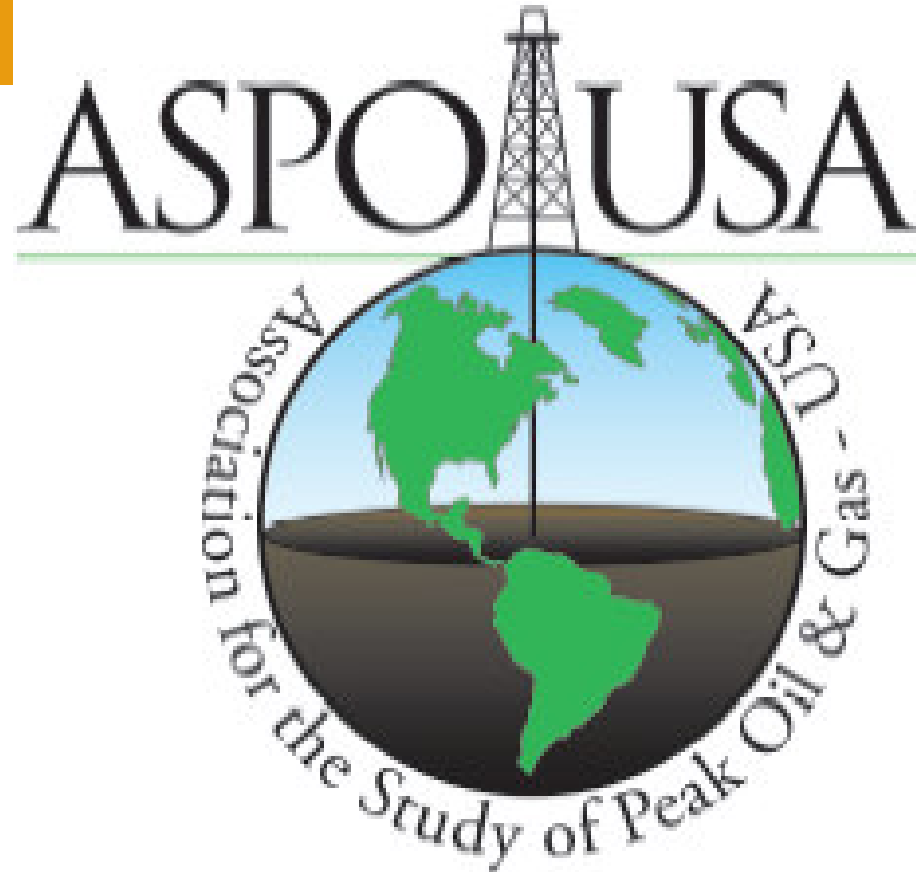


Denver World Oil Conference

Beyond Oil: Intelligent Response to Peak Oil Impacts

A Dialogue with the Experts



*Energy Action for a Healthy Economy
and a Clean Environment*

The production reality

- Chris Skrebowski: Trustee of the Oil Depletion Analysis centre and



of Petroleum Review, Energy
te

Chris Skrebowski
Editor Petroleum Review

An important disclaimer

In this presentation the opinions expressed are entirely those of Chris Skrebowski in his capacity as an ODAC Trustee and as such do not necessarily reflect the view of the Energy Institute for whom he edits Petroleum Review

Some reasons for being here today

- **Oil prices are at their highest levels since the 1978/85 spike which gave us the early 1980s recession**
- **There is little or no immediate spare capacity**
- **Stock markets are getting jittery**
- **And economic growth is under threat**
- **The problem is scale The challenge is flows**
- **In 1970 we used 42mn b/d - We are now using 84mn b/d**

What have I learned in 35 years?

- **Plan early and plan often**
- **Try to ignore your own hopes/fears**
- **Few with a commitment are objective**
- **Let the data speak for itself**
- **Never be afraid of your honest conclusions**
- **When I get new information I change my mind.
What do you do?**
- **Spotting the reaction/adaptation is the difficult bit**

Collectively Humanity is:

- **Very clever, very ingenious, very adaptable**
- **So it is reasonable to be optimistic**
- **It is reasonable to anticipate technical solutions and new fuels we cannot currently envisage**
- **But humanity is also greedy, competitive, short-sighted and tribal**
- **Concern & apprehension are appropriate**

The challenge of Peak Oil

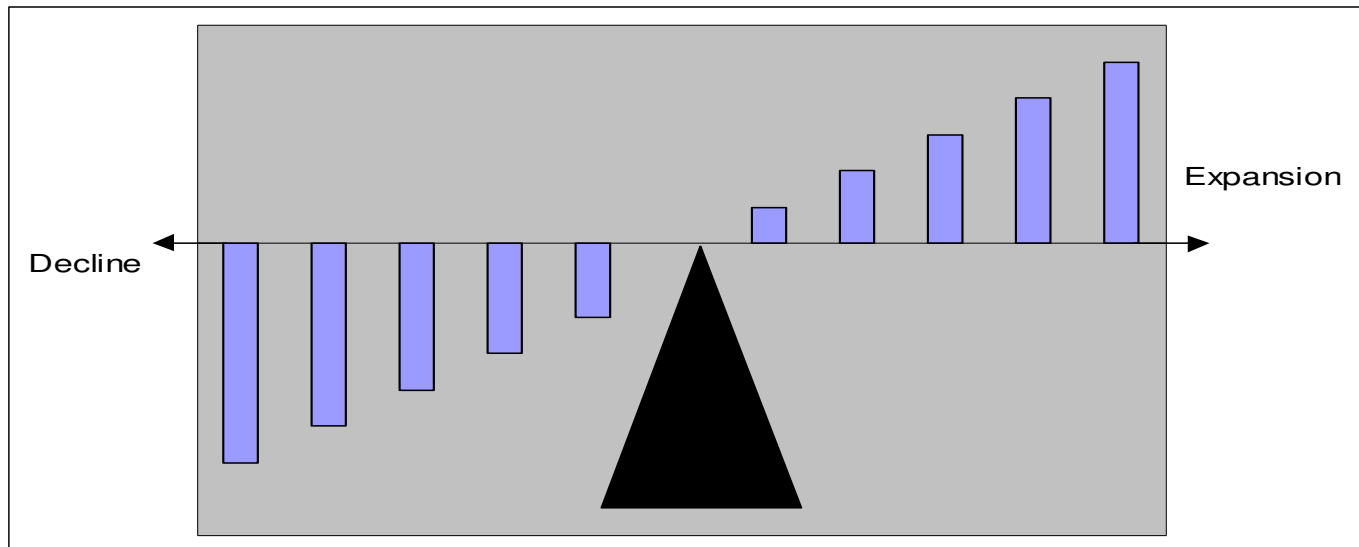
- **To meet a challenge**
- **You first have to recognise you face a challenge**
- **I aim to show you that:**
- **‘Peak Oil’ is real and imminent**
- **That time is short**
- **That adaptation will not be easy**

So what is 'Peak Oil'?

