Climate change science and policy, and some implications for energy

Seminar at University of Otago

Ralph Chapman, 7 September 2007

Plan (1): I will

Source: NASA-GSFC

- Review briefly climate change science & policy

The science

- Interpret conclusions of the recent IPCC AR4, especially WG3
- Touch on other recent scientific evidence

Policy analysis

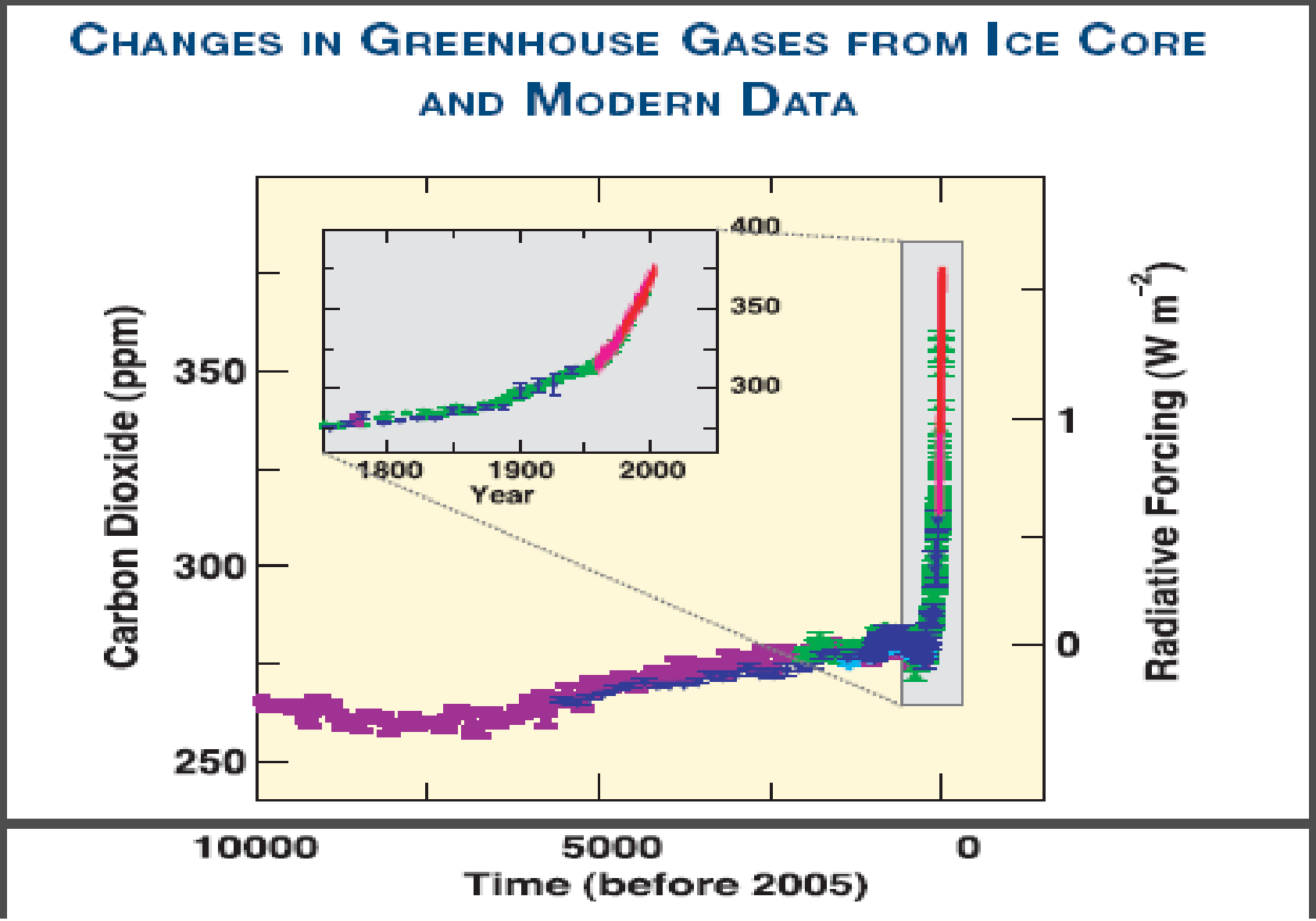
I will touch on:

Source: NASA-GSFC

- Economics, risk and ethics
- Implications for scenarios to focus on
- Principles for considering policy implications of decarbonisation
- Current state of play on NZ climate change policy
- The changing international climate policy context
- Considerations for NZ energy strategy
- Some supporting institutional changes in NZ

1 The science

IPCC AR4 – WG1: physical science



Three key results from WG1

1. It’s real
2. We are responsible
3. It’s accelerated

Three key results from WG1

1. It's real: 'Warming… is unequivocal, …from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.'

Three key results from WG1

2 We are responsible: ‘The observed widespread warming of the atmosphere and ocean, together with ice mass loss, support the conclusion that it is extremely unlikely that global climate change of the past 50 years can be explained without external forcing, and very likely that it is not due to known natural causes alone.’

Three key results from WG1

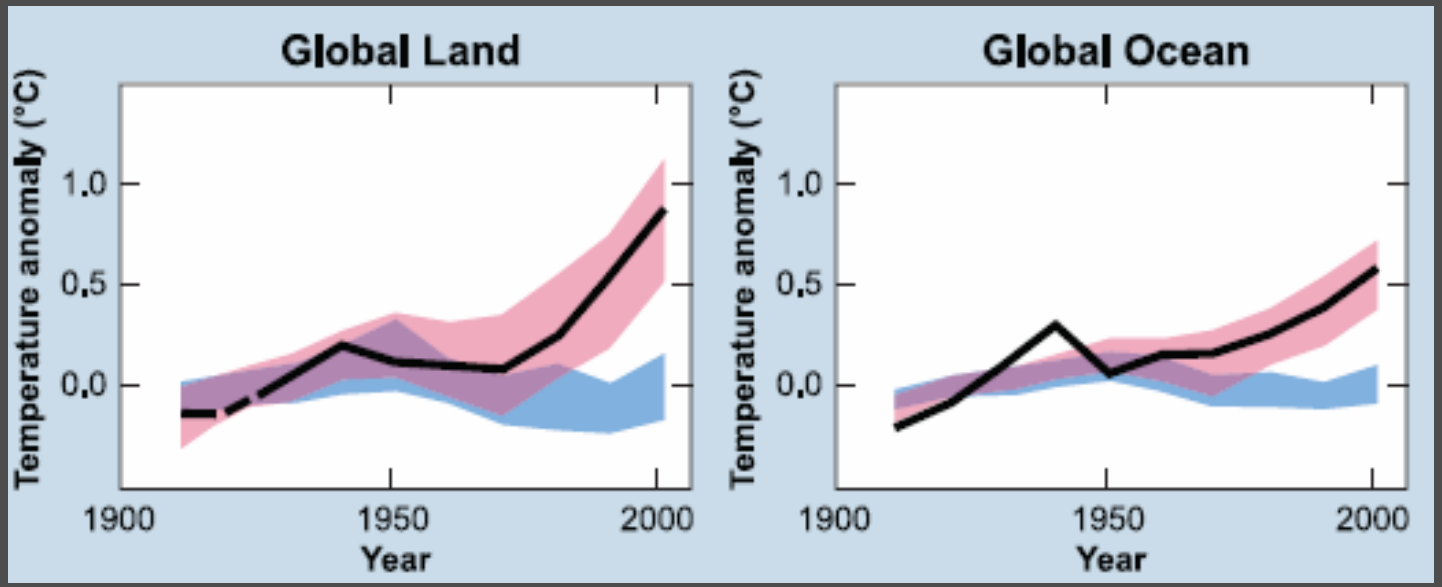
3 It's accelerated: 'The linear warming trend over the last 50 years … is nearly twice that for the last 100 years.'

