

# The challenge of fuelling 21st Century economies

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

# Who am I?

**Chris Skrebowski has spent half a working life working in the oil industry and the other half as an oil journalist. Free of corporate or political pressure he brings a healthy scepticism to the problem**

# **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**

# A sobering thought

- ‘All that separates us from the medieval world is plentiful supplies of low cost hydrocarbons’

# Take a field large enough to feed your family with grain all year

- Take a tractor, a plough, a harrow and a seed drill
- Add 50 litres of diesel and in two days your field is prepared and sown
- Now if you only had a spade how long would it take?
- Don't ask for a horse that needs a another field to feed it

# The current hydrocarbon mix (2005)

<u>Energy</u>	<u>Global</u>	<u>EU 25</u>	<u>Range</u>
Oil	36.8%	40.4%	35-55%
Gas	23.7%	24.4%	10-46%
Coal	27.2%	17.9%	5-48%
Nuclear	6.1%	13.0%	0-13%
Hydro	6.2%	4.3%	2-28%

# Steady energy growth

- The 3 hydrocarbons represent 71%-98% of total energy supplied
- Primary energy 20 year growth 2.2%/yr    2.7% in 2005
- Oil 10 year growth rate 1.95%/yr            1.3% in 2005
- Gas 10 year growth rate 2.81%/yr            2.3% in 2005
- Coal 10 year growth rate 2.54%/yr            5.0% in 2005
- Coal demand driven by China and India
- Slow move to gas and coal at oil's expense?

# Collectively Humanity is:

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

# Five great energy challenges

- The rapidly changing geopolitics of energy
- The peaking and decline of oil supplies
- The peaking and decline of gas supplies
- Making coal usage environmentally acceptable
- Making nuclear environmentally and socially acceptable while meeting the uranium depletion challenge

# The perfect answer

- Use all fuels much more effectively
- Redesign everything to make it more fuel efficient - we did it in the 1970s
- Redesign systems and operations to make them more fuel efficient
- A huge challenge
- A huge opportunity

# 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

# The practical realities of oil depletion

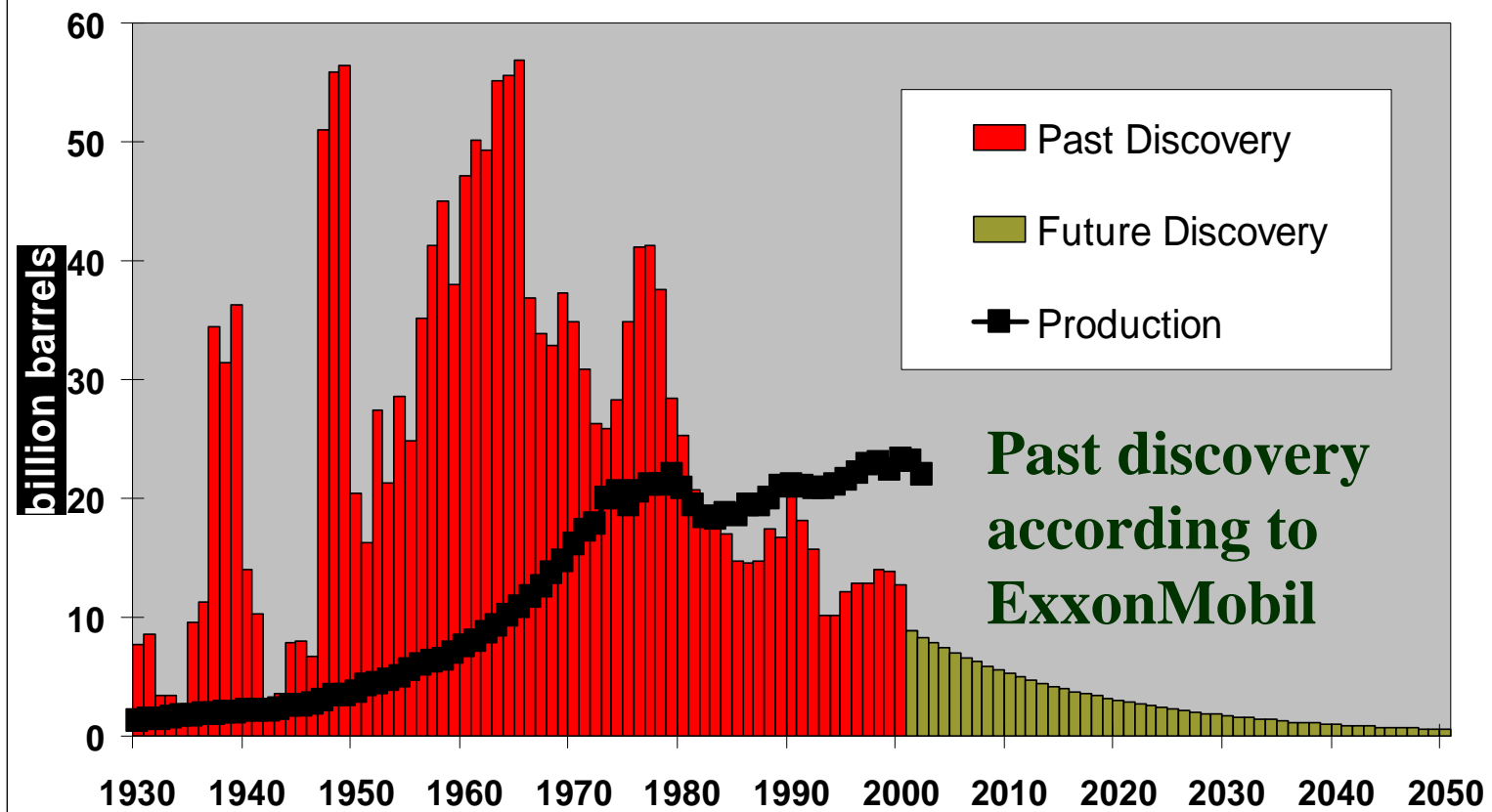
- The world needs oil production **flows**
- Reserves are only useful as **flows**
- Peak oil is when **flows can't** meet the required demand
- This will cause an 'Economic Tsunami'
- There's not much time to accommodate

