon: Energy and Society

A series of key presentations by invited speakers will be supplemented by poster sessions to capture ideas from a wider pool of researchers. There will be ample opportunity for formal and informal discussion, giving the participants a chance to meet each other in an attractive setting in Germany's capital city. Full media coverage is anticipated. See [www.peakoil.net](http://www.peakoil.net) for further details.

For planning purposes it would be helpful if those planning to attend could so inform the Secretariat as soon as possible: S.DeVries@bgr.de (tel. Sabine de Vreis +49 511 643 3208)

### **338 Newsweek asks "Is the Oil Age over?"**

Newsweek of February 16<sup>th</sup> carried cover story with the above title, comprising an exchange between C.J.Campbell of ASPO and Leonardo Maugeri, Chief Economist of Agip, the Italian national oil company. He appears to have broken ranks with his former Chief Executive, Franco Bernabe, who famously predicted peak oil in 2005. (Bernabe, F. 1998, *Cheap oil: enjoy it while it lasts*; Forbes June 15).

### **339 The Nemesis Report - Tales of the Arabian Nights**

Our anonymous contributor from the heart of the oil industry returns to lift the lid on the Middle East.

#### ***Tales of the Arabian Nights***

Fairy stories speak of magic porridge pots that remain full no matter how much is consumed. They resonated with earlier European populations for whom hunger was the common experience, but were relatively harmless. To day we face a dream more fantastical and dangerous than any recorded in the Tales of the Arabian Nights. In it, there are fabulous oil reserves in the Middle East, which grow ever greater. There are wells that never run dry. There are boundless opportunities for new production.

The attraction of this story to the industry, the consumers and their governments is obvious. It is even more attractive to the Middle Eastern producer governments themselves, who have to date been notably unsuccessful at diversifying their economies away from oil and gas even as their populations soar. The myth-makers are aided in their task by the fact that data on reserves in virtually all Middle East countries are now State secrets. In short, those who know, both inside and outside the Middle East, aren't telling; and those who are telling don't know.

So can we divine the truth? Is it possible to find some indicator that would allow us to broadly falsify or confirm the claims?

Middle East reserves were published in the early 1970s in industry journals but attracted little interest except amongst specialists. They were no doubt solidly conservative numbers as traditionally reported by the industry, which had no interest in drawing the attention of the host governments to just how much oil was there.

The available technology was more than sufficient to calculate the reserves fairly accurately, particularly as the large, simple Middle East fields are relatively easy to identify and map. The cross-holdings of the different companies involved confirm that the estimates were valid, if conservative.

Data on production flows and well productivity are published annually by two journals: the Oil and Gas Journal (O&GJ) and World Oil (WO), with the latter listing the number of wells on artificial lift, namely pumping. From this data, it is a straightforward, if tedious, task to calculate well productivity data over an extended period of time.

These calculations testify to the high productivity of the Middle East wells in the early 1970s, which is in marked contrast with the situation today. The current numbers may be calculated by comparing the reported number of flowing wells against estimated production capacity.

Country	Year	Prod. Mb/d	Prod/well b/d	Country	Year	Prod. Mb/d	Prod/well b/d
Iran	1974	6.2	16600	S.Arabia	1974	8.4	12500
	2002	4.0	3570			1979	9.3
Iraq	1975	2.4	15400		2002	9.0	5770
	1979	3.5	13700	UAE	1974	1.8	10900
	2002	2.8	1660			2002	2.5
Kuwait	1974	2.6	3800	Venezuela	1973	3.4	266
	2002	2.3	2900			2002	2.4
N.Zone	2002	0.7	1125	Qatar	2002	0.9	2040

(Note: Notional maximum sustainable capacity values have been applied as follows. Iraq is pre-war capacity. Saudi capacity is commonly quoted at 9.5 Mb/d or even 10.5 Mb/d but is implausible because the recent surges did not exceed even 9.3 Mb/d)

The decline in well productivity between 1974/5 and 2002 provides a rough proxy for the depletion of the reserves, because well-flow is proportional to the pressure driving it. It should be noted that well productivity relates only to fields in production and therefore to their reserves. Discovery in the Middle East since 1973 has been relatively low. The application of pressure maintenance, together with infill or horizontal drilling, leads to reserve growth, which is duly reflected in the average well productivity numbers. It follows that the profile of well productivity decline provides a reasonable guide to the depletion of the fields in production. Geological factors affect well productivity, which ranges widely from area to area, so it is the change in well productivity rather than its absolute level that is important.

