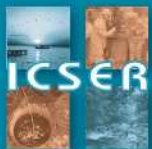


# Critical Risks: Forcing the Transition to Sustainability

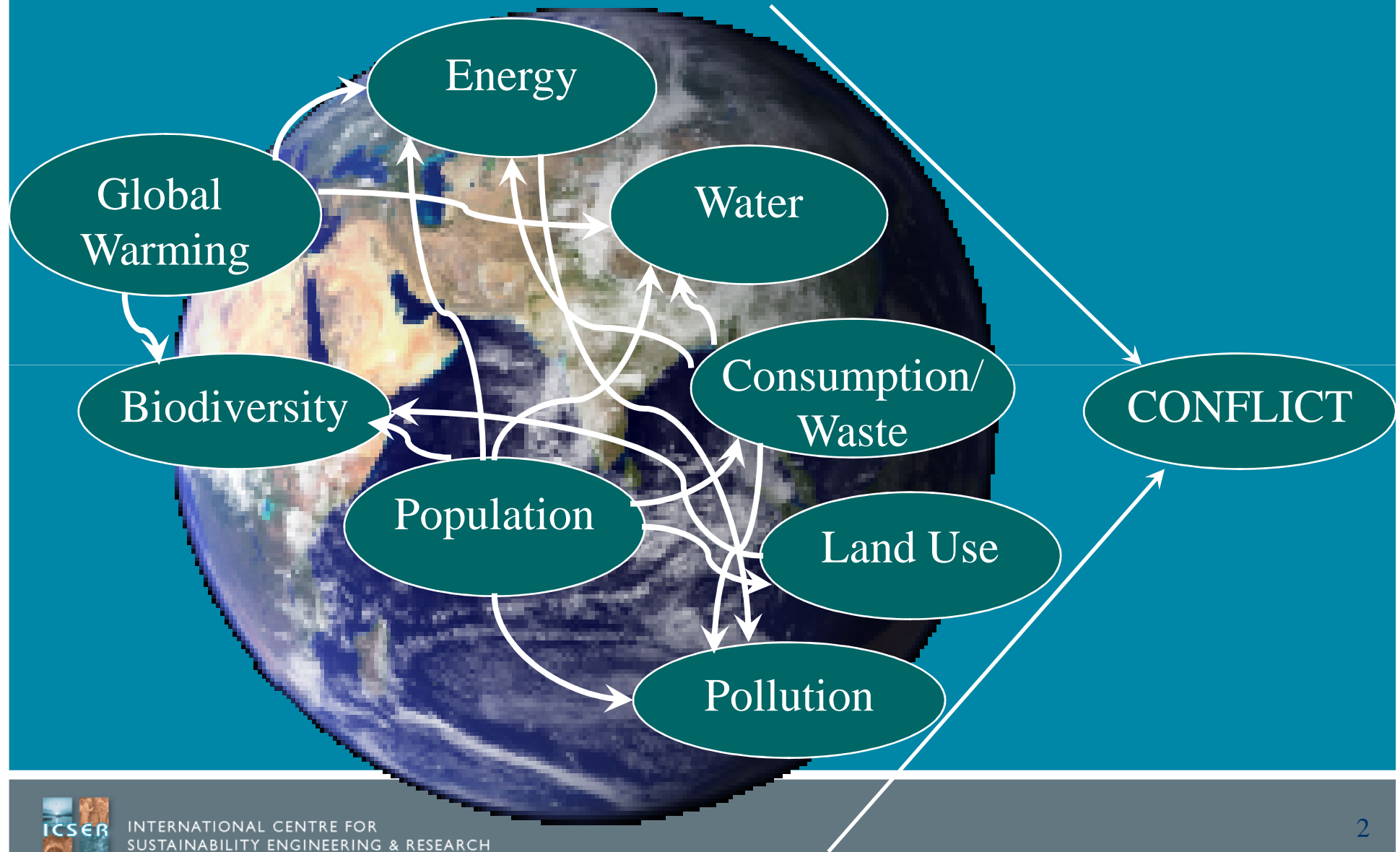
Carol Boyle, Director

International Centre for Sustainability Engineering and Research  
The University of Auckland



