The Countdown to Peak Oil
Who am I?

• Chris Skrebowski has spent the last 38 years working in and around the oil industry

• Half his working life in the oil industry and the rest as an oil journalist

• Worked as a long-range planner for BP

• As a market analyst for Saudi Oil ministry in London

• Edited Offshore Services, Petroleum Economist and Petroleum Review

• Now full-time researcher and speaker on Peak Oil
Opec proved reserves 634.7bn b
Canadian tar sands proved reserves 174bn b
Non-Opec proved reserves 175bn b
Extra claimed reserves 300bn b

Biofuels 1.5mn b/d
Opec output 36mn b/d
Non-Opec output 47.6mn b/d
1.4mn b/d

Discovery rate: 9bn b/yr or 24.6mn b/d

Opec output
Non-Opec output
Biofuels

Consumption 86.5mn b/d
Road Fuels 55%
Other transport 25%
Heat 10%
Non-fuel 10%

1.4mn b/d
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 products to support growth

- Everyone agrees that it will happen at some point. The key question is how soon?
A simple observation
- Peak Oil will be earlier than most expect

‘Global production falls when loss of output from countries in decline exceeds gains in output from those that are expanding.’
World non-Opec supply growth (2007-2009) EIA

EIA Short-Term Energy Outlook, January 2008

Million barrels per day

Brazil, Russia, United States, Azerbaijan, Canada, Kazakhstan, Sudan, Vietnam, China, India, Australia, Gabon, Malaysia, Syria, Other North Sea, Ecuador, Egypt, Colombia, Oman, Norway, United Kingdom, Mexico

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## Getting it all in proportion
(million barrels/day) Source: IEA

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand</td>
<td>84.8</td>
<td>85.8</td>
<td>86.5</td>
</tr>
<tr>
<td>Supply</td>
<td>85.4</td>
<td>85.5</td>
<td>86.5</td>
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<tr>
<td>Opec</td>
<td>35.7</td>
<td>35.4</td>
<td>36.5</td>
</tr>
<tr>
<td>Non-Opec</td>
<td>49.1</td>
<td>49.7</td>
<td>49.8</td>
</tr>
</tbody>
</table>

*Biofuels 0.9 1.1 1.53
Tar Sands 1.15 1.25 1.38
Ven Hvy 0.6 0.6 0.6*
Latest BP statistics show
Peaks are already happening

• OECD production **peaked in 1997** and has now declined by 2.2 million b/d (10.4%)

• Non-Opec, non-FSU production **peaked in 2002**
  Has now declined by 771,000 b/d (2.15%)

• North America/Mexico **peaked in 1997**
• North Sea - UK/Norway/Denmark **peaked in 2000** now declined by 1.6 million b/d (25.4%)
• Around 28 significant producers in decline
• About 35% of global production from decliners
• Once 51% in decline we reach global peak oil
Oil Industry concerns voiced by the CEOs

• ‘World demand for oil may soon outstrip supply as the cost of replacing reserves reaches $80 barrel’ - Christophe de Margerie, CEO Total

• “We’re seeing the beginnings of a bidding war for Middle Eastern oil between East and West” – Dave O’Reilly, CEO Chevron

• “Shell estimates that after 2015 supplies of easy-to-access oil and gas will no longer keep up with demand.” - Jeroen van der Veer, CEO Shell
What the presentation will show
What the presentation will show you

• Peak Oil is real and Peak Oil is imminent
• Consumers need delivery *flows*
• Reserves are only useful as *flows*
• Peak oil is when *flows* can’t meet the demand
• The oil industry is slow moving and predictable
• Many talk of reserves and forgets flows
• Peak Oil will occur no later than 2012
• There are now 1200 days to Peak
Why does Peaking matter?
Why is oil so good?

**Portability** – easy to store and transport

**Ubiquity** – Anywhere there are roads there are oil products

**Concentration** – The highest energy density of any fuel bar nuclear

**Cost**– Historically it has been the cheapest energy source to extract and deliver to market

**Safety** – Lots of experience in handling it in a safe manner

**Consistency** – Rigorous quality control means predictability

Any alternative needs to be better than oil for at least some of these features.
Peak Oil matters because oil dominates its markets

- 80-95% of all transport is fuelled by oil products
- 50-75% 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
- Oil is the most important source of primary energy on the planet accounting for around 36% of all energy
Peak Oil matters because ‘It’s the flows stupid’

- Consumers need delivery **flows**
- Reserves are only useful as **flows**
- Peak oil is when **flows can’t** meet the demand
- The oil industry is slow moving and predictable

- Flows can be geologically constrained – e.g., the North Sea
- Flows can be politically constrained – e.g., Russia, Saudi Arabia
- Flows can be physically constrained – e.g., Nigeria
- Flows can be skills constrained – e.g., lack of experienced engineers
- Flows can be capital constrained – e.g., Mexico, Venezuela

- **Many** talk of **reserves** and ignore **flows**
- **Others** talk about **access** and ignore **flows**

- **Peak Oil flows will occur no later than 2012**
The evidence
Eight key pieces of evidence that we are close to Peak

1. Falling discovery rate, few large discoveries
2. Ever more countries in sustained depletion
3. Companies struggling to hold production
4. Non-geologic threats to future oil supply
5. The current lack of incremental flows
6. Few countries with real growth potential
7. The age of the largest fields
8. Sustained high oil prices
What about the IOCs?

