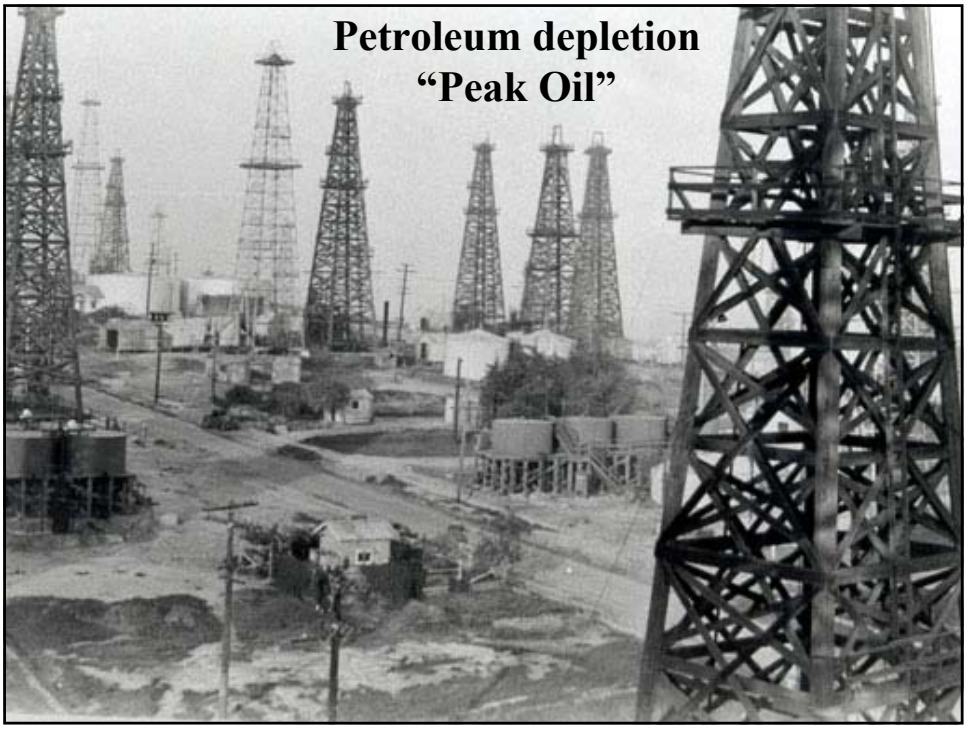
- Why me?
  - Biologist
  - Basic science training - energy
  - Humans as a species limited by resources
  - Physicists and retired petroleum geologists
  - Support from BP's Statistical Review of World Energy

- Serious consequences very possible – take out some insurance even if you are not fully convinced



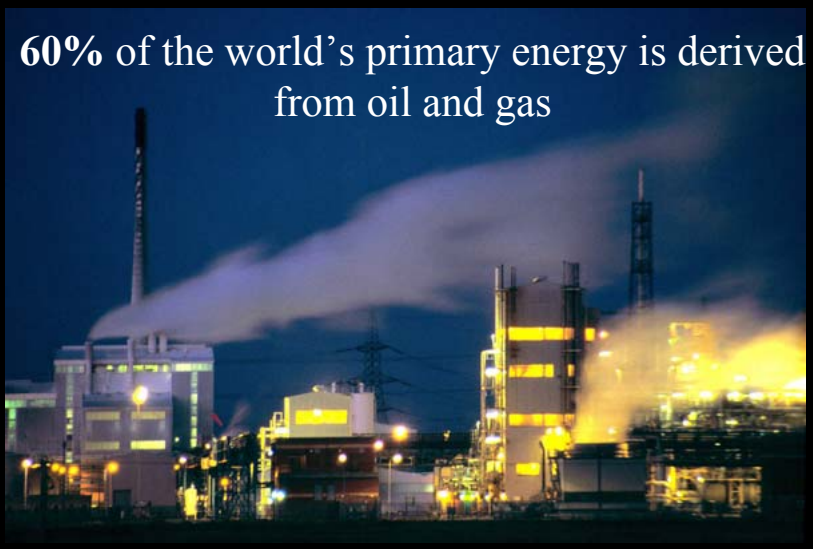
CRISIS = OPPORTUNITY!

TOPICS

- **The central and vital importance of oil in our economy/civilisation**
- **Energy in Australia's economy**
- **"Peak Oil" theory and data supporting it**
- **Australia's oil and gas situation**
- **Alternatives to oil**
- **Geopolitical considerations including food production**
- **The importance of early investment in alternative energy**
- **Refuting the arguments of the cornucopians**
- **Immediate cost-saving strategies for freight logistics from DTED**
- **Future questions and suggestions for action**

A civilization based on hydrocarbon use

60% of the world's primary energy is derived from oil and gas

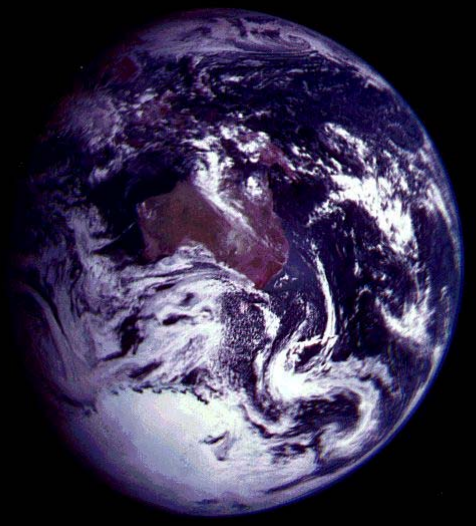


90% of transport fuel comes from oil !

90% of transport fuel comes from oil !

90% of transport fuel comes from oil !

Globalisation is based on cheap transport



Cheap transport is based on cheap oil

Oil is the feedstock for most plastics and pharmaceuticals

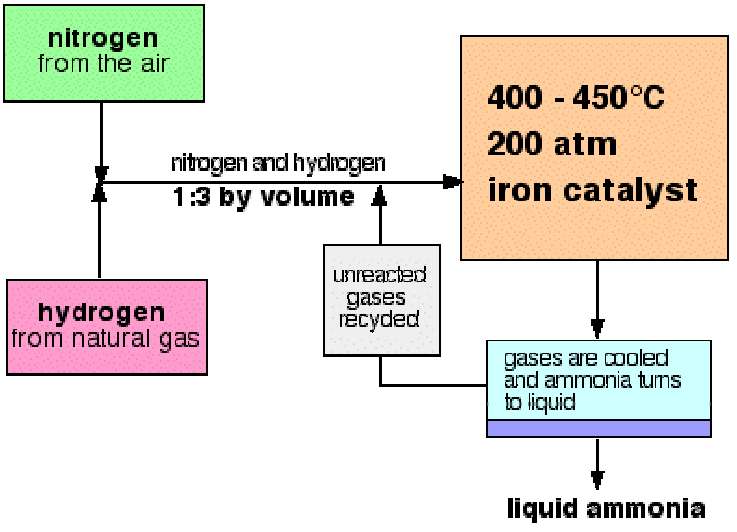
The Haber-Bosch Process

$$N_2 + 3H_2 \leftrightarrow 2NH_3$$

Nitrogen + Hydrogen ↔ Ammonia

One third of the protein in your bodies is derived from nitrogenous fertilizer made using this process.

The Haber-Bosch Process
It keeps >2 billion people alive



From http://www.chemguide.co.uk/physical/equilibria/haber.html

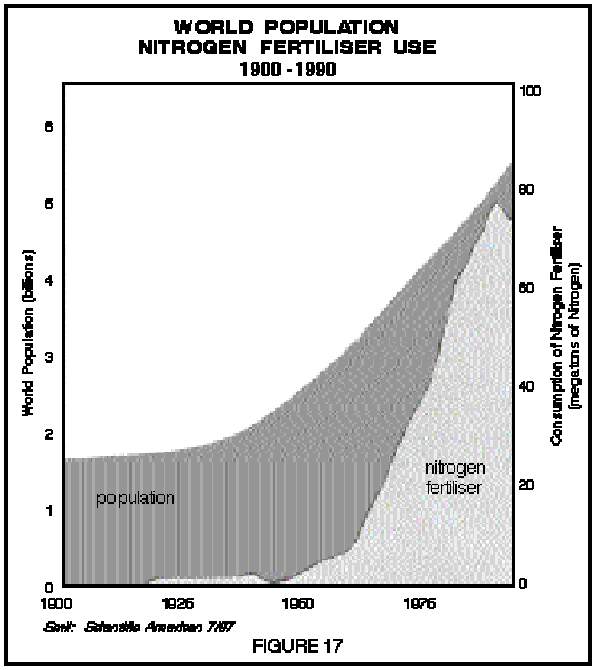


FIGURE 17

The use of nitrogenous fertilizer has allowed the world's population to boom.

Earth's pre-oil human carrying capacity is estimated to be less than 2 billion people.

1 kg of oil is needed to produce every kg of food !

i.e. 10 calories of oil energy are needed to produce 1 calorie of food energy !

"In the United States, 400 gallons of oil equivalents [~ 9.5 barrels or 1,500 litres] are expended annually to feed each American (as of data provided in 1994). Agricultural energy consumption is broken down as follows:

- 31% for the manufacture of inorganic fertilizer
- 19% for the operation of field machinery
- 16% for transportation
- 13% for irrigation
- 8% for raising livestock (not including livestock feed)
- 5% for crop drying
- 5% for pesticide production
- 8% miscellaneous

Energy costs for packaging, refrigeration, transportation to retail outlets, and household cooking are not considered in these figures."

Australia's Energy Use (from Fuel Taxation Inquiry)

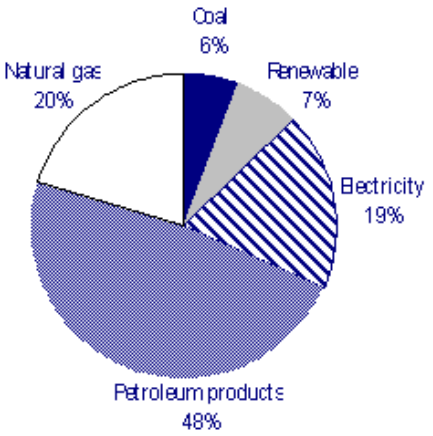
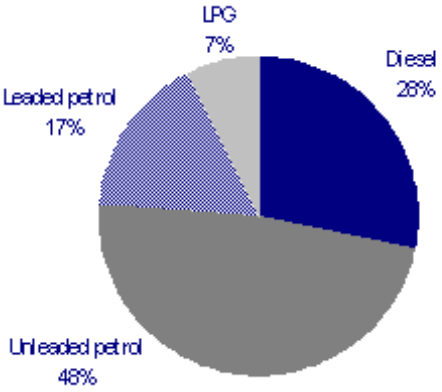


Chart 4.2: Contribution to energy use by final consumers by fuel type 1997/8

Oil is nearly 50% of energy use. Oil and gas together are nearly 70%

Fuel types used by transport sector in Australia



From Chart 4.3: Contribution to energy use by fuel type and sector, 1998-99

LPG is only 7%. Diesel is 28%

"Australia is a trading nation remote from most markets. It has a small population, long internal transport networks and is the third largest per capita consumer of oil after Canada and the USA. …

Transport consumes 26% of primary energy in Australia and 36% of end use energy. Nearly 80% is used by road transport and 11% by aviation (ABARE 1997. p.44). Two-thirds of road transport fuel is used by passenger vehicles, the remainder by freight vehicles, buses and motor cycles. 70 per cent of vehicle kilometres is travelled in urban areas (Austroads 1994, pp. 27-8)."

