Peak Oil

Unsustainable Perverse Fuel Subsidies

- Fossil fuel subsidies encourage wasteful consumption. The global cost of fossil-fuel subsidies expanded to $544 billion in 2012 despite efforts at reform. Financial support to renewable sources of energy totaled just $101 billion. (EIA Dec 2013)
- Governments will keep fuel subsidies in place as long as they can, to keep their economies competitive and to keep a lid on civil unrest.
- Fuel subsidies for some countries are 5% of GDP – as the oil price goes up these cannot be afforded. (IEA Dec 2013)

Oil Price


W-2
Copy 2 to be filed with employ
Tax
APRIL
S M T W T F
1040
Department of the Treasury
U.S. Individual
Label
For the year Jan

Oil Price

- The Brent crude oil price has averaged US$110 per barrel in real terms since 2011, a sustained period of high oil prices that is without parallel in history. (IEA Dec 2013)
- The Brent Crude oil price was US$9 in 1998.
- The EIA predicts a rise to US$128 by 2035.
- The Arab Spring uprising was sparked partly by lack of access to cheap oil and, linked to that, cheap food. People power in the Middle East pushed the oil price to USD120 per barrel on March 14th 2012 – its highest ever price. (Leggett, 2013)
- The Brent Crude Price in August 2015 was USD48, partly because of dirty fracking oil on the market, price manipulation by big oil exporters and an economic downturn.

Why is oil so important?

How many men does it take to push a car?

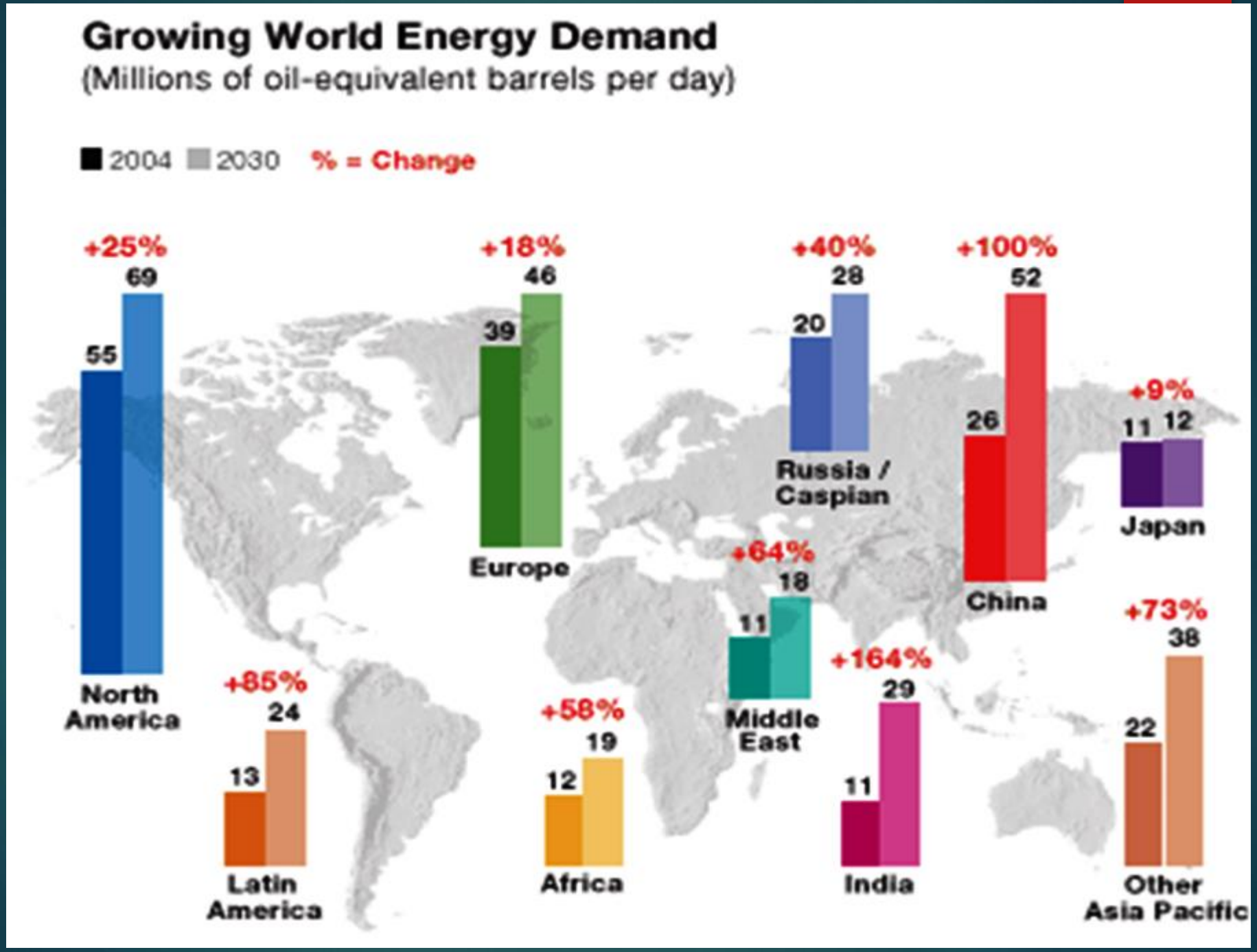
The phenomenal energy in oil

- A tank of petrol contains the equivalent energy of 4 years of human hard work!
- Oil allows us to be around 100 times more productive than human muscle power.
- A one litre bottle of motor oil has the energy of 5 weeks hard work
- No human society had anything near the amount of energy before the discovery of fossil fuels.
- Oil is easy to transport, super-concentrated ancient energy – a unique magic liquid made from ancient sunlight.
- One barrel of oil (42 gallons) gives 20 gallons of petrol.

What do we use Oil for?

What do we use oil for?

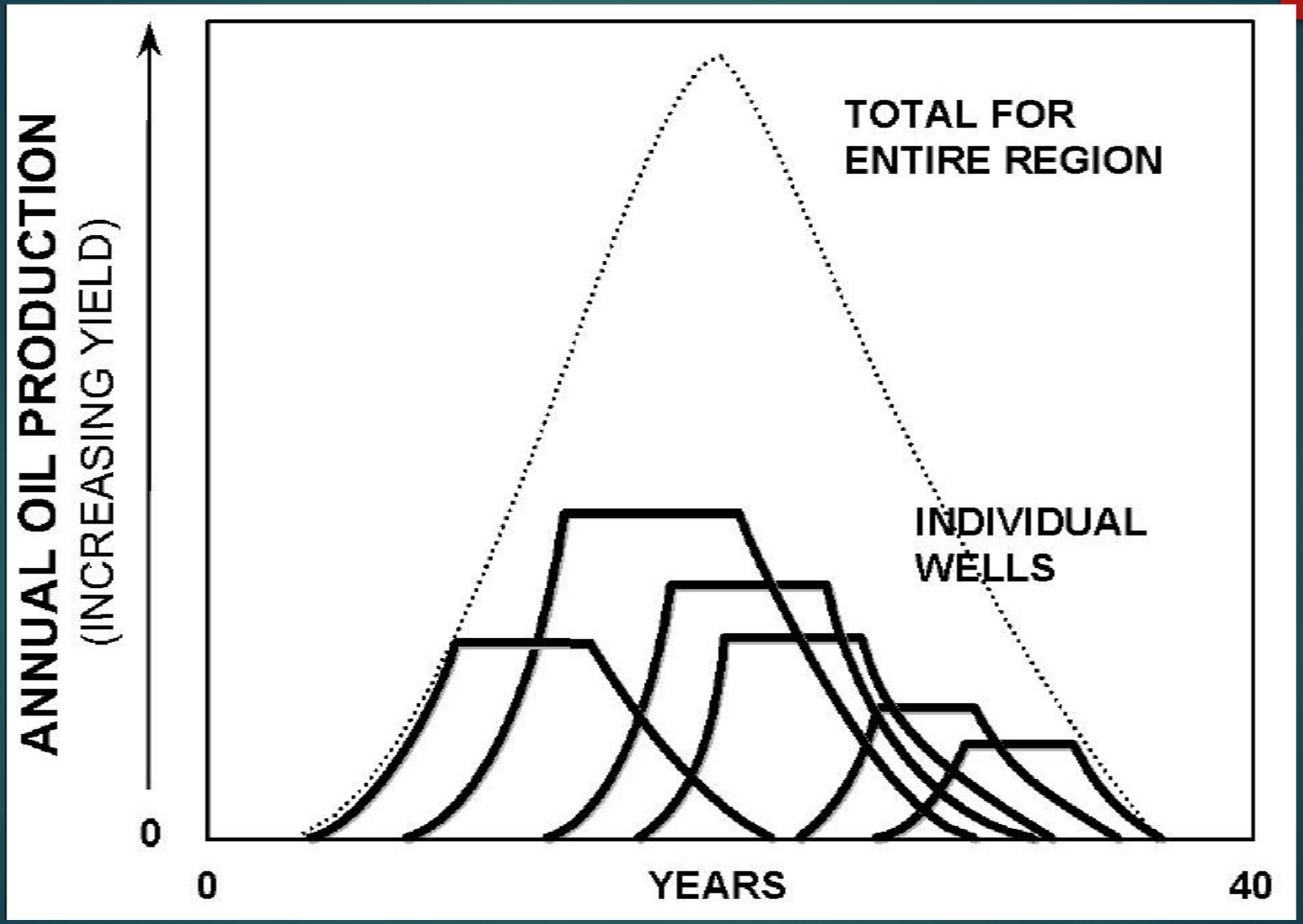
- The entire way of modern urban life, and a huge array of products are reliant on oil.
- Many products are derived from, or use oil or gas as their raw material. Plastics, synthetic fibres, medicines, paints, ink, fertilizers, pesticides… the list is almost endless.
- 95% of our goods and food in shops are oil-dependent.
- The so called 'Green revolution' was not so green, modern agriculture. depends on oil. Fertilisers, herbicide and pesticides are made from oil and natural gas, tractors and machinery use it, irrigation requires huge amounts of energy, food miles, processing, and storing, cooking, and packaging
- Civilization is three days deep – without access to cheap food people power emerges very quickly.
- Most jobs depend on cheap oil – social stability and the financial system are at risk without easy access to cheap oil.