- Total Oil production from the five Megamajors peaked in 2004
  - Chevron peaked in 2002
  - Shell in 2003
  - Total in 2004
  - BP in 2005
  - ExxonMobil in 2006

- Only two large and eight small companies saw production gains in 2007
- Annual decline rates up to 5%, quarterly 8%
- In 2Q 2008 production from the Big Five fell by 615,000 b/d or roughly 6%

* (The top 24 quoted companies account for 24% of global production)
The real discovery trend
More countries going into decline

• 25 major and 40 minor producers already in decline

• Mexico producing 3.8mn b/d went in 2005
• India producing 0.8mn b/d goes in 2008
• China producing 3.6mn b/d goes in 2008-2010

• Collectively 9.9mn b/d or 12.3% of production

• Iran is struggling -- next to go?
• When does Saudi go? As Matt Simmons says
  ‘When Saudi goes so does the world’
Non-Geologic threats to future oil supply flows

• Resource nationalism – Russia, Venezuela, Bolivia, Ecuador - more to follow?
  • Tighter terms and conditions – nearly all countries with oil
  • Civil insurrection – Nigeria, Sudan
  • And – cost inflation, ageing infrastructure, lack of skilled people, refinery constraints
  • How likely is an improvement in any of these?
  • Who will cap or ration production first?
### Rising energy import dependence (2007)

<table>
<thead>
<tr>
<th>Country</th>
<th>Oil imports</th>
<th>Gas imports</th>
<th>Coal imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>99.9%</td>
<td>99.9%</td>
<td>99.4%</td>
</tr>
<tr>
<td>South Korea</td>
<td>99.9%</td>
<td>99.8%</td>
<td>98%</td>
</tr>
<tr>
<td>EU 25</td>
<td>84%</td>
<td>41%</td>
<td>44%</td>
</tr>
<tr>
<td>India</td>
<td>71%</td>
<td>25%</td>
<td>13%</td>
</tr>
<tr>
<td>USA</td>
<td>67%</td>
<td>17%</td>
<td>Exports 2%</td>
</tr>
<tr>
<td>Total OECD</td>
<td>61%</td>
<td>25%</td>
<td>13%</td>
</tr>
<tr>
<td>China</td>
<td>53%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Australia</td>
<td>40%</td>
<td>Exports 73%</td>
<td>Exports 76%</td>
</tr>
<tr>
<td>Brazil</td>
<td>17%</td>
<td>49%</td>
<td>84%</td>
</tr>
<tr>
<td>Canada</td>
<td>Exports 30%</td>
<td>Exports 52%</td>
<td>Exports 21%</td>
</tr>
<tr>
<td>Russia</td>
<td>Exports 72%</td>
<td>Exports 30%</td>
<td>Exports 22%</td>
</tr>
</tbody>
</table>
Between January 2005 and end-2007

Non-Opec producers started up
• 14 projects in 2005
• 19 projects in 2006
• 13 projects in 2007

Opec producers started up
• 13 projects in 2005
• 14 projects in 2006
• 11 projects in 2007

This added gross production of
• 2.5 million b/d in 2005
• 3.0mn b/d in 2006
• Over 3mn b/d in 2007

SO WHAT HAPPENED TO PRODUCTION?
Could this be peak flows?
(Latest EIA data)
The world’s biggest oilfields are old, tired and fading

• Of the 120 largest fields, 50 are in decline, 44 not in decline, 12 unclear and 7 are undeveloped
• Average age of the giants is 42 years
• But, the 120 largest fields give 50% of total production and contain two-thirds of reserves
• 70% of production from fields 30+ years old
• Few large recent discoveries
• We’re dependent on the oil equivalent of ‘Old men and young boys’
The non-importance of reserves

Reserves are just geological curiosities unless they can be mobilised into timely flows to meet world demand.

