



Climate change & sustainable energy:
Ethical decision-making for engineers
ELEC4122 Strategic Leadership & Ethics, 24/9/09





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Outline

- Fossil fuel flow constraints:
 - Risks associated with “peak oil”
- Climate change & carbon constraints:
 - Risks of “tipping points”
- Implications for the stationary energy sector:
 - Particularly the electricity industry
- Implications for engineering decision-making:
 - Intra- & inter-generational equity
 - Decision-making frameworks

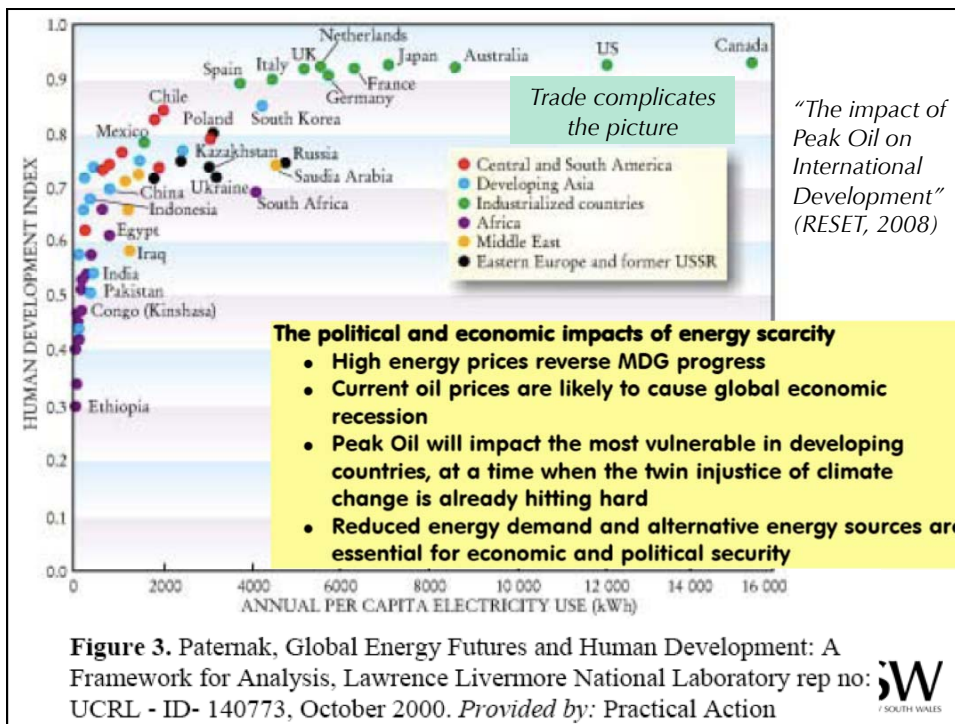
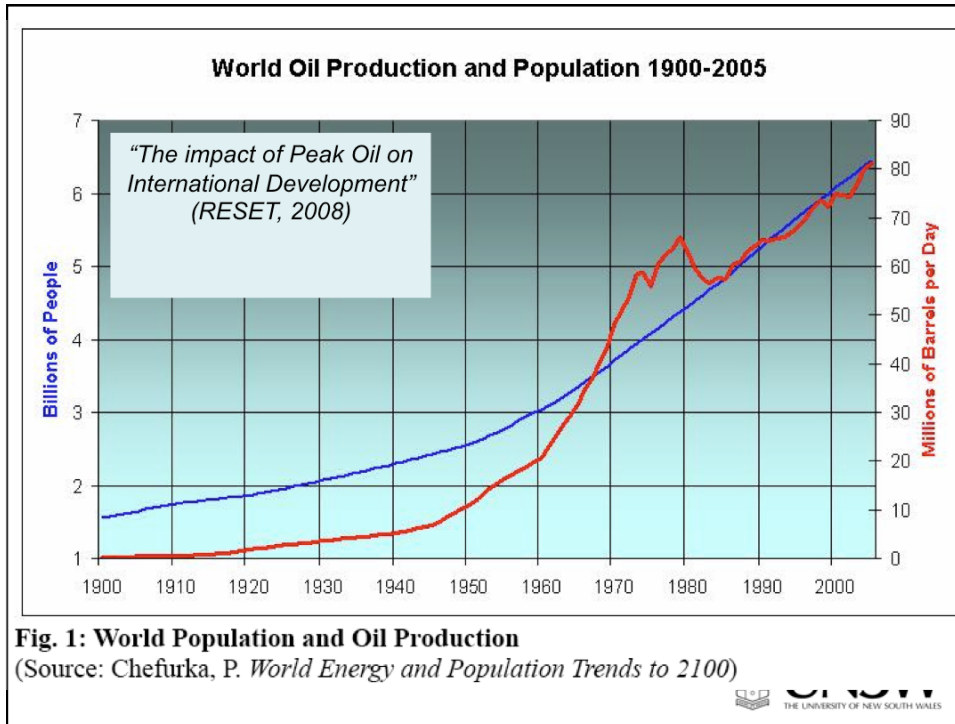


Siemens perspective on global challenges (Sept 08)

Demographic Dynamics	Resource Scarcity	Environmental Focus
		
<ul style="list-style-type: none">▪ Population growth: 7.5 bill. in 2020 (+1.1 bill.)▪ Power consumption: +5.2% p.a. in emerging regions versus 1.4% in developed world▪ Urbanization & megacities (>10 million): 22 megacities by 2015	<ul style="list-style-type: none">▪ Geopolitics: 70% of world's oil and gas reserves concentrated only in a few countries▪ Fuel diversification: Steadily rising oil prices accelerate the shift to a broader fuel mix	<ul style="list-style-type: none">▪ Climate change: Global warming is a fact and poses a threat to mankind and the biosphere▪ Air pollution: Air pollution has intensified worldwide
<small>Sources: UN; IEA; BP; BGR; Siemens; figures based on year 2006</small>		
		