The impact of humans: models using natural and anthropogenic forcings, & observations

Natural forcings only

Models with human forcings also

Observations

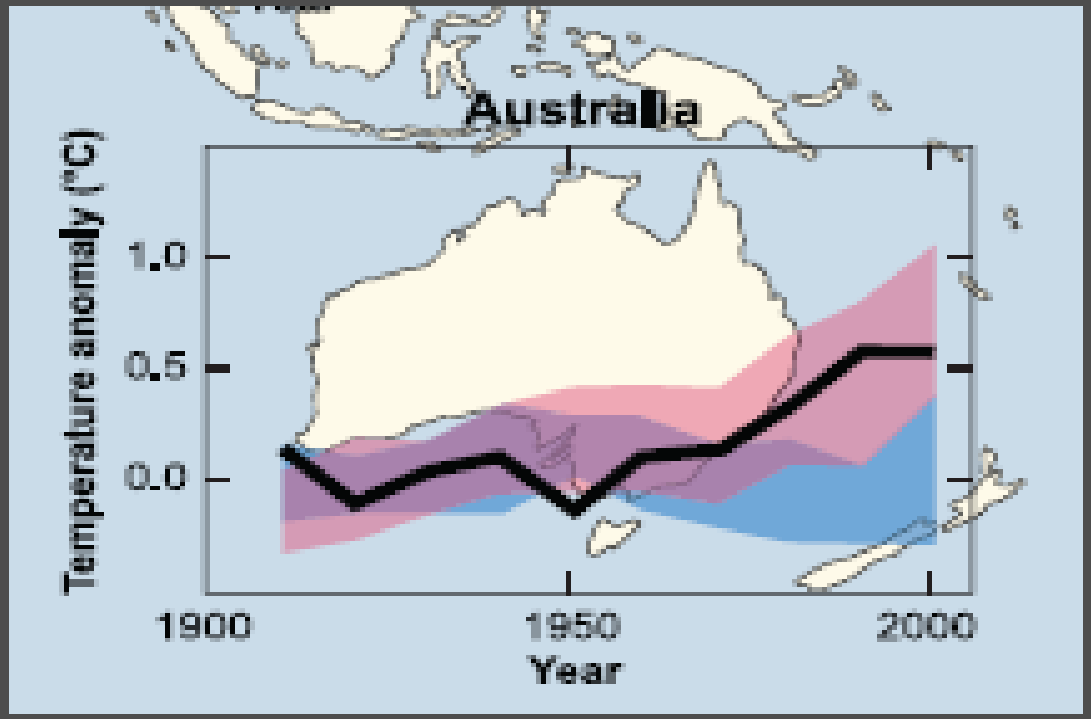


The impact of humans: locally

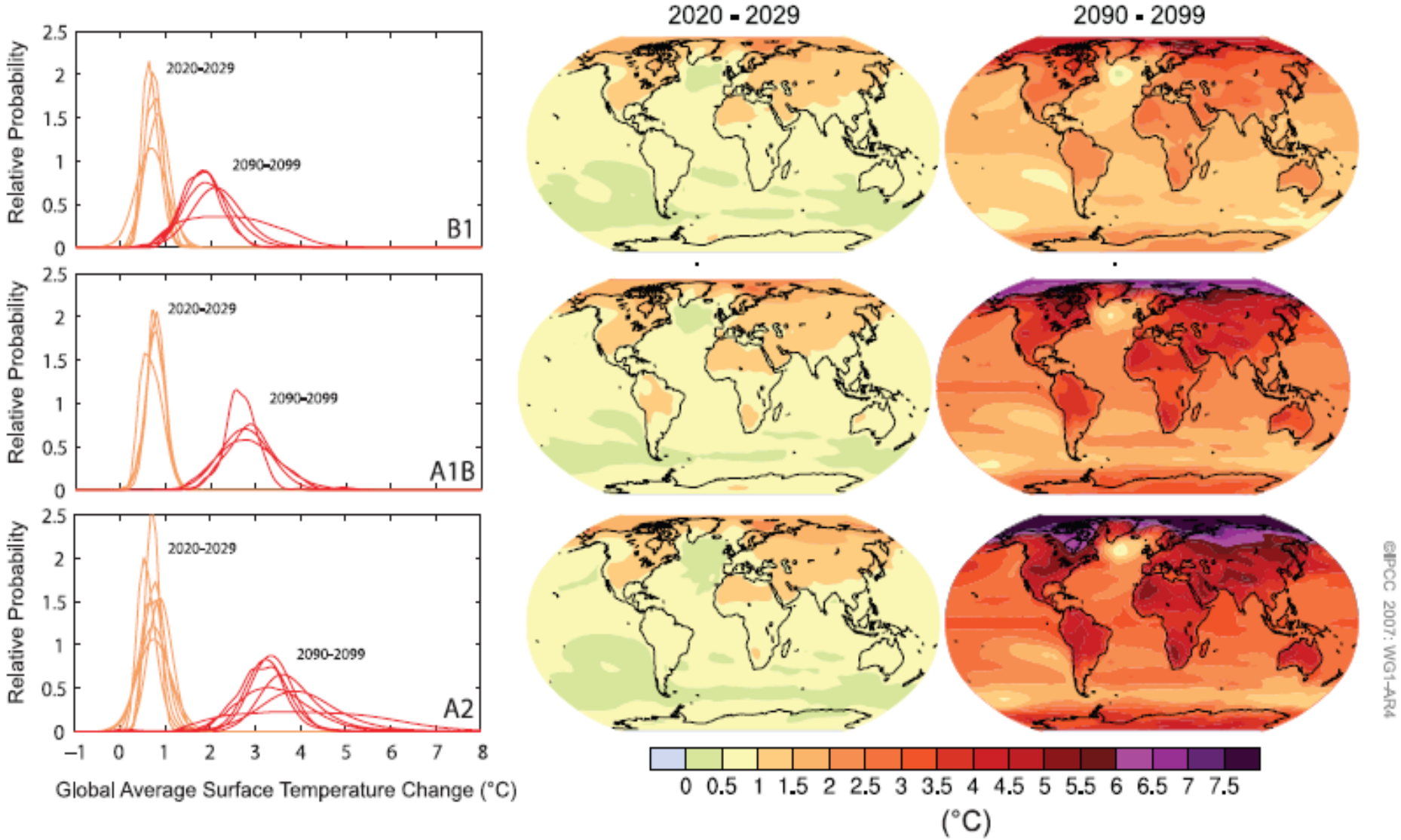
Natural forcings only

Observations

Models with human forcings also



Projected surface temps by 2025 & 2095 (above 1990), by scenario



The IPCC: background

Set up 1988: scientists wanted to speak out in face of government political interests

Governments still approve the Summaries

Risks:

- Inevitably cautious in face of political pressures
- Scientists constrained by pressures exercised by some governments
- Not entirely up to date

But valuable scientific process

Main area of conservatism – WG1

Sea level rise (SLR)

- Ice melt dynamics not adequately pinned down & quantified – therefore largely omitted

Consequence

- SLR findings misunderstood / deliberately misconstrued
- Sense of complacency possibly reinforced
- Underestimation of significant coastal damage by 2100 ?
- Holdren, Rahmstorf, Hansen all worried by SLR