# The challenges to meeting demand

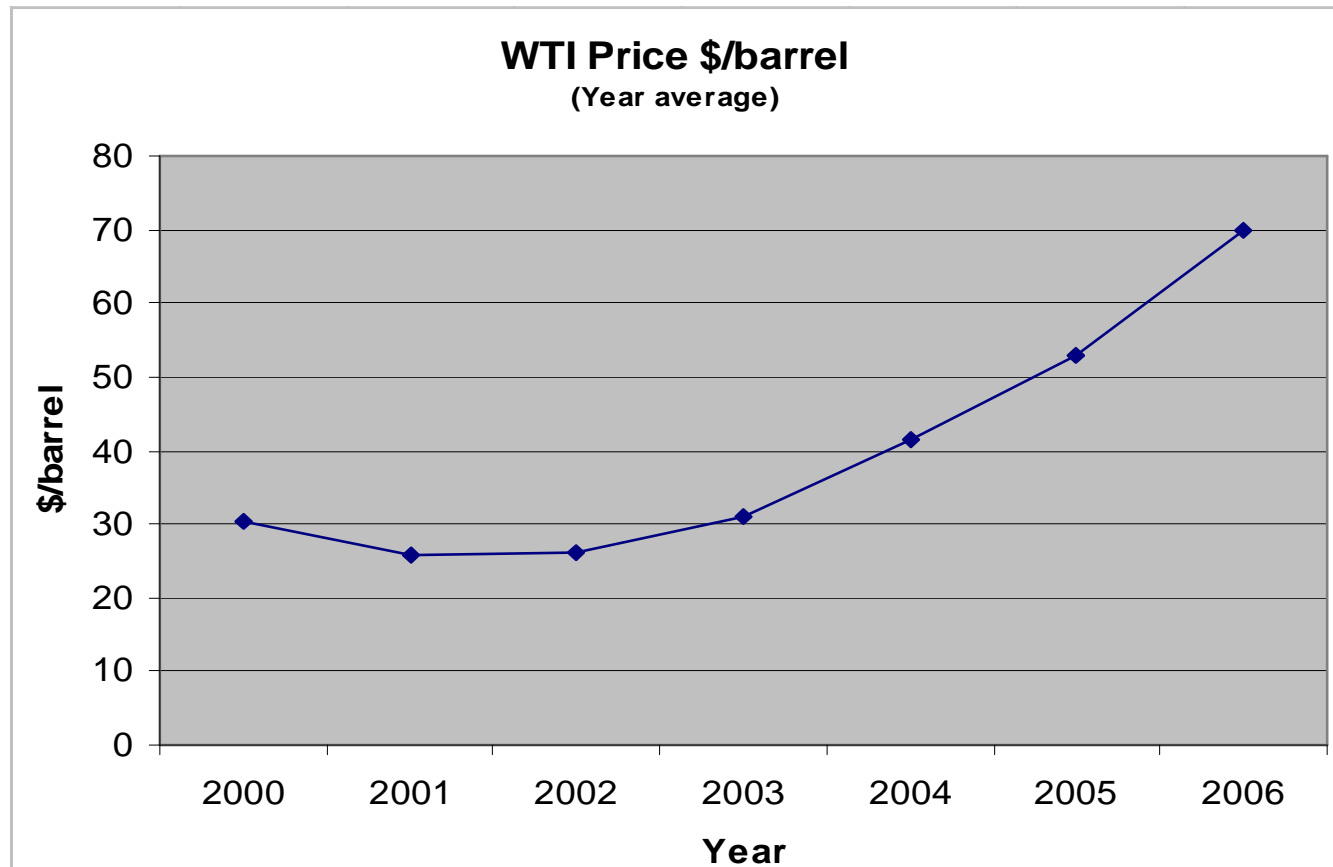
- We are not finding oil fast enough
- We are not developing fields fast enough
- Too many fields are old and declining
- We are short of people and equipment
- Oilfield inflation is soaring
- Our societies are totally oil dependent
- Oil supply will peak soon. How soon?

