Critique of
"Is the World Running out of Oil? A review of the debate"
(BTRE Working Paper 61 published in May 2005)

Example of Government intervention if we are not preparing for peak oil

Highway patrol near Munich checking exemption papers of a lonely car driver during one of the Sunday driving bans in 1973, three years after the US oil production peaked, which allowed OPEC to impose an embargo after the Jom Kippur war, the trigger for the crisis. Oil tankers just did not arrive any more in the required numbers in Rotterdam. The next oil crisis is neither temporary nor an embargo, it is the global peaking of oil production.

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Feature: Table with peak oil years BTRE should have worked on	
Matthew Simmons Investment banker, Advisor to Cheney's 2001 energy task force	"….that peaking of oil will never be accurately predicted until after the fact. But the event will occur, and my analysis is leaning me more by the month, the worry that peaking is at hand; not years away…." http://www.simmonsco-intl.com
K.S. Deffeyes Princeton Uni Paperback ISBN 0-691-11625-3;	"The mathematical peak falls at the year 2004.7; call it 2005…. and there is a fair amount of jitter in the year to year production…. There is nothing plausible that could postpone the peak until 2009. Get used to it." (page 157)
C.J. Campbell Oil geologist from Ireland, founder of ASPO (Association for the Study of Peak Oil & Gas) www.peakoil.net	"When writing, it is easy to describe the situation in terms of 'an imminent peak' without putting a specific date to it.... The real point is not so much the exact date of peak but the statement that the First Half of the Oil Age, which was characterised by growing production, is about to be followed by the Second Half when oil production is set to decline along with all that depends upon it. On that at least we can stand firm." Conventional oil peaks 2006; All liquids peak 2007
S.Bakhtiari Senior expert, corporate planning division, National Iranian Oil Co.	"The latest World oil production capacity model simulation predicts that worldwide crude oil production (inclusive of all other hydrocarbon liquids, such as NGLs etc) will peak during 2006-2007 at about 81 million b/d, +/- 1 mb/d" www.stcwa.org.au/BO2/Bakhtiari-O&GJ-April%202004.doc
C. Skrebowski Editor of Petroleum Review	On the basis of 100 new oil fields up to 2012: "I'll be surprised if we make it to 2008 before the inexorable production decline begins". www.energybulletin.net/newswire.php?id=5266 An optimistic assessment of Chris' database by the author of this critique puts peak oil at 2010
The following scenarios (not forecasts) rely heavily on OPEC, FSU, non-conventional oil and huge, successful investments in exploration, which are by no means guaranteed	
PFC Energy Strategic advisors in global energy, Washington	"OPEC production capacity and reserves will suffer from the additional strain and some models suggest that even OPEC will struggle to fill the differential between Non-Opec supply and global demand beyond 2015-2020". **Source:** www.csis.org 2014 (high demand); 2020 (low demand)
International Energy Agency, (IEA), Paris: World Energy Outlook 2004	Reference Scenario: "Production of conventional oil will not peak before 2030 ***if the necessary investments are made***"; production crash after peak is hidden to unwitting reader; this scenario is not desirable. Low resource case: 2013-2017
US Energy Information Administration (EIA): Long Term World Oil Supply www.iea.org www.eia.doe.gov	USGS 2000 mean estimate: 2037 (2033 rounded) assuming an R/P=10 after the peak which means a production crash no economy can survive; this scenario is not desirable. USGS 2000 mean estimate: 2016 assuming a 2% decline after the peak USGS 2000 95% probability: before 2016

Summary

The BTRE paper does not answer the question it asks in its title. Its authors have neither tried to define what "running out" actually means in terms of oil geology, economy or net energy balance nor have they clearly distinguished a "running out" – however defined - from the global peaking of oil production.

The review of the debate is done by describing the findings from both sides. The protagonists are called "depletionists" (C. Campbell, J. Laherrere etc.) and "anti-depletionists" (international energy agencies). The use of the latter term is already strange as oil is a non-renewable and therefore a depleting resource.

The BTRE paper has failed to realize that the International Energy Agency, Paris, is no longer a fully fledged "anti-depletionist". In a remarkable departure from previous versions, the IEA's World Energy Outlook 2004 in fact describes in the beginning of chapter 3 the peaking of oil production and its causes, though its later optimistic projection with continuing growth of oil production until 2030 contradicts this analysis.

The authors of the BTRE paper should have studied Prof. Aleklett's analysis "IEA accepts Peak Oil" which explains the inconsistencies in the WEO 2004 as follows:

> "at this stage of the analysis [depletion facts] it must have been difficult for the IEA to find a way to make a forecast that would fulfill the political agenda of having production at 120 Mb/d in 2030. The reserve data do not support such a proposition. But is was fortunate to be able to find a life-saver in the form of the USGS [2000 mean estimate]".

Apart from the USGS mean estimate, there is also the USGS 2000 95% probability estimate which is very close to the majority of estimates from other sources. The WEO 2004 defines a "low resource", 90% probability case which peaks around 2015 (table 3.4, page 102).

While this peak is apparently too close for comfort to be mentioned in the BTRE paper, it rightly identifies reserve growth as one of the items explaining the difference between the USGS mean estimate and other estimates. The USGS team itself had demanded that further research be done to confirm the existence of 612 Gb "hypothetical" reserve growth oil for the world outside the US. **The BTRE paper not only fails to do or find such research** but neutralizes the issue by referring to irrelevant and flawed statistics from BP. At the end of the long debate, IEA's reference scenario is adopted which contains just that very contested category of oil.

It is simply IMPRUDENT to accept IEA's WEO 2004 reference scenario (= USGS mean estimate) without confirming research on the reserve growth oil. The same applies to undiscovered oil. The June issue of Offshore Engineer reports that in the first 6 months of 2005, less than 1 Gb of oil was discovered offshore. The USGS assumes that 732 Gb can be found in 30 years, requiring an average success rate of 27 Gb pa.

The BTRE paper is VERY THIN on recommendations compared to the huge amount of work which has gone into writing this virtual debate. The only advise given is to improve the quality and reliability of reserve and production data, wishful thinking given the geo political situation in the Middle East. In fact, the BTRE paper itself could have been used to inform market participants about the current oil supply situation.

The damage done to the economy and our transport system by playing down the concerns of western oil geologists is enormous given that the BTRE paper is being read by many decision makers who seek clarification in the current climate of uncertainty over future oil supplies.

The root causes for BTRE's failure to give proper advise can be grouped as follows:

Lack of Experience

- No experience with previous oil crises and their impact including physical oil shortages. Therefore no sensitivity when first alarm bells are ringing
- The naïve view that OPEC oil from the Middle East will always be a freely available commodity in world markets, reliably supplying the gap between demand and Non-OPEC supply
- Failure to link geo political events to peaking of oil production
- Lack of understanding strategic considerations in URR estimations of various players

Mindset

- An almost religious belief that price mechanisms and market forces will solve all future oil and energy crises
- No appreciation of the magnitude of the problem to replace oil with other fuels or energies
- Failure to recognize and accept that technology cannot by-pass physical laws governing oil depletion and that boundary conditions imposed by nature are not open to debate
- Lack of an auditor's mindset which is essential to lift the veil of confusion

Methodology

- Inability to distinguish, prioritize and categorize technical facts, opinions, interpretations and arguments
- Inability to read between lines in reports and identify hidden warnings

Objectives

- Absence of any objectives (e.g. GHG abatement, improvement of health, reduction in oil vulnerability etc) other than those to ensure "efficient" markets

Trust/Mistrust

- Trust political oil data more than the advise from benevolent oil geologists

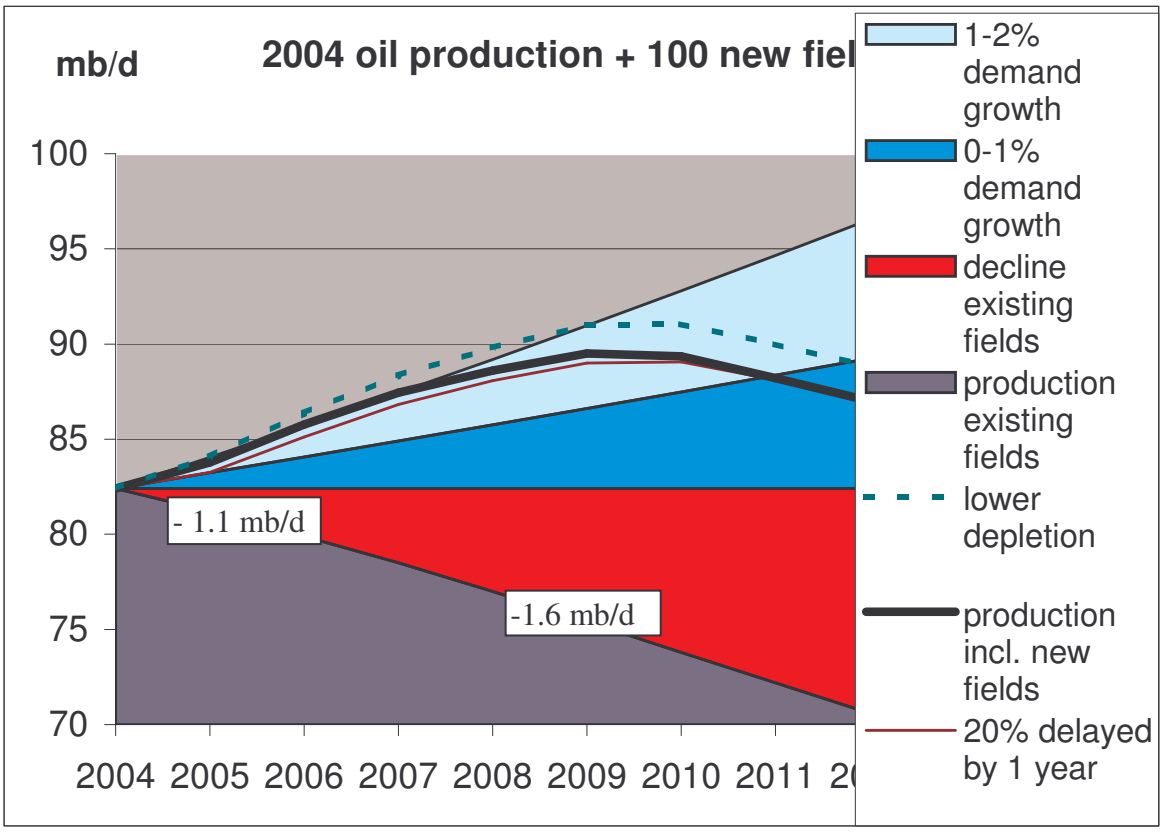
Recommendations

1. Just like the energy white paper "Securing Australia's Energy Future" with its misleading statement that "there are sufficient reserves to supply world demand for around 40 years" the BTRE WP 61 should be withdrawn from circulation and immediately revised before it causes damages to the Australian economy worth billions of dollars
2. Government departments must stop pushing the timing of peak oil conveniently into the far future. They must start visualizing how peak oil will evolve and what it will mean for our economy and our transport system in particular. The following 2 pages contains a graph which could assist in this process
3. BTRE should work on a business plan (by sector – mining, agriculture, transport etc), including a critical path analysis, how market forces (increasing oil prices and shortages) will physically bring about a substitution of oil by other fuels and/or energies before and after peak oil, in quantities sufficient to at least support the existing level of economic activities and assuming various peak oil years and decline rates after the peak. The plan should contain a list of properly phased projects, their timing, proposed source of finance and company resources to implement them. Hint: study the Hirsch report submitted to the DoE

Feature: The 4 phases around peak oil

In its concluding remarks on the role of oil prices the BTRE paper relies on the hope that advances in science and technology will offset diminishing returns of the oil industry as it moves from larger to smaller fields and from better to poorer quality oil.

