

# Knowing and learning to deal with the climate challenge

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Triple Helix Consulting

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# Take home messages

- We are living through a period of unprecedented environmental change, that is likely to intensify - **this is not a blip**
- Business as usual is not a viable trajectory
- Fundamental, systemic change is required of unprecedented breadth and depth
- This gives rise to a huge learning challenge at all levels
  - individuals, families, firms, industries, communities, societies
- It is also a research, innovation & knowledge sharing challenge
  - existing knowledge systems lack direction, purpose, cohesion, breadth
- **Leadership is needed at all levels**
- **To decide not to succeed, is to decide to fail**



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# Outline

- 1. The climate challenge**
- 2. The response menu**
- 3. Implications for knowledge**



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# The human footprint on the planet

	1950	2050
<b>Population</b>	<b>2 billion</b>	<b>9 billion</b>
<b>CO<sub>2</sub></b>	<b>310 ppm</b>	<b>&gt;450ppm</b>
<b>Energy Use</b>	<b>80EJ/yr</b>	<b>&gt;550EJ/yr</b>
<b>Sea Levels</b>	<b>————</b>	<b>0.2-1.5m higher</b>

- This trajectory cannot be sustained without a radical decoupling of economic growth from resource depletion and degradation, and from emissions of greenhouse gases (GHG).
- Achieving such a decoupling is the most profound structural change the world has ever attempted



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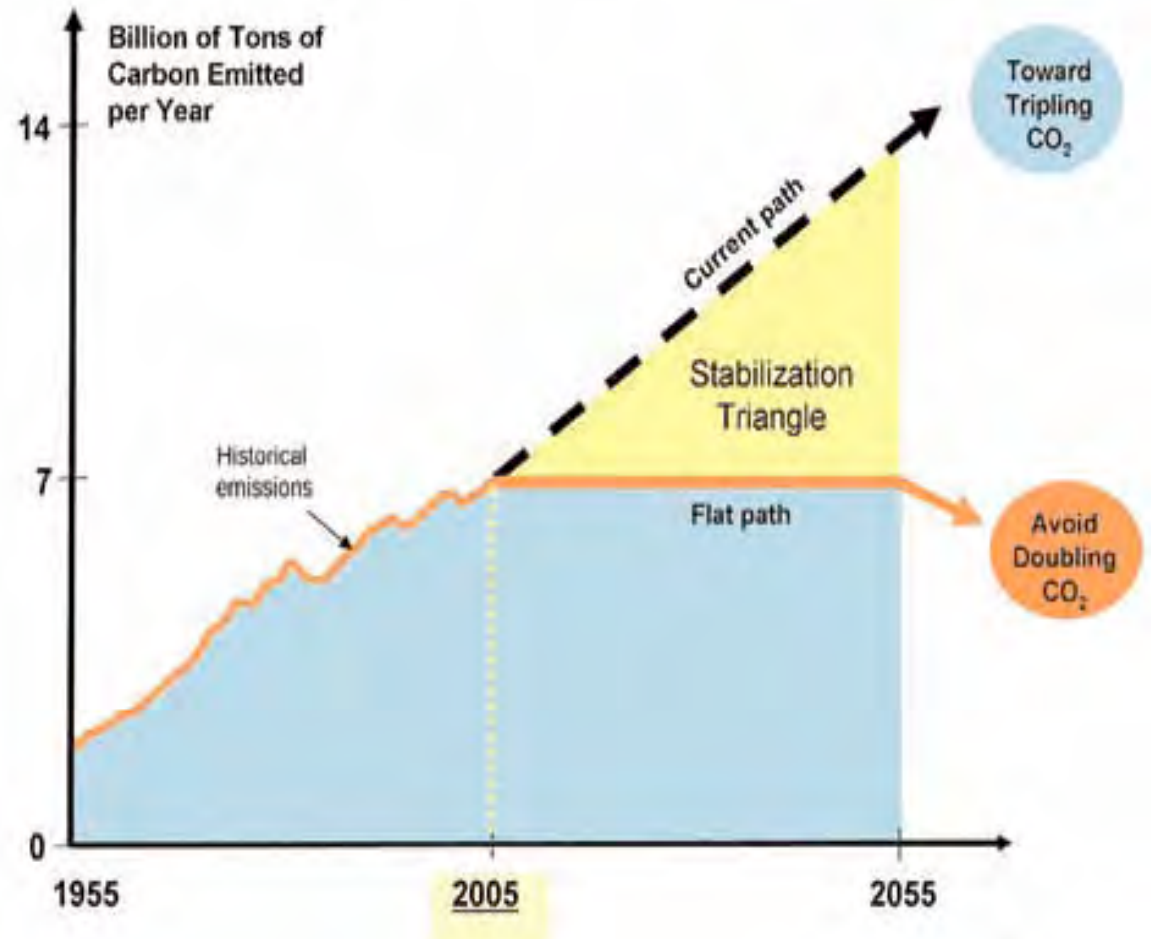
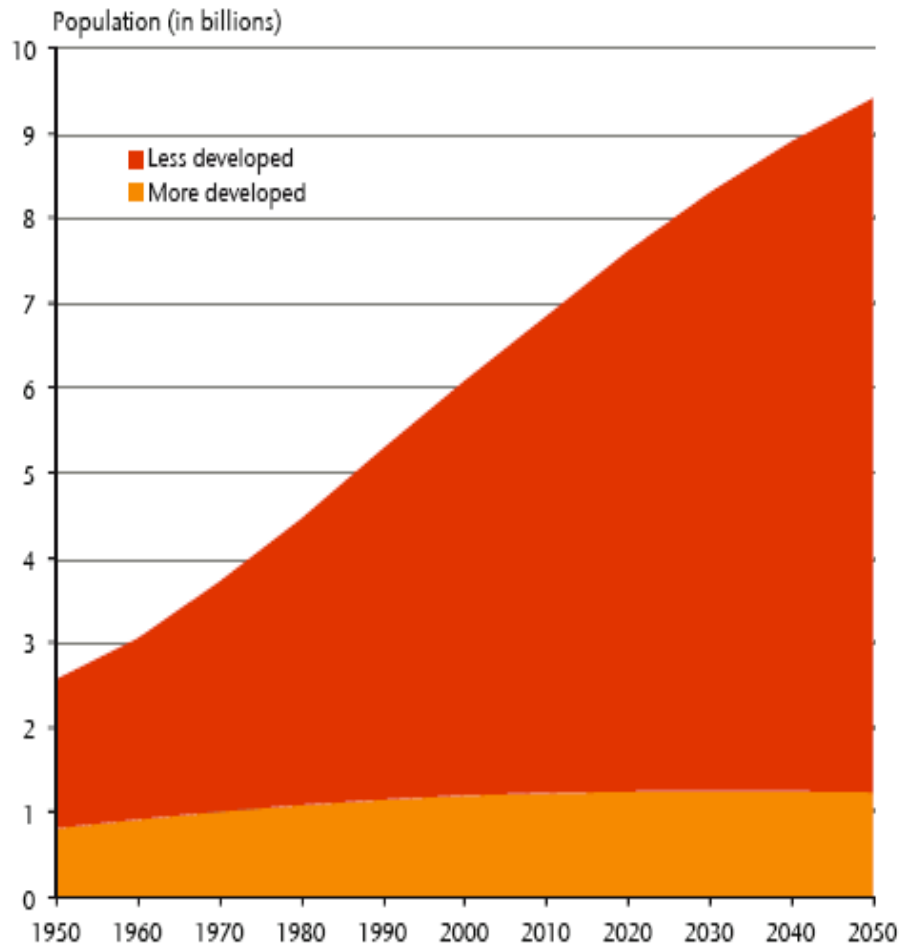
# 1. The climate challenge

- **Direct climate impacts**
- **Flow-on effects:**
  - **Water**
  - **Energy**
  - **Nutrients**
  - **Food**
  - **(not to mention nature & biodiversity)**