Growing World Energy Demand
(Millions of oil-equivalent barrels per day)
2004
2030
% = Change
+25%
69
55
North America
+85%
24
13
Latin America
+18%
46
39
Europe
+58%
19
12
Africa
+64%
18
11
Middle East
+40%
28
20
Russia / Caspian
+164%
29
11
India
+100%
52
26
China
+9%
12
11
Japan
+73%
38
22
Other Asia Pacific

Why is oil so important?

- Economic growth requires growth in our energy supply.
- We have an economic system that is dependent on growth to pay debt.
- This slide shows 2 bars: demand in 2004 & projected demand in 2030.
- International Energy Agency (IEA) forecasts demand of 96 million barrels per day (m/b/d) by late 2015; 106 m/b/d by 2030. (Feb 2014 = 92 mbpd)
- US Department of Energy forecast - 113 m/b/d demand by 2030 – according to experts, this demand is impossible to meet, yet the economic system is dependent on increasing supplies of energy.
- All forecasts of economic growth show rising energy demand.
- With less total energy supply economic growth will slow and decline, probably permanently
- Even today poor countries that cannot afford high oil prices pay up to six times more in total on fuel than on health.

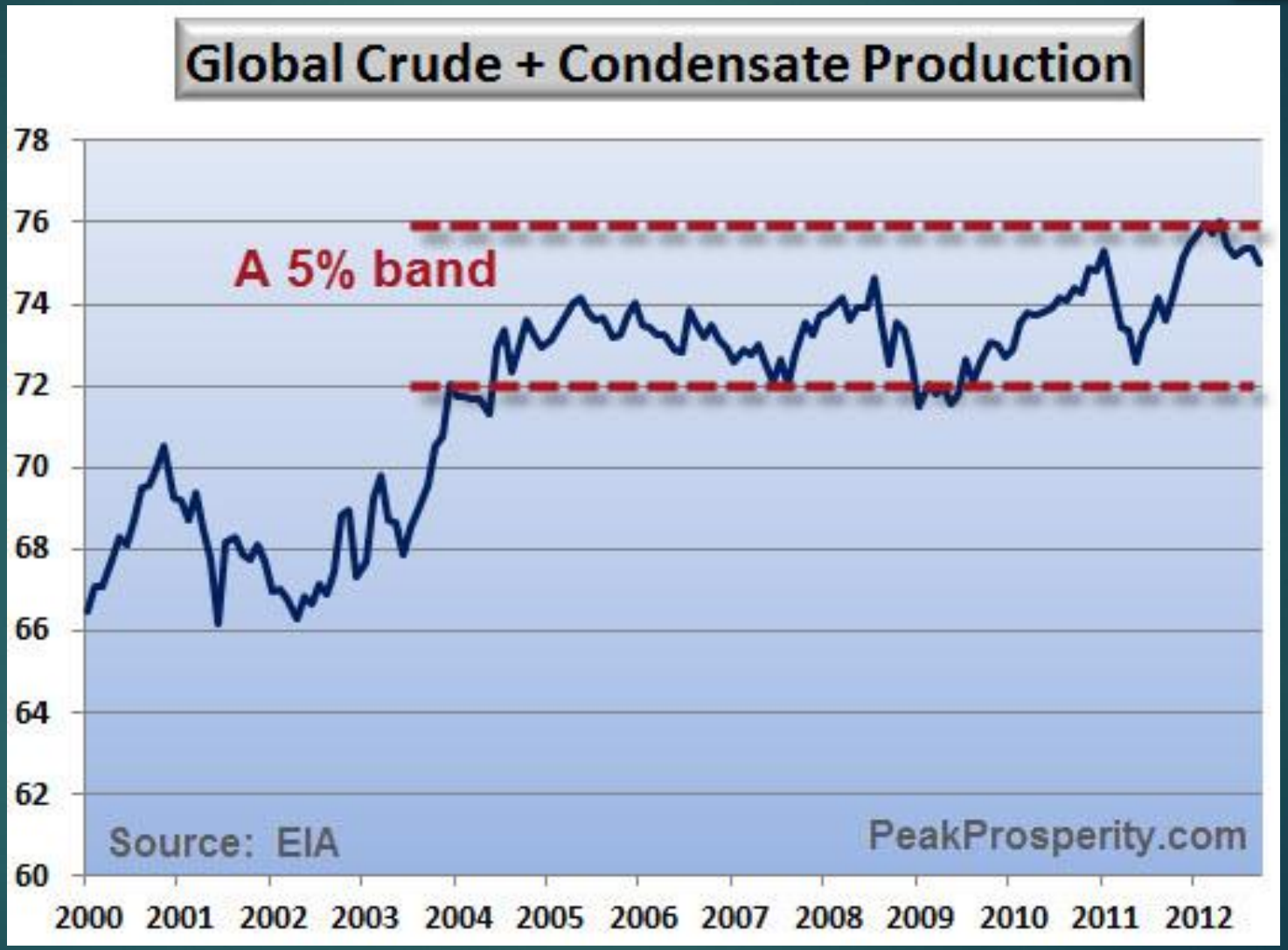
Peak oil


ANNUAL OIL PRODUCTION
(INCREASING YIELD)
TOTAL FOR
ENTIRE REGION
INDIVIDUAL
WELLS
0
0
YEARS
40

Peak Oil- What is it?

- PEAK OIL IS THE POINT AT WHICH WE CAN NO LONGER INCREASE THE AMOUNT OF CRUDE OIL WE EXTRACT AND GLOBALLY PETROLEUM PRODUCTION GOES INTO IRREVERSIBLE DECLINE
- LOCALLY, THIS TYPICALLY HAPPENS WHEN AN OIL PROVINCE HAS EXTRACTED ROUGHLY ½ OF ALL THE OIL THAT COULD EVER BE EXTRACTED FROM THAT PROVINCE - IT IS NOT WHEN THE OIL RUNS OUT
- AFTER THE PEAK THE REMAINING OIL IS USUALLY LOWER QUALITY, TAKES MORE ENERGY TO REFINE AND IS MORE COSTLY TO EXTRACT
- THIS SLIDE ILLUSTRATES WHY THE SUM TOTAL OF A COLLECTION OF OIL FIELDS IN A REGION, WHEN ADDED TOGETHER, CREATES A PEAK AT ABOUT THE HALF WAY POINT IN PRODUCTION

The Glass Ceiling to Recovery



The Glass Ceiling to Recovery

Is Peak Oil Dead? aka 'Peak Oil Light'

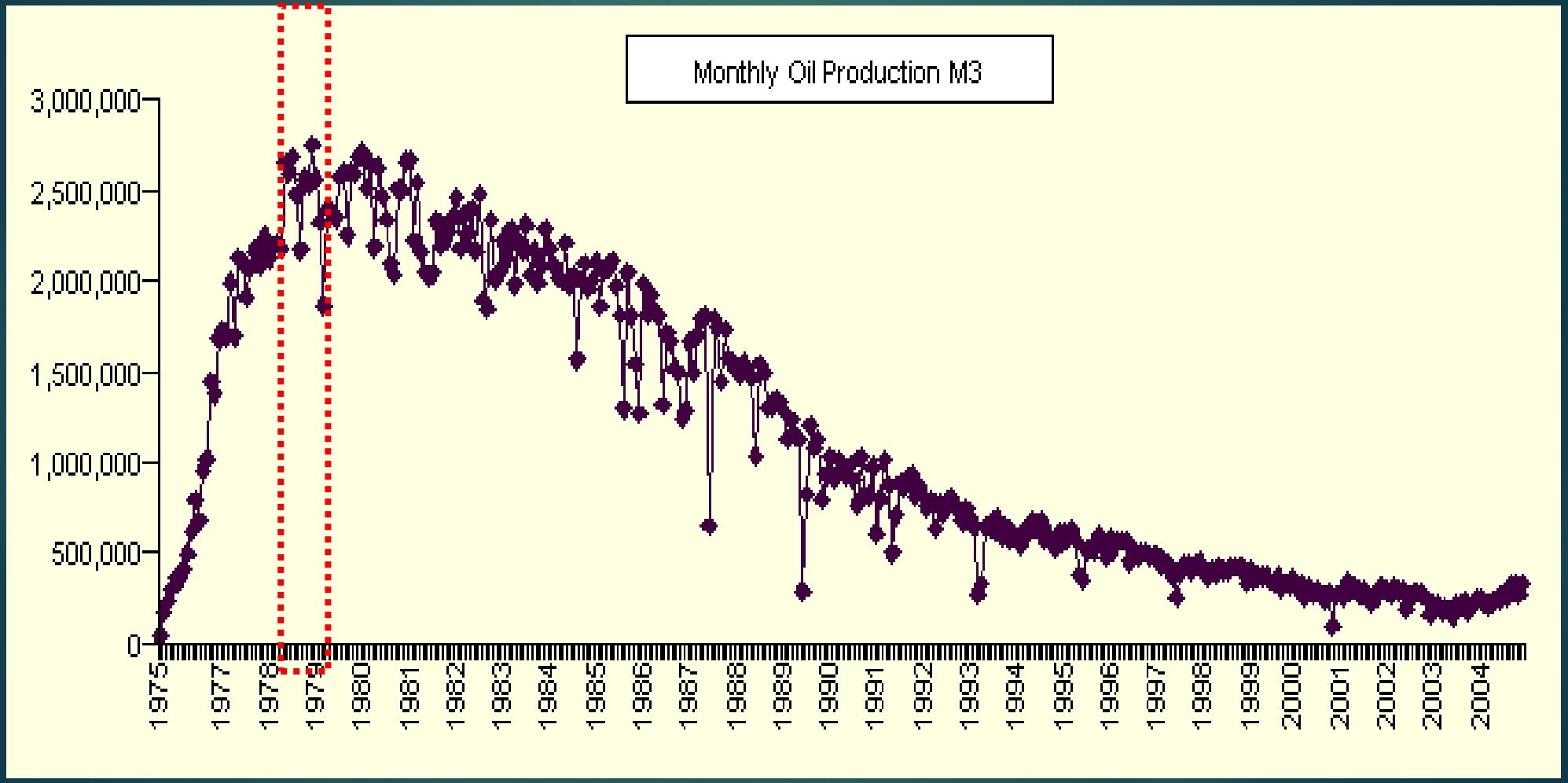
While there may be billions of barrels of oil equivalent locked up in the tar sands and tight oil formations, the economic cost of extracting this energy is high.