This offsetting process is being continuously monitored by Chris Skrebowski, member of the London based Oil Depletion Analysis Centre (ODAC) and editor of the professional oil and gas journal ***Petroleum Review***. In April 2005, he published an update of an earlier study on all oil fields coming on-stream world-wide in the next 5-7 years. The author of this critique has prepared a graphical representation of Chris' work, with his approval and support from ODAC. An extract is presented here so that the reader can visualize the different phases around peak oil.



The above graph shows an **optimistic** oil production curve including capacities from around 100 new oil fields planned up to 2012, including non conventional oil from Canadian tar sands and gas to liquid projects. The period up to 2010 is as good as pre-programmed because new discoveries (mostly offshore) require 5-7 years to reach production stage. Project slippage, accidents (e.g. platform Thunder Horse with a planned 200 Kb/day damaged by hurricane) and other disturbances move the curve lower (thin line).

2004: Base year. An average of 82.4 million barrels/day (=30 Gb pa). Virtually no spare capacity. New fields must first compensate decline in existing fields (1.1 – 1.6 mb/d per year) **which acts as new demand**. Only the balance is available for demand growth

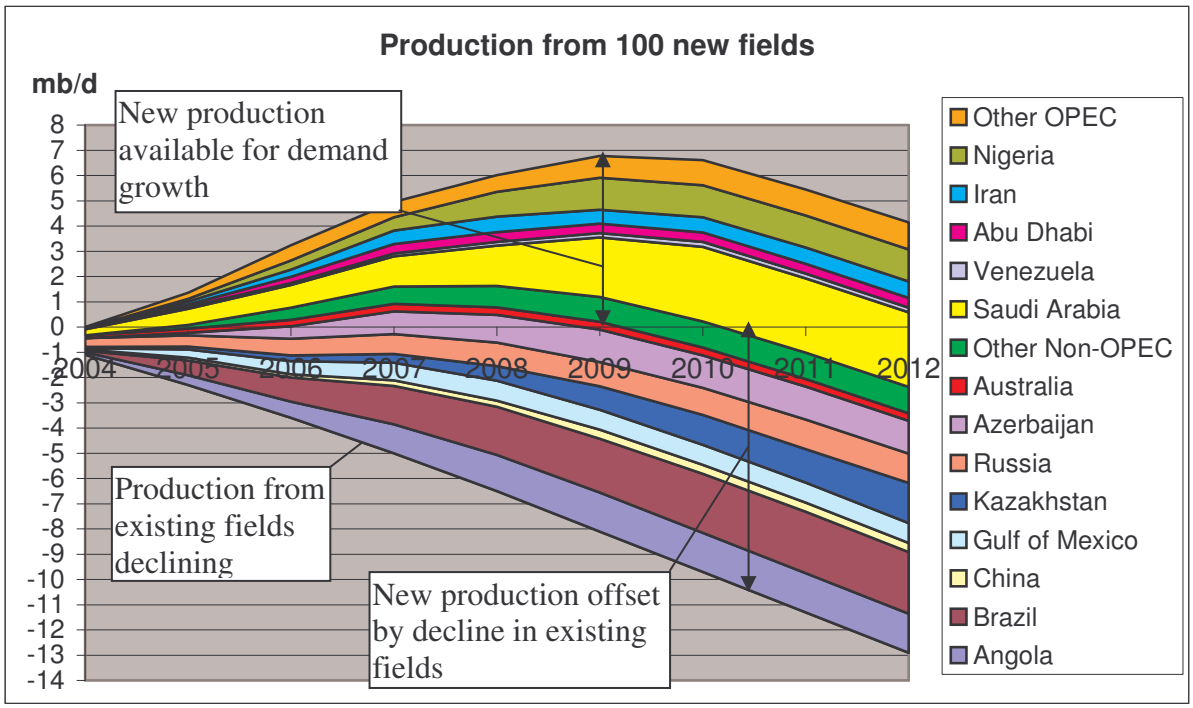
Phase 1: Production struggles to follow a 2% demand growth up to 2008

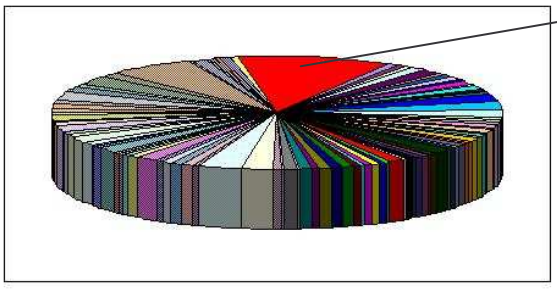
Ctd…

Phase 2: After 2008, a 2% demand growth is no longer physically possible as the production curve turns towards the 1% growth area. Demand destruction occurs by increasing oil prices. Therefore, problems start already **before** peak oil.

Phase 3: Production begins to plateau around 2010 (peak oil). Supply situation is very confusing as production is still in the 1-2% demand growth band (based on 2004) while peaking is already underway. Multiple peaks are possible if new oil field projects are added to the existing list later on. It will be difficult to detect the peak immediately as oil production varies seasonally over a year and as demand may decrease with rising oil prices in phase 2.

Phase 4: After 2010, production from new oil fields can no longer offset decline in the rest of the fields. If trends between 2010 and 2012 continue, the production curve will hit the decline area around 2015 when production will be back to 2004 levels.. Future updates of the oil field database would be needed to confirm this and gain more certainty.





The era of giant oil fields has ended

Daily production from the Mexican giant oil field Cantarell, 2.2 million barrels/day, is shown here in comparison to the new fields. It is obvious that the era of giant fields, on which current oil supplies rely heavily, has ended. The new, additional production comes from many small fields which will deplete quickly, some in just 7 years.

A 20 page detailed paper on the above graphs and supporting research on Chris Skrebowski's article "Understanding Depletion":

www.energybulletin.net/newswire.php?id=5395

can be downloaded at:

http://sydneypeakoil.com/matt/100NewOilFields1of3.pdf
http://sydneypeakoil.com/matt/100NewOilFields2of3.pdf
http://sydneypeakoil.com/matt/100NewOilFields3of3.pdf

General Comments on BTRE WP 61

It is well known in the professional debate on oil depletion that the question "Are we running out of oil?" is, at present, not the critical one. Rather, it is the question: "When will oil production peak?" This is because neither our economy nor our transport system are currently in a position to deal with permanently declining oil production. The second critical question would have to be when and how we have to prepare for the global peaking of oil production.

Nevertheless, this critique was written because the general public perceives oil problems as a "running out" issue rather than a peaking problem, mainly due to a lack of proper information in the media. The question "Are we running out of oil" is often asked but never gets properly answered because the terms in the question are not properly defined and the question itself is in a colloquial form. The authors do not try to answer it as they are not able to actually figure out how that "running out" could occur in its various phases along the oil's depletion path. The following critique will present a set of definitions for "running out" which will be workable and answerable.

The paper describes the various arguments in the peak oil debate put forward by C. Campbell, K.Deffeyes, Laherrere, M.Simmons on one side and the "anti-depletionists" (international energy agencies) on the other side. However, the consistent approach in the paper seems to be to first present the facts of the "depletionists" and then counter them with arguments from the "anti-depletionists". This method leaves a bias for the latter, throwing into doubt the claim of the authors to present an objective summary and analysis of the main issues of debate. Any differences between the 2 sides of the debate remain open and are **not** resolved by BTRE's own research or analysis. In these cases the uninformed reader is left bewildered, confused and helpless.

It is not surprising that the authors seem to favour the "anti-depletionists" as this view allows them to maintain their belief that market forces will result in an efficient and optimal use of oil resources, whatever the terms "optimal" and "efficient" mean. They consider oil-geological limitations and the physical laws of oil depletion as debatable arguments, not as facts to be learned and to be accepted. They conveniently adopt the IEA's peak year around 2030 without realizing that this late peak would result in a production crash after the peak (decline of 6-8% pa) which no economy will survive. Therefore, their peak scenario is actually not desirable, even if a continuous 2% production growth up to this year were oil-geologically possible.

A peaking in the next years is not considered as this would require the authors to prove that a market economy can manage a transition to other fuels/energies in a few years and in the required quantities to fill the emerging oil supply gap without Government intervention. The problem of future oil supplies is seen just as a question of oil prices, not as shortages after the peak. Accordingly, the only advise given to Government is to improve on the availability of more reliable oil data so that oil markets can function more rationally.

While peak oil is actually a number crunching problem requiring the mindset of an auditor, numerical analysis of oil depletion data is not being done in this paper. It remains on a verbal level, another round in an endless debating club competition. This can go on until peak oil actually happens, quite similar to the greenhouse gas debate.

Though released in May 2005, the paper's latest main reference with relevance to oil depletion is the IEA's World Energy Outlook 2004, published in October 2004. Prof.

K.Aleklett's critique "International Energy Agency accepts Peak Oil" has not been incorporated (http://www.peakoil.net/uhdsg/weo2004/TheUppsalaCode.html). Moreover, following major studies, conferences and seminars before May 2005 have also been omitted from the analysis:

- January 2005; IEA Oil Projections Revisited; paper by K. Illum, ECO Consult, Denmark
- February 2005; report by Robert L. Hirsch to the DoE entitled "Peaking of world oil production: impacts, mitigation & risk management"; http://www.cge.uevora.pt/aspo2005/abscom/Abstract_Lisbon_Hirsch.pdf
- March 2005; IEA workshop "Managing Oil Demand in Transport" with the 1st session entitled "How to save fuel in a hurry"; http://www.iru.org/images/WebNews/ParisMar05/prog.pdf
- April 2005; Conference on oil depletion in Edinburgh; http://www.depletion-scotland.org.uk
- Chris Skrebowski's update of his mega oil field study www.energybulletin.net/newswire.php?id=5395)

The authors of the BTRE paper have not even discovered various important studies and events in the course of the year 2004:

- Aug 2004: Dr. M.G. Salameh's article in Petroleum Review „How realistic are Opec's proven oil reserves?", reminds us of OPEC's 300 Gb of paper oil, a legacy of their internal quota war: http://www.odac-info.org/bulletin/documents/DepletionAnalysis.pdf
- Aug 2004: Chris Skrebowski's article "Depletion now running at over 1 mb/d" in Petroleum Review, pages 42-44 http://www.odac-info.org/bulletin/documents/DepletionAnalysis.pdf
- Sep 2004: Center for Strategic and International Studies, Washington, PFC Energy's "Global crude oil and natural gas liquids supply forecast" including lists showing oil depletion levels in many countries. www.csis.org/energy/040908_presentation.pdf
- Sep 2004: Matthew Simmons: "Twilight in the desert; The Fading of Saudi Arabia's Oil"; Hudson Institute, about water injection and future tertiary recovery in maturing Saudi fields http://www.simmonsco-intl.com/files/Hudson%20Institute%20September.pdf

The knowledge and awareness level on peak oil issues is basically that of the precursor paper presented to the ATRF04 (which also was not up to date at the time) with the WEO 2004 and price spikes in Oct 2004 added as an afterthought but not changing the basic line. To maintain the notion of oil prices returning to $30 levels while most market analysts predict prices to stay high for years to come is simply unrealistic.