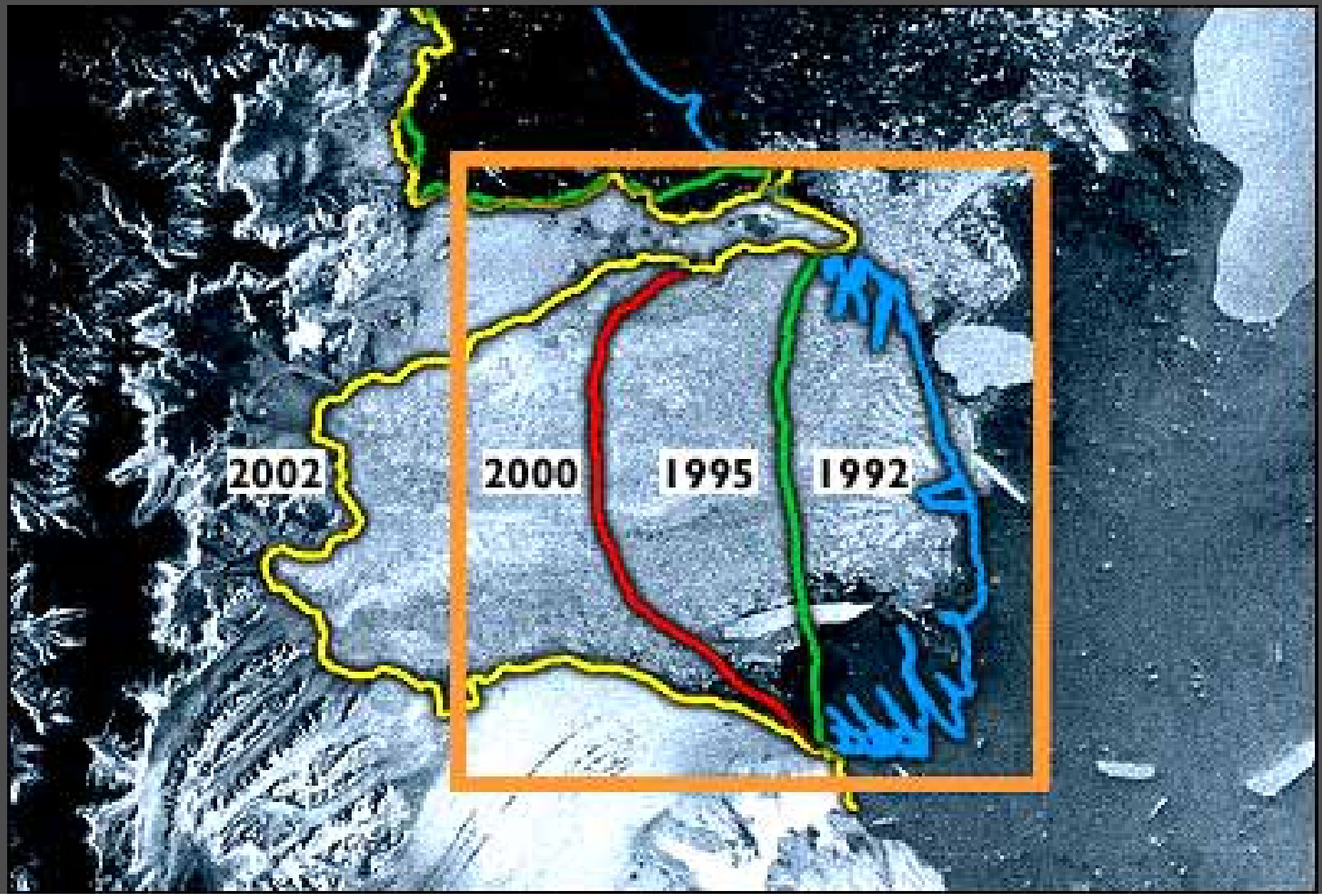
Sea level rise: concerns

Under BAU, ‘a real possibility of rapidly accelerating sea-level rise (2 - 5 m / century??)’ – John Holdren (2007)

‘Our concern that BAU GHG scenarios would cause large sea-level rise this century …differs from estimates of IPCC (2001, 2007), which foresees little or no contribution to twenty-first century sea-level rise from Greenland and Antarctica.

-Hansen et al (May 2007)

Risk of surprises: Larsen ice shelf (Envisat photographs) – the loss of 3,250 km^2 [5x area of Lake Taupo] of ice to the Weddell sea (warming at 0.5 degC/ decade).

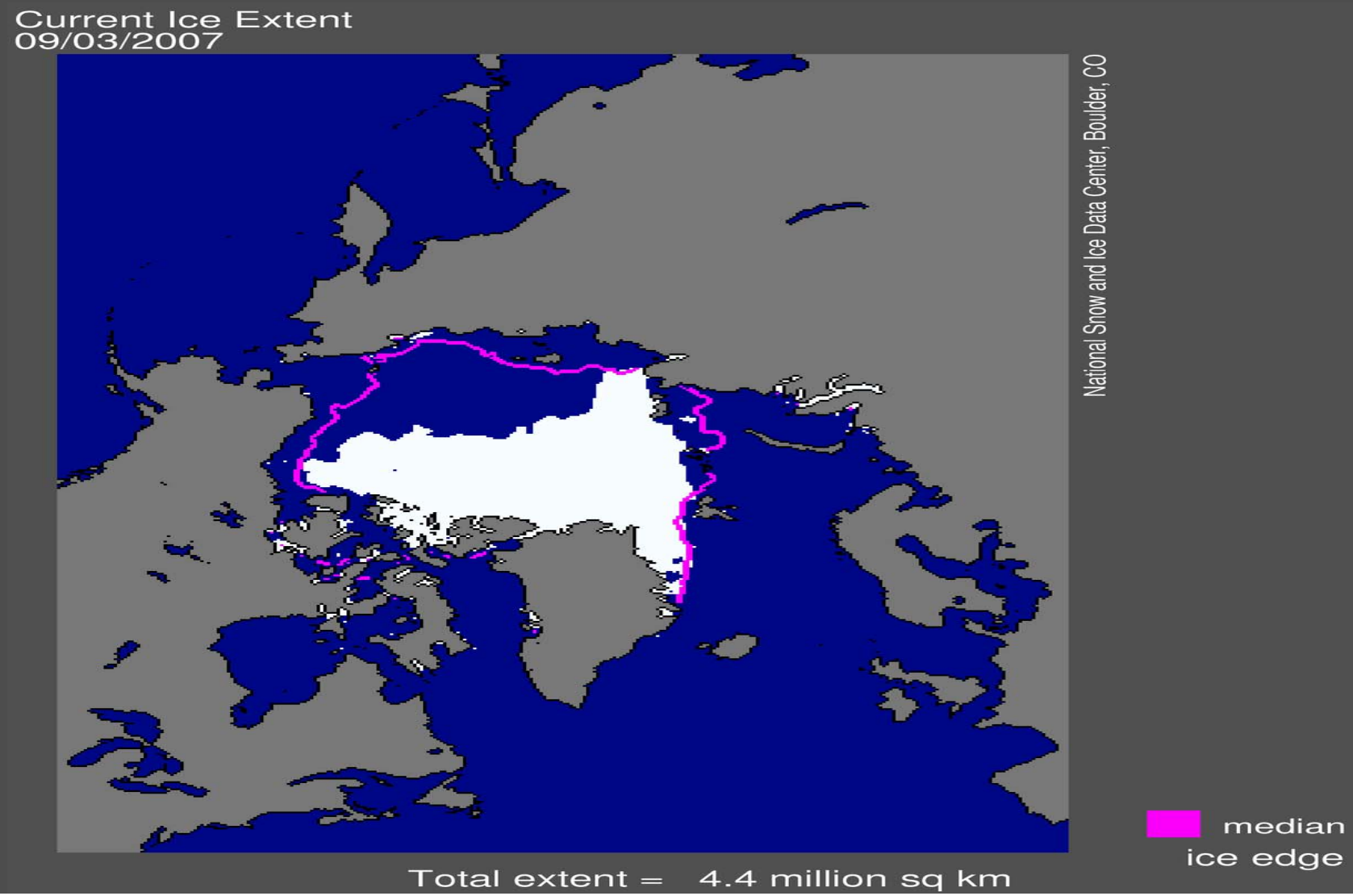


SLR concerns (2)