As economies emerge from the present recession/depression, the price of oil then starts to increase, which then chokes off the economic growth and stifles further recovery. As the recovery fails, demand for oil decreases, investment in extraction and exploration decreases, and supply decreases. This results in the 'saw tooth' pattern in the graph.
There may, therefore, be a glass ceiling to recovery in 'developed' economies.

This is less of an issue in new economies like China, India, and Brazil, as they have built their infrastructure in an era of expensive energy and therefore have less energy intensive economies as a result.

Sources: New Economic Foundation 2012 report: The Economics of Oil Dependency; A Glass Ceiling to Recovery. Peakprosperity.com, International Energy Agency

Typical oil field – Forties field UK sector North Sea

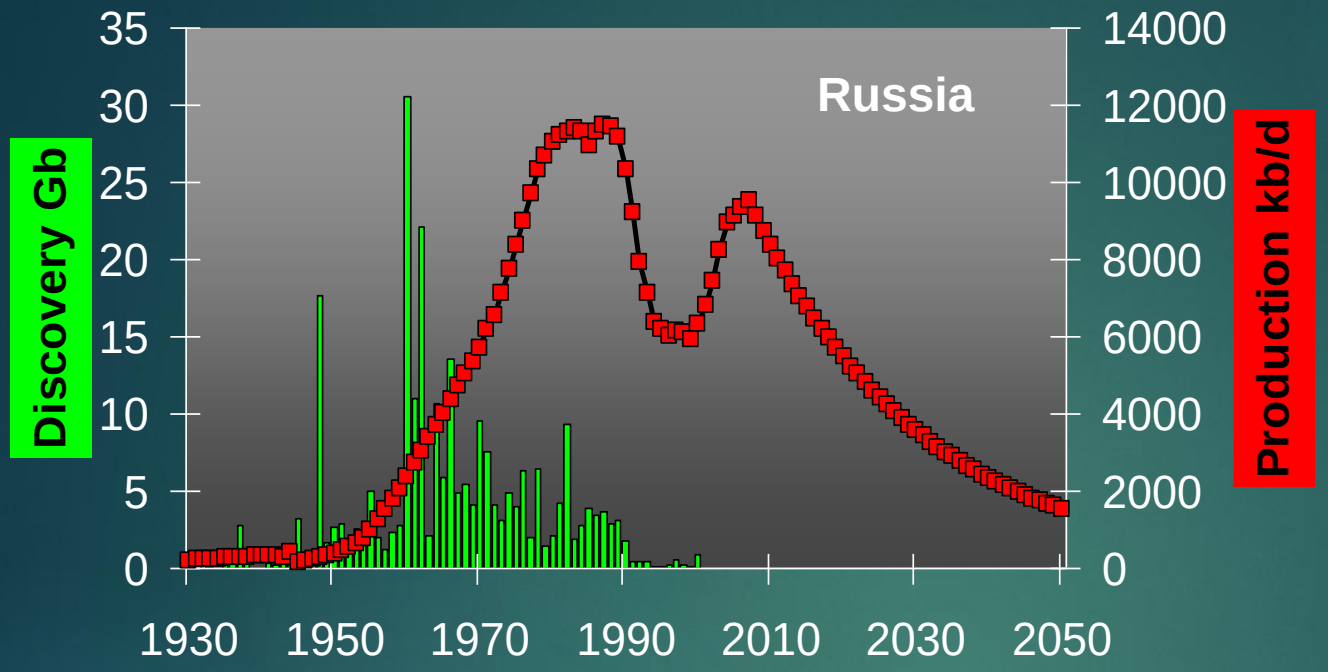


Production in a typical oil field

- The production graph of an oil field illustrates the basic dynamics of oil production:

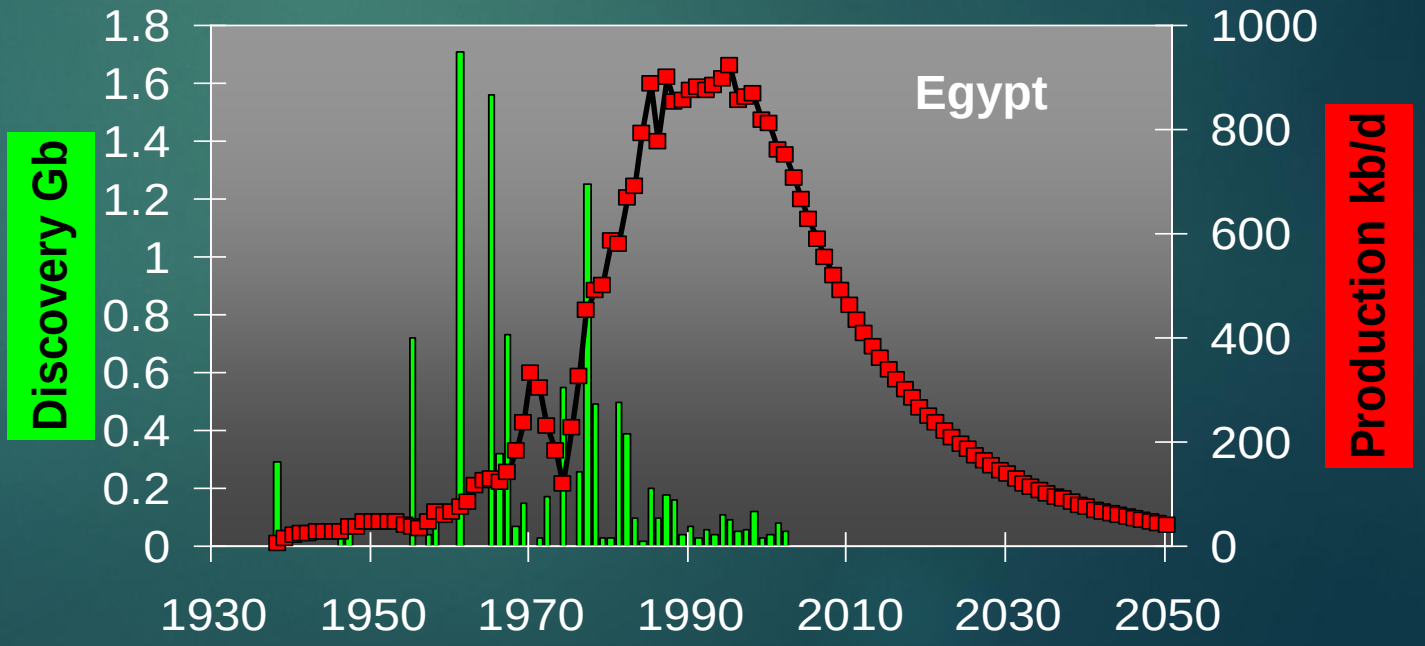
- A steep initial increase, a production plateau and then a slow but irreversible decline.

- Once the peak is past there are many techniques and technologies that can be brought to maximise the declining output, this just speeds up the decline, but it is a losing battle and production will never return to its former levels.



Conventional Oil production follows the discovery curve

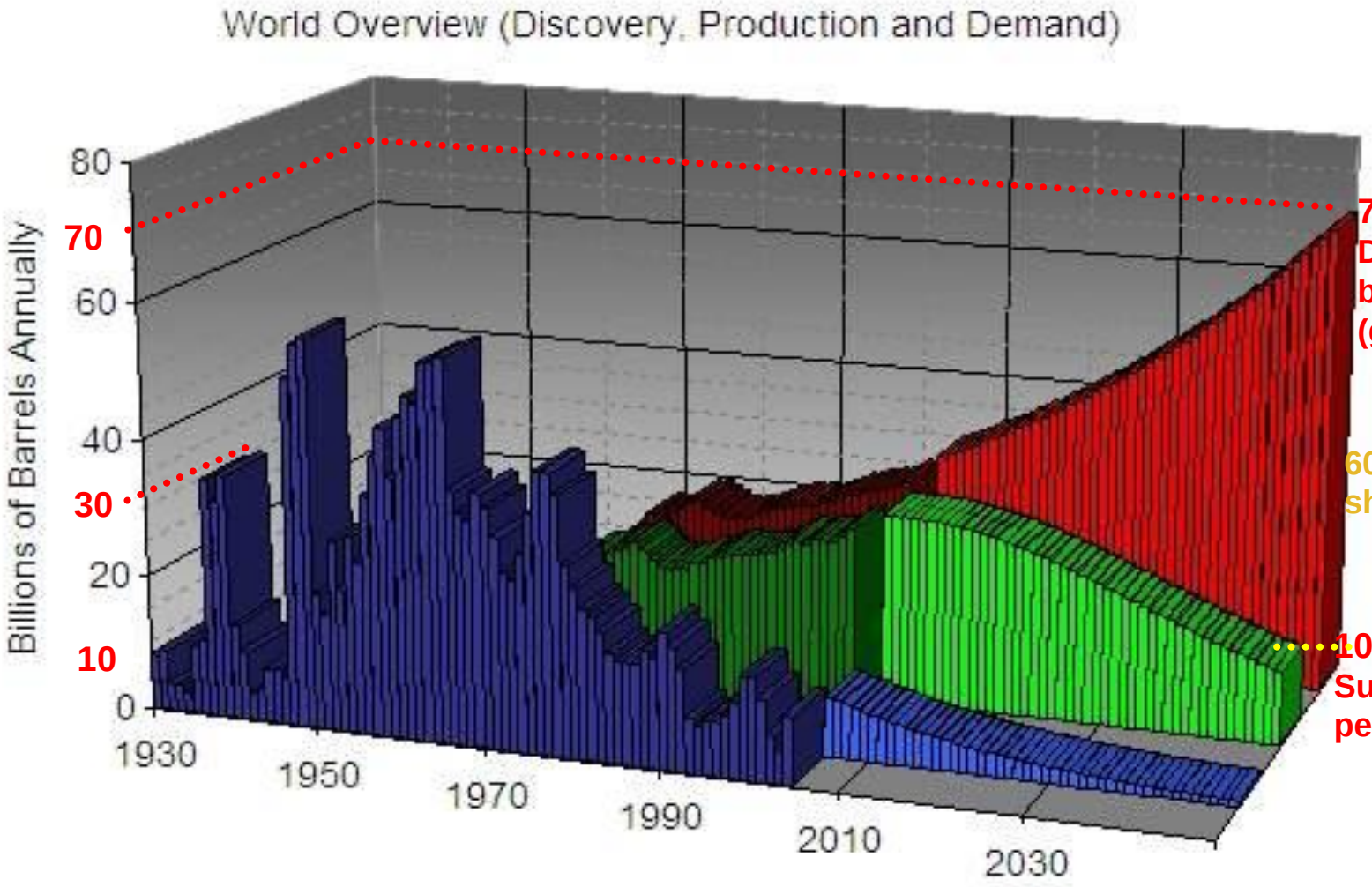
(Gb = Giga barrel = billion barrels 1,000,000,000)