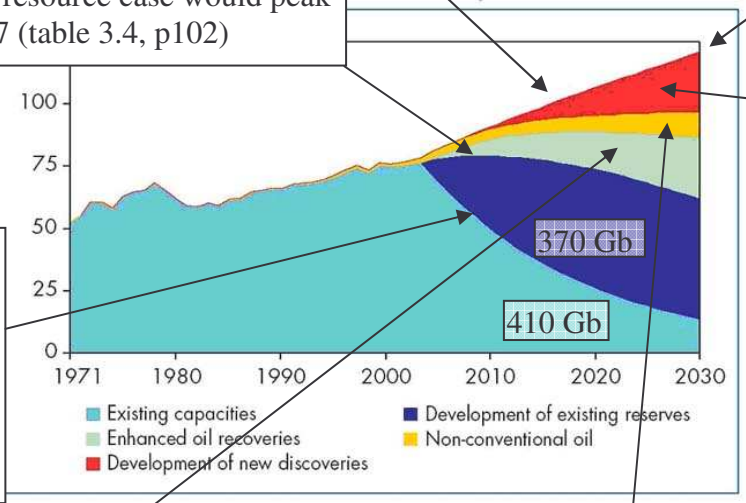
The fundamental underlying assumption of the BTRE paper is the belief that market forces will automatically solve economic problems arising from oil scarcity. It does not present any plausible transition scenarios which would safeguard a timely replacement of oil by other fuels. Neither does it do any cost analysis to determine at which oil price alternative fuels would become competitive. The crucial question: could threshold cost of oil become so high that the economy is damaged before alternative fuels are available in adequate quantities, is not even asked. Physical limitations, net energy balances and technical feasibilities in the provision of alternative fuels/energies are not checked.

Feature: International Energy Agency's World Energy Outlook 2004
Embellished Fig 3.20 (page 103) based on USGS 2000 mean estimate

(1) 2% pa oil demand curve. Oil-geological, technical and financial feasibility has been assumed but not realistically checked.

(2) Peak in 2030 hidden by the graph's conveniently defined period. This peak will result in a production crash (6-8% pa) after the peak which no economy can survive.

Existing capacities and reserves peak in 2010
A 90% probability resource case would peak between 2013-2017 (table 3.4, p102)



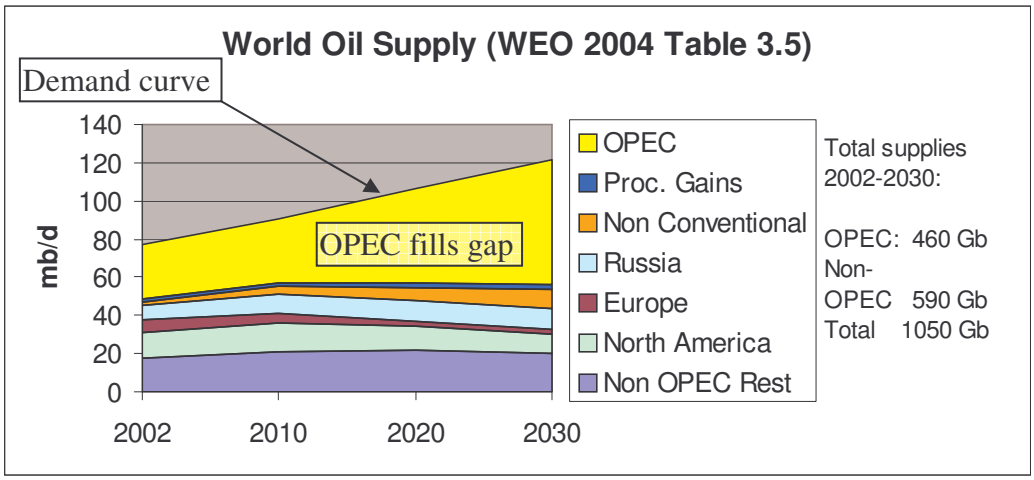
90 Gb new discoveries defying past, declining discovery trends

(3) OPEC's overstated reserves, 230 Gb by IEA's own calculations, have not been deducted here (WEO page 92)

(4) 120 Gb hypothetical reserve growth oil is added here without necessary research as demanded by USGS 2000 in document RG.PDF, page 4: ***"The present study is an attempt to provide a numerical hypothesis for world potential reserve growth that is valuable in itself, and will perhaps act as a stimulus for discussion and research aimed at reducing the uncertainty of world reserve-growth estimates."***

60 Gb non conventional oil includes Canadian tar sands requiring huge amounts of water and gas for processing (mining operation). There are already gas shortages in the US now.

The same graph as above, by producing region. It is obvious that IEA assumes OPEC will always fill the gap between declining Non-OPEC production and demand.



Matthew Simmons comments on OPEC's future oil production capacities that no 3rd party inspector has ever checked OPEC's production data, reserve history and future resources

Definition problem of "anti-depletionists"

The choice of the wording "anti-depletionists" in relation to oil is inappropriate. All non-renewable resources like oil, gas and coal are, by definition, depleting from the first day of their extraction.

In particular, to use the term "anti-depletionist" for the International Energy Agency, Paris, is out of date. The authors have failed to identify a subtle shift in the year 2004 which saw the IEA recognizing and presenting oil depletion issues.

The IEA's turning point can be traced back to a workshop in Rio, in July 2004, in which the then editor of the Oil Market Report, K. Rehaag, asked the question "Is the world facing a 3rd oil shock?" and presented oil data on rampant decline in existing fields world-wide (70% of all fields declining at 7% pa) (www.iea.org/dbtw-wpd/Textbase/speech/2004/kr_**rio**.pdf).

The latest IEA World Energy Outlook, published in October 2004, is a departure from the previous 2002 version. For the first time, the WEO mentions peaking and decline. It says on page 101:

> "For a given estimate of ultimately recoverable conventional oil resources, many different production profiles can be envisaged. In all cases, production reaches a peak and then declines, but the timing of the peak and the rate at which it is reached differ sharply with different assumptions. The fall will be sharper than was the increase to peak if more than half of the ultimate resources have already been produced when the peak is reached".

Overstated OPEC reserves, declining discoveries and smaller field sizes are all mentioned. However, when it comes to actually project production (Fig. 3.20, page 103), the WEO adopts the USGS 2000 mean estimate and presents one of the scenarios of the EIA "Long Term World Oil Supply", cut off shortly before a flattened peak. The apparent discrepancy between analysis and projection can only be explained by outside political pressure.

In continuing their warning signals, the IEA held a workshop in March 2005, entitled "Managing oil demand in transport" with session 1 headed "Saving Oil in a Hurry".

It is therefore incomprehensible how the BTRE paper still sees the IEA as an "anti-depletionist"

Detailed Comments

At a Glance (page v)

Quote (page v): ***The international agencies, the most prominent antidepletionists, maintain that a production peak is unlikely before 2030 and that the remaining resources are sufficient to meet the projected average annual requirements, between now and 2030 70 times over, due mainly to technological advances, improvements in knowledge and changing economics.***

This quote fails to mention that the assumption of a peak in 2030 is not on the safe side (based on the USGS 2000 mean estimate instead of the 95% probability case). There is a big difference between reserves and resources. The WEO 2004 therefore adds, on page 95, that "the rate at which remaining ultimate resources can be converted to reserves, and

the cost of doing so, is, however, very uncertain". IEA's low resource case with a 90% probability similar to the USGS 95% probability peaks around 2015 (table 3.4, page 102). It is typical of the BTRE paper that hidden warnings in reports are consistently either overlooked or deliberately ignored.

Executive Summary (pages vii-ix)

Quote (page vii) ***There are two very distinct schools of thought on the question of whether we are running out of oil. The 'peak theorists'/depletionists argue that half the world's oil supplies have been used and oil production has peaked or is about to peak, signalling a near-term crisis across world economies that will cause massive dislocations.***

The authors fail to:

- define what "running out of oil" means
- distinguish this "running out" from the peaking

First, it is not clear which oil is referred to: conventional oil or all liquids including NGLs? One also has to distinguish between cheap and easy pre-peak oil and the much more slowly flowing and more expensive oil after the peak.

Second, there are following possible definitions of the 'running out' process:

Feature: Possible definitions of "Running Out of Oil"

1. the world is discovering, on an annual basis, less oil than is consumed which means reserves are drawn down without adequate replacements
2. underlying demand exceeds supply for more than 6 months (1 year, 2 years…) with higher oil prices reducing demand to supply levels which
   a. reduce economic growth (=running out of cheap oil)
   b. do not allow economic growth
   c. trigger a recession
3. there are physical shortages, that is higher prices cannot reduce demand to supply levels as all discretionary demand has been reduced to zero in previous price rises
4. the net energy balance from discovering, producing, supplying and using oil is zero; (=running out of oil for the purpose of extracting the oil's energy; this is the scientific definition; oil may still be produced to grease renewable energy machinery)
5. declining oil production after the last peak in a series of peaks around the geological, global plateau of oil production (=running out of easy conventional oil)

Each of these definitions will result in a different answer. The authors of the BTRE paper are aware of (1), know that some of (2) can happen - though rather as a temporary supply disruption and as a result of OPEC manipulation - , ignore (5), do not even think of (3) as they never had any experience with petrol shortages and would not know enough about the physics of energy to understand (4).

Quote (page vii): ***They also focus on resources as a physical limit, calling on 'the immutable physical laws of depletion' to support their case and estimating ultimately recoverable resources (URR) at 1.8 trillion barrels. They predict that the downturn in oil production will be sudden and unanticipated, thrusting an unprepared world into economic and social turmoil***

Physical laws are seen here just as another argument, among many others, with equal weight in a debatable case. Nature and its laws are not open for discussion like an economic theory. One has to learn these laws and use them to one's advantage. The authors do not accept and understand that the flow of oil in reservoir rock is controlled by the same basic laws of fluid mechanics which engineers successfully use to design engines and braking systems in the very cars the authors use to get to their offices.

It is also wrong to quote "depletionists" saying that the decline after the peak will be sudden. For example, both C. Campbell's and S. Bakhtiari's graphs show a flat peak. In fact the authors should have read the above quoted sentence in the WEO 2004. The later the peak the steeper the decline after the peak. The authors' wishful thinking of a late peak around 2030 will result in the very sudden and apocalyptic declines rates they want to attribute to the "depletionists"

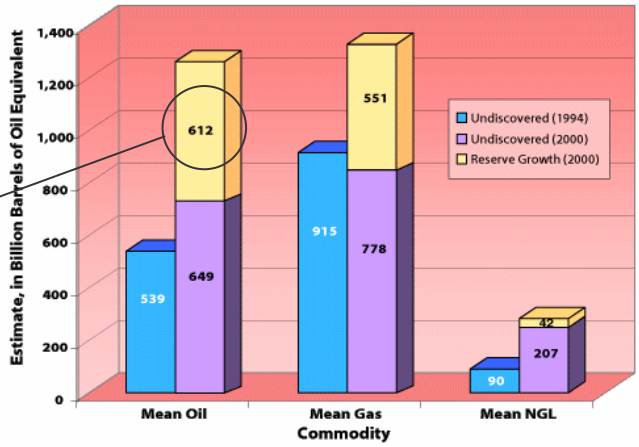
Quote (page viii): ***The antidepletionists estimate a URR of over 3 trillion barrels***
USGS (2000) regard 3 trillion barrels as a conservative estimate given a 95 per cent probability of being an underestimate and reflecting only those parts of the world actually assessed.
See http://pubs.usgs.gov/dds/dds-060/ Chapter AR Table 1.