# Real Discovery Trend

## The Growing Gap



# What is the price telling us?



# 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?

# The CIBC answer

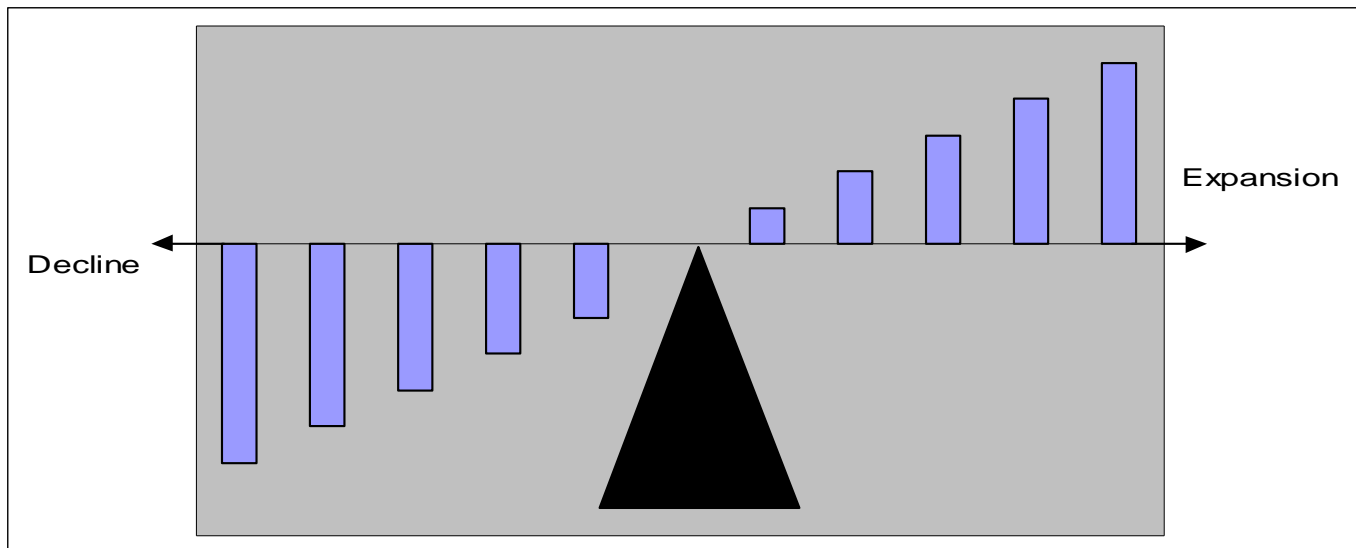
- **Assessed the likely supply shortfall and the oil price needed to reduce demand**
- **2006 1mn b/d and \$61/barrel**
- **2007 2.8mn b/d and \$70/barrel**
- **2008 4.8mn b/d and \$80/barrel**
- **2009 6.7mn b/d and \$90/barrel**
- **2010 8.9mn b/d and \$101/barrel**

# So what is 'Peak Oil'?

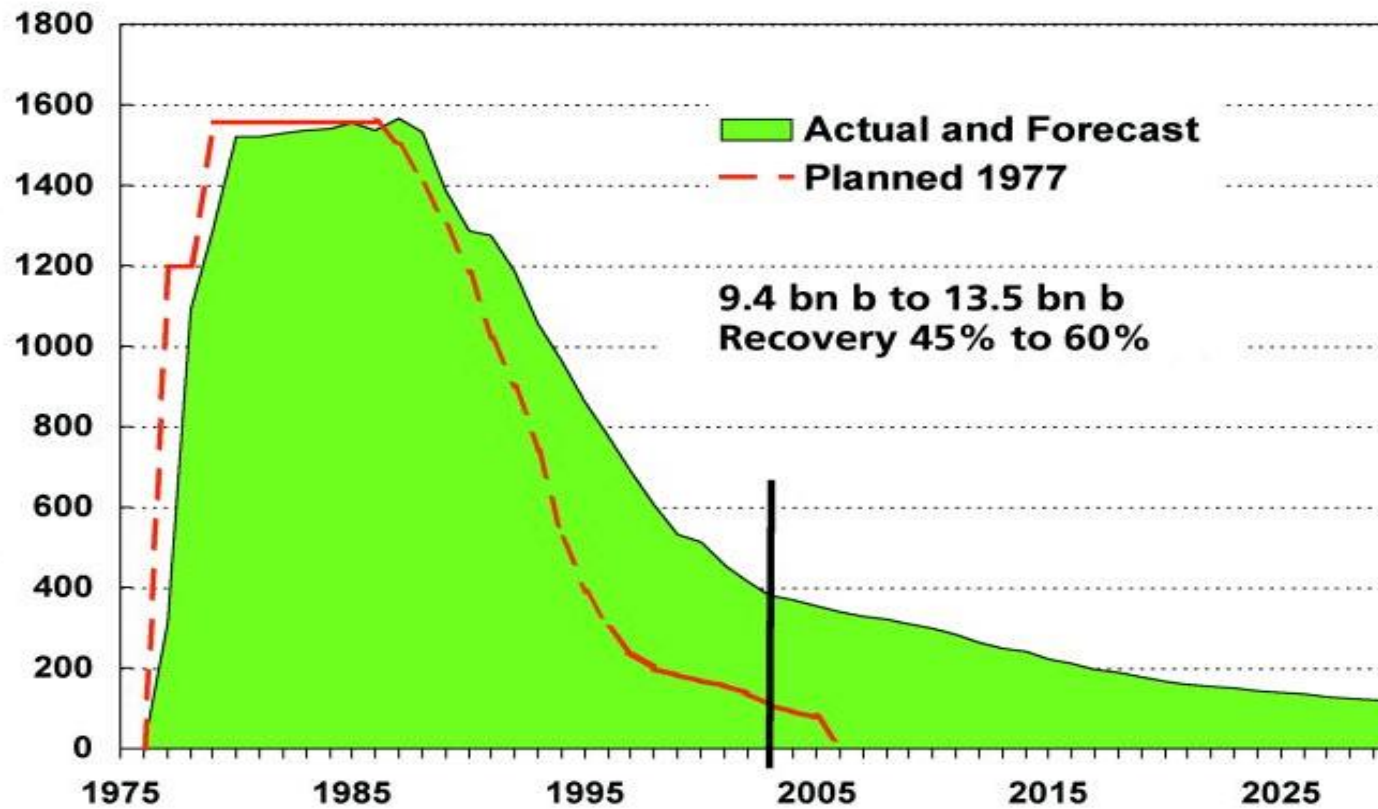
- It is the point when further expansion of oil production becomes impossible because:
- New production flows are fully offset by production declines (depletion)
- You never run out of oil
- You do run out of incremental flows
- The world needs oil to support growth