- **It is the point when further expansion of oil production becomes impossible because:**
- **New production flows are fully offset by production declines (depletion)**
- **You never run out of oil**
- **You do run out of incremental flows**
- **The world depends on oil products to support growth**

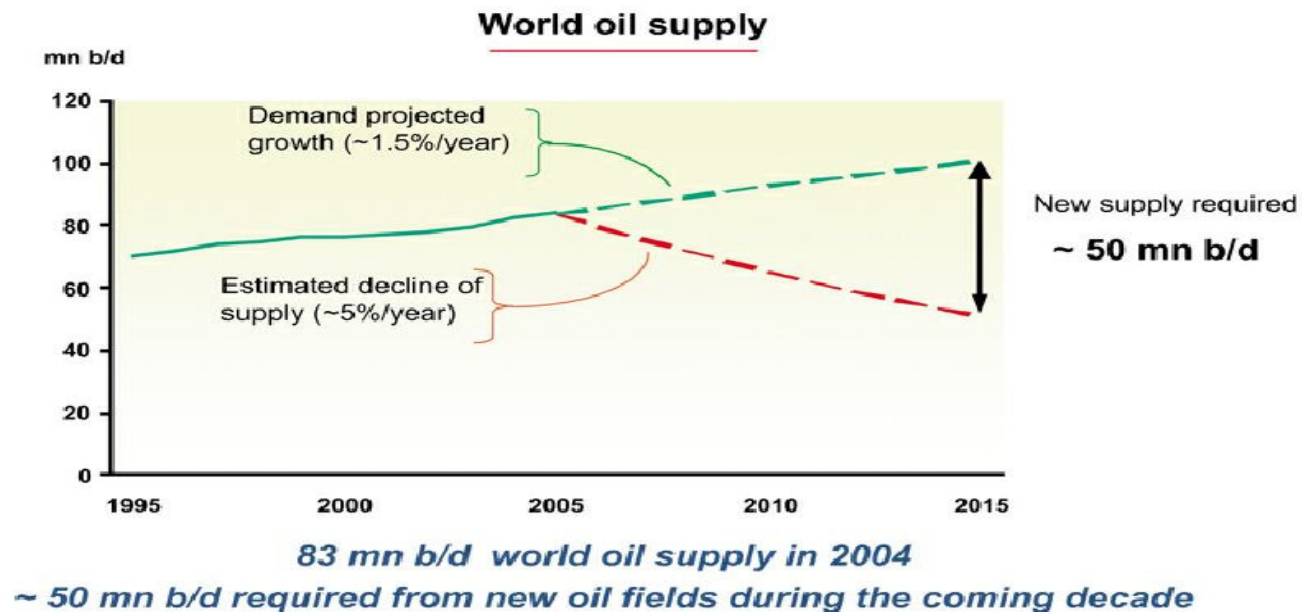
A simple observation

‘Global production falls when loss of output from countries in decline exceeds gains in output from those that are expanding.’

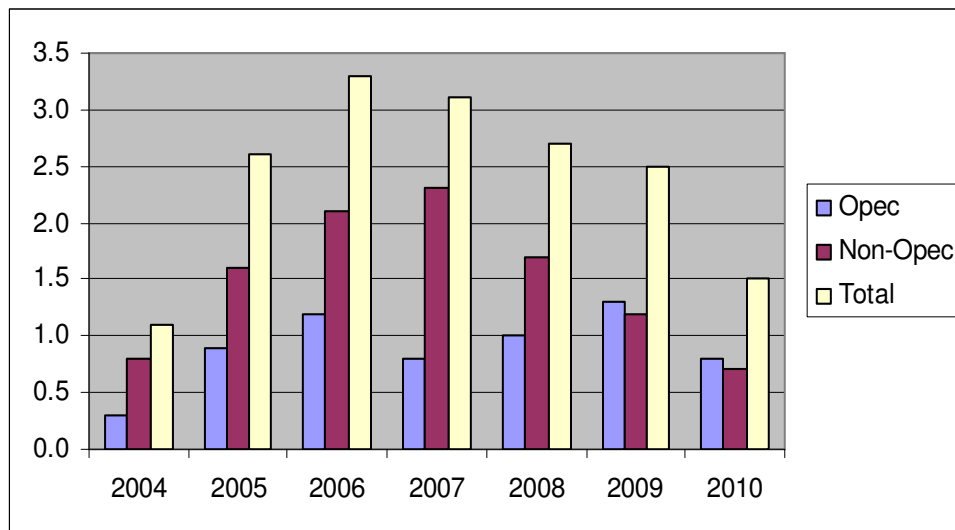


The depletion challenge

Answering the global call for oil represents a key challenge for the industry over the coming decade

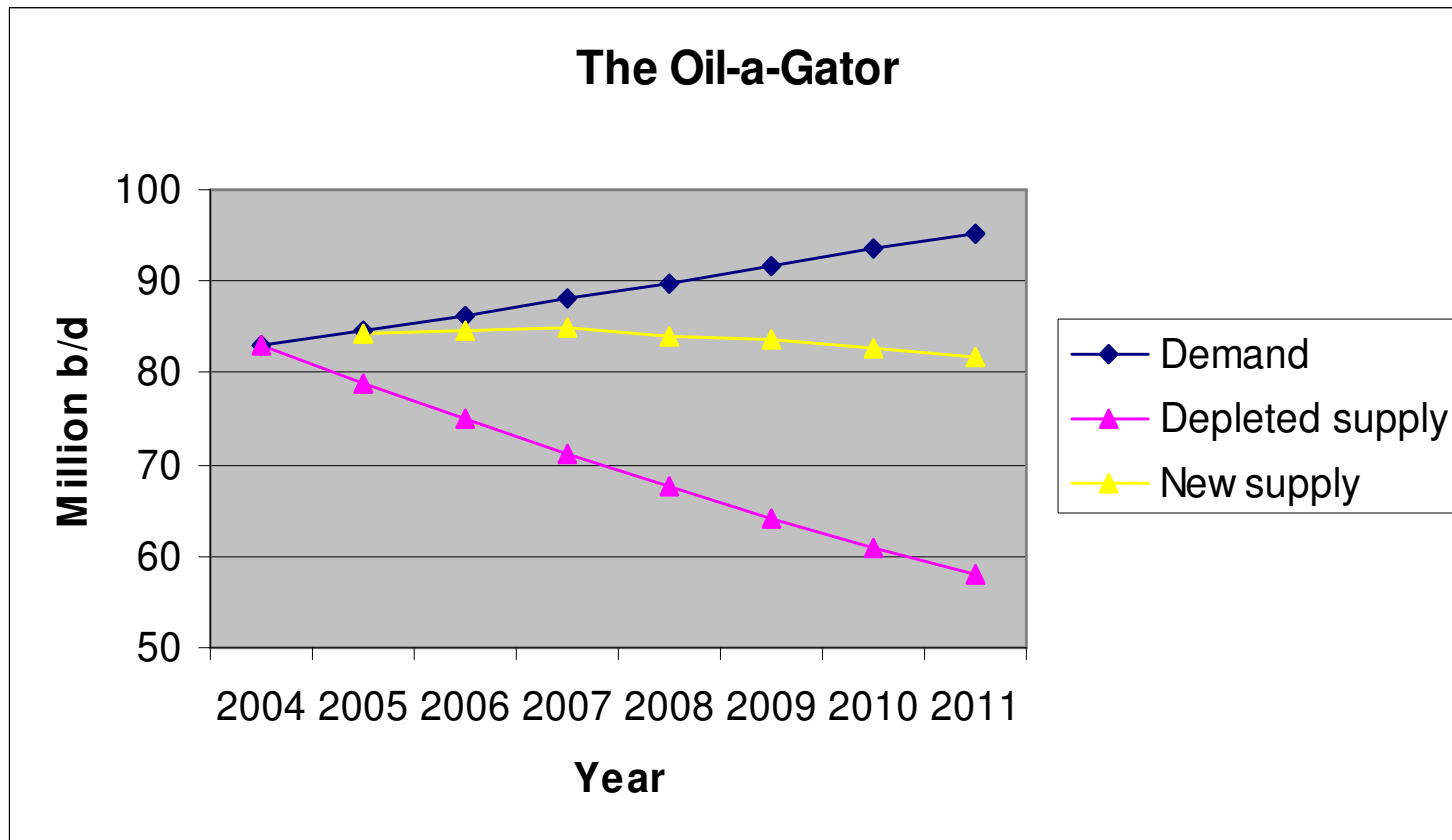


New supply from Megaprojects (In million barrels/day)



| | Opec | Non-Opec | Total |
|------|------|----------|-------|
| 2004 | 0.3 | 0.8 | 1.1 |
| 2005 | 0.9 | 1.5 | 2.4 |
| 2006 | 1.1 | 2.1 | 3.2 |
| 2007 | 1.0 | 2.1 | 3.1 |
| 2008 | 0.9 | 1.7 | 2.6 |
| 2009 | 1.3 | 1.3 | 2.6 |
| 2010 | 0.8 | 0.7 | 1.5 |