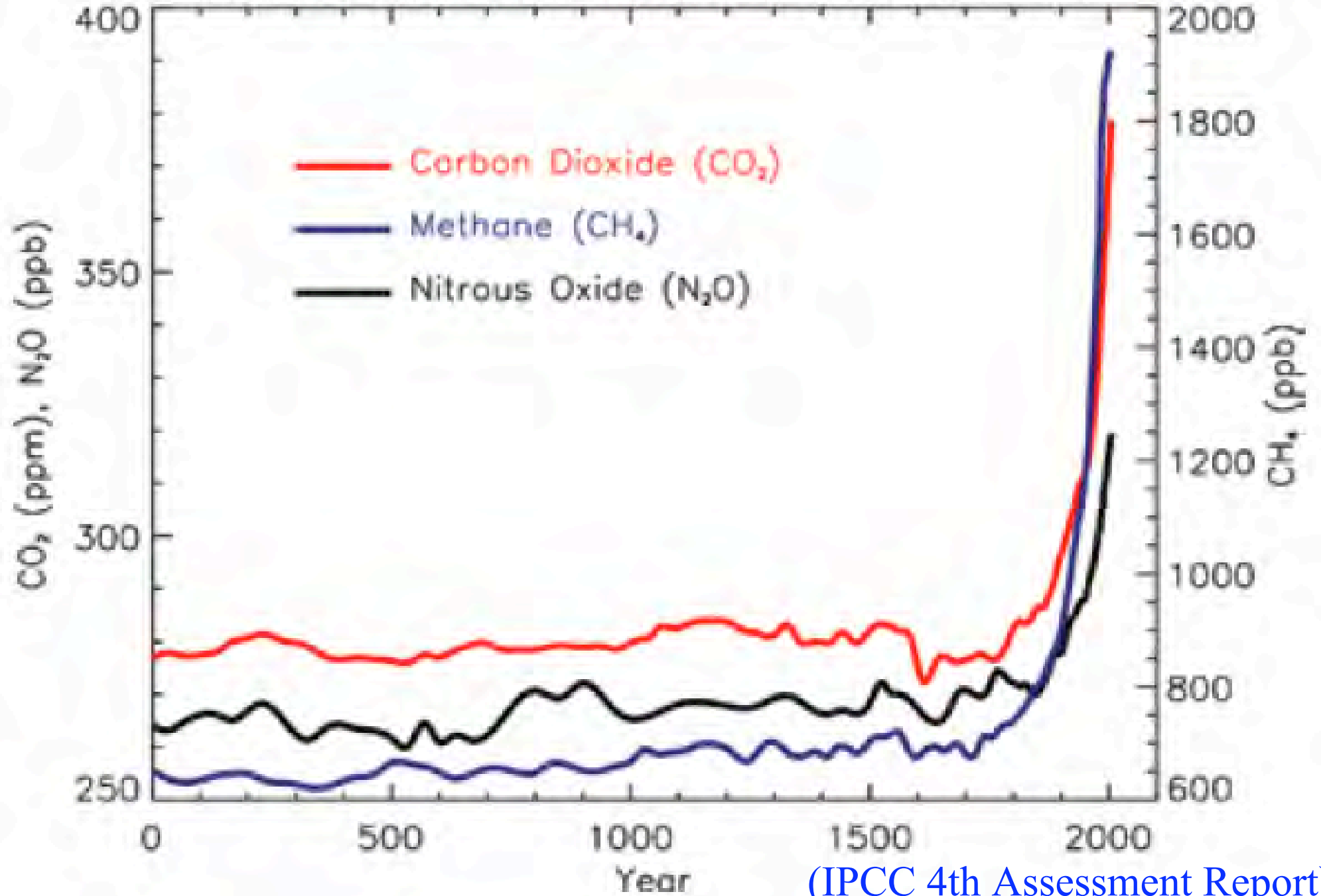
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# Population & carbon emissions



Source: WBCSD & IUCN 2008; Harvard Medical School 2008

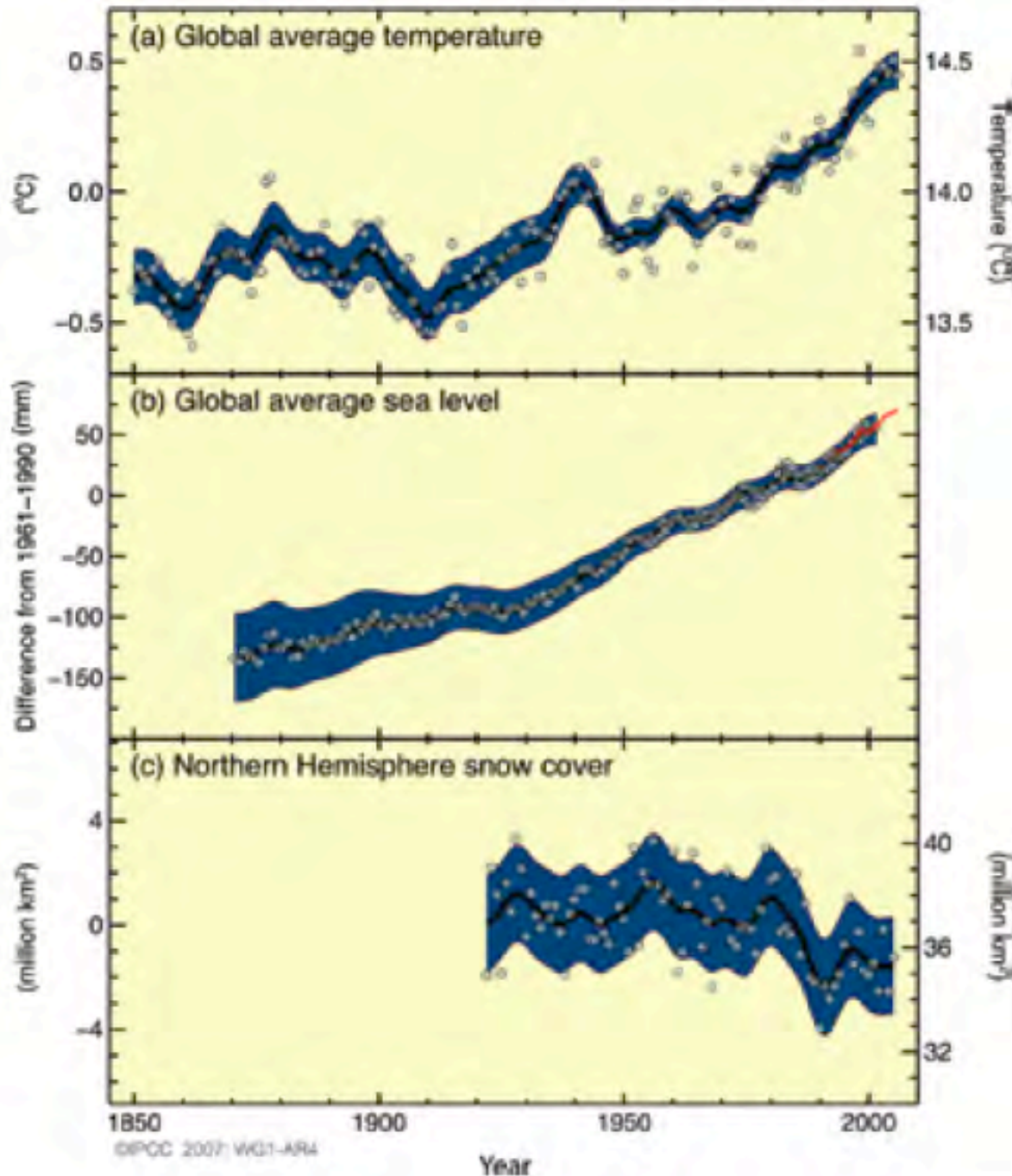
Concentrations of Greenhouse Gases from 0 to 2005