# A simple observation

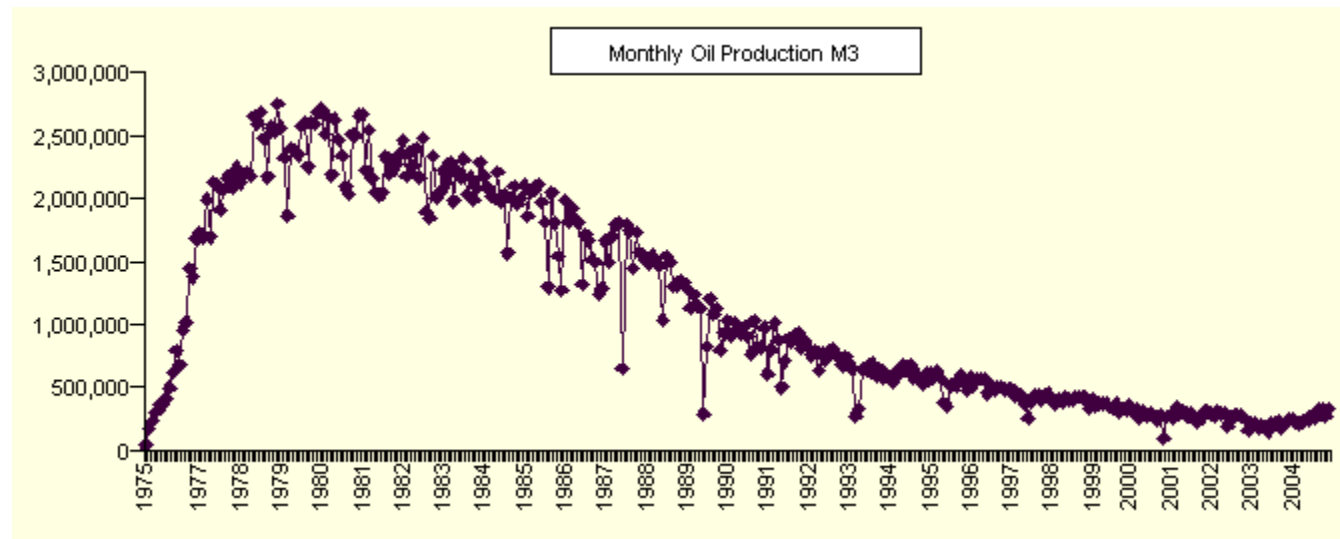
‘Global production falls when loss of output from countries in decline exceeds gains in output from those that are expanding.’



# Alaskan North Slope Production Reserves grow -- Production falls



# North Sea production by field



**Forties monthly production to date**

# Let's have a look at the UK North Sea (Production change in thousand b/d)

- 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
- In 2004 it was 10% down or -230 kb/d
- In 2005 it was 11.1% down or -230 kb/d
- In 2006 IEA says 4.9% down or -90 kb/d

# The top five decliners in 2005

Country	Production	Peak Year	Decline
USA	6.8mn b/d	1985	-5.51%
Norway	2.9mn b/d	2001	-6.90%
UK	1.8mn b/d	1999	-10.80%
Mexico	3.8mn b/d	2004	-1.70%
Syria	0.5mn b/d	1995	-11.30%

# About to go into decline (More Type 3 losses)

- **Denmark producing 0.4mn b/d went in 2005**
- **Malaysia producing 0.9mn b/d went in 2005**
- **Mexico producing 3.8mn b/d went in 2005**
- **Vietnam producing 0.4mn b/d went in 2005**
- **India producing 0.8mn b/d goes in 2006/07**
- **China producing 3.6mn b/d goes in 2007/08**
- **Collectively 9.9mn b/d or 12.3% of production**

# The oil depletion balance sheet at mid 2006

- In decline 28% but rising to 40% by 2008/9
- In danger 12% but down to 10% by 2008/9
- Russia 12% and steady at 12% by 2008/9
- Growing 48% and down to 38% by 2008/9
- The scales are 'balanced' by 2008/9
- So does President Putin decide when decline starts? Or does Saudi geology?