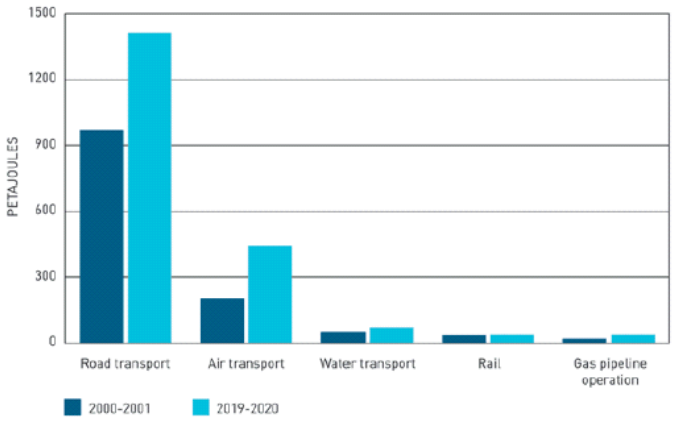
Fleay 1998

"In the UK, where JIT [Just-In-Time] involves more deliveries being made in smaller vehicles not filled to capacity, transport costs were found to be over twice those of conventional logistics. In W.A. road freight diesel fuel use rose by 17% from … 1984 to … 1994 while freight movement increased from 8,000 to 14,000 million tonne-kilometres. The considerable improvement in fuel efficiency of trucks over the same time has masked the real increase in diesel fuel use … due to JIT. In 1994 Westrail fuel use was … nearly five times more fuel efficient than heavy road transport (Select Committee 1996, p. 33 & 56).

Fleay 1998

Forecast Transport Energy Consumption Growth for Australia

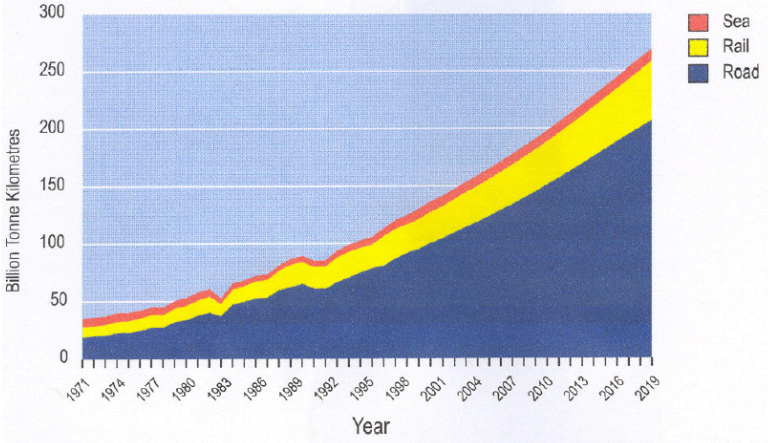
Source: Energy White Paper 2004



Non-bulk freight 1970-2020 (Australia)

Source: AusLink White Paper 2004

Figure 3 Total non-bulk freight by mode, 1970–2020



South Australian Transport – points to note.

South Australia is an export-driven economy so transport is critical (SA exports 2.16 x what it imports.)

Some important exports and methods:

How many of these exports would still be competitive if transport costs increased many fold?

Wine – by sea

Fish – on ice by air and frozen by sea

Electronics - by air and sea (but what imported components are required in the manufacturing supply chain?)

Exported meat – by sea live or frozen

Automotive industry – by sea to Middle East and components by road/rail to Melbourne

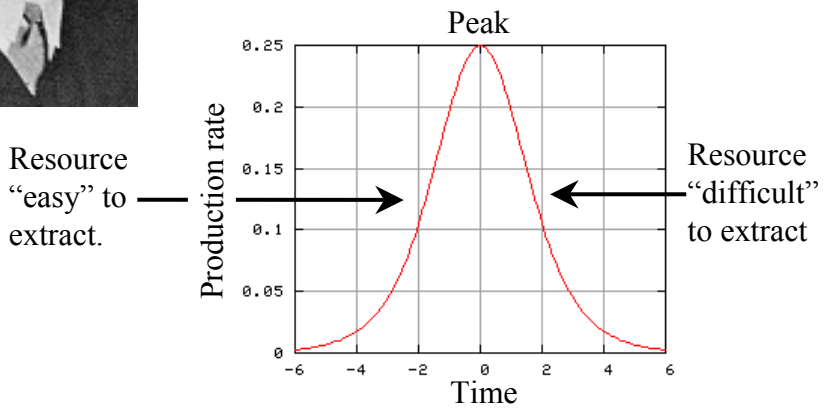
M. King Hubbert 1903-1989
Geophysicist for Shell and the
US Geological Survey

A temperamental genius:

"That Hubbert is a bastard,
but at least he's *our* bastard!"

(Shell colleagues)

Hubbert's great insight – utilization of a resource approximates a bell-shaped curve. This can be used to predict the moment of peak production and the final amount recoverable.



In 1956 Hubbert correctly predicted the peaking of US oil production in 1970 and its decline thereafter.

He was ridiculed during the 1960s but later vindicated.

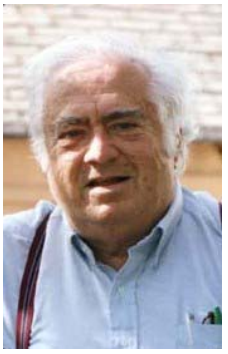
Oil production from the "lower 48" states is now less than half that of the 1970 peak.

In the mid-1990's a number of "oilmen academics" began to warn of an impending peak in world oil production.

Dr.
Colin Campbell
Petroleum geologist with BP, Texaco, Fina, Amoco and consultant to Shell and Esso.

Matt Simmons
Chairman of Simmons and Co International
Energy investment banker and advisor to President Bush on energy policy

Prof.
Kjell Aleklett
Physicist at Uppsala University Sweden
Head, Uppsala Hydrocarbon Depletion Study Group

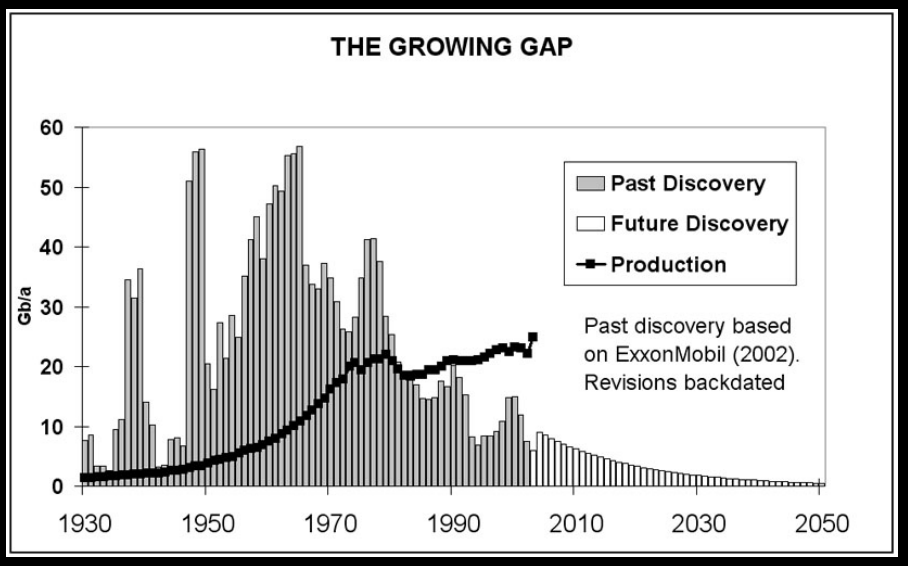


Prof.
Ken Deffeyes
Geologist at Princeton Uni and for Shell Oil
Worked with M.King Hubbert

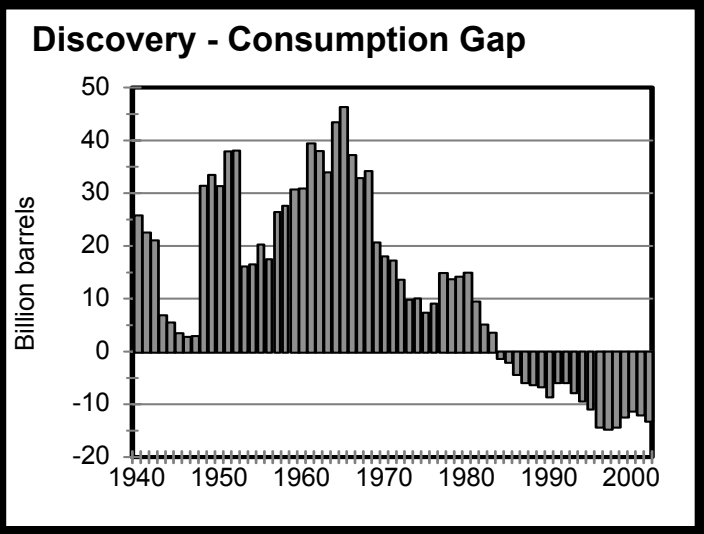
SIMMONS & COMPANY INTERNATIONAL

Simmons & Company International is the only independent investment bank specializing in the entire spectrum of the energy industry. Founded in 1974, the firm has acted as financial advisor in nearly $62.8 billion of transactions, including 385 merger and acquisition transactions worth $49.3 billion. Simmons has served as co-manager on more than $10.2 billion in public debt and equity offerings. The firm's clients range from small, privately held companies to multi-billion dollar public entities.

How do you introduce "peak oil"?



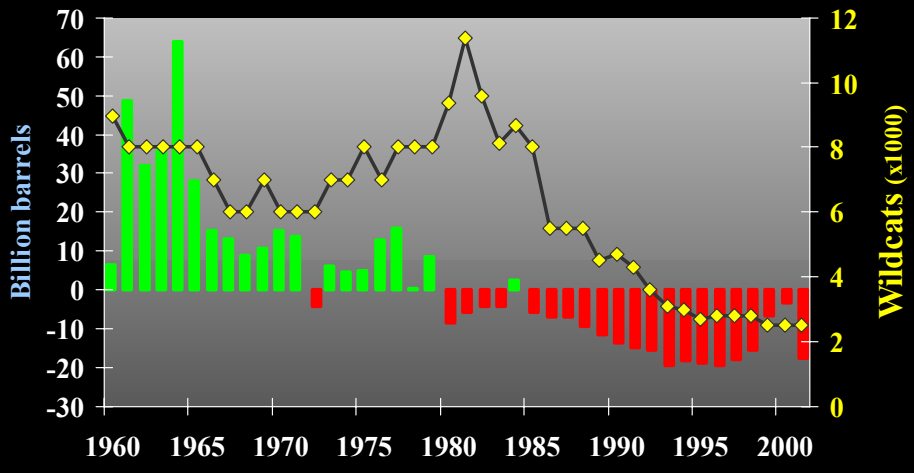
Petroleum discovery tends to precede maximum production by approximately 30 years.



Aleklett and Campbell 2003

We now consume 4 barrels of oil for every 1 barrel we find!

Drilling more does not help. Why?



From Colin Campbell

Most of the world's oil production comes from a small number of large oil fields discovered 40+ years ago!

Of the 40,000 oil fields *some 360 ageing giant-sized ones that held > 500 million barrels (80 GL) of recoverable oil on initial discovery, supply 60 per cent of crude oil at low cost. 120 giants supply nearly 50 per cent, 14 supply 20 per cent, while FOUR super giants supply 11 per cent!* Crude oil supply is heavily skewed to a small number of large oil fields (Simmons 2002).