Oil production follows discovery

- Global ‘peak discovery’ of oil was in 1965
- Oil production peak follows oil discovery peak, 25-40 years later.
- 25 – 40 years is the time it takes to get production to full capacity after the initial finding.
- In country after country and oil province after oil province the pattern is broadly the same
- In the 1950’s, we discovered 5 barrels for every one we used
- Globally we are now discovering 1 barrel of oil for every 5 that we use.
- Production of conventional oil in the USA peaked in 1974

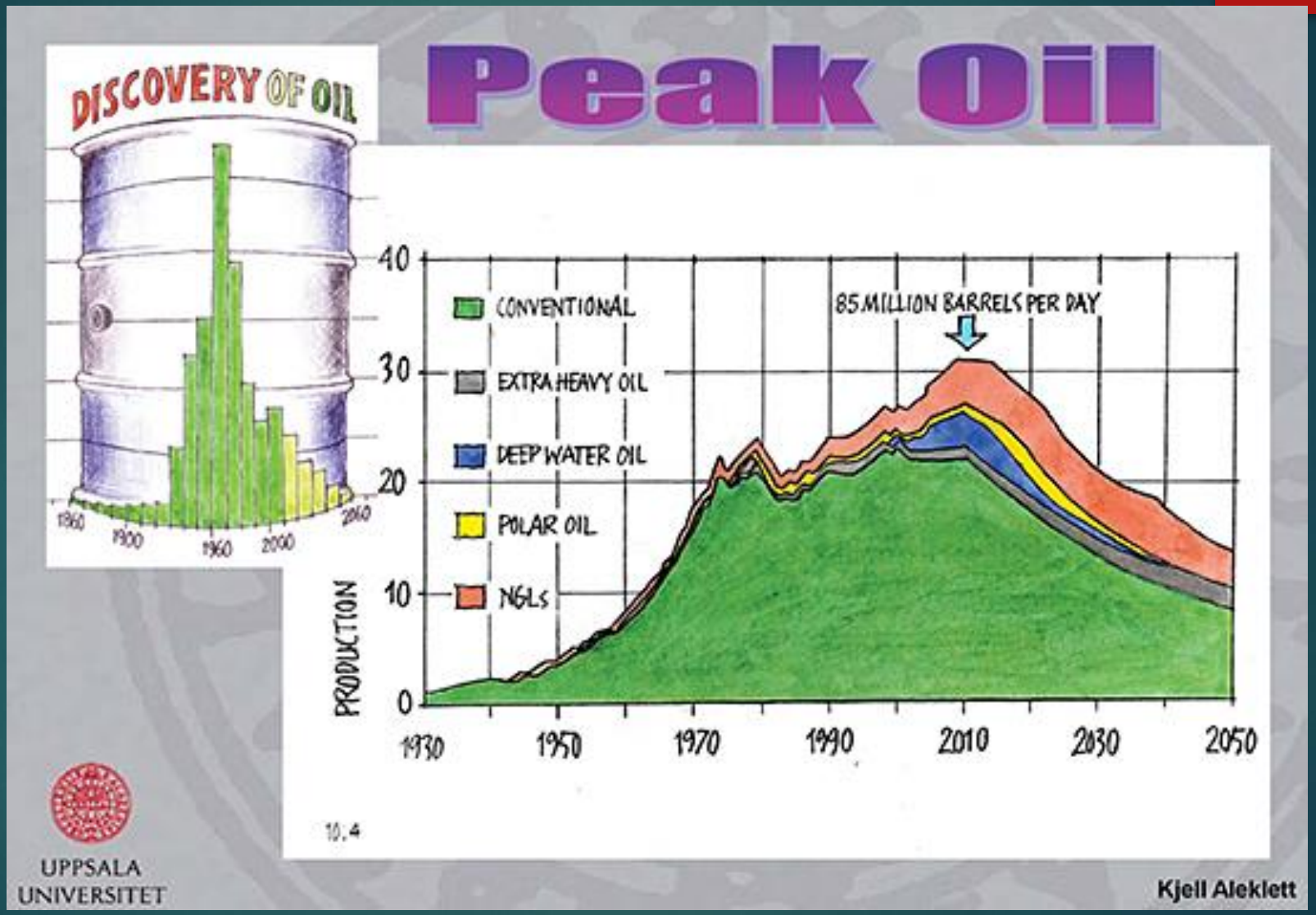
Global oil discovery and production



Global oil discovery, production, and demand

- To produce oil you first have to discover it. World **discovery** peaked in the late 1960's and has been falling ever since, and despite rapidly improving and sophisticated technology there is no prospect of discovery ever increasing.
- At the same time production levels have been rapidly rising.
- The Deep Water Horizon accident (Gulf of Mexico) shows that deep water drilling is not easy or cheap.
- The CEO of TOTAL has stated, "100 mbpd is not likely, this is the honest industry view."
- Demand is projected to go on rising to 96mbpd by the end of 2015, (with production failing to keep up), especially in rapidly industrialising countries like China and India, and will lead to rapidly rising oil prices – if there is no price manipulation or filling in with fracking and tar-sands.
- Petrobas Brazil CEO predicted in Feb 2010 that "Peak production will come in 2010 and will decline at 5%pa thereafter. Supply beyond 96mbpd (33 gb/py) is highly unlikely." We now know that the conventional oil production peak was in 2006
- By 2050 there is a predicted shortfall of 60 billion barrels per year.
- Coal production peak is predicted for 2015. Natural Gas peak is predicted for 2015/2020.

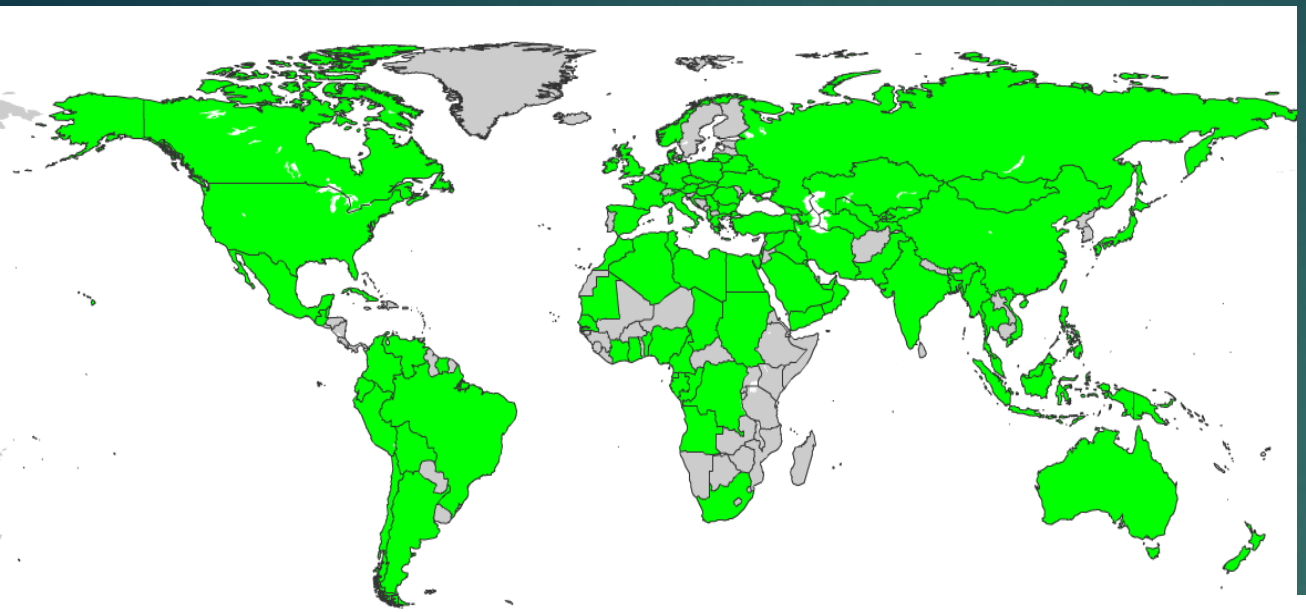
Global oil discovery and production



When global conventional oil production peak?