# Why does 'Peak Oil' matter?

- Our economies are totally oil dependent
- Economic progress requires growth
- Growth requires oil, preferably cheap oil
- Fuel changes require time and large investments which in turn require energy
- What is at risk? History shows us that supply shortfalls lead to high oil prices and high oil prices lead to economic recessions

# Oil dominates its markets

- **80-95% of all transport is fuelled by oil products**
- **70-75% of all oil is used for transportation**
- **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**

# You can't drink oil so how do we make use of it in Europe?

- 24.1% gasolines -- petrochemicals/petrol
- 45.3% middle distillates -- jet kero/diesel/ho
- 11.3% fuel oil -- heavy industry/ships/power
- 19.3% other-- lubes, solvents, gases

# Are there realistic substitutes for the main oil products?

- **Petrochemicals – naphtha, coal derived chemicals, sugar derived, some gas/LPG. (Few alternatives)**
- **Aircraft fuel – jet kerosene, some Avgas, alcohols as extenders. (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 - Coal? Sails?)**
- **Lubricants and greases – (very limited alternatives)**
- **Power generation – (little oil now used 9% globally)**
- **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**
- **Oil is the most flexible of all the energies**
- **This means all alternatives are inferior**
  - **You can cook sausages by collecting and burning straw but you may use more calories collecting the straw 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

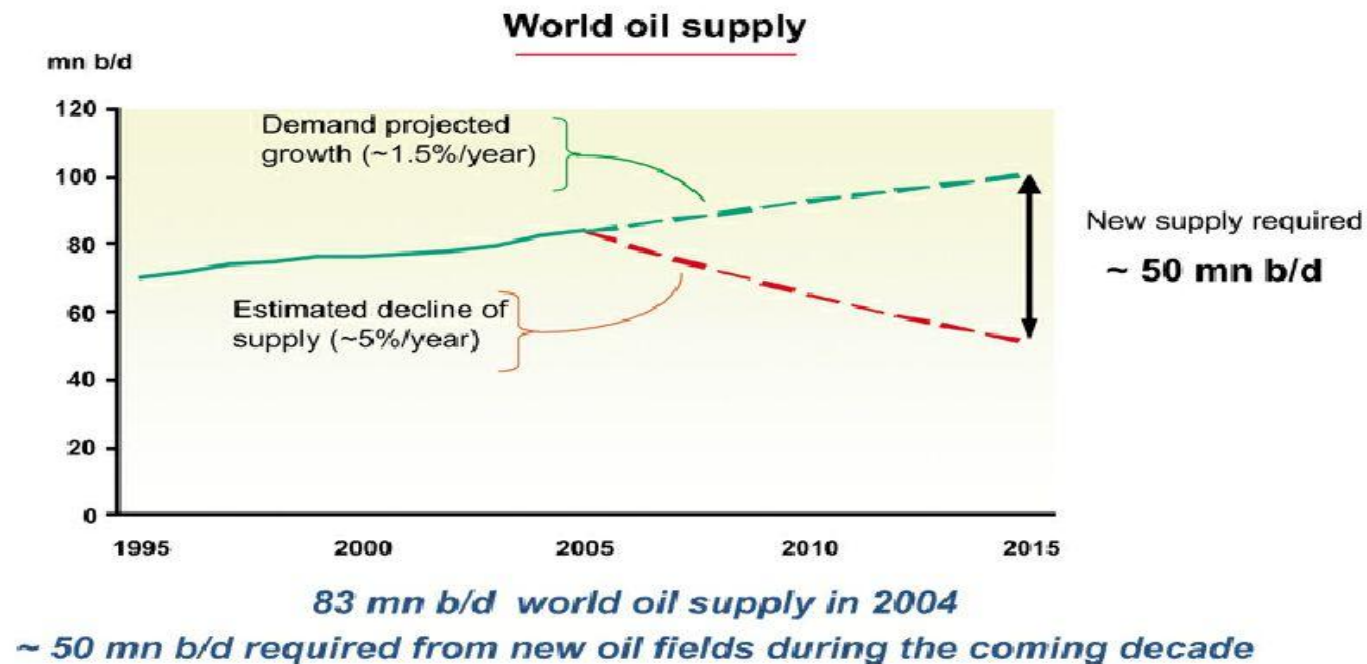
*Hydro, nuclear, wind, waves and biomass can all generate power. But at what cost? Little oil is now used for power generation (9% globally).*

*Can we make our economies all electric?*

*Can we make coal-to-liquids economic?*

# The depletion challenge

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



# 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 1.2mn b/d but rising

# Type 3 depletion acts like new demand

- Over 50 countries now depleting (20 large)
- In 2005 some 28% of supply came from countries in outright depletion
- Ten countries each producing over 0.5mn b/d were in decline in 2005
- More large producers are set to decline
- No country has reversed a real decline