Introducing the Gator

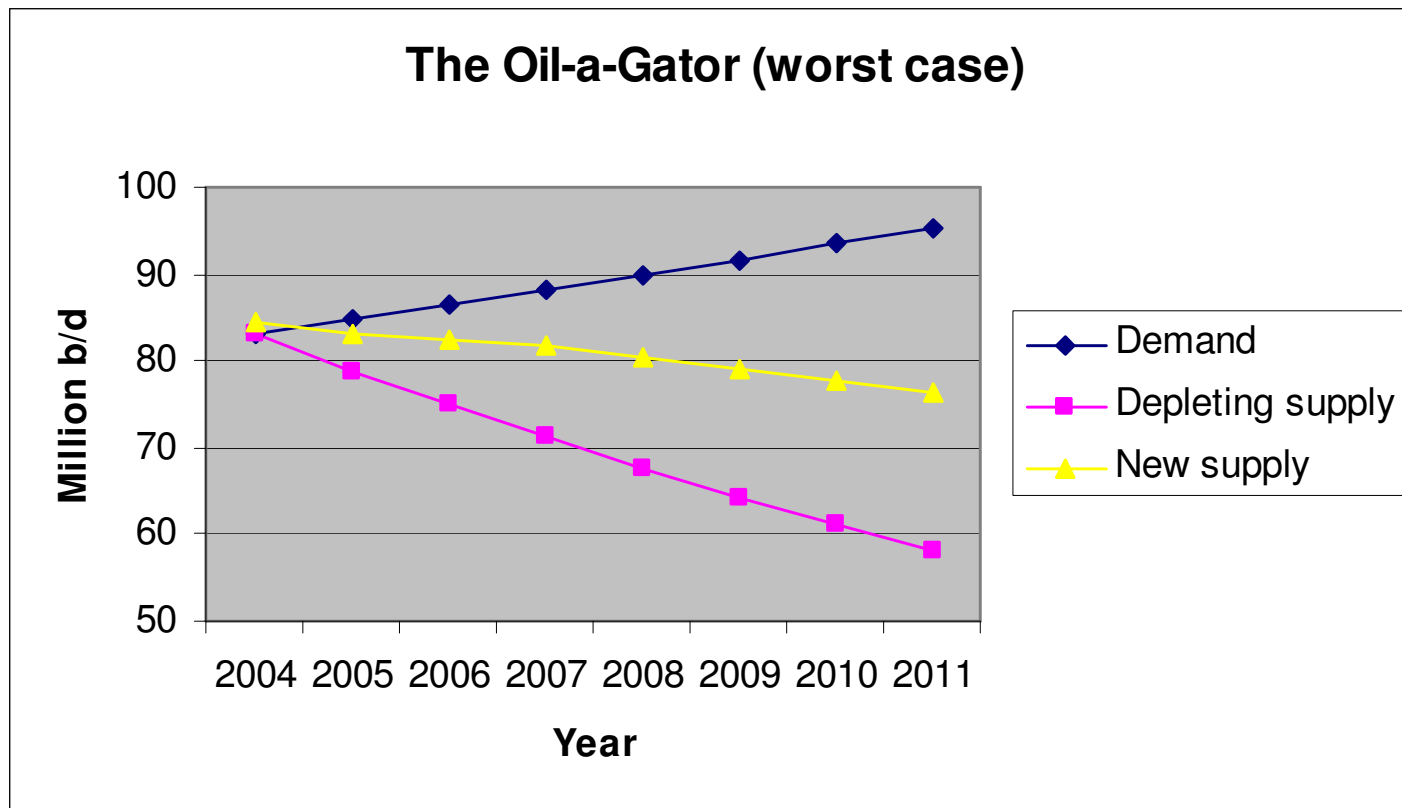


Actual supply will always be lower

(Remember the random factors)

- **Projects slip (typically 10-20% each year)**
- **Companies are always optimistic (take off 10%?)**
- **Governments are always optimistic**
- **Enhanced recovery is slow and limited (0.5%-1.0%/yr?)**
- **Depletion rates are rising (6%? 8%?)**
- **The number of countries in decline is rising**
- **90% of known reserves are in production (oil higher)**

Realistic or dire?



Why does 'Peak Oil' matter?

- **80-95% of all transport on the planet is fuelled by oil products and transport accounts for 70% of oil use**
- **All petrochemicals are produced from oil**
- **99% of all lubrication is done with oil products**
- **95% of all goods in the shops get there using oil**
- **99% of our food involves oil or gas for fertilisers, agrochemicals, tilling, cultivation and transport**
- **So use more efficiently or do without**

Are there realistic substitutes for the main oil products?

- **Petrochemicals – naphtha, some gas/LPG. (Few alternatives)**
- **Aircraft fuel – jet kerosene, some Avgas. (No realistic alternatives)**
- **Road vehicle fuels – Gasoline and Diesel dominant. (Alternatives - Large Investments/capital write-offs)**
- **Ships and boats – marine diesel and fuel oil. (No realistic alternatives)**
- **Lubricants and greases – (limited alternatives)**
- **Power generation – (little oil now used)**
- **Heating – (increasingly substituted by gas)**

What's the problem with alternatives?

- **Oil has the greatest energy density of any fuel known to man, apart from nuclear**
- **This means all alternatives are inferior**
 - **You can cook sausages by collecting and burning straw but you may use more calories than you get by eating the sausages**

What are the substitutes?

- Alcohols - fuels and extenders (energy gain?)
- Vegetable oils - diesel substitute/extender
- Gas liquids - road fuels, feedstocks
- Coal - heating, power generation

Hydro, nuclear, wind, waves and biomass can all generate power. But at what cost? Little oil is now used for power generation.

Can we make our economies all electric?