Quotations from Australian Defence White Paper, 2009

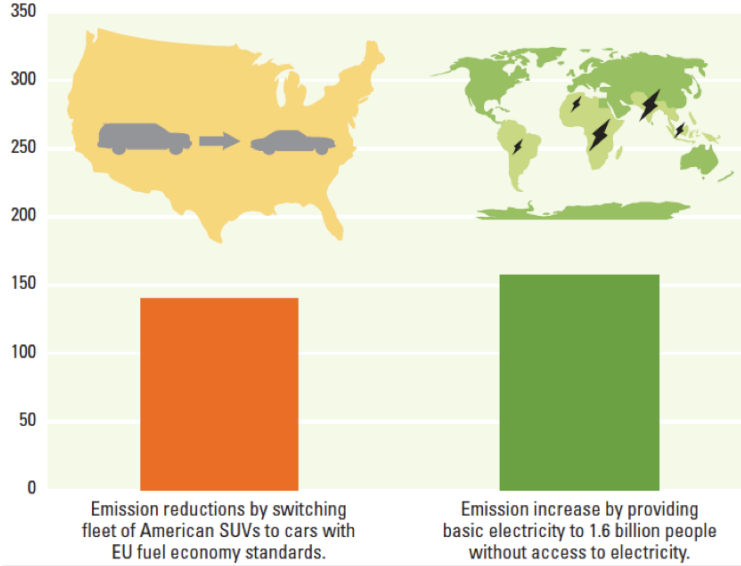
- Beyond our region, Australia cannot be secure in an insecure world. We have a strategic interest in preserving an international order that restrains aggression by states against each other, and can effectively manage other risks and threats, such as the proliferation of WMD, terrorism, state fragility and failure, intra-state conflict, and the **security impacts of climate change and resource scarcity**. (p 12)
- In the past decade we have also become increasingly more conscious of the potential **security impacts of changing climate patterns, resource and energy scarcity**, and persistent patterns of poverty and poor governance in many parts of the world (p 16)
- **Changing climate** patterns, combined with **booming population growth**, will sharpen **competition for scarce food, water and energy resources** in many parts of the world (p 31)
- It may be that the new potential sources of conflict related to our planet's **changing climate, or resource scarcity**, give rise to very old forms of confrontation and war, such as clashes between states over resources (p 40)



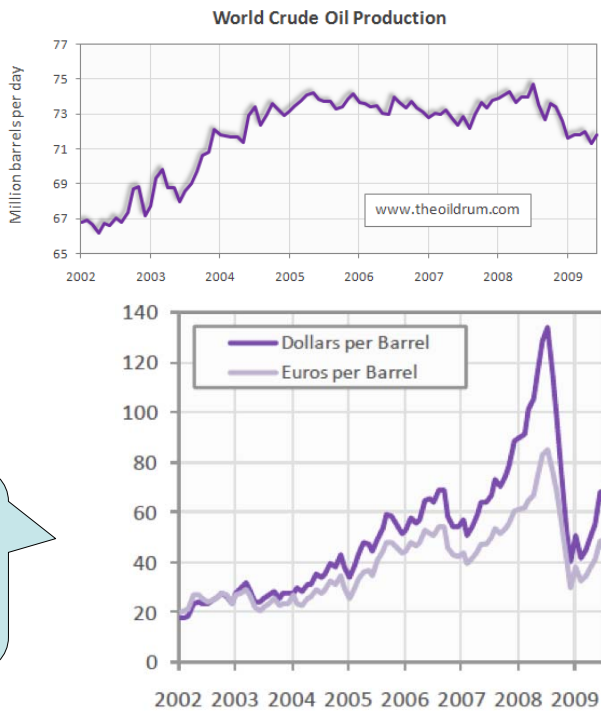
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Figure 2 Rebalancing act: Switching from SUVs to fuel-efficient passenger cars in the U.S. alone would nearly offset the emissions generated in providing electricity to 1.6 billion more people

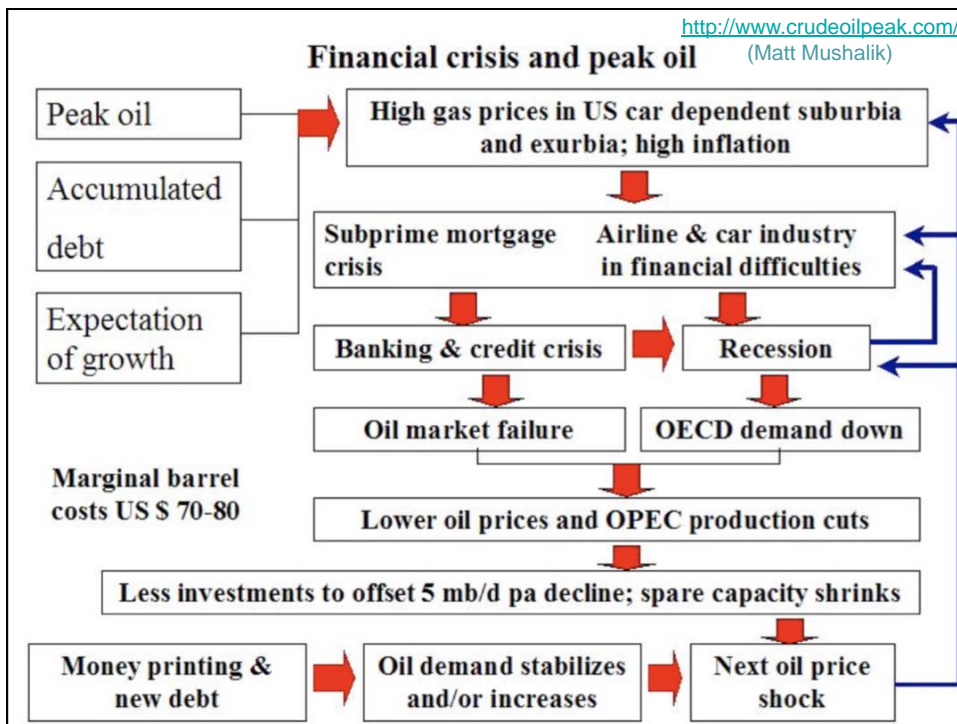
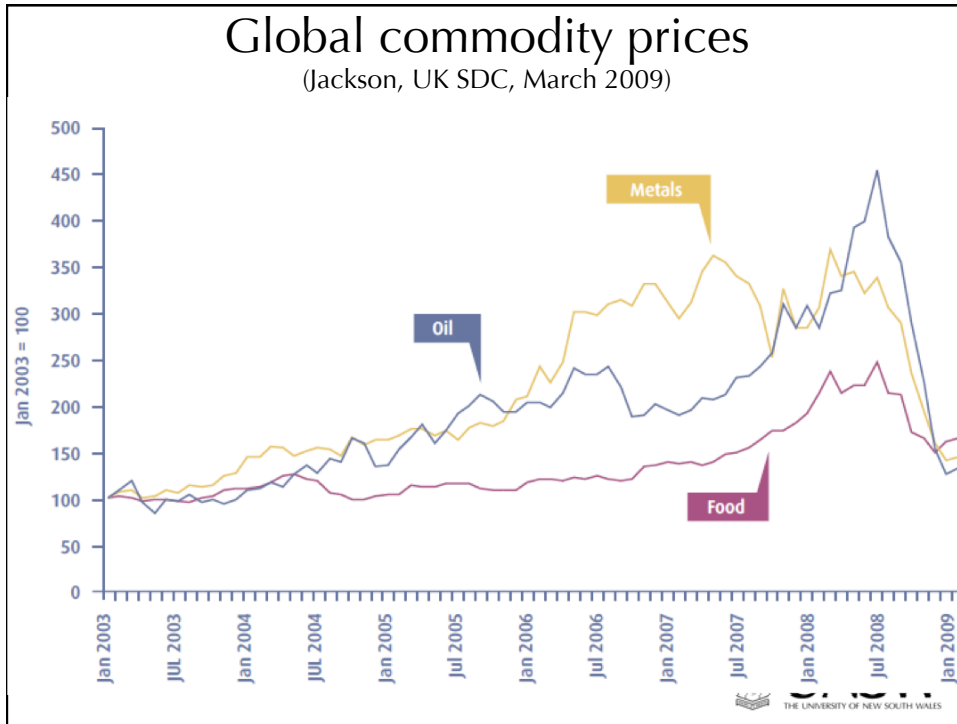
Emissions (million tons of CO₂)