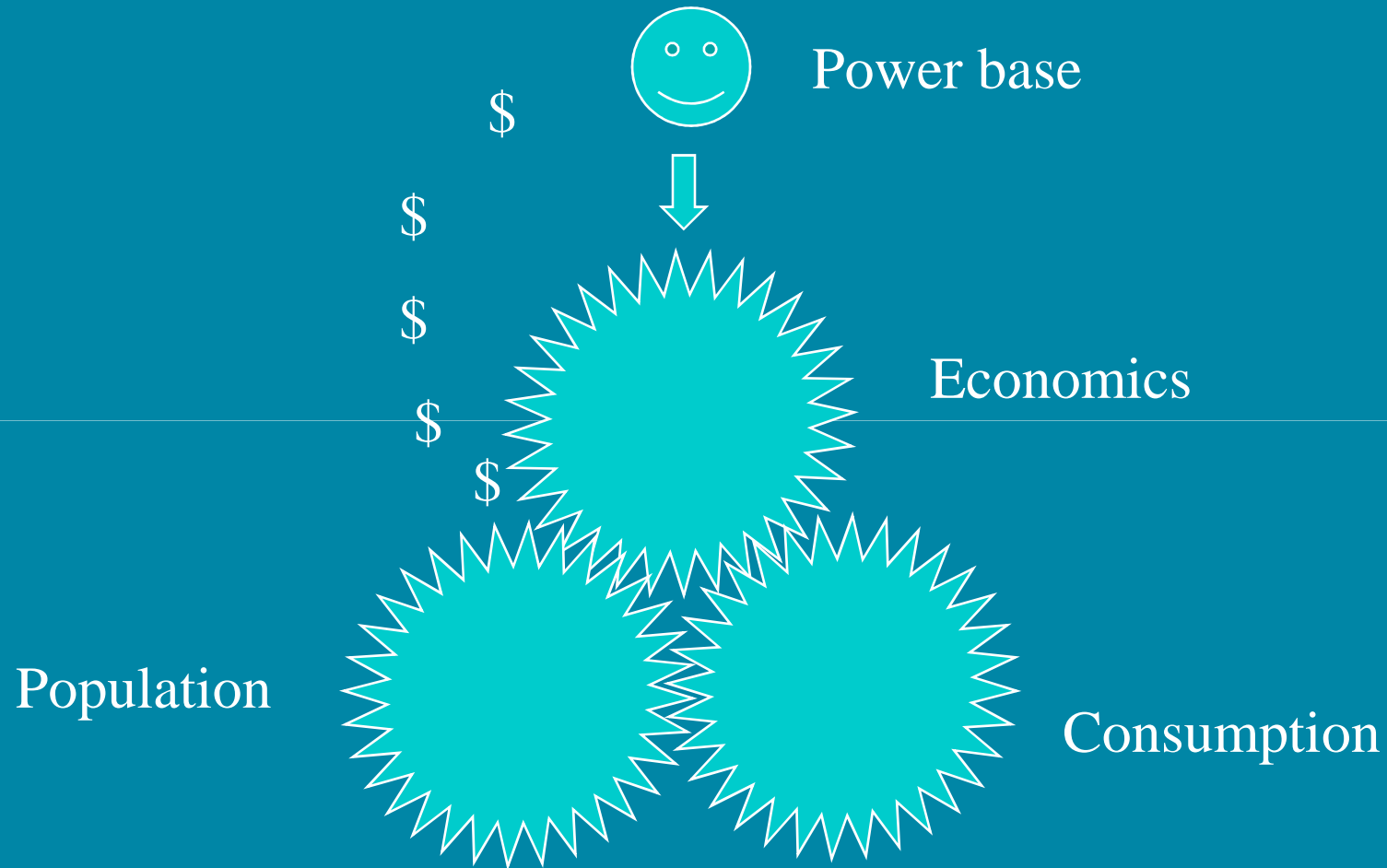
INTERNATIONAL CENTRE FOR  
SUSTAINABILITY ENGINEERING & RESEARCH

# Major Recognised Global Risks

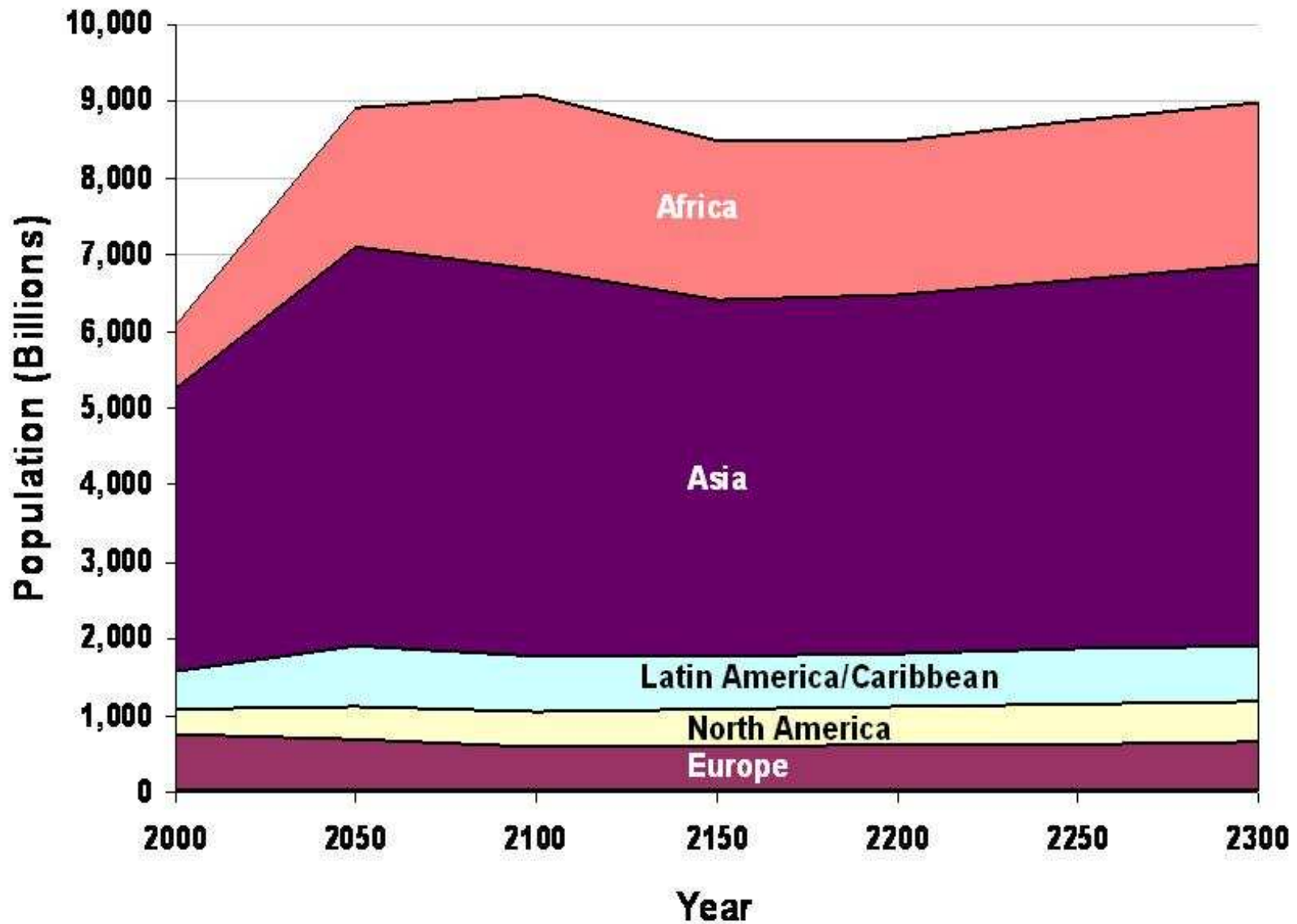


# Current economic drivers

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# Projected Population, Medium Scenario 2004