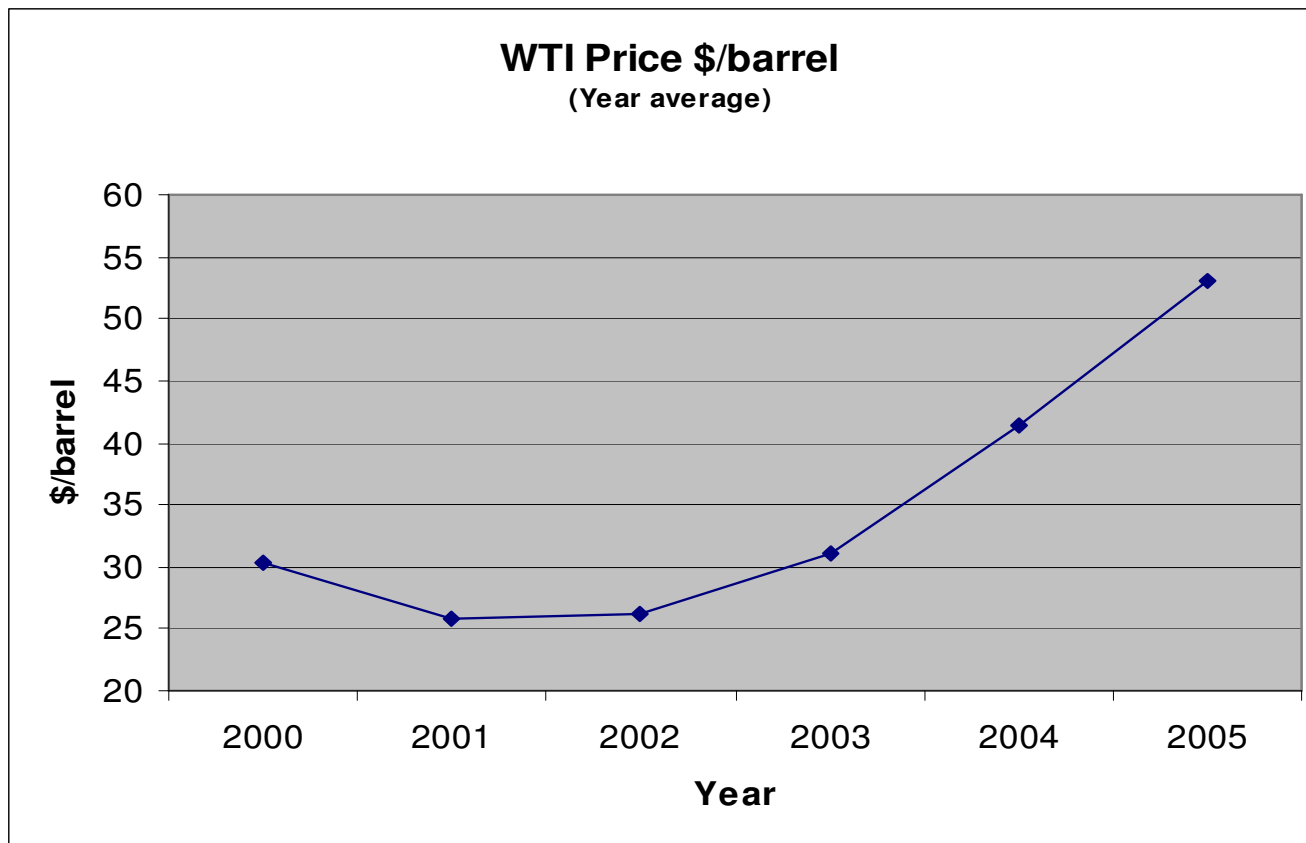
The practical realities of oil depletion

- The world needs oil production *flows*
- Reserves are only useful as *flows*
- Peak oil is when *flows can't* meet the required demand
- This will cause an 'Economic Tsunami'
- There's not much time to accommodate

What economics really says

- **Economics requires that supply and demand always balance**
- **Economists have assumed that supply will expand to meet demand via a high price signal**
- **If supply can't expand we need the high prices to 'destroy demand'**
- **How high do prices need to go?**

What is the price telling us?



The CIBC answer

- Assessed the likely supply shortfall and the oil price needed to reduce demand
- 2006 1mn b/d and \$61/barrel *1.8mn b/d*
- 2007 2.8mn b/d and \$70/barrel *3.2mn b/d*
- 2008 4.8mn b/d and \$80/barrel *5.7mn b/d*
- 2009 6.7mn b/d and \$90/barrel *8.1mn b/d*
- 2010 8.9mn b/d & \$101/barrel *10.7mn b/d*

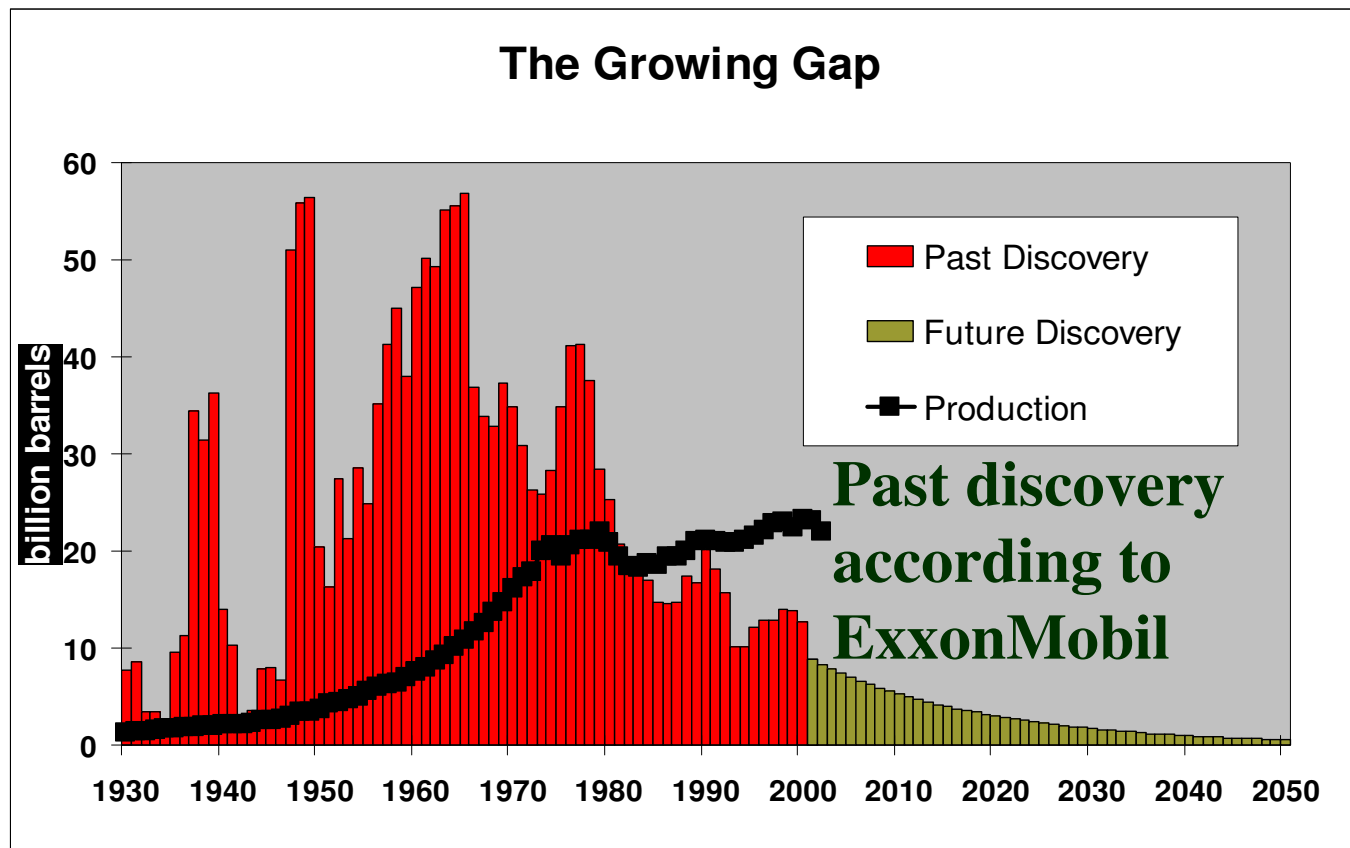
2004 was a key year for depletion

- **All spare capacity used (0.5-1.0mn b/d in Saudi?)**
- **So now we have an accurate baseline**
- **But also in 2004:**
- **Refinery spare capacity nearly disappeared**
- **Sulphur removal capacity did disappear**
- **Chinese demand exploded**
- **Tankers were costly and in short supply**
- **But, skilled personnel is the biggest shortfall**

Why am I sure 'Peak Oil' is close?