# The oil companies are already struggling to hold production

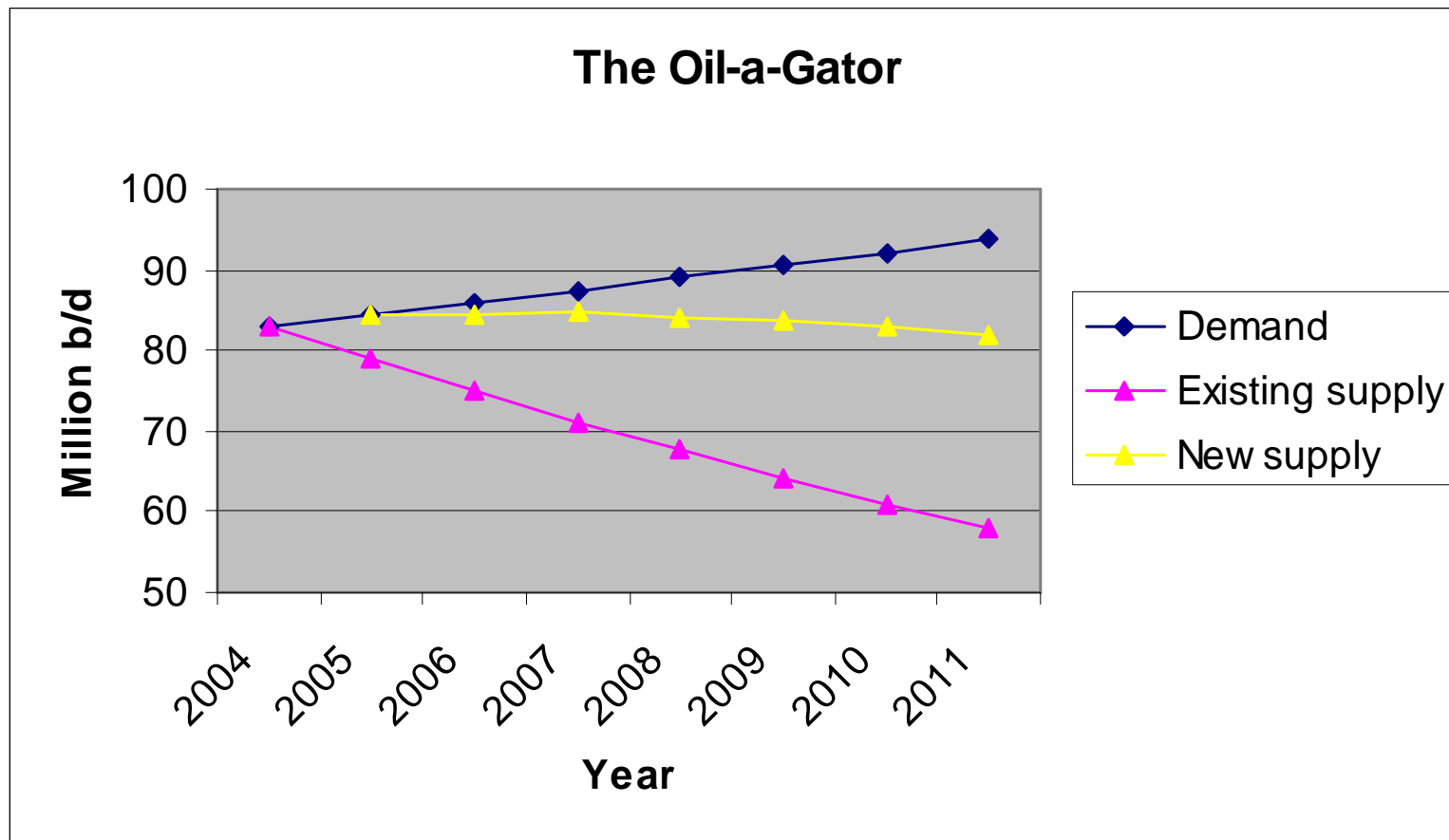
(21 quoted co's account for 25% of global production)

- In 2004 and 2005 oil production growth was:
  - 3.8% (04) but 0.4% (05) for the top 5 (13.5% of global)
  - 2.5% (04) but 1.3% (05) for the top 10 (21% of global)
  - 3.2% (04) but 0.5% (05) for the top 21 (26% of global)
- In 2004 and 2005 gas production growth was:
  - -1.7% (04) but -3.0% (05) top 5 (13.5% of global)
  - 2.5% (04) but 1.3% (05) for the top 10 (20% of global)
  - 3.2% (04) but 0.5% (05) for the top 21 (28% of global)
- Annual decline rates up to 5%, quarterly 8%