Giant fields are usually found first when exploring an area.
They are getting harder to find

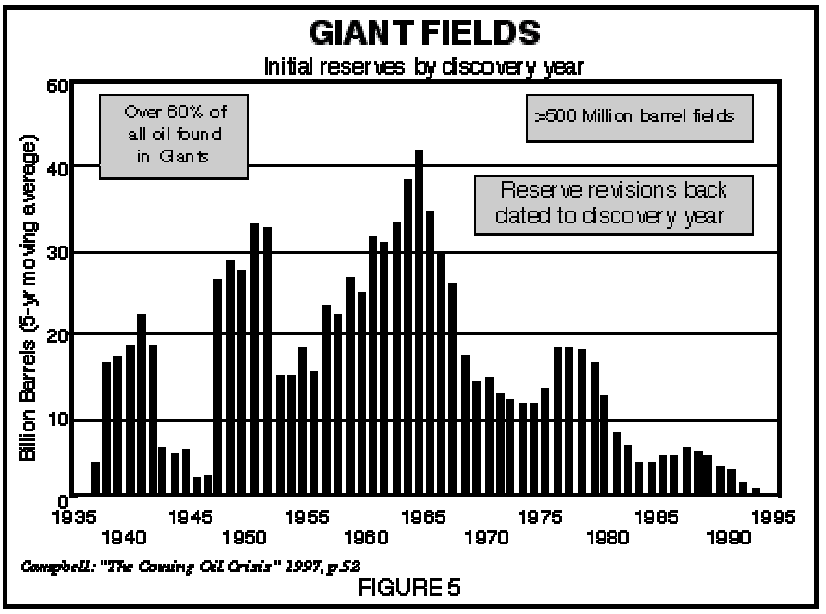


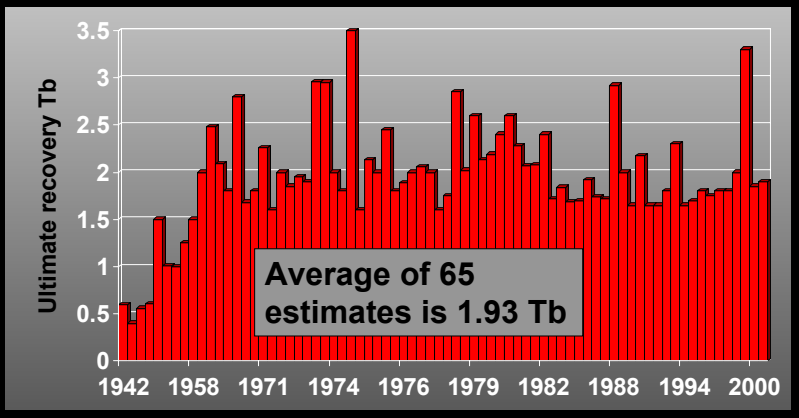
FIGURE 5

How much oil is there in the world that can be extracted?

We now know quite well what geology is required for oil production and the world has been fairly thoroughly prospected.

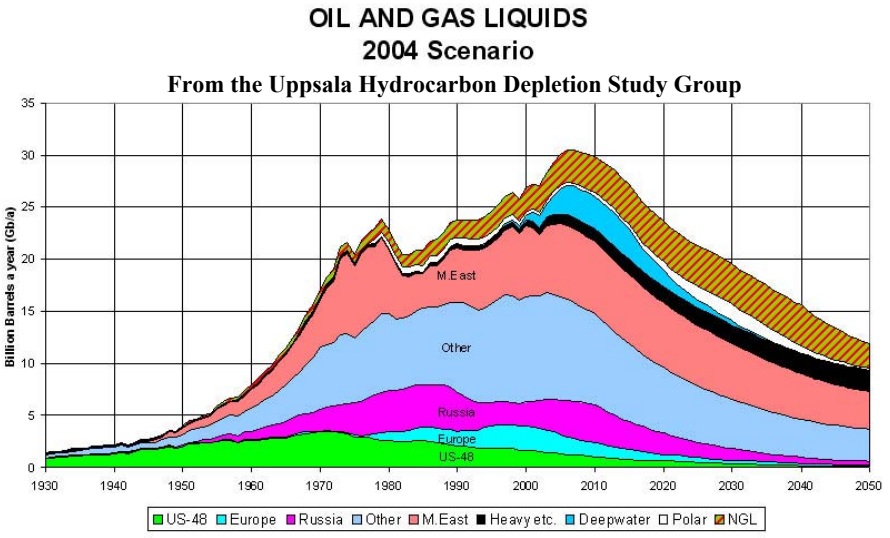
The remaining oil recoverable can be estimated by examining reserves or by statistical projections.

Examining reserves:



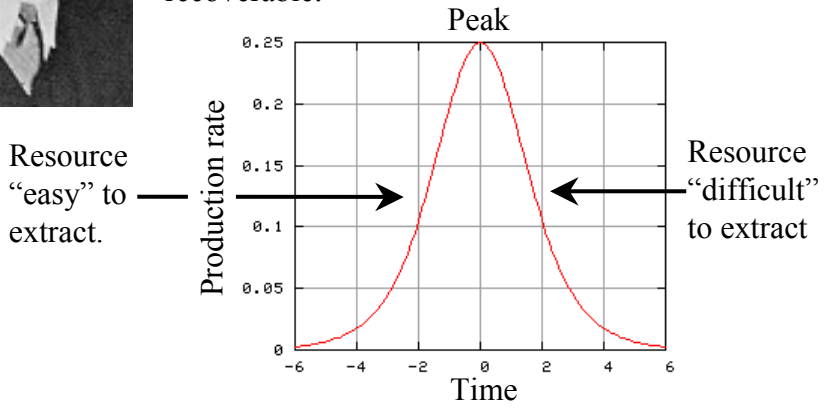
1.85 trillion barrels

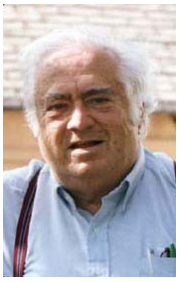
Our estimate is 1.85 Tb (trillion barrels) [Campbell, "The Truth About Oil" powerpoint presentations, 2003]

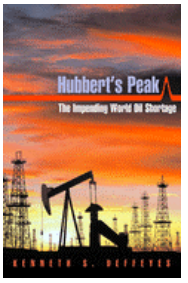


Oil peak is 2004/5
Natural gas peak is in 2020-25
All oil and gas liquids peak is 2007/8

Amazingly, the total amount of oil recoverable in the world can also be estimated by analysing the rate of production. This was Hubbert's great insight – utilization of a resource follows a bell-shaped curve and this can be used to predict the moment of peak production and the final amount recoverable.

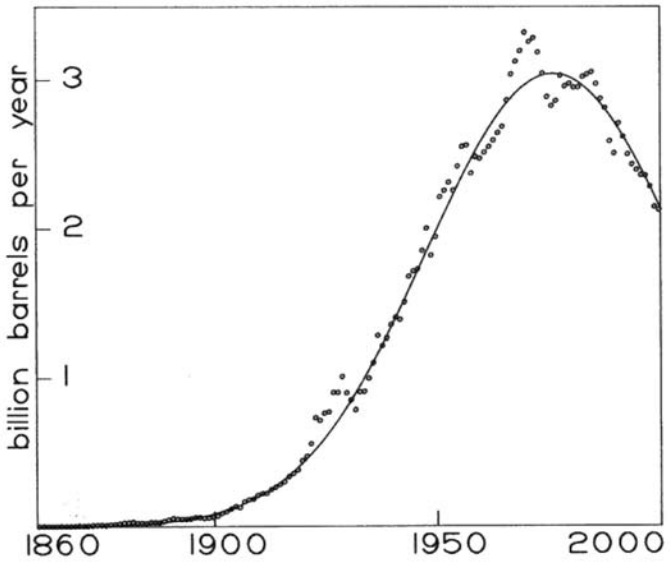






The three commonly used bell-shaped distributions, plotted with the same total area under the curve and with the same width at half the maximum height. The Gaussian distribution (solid line) is slightly wider near the peak but is much narrower on the flanks.

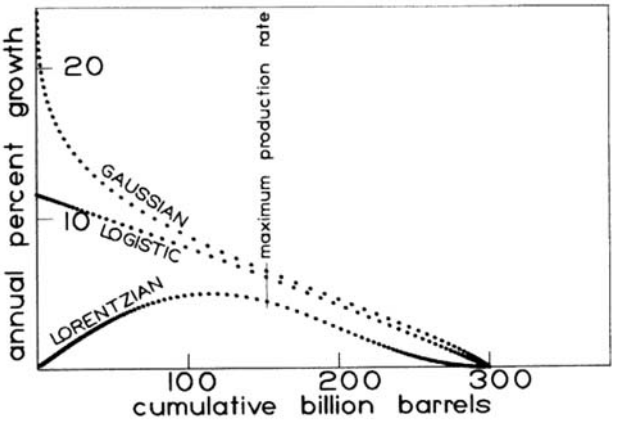
From Ken Deffeyes Hubberts Peak – The Impending World Oil Shortage



Note:
Quite a smooth curve despite the impact of two World Wars and the Great Depression!

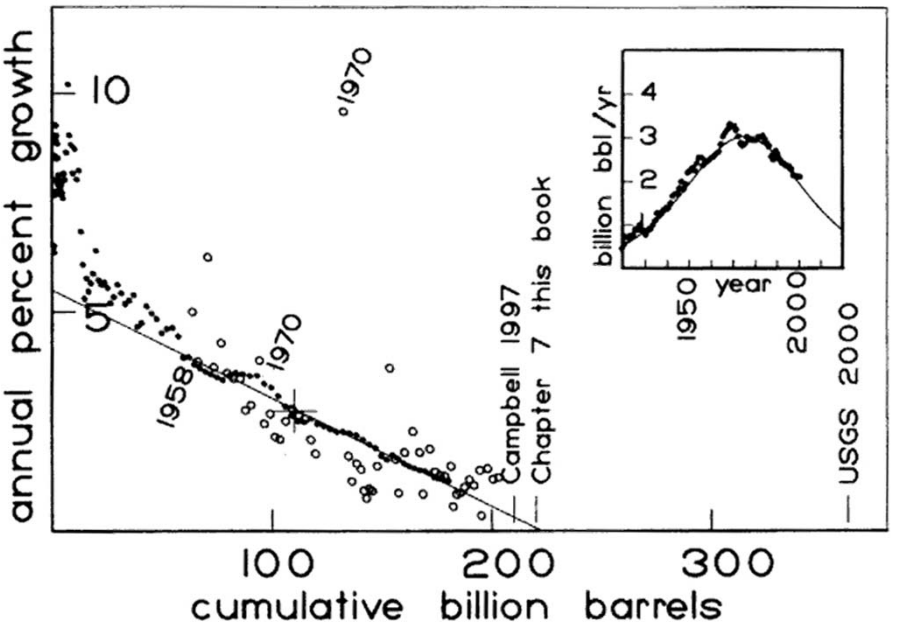
Annual production of U.S. crude oil (circles) with the best-fitting Gaussian curve superimposed as a solid line. Production from Alaska and from offshore oil fields is included.

From Ken Deffeyes Hubberts Peak – The Impending World Oil Shortage

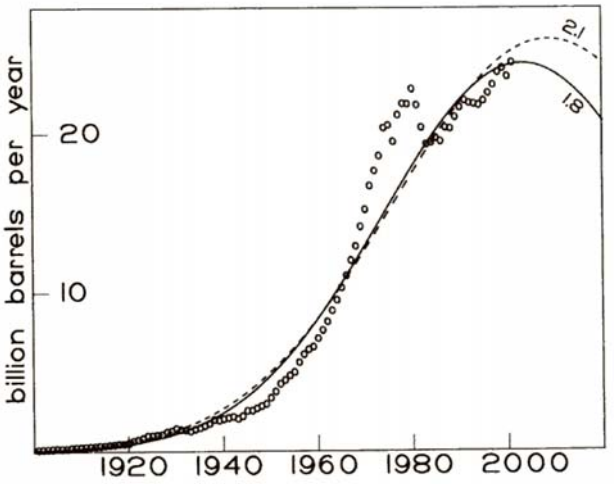


On a growth rate versus cumulative graph, a Gaussian curve lies reasonably close to the straight logistic line through the latter part of its history. However, on the left the Gaussian curve is well above the logistic. The U.S. and the world oil production histories have the same feature, suggesting that at least their initial years are close to Gaussian. The Lorentzian history has a bump in the center, which does not match any of the actual production histories examined to date.