Oil production & price trends to July 2009
(Oilwatch Monthly Sept 09
(www.theoil drum.com))

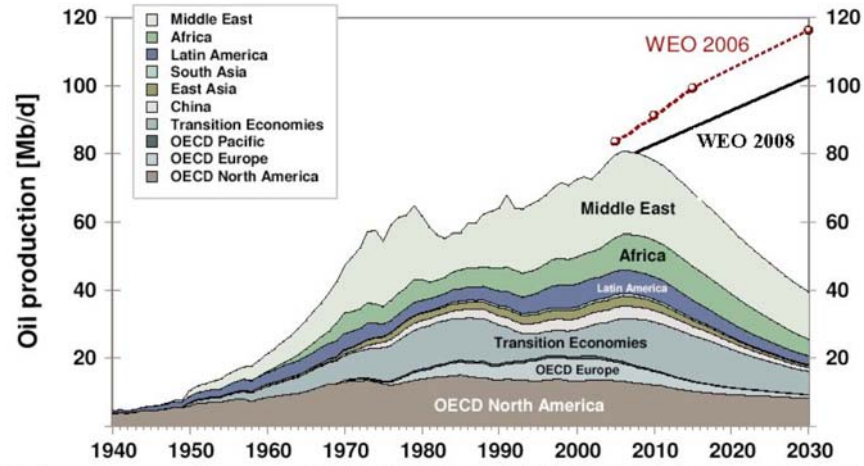


Global annual oil production constraint caused high prices which forced down demand; this behaviour likely to recur in next few years, possibly at a lower level of demand



Debated future for oil production (Energy Watch Group & WEO)

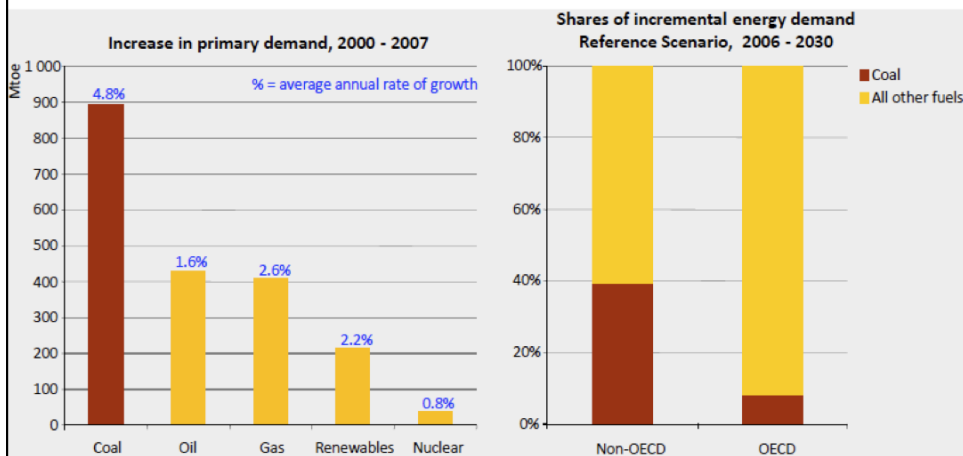
Figure 40: Oil production world summary

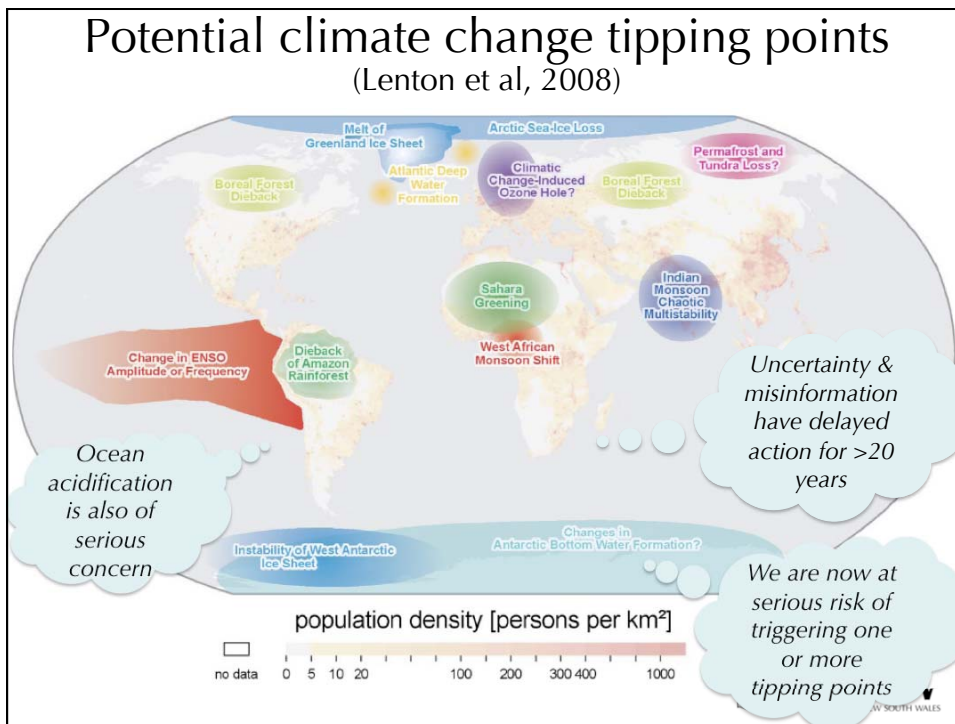
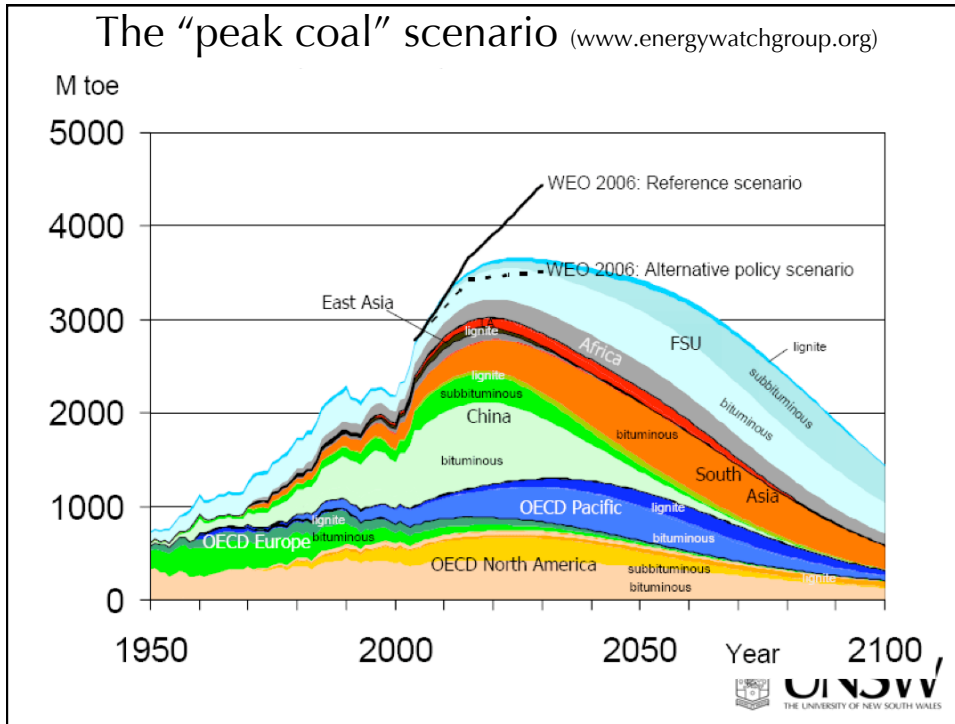