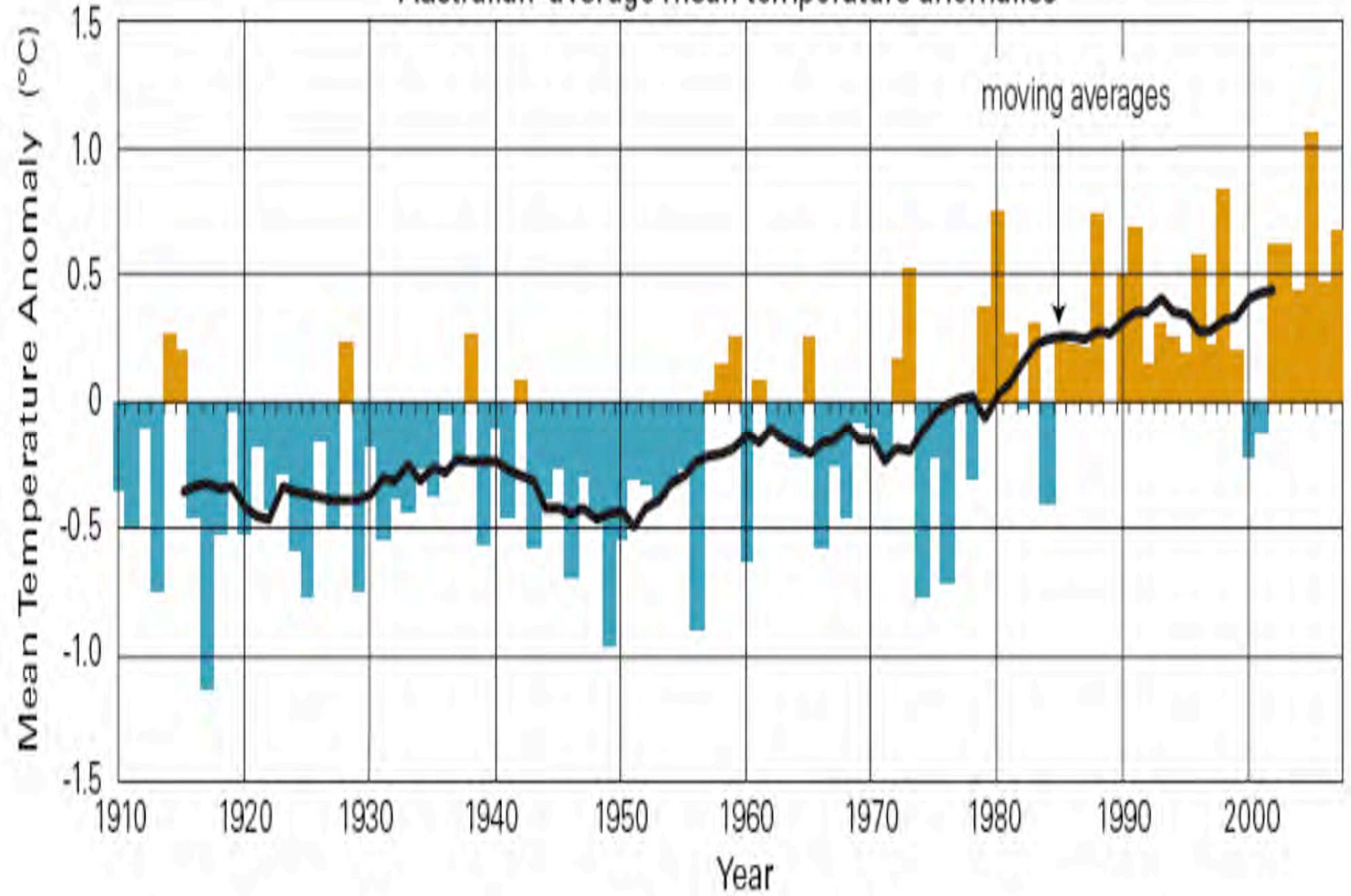
(IPCC 4th Assessment Report)

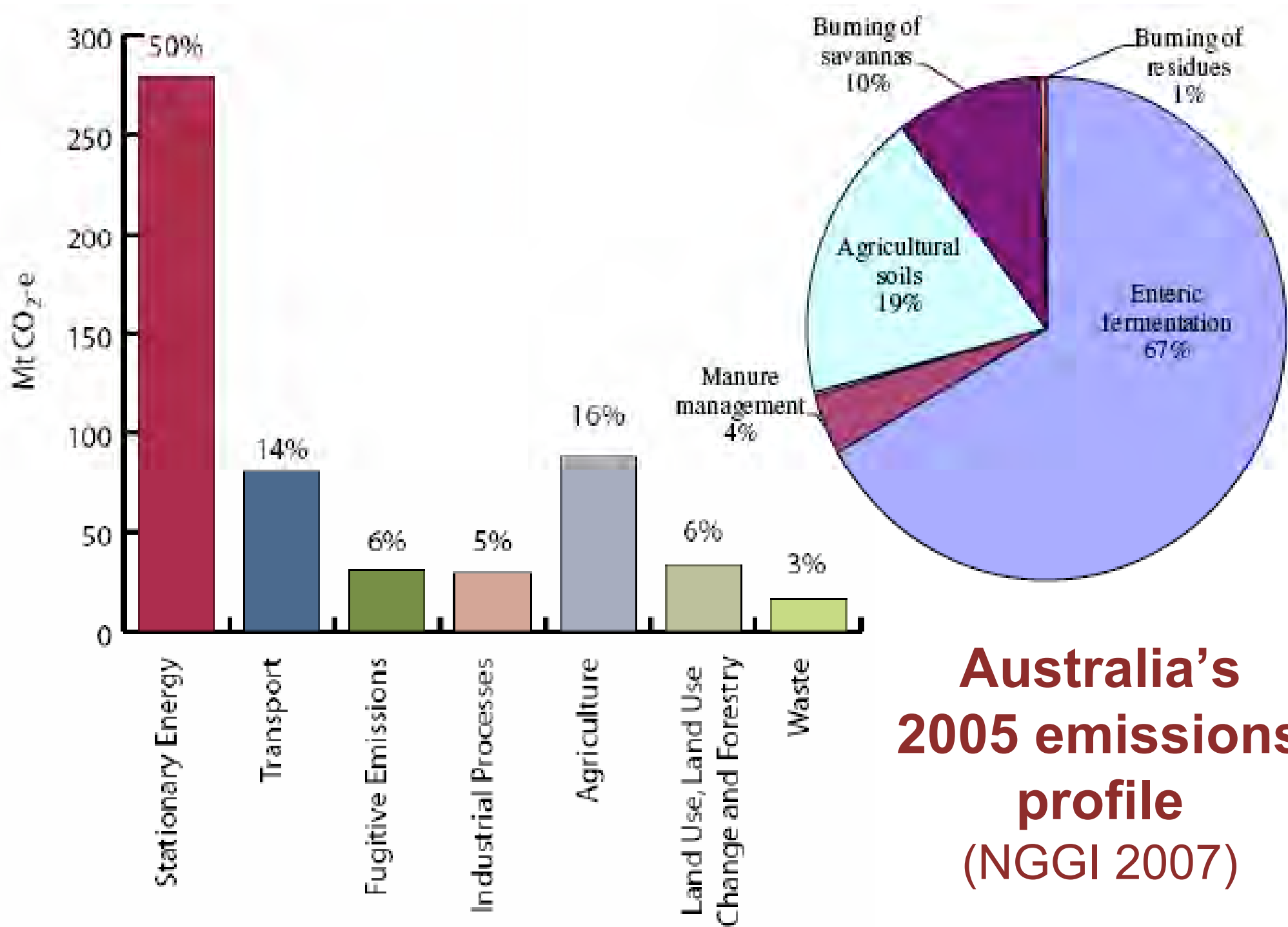
# Impacts

- As greenhouse gases increase
  - So does temperature
  - and sea levels
  - Sea acidifies
  - Snow & ice melt
  - More variable climate
  - More extreme weather
- Climate change is the biggest market failure the world has ever seen (Stern, Garnaut)