From Ken Deffeyes Hubberts Peak – The Impending World Oil Shortage

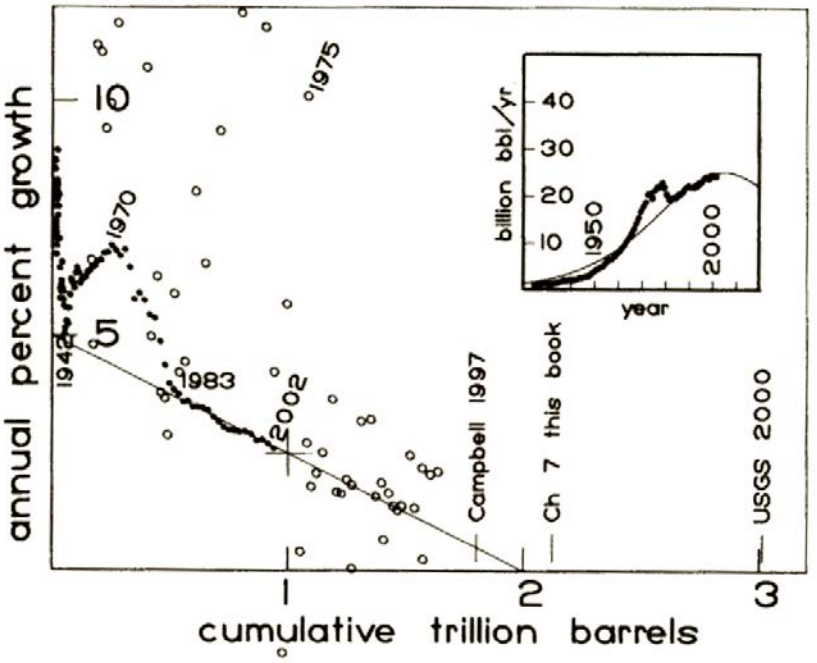


From Ken Deffeyes Hubberts Peak – The Impending World Oil Shortage

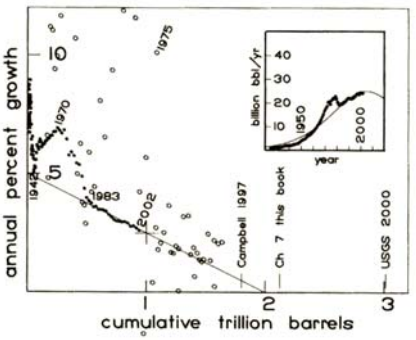


Annual production of world oil (circles), with Gaussian curves corresponding to total eventual oil recovery of 1.8 and 2.1 trillion barrels. A steeper rising curve with its top chopped off by market limitations would make a better fit.

From Ken Deffeyes Hubberts Peak – The Impending World Oil Shortage

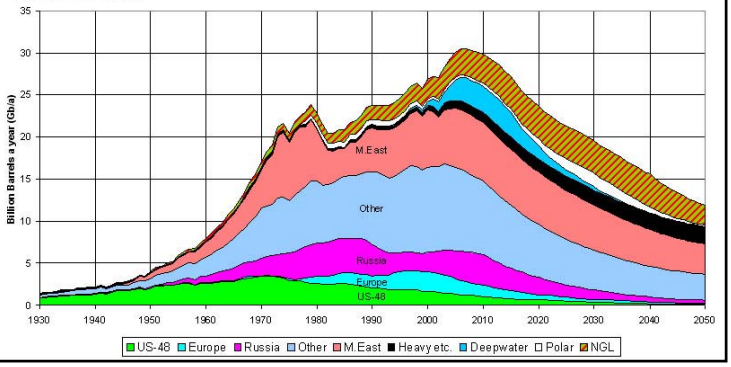


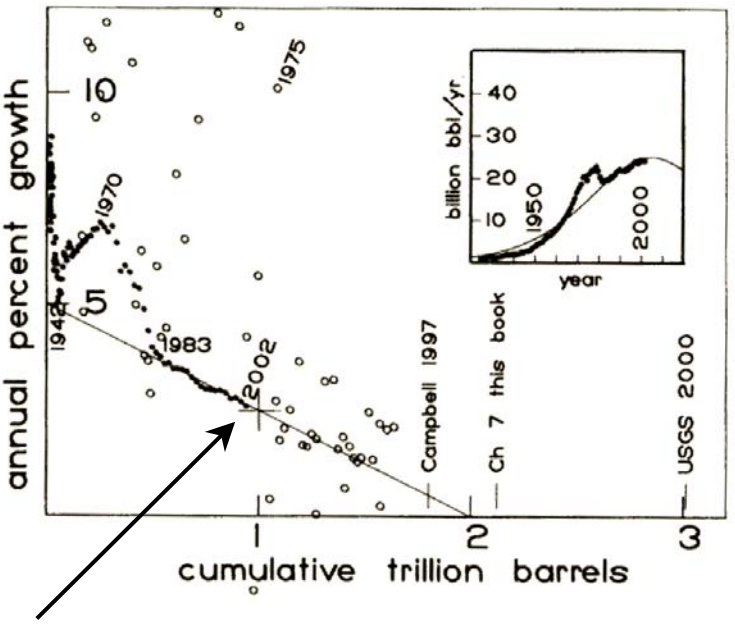
From Ken Deffeyes Hubberts Peak – The Impending World Oil Shortage



Two largely independent methods for estimating the world's total recoverable liquid hydrocarbon reserves give the same result. Total recovered will be close to 2 trillion barrels.

OIL AND GAS LIQUIDS
2004 Scenario





We have produced nearly <u>1 trillion barrels</u> = half = time for peak!

So, we have nearly used up half of all the oil we will ever extract. However, there is another problem. The most important thing is not how much oil there is but how much NET ENERGY it will yield. Net energy depends on the <u>Energy Profit Ratio</u>: EROEI (also called EPR or "payback")

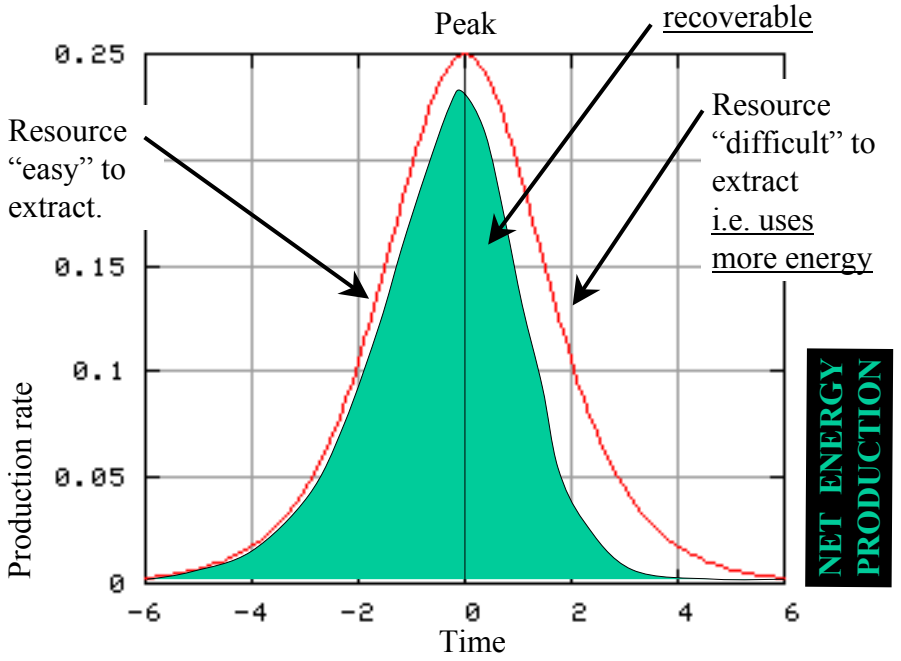
Energy
Returned
On
Energy
Invested

Must be >1 or energy extraction cannot happen (without a subsidy)

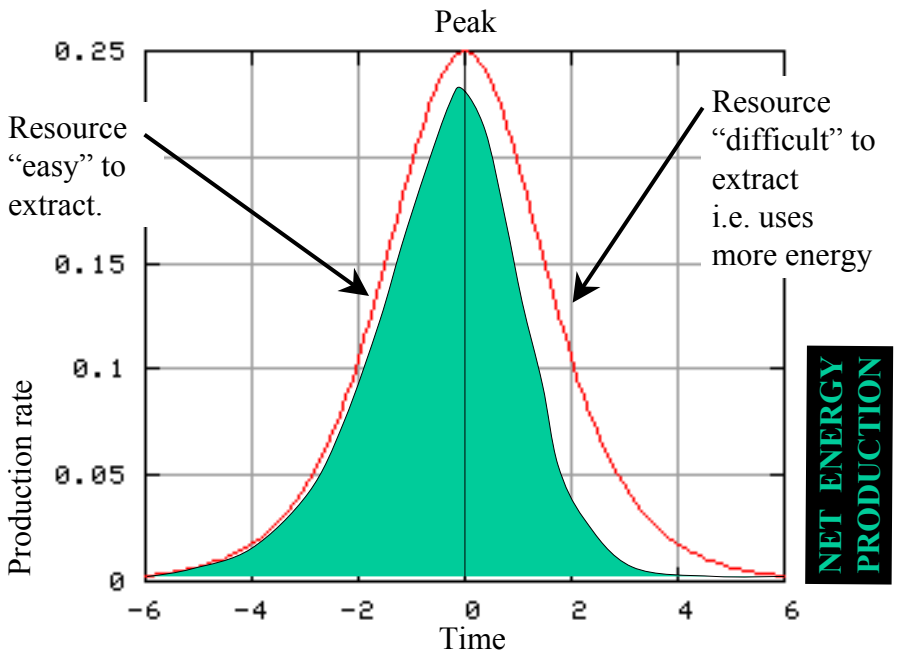
(Energy Returned) – (Energy Invested) = Net Energy

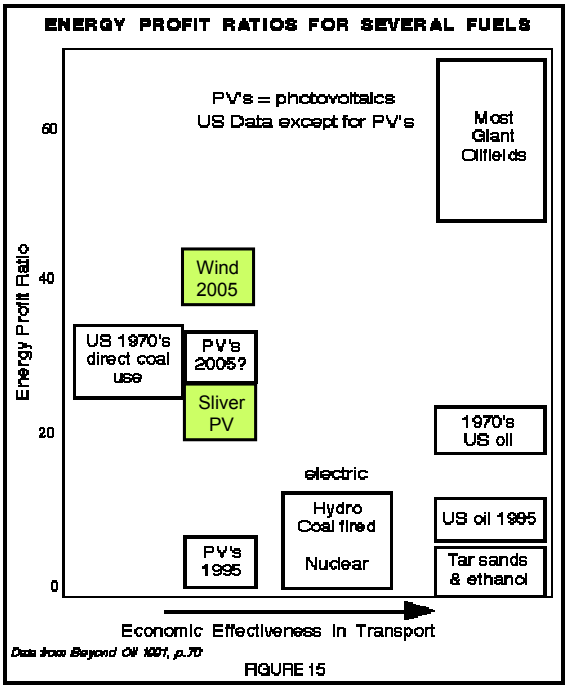
i.e. Like money, you need to spend energy to make energy – but it is simply NOT POSSIBLE to spend more than energy you can make! "EROEI" will be the defining acronym of the 21st Century!

When you are at peak, you have used more than half the net energy recoverable



This is why we will never extract all the oil that exists in the world





"EROEI" or "EPR"

Fleay 1998

What about Australia's oil?