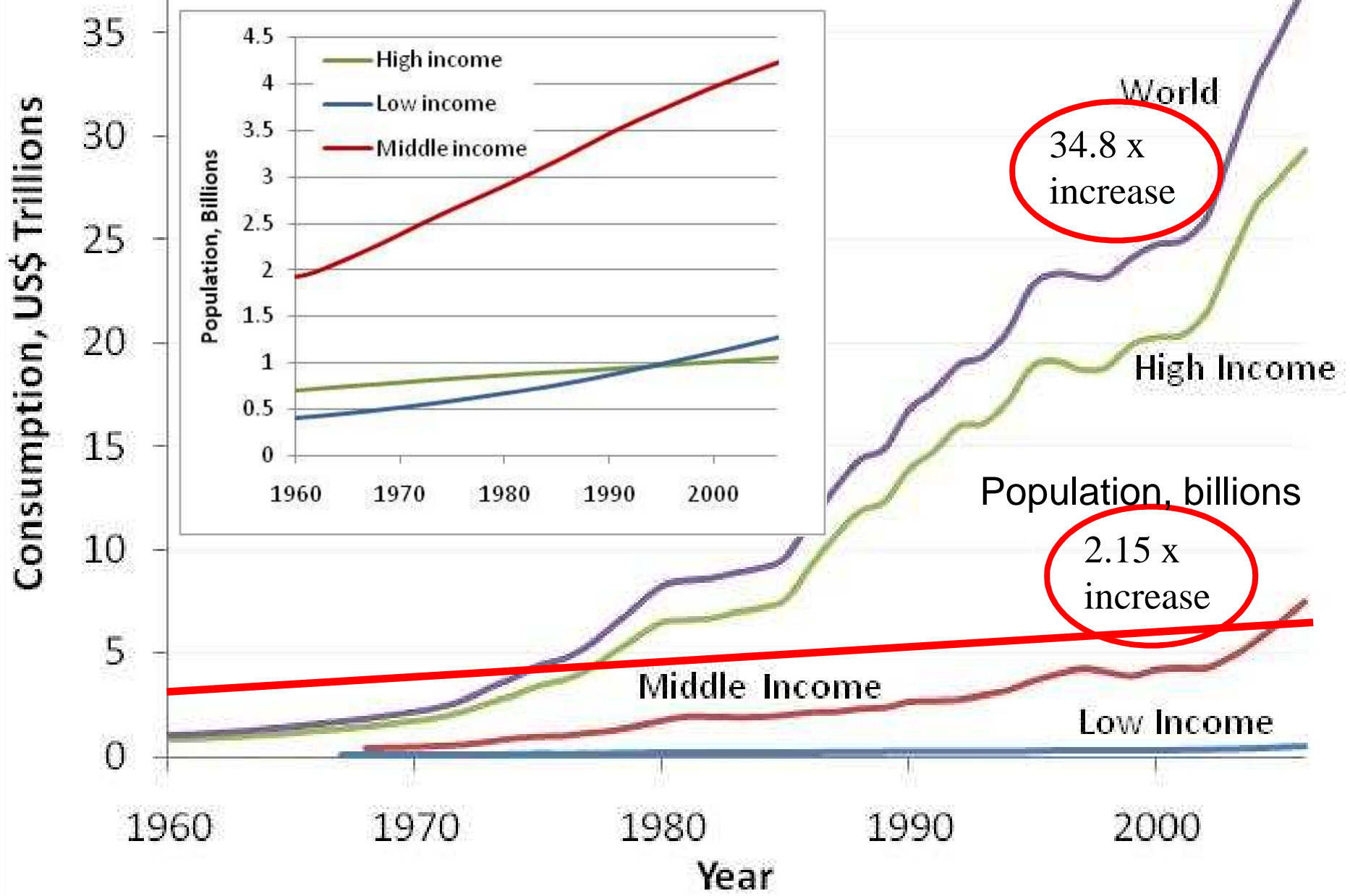


# Population Trends, 2008

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- Current population is at 6.9 billion, gaining 79 million people per year
- Fertility levels are declining but slower than expected
- In developing countries fertility is at 2.56 children per woman; even at 2.02 children per woman, the population will grow until 2050
- Population growth in the developed world is increasing slightly
- For the medium scenario, the population is expected to reach over 9 billion by 2050 with 31 million being added per year
- Over 60% will live in urban areas

# Total consumption, Current US\$, Trillions



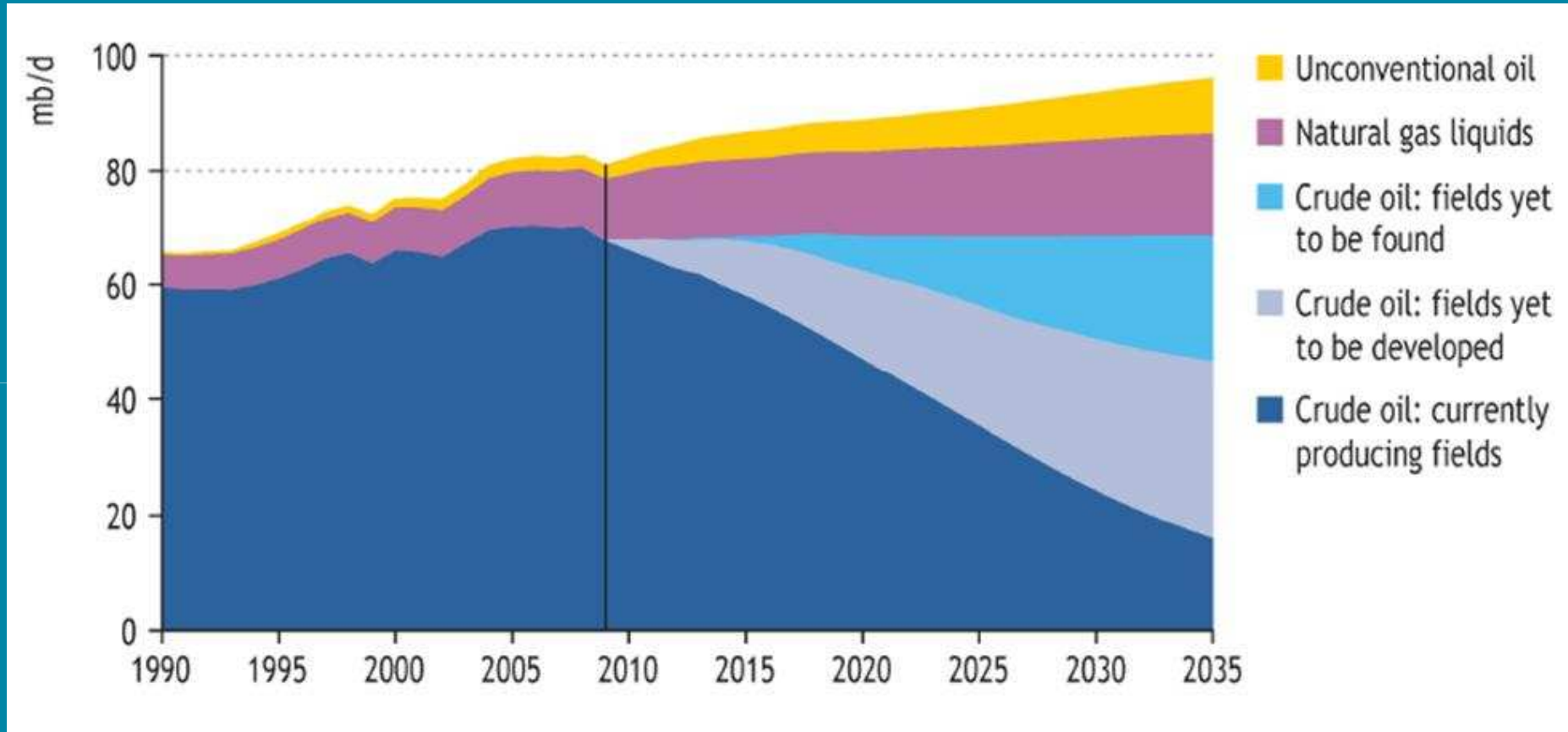
# Changing consumption patterns

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- In 2007, emerging markets outspent the US
- By 2015, emerging markets (e.g. India, China) are expected to account for 37% of global consumption
- India's middle class is now 34% of the population, up from 22% in 2002 and consequently consuming at a higher rate
- China is now the third largest economy (based on GDP) and the world's highest consumer of energy

# Oil/Gas Sources to 2035

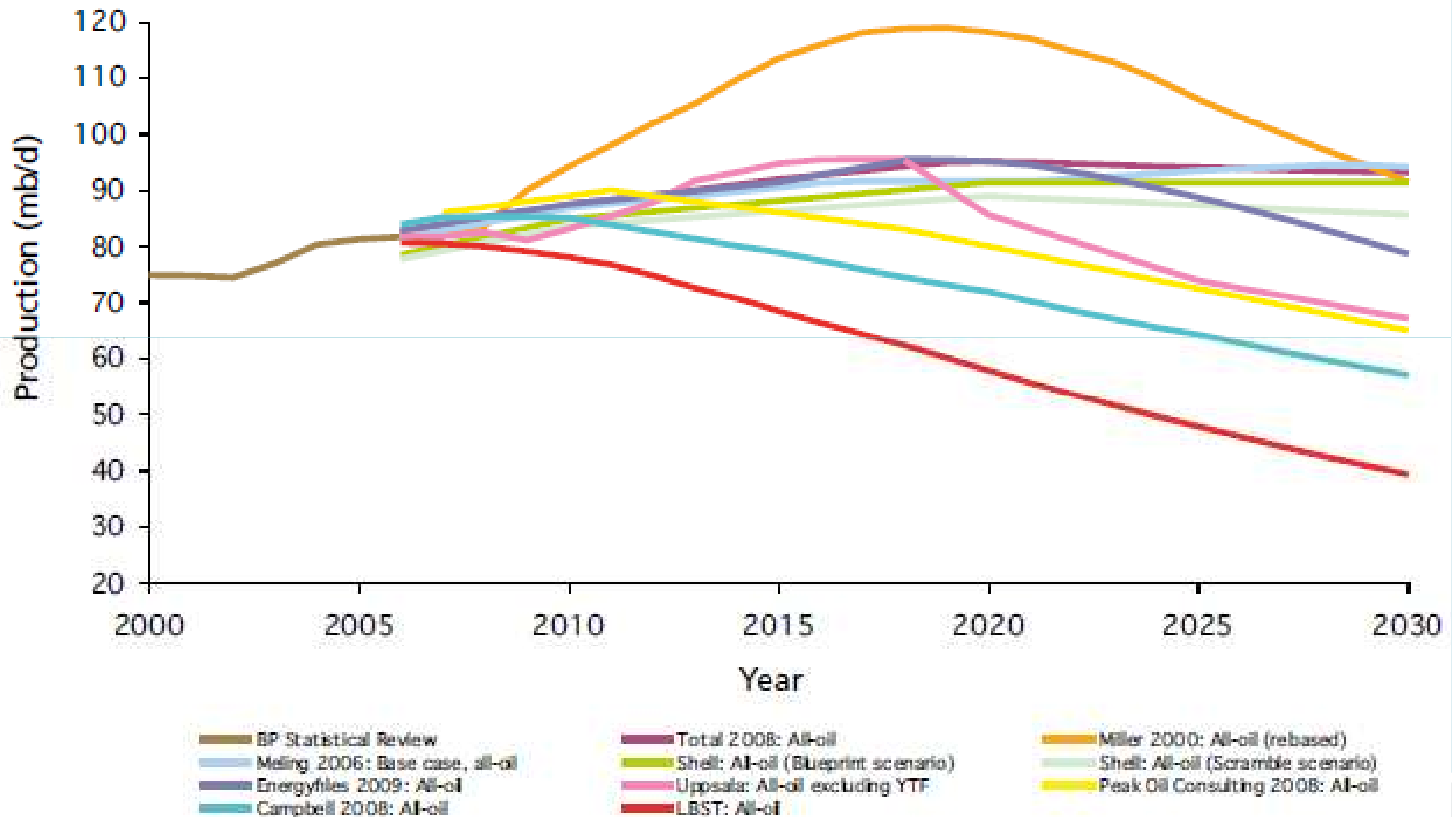
(2009 World Energy Outlook)