Australian-average mean temperature anomalies





# Water

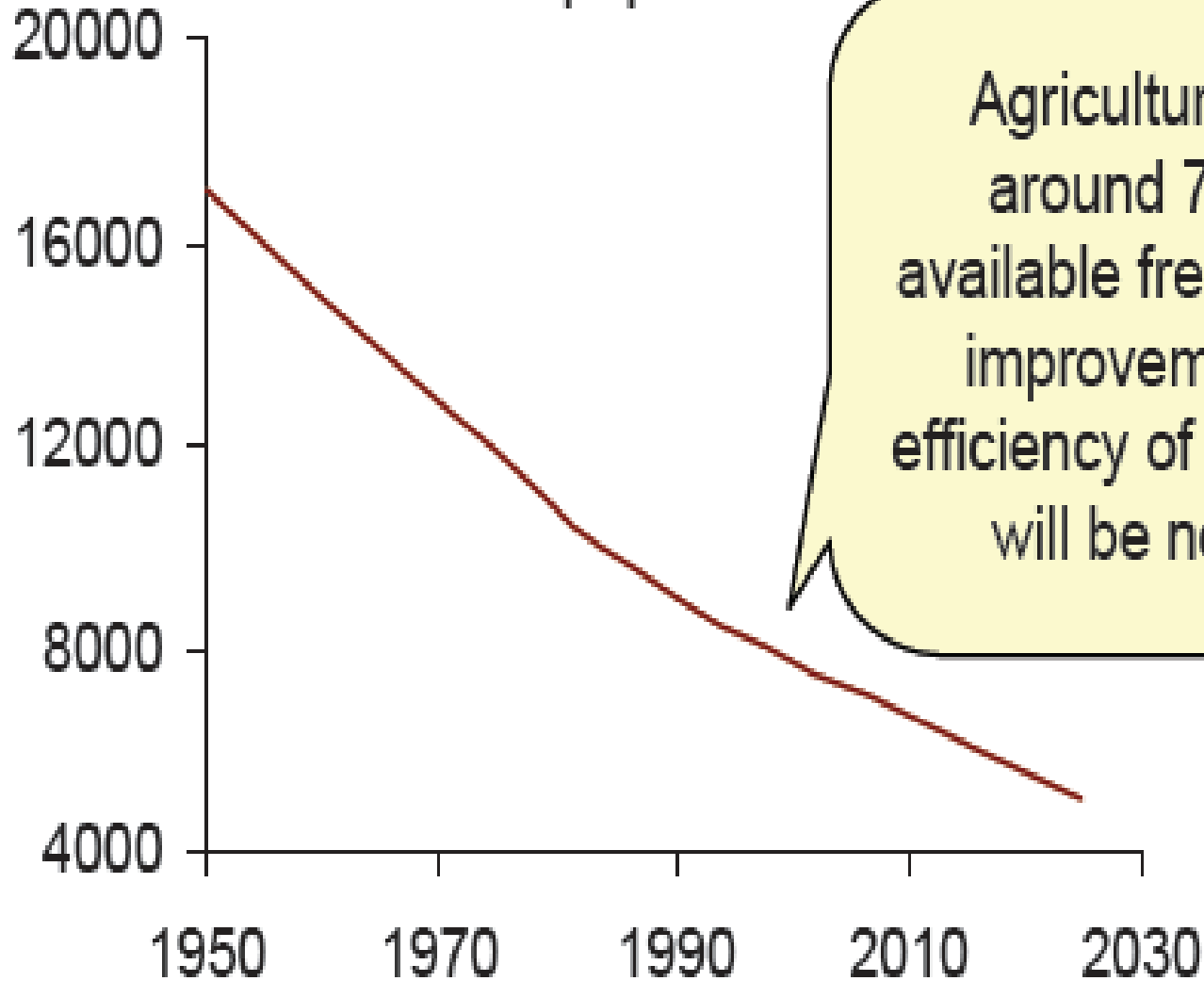
- Each calorie takes one litre of water to produce, on average
- Given population growth and consumption trends, without improvements in water productivity, agricultural water demand (ET) doubles from 6400 km<sup>3</sup> to 12000 km<sup>3</sup> by 2050
- BUT: Like the Murray Darling Basin, all the world's major food producing basins are effectively 'closed' or already over-allocated
  - Yellow River, Colorado, Amu/Syr Darya, Nile, Lerma-Chapala, Jordan, Gediz, Zayanda Rud, Indus, Cauvery, Krishna, Chao Phraya....



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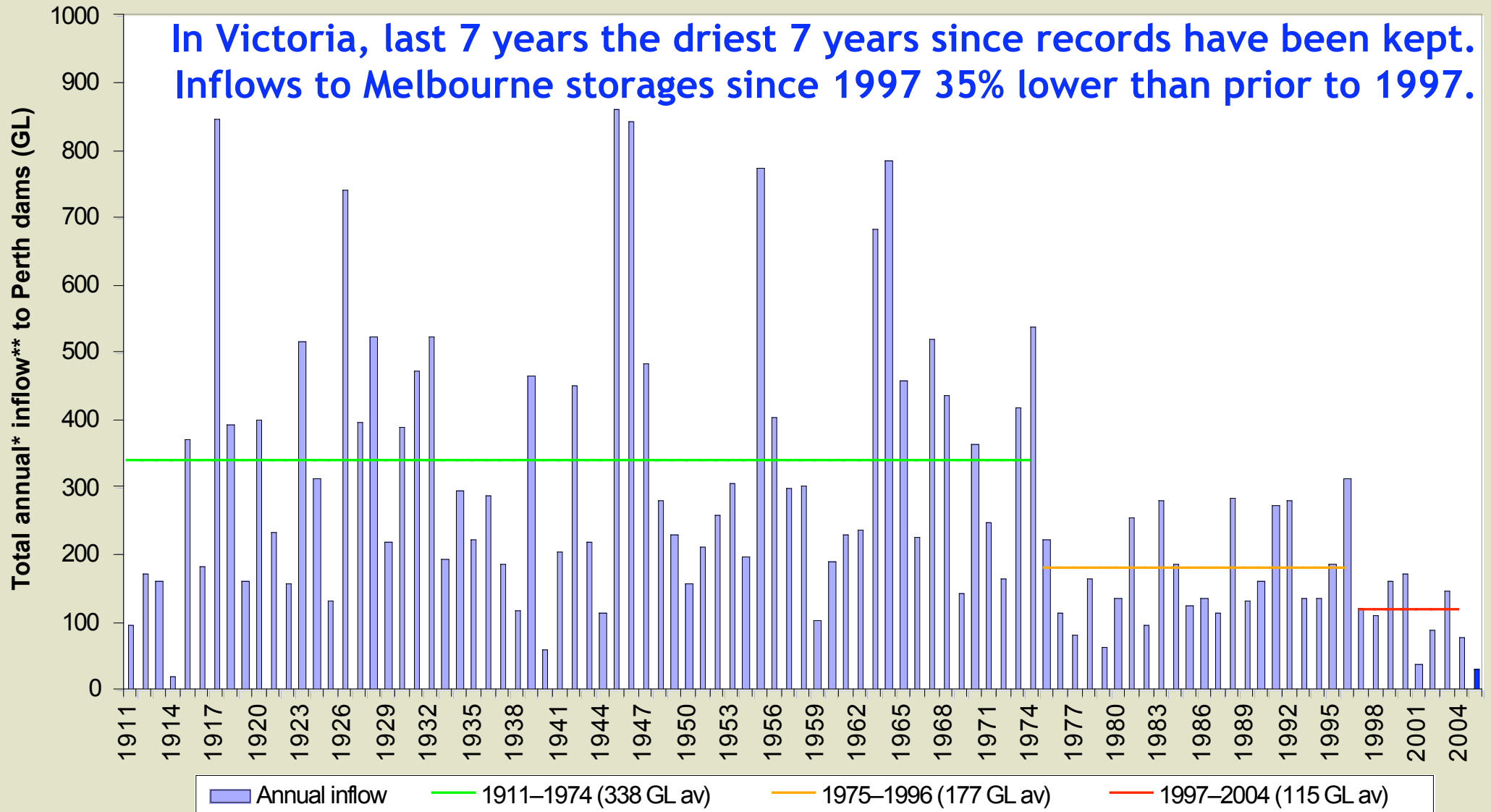
# Water

Actual and projected freshwater availability, cubic metres per head of total world population<sup>1</sup>



Agriculture uses around 70% of available freshwater – improvements in efficiency of water use will be needed

# Perth's Annual Storage Inflow GL (1911-2005)



Notes: \* year is taken as May to April and labelled year is beginning (winter) of year  
 \*\* inflow is simulated based on Perth dams in 2001 and 2005 is total until 3 August 2005

# Boating Safety Information Lake Wendouree

Rowers Operating In Area  
Caution Swimmers  
Power Boating  
Speed 5 Knots  
Caution Floating Objects



**Get on board with life jackets.**

**SAFE OPERATION**

- 1. Obey all signs and regulations.
- 2. Do not drink and drive.
- 3. Do not drink and operate a motorboat.
- 4. Do not use alcohol or drugs while boating.
- 5. Do not operate a motorboat if you are under the influence of alcohol or drugs.
- 6. Do not operate a motorboat if you are impaired by alcohol or drugs.
- 7. Do not operate a motorboat if you are tired or drowsy.
- 8. Do not operate a motorboat if you are ill or injured.
- 9. Do not operate a motorboat if you are wearing a seat belt.
- 10. Do not operate a motorboat if you are wearing a seat belt.