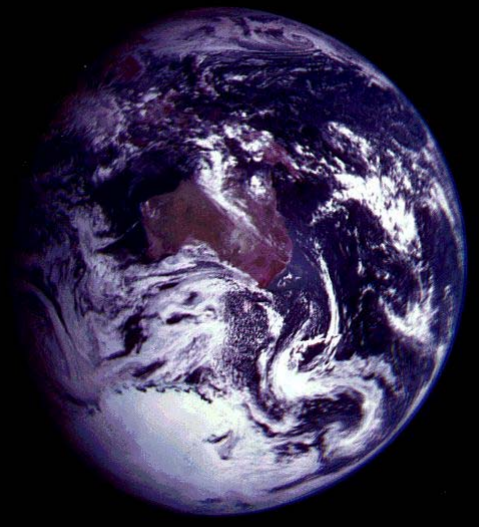
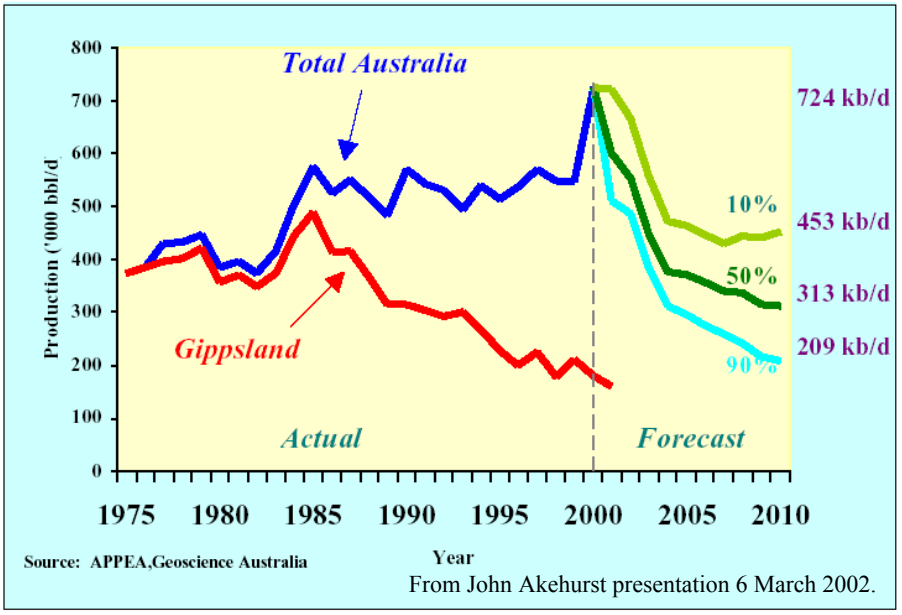


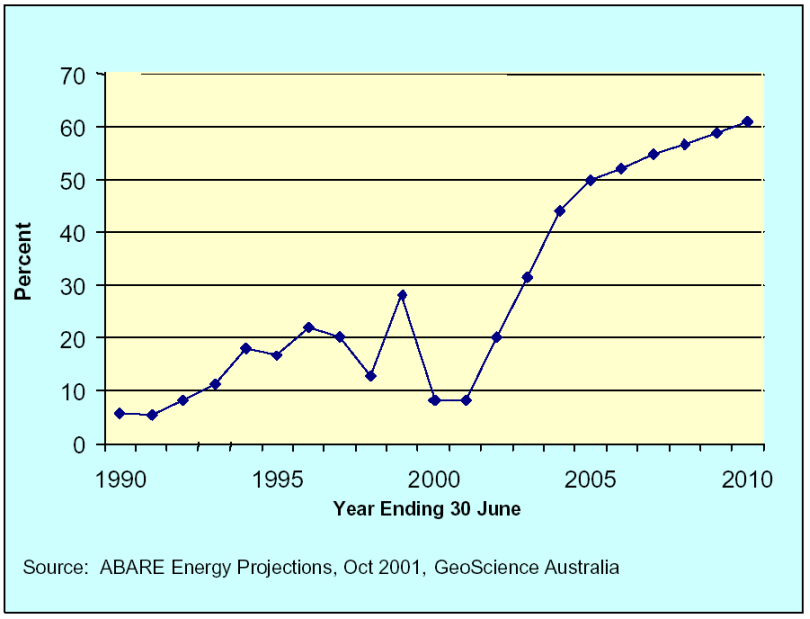
Figure 2: Australian Oil and Condensate Production



Source: APPEA,Geoscience Australia

From John Akehurst presentation 6 March 2002.

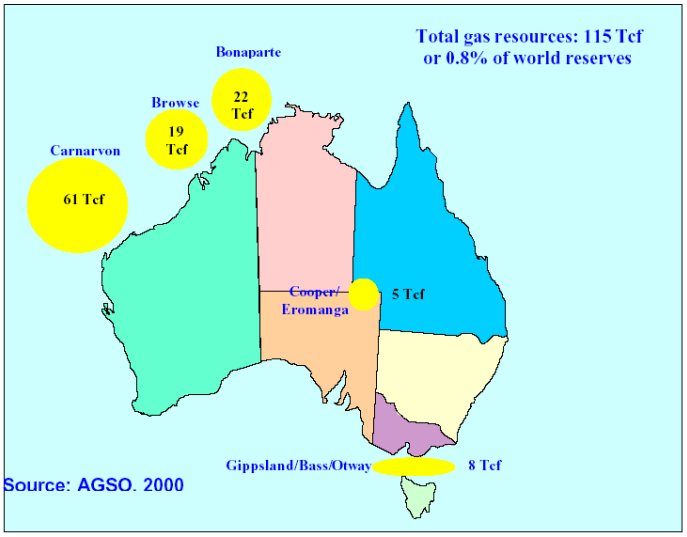
Australia – increasing dependence on oil imports



Source: ABARE Energy Projections, Oct 2001, GeoScience Australia

Figure 8: Australian Gas Resources

From John Akehurst – ABARE Outlook 2002

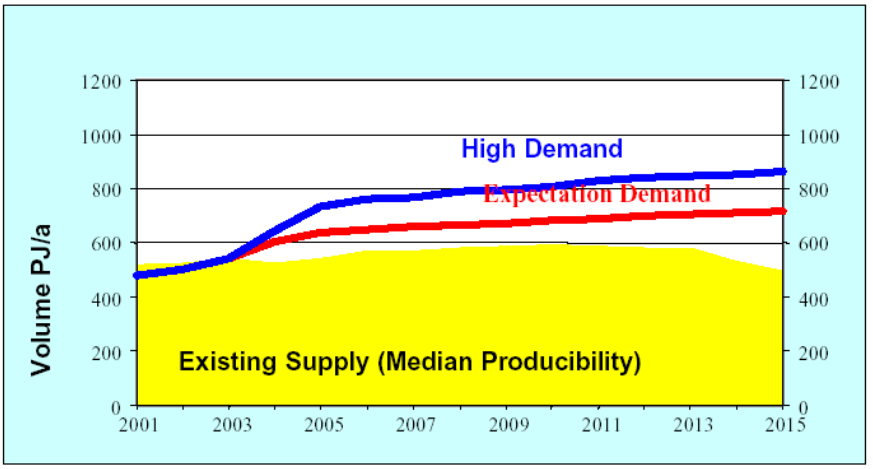


Australia's Natural Gas

However, greater use of gas will require substantially more investment in gas production and pipeline infrastructure. Without such investment, south eastern Australian gas markets will, within a few years, face possible gas shortages. Major consumers will find it more difficult to secure long term supply contracts on sufficiently competitive terms (see Figure 9).

Eastern states could soon face gas shortages

Figure 9: Eastern States Domestic Gas Market (Qld, NWS, SA, Vic)
Existing Gas Supply Vs Forecast Demand



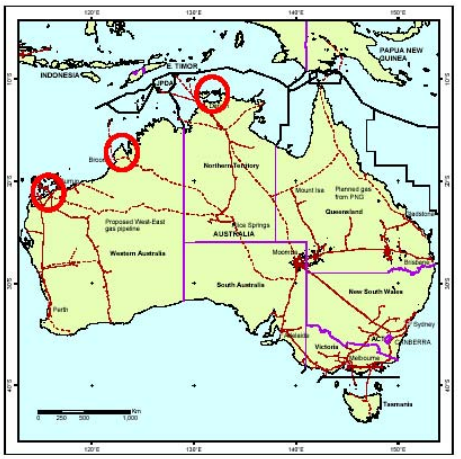
From John Akehurst – ABARE Outlook 2002

Delivering Gas to Eastern Australia

Total Capex

- **Burrup to Moomba** A$3,200 Million (2,900 km)
- **Broome to Moomba** A$2,700 Million (2,300 km)
- **Darwin to Moomba** A$2,300 Million (2,200 km)

Tariffs assume 10% real pre-tax IRR; 30 year life; initial 30" diameter.



Wood Mackenzie

energy@woodmac.com
www.woodmac.com

Extract from "WA & NT Bounty or Bounded?" a Wood Mackenzie Study (completed June 2004)

Some alternatives – but all have severe drawbacks

Natural Gas (temporary solution and price will rise as oil availability decreases).

"Natural gas can be used in modified petrol and diesel engines, but the highest efficiency is obtained from engines specifically designed to use natural gas. Direct injection of CNG into engine cylinders with precision combustion control by computer is now a maturing technology for conversion of diesel engines to gas without loss of power or efficiency.

Emissions from gas powered engines are less polluting than from diesel. However, pressure vessels are needed for fuel tanks and these are heavier and two to three times larger than those for liquid fuels for the same trip range, a problem most acute for small vehicles. The absence of extensive fuel distribution networks is a barrier to widespread use of natural gas and other alternative fuels for vehicles.

Diesel shortages could develop in Australia by the middle of next decade [i.e. around 2005], as discussed earlier. Diesel powered transport fleets should begin converting to gas now. Gas is critical in Australia as a bridging fuel for adapting transport and agriculture to an era "beyond petroleum"." (Fleay 1998)

Some "alternatives" – but all have severe drawbacks

Hybrid vehicles – an intermediate solution but high-tech and expensive

Fuel Cells – Hi-tech but promise much greater efficiency of hydrocarbon use

Electricity – For short distance transport. Scarcity of battery materials may limit worldwide replacement of motor fleet.

BioDiesel – Low EROEI and could only replace a fraction of oil use. Maybe farmers can produce locally for own use.

Ethanol – Conversion of Australia's entire wheat crop to alcohol would only replace 15% of Australian oil consumption (Fleay 1998). And this would not be possible anyway because the EROEI is barely >1. (Current ethanol production has huge energy subsidy)

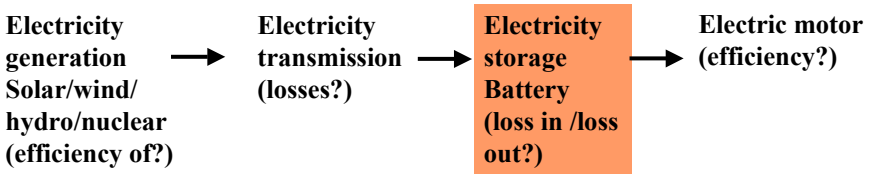
Coal Liquefaction – EROEI <8 (Fleay 1998) and would produce huge amounts of greenhouse gas.

Some alternatives – but all have severe drawbacks

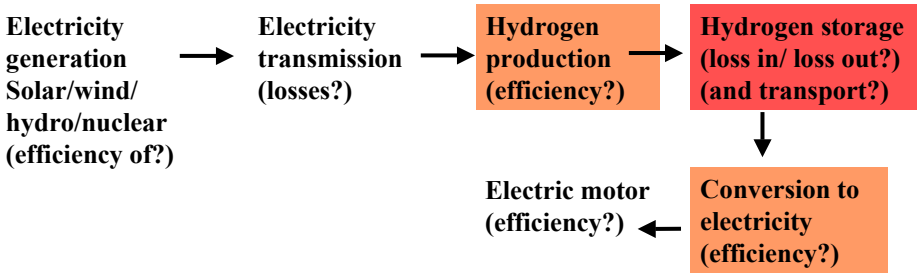
Hydrogen – Not an energy source. Can be produced from Natural Gas (relatively inefficient) or by electrolysis of water. Low energy density and storage is a problem. Low EROEI (Can be <1). Better to put electricity directly into a battery to drive an electric motor (see next slide).

The current popularity of the possibility of a "hydrogen economy" is based on the idea that hydrogen use does not produce CO_2. However, this is only really true if hydrogen is produced by electrolysis of water using electricity from nuclear, wind or solar power.