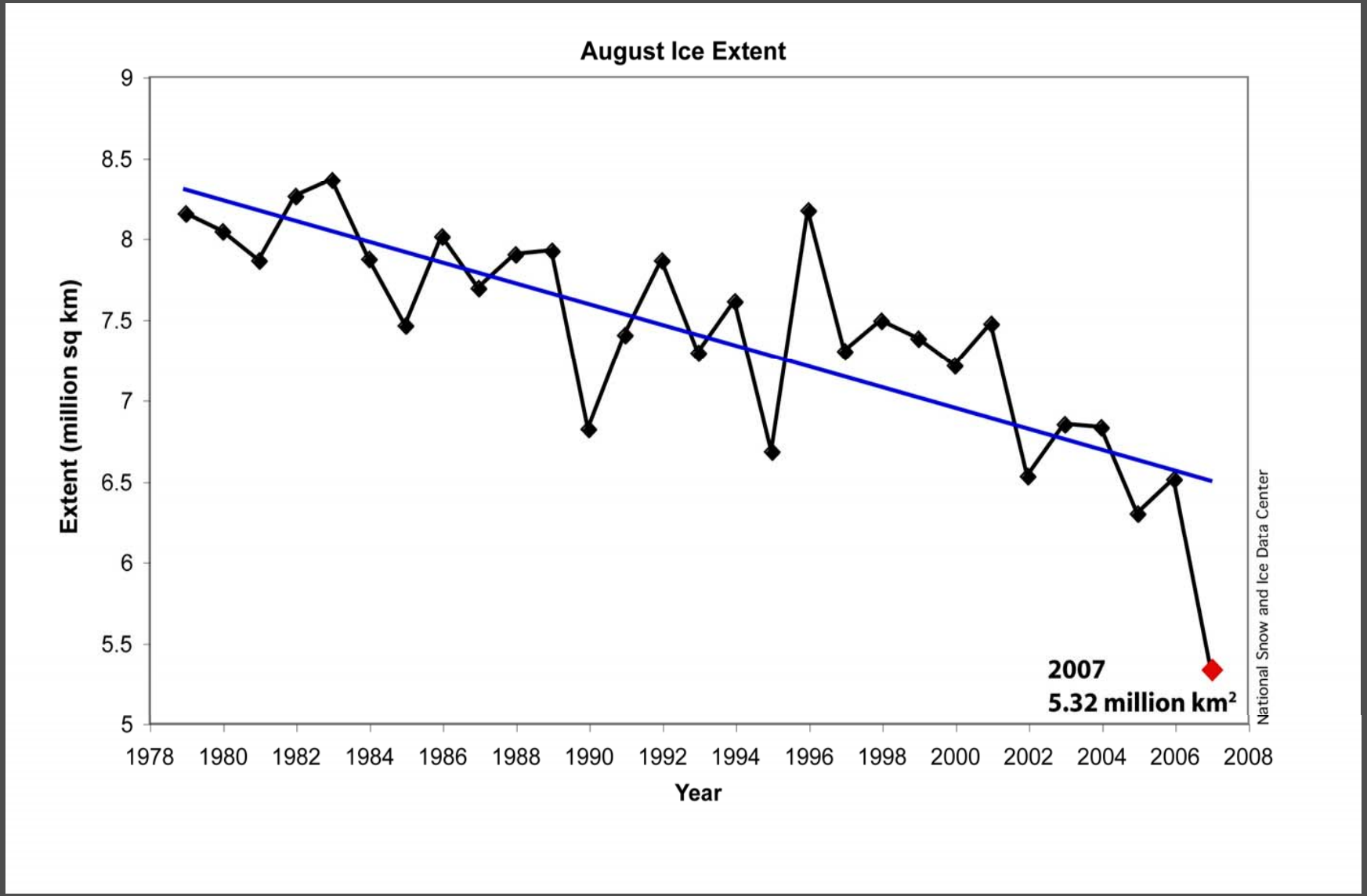
'…the IPCC analyses and projections do not well account for the nonlinear physics of wet ice sheet disintegration, ice streams and eroding ice shelves, nor are they consistent with the palaeoclimate evidence … for the absence of discernable lag between ice sheet forcing and sea-level rise.

- Hansen et al (2007)

Arctic sea ice evidence – greater summer melting



Record and accelerating melt in 2007



‘The best chance for averting ice sheet disintegration seems to be intense simultaneous efforts to reduce both CO2 emissions and non-CO2 climate forcings.’

- Hansen et al (May 2007)

Working Group 2 – Impacts, adaptation & vulnerability

- A range of projections, many of major concern
- e.g. in relation to ecosystems:

  ‘The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects, ocean acidification), and other global change drivers (e.g., land use change, pollution, overexploitation of resources).’ ** [High confidence]

Coasts and flooding

‘Many millions more people are projected to be flooded every year due to sea-level rise by the 2080s. Those densely-populated and low-lying areas where adaptive capacity is relatively low, and which already face other challenges such as tropical storms or local coastal subsidence, are especially at risk… [and] small islands are especially vulnerable.*** [v high conf.]

(my emphasis added)

IPCC report tweaking - example

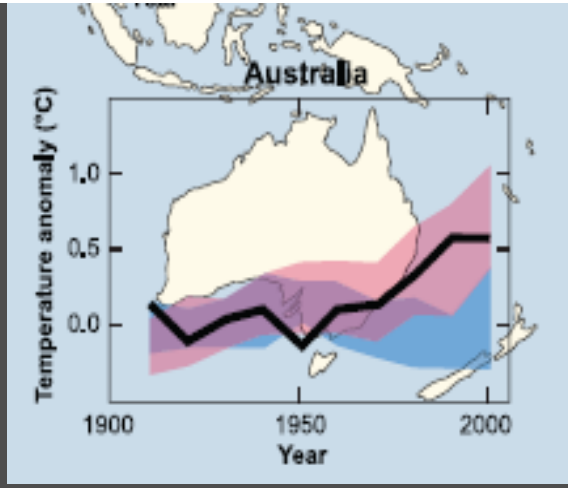
Both draft and final versions draw attention to the fact and quantification of acidification of ocean surface water due to increase in concentration of atmospheric CO2. The draft text includes the phrase: "raising concerns for marine calcifying organisms" The phrase is omitted from the final version.

Sinks (e.g. forests) and species

- Over the course of this century, net carbon uptake by terrestrial ecosystems is likely to peak before mid-century and then weaken or even reverse, thus amplifying climate change. **

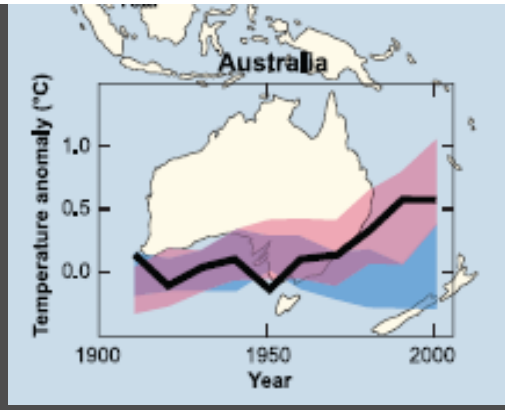
- Approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5-2.5°C (relative to 1990 temps). *

Particular results for Aus & NZ



- As a result of reduced precipitation and increased evaporation, water security problems are projected to intensify by 2030 in southern and eastern Australia and, in New Zealand, in Northland and some eastern regions. **