- **The oil industry is slow moving**
- **It is not finding oil fast enough**
- **It is not developing oil fast enough**
- **There are few known undeveloped reserves**
- **Enhanced recovery is small**
- **The world needs flows**
- **Reserve estimates are weak (relevant?)**

The Real Discovery Trend



Exploration is the route to new reserves but exploration is not ‘treasure hunting’

- **The likely rewards must exceed the likely costs**
- **Wood Mackenzie tells us the large oil companies destroyed value in the North Sea by going on exploring**
- **Now they tell us that the 10 largest private oil companies, between 2000 and 2003, discovered oil with a NPV of \$4billion at a cost of \$8bn**
- **Tax offsets make exploring cheap - the 10 cent dollar**
- **Higher oil prices may help but they don't create oil**
- **Future development now requires high oil prices**
- **So far discovery is still falling**

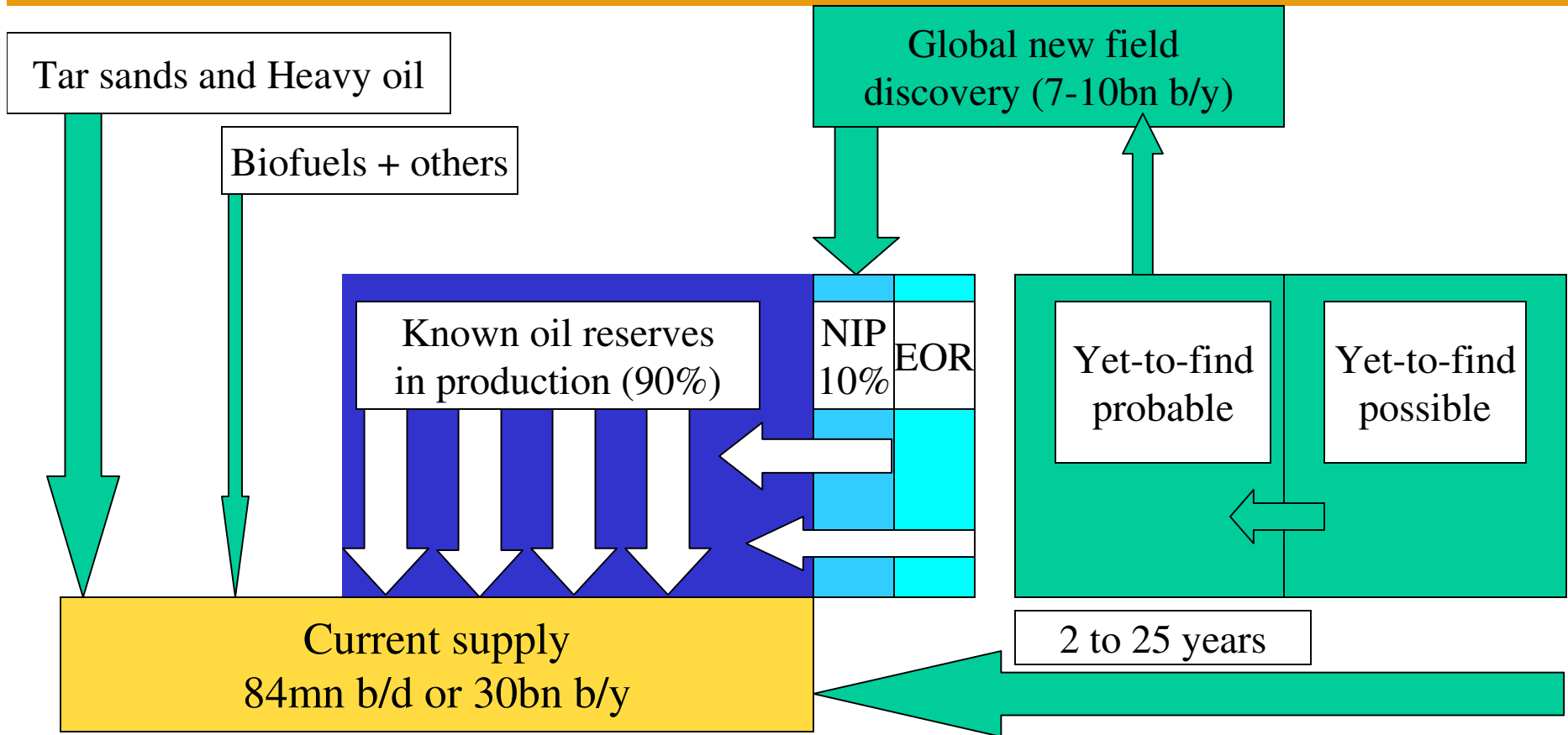
Projects are slow and well publicised

- **2.5 years for an onshore rework (Saudi AFK)**
- **3-4 years for new onshore projects (Algeria)**
- **5-7 years for a major offshore field development**
- **8-9 years for Nigeria - Bonga, Agbami, Akpo**
- **5-6 years for a new refinery**
- **Over 2 years for a new sulphur removal plant**
- **The development die is largely cast to 2010**
- **That's why the economists are misleading us**

A terrible calculation

- No more than 8-10% of oil field reserves can be produced at a fields' peak flows
- A 1bn barrel field gives peak flows of 250,000 b/d
- To get a flow of 1 million b/d you need to develop reserves of 3.7- 4.6 billion barrels
- In 2004 total world discovery was 7bn barrels
- In 2004 demand growth was 2.9mn b/d
- That needs production from 13bn barrels of new reserves
- Recent discovery has averaged 10bn b/y which gives 2.5mn b/d five years later **BUT WE NEED 5mn b/d**

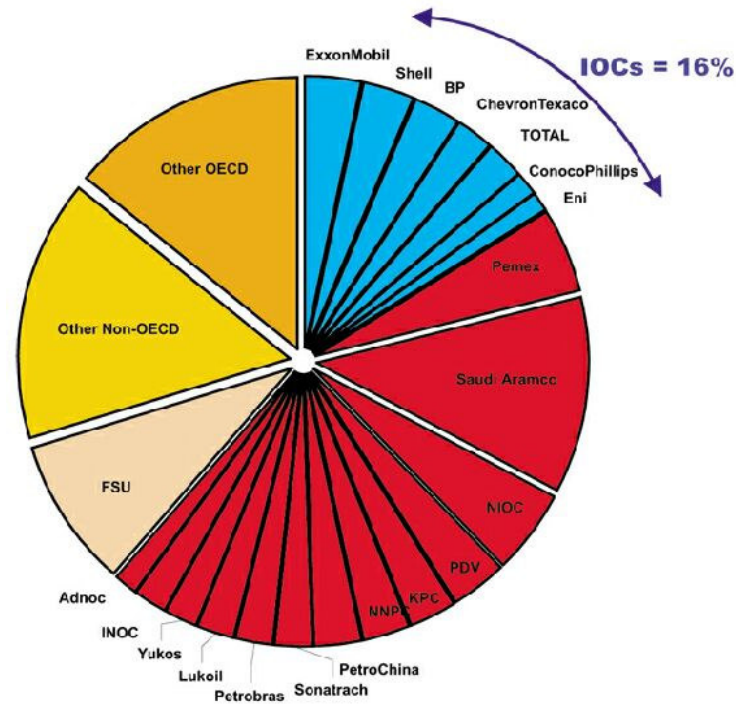
Oil production flows- all new flows take two to twenty-five years



The oil companies are already struggling to hold production

- In the first half of 2005 oil production was:
 - Down --1.72% below 2004 for the Big 5
 - Down --1.14% below 2004 for the Big 10
 - Down -- 0.92% for the 22 largest quoted companies
- These are the best, richest and most mobile
- They are failing to hold their market share
- Quarterly oil decline rates range up to 8%
- Annual gas decline rates of up to 5%

20 companies produce 67% of global production



*20 companies produce just over 60% of world production
Amongst those, only 7 are international oil companies (IOCs)*

Future oil demand growth

- In 2003 oil demand grew by 1.8mn b/d (2.3%)
- In 2004 oil demand grew by 2.8mn b/d (3.5%)
- In 2005 5th revision is 1.4mn b/d (1.7%)
- In 2006 first estimate is 1.75mn b/d (2.1%)
- Twenty year average is only 1.5-1.8mn b/d (1.8%)
- So 2% growth is an easy working rule
- Does Chinese and Indian demand growth represent a paradigm shift?