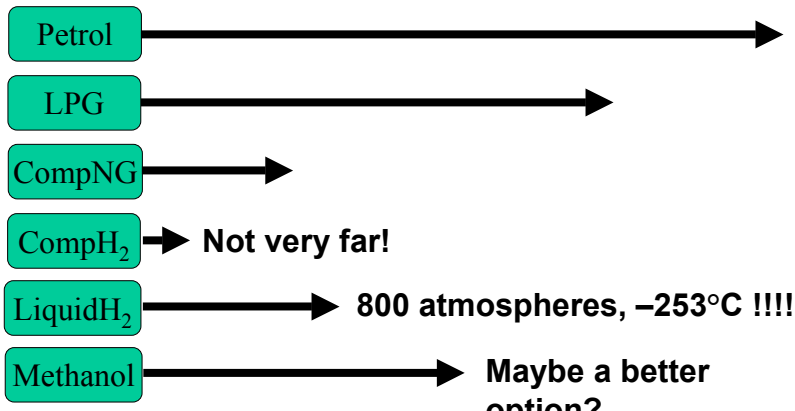
Battery driven car (lower tech)



Hydrogen-driven car (higher tech)



How far on a tank…



There are MORE H_2 atoms in a litre of water than in a litre of liquid H_2
Even more in a litre of petrol…. Hence its high energy density

(Courtesy of Mike Stasse, 2003)

Hydrogen for aviation (Fleay 1998):

"Commercial aviation is most vulnerable to the coming decline of conventional oil, the transport mode least able to adapt. Liquid hydrogen is the best alternative on the horizon. It has a heat of combustion per kilogram three times that of jet fuel but occupies four times the volume. Cryogenic fuel tanks constructed to rigorous safety standards are required, most likely located in the fuselage ceiling. A new generation of aircraft and engines is required.

Deutsche Airbus and the Tupolev design bureau have successfully flown an airliner with one engine modified to burn natural gas or hydrogen. Boeing has examined modifying the 747 to run on hydrogen and concluded that such a plane would have a 24% lower take-off weight. It could operate at higher altitudes, would require less runway and produce less noise (Cadwallader & Donovan 1996).

Introduction of hydrogen powered airliners would take 20 years, given the 25 year life of commercial aircraft and the lead time for new designs. Investment of billions of dollars would be required in a high risk commercial venture. Furthermore, a substantial investment in hydrogen manufacture, storage and fuelling systems would be required at major airports. Substantial electric power capacity would be needed for the electrolysis of water to produce the hydrogen (Cadwallader & Donovan 1996)."

Some geopolitical considerations:
Probable future international conflict over oil supplies – Middle East holds 65% of the world's oil reserves and 32% of gas reserves (Institute of Petroleum, UK) but is highly unstable. The Iraq conflict shows that the USA cannot secure oil supplies by military force. (The USA has strategic military bases near many oil supply lines.)

Russia does not currently supply the USA directly with oil. Yukos was the only company contemplating this. The prosecution of Yukos by the Russian government may be seen as a "renationalisation" of oil resources. Russia is a future supplier of oil and gas to China, Japan and Europe and will play a powerful geopolitical role in this century.

Japan has a huge LNG tanker fleet and military. Japan and Germany are investing very heavily in renewables e.g. photovoltaic cells.

Dick Cheney as Chairman of Haliburton.
Speech at London Institute of Petroleum Autumn lunch in 1999

"For the world as a whole, oil companies are expected to keep finding and developing enough oil to offset our 71 million plus barrel a day of oil depletion, but also to meet new demand. **By some estimates there will be an average of 2% annual growth in global oil demand over the years ahead along with conservatively a 3% natural decline in production from existing reserves. That means by 2010 we will need on the order of an additional 50 million barrels a day. [i.e. 121 Mb/d]** So where is the oil going to come from? Governments and the national oil companies are obviously in control of about ninety per cent of the assets. **Oil remains fundamentally a government business. While many regions of the world offer great oil opportunities, the Middle East with two thirds of the world's oil and the lowest cost, is still where the prize ultimately lies. Even though companies are anxious for greater access there, progress continues to be slow.**"

(World prod. now = 81 Mb/d. 121Mb/d is a 49% increase = 5 x Saudi Arabia)

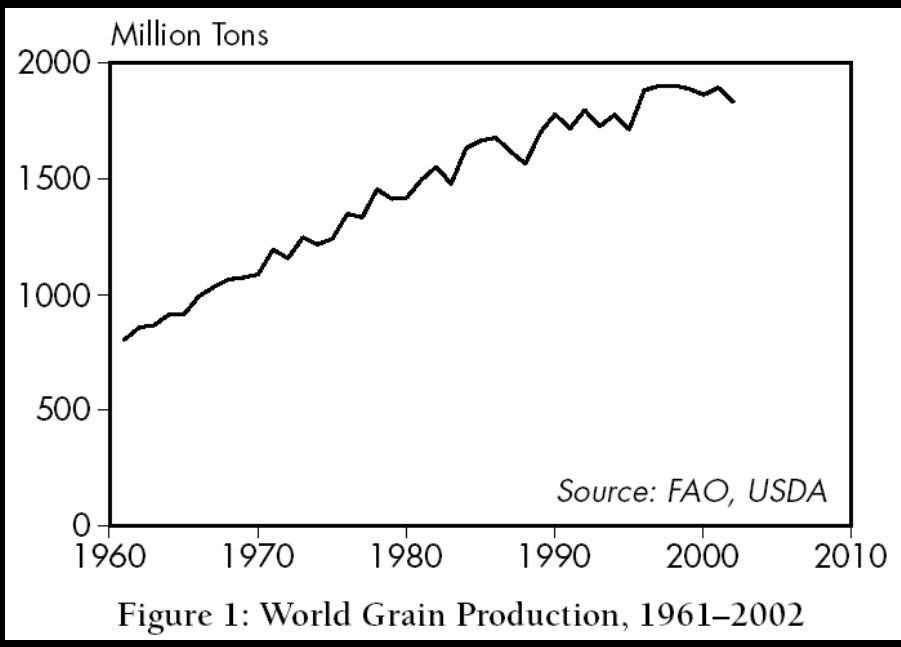


Figure 1: World Grain Production, 1961–2002

Word Watch Vital Statistics 2003

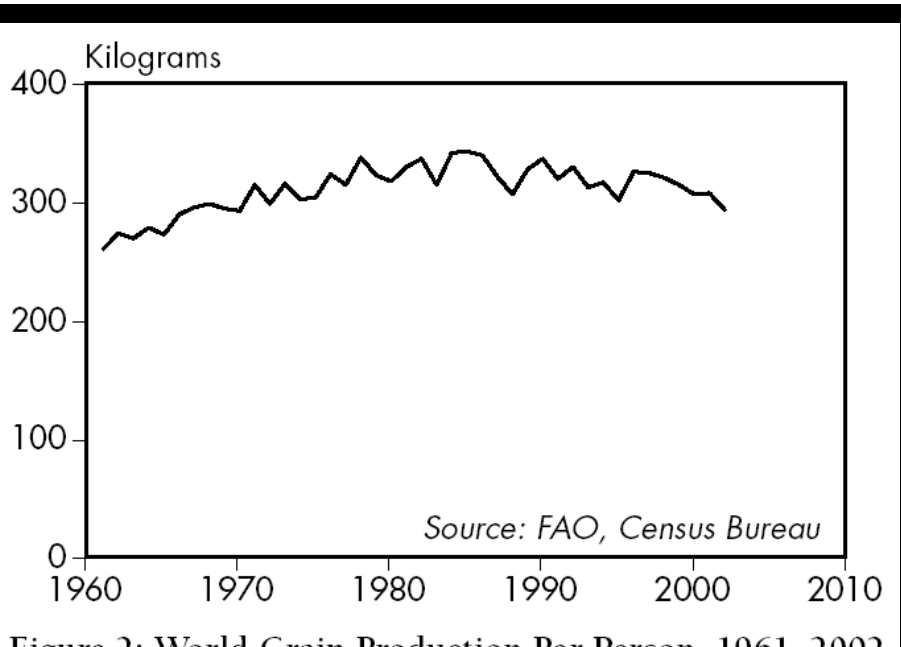


Figure 2: World Grain Production Per Person, 1961–2002

Word Watch Vital Statistics 2003

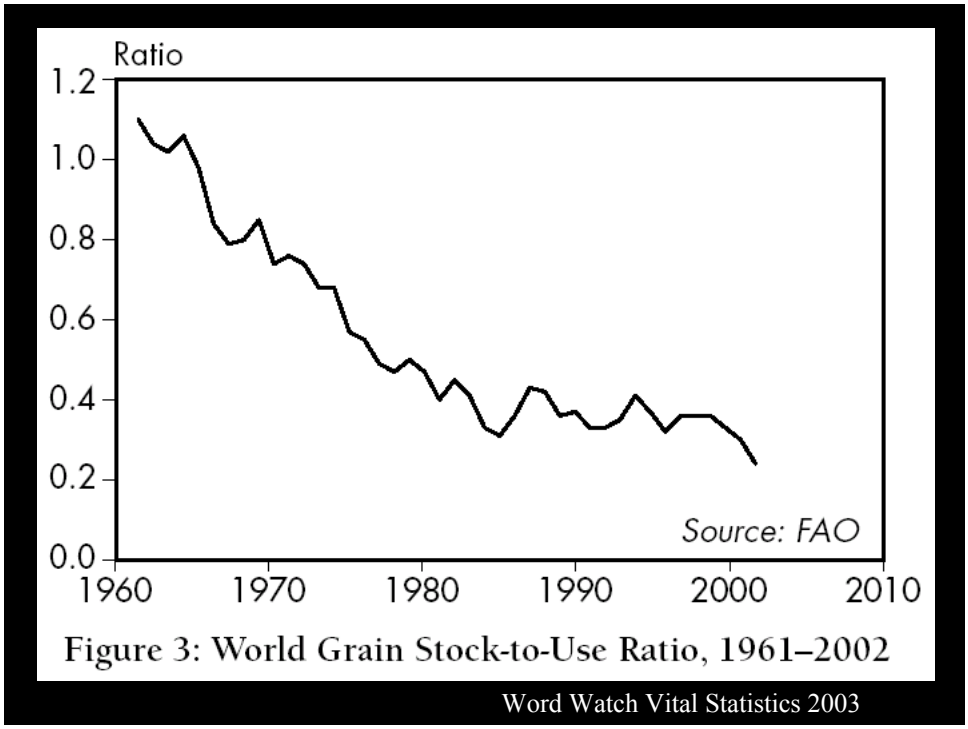
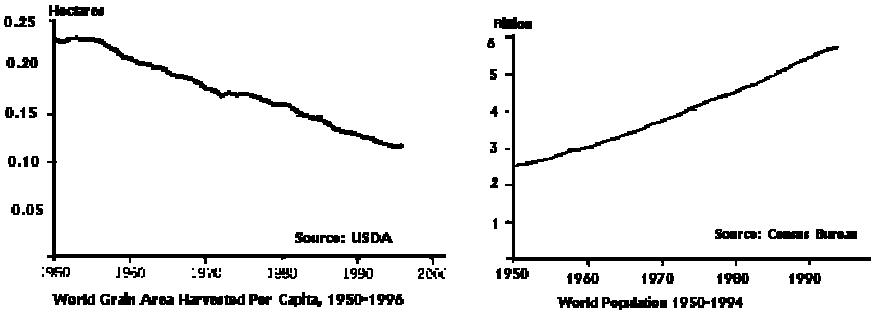


Figure 3: World Grain Stock-to-Use Ratio, 1961–2002

Word Watch Vital Statistics 2003



Patricia S. Muir, Oregon State University: BI301 Human impacts on ecosystems, 2002. http://oregonstate.edu/instruction/bi301/landlim.htm. Data from World Watch.

- World population has doubled in less than 40 years.
- The world does not have the capacity for doubling in the next 40.
- In fact, it is difficult to see how it can increase after 2010.