Particular results for Aus & NZ

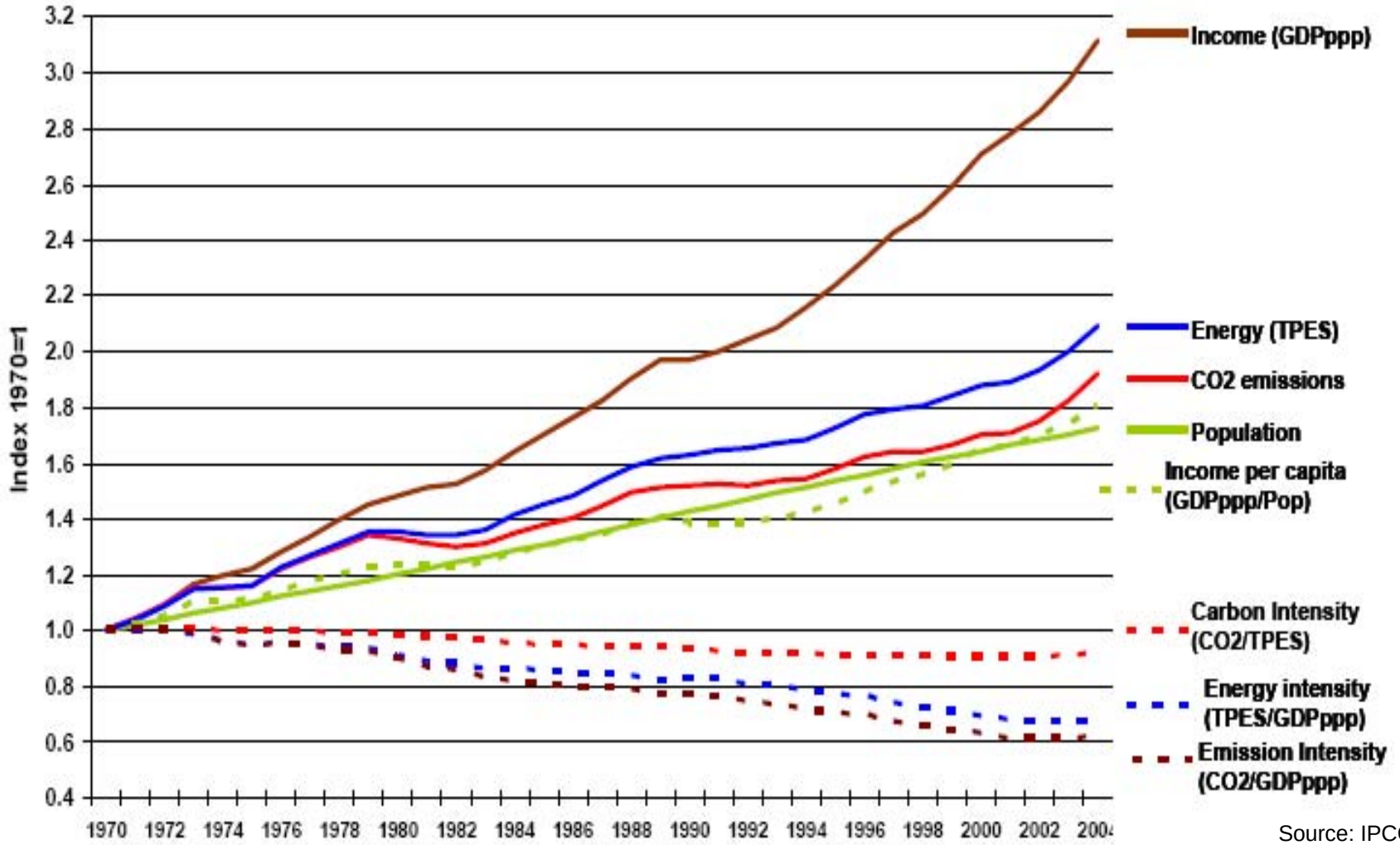


- Ongoing coastal development and population growth in areas such as …Northland to Bay of Plenty … are projected to exacerbate risks from sea-level rise and increases in the severity and frequency of storms and coastal flooding by 2050. ***

Working Group 3: Responses
Key results

- Global increase in CO_2 emissions of 28% since 1990, and +24% for all GHGs
- Big drivers:
  - Global income growth +77%
  - Global population growth +69%
- Energy intensity gains (-33%) overshadowed by income growth

Only weak decoupling of CO_2



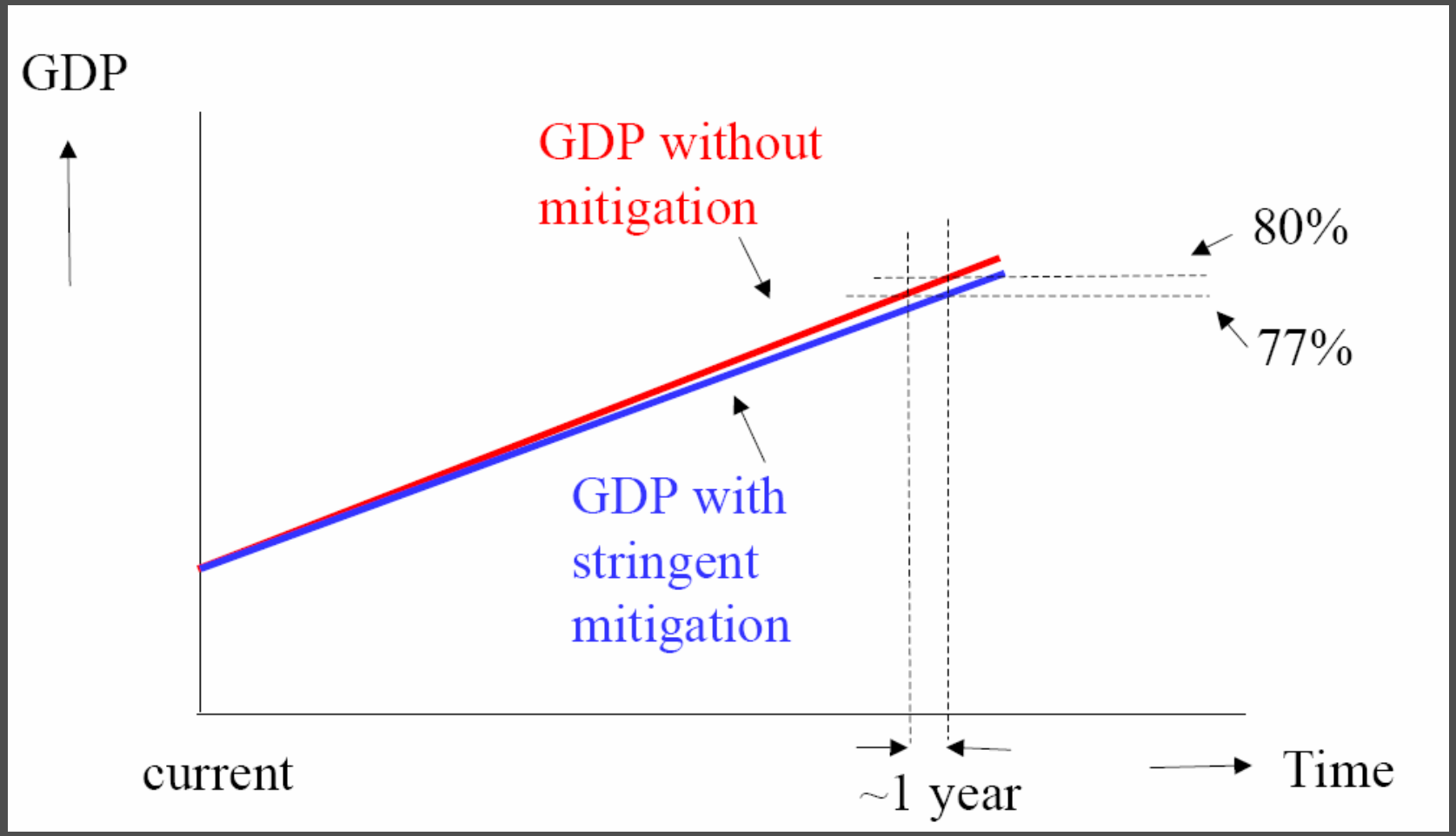
Source: IPCC

WG3 further key results

- Wide range of effective mitigation options - varying costs
- Emission reductions to stabilise CO_2e at around 500 ppm would likely cost <3% of GDP in 2030, or <0.1% pa in GDP growth rate

- High co-benefits in some areas provide offsetting savings
  - E.g. ‘About 30% of projected GHG emissions in the building sector can be avoided with net economic benefit’

Framing the costs of mitigation



Source: WG3, IPCC

Examples of mitigation technologies currently commercially available

Transport [5.4]	More fuel efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning
Buildings [6.5]	Efficient lighting and daylighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves, improved insulation ; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycle of fluorinated gases