**MINIMUM SAFETY EQUIPMENT**

Boat Length	Minimum Safety Equipment
Up to 3.0m	1. Life jackets for all persons on board. 2. Fire extinguisher. 3. Sound producing device. 4. Visual distress signal.
3.0m to 4.5m	1. Life jackets for all persons on board. 2. Fire extinguisher. 3. Sound producing device. 4. Visual distress signal. 5. First aid kit.
4.5m to 6.0m	1. Life jackets for all persons on board. 2. Fire extinguisher. 3. Sound producing device. 4. Visual distress signal. 5. First aid kit. 6. Throwable flotation device.
Over 6.0m	1. Life jackets for all persons on board. 2. Fire extinguisher. 3. Sound producing device. 4. Visual distress signal. 5. First aid kit. 6. Throwable flotation device. 7. Bilge pump.

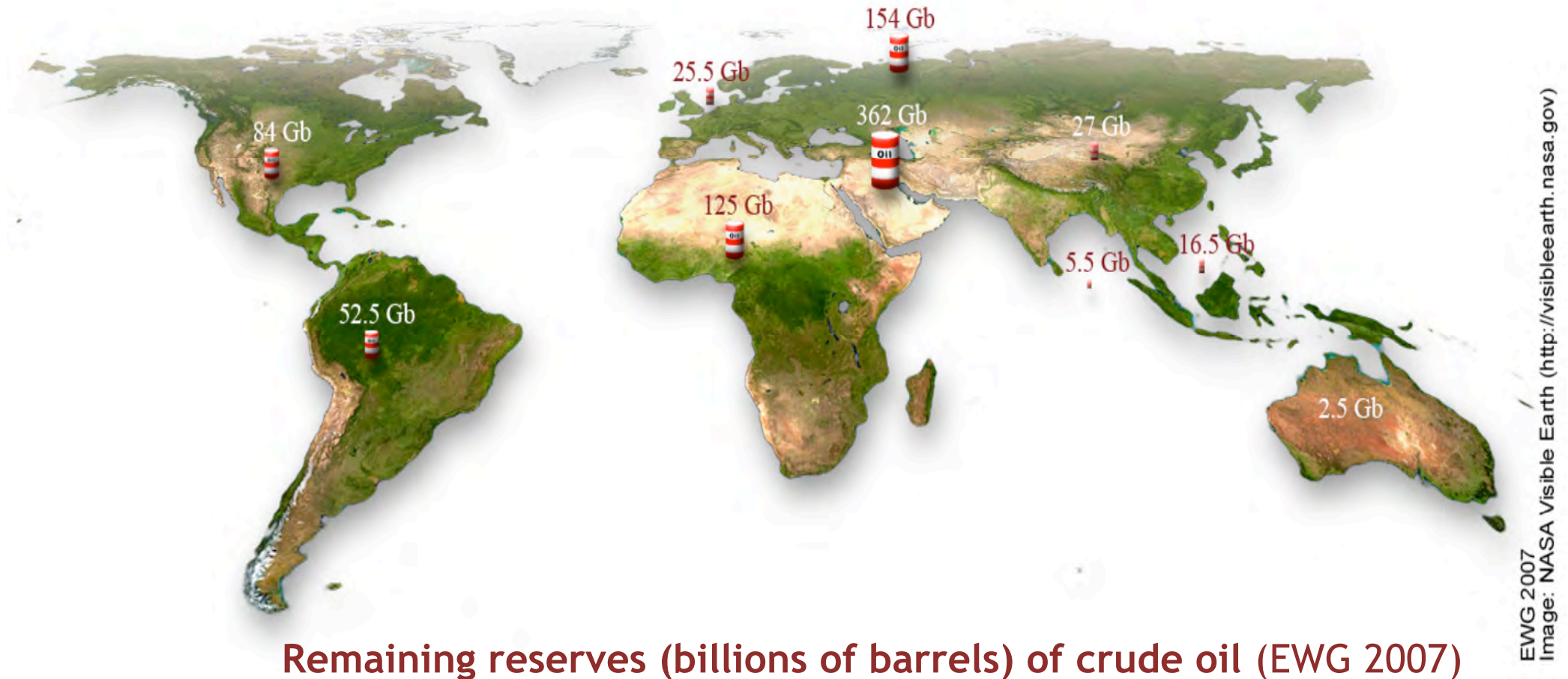
**EMERGENCY PROCEDURES**

- 1. Call 000 for emergency services.
- 2. Call 5320 7401 for the City of Ballarat.
- 3. Call 13 23 23 for the Victorian Water Police.

**EMERGENCY 000**  
City of Ballarat 5320 7401

# Energy & nutrients

- The era of abundant, cheap fossil fuels is over
- 30-40 years of oil left, but prices will rise steeply long before it runs out (the stone age did not end because they ran out of stones...)



Remaining reserves (billions of barrels) of crude oil (EWG 2007)

# Feeding the world

- **In essence, the world needs to double food production by about 2050, & improve distribution**
- **We have done this in the past, mainly through clearing, cultivating and irrigating more land**
  - and to a lesser extent better varieties, more fertiliser etc
- **Climate change is narrowing those options, with limits to:**
  - water
  - land
  - energy
  - nutrients