"Since 1967, the US has lost over 25 million acres of farmland to urban sprawl. This is an area larger than New Hampshire + Vermont + Massachusetts + Connecticut + New Jersey!!
In the US, 90 ha (220 acres) of actual or potential farmland is taken out of production every HOUR (= 2160 HA PER DAY [~5300 ACRE PER DAY] . This totals to 1.9 million acres of US farmland (actual + potential) per year converted to nonagricultural uses. Graphically, this represents an annual loss of a strip of land 1 km wide running from New York to San Francisco! (This doesn't include losses of rangeland, which are about 600 ha (1500 acres) per day.)"

Patricia S. Muir, Oregon State University: BI301 Human impacts on ecosystems, 2002. http://oregonstate.edu/instruction/bi301/landlim.htm

"China has been losing 1 million acres of arable land per year for the last 3 decades to industry, housing, roads, and recently cemeteries. (This rate of loss is slightly less than US rate actually...) Between 1990 and 1994, the loss rate was 1% per year (from 90.8 down to 87.4 million cultivated acres). …

The net result of population growth and loss of arable land in China is that per capita land area planted in grain is now less than HALF what it was when People's republic was founded in 1949 . The huge industrialization push in China, coupled with the growing population, is the main driver of this trend. … This matches the global trend."

Patricia S. Muir, Oregon State University: BI301 Human impacts on ecosystems, 2002. http://oregonstate.edu/instruction/bi301/landlim.htm

The next 15 years are set to be the most unstable since WWII

Oil provides us with a very rich (high EROEI), cheap and versatile source of energy. We have grown up in a temporarily energy-rich world so we do not appreciate the extent to which OIL ENERGY SUBSIDISES ALL OTHER ACTIVITIES!

We <u>MUST</u> invest in alternative energy technologies

NOW

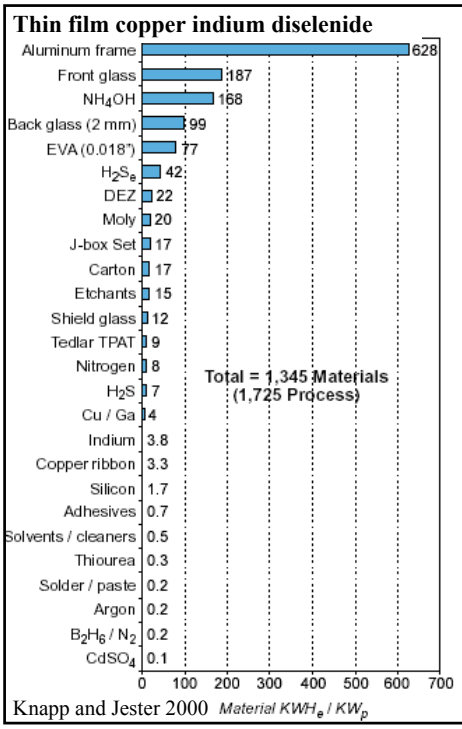
<u>IT WILL NOT BE POSSIBLE LATER</u>

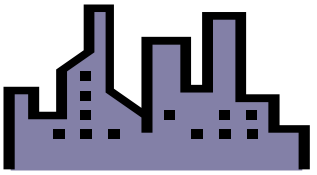
Why we cannot wait for later to invest in alternative energy

Photovoltaic energy payback study by **Karl E. Knapp & Theresa L. Jester, 2000**

"…two types of Siemens PV modules—single-crystalline silicon and thin film copper indium diselenide. … Over their lifetime, **these solar panels generate 9 to 17 times the energy required to produce them**."

(This is only the energy cost inherent in the production of the materials and final device. It does not include the energy required to drive the workers to work etc.! PV lifetime is 25 – 30 years)



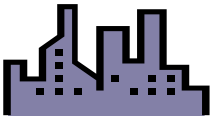


Imagine if one factory could supply all the processes and materials to produce a PV panel and was driven by the PV panels it was producing:

Based on 17 x payback over a 30 year lifetime (EROEI = 17), a factory with a single PV panel would need 1.8 years to produce one panel.

To produce 1 panel a day a factory needs 657 panels.

Let's think more about that:



To produce 1 panel a day a factory needs 657 panels.

To produce 1000 panels a day the factory will need 657,000 panels!

1/17th (~6%) of the factory's production will go to replacing its own panels.

A factory that starts with 1000 panels on its roof will take about 13 years until it has 657,000 on its roof and can start production for profit!

Lesson:
Put your alternative energy infrastructure in place while oil energy is cheap because it will not be possible later!

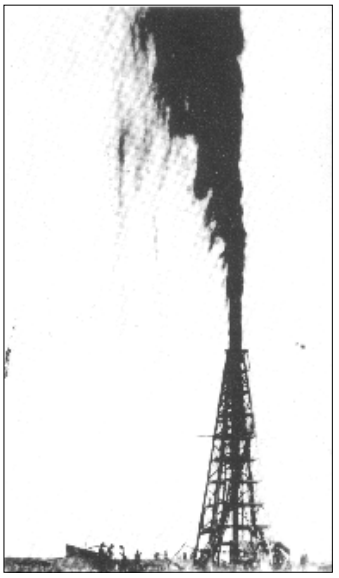
If a wind turbine lasts for 20 years and has an EROEI (payback) of 40, then it takes 6 months to produce the energy to make one turbine.

Arguments of the cornucopians

- "The stone age did not end because the world ran out of stones, and the oil age will end long before the world runs out of oil." Sheikh Zaki Yamani (i.e. alternatives will be found)

- Reported reserves are constantly increasing (technology helps us find more and get more out)

- As the oil price rises, other reserves become commercially viable ("Resource Pyramid")



"Backdating" reserves to date of field discovery reveals the true trend

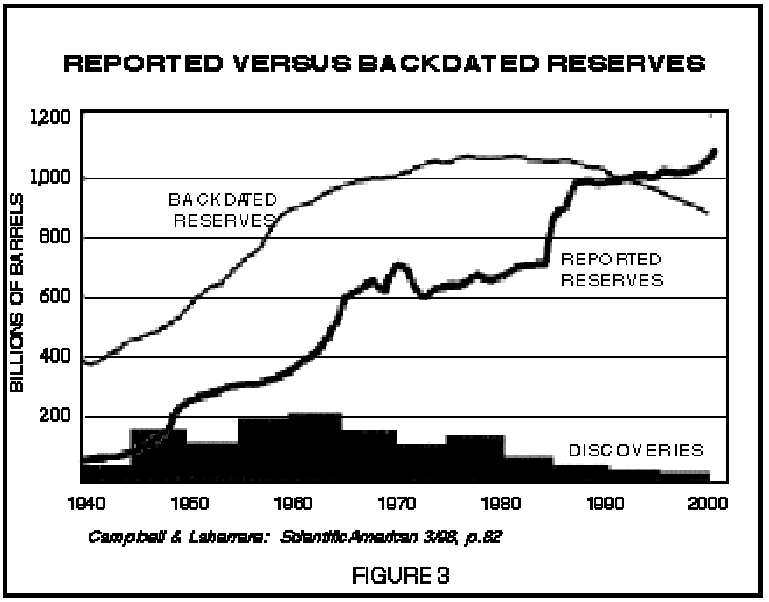
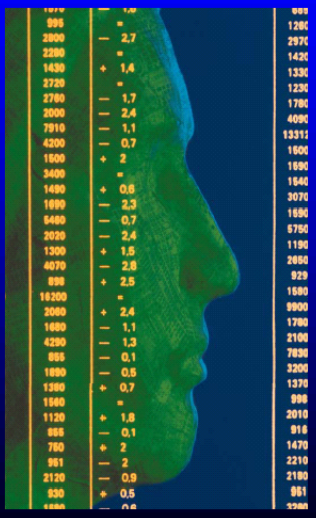


FIGURE 3

From Simmons' Feb '04 presentation at CSIS

Are My Saudi Or Overall Energy Worries Moot Because Of "New Technology"?



- The global E&P business convinced itself that technology changed the game.
- Technology was supposed to "eliminate dry holes".
- It made reserve appreciation the best way to find new oil.
- It reduced F&D costs.
- These beliefs became "The Energy Mantra Of Last Decade".

SIMMONS & COMPANY INTERNATIONAL

Most Of High Technology Thesis Was "Hype"

- Various great technical revolutions changed the way oil and gas is now developed.
  - 3-D seismic
  - Horizontal drilling
  - Multilateral well completions
  - Subsea oil production techniques
  - Etc., etc., etc.

  } The Revolution

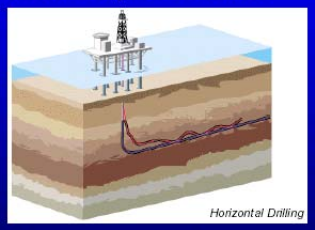
- For a decade, industry executives believed these created easy supply growth.
- Instead, the technology revolution created monstrous decline rates.
- Proven reserve write-off is likely worldwide.

SIMMONS & COMPANY INTERNATIONAL

From Simmons' Feb '04 presentation at CSIS

Oilfield Technology Was A "Miracle Drug"

- 3-D seismic, horizontal drilling, multilateral well completions, etc. changed the nature of hydrocarbon extraction.
- They accelerated the extraction.
- They enabled extraction of small pockets of hydrocarbon.



- At times, they increased recoverable reserves by a small degree.
- They rarely increased original oil in place.

SIMMONS & COMPANY INTERNATIONAL

From Simmons' Feb '04 presentation at CSIS

Added Oil Recovery Has Been "The Exception"

- Case studies where technology added great amounts of added oil were the exception, not the rule.
  - Norway's Troll field's thin oil column.
  - Ekofisk's secondary oil reservoirs.
- Most giant oilfields' original oil in place and recoverable reserves stayed static from 1974 through 2004.
- Many "proven reserve additions" failed to increase daily oil output.

SIMMONS & COMPANY INTERNATIONAL

From Simmons' Feb '04 presentation at CSIS

North Sea Giant Fields: A Technology Case Study

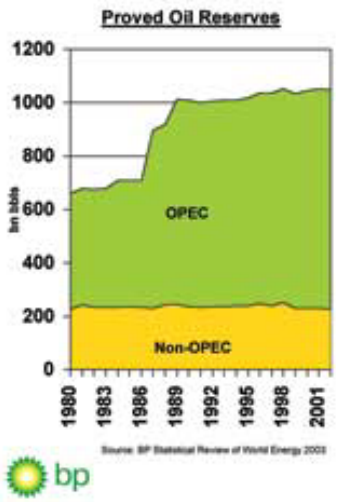
Operator's Estimates Of Recoverable Oil:	In Million Tons Forties	Brent
1985 Estimate	329	241
2003 Estimate	347	263
(Increase)	*(5%)*	*(9%)*
Initial Production (Year)	1975	1976
Peak Production (Year)	1978	1984
Peak Rate (Million Tons)	24.6	20.1
2002 Production	2.6	1.9
Decline	*89%*	*91%*
Cumulative Production	331	256
Total Recovery	*95%*	*97%*

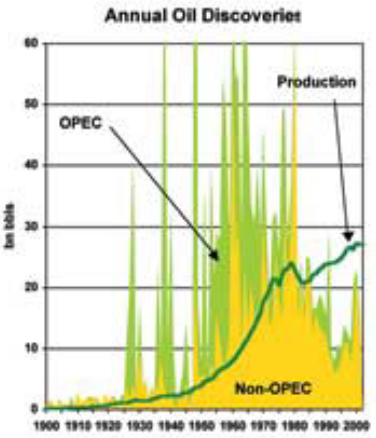
SIMMONS & COMPANY INTERNATIONAL

From Simmons' Feb '04 presentation at CSIS

Reserves and Discovery

Oil Reserve Data





Comment from ASPO Newsletter 42 on BP Statistical Review of World Energy June 2004:

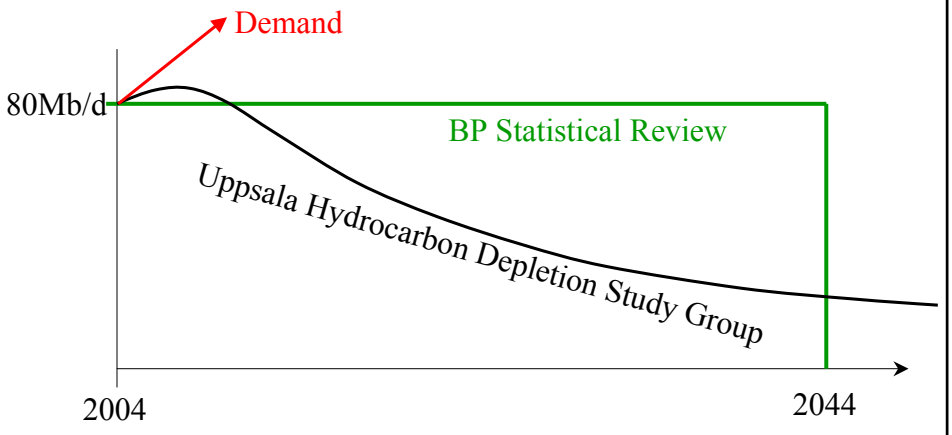
"...Our model refers to so-called Regular Oil, which includes condensate, but excludes heavy, deep-water, Polar, and NGL from gasfields. The grand total for all categories is not in fact far from what BP reports on a different basis, but there are many marked differences for individual countries.