How does depletion work?

Three sorts of depletion:

- Type 1 is 'within field' like different pumps in bar
- Type 2 is 'within country' like different bars
- Type 3 and most important is 'national' like different pubs, it is *visible* depletion
- Total (1,2 &3) depletion around 5% or 4mn b/d/yr but may actually be nearer 7%
- Type 3 depletion is around 1mn b/d but rising

Type 3 depletion acts like new demand

- **Over 50 countries now depleting (20 large)**
- **In 2004 some 27.4% of supply came from countries in outright depletion**
- **Ten countries producing over 0.5mn b/d were in decline in 2004**
- **More large producers are set to decline**

The oil depletion balance sheet at end 2004/early 2005

- In decline 28% but 40% by 2007/8
- In danger 12% but 10% by 2007/8
- Russia 12% and 12% by 2007/8
- Growing 48% and 38% by 2007/8
- The scales are 'balanced' by 2007/8
- So does President Putin decide when decline starts? Or does Saudi geology?

The top five decliners in 2004

(weighted average decline 3.6%)

| Country | Production | Peak Year | Decline |
|-----------|------------|-----------|---------|
| USA | 7.2mn b/d | 1985 | -2.15% |
| Norway | 3.2mn b/d | 2001 | -2.30% |
| UK | 2.0mn b/d | 1999 | -10.10% |
| Indonesia | 1.1mn b/d | 1991 | -4.80% |
| Oman | 0.8mn b/d | 2001 | -4.60% |

About to go into decline (More Type 3 losses)

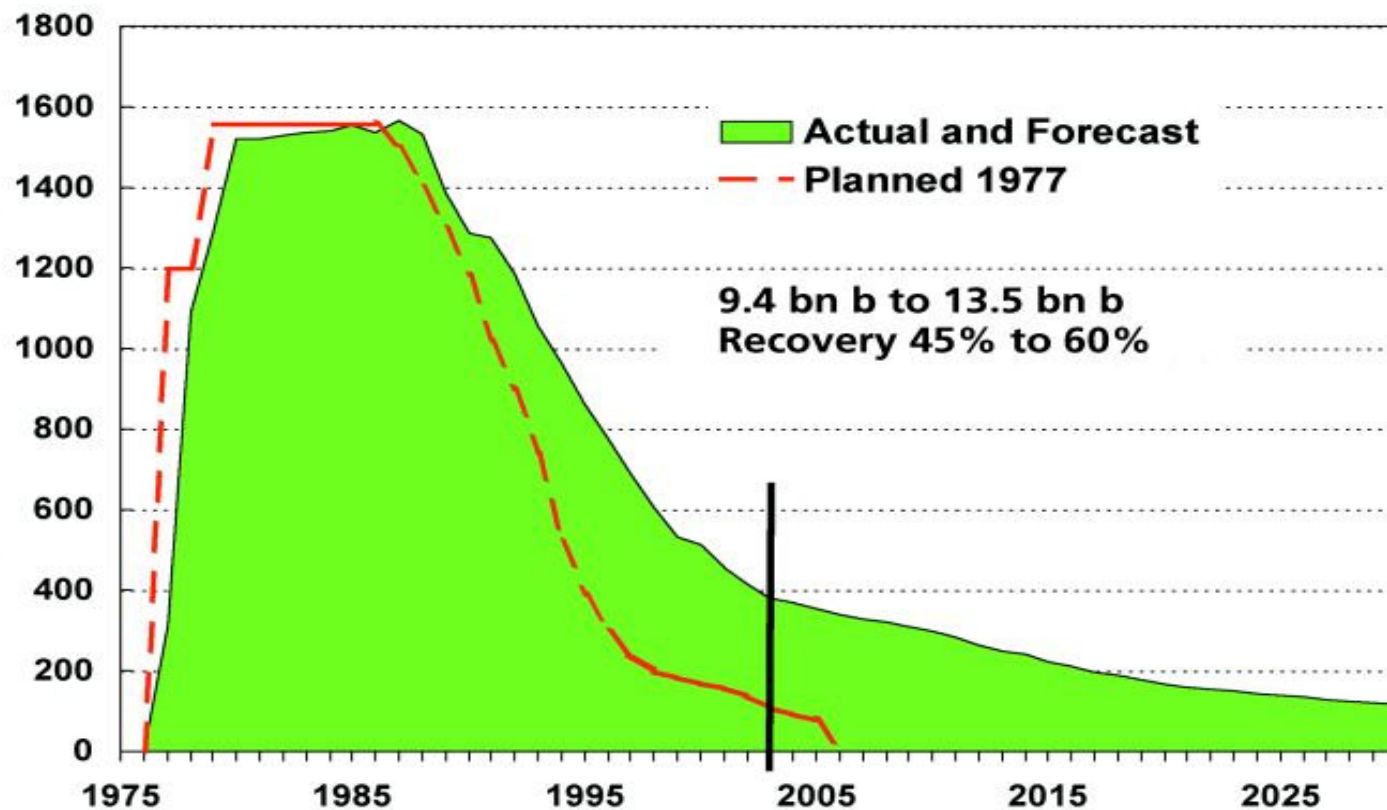
- **Denmark producing 0.4mn b/d goes in 2005**
- **Malaysia producing 0.9mn b/d goes in 2005/06**
- **China producing 3.4mn b/d goes in 2005/06**
- **Mexico producing 3.8mn b/d goes in 2005/06**
- **Brunei producing 0.2mn b/d goes in 2006/07**
- **India producing 0.8mn b/d goes in 2006/07**
- **Collectively 9.5mn b/d or 12.3% of production**

Are all reserves equal or are some reserves more equal than others?