Examples of new technologies likely to be commercialised by 2030

Second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries

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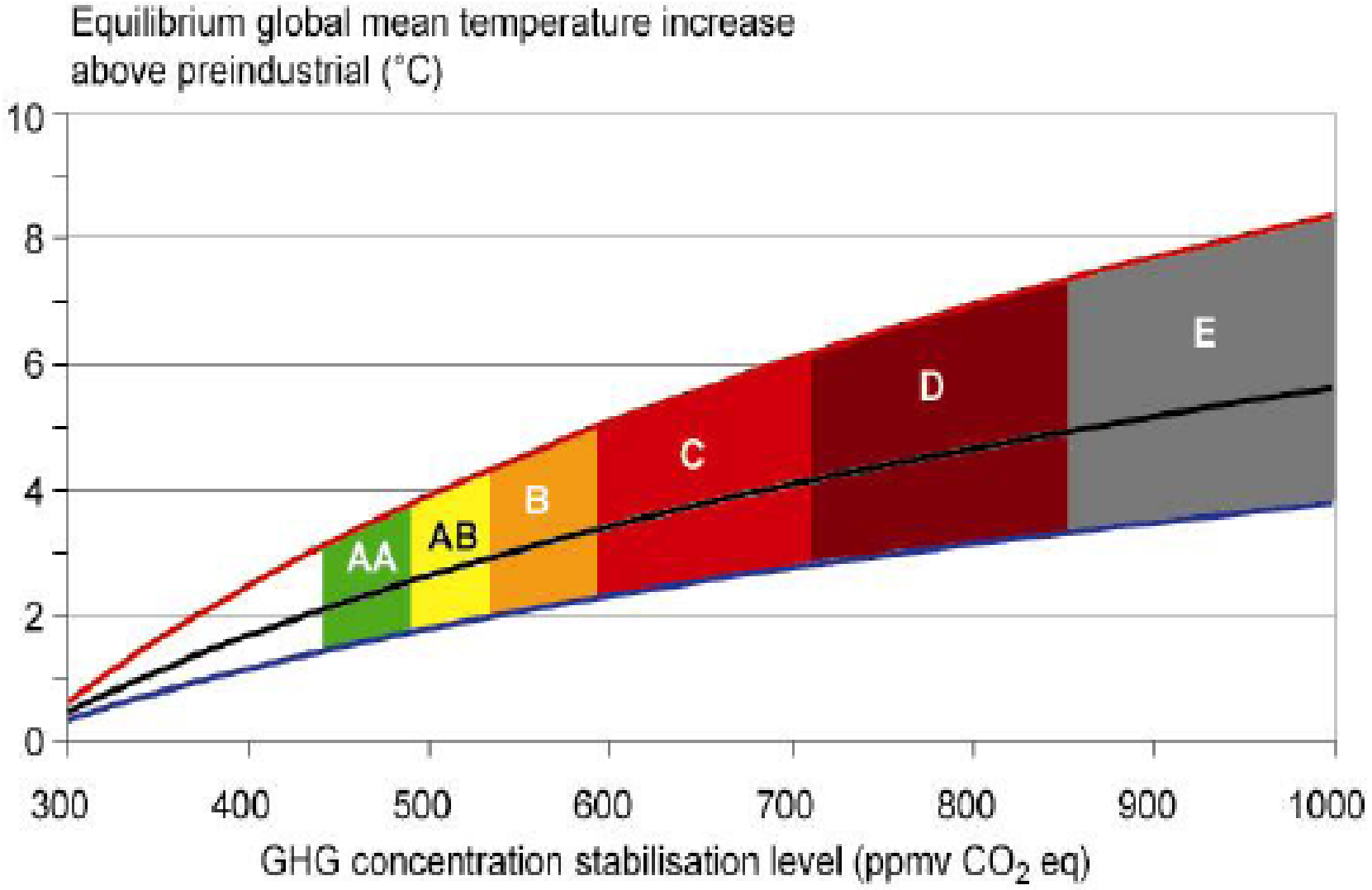
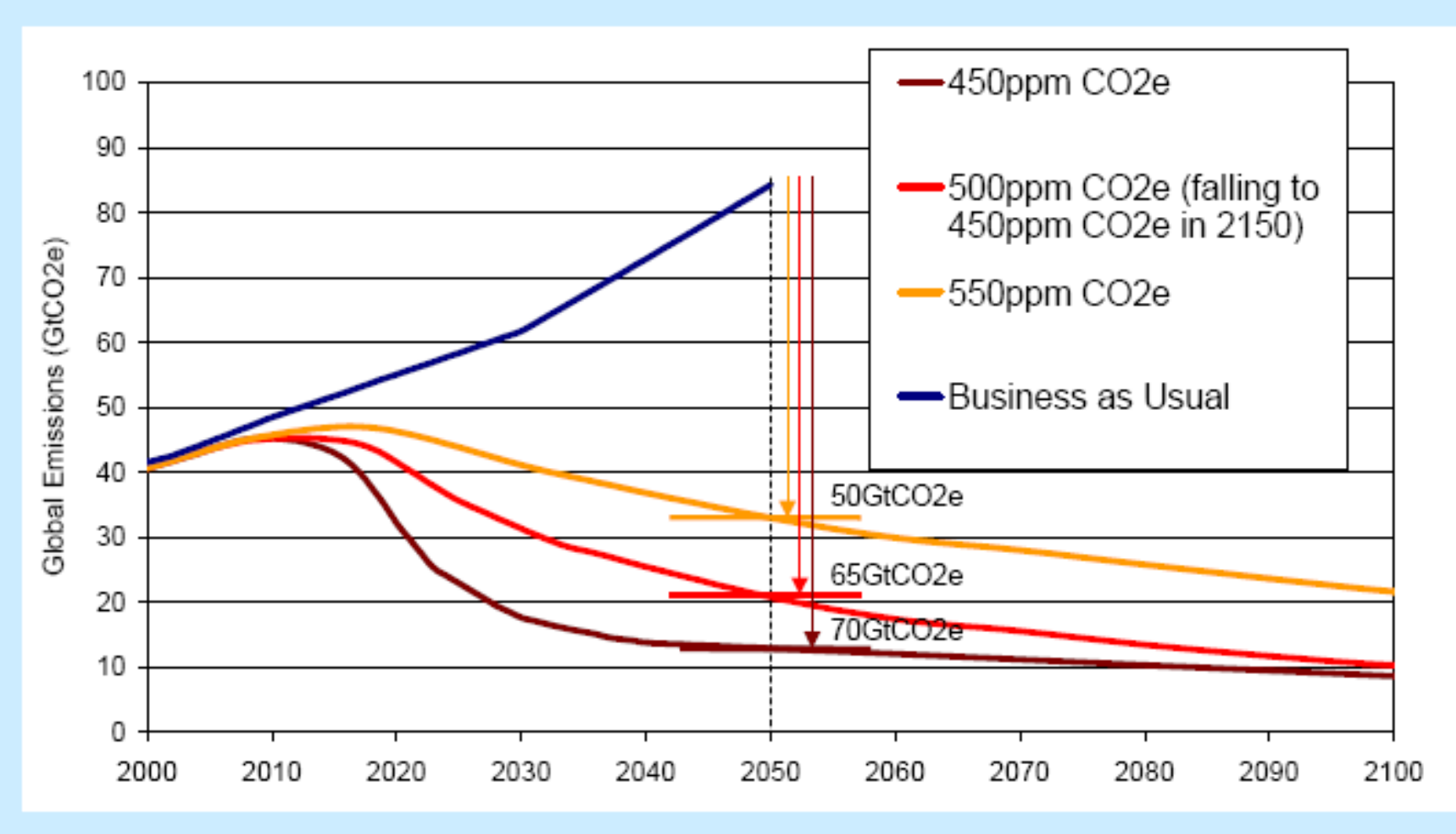
Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control; solar PV integrated in buildings

WG3: temp. increases by scenario class: probably understates the uncertainties



Emission paths to stabilisation:

for red or brown paths, need to peak emissions by ~2015



Source: Stern Review

2 Policy analysis: evaluating strategies

Moving from science to policy: What is ‘acceptable’ and why?