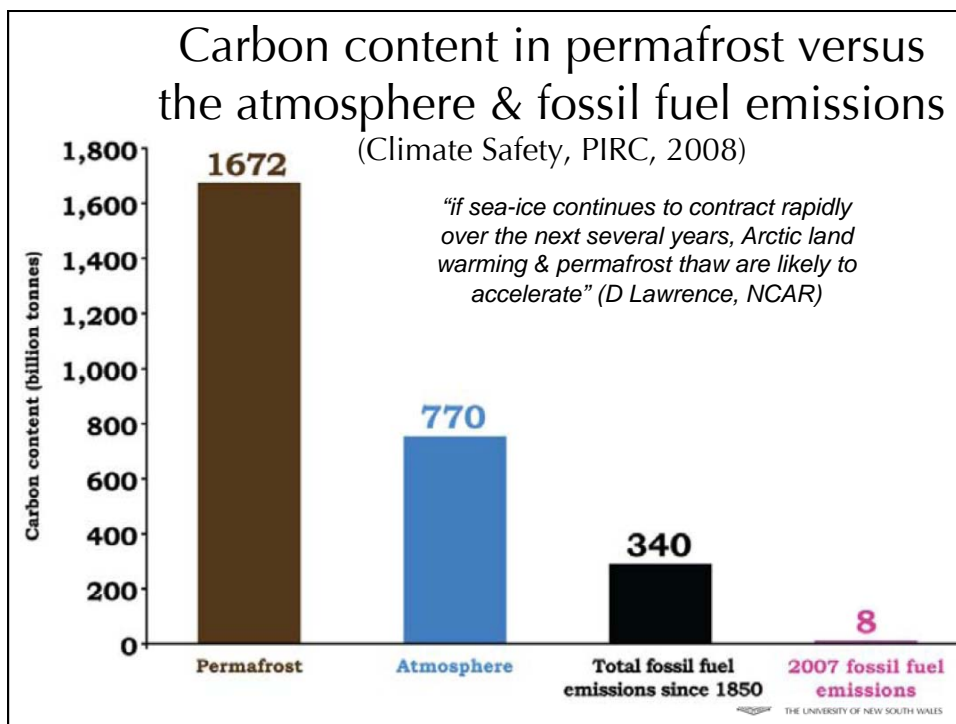
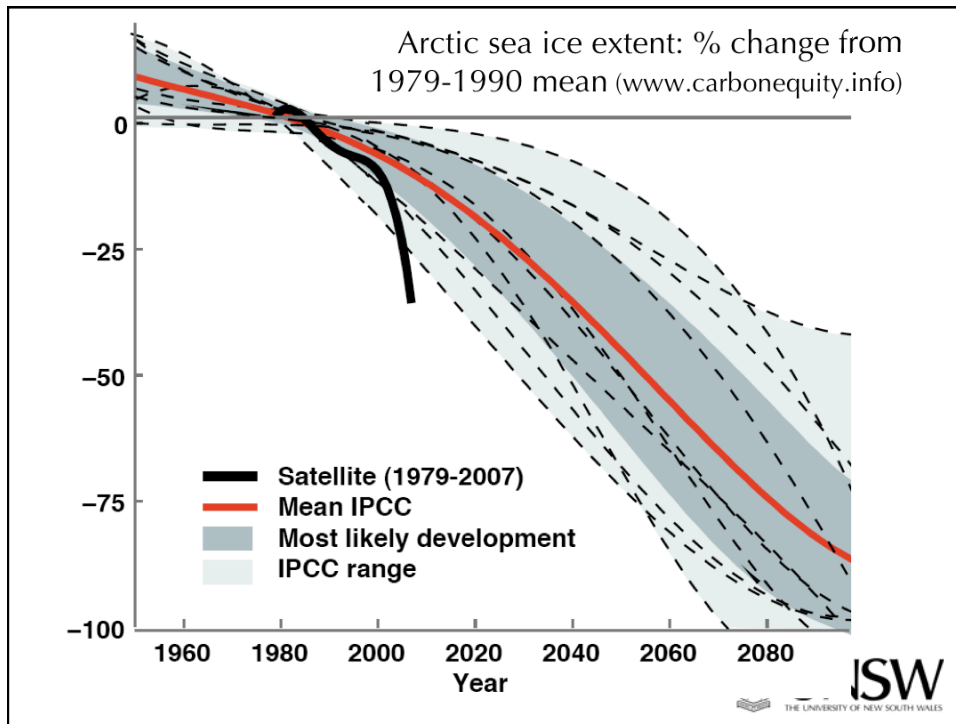
http://www.energywatchgroup.org/fileadmin/global/pdf/2008-02_EWG_Oil_Report_updated.pdf