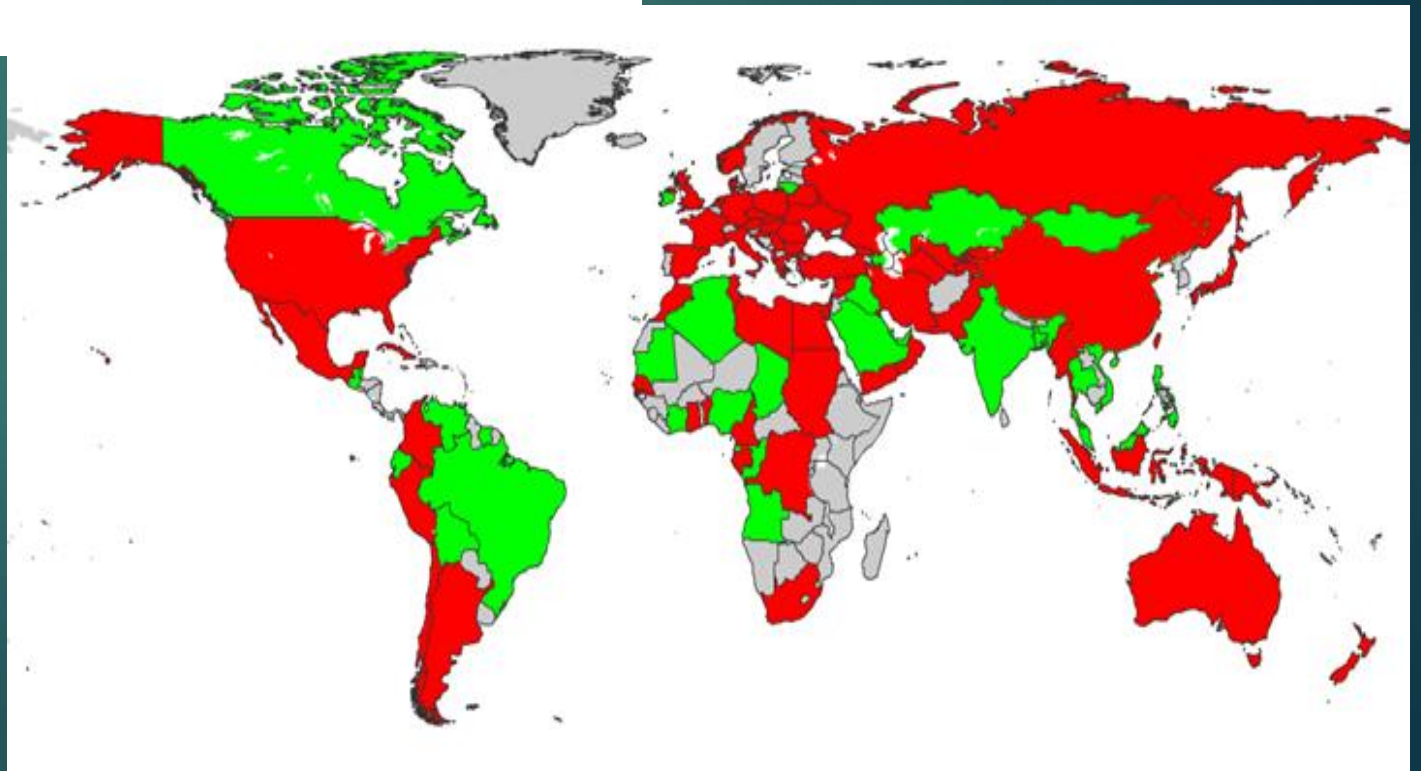
- The argument is when will we peak, not whether. This graph shows various predictions of the global conventional oil peak. They cluster around 2010, with a few optimistic analysts, predicting a peak many years in the future. The IEA believes that conventional oil peaked in 2006. We are propped up by unconventional oil.

- Dr James R. Schlesinger, former US Energy Secretary stated in 2007, "You [peak oilists] are no longer the beleaguered small minority of voices crying in the wilderness. You are now main stream."
- The predictions are from government bodies like the International Energy Agency, oil companies like BP, and independent researchers like Chris Skrebowski.
- On April 11th 2010 US Military predicted massive shortages of 10mbpd by 2015 with the consequence of failing states, economic growth reduction, tensions, and totalitarian domination.
- Actually, when the effects of Peak Oil is to hit is less important – the key is to be prepared.



Oil producers (98)

Post peak oil producers (65)

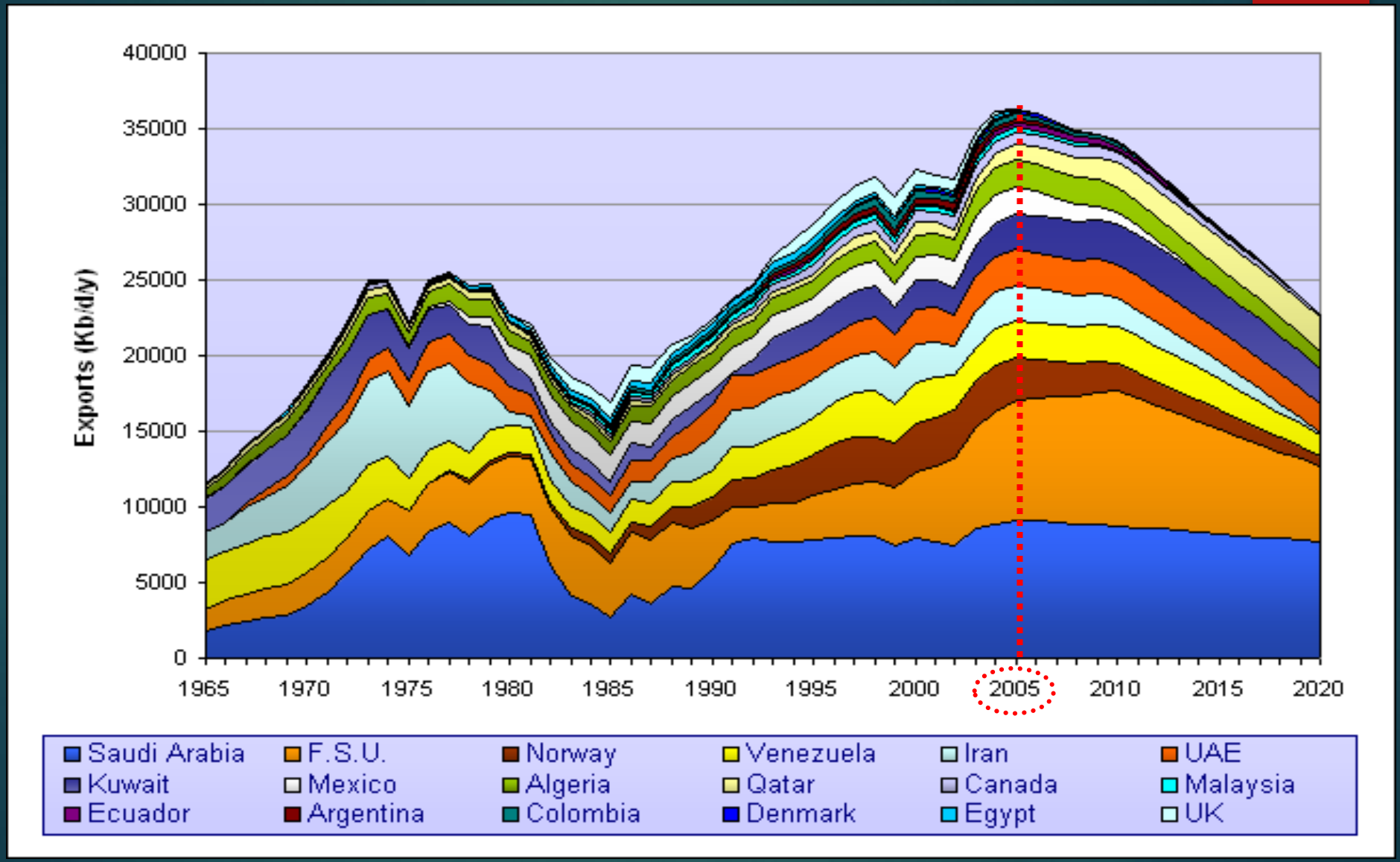


www.lastoilshock.com

Of the 98 producers 65 countries have already peaked.

- There are 98 countries in the word that produce conventional oil, some large some small
- The countries in red are the countries that are now ‘post peak’
- Their conventional oil production is now in decline and nothing they can do will ever reverse that
- Of 98 producers 65 have already peaked. Not one has ever failed to follow the ‘Hubbert’s peak’ – peak and then decline
- China is believed to have peaked in 2008, China now buys up the reserves and drilling rights in other countries.
- The global peak was in 2006 (Source: Intl Energy Agency)