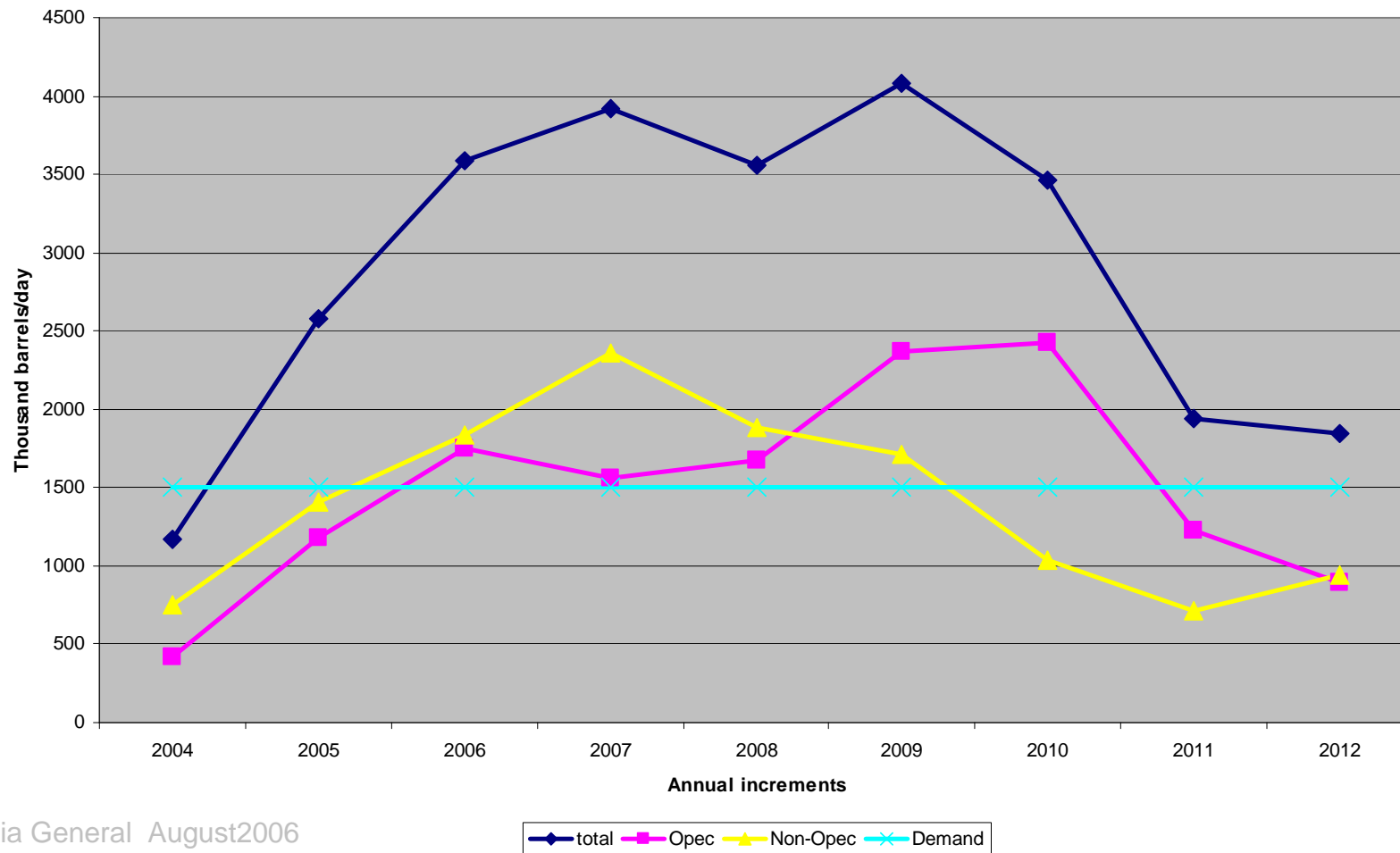
# **Oil projects are slow and well publicised**

- **3 years for an onshore rework (Saudi AFK)**
- **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 cast to 2010 even 2012**
- **That's why the economists are misleading US**