The USGS estimate of 3 trillion barrels is not a 95% probable estimate but the mean estimate as shown in the following table:

From Table 1 of the USGS 2000 Executive Summary:

	Oil			
	Billion Barrels			
	F95	F50	F5	Mean
World (excluding United States)				
Undiscovered conventional	334	607	1,107	649
Reserve growth (conventional)	192	612	1,031	612
Remaining reserves*				859
Cumulative production*				539
Total				2,659
United States				
Undiscovered conventional	66		104	83
Reserve growth (conventional)				76
Remaining reserves*				32
Cumulative production*				171
Total				362
World Total (including United States)				3,012

All figures normalized to 1995

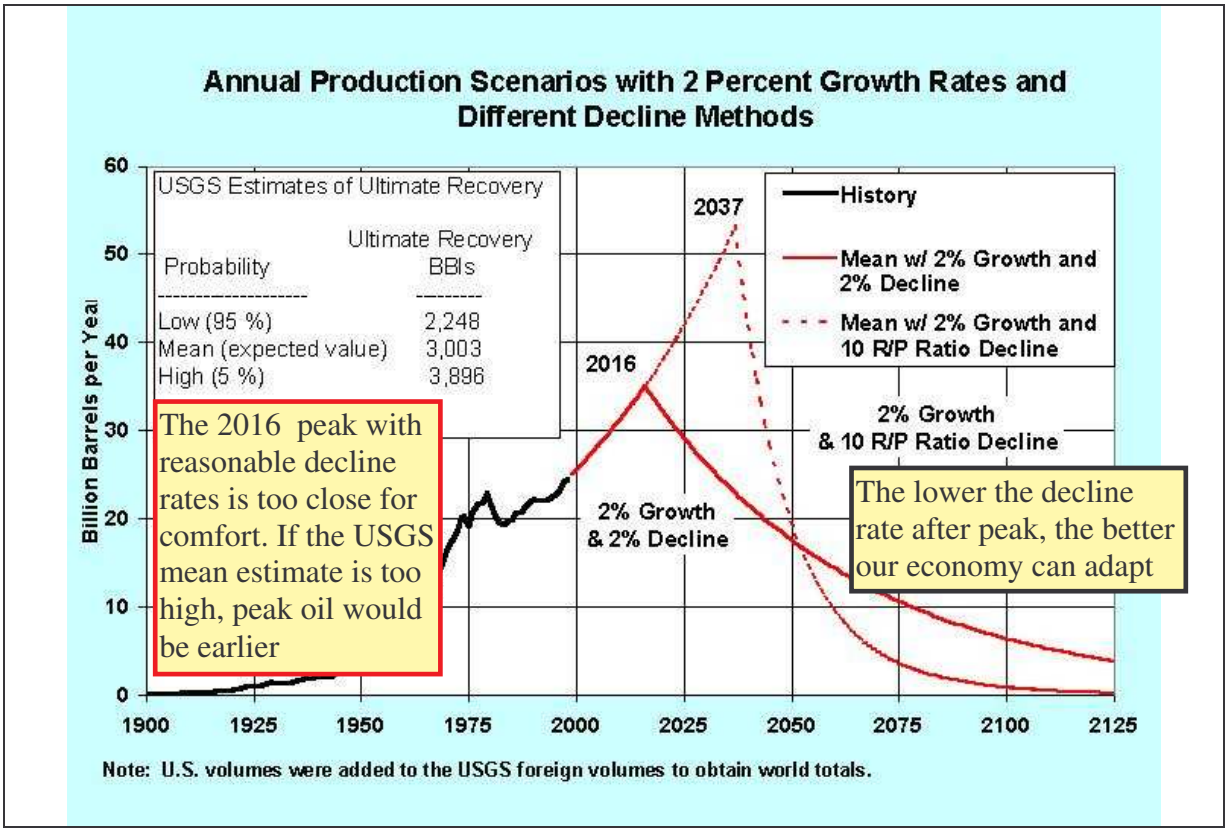


Comparison of 2 recent USGS estimates for the world (excluding US) in these column pairs: left: USGS Masters 1994; right: USGS 2000

The USGS 2000 study adds an extra 612 Gb of oil for reserve growth outside the US, increasing the undiscovered oil plus remaining reserves by 40%.

The difference between USGS mean and 95% estimate goes to the very core of the critique by ASPO. The USGS 95% estimate may result in a peak by or before 2015.
Further down in the BTRE paper, on page 5, the 3 trillion Gb estimate is rightly quoted as a mean estimate.

Quote (table 1, page viii): "***Antidepletionists"***	
How sudden will the decline be?	***Gradual and reflected in long term price; rises encouraging timely adjustment.***
Will the market anticipate the decline?	***Markets have very strong incentives to get the prices right***
What is the relative role of the market and governments?	***Inform the market and assess whether additional incentives are justified***

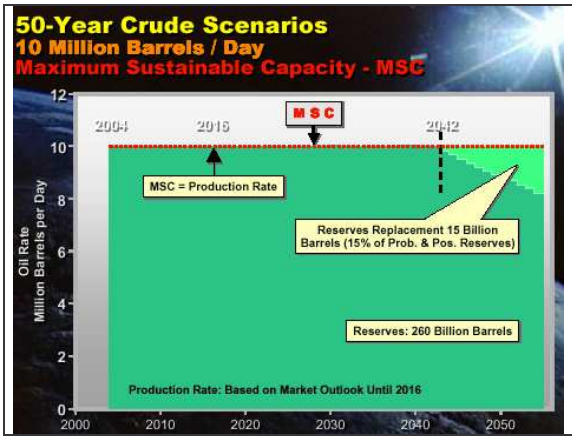


The above graph shows 2 of the scenarios (not forecasts) contained in the slide show "Long Term World Oil Supply" available on the web page www.eia.doe.gov of the US Energy Information Administration, one of the "antidepletionist" agencies.
The reader is encouraged to find answers on the above graph for following questions:

- Is the decline after 2037 gradual?
- Will markets which are used to 30 years of further growth foresee a sudden peak in that year?
- What kind of information to the market is that very graph?

Quote (page ix): ***While there have been dramatic price rises in the past, these have generally reflected short-term pressures such as market control by OPEC countries and, more recently, an unanticipated surge in demand coinciding with supply concerns due to unrest in key producing countries— Saudi Arabia, Iraq, Nigeria, Venezuela, and Russia—rather than signal impending depletion of the resource***.

For a paper published in May 2005 it should have become clear that price rises which started in 2004 are no longer short-term but reflective of fundamental changes in the oil market. The underlying determining factor is now increasing production decline in many oil supplying countries as shown in many statistics, and the lack of genuinely new discoveries during the last few years. Due to the tight supply situation unrest in the above mentioned countries is a trigger rather than a cause for a crisis. It also slipped the attention of the authors that Saudi Arabia declared in a conference that their maximum sustainable capacity is between 10 and 12 mill. barrels/day



In a conference in Feb 2004, at the Center for Strategic and International Studies in Washington, Aramco, the Saudi national oil company, presented future production scenarios showing a maximum sustainable capacity of 10 million barrels/day (currently around 9.5 mb/d) which could be increased to 12 mb/d by 2016. This is far from the 19 mb/d assumed and included in the energy white paper's quoted total world production of 104 mb/d in 2020.

Quote (page ix): ***From a longer term policy perspective, if the 'depletionists' view were endorsed, it should be noted that the 'first-best' policy mechanisms are already in place in Australia and other OECD countries. Taxation rates that significantly increase the price of fossil fuel products, thereby discouraging usage, are a hallmark of the developed countries.***

The reality is just the other way around. Taxation rates in Australia are among the lowest in OECD countries. There are numerous tax breaks and incentives to encourage the use of private vehicles (e.g. lease back cars). Moreover, the tax revenue from fuels is not spent on the development of alternative fuels and energies.

Quote (page ix): ***The concessionary taxation treatment of alternative fuels already provides a stimulus for their production and usage.***

The Government has just introduced **new taxes** on alternative fuels and made them thus less attractive.

Quote (page ix): ***The question that would remain is how much more should the price of oil products be increased to accurately reflect what the depletionists regard as oil's scarcity value?***

The proper policy is to tax oil based fuels to

1. compensate damages caused by the use of these fuels to the environment, climate, health etc. (this concept of internalization of external cost is known to economists for more than 30 years now but never implemented and again ignored in this paper)
2. compensate costs of oil wars and their associated terrorism
3. fund the necessary investments in alternative fuel infrastructure and oil independent transport systems with the aim that, come peak oil, these capacities are immediately available when the first physical oil shortages emerge.

The BTRE summary is an accumulation of selectively presented items, often twisted to fit the case of the authors. It therefore contains incorrect facts, flaws and contradictions which are not resolved, e.g. by own research or calculations. The review of the debate remains on a verbal discussion level.

Background (page 1)

Quote (page 1): ***A combination of record demand growth and low spare capacity saw prices reach record highs in 2004.***

The paper fails to analyse why the spare capacity is so low: the peaking of oil production in the North Sea in 2003, the reaching of a production plateau in China itself, the technical problems of increasing production in Saudi Arabia etc.

Quote (page 1): ***While there is clearly a downside to Australia from higher oil prices, there are also some gains in the form of higher prices for our energy exports.***

One would have expected some detailed calculations on this import/export balance here, both in energy units and dollars and including a sensitivity analysis with various oil/gas price and exchange rate scenarios over the next years.

Quote (page 2): ***Transport, already a major user of oil and with few viable alternatives, is expected to account for an increasing share of oil demand as the growing abundance of natural gas encourages other users to shift to the cheaper alternative***.

Which abundance of natural gas and where? What does "abundance" actually mean in numbers? In the US, natural gas is already in short supply. The UK has become importer of gas again. In Australia, gas is expected to peak around 2030 (CSIRO; "Future Dilemmas", chapter 5; The future of energy; page 172)

The Protagonists (page 4)