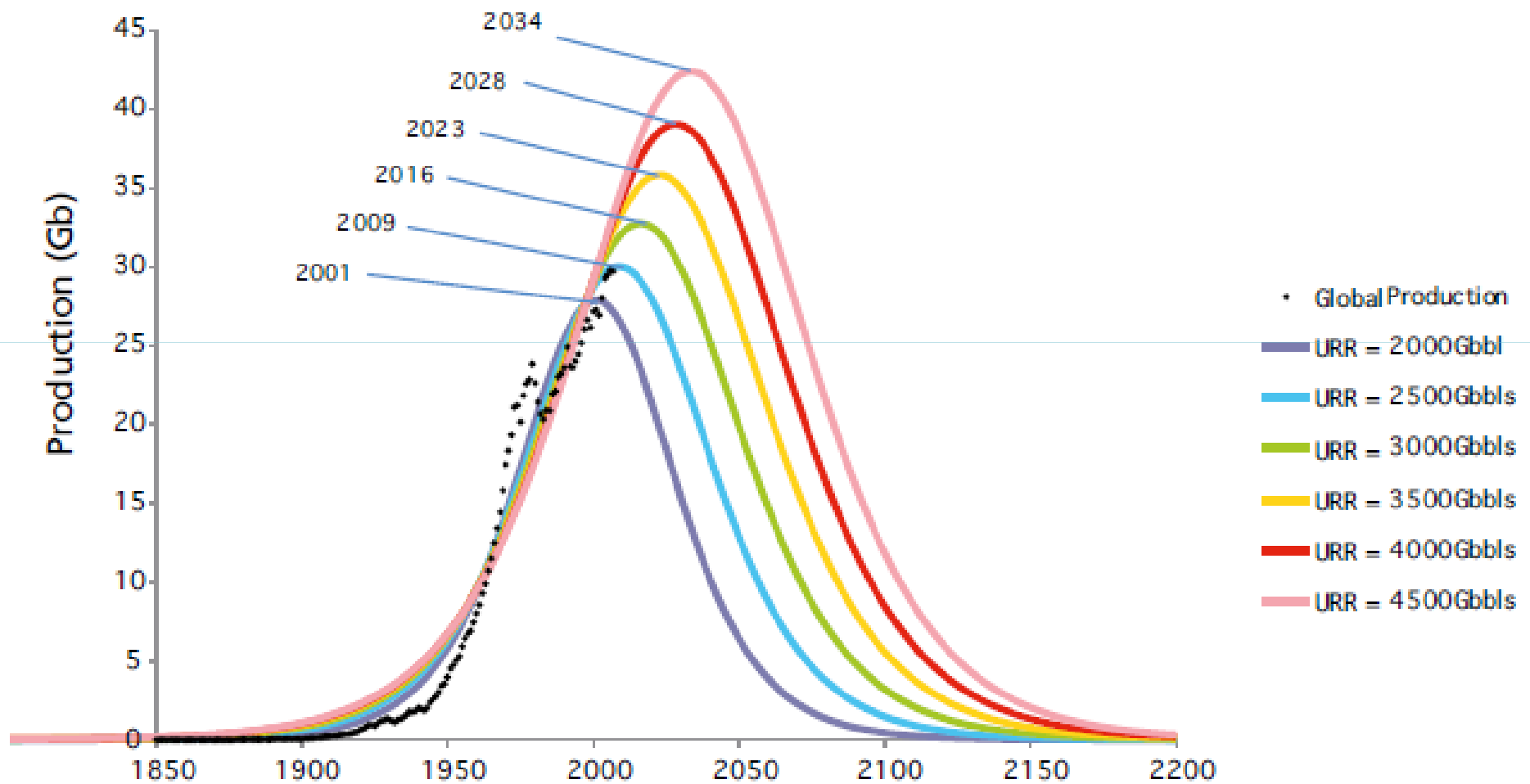
# Estimates of Peak Oil

(2010, UK Energy Research Centre)

