



ENERGY AND ENVIRONMENT ISSUES FOR THE 21ST CENTURY

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Resource depletion: reserves & peak production

- 1 Proven reserves of conventional oil are running out at present levels of consumption or higher. Non-conventional oil would keep us going longer (some already being produced), but at a higher cost.
 - 1 **Warning: resource base and reserves are dynamic concepts** (change over time, depending on technology, knowledge stock, prices and other economic factors).
- Q: When will hydrocarbon production peak?**
- 1 For conventional oil- at current production growth rates peak production could happen anytime between 2010 (Campbell) and 2050; after 2030 for IEA.
 - 1 For gas, production peaking should take place > 2050.



Q.: When will we run out of oil?

- 1 Some conventional and unconventional oil will be around beyond the end of this century, even assuming we are still interested. Gas outlook brighter.
- 1 In human history no “exhaustible resource” has yet been depleted. This is certainly true for minerals.
- 1 The oil age will not end because we will run out of oil.
 - u Unfortunately this has not been the case for some “reproducible natural resources”. This apparent paradox should make us think.
- 1 Technology important in finding new resources, improving efficiency of extraction, and efficiency of use and by making possible long term transitions to other resources.



Supply security: whose problem is it?

- 1 Increasing dependence of oil (and gas) consuming countries on politically unstable supply regions.
 - u Q. Is political instability in those areas independent of the fact that oil and gas resources are concentrated there?
- 1 Most parts of the world where significant hydrocarbon resources exist are politically unstable
 - u Algeria, Libya, Egypt, Sudan, Nigeria, Angola, Russia, former soviet republics in Central Asia, Indonesia, Venezuela].
 - u US, Canada, Norway, UK, Mexico, Brazil the exception.
- 1 Concentration of resources a problem also for countries that own the oil resources. The issue of who should control the resources (and related revenues) part of the problem, especially if nationalistic aspirations strong.



Future geopolitical issues

- 1 In the coming fifty years the countries around the Persian Gulf are increasingly going to be the swing producers of oil.
- 1 How they will behave will have a heavy impact on the price we will pay for the resources and on the resource depletion path. Unfortunately this is very difficult to predict.
- 1 Consuming countries can also affect this process, both through dialogue and through their own long-term strategies.
- 1 What long-term strategies will large consumers like the US, China and India carry out in the coming 50 years is just as critical.



Energy and climate change: a sustainable resource management problem

- 1 Continuing present rate of energy related CO₂ emissions could cause abrupt changes in existing climate patterns.
- 1 Uncertainties on scale and geographical distribution of these impacts, and on resilience of the global ecosystem.
- 1 As we are unable to control climate response to GHG emissions increase, any solution to this problem requires reducing GHG emissions and performing a global transition to energy sources/technologies that do not emit CO₂.
- 1 Technology holds the key for the solution:
 - u progressive abandonment of carbon based fossil fuels, in favour of renewables, nuclear fission/fusion,
 - u or finding suitable ways to separate, capture and sequester CO₂ on a large scale and for the long term.



Conclusion

- 1 Anything we do in the direction of abandoning fossil fuels in favour of some form of reproducible energy vector or fuel will automatically ease the resource scarcity problem.
- 1 In this respect environmental sustainability, sustainable resource use and long term supply security may well have the same solution.