Exports from oil producers

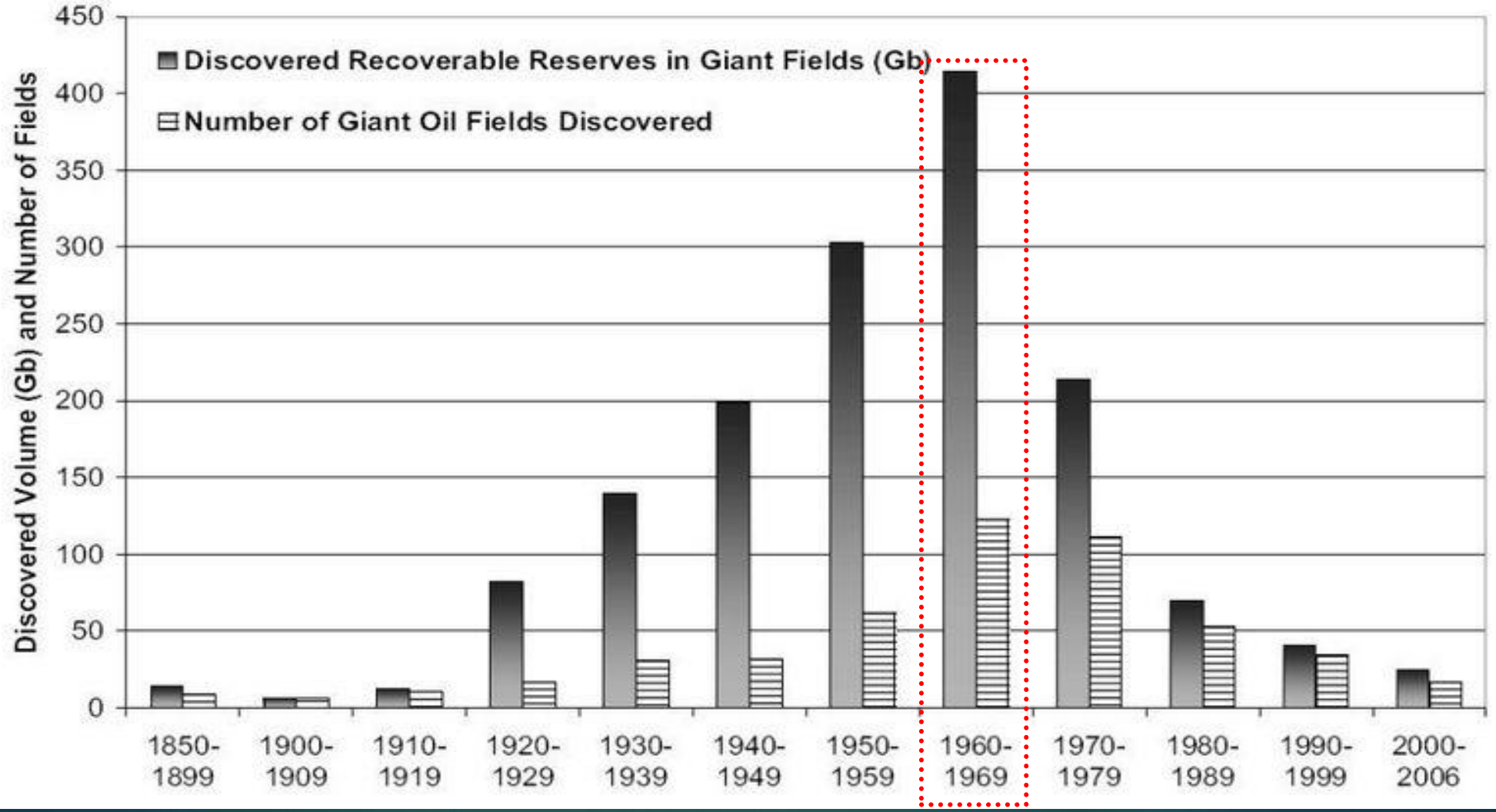


Exports from oil exporting nations

- Oil exporting nations are using their oil for their own internal consumption at an ever increasing rate.
- Oil is often very cheap, like in Saudi Arabia, 0.30 GBP per gallon (HKD 0.99 per litre), so there is no incentive to conserve. Domestic consumption rose 16% in 2009 yr on yr. 2.8 mbpd and rising.
- As their economies are booming, and their population is also growing rapidly, this means they use more themselves and have less oil to export.
- Oil export peaked in 2005, and after a short plateau, is declining rapidly. This is very bad news for countries like the USA which need to import 16 million barrels of oil a day – unless it relies on uneconomic and dirty fracking and tar sands.
- As at Feb. 2014 the USA does not export oil – by law.

80:20 rule and GIANT OILFIELDS

The world's **giant** oilfields are in steep decline



80:20 rule – decline of the giant oil fields

- The 80:20 rule is that 80% of your result comes from the first 20% of your effort – with diminishing returns after that

- Producers find the ‘easy to find and produce’ oil first - the largest oil fields.
- Out of over 4,000 fields 50% of global oil is produced by the 120 largest oil fields in the world.

- The taller left-hand bars on this graph show the amount of reserves in giant oil fields. The right hand / smaller bar shows that discovery of giant oil fields peaked in the late 1960’s. Now we find very few giant (greater than 1 billion barrels total) oil fields, and that rate of discovery is declining.

- March 25th 2010 ConocoPhillips CEO announces that it is selling off its remaining underground oil assets as it is not economic to recover them – as they are lower grade and harder to get at. Exxon Mobile has done the same over the last 5 years.

A new ‘transition’ from conventional oil to new ‘extreme energy’ ?

A new ‘transition’ from conventional oil to new ‘extreme energy’?

Because conventional oil peaked in 2006 we have recently seen a rapid increase in the exploitation of ‘unconventional’ oil and gas. There are three prominent examples of ‘extreme energy’; hydro-fracking, tar sands and drilling for crude oil in technically difficult and risky environments Examples include the Arctic ocean and deep water, such as BP’s disastrous Deepwater Horizon well.

Previously not considered feasible, these now seem to be the only way we can continue to use hydrocarbons to fuel continuous economic growth, as the age of cheap oil draws to a close. These ‘unconventional’ sources are significantly more polluting in terms of CO2, and carry much higher additional environmental impacts.

These include: the contamination of drinking water by fracking; pollution of the oceans caused by deep water and arctic drilling, and vast ecological destruction in the case of the tar sands.

Fracking has masked the immediate effects of the 2006 Peak in Conventional Oil production

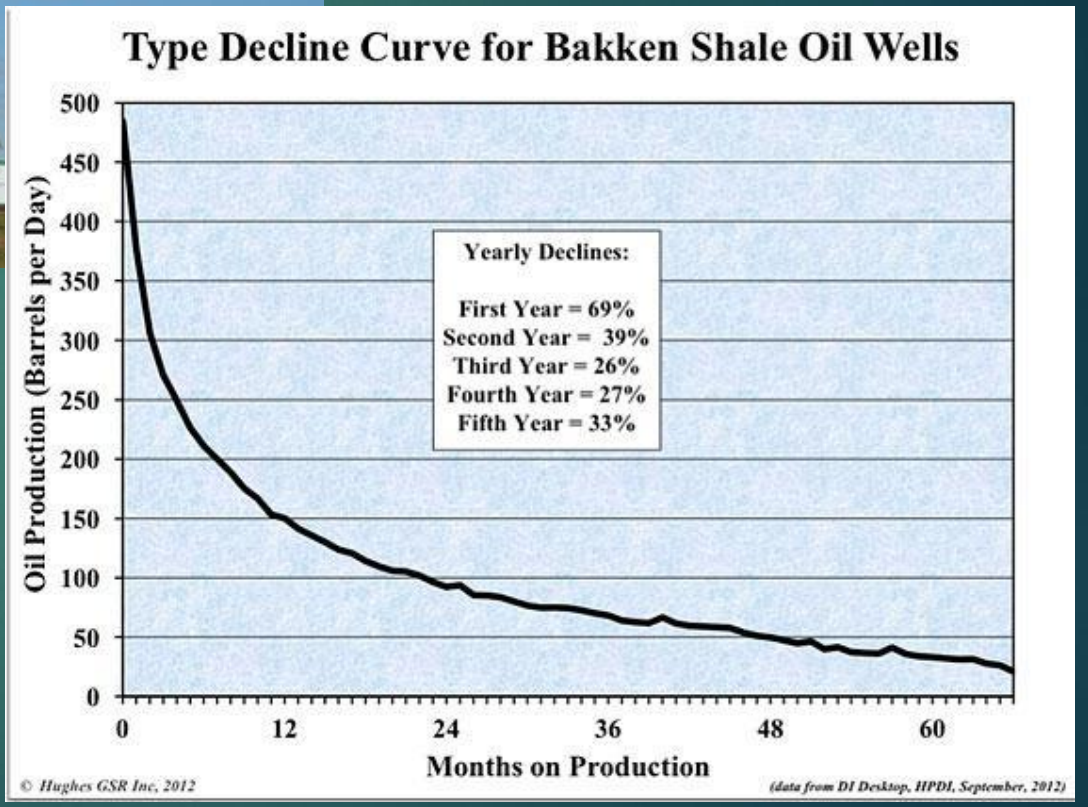
- .

Fracking

- **Fracking** is the fracturing of rock by a pressurized liquid.
- Typically, water is mixed with sand and chemicals, and the mixture is injected at high pressure into a wellbore (drilled hole) to create small fractures (typically less than 1mm), along which fluids such as gas, oil, uranium-bearing solution, and brine water may migrate to the well.
- It is expensive and environmentally destructive and is used when conventional oil and gas extraction is not possible. It is now falsely hyped in the USA as unlimited energy. However there is still output, which, along with economic decline has masked the effects of Peak Conventional Oil in 2006.
- Fracking has been described as going to a bar, asking for a beer and being told by the barman, “Sorry the beer is run out, but you can suck some out from the old carpet beneath your feet if you like.”

Hydrofracking

Hydro Fracking well in the Bakken Formation, USA



Hydrofracking loses money

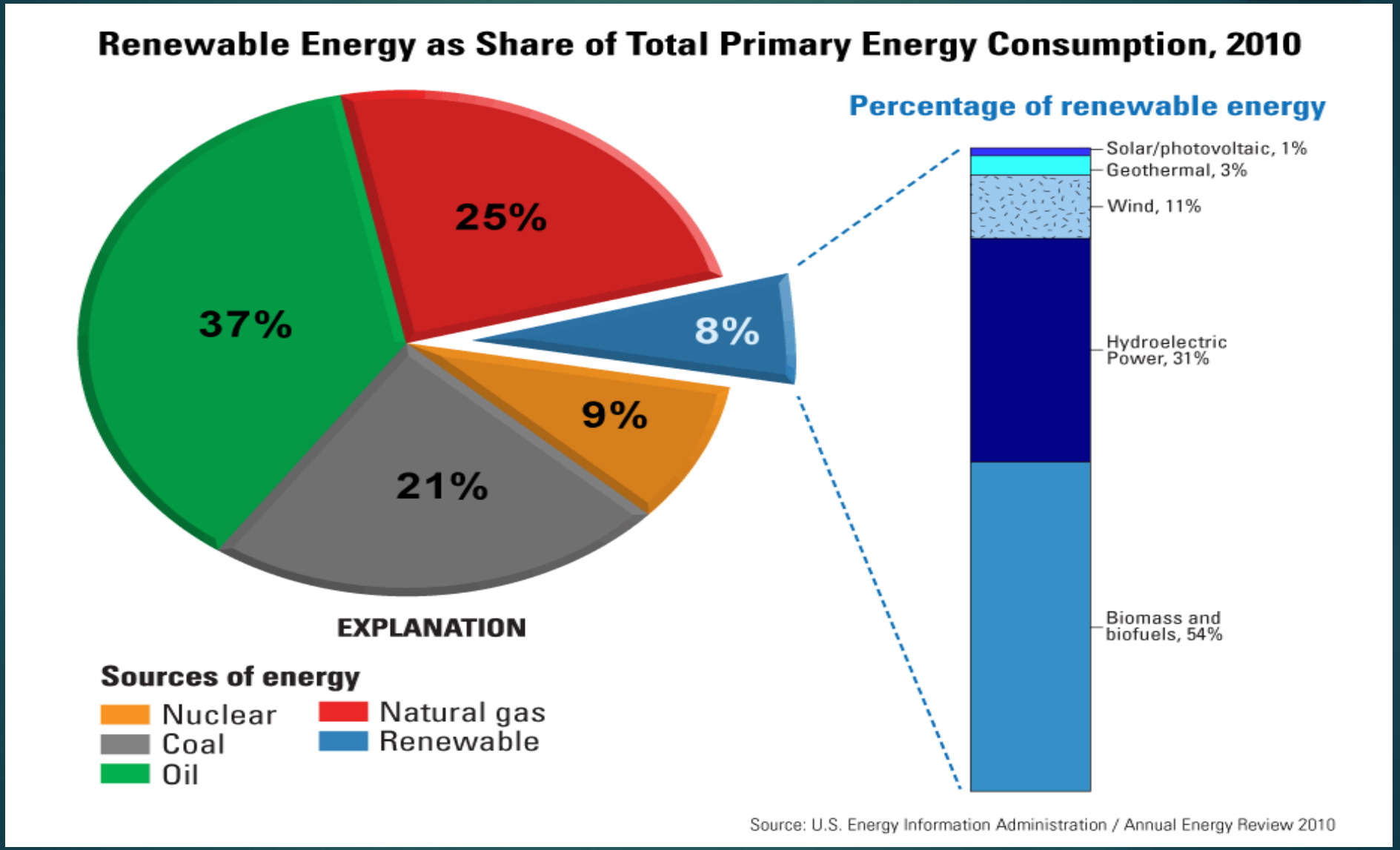
Hydrofracking wells peak immediately and generally decline by 69% in the first year, so the only way to keep production increasing is to keep drilling.