- We have looked at the science and assessed what we are about to be physically ‘committed to’
- Now need to ask: is a ‘fair probability’ of 3°C or above at all acceptable?
- IPCC and modellers cannot answer these questions: the answers depend on economics and ethics -- views about costs, benefits, risks, and values

The economics

1 Common modelling conclusion (see WG3):

- Early action substantially reduces costs of acting (mitigation): there is a large procrastination penalty as capital is locked in

2 Hatfield-Dodds:

- The costs of acting are small relative to long-term growth in GDP
- Public willingness to pay is sensitive to how ‘costs’ are framed
- Misleading to frame as loss when cost of action simply reduces size of future income gain

Economic costs of acting & not acting

3 Stern:

- “The benefits of strong and early action far outweigh the economic costs of not acting”
- The costs of **not** acting: ~5 to 20% of GDP/year lost ‘forever’
- The costs of acting can be limited to ~1% of global GDP/yr
- Frameworks must accelerate action over the next decade

Risk evaluation: a ‘Swiss Re’ take on climate impacts already visible

...all that, and the globe warmed by less than 1°C during the whole of the last century

Source: Lash and Wellington (2007)

From economics to risk evaluation, and ethics

Even at 500 ppm, probability of exceeding 3°C is between ~30 and 40% (i.e. not a low probability): should we take this risk?

Given the consequences, it's a huge risk.

Risk taking at this level may impose large future costs and limit development options of future generations

We move from economics to ethics

Risk evaluation: understand the scenarios

“Further global warming [above now] of 1°C defines a critical level. …if [it] reaches 2 or 3 °C we will likely see changes that make Earth a different planet than the one we know.

The last time it was that warm was in the middle Pliocene, about three million years ago, when sea level was estimated to have been about 25 meters (80 feet) higher than today."

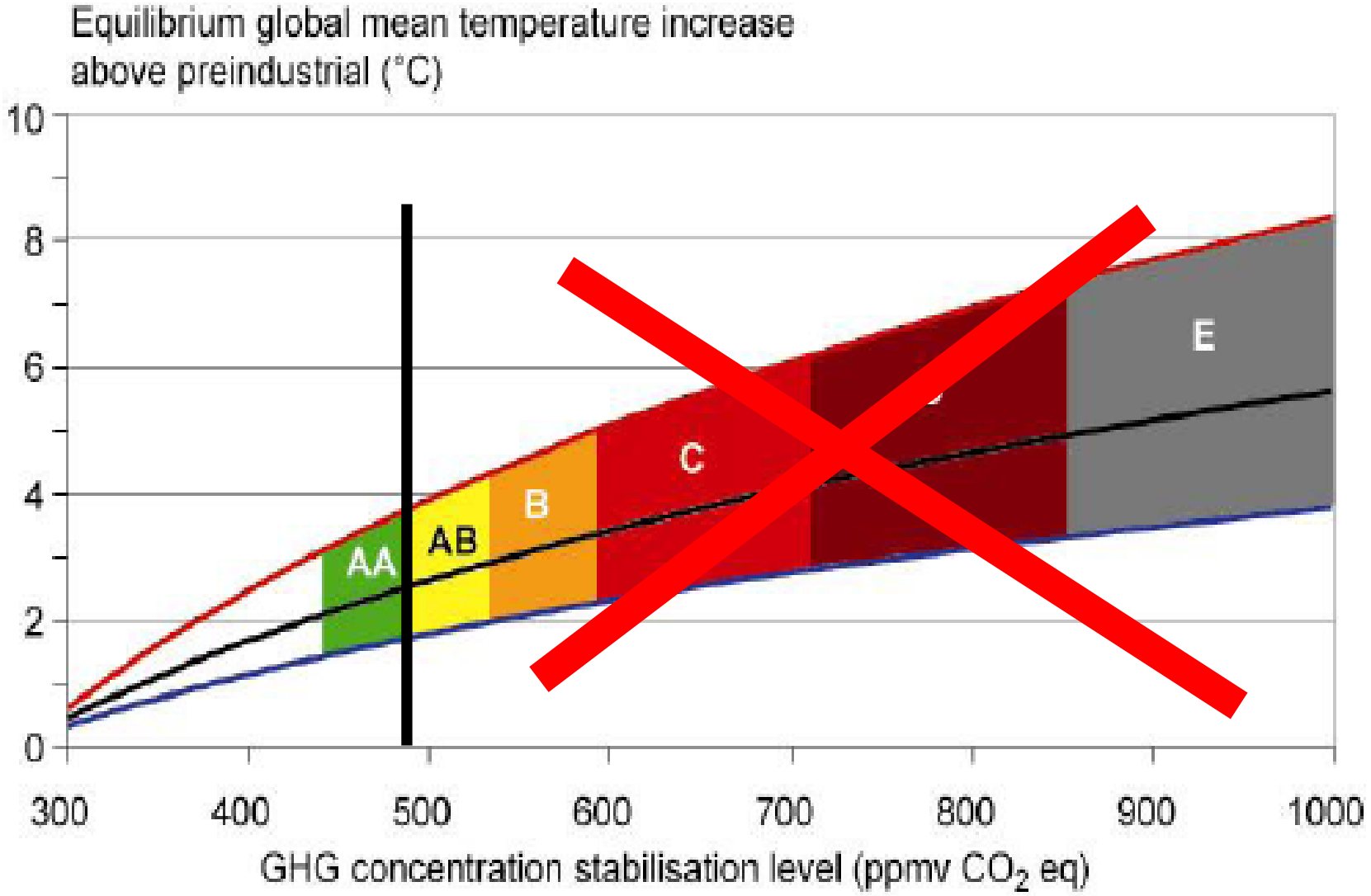
- James Hansen, Goddard Space Centre, 2006

Risk evaluation: understand the scenarios

We need to start serious measures to reduce greenhouse gases within the next decade, (and) if we don't do something soon, we're committed to 4 to 6 meters (13 to 20 feet) of sea level rise in the future.