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# Buenos Aires Herald

A WORLD OF INFORMATION IN A FEW WORDS

## Rising food prices may trigger social unrest, instability

**THE AGE**  
Newspaper of the Year

### Food prices to soar

**The Nation**  
Food prices spiral

**The Seattle Times**

### Somalis riot over food prices

人民网 English  
People's Daily Online

### Food in Crisis?

**DAILY EXPRESS**  
THE WORLD'S GREATEST NEWSPAPER

### PRICE OF FOOD SOARS TO ALL-TIME RECORD

**DAILY GUIDE**

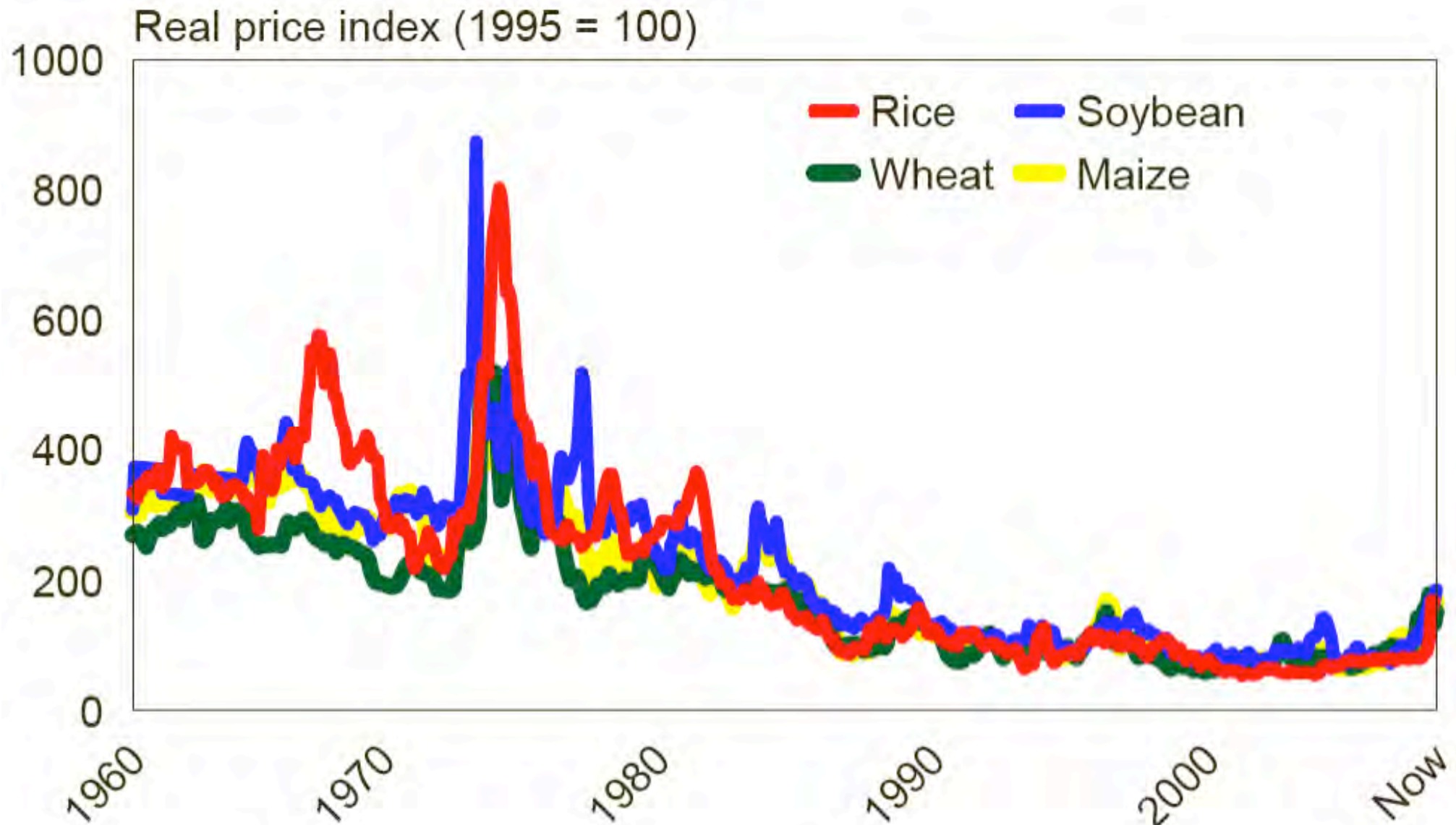
### Food Price Hike Hits Ghana

The Economist

**THE HINDU**  
Food Prices Just Keep on Rising

## Food Prices: The Silent Tsunami

But maybe we ain't seen nothin yet....



# Potential shocks & discontinuities

- The Greenland Ice Sheet is melting much faster than the IPCC worst case scenario. Sea levels could rise metres this century, not just 20cm.
- The Himalayan glaciers feed rivers that water India, Pakistan & Bangladesh (among others). They are disappearing much faster than worst case scenarios. Huge potential for conflict and massive refugee flows, war or not.
- The gulf stream 'conveyor belt' that warms western Europe could flip, tipping it into a mini Ice Age.
- The disappearance of the Arctic Sea Ice in summer (for the first time in at least 14 million years) will lead to a rapid acceleration in warming through the albedo effect, potentially accelerating tipping points.
- Trade barriers & farm subsidies go up. Countries hoard oil.
- There will be wars over land and water.

## 2. The response menu

- **The nature of the human economy**
- **Human behaviour & social organisation**
- **Systemic reform:**
  - **Energy**
  - **Transport**
  - **Urban design & planning**
  - **The built environment**
  - **Farming Systems**
- **Making better use of knowledge**



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# Decarbonising the human economy

- **The biggest structural reform ever attempted**
- **Requiring unprecedented international cooperation**
- **The current melt-down in world financial systems is a great opportunity**
  - **Govts can find hundreds of billions to bail out banks**
  - **Unusual levels of intervention (including nationalisation) are the new norm**
  - **This is exactly the time to be implementing structural economic reform to decouple economic growth from carbon emissions**
  - **From a climate change perspective, this may be the recession/depression we had to have**



# Human behaviour & social organisation

- **Values**
- **Lifestyle**
  - Diet, food production systems
  - Energy use
  - Travel, holidays
- **Social structure**
  - Localism vs globalism
  - Resilience & connectedness  
(drought, fire, flood mentality)



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# Unprecedented systemic reform

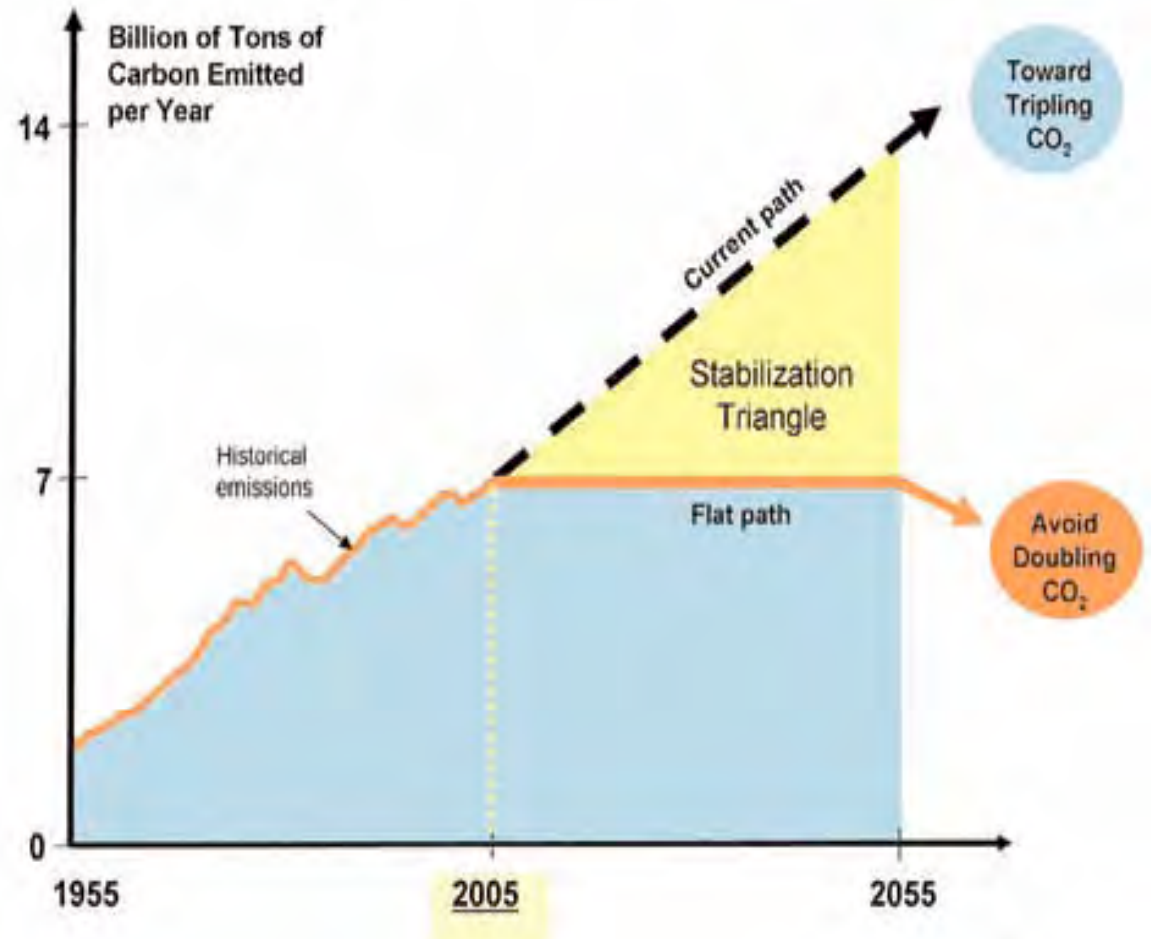
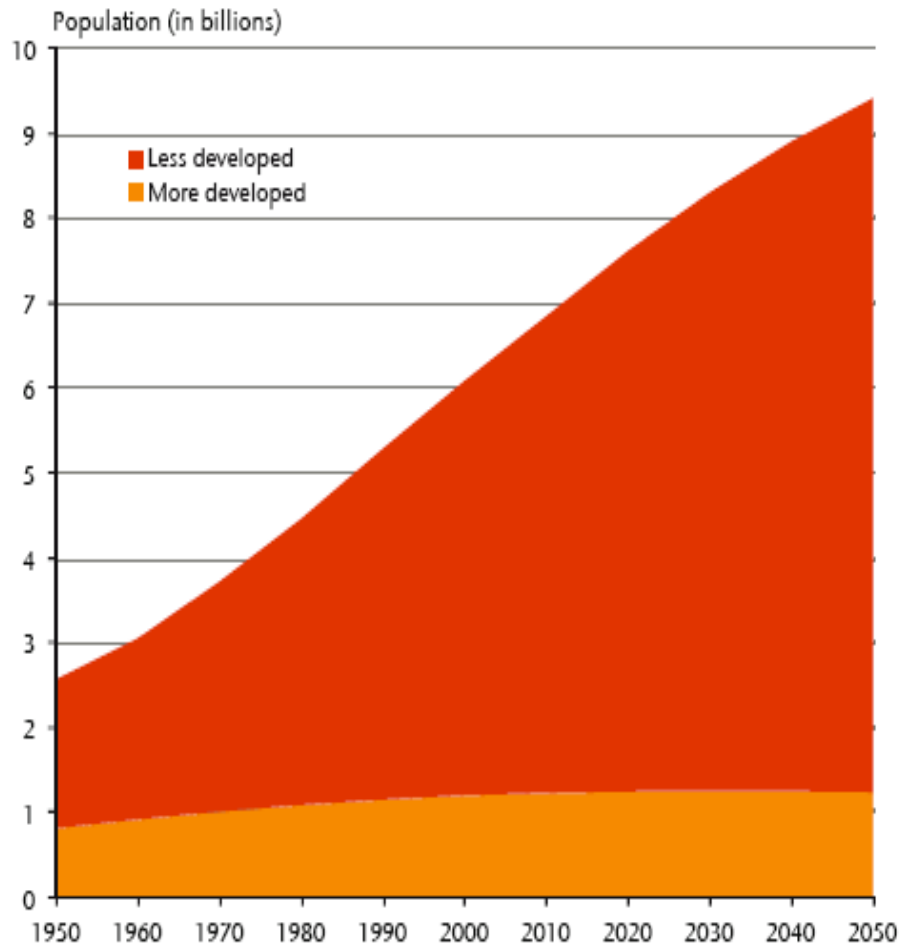
**PRINCIPLES:** Avoid or reduce consumption; reuse or recycle; switch to renewable sources; close loops (eliminate waste)