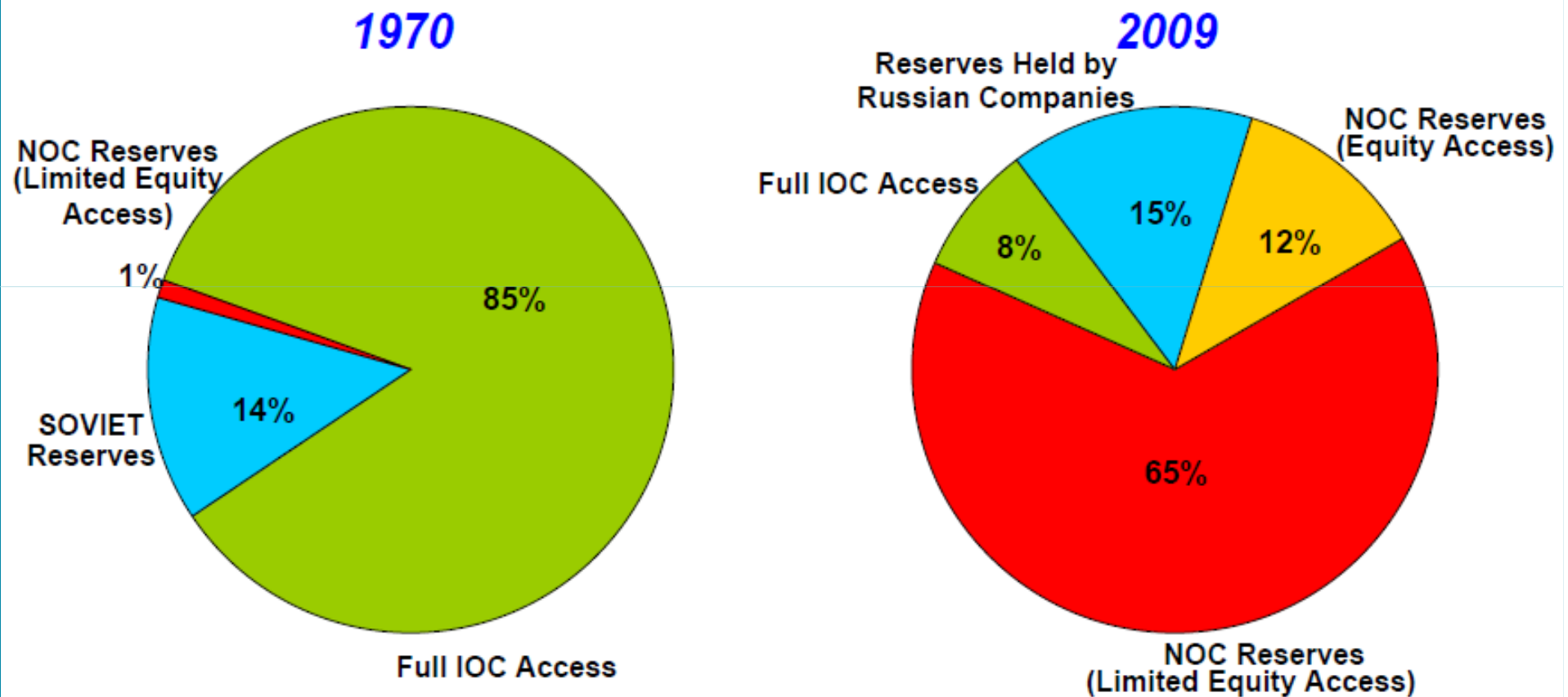


# Ultimate Recoverable Reserves

(2010, UK Energy Research Centre)



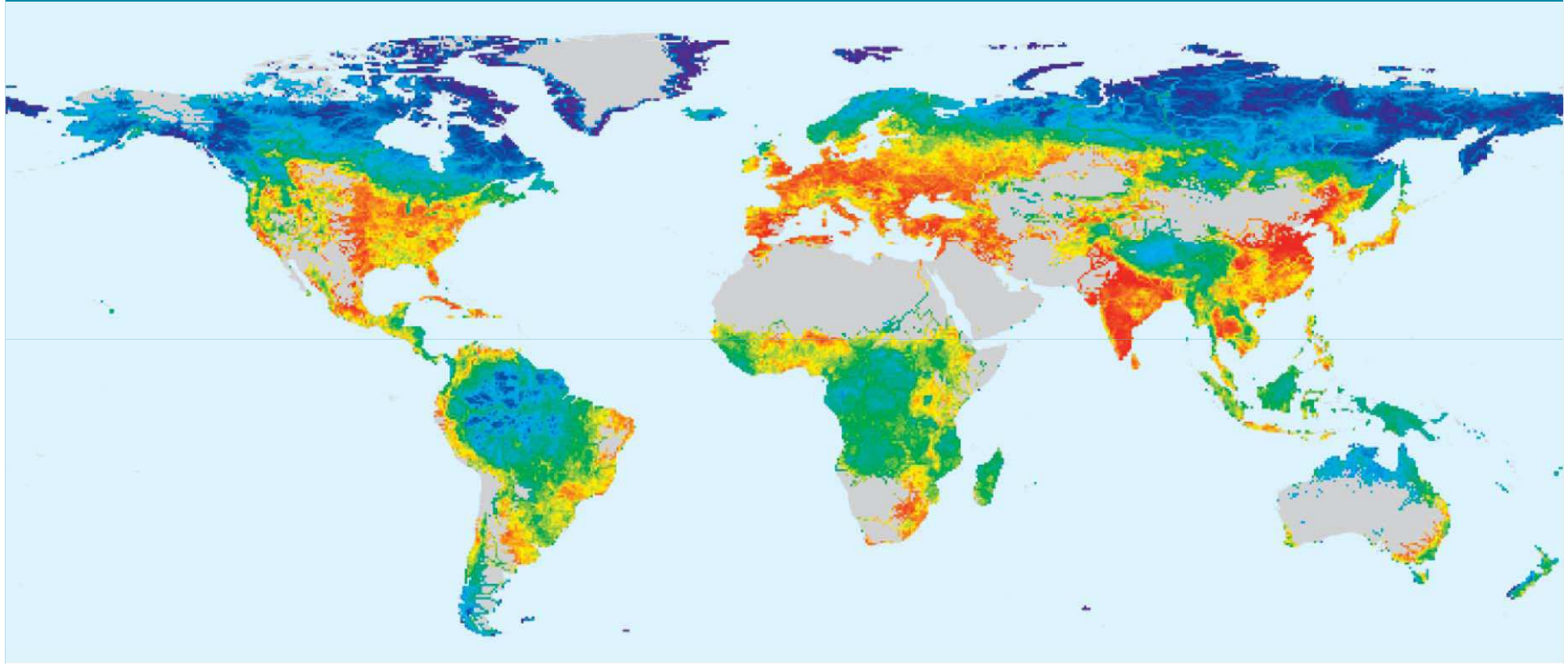
# NOCs Increasing Control over the World's Oil and Gas Reserves