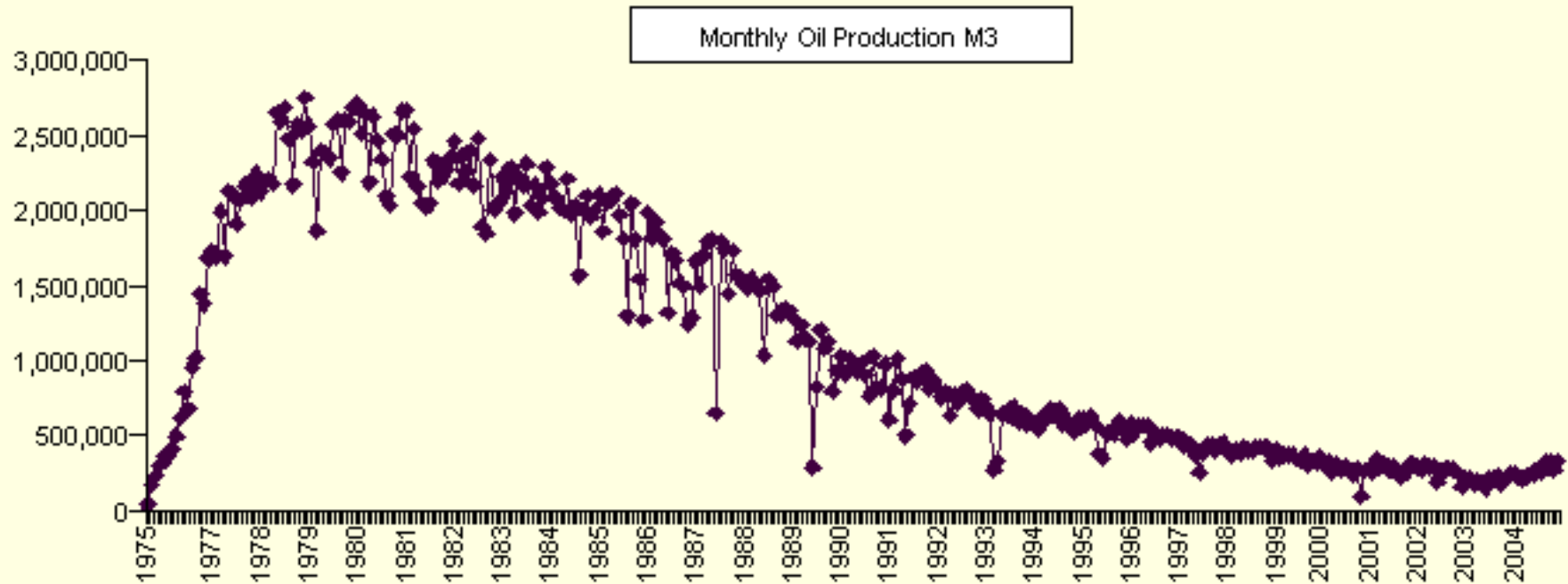
- **A new field can be produced at high flow rates**
- **A field in decline can only be produced slowly**
- **Oil companies, analysts and the financial world treats all reserves as equal**
- **Does this make sense?**
- **Can it be made to make sense?**
- **Lets look at a real example**

Alaskan North Slope Production

Reserves grow -- Production falls



North Sea Forties field production by month



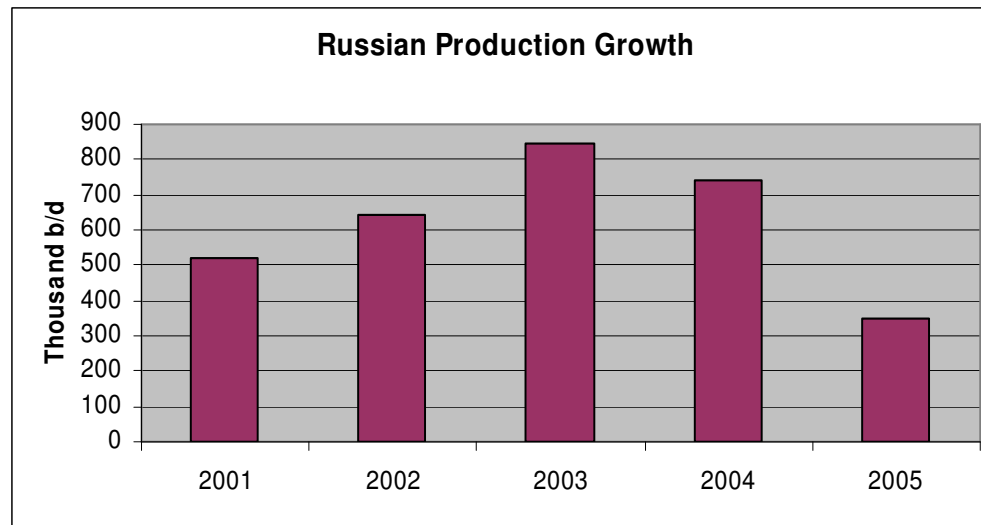
Technology. Answer or illusion?

- **Almost heresy to question the merit of technology**
- **But is it just getting round high costs?**
- **Just allowing faster drainage of reservoirs?**
- **How much new oil is it really accessing?**
- **Is it really opening up new opportunities?**
- **What is the scale of technologies impact?**
- **As Colin Campbell says ‘The new seismic allows you to find a needle in a haystack, but it is still a needle’**

The rise and fall of UK North Sea production

- In 1999 it grew by 3.58% or 100 kb/d
- But in 2000 it fell by 8.15% or -236 kb/d
- And in 2001 it fell by 6.81% or -181 kb/d
- But in 2002 it fell by just 0.52% or -13 kb/d
- But in 2003 it fell by 8.85% or -218 kb/d
- And in 2004 it was 10% down or -230 kb/d
- IEA estimates -105kb/d (05), -180kb/d (06)

The Russian Enigma

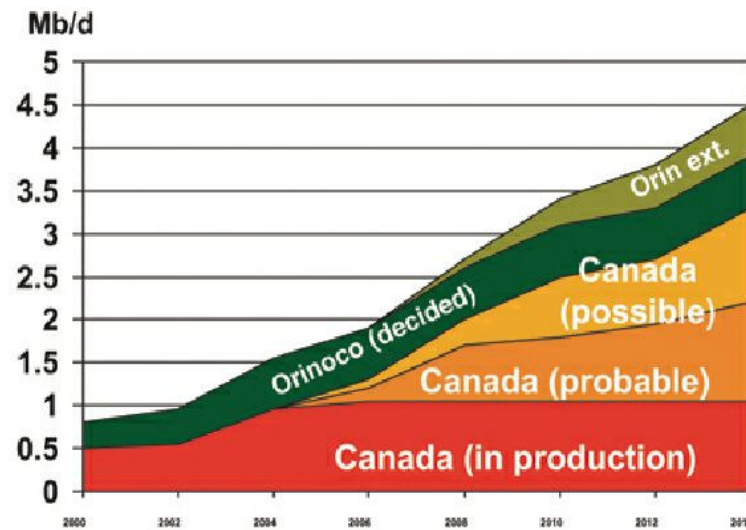


- **50-95% of non-Opec growth in 2001-2004**
- **1.4% growth in Russian production in 1H2005**
- **Has policy changed? Has growth run out?**

Some good news (production by end 2005)

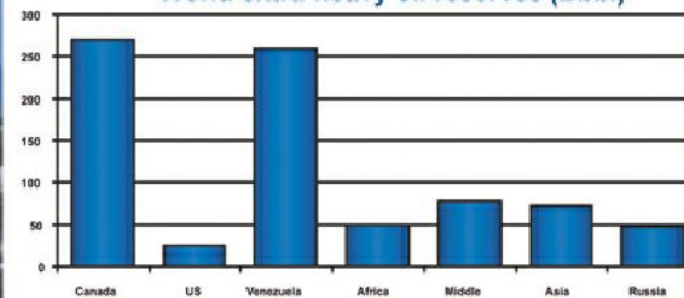
- **Rapid production growth from:**
- **Kazakhstan (1.3mn b/d) and Azerbaijan (0.8mn b/d)**
- **Gulf of Mexico (1.7mn b/d?) and Brazil (2.1mn b/d)**
- **Sudan (0.4mn b/d) and Equatorial Guinea (0.3mn b/d)**
- **From 5mn b/d in 2003 to over 8mn b/d in 2010**

Heavy oil -- nice to have but....