# Introducing the Gator



# New Opec and non-Opec capacity (or the puzzled optimists view)

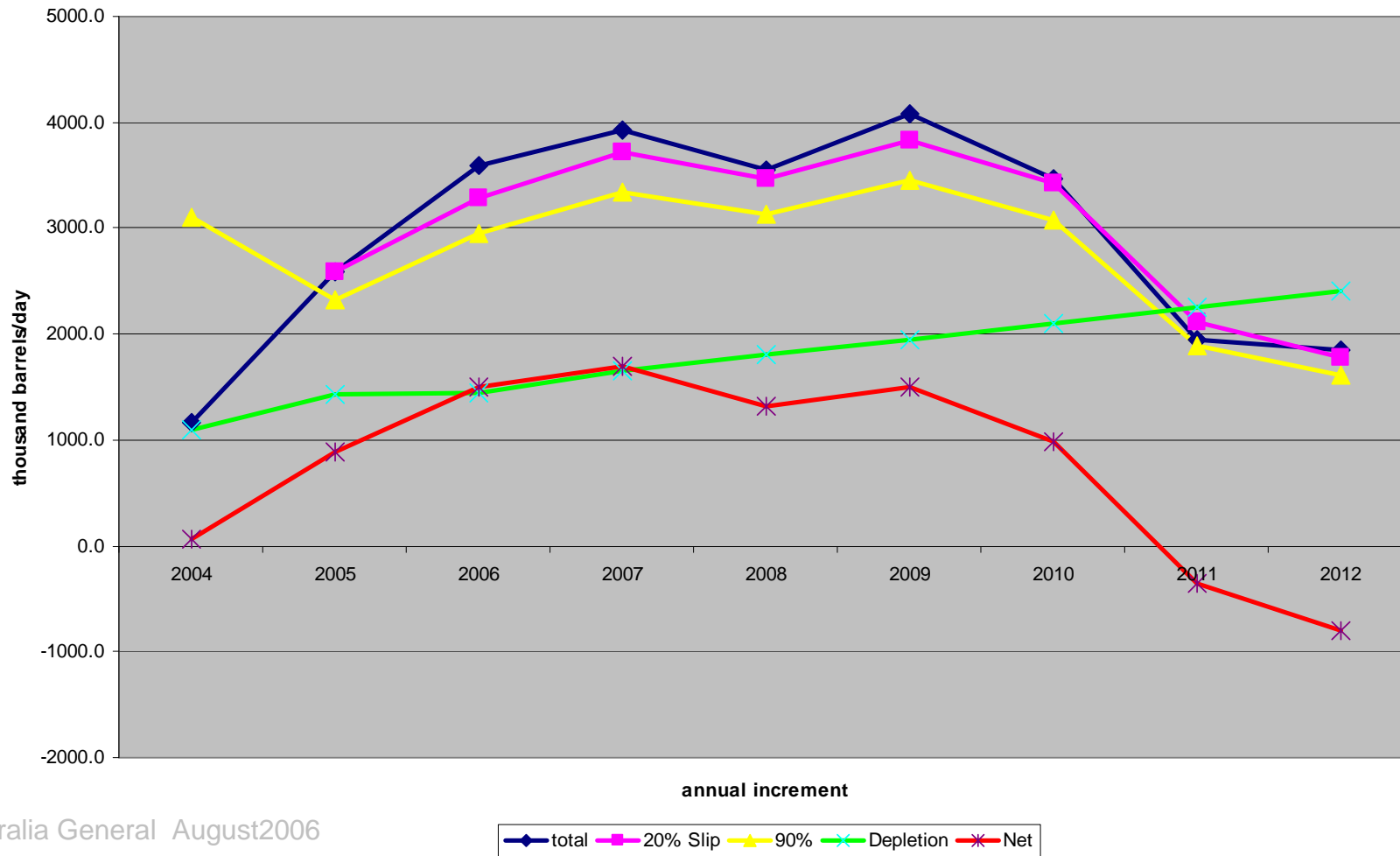


# Actual supply will always be lower

(Remember the random factors)

- Projects slip (typically 10-20% each year)
- Companies are always optimistic (take off 10%?)
- Shortages and oilfield inflation add to delays
- 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)

# This is the actual new capacity to 2012 (The realist view)



## Likely future oil demand growth (In million barrels/day)

- In 2003 oil demand grew by 1.8mn b/d (2.3%)
- In 2004 oil demand grew by 3.2mn b/d (4.0%)
- In 2005 oil demand grew by 1.0mn b/d (1.3%)
- In 2006 latest estimate is 1.2mn b/d (1.5%)
- Twenty year average is only 1.5-1.8mn b/d (1.8%)
- High prices clearly slowing growth
- Does Chinese and Indian demand growth represent a paradigm shift?

# A wild card --- Opec demand

- Rapid 5-6% oil demand growth
- Subsidised prices seen as right
- No reason to use fuel efficiently
- Economies booming on oil earnings
- China still subsidises demand
- Russia still subsidises oil demand
- High oil prices have little impact

# Delaying 'Peak Oil'

- **Economic slowdown/recession**
- **Demand destruction via high prices**
- **Systems working better than expected**
- **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**

# My conclusions?

- There are, at best, 48 months to Peak Oil
- 'Business as usual' after 2010 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
- The developing world will be badly hit

# Gas discovery is also falling short

- Gas discovery peaked in 1970s
- Demand first exceeded discovery in 1985 then continuously from 1990 to 1995
- Since 2001 discovery has been under half of usage
- Gas production is already falling in the USA, Canada, UK, Germany, Italy and New Zealand

## Some troubling gas facts

- Russia can't meet new contracts until it develops Shtokman and the Yamal fields which won't be before 2012/2014
- 90% of LNG availability to 2010 already sold
- Only one new LNG project in 2005 (Pluto)
- Mackenzie delta pipeline not before 2012
- Alaska pipeline not before 2015
- EU 25 gas production fell 7% in 2005

# Gas will be different from oil

- Large reserves but restricted production flows -- pipelines, LNG facilities
- Facilities effectively ration out supplies
- High LNG costs sterilise large reserves
- Flows may be restrictive but will be maintained for extended periods
- Gas peak unlikely before 2025

# Making coal acceptable

- Means capturing carbon dioxide
- Making coal to liquids competitive
- Making gasification to hydrogen with carbon dioxide capture competitive
- Making in-situ gasification competitive
- A rewarding challenge because coal supplies are extensive and widely dispersed

# Making nuclear acceptable

- Means acceptable and safe waste disposal
- Making it socially acceptable
- Using nuclear fuel much more efficiently
- Developing effective and safe breeder reactors
- Utilising low grade uranium or utilising more plentiful nuclear materials such as thorium

# The geopolitics challenge

- Possibly the hardest of all
- How to reward those with the energy supply
- Without undermining consumer economies

# By 2010

**Will this be the  
only practical  
use for SUVs or 4X4s?**



## Contact:

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

Depletion Analysis Centre and

- Editor of Petroleum Review, Energy Institute, London