The peaking of oil supplies is the failure to mobilise timely flows.
Alaskan North Slope Production
Reserves grow – Production falls

[Graph showing production decline from 1975 to 2025 with estimated recovery of 45% to 60%]

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Impact of economics
Economics isn’t working very well

• Demand side
  • Many governments subsidise fuels
  • Gasoline costs from 20 cents to $9 a gallon
  • Jet kerosene is not taxed
  • Automobile half-life in the USA is 17 years
  • Technology response 3-10 years

• Supply side
  • Producer governments
  • Response times to changing price signals is very long
  • Bottlenecks produce project inflation
  • Projects take 6-9 years to get into production
  • Engineers take up to 10 years to be fully trained
  • Discovery rates have fallen to a third of consumption
North Sea –Forties field monthly production
Prices reconcile stagnant supply with demand by pricing demand out of the market
Prices reconcile stagnant supply with demand by pricing demand out of the market
Megaprojects Analysis
How am I so sure? – the basics of Megaprojects analysis

• List of all known and verifiable projects

• We measure incremental flows into the global supply by looking at new projects due on-stream

• It takes 6-7 years from discovery for any project to come on-stream – therefore the future is fixed within that timeframe and new discoveries won’t help

• We add in the new projects on top of existing capacity
  • (the database lists the 258 projects with estimated peak flows greater than 40,000 b/d)

• We deplete existing capacity by a depletion estimate (4-6% per year)

• Currently additional delays to announced start up in production average 3 months

• Existing production is effectively flat-out

• Therefore I can tell you the last realistic date by which Peak Oil will have happened,--------- But it could be right now.
The hole in the bucket
- How big and how fast is depletion?

• Depletion acts as a negative flow

• Around 5%-15% for areas in decline
  • Global depletion is 4.5% or around 3.7mn b/d/yr

• This is treble demand growth
  • Or more than tar sands, biofuels and heavy oil together.

• How do we know? IEA Medium Term Report
  • Is depletion accelerating? – Yes maybe 0.3-0.4mn b/d/yr
  • Can it be ameliorated? – Yes, slow production flows down
The Megaprojects database
– projects starting up in 2008 or later
Supply and demand to 2016

The diagram shows the supply and demand trends from 2005 to 2016. The supply is represented by blue bars, and the demand is shown by red bars. The demand is projected to increase each year with a growth rate of 3.6% per year. The supply, on the other hand, increases steadily but at a slower rate compared to demand.
So what can we do?
Post-peak we are going to need other energy sources

• How fast will supply decline post-peak?
• Possibly around 2-3%/year like the US onshore but initially at just 1-2%
• But, it could be much faster
• Suppliers could anticipate, ration out supplies, delay peak and force adaptation
• Some might use military strength to commandeer supplies
Squaring the circle
or making supply and demand equate

1  Depress demand – slowdown, recession, depression, slump
   • To date, little demand response to high prices
   • By efficiency in use

2  Expand supply by:
   • Producing more oil
   • By utilising substitutes
Are there realistic substitutes for the main oil products?

• **Petrochemicals** – napthta/LPGs :- coal derived chemicals, sugar derived, some gas/LNG. (Few alternatives)

• **Aircraft fuel** – jet kerosene/Avgas :- alcohols as extenders, jet from coal or gas -CTL or GTL (Few realistic alternatives)

• **Road vehicle fuels** – Gasoline and Diesel dominant :- Gas, LPG, alcohols, Electric. (Large existing Investments)

• **Ships and boats** – marine diesel and fuel oil:- Coal? Sails? Nuclear? (No realistic alternatives)

• **Lubricants and greases** – (very limited alternatives)

• **Power generation** – (little fuel oil now used - 9% globally)

• **Heating** – (increasingly substituted by gas)

• **What are the priority uses and how do we meet them?**
How the barrel breaks down

- Gases 4.5-5.5%
- LPGs 2.3%
- Naptha 2-5%
- Solvents 1.5-1.5%
- Gasoline 25-50%
- Kerosene 1-1.5%
- Jet Kerosene 7-12%
- Diesel 10-25%
- Gas Oil 5-5%
- Fuel Oil 10-40%
- Lubes 1-1%

- Roads 2-3%
- Petrochemicals 5-7.5%
- Heat 10-12%
- Lubricants 1%
- Transport 76.5-82%
Worldwide crash program mitigation of conventional oil production peaking
A study for DOE NETL (2005)
My conclusions at very best

• Supply will remain tight and prices high barring a major economic setback
• Oil supply will peak in 2011/12 at around 93 million barrels/day
• There could be supply shortfalls in winter before Peak
• Oil supply in international trade will peak earlier than the oil production peak
• We remain reluctant to face up to Peak Oil
• There are huge challenges and huge opportunities
There is hope

• The world will not stop turning after Peak Oil
• The world will need to find smart solutions to the problems it previously solved with cheap oil
• More engineers, scientists and creative thinkers will be needed than ever before.
• Solutions exist already to meet many of these challenges

• “The future is already here. It's just not very evenly distributed.” – William Gibson
Many thanks for your attention
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