Source: PFC Energy, Oil & Gas Journal, BP Statistical Review

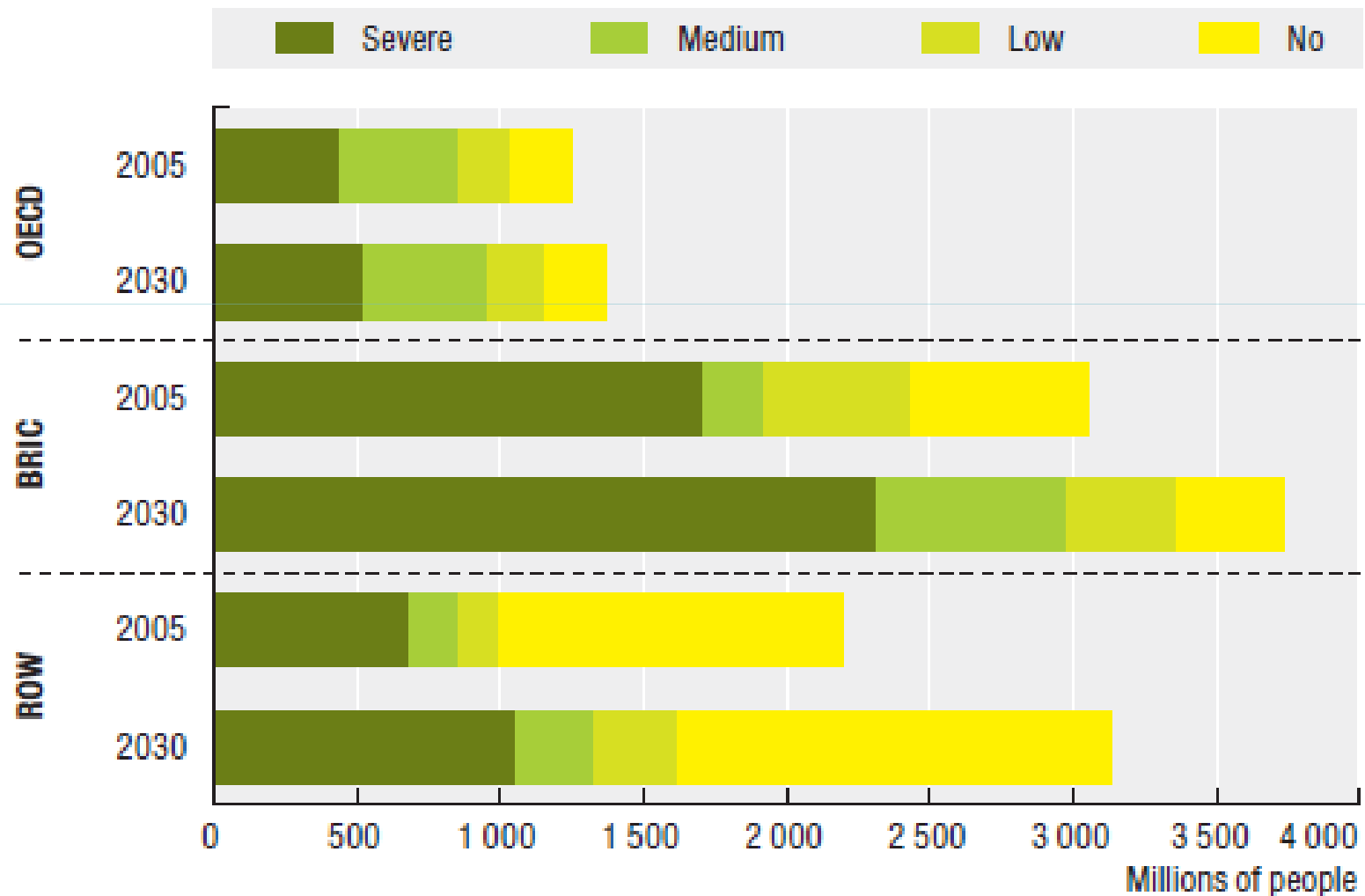
# Water Stress 2000

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# People living in areas of stress

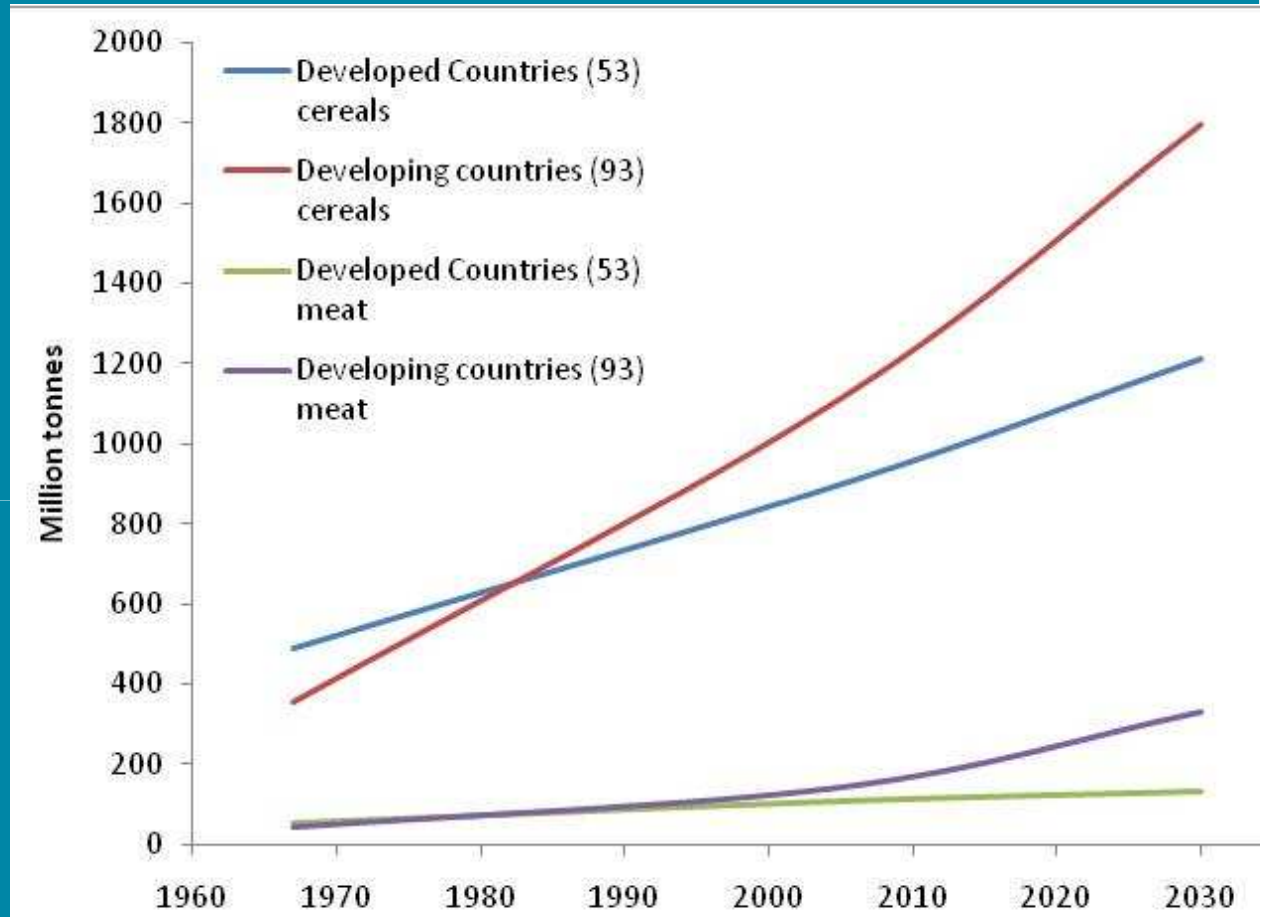
(millions of people)



# Food Production

To feed 9.1 billion people in 2050 will require an increase of 70% in food production