- **Energy**
- **Transport**
  - Beyond oil; 2nd Gen biofuels, Rail, CNG, hybrids, fuel cells, plug-ins
- **Water**
  - Reconfiguring irrigation, stormwater re-use & sewer mining in urban areas, household-level water trading  
radical lifts in water productivity,  
both irrigation and rain-fed



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# Population & carbon emissions



Source: WBCSD & IUCN 2008; Harvard Medical School 2008

# Decoupling economic growth from carbon emissions

## Energy Options (15 energy 'wedges', each able to ↓ emissions x 1 billion t)

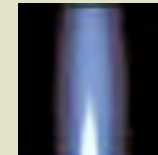
### Efficiency



1. Double fuel economy for 2 billion cars to 60mpg (4.5l/100km)
2. Halve distance traveled for 2 billion cars: urban design, mass transit, telecommuting
3. 25% cut in emissions from buildings & appliances
4. Double coal-power output with advanced high temperature materials

### Fuel Shift

5. Replace 1400GW of coal-fired power with natural gas plants (ave plant = 1 GW)



### CO<sub>2</sub> Capture & Storage (CCS)



6. CCS for 800GW worth of coal or 1600GW of natural gas (ave plant = 1 GW)
7. Capture CO<sub>2</sub> at plants producing H<sub>2</sub> from coal or natural gas
8. CCS at synfuels plants producing 30 million barrels of oil a day from coal

### Nuclear Fission

9. add 700GW (twice the current capacity)



### Renewable electricity & fuels



10. Add 2 million 1MW-peak windmills (50 times current capacity)
11. Wind-derived H<sub>2</sub> for fuel cells in hybrid cars: add 4 million 1MW peak windmills to make H<sub>2</sub> (100 times current capacity)
12. Add 2000 GW-peak photovoltaics (PV) (700 times current capacity)
13. Add 100 times current ethanol production: one-sixth of world's cropland

### Forests and agricultural soils

14. Eliminate deforestation. Plant 300Mha of new trees (twice current rate)
15. Conservation tillage for all cropland (10 times current rate)



Source: Pacala & Socolow, *Science* 2004; 305:968-971

# The built environment

- **Cities**

- For the first time in human history, more people now live in cities than in the country
- Cities have a huge ecological footprint
  - Urban design — transport, services, infrastructure — is critical
  - Potentially efficient: sinks for energy, water & nutrients
  - Scope for steep increases in urban food production & rapid innovation
  - Food & Water Sensitive Urban Design a priority

- **Households**

- Food production & consumption is the biggest part of the household footprint
- Much can be done to lift energy & water efficiency (existing know-how)

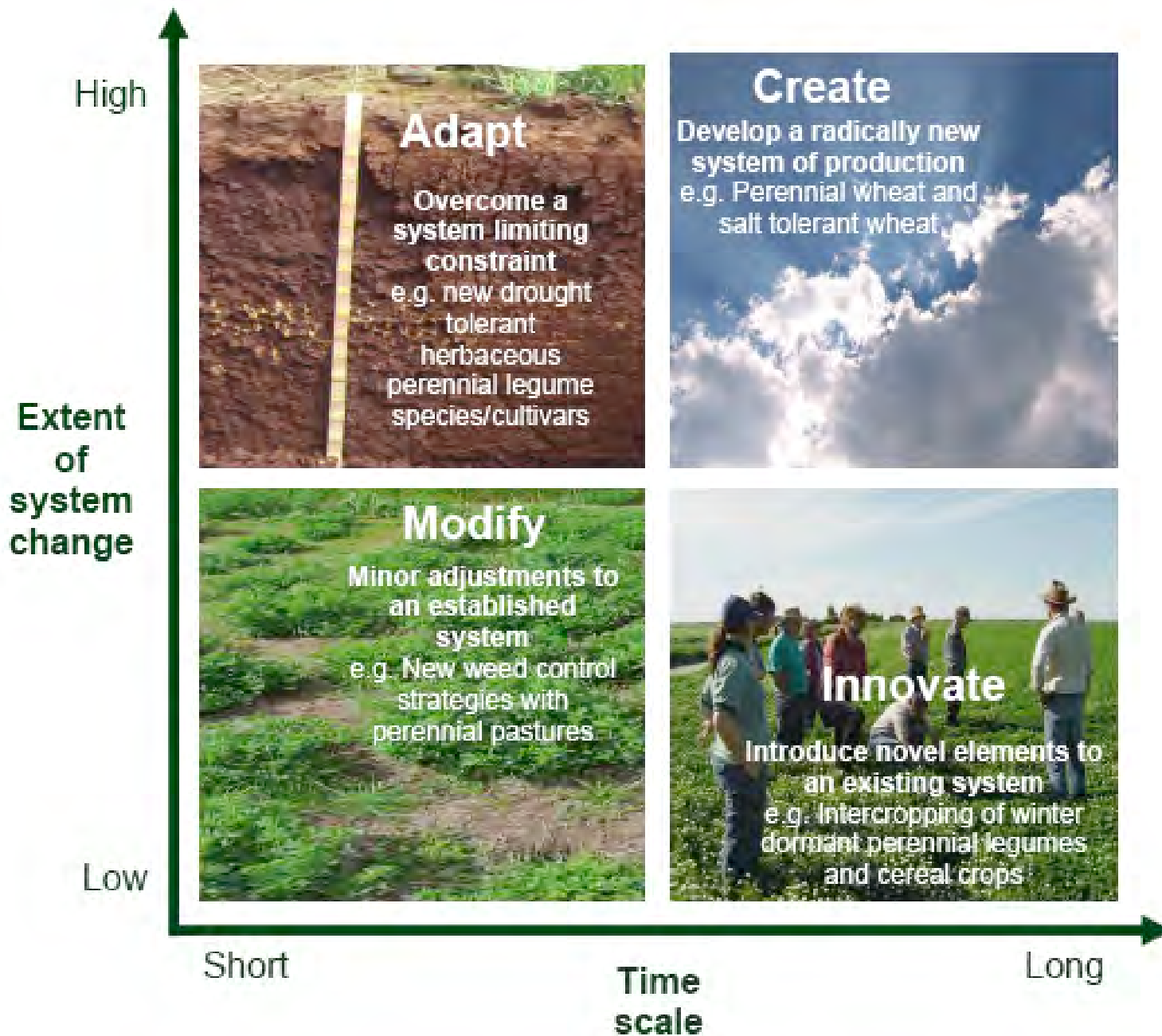
- **Waste**

- Where it can't be avoided or reduced, look to reuse it for nutrients, water and energy