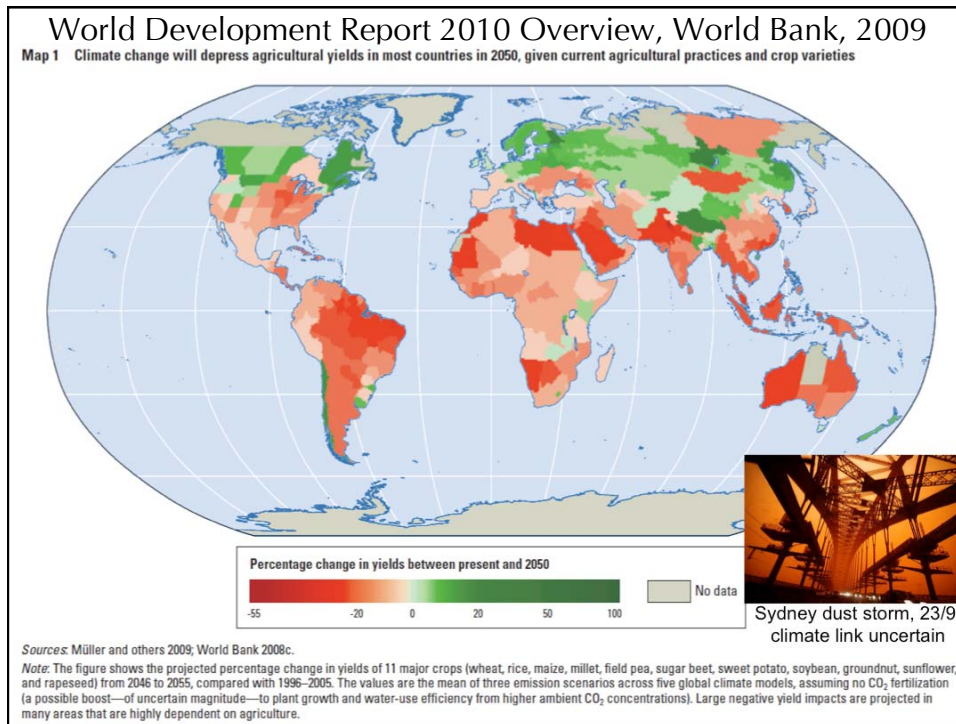


Coal has a growing share of fossil fuel consumption (IEA, 2008)









Summary & conclusions

World Energy Outlook 2008

- Current energy trends are patently unsustainable — socially, environmentally, economically
- Oil will remain the leading energy source but...
 - > The era of cheap oil is over, although price volatility will remain
 - > Oilfield decline is the key determinant of investment needs
 - > The oil market is undergoing major and lasting structural change, with national companies in the ascendancy
- To avoid "abrupt and irreversible" climate change we need a major decarbonisation of the world's energy system
 - > Copenhagen must deliver a credible post-2012 climate regime
 - > Limiting temperature rise to 2 °C will require significant emission reductions in all regions & technological breakthroughs
 - > Mitigating climate change will substantially improve energy security
- The present economic worries do not excuse back-tracking or delays in taking action to address energy challenges

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Quotes from UN Climate Change Conference, 22/9/09

- "Failure to reach broad agreement in Copenhagen would be morally inexcusable, economically short-sighted and politically unwise", Ban Ki-moon
- "We will endeavor to cut carbon dioxide emissions per unit of GDP by a notable margin by 2020 from the 2005 level", Hu Jintao
- "Our generation's response to this challenge will be judged by history, for if we fail to meet it -- boldly, swiftly, and together -- we risk consigning future generations to an irreversible catastrophe ... The time we have to reverse this tide is running out" Barack Obama



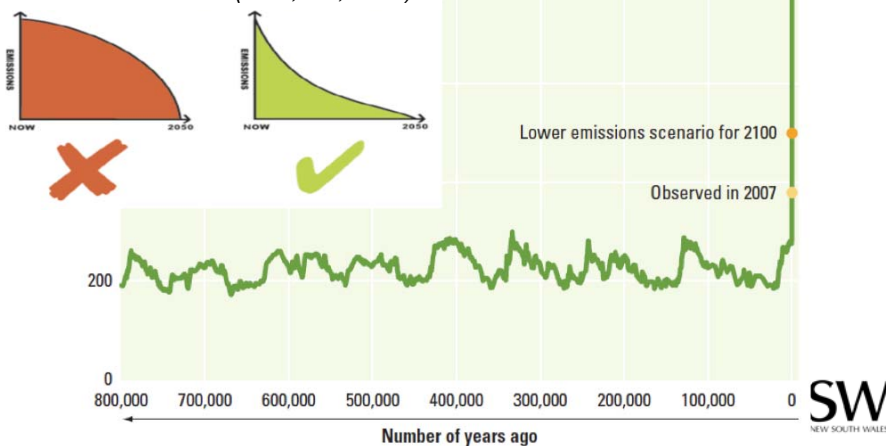
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Figure 4 Off the charts with CO₂

Carbon dioxide concentration (ppm)

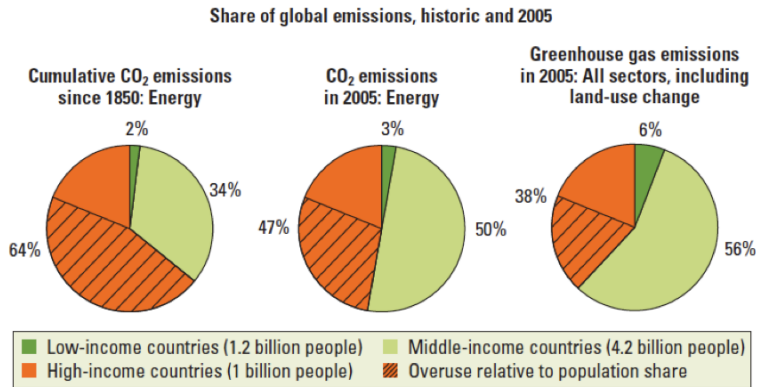
1,000

Importance of early reduction in emission rate: the area under the curve represents cumulative emissions (FOE, UK, 2009)