Additional 1 billion tonnes cereals, 200 million tonnes meat



# Food production impacts

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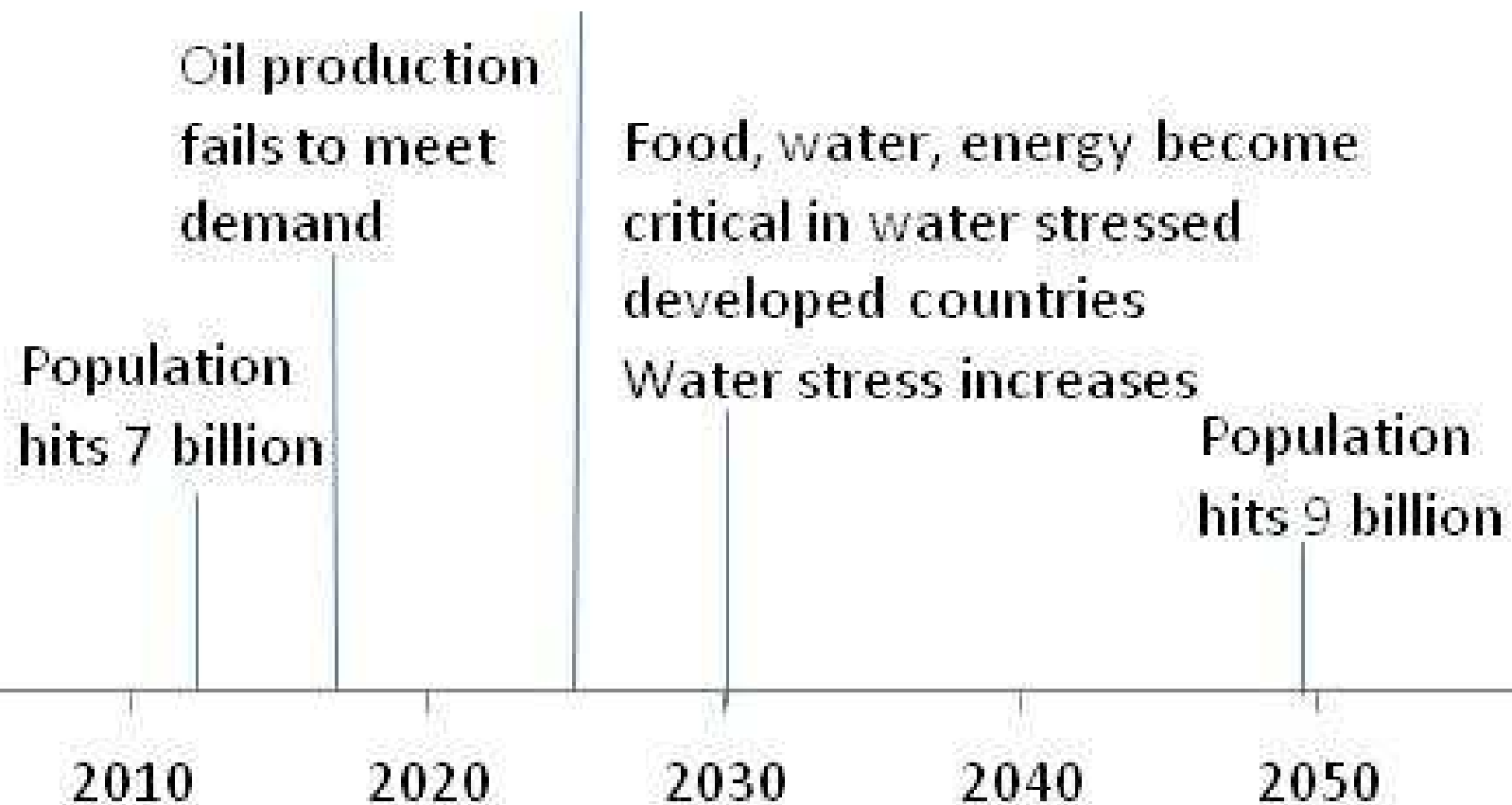
- Fossil fuel inputs for cereal and meat production alone will increase from 1100 million barrels per annum (2010) to 1850 million barrels per annum (2050)
- Agriculture already uses 70% of freshwater withdrawals but even with increasing efficiency will need another 11% to meet increasing irrigation needs
- Increasing land use for prime agricultural land will compete with increasing urbanisation and with existing forests and reserves
- This does not consider global warming
- It is now expected that temperature rise may be up to 4°C

Population hits 8 billion

Peak oil

Coal becomes major fossil fuel

Food, water, energy become critical in  
water stressed developing countries





# Stocktake

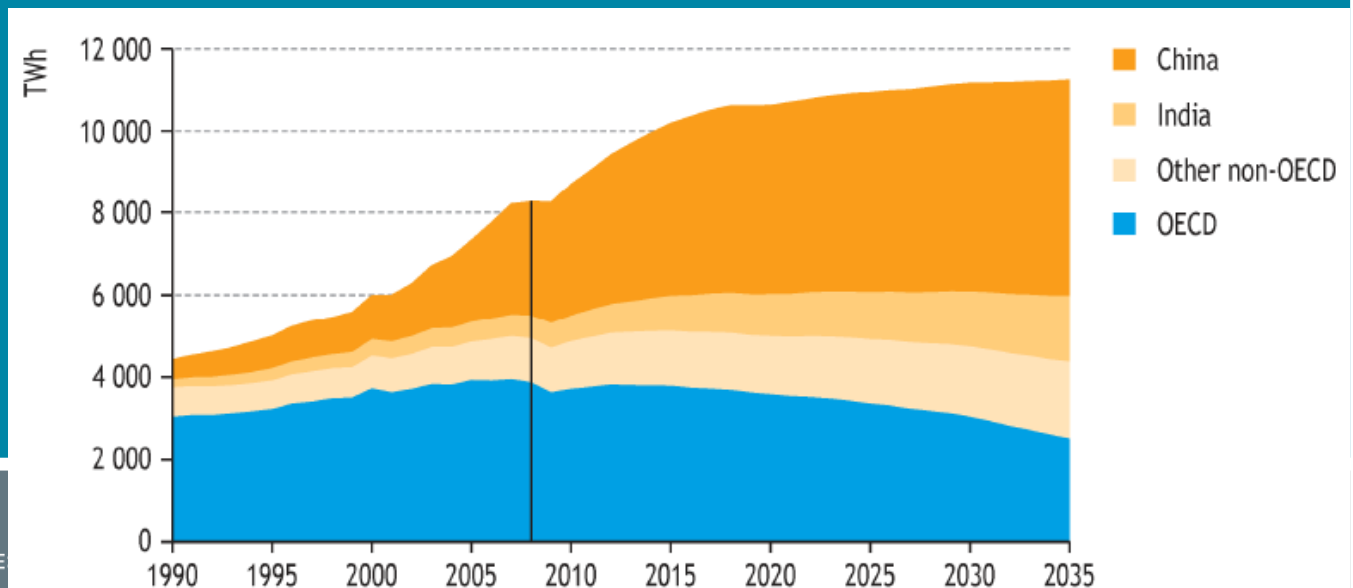
Currently we cannot get agreement on even basic reductions in CO2 emissions

Current government policies still favour fossil fuel energies

Focus is still on growth economy, growth consumerism, growth population

Projects such as desalination are only short term, energy and cost intensive stopgaps

Coal fired  
electricity  
generation  
by region



# Stocktake

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It is possible that the next oil shock (likely to happen between 2012-2015) will accelerate shifts to renewable energy

It may also shift towards gas, coal and nuclear

It is not yet clear if this will be the start of declines in oil availability or if there will be ongoing fluctuations with an overall downward trend

Advances in coal liquifaction and CO<sub>2</sub> sequestration may moderate the impact of coal useage but countries such as China have rapidly shifted to coal without such mitigation measures

The time for construction of advanced liquifaction plants and large scale sequestration operations is at least 10 years

# Stocktake

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Europe is looking to renewable energy at multiple levels and on a widespread scale

Even in the US renewable energy is gaining traction

China is putting major investment into renewable energies, expecting to produce micro generation wind and solar technologies at affordable costs

Efficiencies and effectiveness still need to be assessed

Texas has over 6000 wind turbines providing 9000MW of power, comparable to 9 power stations



# Stocktake

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Life cycle thinking is now becoming more important for larger companies

Incremental changes are occurring, particularly in managing water, energy and some resources

Consumers are becoming more aware and many communities are starting to develop sustainability programmes

Education efforts on sustainability are now starting in primary schools

There is widespread awareness but there is still a lot of misinformation especially about climate change being disseminated on high intensity level throughout the media