- **Coasts (low-lying) need a complete re-think**



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# Farming Systems

We need to be operating in each of these quadrants

Develop research partnerships +/- or link into existing collaborations



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# **We need a third agricultural revolution — what might it look like?**

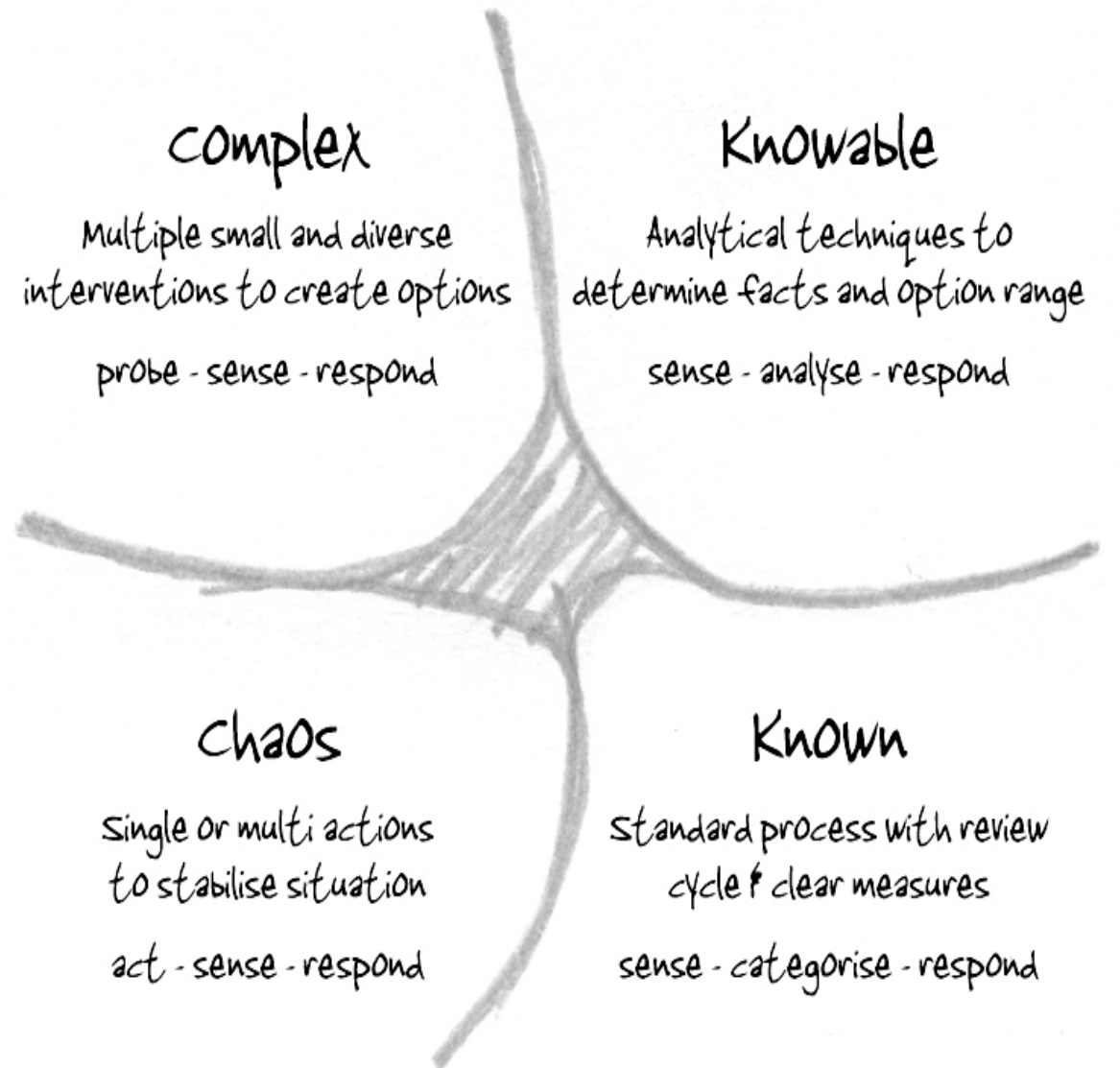
- **Closed loop farming systems**
- **Smart metering, sensing, telemetry, robotics, guidance**
- **Understanding & use of soil microbial activity (&GM)**
- **Urban food production (roofs etc), recycling waste streams & all urban water and nutrients**
- **Detailed product specification (Tesco) & more returns to farmers**
- **‘Carbon plus’ offsets and incentives**
- **New marketing options,  
integrated with transport network**



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# 3. Implications for knowledge needs

[through the Cynefin lens]



- Climate change spans all of these domains
- If temp increase  $> 2^{\circ}\text{C}$ , then disorder & chaos will reign
- The challenge is to handle the necessary range of simultaneous responses
  - to work in all of these domains at once
  - to develop a system-wide perspective
  - & the knowledge systems and learning strategies to underpin that perspective
- and to bring people along

# Observations on the current situation

- Community concern exceeds political will
- But knowledge at all levels is patchy
- *“De Nile ain’t just a river in Egypt...”*
- Research investment is concentrated in a few big players
- Alternative technologies/approaches struggle for funds
- SMEs need to be more engaged & better resourced
  - We need nimble, lateral, unconstrained innovators (unfettered by shackles of IP protection and in-house lawyers)
- Cross-system learning is poor
- Climate change literacy is far too low
  - in the wider community
  - in the bureaucracy
  - in corporate boardrooms & management



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# Knowledge, Research and Innovation

- Explicit, conscious work is needed in all four Cynefin quadrants
- The 'big science' of CSIRO & BoM needs to be complemented and augmented by other approaches and many smaller players, alone and collaboratively
- We invest in applied R&D in order to: make better decisions; underpin innovation; and learn as we go along
  - again, we need to ensure sufficient weight in each of these spaces
  - the latter requires a decent monitoring effort & a good system
- Revisit community engagement & empowerment models
  - KM 2.0 is ideally suited here - social tools critical
  - Most of the adaptation knowledge will come from the community, not from experts



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# Skills, Education & Training

- A huge agenda
- We are where we are, in large part because of our worldview & skills
  - We need to revisit the very notion of what it means to be Australian (e.g. 'drought')
- At a community level, we need much deeper and broader environmental literacy
  - make the invisible more visible - community environmental monitoring
  - reactivate the 'watch' programs e.g. WaterWatch, FrogWatch
  - smart metering everywhere - community 'sustainability dashboards'
  - better connect schools & communities



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# Skills, Education & Training (2)

- At a professional level, we need people confident with the tools & skills needed to operate effectively in each Cynefin domain
- They need to be supported with easy access to existing know-how (across disciplinary and organisational silos) and encouragement to fill knowledge gaps where necessary



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# Policy - putting it all together

- “Joined-up Government” has to be more than a slogan
- New alliances, platforms, networks are needed
- Climate change (or climate chaos) is a row, not a column
  - It is connected to everything else
- Planning for carbon, energy, transport, waste, education, health, food and demographics needs integration
  - as does policy for all of the above and more
- This requires a solid and extensive evidence base in the ‘known’, ‘knowable’ and ‘complex’ domains
  - and very good adaptive tools (e.g. real-time monitoring) in chaotic situations
  - an arena ideally suited to web 2.0 social tools (e.g. CEFE on south coast) & KM 2.0?



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# Leadership

- *“The future is not some place we are going to but one we are creating. Paths to it are made, not found...”*
- **A time for real leaders and leadership**
  - good leaders change perceptions about what is possible
  - they can tip the balance between fate and desire
- **Time for a new Bretton Woods Agreement?**
- **Leadership from below and beyond**
  - Making political space for politicians
- **Building cohorts of leaders**
  - across traditional boundaries



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# Take home messages

- We are living through a period of unprecedented environmental change, that is likely to intensify
  - **this is not a blip**
- Business as usual is not a viable trajectory
- **To decide not to succeed, is to decide to fail**
- New alliances are needed
- Leadership is needed at all levels
- **Knowledge professionals have an important role to play**



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including detailed background papers**

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