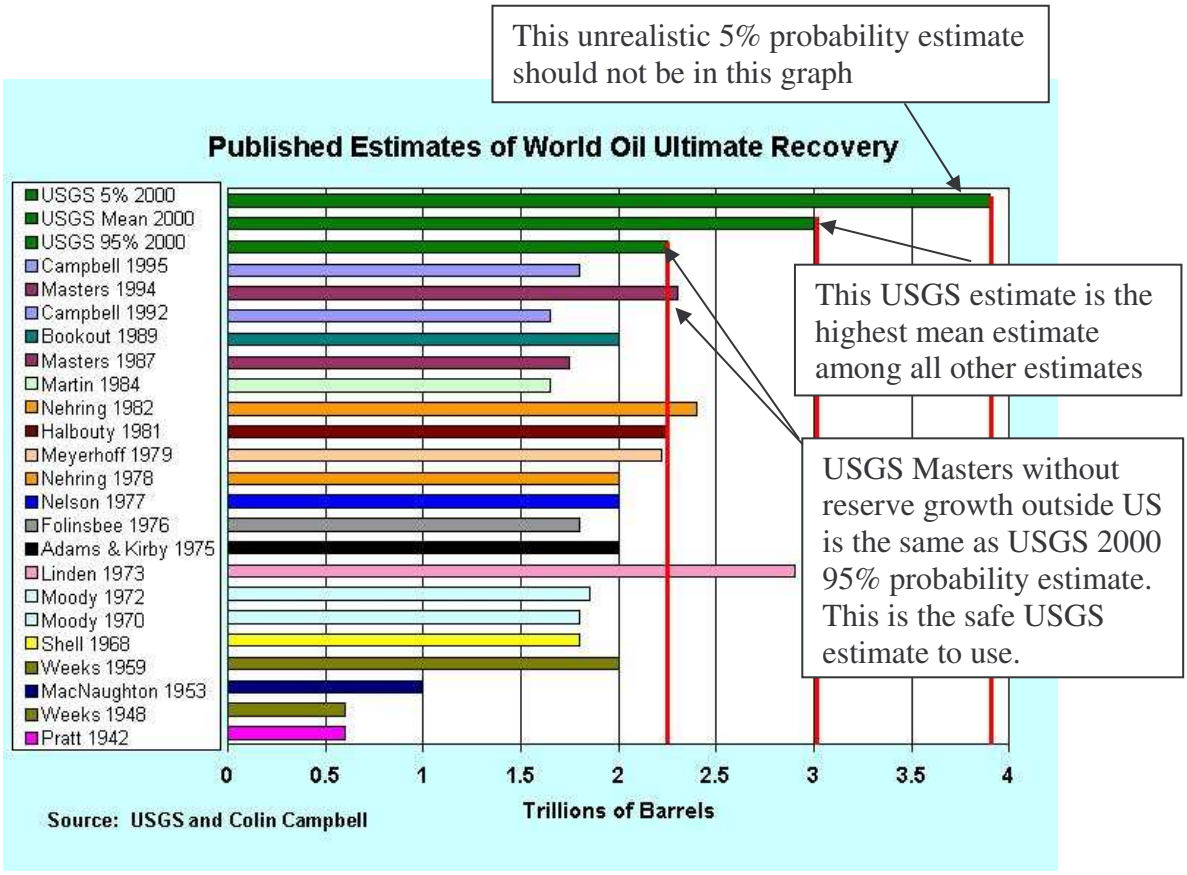
Quote (page 4): ***The depletionists estimate that the rate of discoveries are declining and hence that a dramatic decline in oil production may be just around the corner (see Figure 4 below).***

It is not only the "depletionists" who report about declining discoveries. The authors of this paper should have looked at the WEO 2004, page 97, Figure 3.14 which also shows declining discoveries. Figure 4 does not contain any oil production curve, only the discovery trend. These are facts, not debatable arguments by one side or the other. It is self evident that oil must first be discovered before it is produced.

Quote (page 5): ***Over the last 50 years estimates of ultimate oil reserves have risen as fast as or faster than cumulative oil production Deming (2000).***

This is not correct. Since 1955, estimates have hovered around the 2 trillion Gb mark, including a USGS estimate by Masters. The only estimates which are far higher are those from Linden and the USGS 2000 mean estimate. One of the 2 main reasons for the higher USGS mean estimate is the inclusion of 612 Gb of reserve growth oil for the rest of the world, which has been calculated, by the stroke of a pen and without supporting research, by applying the US reserve growth factor (44%) to the rest of the world, a methodology Masters had rejected earlier on.

This crucial reserve growth issue comes up several times in the BTRE paper but is not properly understood and never resolved by adopting a safe estimate without that risk, a main weakness in this paper. This critique repeats to refer to it wherever the issue comes up even if this a duplication. There is a feature page



Source: Long Term World Oil Supply, www.eia.doe.gov

Quote (page 5): ***The antidepletionists point to the many past predictions of the decline of oil production (see Table 2 below), in the same vein as those contained in the Limits to Growth submission to the Club of Rome in 1972, when 'sudden and uncontrollable decline in both population and industrial capacity' were forecast.***

If past predictions were wrong than that would be reason enough to study them why they were wrong and what could be done to improve forecasting. There is no logic in saying: "as past predictions were wrong, so are present predictions". Moreover, one cannot compare estimates from 1855, 1914 or even 1977 with later estimates as the know how where to find oil and, even more importantly, where not to find oil (oil window) has substantially increased over the last decades. The probability that peak oil happens in year x does not depend on the quality or otherwise of previous forecasts

Quote (page 6): ***Oil is not the only resource where physical limits have been confused with economic scarcity, leading to pessimistic projections about declining supply.***

Physical limits are given by nature's laws. Economic scarcity, as measured by prices, is an artificial human construct and therefore only of limited use in determining physical supply limits. If the present oil market knew more about the facts of peaking oil production, prices would possibly be already much higher. None of the "depletionists" tries to forecast oil prices.

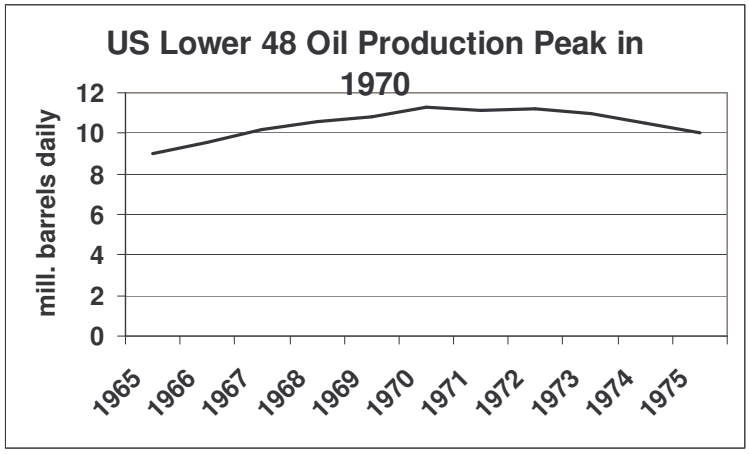
Quote (page 7): ***After decades of predicting massive shortages of various natural resources, biologist Paul Ehrlich was challenged by economist Julian Simon to bet on future scarcity of natural resources, as reflected in prices…… Simon offered Ehrlich a bet that, despite continued mining and depletion of minerals, prices would fall rather than rise. If Simon won, it would indicate that, despite declining physical resources, the metals had not become more 'scarce'.***

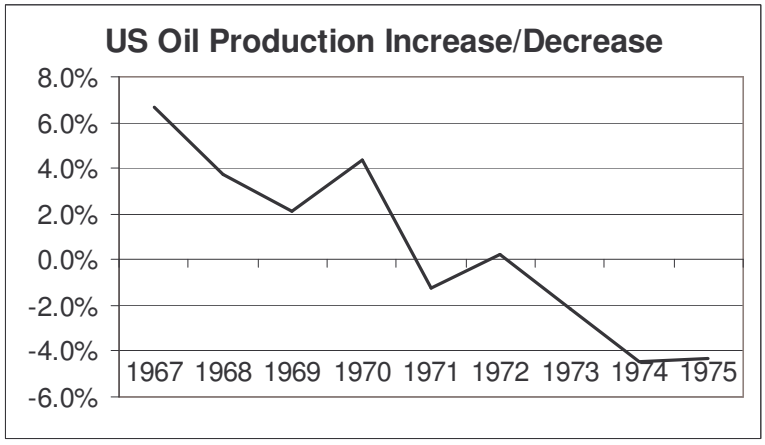
Scarcity and depletion are different. Scarcity describes the demand/supply situation over a short period at any given time. It also depends on the subjective value the market attaches to any imbalances. It is a differential calculation. Depletion, in the contrary, is accumulative consumption of a finite resource and objectively measurable. If a resource has a peaking production profile over time and if supply always stays above demand, a market will, before the peak, neither detect scarcity nor future decline problems.
In the example, the reduction in prices between 1990 and 1980 of certain minerals was possibly caused by cheap oil in the glut years of the late 80s. The resource rent tax, one of the cost factors, is also not indirectly proportional to the remaining reserves, one of the design flaws in taxation policy. A case by case analysis of cost structures would be more important than speculating on prices reflecting depletion problems. The Ehrlich/Simon bet actually shows that prices may not tell you all what physically happens to your resource base. A very dangerous situation in fact as warning times may be very short.

Main areas of conflict (page 8)

Quote (page 9): ***Figure 7 below illustrates total world production over the past quarter of a century, with some fluctuations but no apparent peak to date.***

BP's past total production curve as shown in figure 7 does not show the different production profiles in various countries and is therefore unsuitable to form a basis for any prediction. If an "apparent peak" were visible from a total production curve, this paper would not need to be written. Let's have a look at how peak oil happened in the US in 1970 (source of data: BP Statistical review of energy)





In 1973 it was clear that 1972 was the last rebound which would bring a growth rate just above zero.

US oil production peaked in 1970. Even oil from Alaska later in the mid 80s could not change this. (It produced a 2nd, lower peak)

Suppose you are in 1969 and look at the growing curve 1965-69. Would you suspect a peak to happen in 1970? Perhaps by looking at the falling growth rate from 4% in 1968 to 2% in 1969. However, in the peak year itself, production growth had rebounded to 4% again. In 1971, growth had changed into decline, for good.

Production came from 530,000 wells, at 18 barrels per day. Today it is 11 barrels/day

Feature: Undiscovered conventional oil

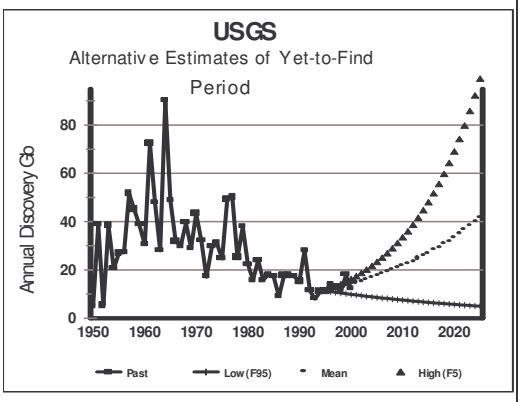
C. Campbell's comments on the frontier country of future oil exploration

The USGS mean estimate also includes (as of end 1995) undiscovered conventional oil of 83 Gb for the US and 649 Gb for the rest of the world.

Colin Campbell writes about the yet to be found oil in ASPO newsletter Feb 2002:

"In brief, it [USGS] made an assessment of the subjective probability of new discovery in each of the world's basins. For example, in the unknown, untested, frozen basin of East Greenland, it concluded that there was a 95% probability of finding more than zero, namely at least one barrel, and a 5% probability of finding more than 112 billion barrels. A Mean value of 47 billion was computed from this range. Since the numbers were quoted to three decimal places, the reader could be forgiven for assuming them to be accurate.

But a moment's reflection would question the very concept of a ***subjective*** 5% probability. In plain language, it was a guess that could as well be half or double, yet it entered the calculations distorting the Mean value. Common sense would cast doubt on the prospect of this unknown, difficult place delivering as much as 70% of the North Sea.



The plot (right) shows the implications of these absurd findings on discovery. (Note that since the USGS did not forecast production itself, the trends have been constructed to deliver the indicated amounts. Note too how the high case implies finding at least as much again after 2025, which is most implausible).

It is more than evident that only the low (F95) case bears any reasonable relationship with the past actual trend, which, it is stressed, resulted from the diligent efforts of the industry in a worldwide quest for the biggest and best prospects, having the benefit of all the much vaunted advances of technology and geological knowledge.

It follows that if more could have been found, it would have been found, especially recognizing that the industry operates under extraordinarily favourable economic terms whereby the cost of exploration is offset against high marginal tax rates. It effectively spends 10c dollars on exploration."