Contrasting the well productivity of the early 1970s with that of 2002, we find that Kuwait now stands at 76% of its earlier level; Saudi at 46%; Iran at 21%; the UAE at 18%; and Iraq at 11%. We may usefully compare this with North Sea experience. The United Kingdom and Norway had effective peaks of 5900 b/d/well in 1983 and 1994 respectively. By 2002, productivity in the UK had fallen to 1630 b/d/well, or 28% of the peak level, with production being in its third year of decline. For Norway, productivity was 3750 b/d/well, or 64% of peak, with production being in its first year of decline. The ratio of the remaining reserves in producing fields relative to the initial reserves should roughly correspond with the change in well productivity between the two periods. The UK fields in production have around 8 Gb (billion barrels) left to produce, out of the 26-28 Gb of initial reserves. Applying the 28% productivity decline factor gives 7.8 Gb, which indeed is close to the most likely remaining *Proved & Probable Reserves*. Similarly for Norway, 64% of the initial 29 Gb is 18.5 Gb, which is close to the most likely remaining *Proved & Probable Reserves*, namely 15 Gb.

While much more work would have to be done to confirm the relationship, it is already fairly clear that this is a reasonable and straightforward way to establish 'ball park' reserve figures. It also provides a simple 'litmus test' of the plausibility of Middle East reserve claims.

The published reserves numbers for the Middle East moved in fairly narrow ranges up to 1984 when Kuwait suddenly uplifted its reserves from 63.9 Gb to 90 Gb. This overnight increase of over 40% did not reflect any particular event in the oilfields, but might have been a reaction to Iraq's revision of its reserves from 29.7 Gb, first to 41 Gb and then to 43 Gb, which may in fact have been partly justified by the late reporting of the East Baghdad field, found in 1978. These were evidently the first shots in what was to become known as the 'quota wars'.

Things really hotted up in 1987, an 'annus mirabilis', in which, without the benefit of any obvious discovery, four countries announced massive increases. Abu Dhabi increased its reserves by 197% from 31 to 92.2 Gb, Dubai announced an increase of 186% from 1.4 to 4.0 Gb, Iran settled for a relatively modest 90% increase from 48.8 to 92.9 Gb, while Iraq reacted with a 112% increase from 47.1 to 92.9 Gb. Two years later, Saudi Arabia felt obliged to follow, increasing its reserves by a comparatively modest 51.5% from 170 to 257.5 Gb. Can any credibility attach to these reserve gains?

The World chose to believe the tale that the earlier numbers were too conservative and that the uplifts merely put the record right. But the sheer range of revisions suggests this idea is nonsense. How do we unravel the truth? If we believe the oil company numbers were broadly valid albeit conservative, would a 30% increase be a better reflection of reality? Would 50% be more appropriate? The table below compares a 30% uplift of company-reported reserves against various published reserves estimates:

Once again, we get the same pattern as with the well productivity. When compared with the 30% uplift, the claimed Saudi and Kuwaiti reserves look high but just about possible: whereas the others are much less plausible. The parity between Iran and Abu Dhabi looks particularly suspicious. There seems little to link the various estimates. The two trade journals reporting reserves cannot do other than print what they are told. No new discoveries are reported for Abu Dhabi during the period (the most recent finds being Arzanah in 1973 and Satah in 1975), so to get current reserves only the production needs to be netted off the earlier valid reserves estimates. But netted off which reserve estimate?

	1987	1987	1988	1988-95	1996	2002	2002	2002
	Company	Co.+30%	Country	Production	Industry	ASPO	WO	O&GJ
Abu Dhabi	31	40.	92	-6.8	57.7	56.1	62	92
Dubai	1.4	1.8	4.0		1.0	0.8	0.6	4.0
Iran	49	63	93	-9.7	64.7	67.6	99	90
Iraq	47	61	100	-3.7	77.4	90.0	115	92
Kuwait	64	83	92	-4.3	52	52.9	97	94
Saudi Arabia	167	217	258	-23	222.6	192	259	259
N.Zone	5.3	7	5	-1.1	8.2	5.5	4.7	5.0

According to World Oil some 150 of the 1205 producing wells in Abu Dhabi were on artificial lift by 2002., whereas in Dubai 199 of the 212 producing wells were in this condition. Abu Dhabi currently has major investment plans featuring complete refurbishment and gas injection for fields that already have water injection. It strongly suggests that the reserves are significantly depleted.

In Iran, the only important new discovery in the period was Shadegan in 1989 and before that the Sirri fields in the late 1970s, so there are few new reserves to offset production. Again, there is no obvious link between the numbers. Later undeveloped discoveries obviously have had virtually no impact on current well productivity. However, unlike in Abu Dhabi, all of Iran's 1331 producing wells flow naturally. Some of the more recent discoveries, such as Azadegan, are genuine, but other claims appear to be the re-announcement of earlier undeveloped finds. Very recently, the Iranians have expanded their reserves by 25 Gb, but it is difficult to accept that the claimed 125 Gb can be other than fantasy.