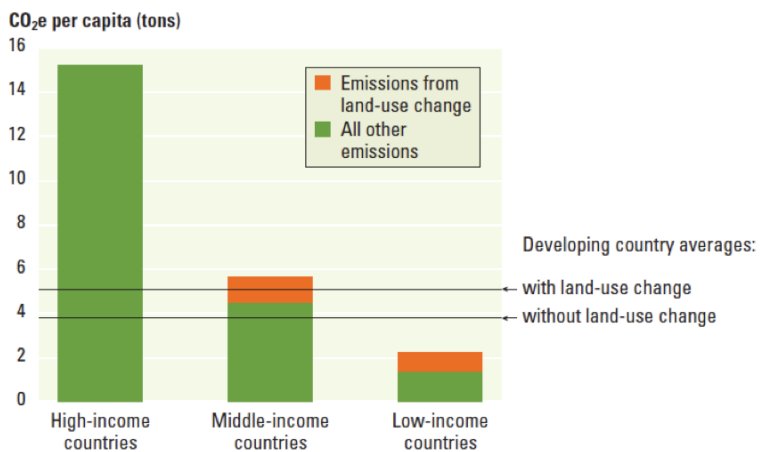
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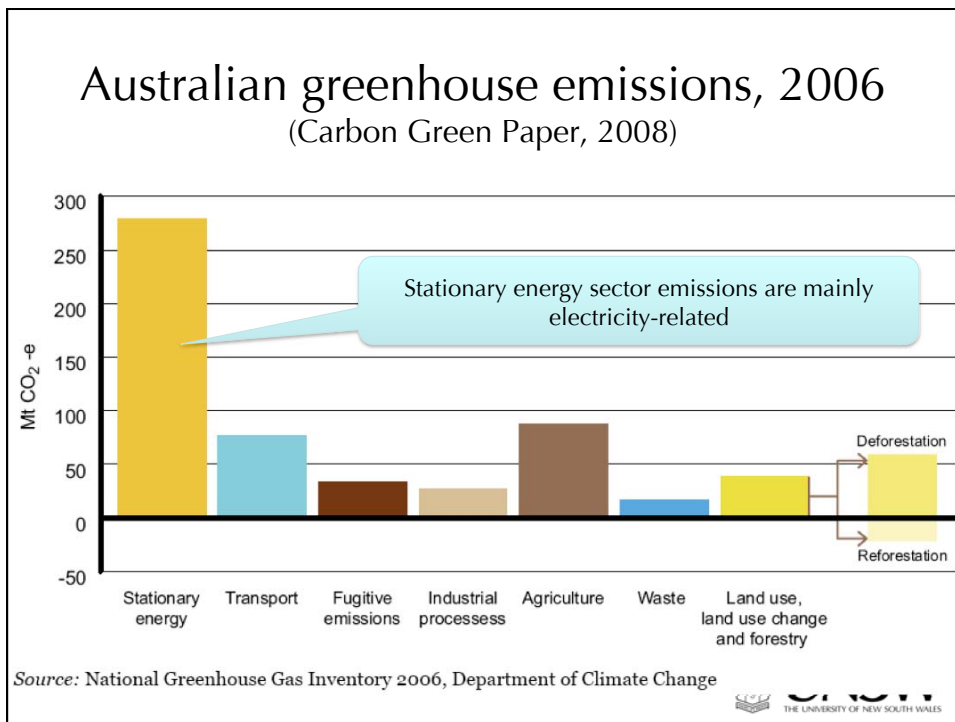
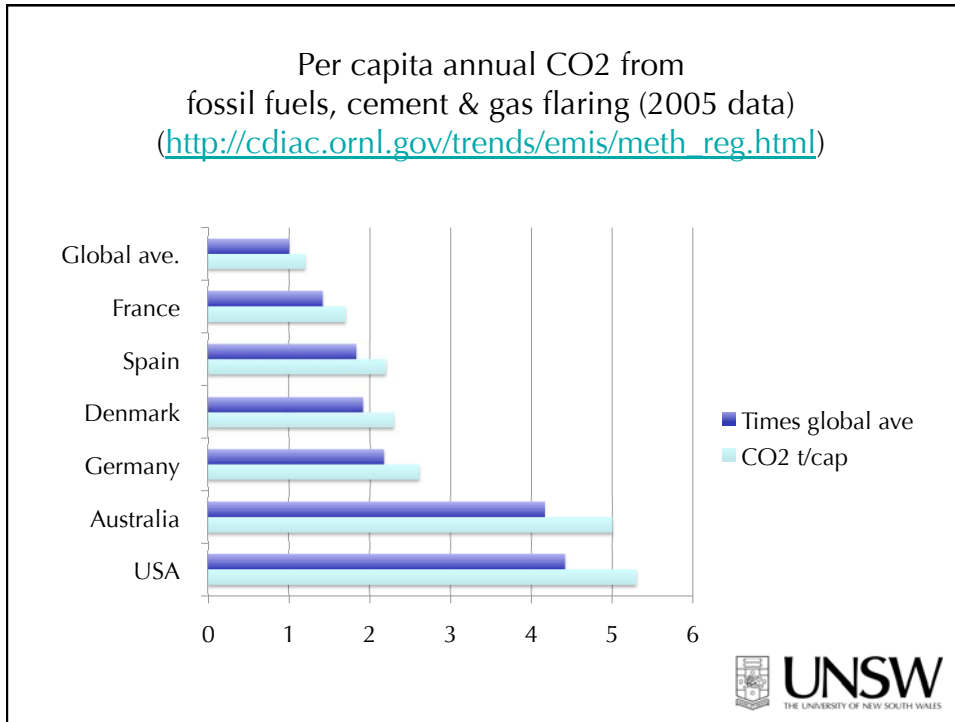
Figure 3 High-income countries have historically contributed a disproportionate share of global emissions and still do



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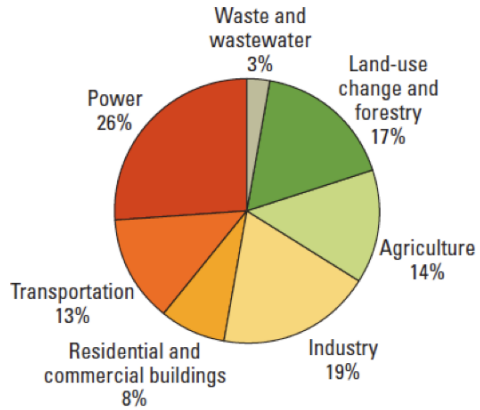
Figure 1 Unequal footprints: Emissions per capita in low-, middle-, and high-income countries, 2005





World Development Report 2010 Overview, World Bank, 2009

Figure 7 Global CO₂e emissions by sector: Energy, but also agriculture and forestry, are major sources