50 wells have been drilled in Europe and none so far yielded commercially extractable hydrocarbons.

The majority of US wells are uneconomic as of 2014.

Source: http://slate.me/WPBLUg

Where we get our energy



Where we get our energy

It is frightening how dependent we are on fossil fuels. We have only just begun the move away from fossil fuel energy. To meet projected needs we would need to increase nuclear ten fold, or increase bio-fuel ten fold.

US Energy Department report in 2005 stated that ‘the effects of Peak Oil will be abrupt, revolutionary, not temporary and bring an unprecedented risk’.

Even if we were to double the amount of energy we get from renewables, and then double it, and then double again, which would be a heroic achievement, it would still only create 3% of energy requirements.

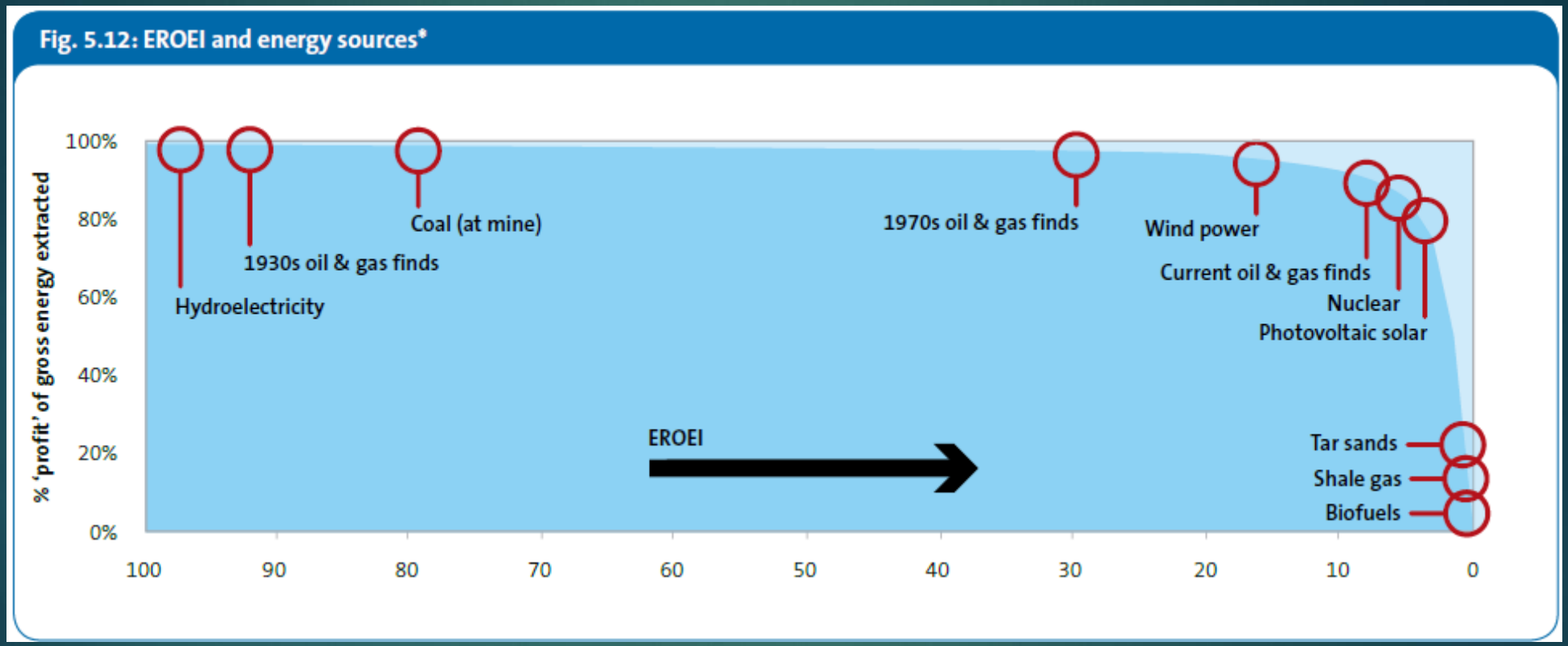
Soil and oil – production of rice in China has been high because of repeated application of large amounts of oil based fertilizers, pesticides, herbicides. Now the soil is dead. Soon there will be no cheap oil. Without cheap fertilizer to put on the dead soil we will see food shortages.

To build wind farms and solar panels we require oil, water and rare minerals– which are also in decline. Electric vehicles require lithium for batteries – also well beyond its peak.

Uneconomic – Energy Return On Energy Invested (EROEI). Gushing early-stage land oil wells have an EROEI of 100:1. Ethanol 1:1; Low grade crude oil 15:1; Solar panels 2:1 to 10:1

The Net Energy Cliff

EROI – Energy Returned On Energy Invested



EROI – Energy Returned On Energy Invested

Early fossil fuel extraction found the easy, high return energy first. This is expressed in the Energy Returned to Energy Invested equation (EROI).

In the early days of oil production the EROI ratio averaged 100:1. This meant lots of surplus energy was available.

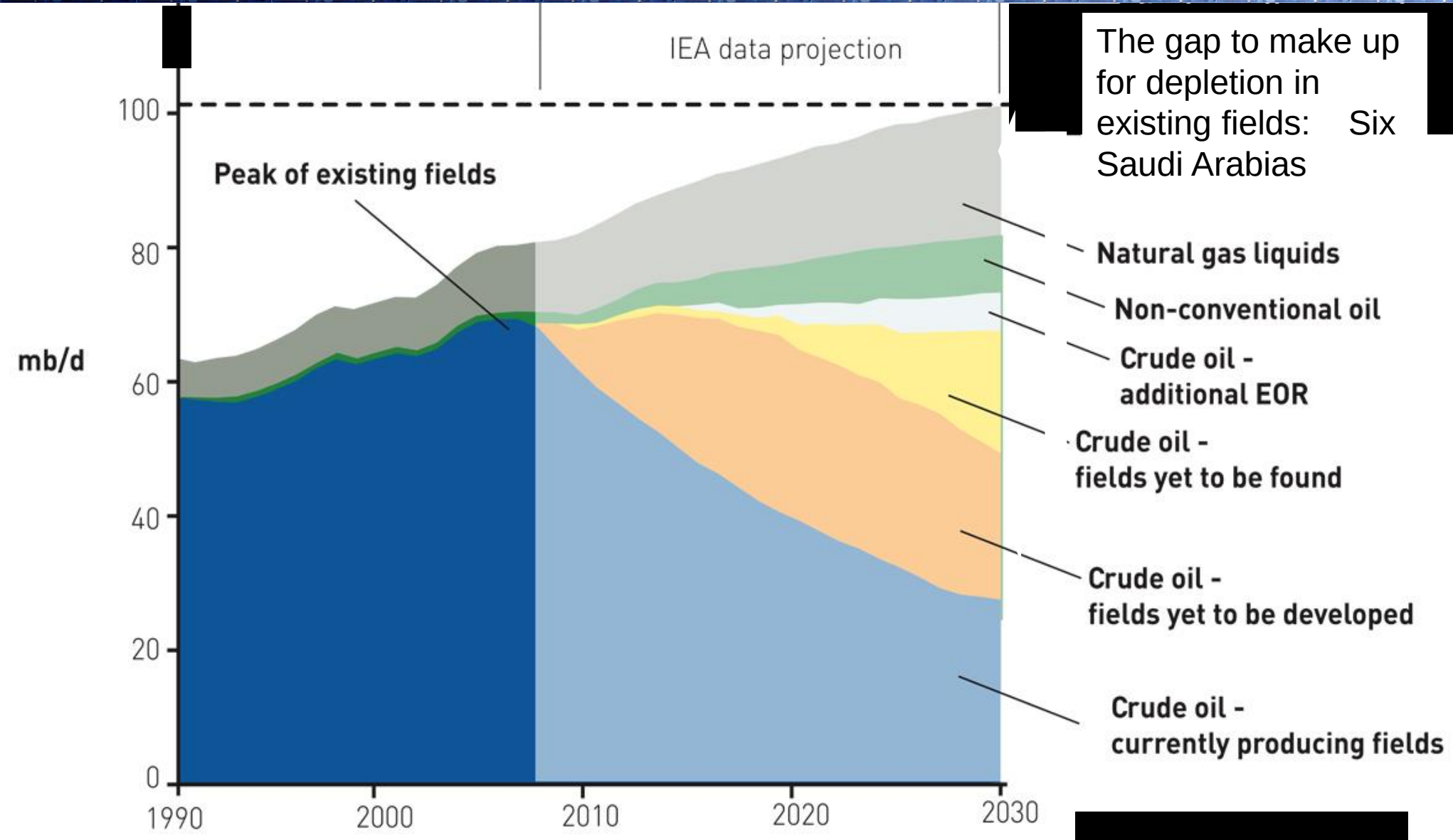
We now have to spend lots more energy (and money) to extract the same amount of energy. We are getting a much poorer return on our investment.