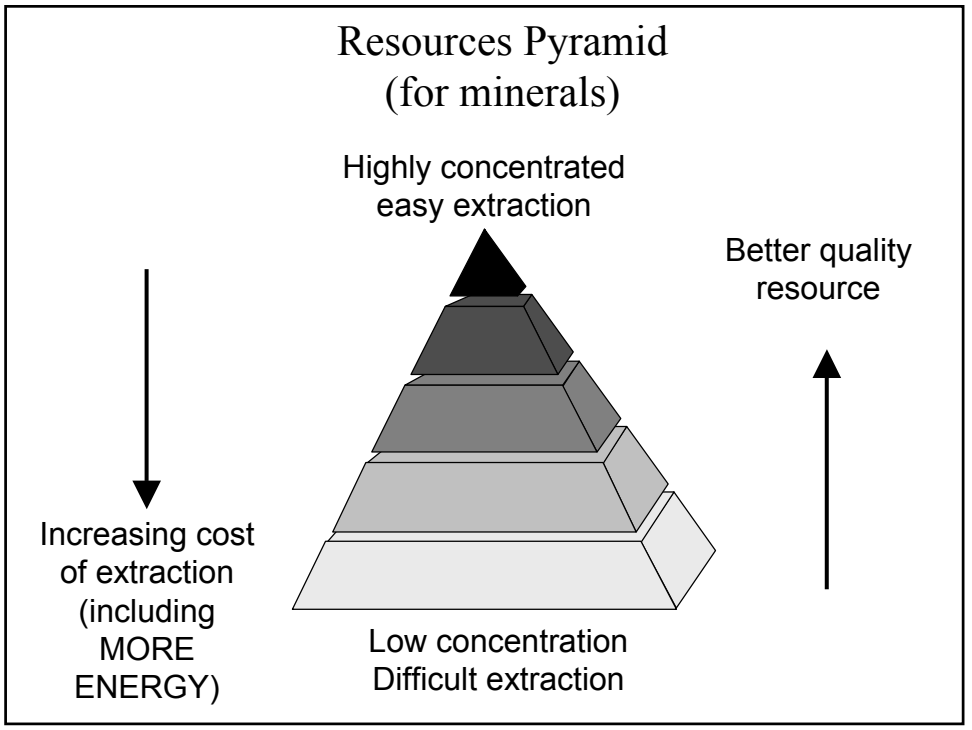
The scale of confusion on the whole topic is well demonstrated. The object of the exercise is to forecast future production with appropriate depletion profiles for each category, taking into account past production and discovery trends.

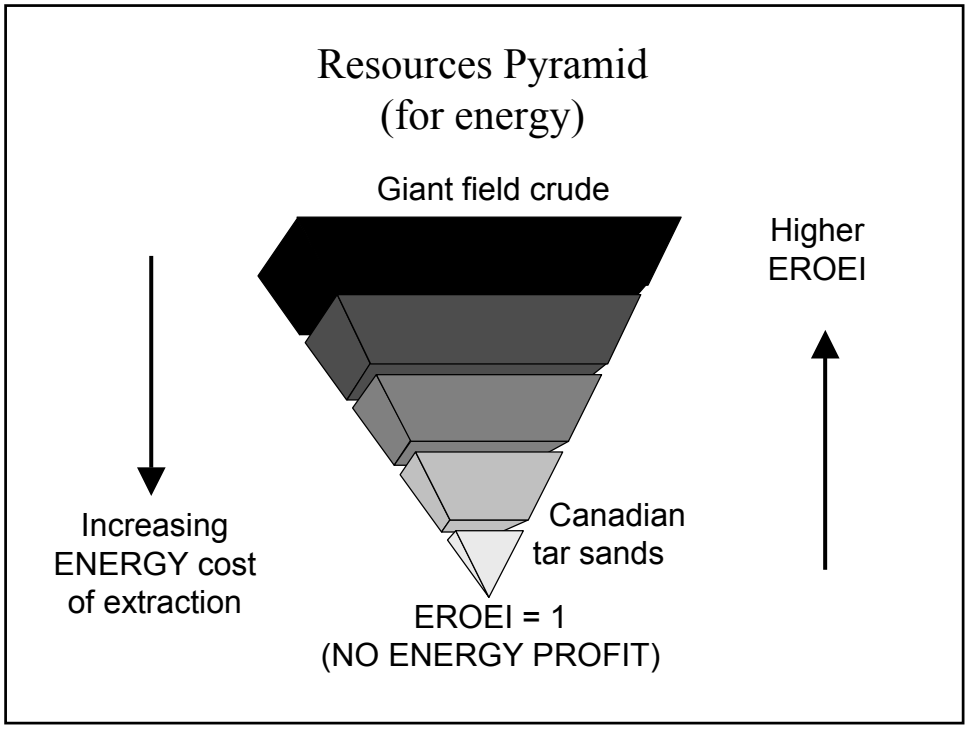
The most fatuous and misleading approach is to take the Reserve number and divide it by current production to say that the Reserves support current production for 41 years, ignoring the natural decline observed in all fields and countries. It is in this regard that BP deserves serious criticism. If its objective is to evade the issue of depletion to impress the stockmarket with the pretence that finding oil is just a matter of economic incentive and technology, it risks being accused of culpable fraud.

That contrasts with the stance of other oil companies. ExxonMobil has stressed how discovery has been declining for forty years, despite every incentive, a worldwide search, always aimed at the biggest and best prospects, technological progress and greatly improved geological knowledge. Chevron-Texaco gives the same message."

"The most fatuous and misleading approach is to take the Reserve number and divide it by current production to say that the Reserves support current production for 41 years, ignoring the natural decline observed in all fields and countries." (ASPO)

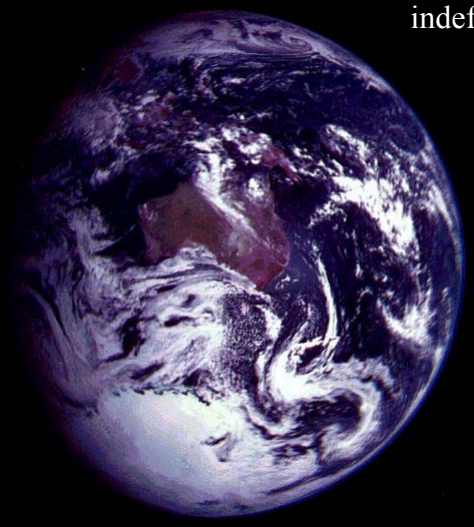



Resources Pyramid
(for minerals)
Highly concentrated
easy extraction
Better quality
resource
Increasing cost
of extraction
(including
MORE
ENERGY)
Low concentration
Difficult extraction


Resources Pyramid
(for energy)
Giant field crude
Higher
EROEI
Increasing
ENERGY cost
of extraction
Canadian
tar sands
EROEI = 1
(NO ENERGY PROFIT)

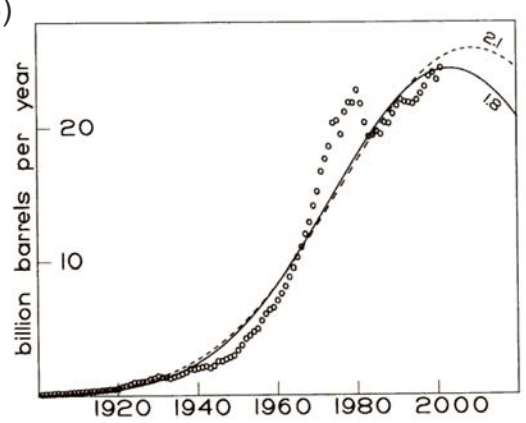
Earth's resources are finite

Economic/population/resource growth cannot continue indefinitely



The Earth receives more energy from the Sun in one day than is contained in all the oil that we will ever burn.

Since 1973, the fuel efficiency of passenger cars, vans, pickups and SUV's has increased by more than 60%. (US Energy Information Administration, Monthly Energy Review, October 2003)



Annual production of world oil (circles), with Gaussian curves corresponding to total eventual oil recovery of 1.8 and 2.1 trillion barrels. A steeper rising curve with its top chopped off by market limitations would make a better fit.

From Ken Deffeyes Hubberts Peak – The Impending World Oil Shortage

Some of the many questions you need to consider for the future of your business:

• What will happen to my export markets as transport prices increase and the world becomes more politically unstable?
• How sensitive is my business to the price of oil?
• How sensitive is my business to increases in interest rates?
• If economics becomes much more local, will I still have a market, what will it need and what will it be able to afford?
• What imported inputs can I replace with locally-sourced inputs?
• How can I operate with greater energy efficiency?
• How can I operate with decreased access to imported technology?
• [Can I run my business without a computer?]
• What should I invest in now to position myself for a localised economy with high initial unemployment and high food and energy prices?

Some ideas for action:

Invite Brian Fleay to Adelaide as a "Thinker in Residence".

Begin ASAP emergency planning for:

- Rapid expansion of public transport
- Maintaining fuel and fertilizer supplies to agriculture
- Coping with collapse of financial institutions (preventing collapse of agriculture)
- Feeding and housing the unemployed and bankrupt
- Maintaining a fuel reserve (federal action)

Begin planning and investment for:

- Large expansion of local agriculture (location, water supply, training in permaculture techniques)
- Expansion of renewable energy and light rail
- Recreation of local manufacturing

"There are 1,001 solutions already but you have to think about it... and there is no panacea you know. There is no hydrogen economy at the horizon. There [are] small little things in my opinion you can do and when you add these all up, it amounts to quite a lot, but you have also to get ready to live with less oil."

Dr Ali Samsam Bakhtiari
National Iranian Oil Company.

Best websites (among many!) for information on Peak Oil and how to handle the consequences:

Association for the Study of Peak Oil and Gas, ASPO
www.peakoil.net and see also www.peakoil.com for recent news

The Energy Bulletin
www.energybulletin.net

Global Public Media
www.globalpublicmedia.com

The Community Solution
www.communitysolution.org

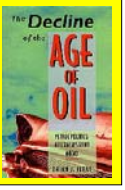
Australian Peak Oil
www.arach.net.au/~zeug/sites/

Brian Fleay – articles on implications of the oil peak for Australia's future:

Climaxing Oil: How Will Transport Adapt?
http://wwwistp.murdoch.edu.au/publications/projects/oilfleay/00content.html

and

Natural Gas "Magic Pudding" or Depleting Resource
http://www.oilcrisis.com/fleay/WA_GasFutureRevised.pdf



The Sustainable Transport Coalition WA
www.stcwa.org.au

Dry Dipstick – A Peak Oil Metadirectory
www.drydipstick.com

and, if you think that you can handle the truth see Die Off at www.dieoff.org for a very good summary and collection of articles