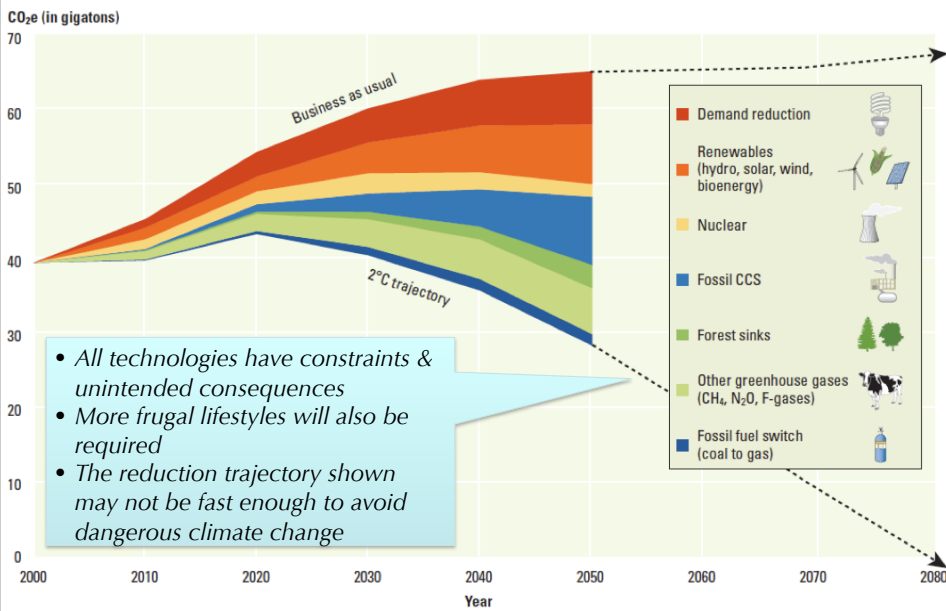


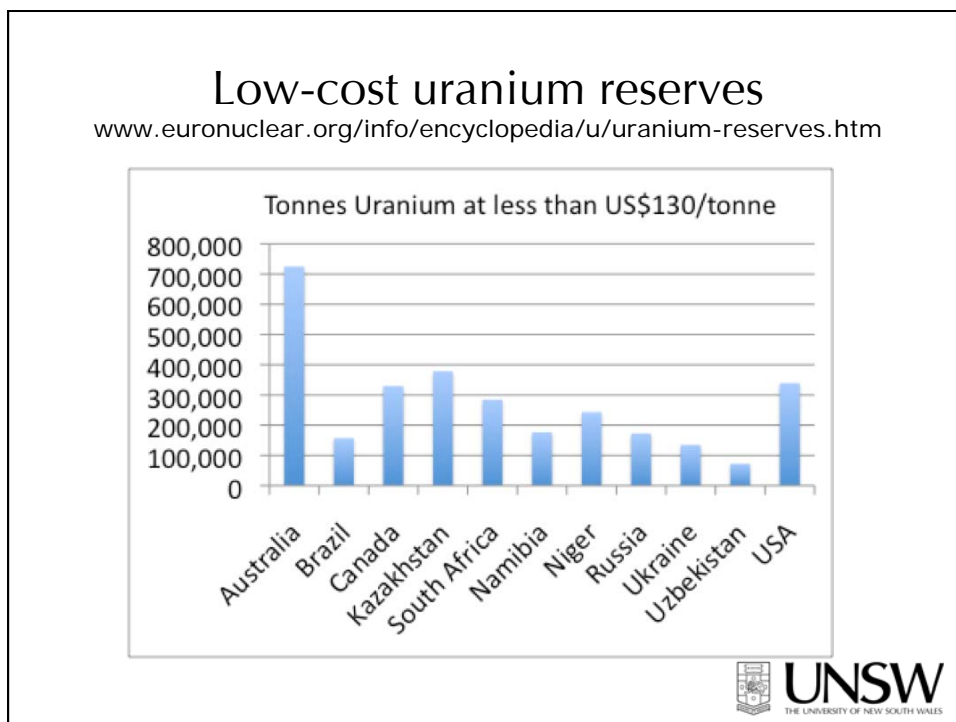
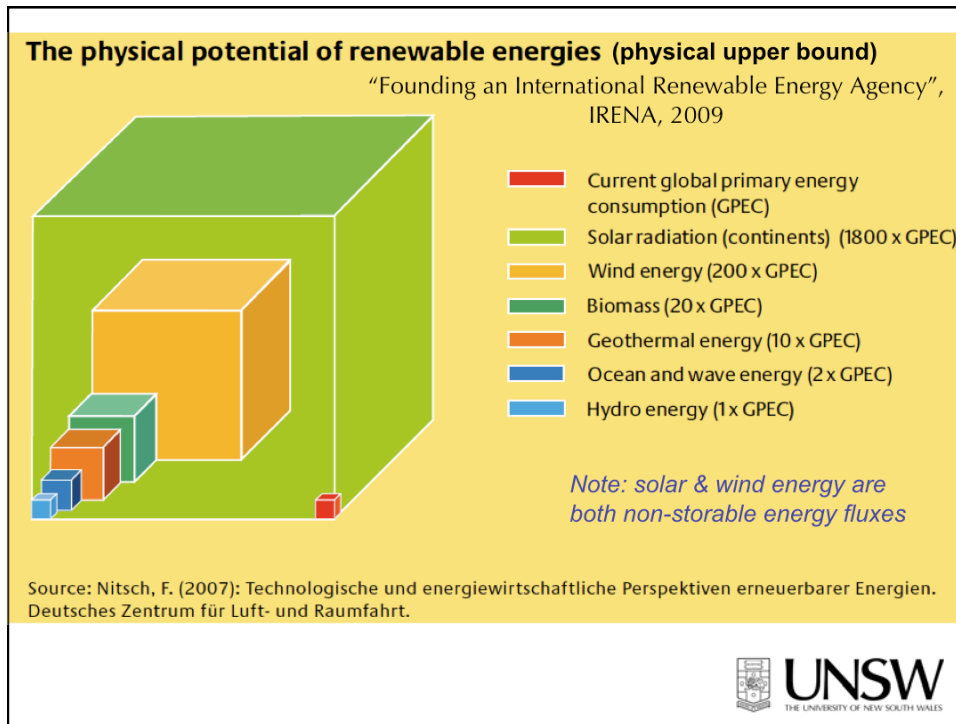
Source: IPCC 2007a, figure 2.1.