Iraq also follows the same largely incomprehensible pattern. Balad, a 1983/88 discovery, along with Suffayah (1978), West Tikrit (1985), and East Baghdad (1975/89), as well as very limited volumes from Bin Umr/Nahr Umr (1949/75), Majnoon (1977/02) and West Qurna (1973/99), are now in production and added to reserves in the period. Some sixty-one named discoveries mean that Iraq probably has an undeveloped or underdeveloped reserves bank of at least 60 Gb. For currently accessible reserves, it looks as though the oil company +30% and the industry figures can be reconciled. No well data are available from World Oil, but the Oil and Gas Journal reports 1685 producing wells in 2002.

The total absence of discovery in Kuwait since 1962, means that it is hard to discern any reserves logic linking the various reserves numbers. But deflating reserve claims in line with well productivity changes should provide a reasonable guide, because Kuwait, unlike Iraq and Iran, has not suffered from under-investment and poor oilfield practise. The three underdeveloped fields on the Iraq border are expected to add no more than 200,000 b/d when fully developed. All 800 producing wells flow naturally.

The Neutral Zone, which is shared by Kuwait and Saudi Arabia, presents a paradox. Without the earlier well productivity it is hard to estimate the decline. Clearly it is implausible that the reserves should remain little changed from 1974 and 2002, given that the most recent field discovery was Hout in 1969. The industry reserve number of 8.2 Gb in 1996 looks suspect, undermining virtually all the other reserve numbers. Artificial lift (pumping) is applied to 387 of the 600 producing wells, which suggests that Neutral Zone reserves are heavily depleted.

From all viewpoints and by all measures, easily the most important reserve numbers are those for Saudi Arabia. But, before analysing them it is worth looking at the impact of using well productivity to adjust the old oil company estimates uplifted by 30% and 50%. See below:

	1987	+30%	Dep %	Remaining Res.	+50%	Remaining Res.
Abu Dhabi	31	40	18	7.5	47	8
Dubai	1.4	1.8	18	0.3	2.1	0.4
Iran	48.8	63.	21	13.	73	15
Iraq	47.1	61.	11	7	70	8
Kuwait	63.9	83.	76	63	96	73
Saudi Arabia	167	217	46	100	250	115

The 30% factor gives truly shocking results, but increasing it to 50% means that only Kuwait and Saudi Arabia have significant remaining reserves. Given its importance, we need to scrutinise Saudi Arabia further. According to industry sources, Saudi's current total discovery amounts to some 300 Gb, compared with 270 Gb reported in 1994. It is difficult to accept that 30 Gb have been added in the last ten years as reported from new discovery and reserve revision of respectively 18 Gb and 12 Gb. The Ghawar Field allegedly grew from 100 to 115 Gb; Safaniya from 27 to 35 Gb; Shaybah from 7 to 15 Gb; while Berri shrank from 25 to 12 Gb. Only Shaybah was placed on production, and it is hard to imagine that the ageing fields were subject to such large upward revisions. There are only fifteen producing fields in Saudi Arabia, and the claimed 51 discoveries over the past thirty years have not been confirmed by appraisal drilling. The potential reserves attributed to them appear arbitrary if not random. We may also ask why Saudi would prefer to go to such

lengths to try to maintain production from its four main ageing fields if it had all these new discoveries ready to yield flush production.

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**Insofar as we can draw any valid conclusion from the morass of conflicting evidence, it is that Middle East reserves have been massively over-stated. As a best guess we could add 50% to the old industry estimates and then deflate them by the declining productivity factor, as follows:**

	1987	+50%	Dep. %	Remaining Reserves.	Undeveloped	Total Reserves
Abu Dhabi	31	47	18	8	2.1	11
Dubai	1.4	2.1	18	0.4	0	0.4
Iran	49	73	21	15	20	35
Iraq	47	71	11	8	60	68
Kuwait	64	96	76	73	2	75
Saudi Arabia	167	250	46	115	30	145

**The BP Statistical Review, which reproduces the Oil & Gas Journal's data, attributes reserves of as much as 674 Gb to the big five producers of the Middle East. So, to propose that in reality they may hold only 334 Gb may sound little short apocalyptic and yet that is where the evidence leads us. The symmetry of depletion means that a fall of 100 Gb in reserves advances the overall peak of production by two years.**

**As the concern about the impending peak and decline of oil production gains momentum, recognising the critical role of oil to the modern economy, we desperately need more transparency about the size and definition of reserves, nowhere more so than in the Middle East.**

The distribution of the newsletter by modern methods has been made possible by a generous philanthropic gesture from Mr O'Byrne. Contributions from ASPO members and other readers, who wish to draw attention to items of interest or the progress of their own research are welcomed **Permission to reproduce the Newsletter, with due acknowledgement, is expressly granted.**

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