The newer forms of 'extreme energy' (tar sands, fracking, and deep water exploration) return a very low net energy; around 3:1. Anything lower than 5:1 net energy is not enough to run an advanced, complex society.

It doesn't matter how much energy there is in extreme energy, if the net return is so low, it is essentially worthless.

Source: Tullett Prebon report; *Perfect Storm*, *Energy, Finance, and the End of Growth*, Tim Morgan 2013

The International Energy Agency's view: WEO 2008

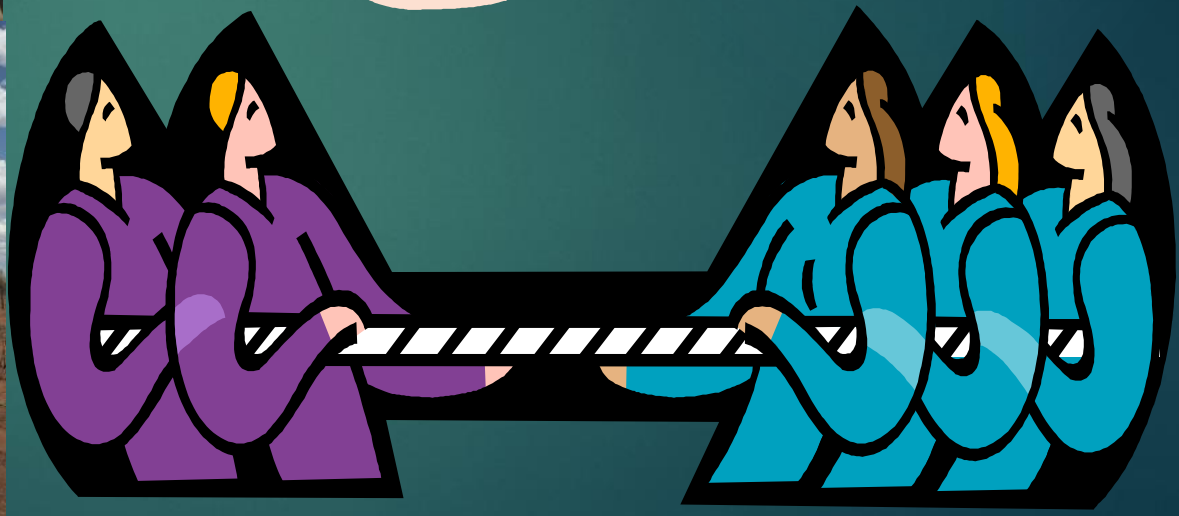


The gap to make up for depletion in existing fields: Six Saudi Arabias

Source: IEA World Energy Outlook 2008

- The International Energy Agency (long term Peak Oil deniers), are funded by major Governments. They now say that Peak Oil probably passed in 2006, but they tell us not to worry, the gap will be filled by other means. This would mean the equivalent of finding discoveries of the size six times the Saudi Arabian reserves by 2030; better technology making exploration and processing easier and cheaper; developing the reserves claimed to be underground (which are widely thought to be over-reported); relatively slow decline in current oil fields; and a huge increase in gas.
- This scenario is thought by many experts to be unrealistic.

So What?



Is the oil price important?

- In 1976, an oil shortage in UK saw the price increase 10 fold (from 3 dollars per barrel to 30 dollars per barrel). Economics works that when demand outstrips supply, the price must go up to squeeze some demand (users) out of the market, so that balance between demand and supply can return.
- Brent Crude Oil was USD110 per barrel in March 2014. In the Arab Spring of 2011 experts thought it would go to US$200pb.
- Availability of useable energy is more important than price
- Price is low only if demand is low. Demand and price may become low through economic depression, or widespread transition to low carbon lifestyles.

Leave the Fossil Fuels in the ground

"Leave fossil fuels in the ground"

- 12 December 2013, **Forbes**
- The International Energy Agency's World Energy Outlook 2013 highlighted the danger – current energy consumption puts the world on course for an increase in average temperatures of 3.6° C, far in excess of the 2° C the international community is aiming for. To have any hope of meeting the 2° C, **we need to leave two thirds of current fossil fuel reserves underground**, the IEA says

- According to Climate Experts on the IPCC

  500 ppm = + 3.5 degrees (above pre-industrial levels) = up to 70% extinction of animals and plants

If conventional peak oil had already happened, what sorts of things would we see?

The Signs of Peaking

- Light sweet crude peaks. This is the most profitable and easy to extract and refine oil, so it will be exploited first
- The worlds largest oil fields peak and begin to decline
- More and more oil producing countries start to decline
- Oil price increases rapidly, and then maybe crashes, erratic behaviour
- Exports from oil producers peak and start to decline
- Oil producer countries take control of their resources

.....all this has already happened, and has accelerated in the last 5 years. The Senior Economist of the International Energy Agency said in May 2011 – 'I feel that the peak in conventional oil may already have occurred in 2006' - we are being kept going in the short term by expensive and destructive fracking.

- It must be the end of energy intensive life styles for most of us.
- Low-carbon living is our future, whether we want it or not.

Net Energy and Economic Growth

Fig. 5.14: High EROEI

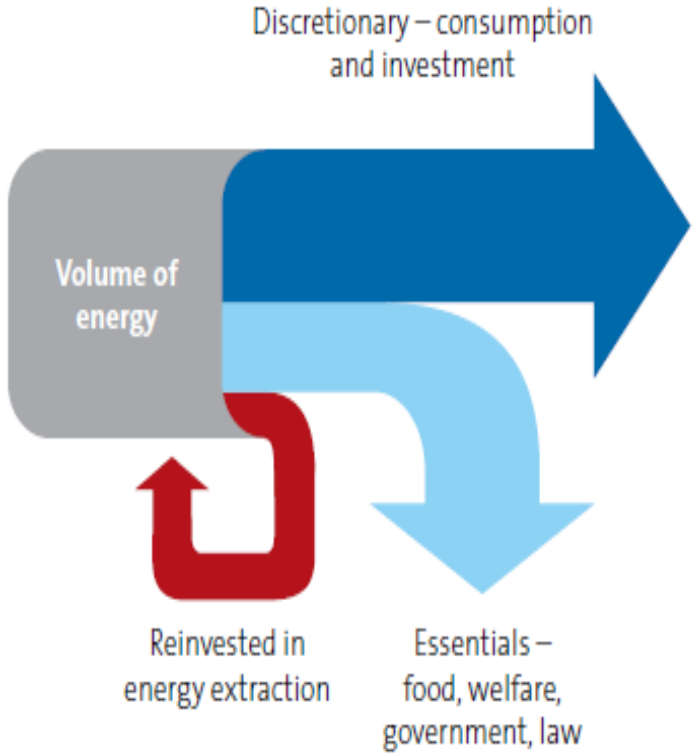
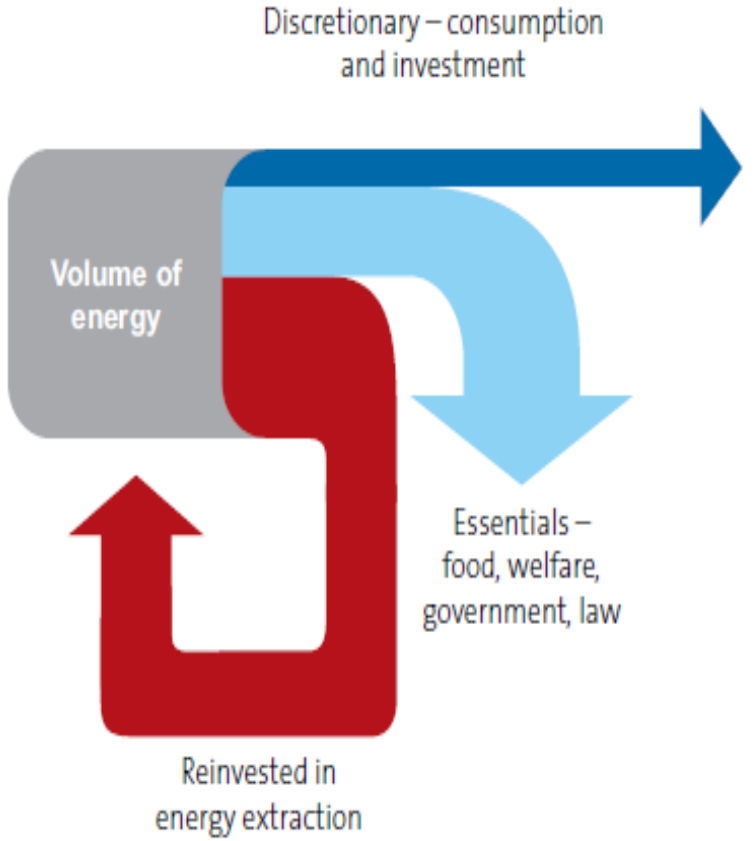


Fig. 5.15: Low EROEI



Net Energy and Economic Growth

As the global economy is based on the use of energy, economic growth becomes limited as net energy available decreases.

As the energy required to find and produce energy increases, the energy available to do everything else decreases.

As we are required to maintain the basics of society – for example infrastructure (roads, water, sewage, electricity grid, railways etc) and government - there will be little left over for everything else (also know as discretionary spending).

As Europe and the USA has focussed their economies to supply the more profitable discretionary spending elements, economic growth for those economies may now be impossible.

Uncertainty about government statistics and the use of debt to 'pay' for our lifestyles in the West may mean that we have not experienced any economic growth since the late 1980's. The bursting of the debt bubble in 2007/2008 has brought an end to the illusion of growth that we, as yet, mostly can't see.

Source: Tullett Prebon report; *Perfect Storm*, *Energy, Finance, and the End of Growth*, Tim Morgan 2013

- We can help the situation by adjusting our lifestyles and expectations now.
- Get used to having no cheap oil around – scale down now and get prepared by exploring what it is like to live a low-energy lifestyle.
- Using less oil now in travel, high-mileage food, and consumer goods will ease the acceleration of climate change
- Change starts with us as individuals
- Spread the word, please