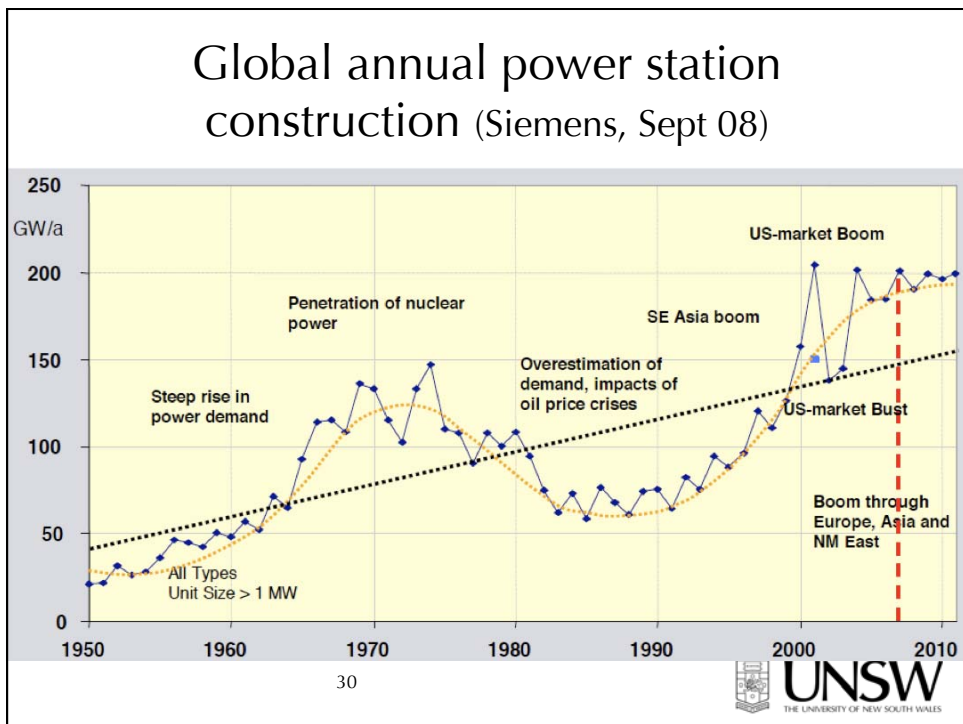
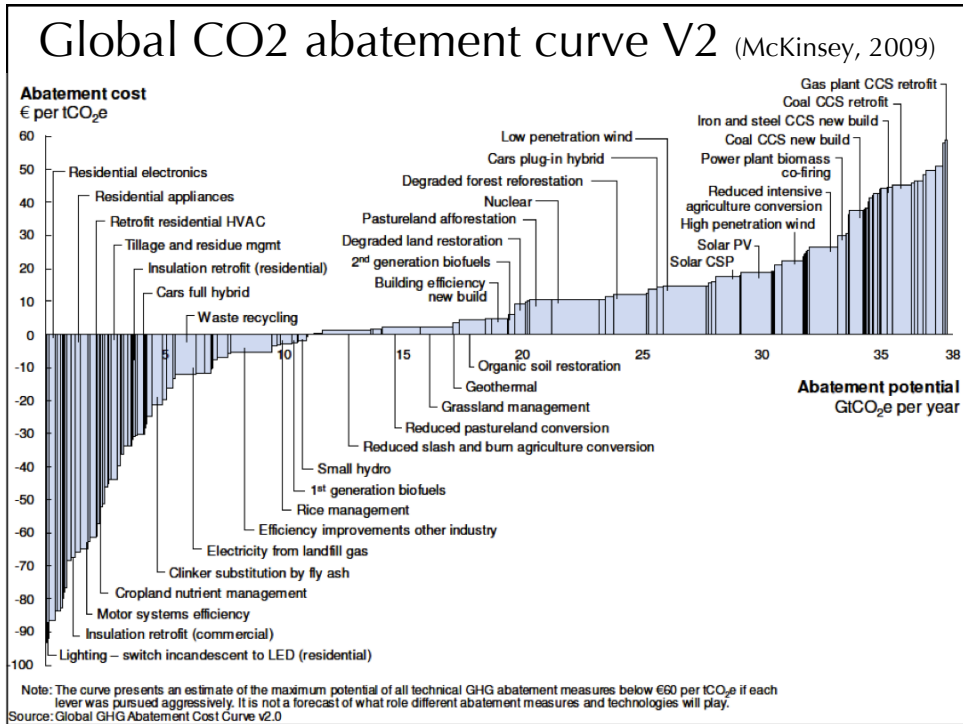
Note: Share of anthropogenic (human-caused) greenhouse gas emissions in 2004 in CO₂e (see figure 1 for the definition of CO₂e). Emissions associated with land use and land-use change, such as agricultural fertilizers, livestock, deforestation, and burning, account for about 30 percent of total greenhouse gas emissions. And uptakes of carbon into forests and other vegetation and soils constitute an important carbon sink, so improved land-use management is essential in efforts to reduce greenhouse gases in the atmosphere.

World Development Report 2010 Overview, World Bank, 2009

Figure 8 The full portfolio of existing measures and advanced technologies, not a silver bullet, will be needed to get the world onto a 2°C path







Achieving low-emission outcomes: *National government responsibilities*

- Agree on key parameters:
 - National emission reduction targets & timelines:
 - According to natural, human, physical, financial resources
 - Financial assistance for developing countries:
 - Wealth transfer to compensate for historical exploitation
 - Technological innovation strategy:
 - Cost, risk & benefit sharing
- Use policies to marshal & allocate resources:
 - Develop expertise, deploy low emission technology, encourage frugal lifestyles
 - *Strong action required*



Achieving low-emission outcomes: *Engineers' ethical responsibilities*

- Become part of solution not part of problem:
 - Yesterday's technology is tomorrow's problem
- Develop & deploy low-carbon technology:
 - For example, for electricity production & use, noting that this will be challenging
- Avoid false claims:
 - Technology champions often overstate their case
- Walk the talk (we are all carbon addicts):
 - Adopt a frugal lifestyle



Issues in applying ethical principles to climate change & energy flow constraints

- Utilitarianism:
 - For long-term, global-scale costs & benefits:
 - Who should assess: Stern? Garnout?
 - Who should decide: UN? USA? China?
- Respect for persons principles:
 - Virtues: A global consensus on deep frugality?
 - Rights: Universal Declaration on Human Rights?
 - Duties: Millennium Development Goals?



Conclusions

- Climate change & energy flow constraints present humans with “diabolical” problems
- Success will require global consensus on:
 - Characterisation of extent & timing of problems under great uncertainty
 - Strategies for risk mitigation & adaptation to a carbon-constrained world
 - Strategies for sharing associated costs & benefits
- *Engineers can contribute via strategic leadership & ethical behaviour*



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Hugh retired in 2007 after a 35-year career at UNSW, most recently as Presiding Director, Centre for Energy and Environmental Markets and Head, Electrical Energy Research Group, School of Electrical Engineering and Telecommunications.

During his career, Hugh has been a Fulbright Senior Fellow at the University of California Berkeley, a Board Member of the Australian Cooperative Research Centre for Renewable Energy, an Associate Director of UNSW's Centre for Photovoltaic Devices and Systems, a Member of CSIRO's Energy Flagship Advisory Committee, a Member of the National Electricity Tribunal and a Member of the New South Wales Licence Compliance Advisory Board. He is a Lead Author for the IPCC Special Report on Renewable Energy & Climate Change Mitigation, to be published in 2010.

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