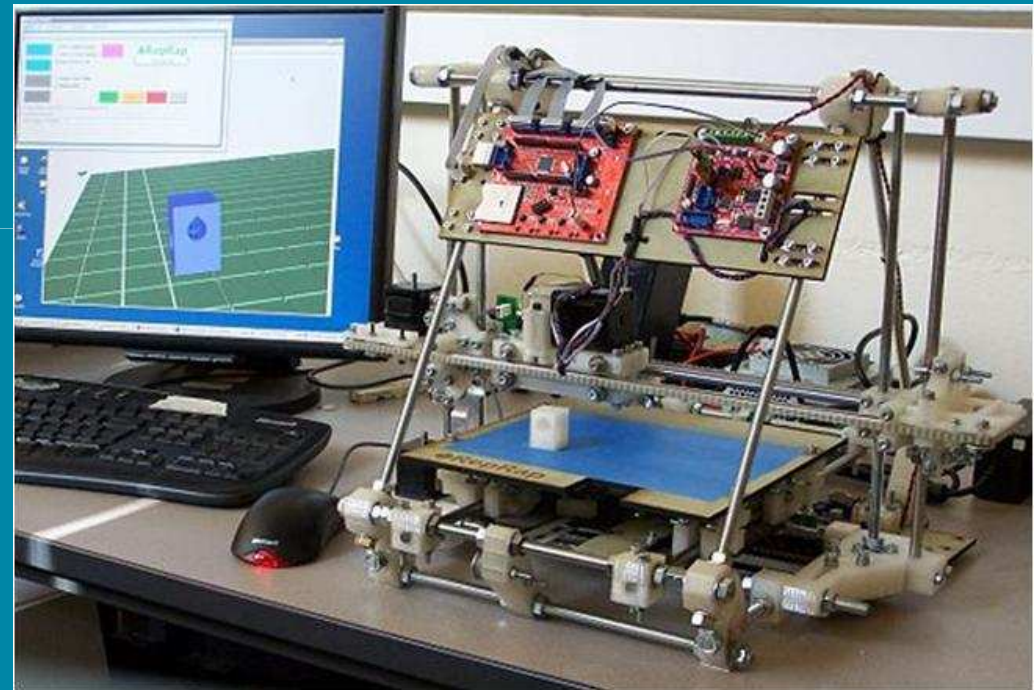


# Stocktake

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Legislation on hazardous chemical, product take back, cradle to cradle design will drive new technologies, new processes and new directions

3D printing – Mendel RepRap  
self replicating printer  
Allows recycling of materials  
For future products, companies  
would sell designs  
Component printing specs would  
be provided for household goods



# Stocktake

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**Biomimicry and nano-processing** – changing processing energy requirements, reducing temperature, pressure and use of hazardous materials

**Bio concretes** – may be able to replace traditional concrete

Will absorb CO<sup>2</sup> during production and requires mainly ambient conditions for production

**E-readers** – potential loss of global pulp production for newspaper and books

Cellulose and lignin can now be processed into jet biofuels



# Implementing sustainability

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‘Leaders in the water sector – in water supply and sanitation, hydropower, irrigation and flood control – have long been aware that water is essential to sustainable development

But they often have a narrow, sectoral perspective that blinds many decisions on water

They do not make the decisions on development objectives and the allocation of human and financial resources to meet them

These decisions are made or influenced by leaders in government, the private sector and civil society, who must learn to recognize water’s role in obtaining their objectives’

- 2009, UN World Water Development Report 3



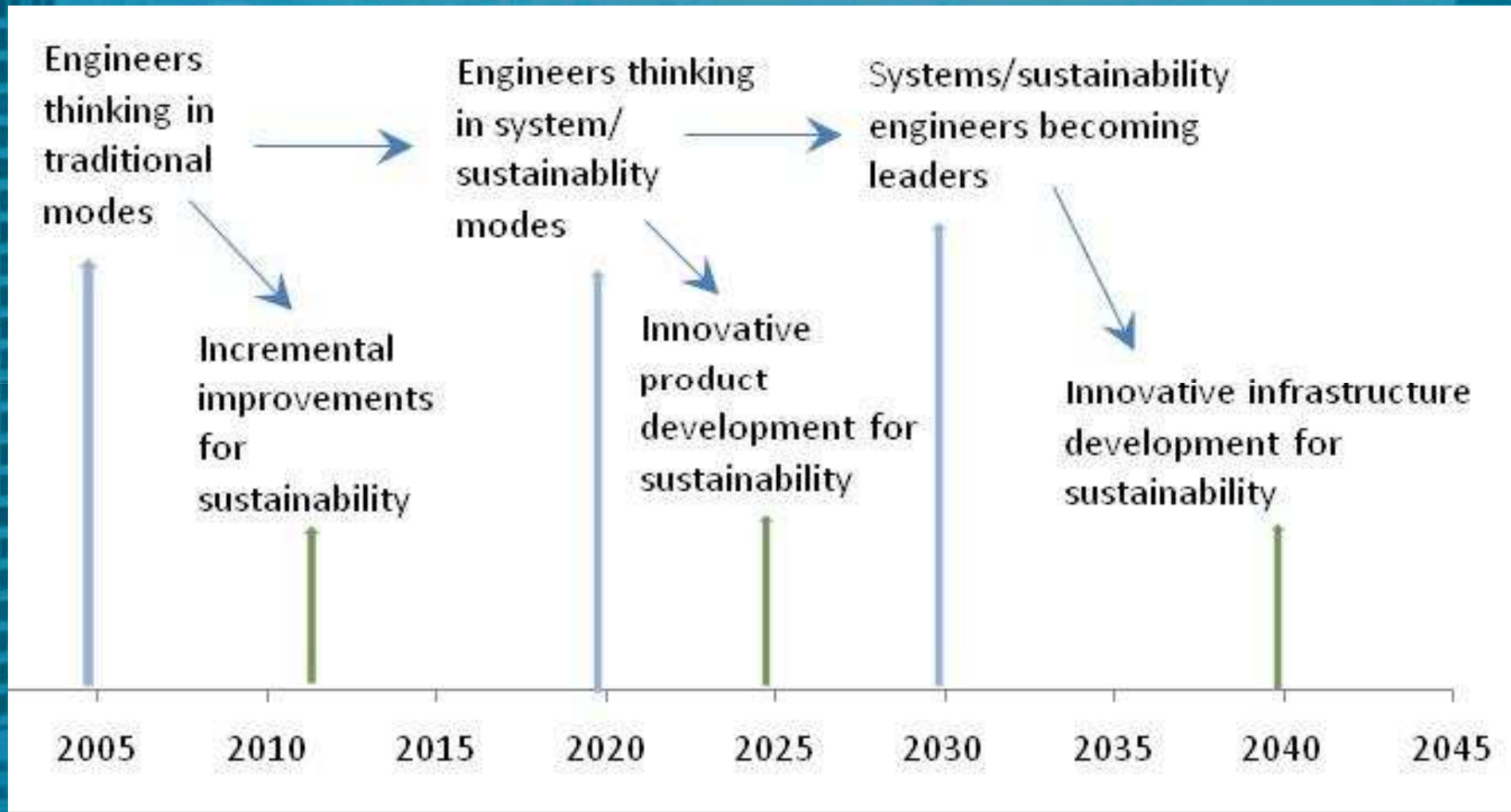
# UN Water Development Report 3

‘We need to step outside the ‘water box’ – the narrow perspective of the water sector that has blinded many decisions about water – and adopt a much broader perspective that places water in the broader framework of social and economic development. Only by doing this will we begin to solve the world’s water crises – starting today.’





# Educating engineering leaders



# Transitioning to 2030 and beyond

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- We are faced with a rapidly changing world with growing population, growing consumption and an embedded economic paradigm of growth
- Much will depend on whether we shift towards more efficient and sustainable energy and technologies with the next energy shock
- There are solutions which could be implemented from the grass roots level, including new economic concepts, new materials and new technologies
- Overall, we, as engineers, need to strengthen the messages we are giving to governments, councils, communities, people, other engineers and universities
- We need to promote thinking innovation and outside the box if we are going to achieve sustainability