New frontier country for oil exploration: Greenland

- Ice infested waters
- Short drilling seasons
- Many technical and environmental problems
- Wells at US$25 mill. each

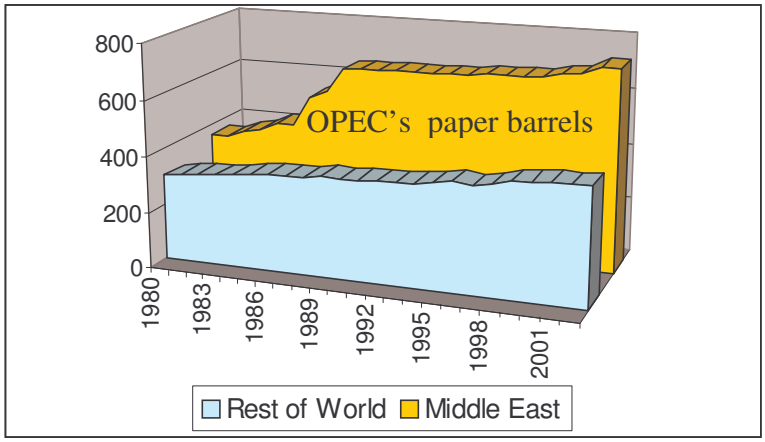
Greenland Bureau of Minerals and Petroleum:
"A time frame of 15-20 years seems plausible."
Source: www.aapg.org

Quote (page 9): ***Major international forecasters do not provide support for a production peak within the next two decades—see Figure 8 below. In general, oil production is expected to increase steadily in response to growing world demand.***

This is not correct. As mentioned above, Table 3.4 of the IEA's WEO 2004 shows a peaking between 2013 and 2017 for a low resource case, being a safe, 90% probability estimate. Even the EIA's "Long Term World Oil Supply" contains a scenario (albeit not forecast) showing a peak in 2016, assuming a 2% growth and allowing a modest, possibly manageable 2% decline after the peak.

Quote (page 10): ***However, the company responsible for the operation of Ghawar, Saudi Aramco, reports that Ghawar still has 70 billion barrels of remaining reserves of Arabian Light crude and, at the current rate of output, this represents 38 years of production. The lack of transparency of oil well data makes it difficult to confirm this estimate.***

It is an established fact that some OPEC countries are reporting as "reserves" not the remaining reserves but total reserves ever found, including past production. Therefore the reserves published by BP contain oil already consumed, a fact not mentioned in the BTRE paper. Even the IEA calculates in its WEO 2004, page 92, that 230 Gb of OPEC reserves are overstated. The truth of the matter will come out soon as OPEC countries seem to have problems to increase their output which should have been no problem if they had all the reserves they claim they have.



Source: BP Statistical Review of World Energy 2004

Middle East's implausible reserve history compared to an only slightly increasing reserve curve for the rest of the world caused by rather modest revisions and additions from small new fields (in bn barrels of oil). Another North Sea sized reserve was added in 2004 to smaller ME reserves already published in 2003.

The author of this critique has written a special paper on this topic entitled: "Next intelligence failure: 300 Gb OPEC oil missing", available at the Productivity Commission: (www.pc.gov.au/inquiry/energy/subs/sub075attachment2.pdf)

Quote (page 14): ***The significance of reserve growth is apparent in the latest USGS assessment of and along with 'undiscovered conventional', account for much of the difference in the estimates of the depletionists and the antidepletionists.***

While the BTRE paper covers the reserve growth issue (but in the end ignores it), it completely omits to discuss the undiscovered conventional oil, 649 Gb in the USGS mean estimate for the world outside the US. See the feature on the previous page.

Feature: The Reserve Growth Issue

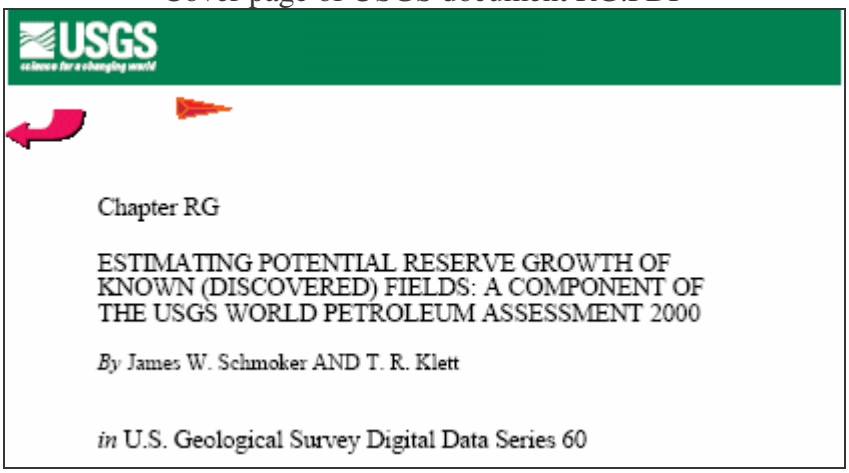
Unbelievable, but true: the world will soon run on hypothetical oil

The USGS mean estimate (total 3003 Gb – 955 Gb consumed by end 2004 = 2048 Gb) contains 612 Gb of so-called reserve growth oil for the rest of the world. This is a reserve reporting phenomenon found mainly in America where early, conservative estimates ("proved reserves") according to SEC rules were later consecutively revised upwards as reserve categories "probable" and "possible" were developed and produced. Only 6% of US reserve additions over the past 20 years came from new discoveries. The growth factor based on US experience was found to be 44% (page RG-26). This percentage was then applied to the known fields of the rest of the world, though reserve reporting procedures are different there.

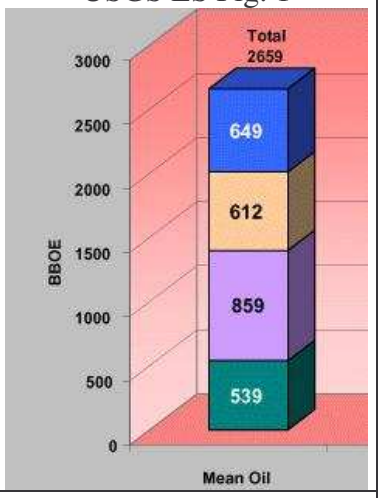
Reserve Growth (conventional) = Known Petroleum Volume * 30 year Growth Multiplier
= (859 Gb + 539 Gb) * 0.44 = 612 Gb

The USGS 1994 estimate by C.D. Masters had rejected the idea of the above mentioned reserve growth for the rest of the world by noting that many other countries, in particular all OPEC countries, the former Sowjet Union, China and Mexico are reporting proved + probable + possible reserves thereby already including future reserve growth.

Cover page of USGS document RG.PDF



USGS ES Fig. 1



Quote from page 4:

"The forecast of world potential reserve growth described here is considered to be preliminary. Much work remains to be done on the subject of world potential reserve growth. The present study is an attempt to provide a numerical ***hypothesis*** for world potential reserve growth that is valuable in itself, and will ***perhaps*** act as a ***stimulus for discussion*** and research aimed at reducing the ***uncertainty*** of world reserve-growth estimates."

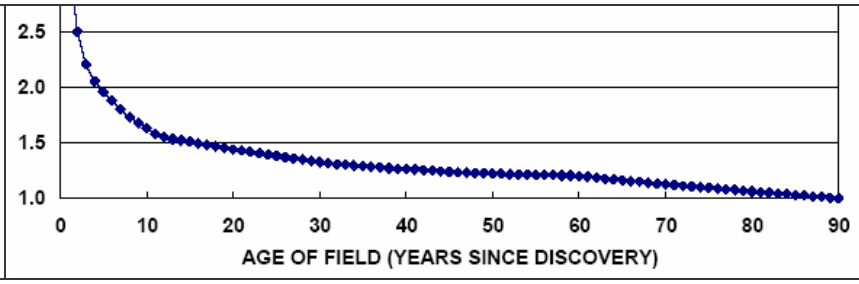
Quote from page 8:

"The reserve-growth model described here is intended to estimate volumes of petroleum having the ***potential*** to be added to known fields in the next 30 years. Because of the many ***indeterminate factors*** involved, it is not feasible to attempt to predict volumes of petroleum that will ***actually*** be added to known fields in this time period. To do so would require the ability to predict the future course of the petroleum industry in all of its details."

Highlighted and underlined by author

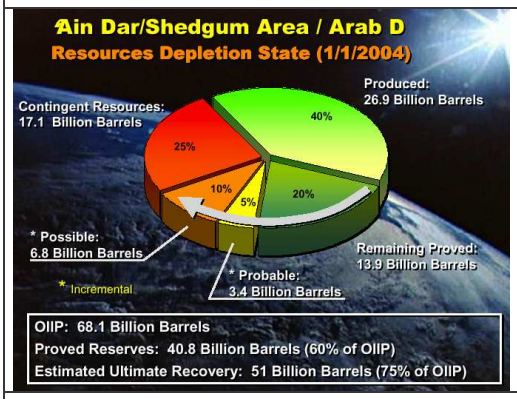
Reserve growth function for the US lower 48 states (Fig. RG-1), right.

30-year growth multipliers depend on the age of the field, the average is 1.44



Feature: The Reserve Growth Issue (ctd)

Example of an unreliable reserve growth calculation using the USGS model



Let's have a look at this Saudi oil field (left).

oil category	Gb	
produced	26.9	40%
remaining proved res.	13.9	20%
probable	3.4	5%
possible	6.8	10%
contingent	17.1	25%
oil in place	68.1	100%

The actual reserve growth would be 'probable' + 'possible':

3.4 + 6.8 =10.2 Gb

or 10.2/(26.9+13.9)=25% of past production and remaining reserves, not 44%

Using the USGS method, the calculation would be: (26.9+13.9) x .44=18 Gb or 80% more than actually available. Since the OPEC reserve reporting is not clear, there are 2 more possibilities:

(a) If the Saudis include 'probable' and 'possible' in their published reserves , the USGS reserve growth calculation will assume: 51 x .44 = 22 Gb

(b) If the Saudis report total reserves ever found instead of remaining reserves, the USGS formula would yield: (40.8+26.9) x .44 = 30 Gb.

In both cases (a) and (b), the reserve growth is already included in the reserves and should therefore not be counted twice.

Source of graph: www.csis.org/energy/040224_baqiandsaleni.pdf

Quote (page 15): ***Other agencies have long incorporated reserve growth into their estimates. The BP Statistical Review of World Energy (2004) depict reserves increasing by a third in the 20 years to 2003—see Figure 10 below.***

BP's growing reserves over the last 20 years as published in their statistical review resulted mainly from spurious reserve additions by OPEC. They have little to do with the expected future reserve growth as defined in the USGS and as mentioned in footnote 20 on page 14: the USGS applies a 44% growth factor obtained from US experience on all known oil reserves of the rest of the world, including past production and the overstated OPEC reserves. This simple, dubious calculation yields a whopping 612 Gb, equal to 20 years of current oil consumption. The previous USGS study by Masters had found that reserve growth was already included in most non-US reserves. The USGS 2000 mean estimate therefore contains oil counted twice. The BTRE paper fails to clarify this absolutely vital point. Refer to the feature on the next page.

The important footnote 20 should have actually been in the main text. This is a typical example how the BTRE paper uses statistics in a carefully sequenced line of arguments to neutralize other critique, without understanding how to match different types of reserves in one estimate compared to those in another estimate.

Quote (page 16): ***The USGS estimates of total world resource doubled between 1984 and the most recent study (see Figure 11 below)***

Not mentioned is the USGS' own comment on 612 Gb of reserve growth oil for the rest of the world which was added to its previous estimate done by Masters (see feature)

Quote (page 17): ***The depletionists posit that no credence can be placed in the reserves reported by the five Middle East key countries since reported discoveries amounted to no more than 10 Gb and that the estimates are no more than arbitrary revisions aimed at achieving a higher allocation of the OPEC quota. This interpretation finds little argument amongst the antidepletionists: 'This hike in OPEC countries' estimates of their reserves was driven by negotiations at the time over production quotas, and had little to do with the actual discovery of new reserves' (IEA 2004b p. 92).***

This sequence of sentences is totally illogic. If anything, the IEA supports the findings of the "depletionists" in this quote.