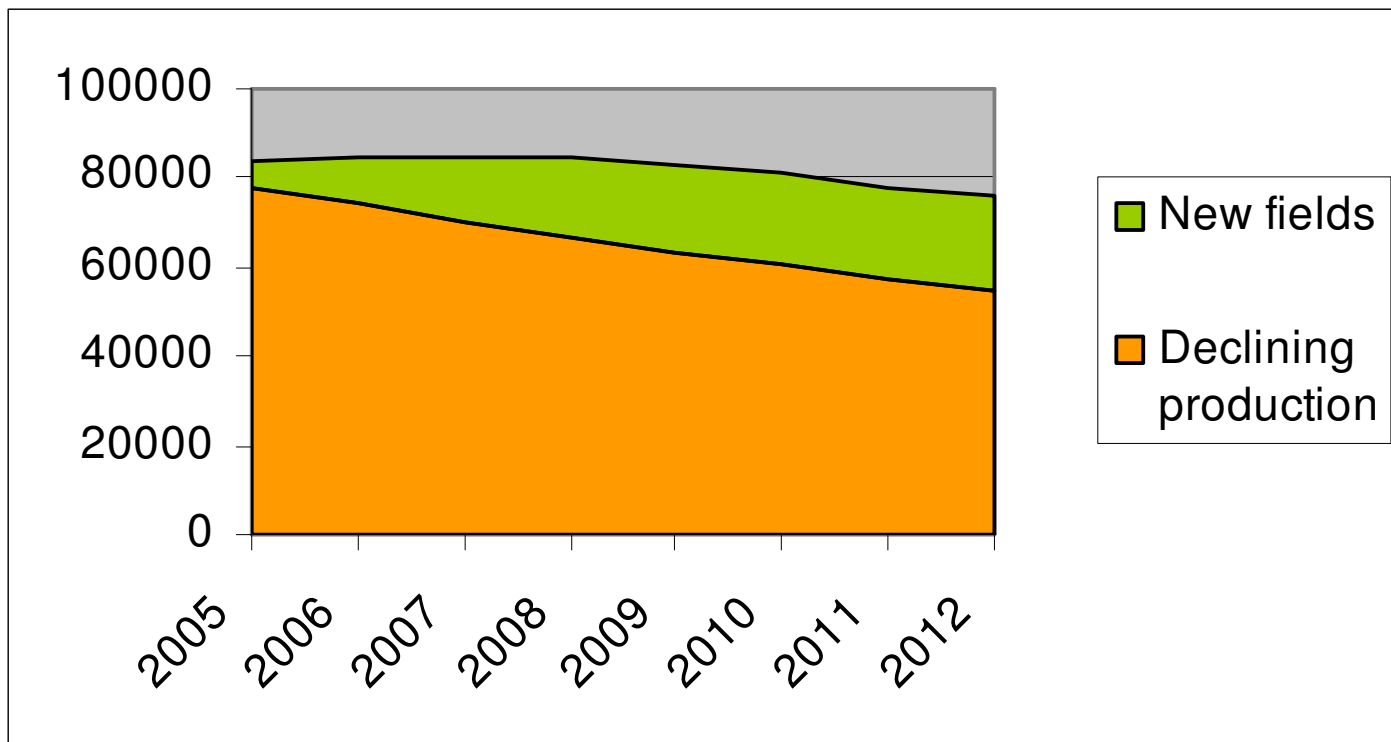
Denver ASPC

World extra-heavy oil reserves (Bbbl)



Source: BPMA, Core IISSE

A visual summary



Delaying 'Peak Oil'

- **Economic slowdown/recession**
- **Demand destruction via high prices**
- **Large scale Opec investment, but it takes time**
- **Peace in Iraq**
- **Middle East opening to investment**
- **But, accelerating projects produces cost inflation rather than more oil**

Advancing 'Peak Oil'

- Project slippage (happens regularly)
- Increasing taxes/tighter terms (happening)
- Accelerating decline (happening)
- Upheaval in major producers (Iraq, Nigeria, Venezuela already happened)
- Accelerating demand growth (China, India)
- System breakdowns, wars and revolutions, storms and hurricanes (happening)

‘Peak Oil’ in 2008?

- **Whatever approach we use the answer seems to be ‘Peak’ by 2008**
- **Before that, if all goes to plan, the world can, possibly, meet likely demand**
- **After that demand can only be met by massive demand destruction/recession**
- **But, Peak could be this winter**

My conclusions?

- **There are, at best, 30 months to Peak Oil**
- **'Business as usual' after 2008 is unlikely**
- **High prices will continue**
- **Restricted supply will continue**
- **We are moving into a new world**
- **It is a land without maps**
- **We are all likely to be poorer**

My three recommendations

- Ask employees and taxpayers for ideas. Collectively we're smarter than any individual or organisation
- Invest now to minimise fuel use - it cannot be a misinvestment
- Do everything possible to reduce travelling distances



**Many thanks for
inviting me to
Denver**

Contact:

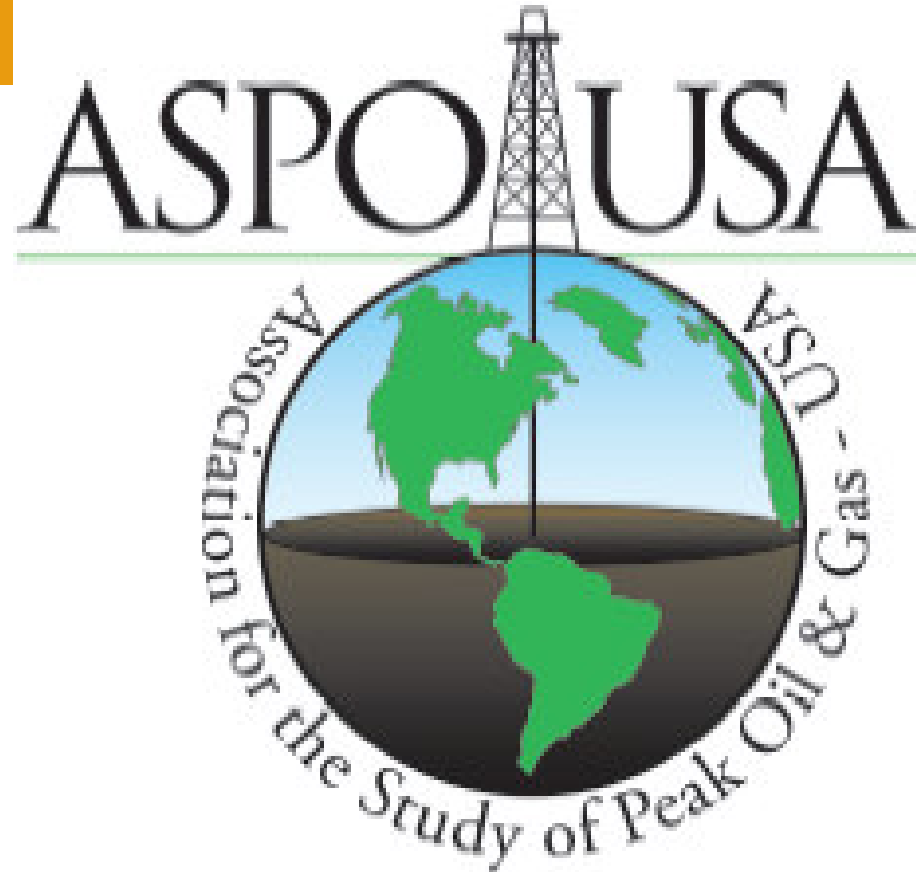
Chris Skrebowski
Editor, Petroleum Review
cs@energyinst.org.uk
+ 44 (0)20 7467 7117

- Chris Skrebowski: Trustee of the Oil Depletion Analysis centre and
- Editor of Petroleum Review, Energy Institute

Denver World Oil Conference

Beyond Oil: Intelligent Response to Peak Oil Impacts

A Dialogue with the Experts



*Energy Action for a Healthy Economy
and a Clean Environment*