Quote (page 17): ***However, the evidence suggests that this arbitrary upward revision is a symptom of the unreliability of OPEC reserve figures rather than an isolated incident that can be dealt with through an offsetting adjustment.***

The unreliability of OPEC reserve figures actually demands offsetting adjustments as has been tried by various authors e.g. by:
Dr. Salameh (www.odac-info.org/welcome/documents/SALAMEH-PETREVIEW.pdf) or Chris Skrebowski in ASPO's newsletter #46

Quote (page 19): ***There have been significant advances over the past decade in the science and technology of oil exploration and production. Wells can now be drilled up to 30,000 feet deep and long horizontal–reach wells are possible, stretching up to several kilometres.***

The so called oil-window is between 7,500 and 15,000 ft. so a 30,000 ft deep well will not help in finding more oil.
Oil extraction goes through several distinctive phases. Horizontal wells can assist in maintaining a constant flow of oil for a longer time. However, once this phase comes to an end, the decline in a field can be quite steep, as experienced in Oman.

Quote (page 20): ***The amount of oil that can be extracted worldwide from oil shales has been estimated as up to 14,000 billion barrels—enough to supply the world for 500 years (Deming 2003).***

The production of oil from shales is basically a mining process and is controlled by completely different factors than those governing conventional oil production. Huge amounts of water and natural gas are needed for the extraction and refining operation. Production will be slow over time and the net energy profit is very low.

Quote (page 21): ***However, improvements in technology have increased the exploration success rate—from 20 per cent in the late 1940s to over 40 per cent in recent years—as well as reduced the cost of drilling wells (IEA 2004b p. 99).***

2 pages earlier, the same WEO 2004 report notes that a drop in oil discoveries and a fall in the average size of oil fields "have more than offset an increase in exploration success rates".

This is another example how arguments are diligently collected, removed out of context and slotted in wherever the authors saw fit

Quote (page 21): ***For instance, oil in the Troll field in Norway was once considered 'uncommercial'. The use of advanced technology increased the recovery rate to 70 per cent and reserves fivefold between 1990 and 2002 (IEA 2004b p. 100)***

New technology has delayed but could not stop the peaking of oil production in the North Sea which happened in 2003. This is the main point missed in the paper: advanced technology has, without us knowing, already contributed to maintain high levels of oil production in the last 10-15 years which would have otherwise already fallen years ago. We can't use the same trick twice. We have to rely here on the advise given by experienced oil geologists and oil engineers.

Quote (page 25): ***Saudi Aramco expresses confidence that it can meet the increased demand for oil:***
…we stand upon a firm foundation of 260 billion barrels of crude. Those reserves are spread across 85 fields and 320 different reservoirs, and represent a conservative accounting of our total reserve base, given our cautious assumptions about ultimate recovery rates. We are also working hard to identify new reserves through additional discoveries, enhanced recovery techniques…for many years we have been able to make healthy additions to our reserves, or at the very least to replace our production, meaning that despite our prolific output, we have not had to draw down our total reserves.… Depending on market demand, we can now produce 10 million barrels of oil daily, and easily sustain that production level for the next five decades…we have developed a range of long-term crude development scenarios that would raise our production capacity to 12 or even 15 million barrels a day.

We do not know what "a firm foundation of 260 billion barrels" means. Why would Aramco have to work hard now to identify new reserves if remaining reserves were 260 Gb? 10 million barrels per day for 50 years would be approximately 180 Gb.

Colin Campbell's assessment of these Saudi reserves: "97 Gb have been produced so far, 144 Gb will come from known fields and 18 Gb from new discovery, giving a total of 260 Gb, the number claimed as remaining reserves".

It is to be noted that IEA's estimates for daily production in 2025 assume that Saudi Arabia contributes 22.5 mb/d. There are irreconcilable differences within the Aramco statements and between these statements and the IEA assumptions.

Implications (page 27)

Quote (page 27): ***Hence, even with the dramatic increase in world oil prices, pump prices in the U.S. are still low by historic standards. Australian motorists 'benefit' from higher fuel excises that serve to buffer domestic pump prices from fluctuations in world oil prices.***

The buffer is, in fact, very small compared to Europe where fuel taxes are much higher. This is an example how the paper selectively picks out data and turns them into arguments in favour of a certain line of reasoning.

Quote (page 27): ***From a longer term policy perspective, the main issue is not so much one of the physical quantities of oil remaining, nor of the dynamic measure of oil supplies resulting from the overlay of economic factors, but of the efficient operation of the oil market and the factors that may inhibit that operation.***

The authors of the BTRE paper have not experienced the sort of physical oil shortages which occurred in other countries in the 1970s. This is the reason why the cover of this critique reminds the reader that one cannot take ever easily flowing oil for granted.

The above sentence shows that the authors of this paper, after studying all of the sources referenced, still have not understood the geological and economic reasons for the peaking of oil production and its consequences for the economy. The efficient operation of the oil market is seen here as an end in itself whereby the term "efficient" is not defined at all. The next sentence uses the term optimal, again not defined:

Is oil being depleted at an optimal rate, taking into account future estimates of supply and demand, exploration and extraction costs and technological improvements?

This view puts the actual, physical task of transition from a finite resource to a renewable energy system on its head. If there were anything like an optimal rate at which oil should be depleted then it would be a rate which allows a smooth transition to other renewable fuels/energies/transport systems.

Quote (page 27): ***"The sub-text in the Peak Theorists' argument is the view that governments should divert more taxpayer funds into alternatives to oil and into measures aimed at reducing 'oil dependency' in general because the market cannot be trusted to find the right solutions. Such intervention may take a variety of forms but generally translates into subsidies that would not normally be warranted"***

Since the authors are so much concerned about subsidies, they should first call for the removal of all direct and indirect subsidies in the use of fossil fuels, e.g. in the aviation industry, in oil & gas exploration, the use of private cars etc. These subsidies have resulted in entrenched consumption patterns, physical city structures, industrial complexes, agricultural production methods and mineral use which are all unsustainable after peak oil and which will endanger the financial stability of our economy.

If external costs, including CO_2 sequestration, were included in taxing fuels, many distortions in the current oil market would disappear. Moreover, in our present system, we are drawing our oil & gas asset accounts down to zero without replacing the consumed energy with an equivalent renewable capacity, also a market distortion. This is equivalent to a company not making provisions for depreciation, which would be considered as a fatal accountancy error. If we introduced an **energy equivalence principle** (see Appendix 20) in our non-renewable resource consumption, market forces would do the transition job to other fuels/energies smoothly since the oil price would then be something like production cost plus replacement cost plus a % profit. But unfortunately, oil prices are highly volatile, irrational and speculative because oil is basically considered to be a free commodity provided by nature.

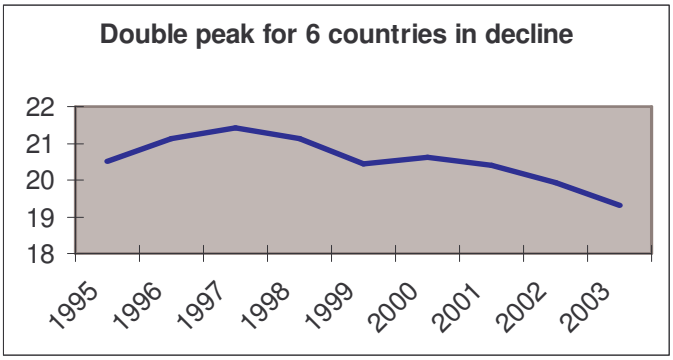
With short market vision, unequal production costs, a multi-peak production plateau and uninformed market participants constantly mindful of being manipulated, one cannot expect one-directional price signals before and during the peak which would allow a smooth and seamless transition to other fuels.

Quote (page 27): ***"However, a basic rule of government intervention is to treat market failure at its source. If, as is implied, the absence of reliable data is the source of the problem, then options for treating the problem directly (say through government action to ensure the provision of reliable data) should be explored"***

If Government waited with preparing for peak oil until data were reliable, we would see peak oil happening before that. This is clearly a bureaucratic excuse for doing nothing. Both OPEC and the US are locked into a fierce propaganda battle over oil reserves, each claiming to have more than there actually is. OPEC, with the aim to stop or delay

development of renewable energies so that later they can exploit their monopolistic market position, the US by beating up non-OPEC reserves in order to gain better bargaining power. Unfortunately, with so many doctored oil estimates around, no one really knows exactly where the world stands. In view of this situation the motivation of protagonists is indeed very important to know.

The only logical and prudent conclusion from this situation is to be on the safe side and assume only conservative oil production estimates, with any production exceeding the minimum a welcome bonus that will help to smooth the transition after peak oil.



Zoom on the production curve > 18 Gb pa for the US, Venezuela, UK, Norway, Nigeria and Indonesia

The period around the global peak is likely to be a bumpy oil production plateau rather than a pointed peak, possibly with more than one peak and intermittent growing & declining production phases stretching over a couple of years. As an example, the peaking of 6 countries is shown in the graph (left). The last of this series of peaks or the end of the plateau will be the beginning of the terminal decline, which will only be discovered after it has happened.

Quote (page 28): ***Regardless of which side of the argument policymakers find more convincing, any policy response would require sound data. If it were to be collected as a prelude to direct government intervention then arguably a case could be made to take the step of better informing the market (treating the problem at its source) before embarking on the next stage of overriding market preferences***

This is single track, sequential thinking at its best, paralyzing any attempts to manage long term energy planning. The acquisition of sound oil data from areas where it matters, the Middle East, will never happen before peak oil. There are too many strategic objectives of the main players at work here. A transparent, free and well informed oil market is wishful thinking. The authors of this paper should have learned this from the study of their sources and literature. In fact, their own paper itself is not a contribution to enlighten markets.

Quote (page 28): ***The question facing the depletionists is how much higher such prices should be to meet their expectations.***

The authors of this paper are encouraged to write to C. Campbell and ask him what he thinks how oil prices will develop in future. They will get back a reply that he is in the business of predicting oil production, not oil prices.

Quote (page 29): ***A related question is that of resource security. Welfare economists would argue that a soundly operating market is more likely to deal effectively with the timely and efficient allocation of scarce oil reserves than government planners who, in the words of one U.S. Congressional witness 'simply do not have a very good track record when it comes to the centralized allocation of resources'***

This refers to what happened in the US in the 1970s during and after the 1st and 2nd oil shocks. A centralized allocation of resources is necessary when physical shortages occur to such a degree that market forces can no longer bring supply and demand together or higher prices damage important sectors of the economy.

Preparing the economy and transport systems for peak oil is not equal to centralized allocation of resources but a strategy to retain flexibility when it happens.

Quote (page 29) from Seltzer: ***"Often ignored, however, is that the price spikes experienced in 1973, 1979, and 1990 were not caused primarily by international oil shortages… Rationing, punishing taxation, trade restrictions and political embargos – not dramatic supply cutbacks by producing nations – are what caused the price increases of those years"***

Wrong. An oil crisis is always **caused** by the peaking of oil production in a major oil producing country and the structural and geographical changes in global oil flows resulting from this peaking. We must distinguish the cause from the trigger. The 1973 OPEC oil embargo was **triggered** by the Jom Kippur war and was indeed a geo political punishment for the West. But without the previous peaking of US oil production, the embargo would not have been as effective as it was.

Quote (page 29): ***Australia is in a different position to many countries of the world in that it both wins and loses from rising world oil prices: benefiting from the resultant rise in the value of energy exports but losing through higher domestic energy prices and lower world growth than otherwise. However, the chances of a net loss would increase if governments were to embark on a program of subsidizing non-viable energy sources and thereby producing negative returns for the taxpayer"***

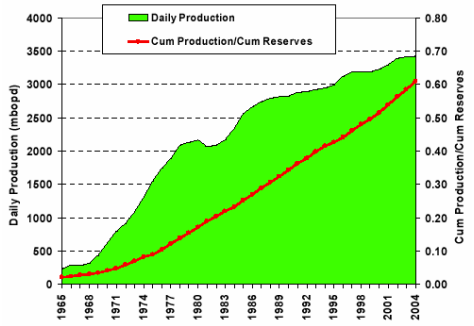
Australia's increasing oil imports are not mentioned here. The authors really should have gone into some detailed calculations before arguing verbally. Over which period would such net losses be calculated? If you took a period just up to peak oil the net losses could be the cost for preparing for peak oil. But what would be the net losses after peak oil without preparing for it? Will Australia win by exporting gas (lower prices per energy unit in long-term contracts) and using gas revenues to finance oil imports (higher prices from spot markets)? Oil and other raw materials are being used worldwide in certain ratios depending on technology. If oil production declines, so will demand for metals, for example. How will that effect Australia's mining sector? There are many unanswered questions here, which wait to be worked out by economists. But since peak oil is not on their radar, they fail to tackle the real issues.

Concluding Remarks (page 30)

Quote (page 30): ***Prices exceeded US$55 a barrel in October 2004, in response to a combination of strong and unanticipated demand growth, scarce production capacity, concerns about continuity of supplies in the event of output disruptions in key countries and jittery speculator activity. None of these factors touch on the key elements of the debate between the depletionists and the international institutions—the estimate of ultimate recoverable resources, the role of prices, and the appropriate role for the government.***

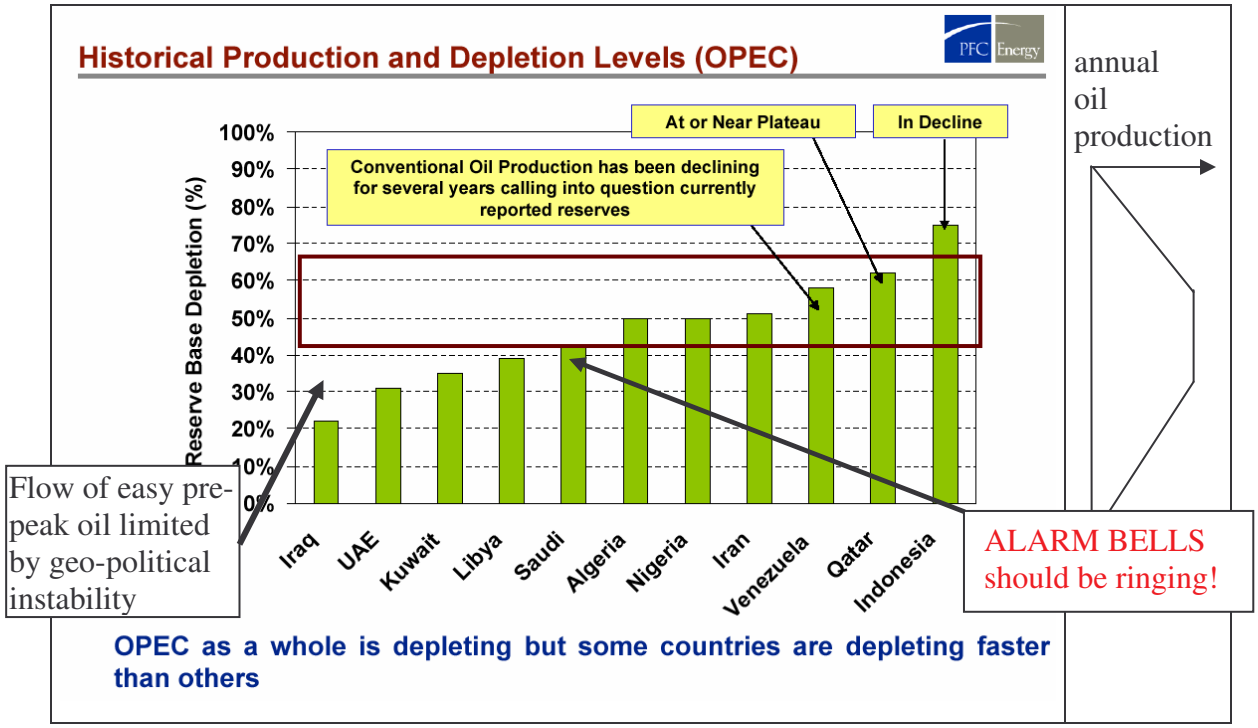
Scarce production capacity is caused by declining or stagnating oil production in many major oil supplying countries.

The strong demand from China, for example, is not only a result of the economic growth there but also because Chinese oil production is reaching a plateau:



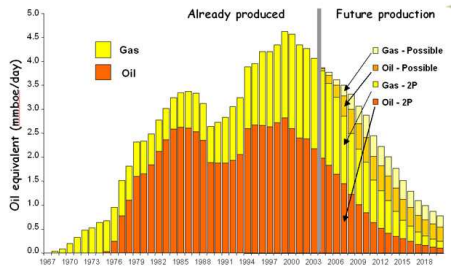
China has consumed 60% of its oil and has now reached a plateau in production. Demand for oil in 2004 is expected to be 6.3 mill. barrels/day of which only 3.45 mb/d can be supplied from Chinese oil fields.
In just 3 years, Chinese imports have doubled from 1.4 mb/d to 2.85 mb/d. **China's future growth has therefore to be fully supplied from the world oil market.** (Source: PFC Energy's forecast Sep 2004)

Saudi Arabia, which was a swing producer for many years, has apparently also reached a production plateau:

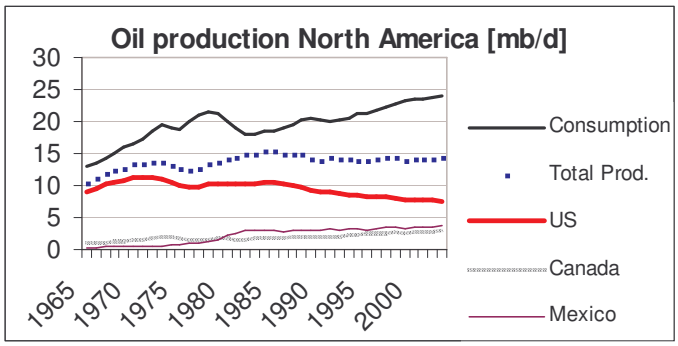


Source: www.csis.org/energy/040908_presentation.pdf
Output disruptions in Venezuela may be directly caused by temporary political problems, but the more serious issue here is that depletion levels of conventional oil production are now between 50-60%, with production declining for several years (graph, up) already. Heavy oils from Venezuela have different depletion curves which means that this oil will flow more slowly over time.

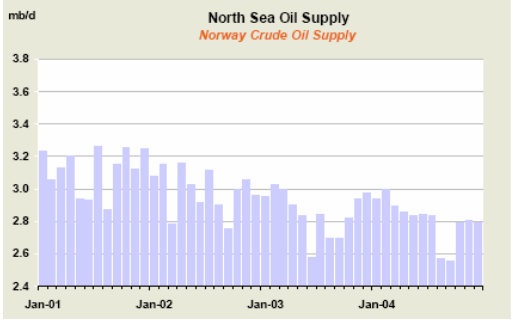
Peaking of oil production in the North Sea, North American production on a plateau:



Source: ASPO
UK's oil production peaked in 1999 (up, the dip is a result of the accident on the Alpha Piper platform), Norway's in 2002 (down). The total of the North Sea oil production has peaked.



North American oil production (US 48 + Alaska + Mexico + Canada) is on a 10 year long plateau; US 48 States peaked in 1970/71; the 2nd, lower peak in the mid 80s was from Alaska which is now producing at only half of its peak capacity. Producing oil from



Source: IEA monthly oil market report, 6/2004

the Arctic National Wildlife Refuge (estimated total of 10.7 Gb equivalent to 1.5 years US consumption) would be just another small hump on an otherwise ever declining US production curve.
Canadian tar sands will require huge amounts of natural gas (which is also short in supply) for processing. The gap between consumption and production is widening, requiring increasing imports. This cannot go on for very long.
Source of data: BP Statistical Review of World Energy 2004

Quote (page 30): ***Part of the difference in the URR estimates can be attributed to the use of different recovery factors and the inclusion of reserve growth by the international agencies when formulating their estimates. Hence, these differences stem more from differing economic and technological assumptions than from disagreements about geology.***

The USGS figure of 649Gb of undiscovered oil for the rest of the world is very much a geological difference (refer to C. Campbell's remarks on Greenland's frontier exploration)

The USGS 2000 mean estimate, compared to an earlier USGS estimate under Masters, added an all-important 612 Gb of reserve growth oil (=20 years world production) by applying the US growth factor of 44% to the known fields of the rest of the world. Reserve growth in the US results from a conservative proved reserve definition according to SEC rules where probable and possible reserve categories are converted and added to proved reserves while oil fields become better known during production. Most published reserves in the rest of the world already contain this reserve growth oil. The USGS knows about this and notes in document RG.PDF, page 4, that this reserve growth is a "numerical hypothesis" which will "perhaps act as a stimulus for discussion and research". That is why the IEA came up with the above warning. The USGS mean estimate **is too high.**

Appendix: What economists should really work on

Government must get reliable answers to 4 important questions:

(1) In which period is peak oil likely to happen?
(2) What will be the oil production decline rates after peak oil?
(3) Which action and when has Government to take to prepare our economy and in particular our transport system for permanently declining oil production? What is the critical path fur such preparations? Are there points of no return?
(4) Which risks and future costs are involved if assessments under (1) - (3) are incorrect?

The disagreements over terminology and estimation techniques, instead of confusing and demotivating policy makers, should be seen as risk factors which have to be taken into account when answering the above questions.

Economists must come out of the deadlock of a fruitless, ideological peak oil debate, do some practical number crunching in input/output tables and try answering some hard questions, for example:

- What is the critical decline rate d_{cr} at which our economy (by region and sector) starts to be damaged by declining oil production?
- What would be the cost of such damage compared to the cost of preparing for peak oil, depending on when it occurs?
- What would be the production cost and the timing of production of at least some of the 649 Gb undiscovered future oil contained in the USGS mean estimates e.g. from Greenland, 47 Gb of it, in a frontier area with drifting icebergs, 2-3 month/year drilling period and a possible development time frame of 20 years? Would the resulting oil prices and the delay in production damage our economy?
- Who will provide how much risk capital for exploration in these inhospitable areas if the private sector is not prepared to do it because the easy oil is gone?
- How will all the CBAs (cost benefit analysis) for major infrastructure projects change with peak oil? How will cash flows of infrastructure banks be affected?
- Which super annuation funds are exposed to oil dependent infrastructure and to which degree?
- The mining industry, including uranium mining, requires huge amounts of fossil fuels for processing. How will this sector be affected by declining oil production?
- The same applies to agriculture. What is the sensitivity of food prices with rising oil prices and shrinking quantities?

Which responsibility does BTRE assume to advise toll-way companies on possible peak oil timings?