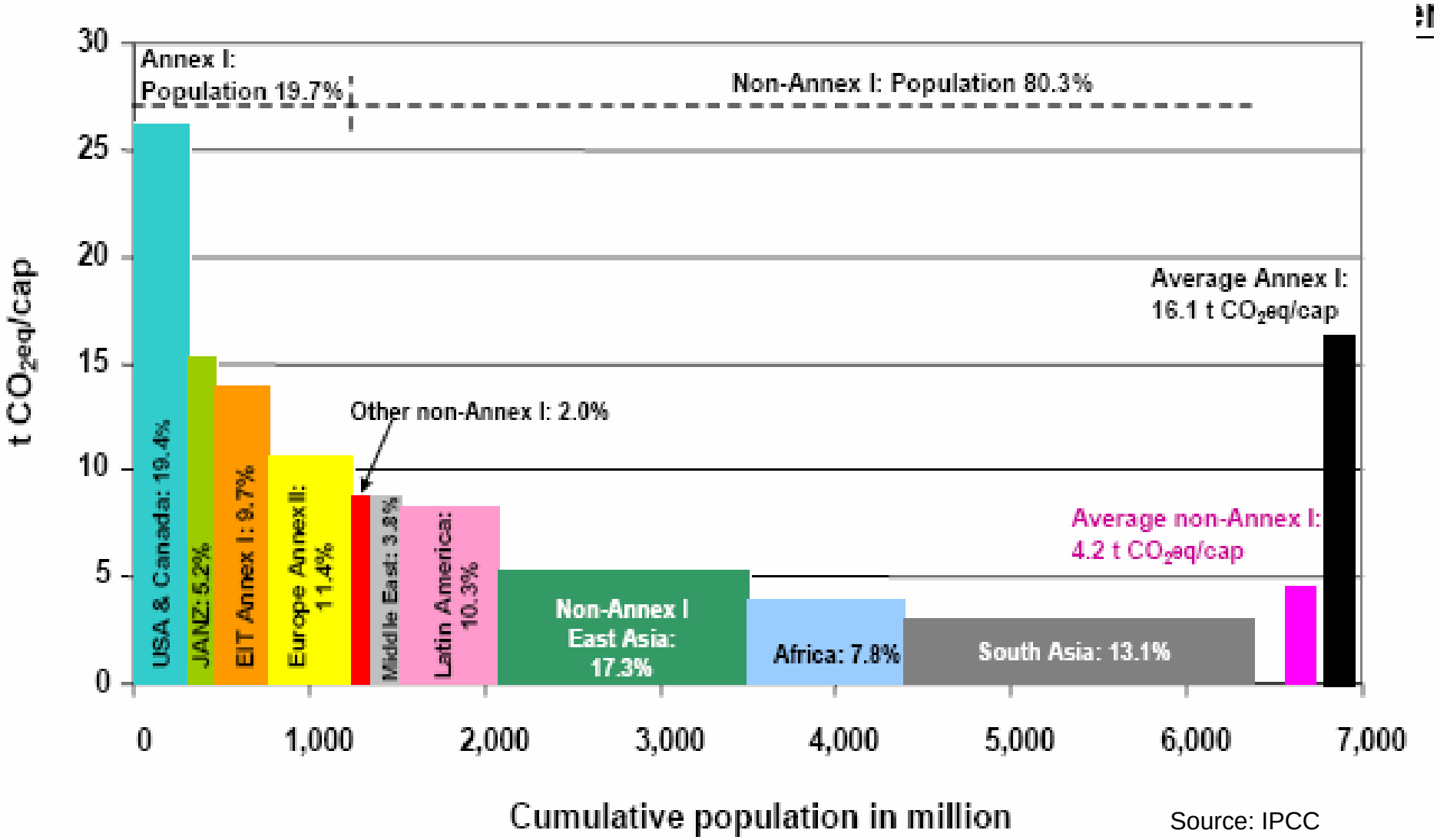
– Jonathan Overpeck, 2006

Implications for acceptable concentration scenarios: my view



Ethics in action: emissions per capita

by region and by population (IPCC WG3 graph)



Source: IPCC

Ethics includes consideration of future security

- "…we are dangerously behind the curve. We are on a direct path to climate chaos. …The threat we face is to the most basic conditions underpinning our global society."

  – British Foreign Secretary Oct 06

- "...if we don't do anything about climate change… it is simply inconceivable that there will not be a profound and possibly devastating effect on our collective and individual security"

  – British Foreign Secretary April 2007

A framework for considering policy implications of decarbonising NZ: 6 propositions

1. Initial impacts of climate change will flow most strongly not from the direct effects of climate change itself, but from policies adopted to decarbonise

2. Implications will depend strongly on the nature of policies adopted, including revenue recycling

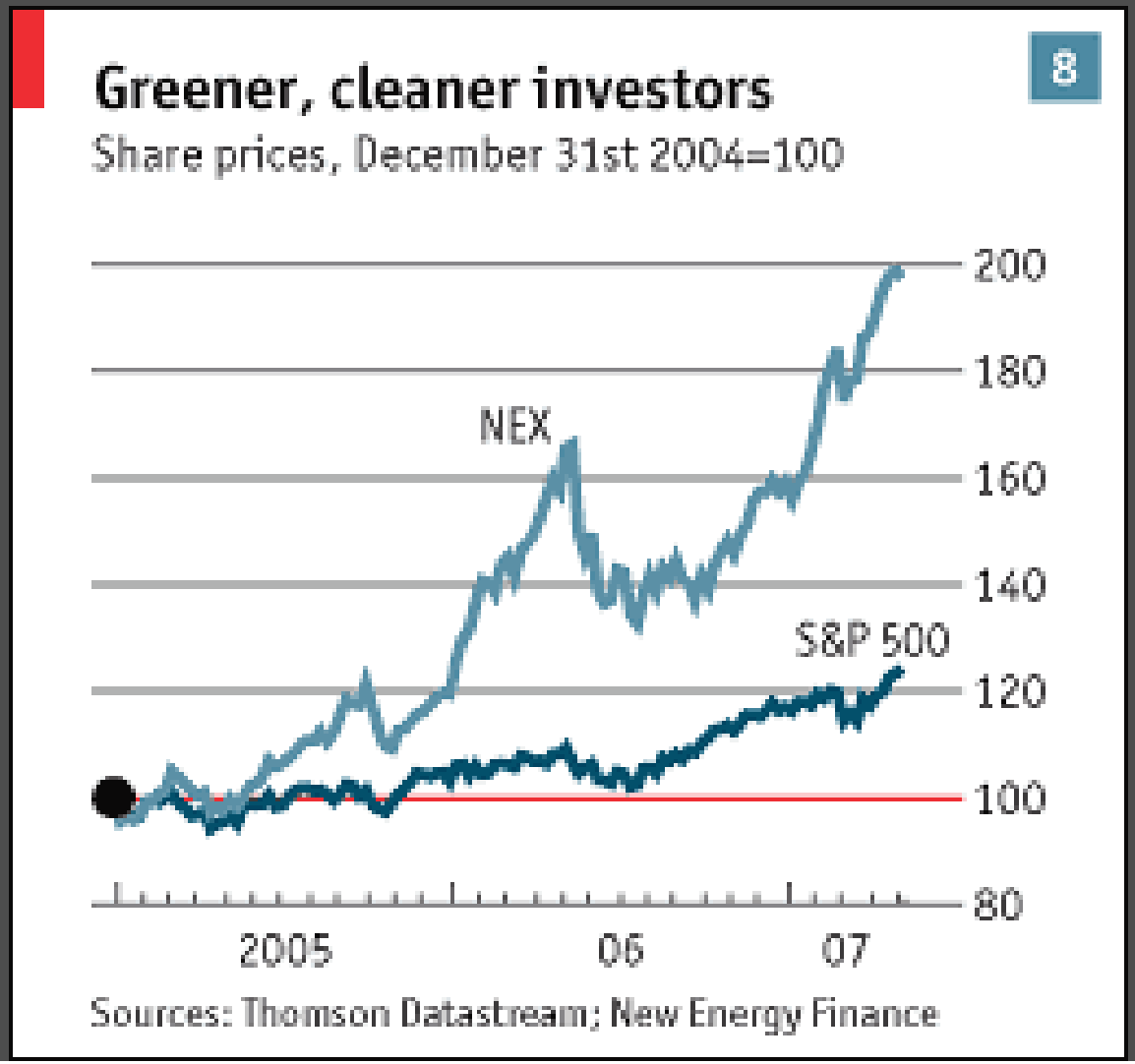
3. Implications will be influenced by foresight exercised in central and local government policy; & private sector & individual repositioning

Source: Chapman and Boston (2007)

Illustrating Proposition 3 (Foresight matters)

- Leadership and pro-activity are central
- International context moving rapidly; investors and others intensifying scrutiny (upsides, downsides)
- Opportunity: climate change and new energy will create the “mother of all markets”
  - John Doerr, venture capitalist
- Capitalising on NZ’s clean, green, innovative reputation through strategic positioning can, for example, help attract and retain talented people

Opportunities: NEX doing well (represents clean-energy coys)



NEX example: Denmark's Vestas: market capitalisation of $12.5 billion

Source: The Economist (2007)

Framework for implications (2)

4. Implications depend on resilience of various sectors, and people's adaptability and commitment to developing more sustainable ways of living, as well as lifetime of economic capital
5. Implications less disruptive if opportunities for communities and individuals to engage directly in developing actions to reduce emissions
6. Uncertainty around size of climate change impacts, & social/econ. responses, means case for more demanding mitigation action, not less.

Summary thus far

- To avoid signif. risk of ‘catastrophic’ changes, we need to stabilise CO_2e levels under 500 ppm; preferably closer to 450 ppm
- Requires global emission cuts of ~80% from 2005 levels; the sooner we start the less painful the adjustment
- “We have at most 10 years — not 10 years to decide upon action, but 10 years to alter fundamentally the trajectory of global greenhouse emissions” - Hansen
- Path dependence and big lags in global and local policy systems, energy/transport systems, etc.
- But major business / economic opportunities, especially in the energy area

The global policy context

- Inertia in global economy, social patterns
- Pushing developing countries to cut emissions a big ask, given distribution of responsibilities for past emissions (next slide)
- Cutting developed country emissions 90% is ~ comparable to developing country cuts of around 10%
- But need Kyoto-style flexibility mechanisms (e.g. CDM)

The global policy context (2)

- Kyoto CP1 imminent – legally binding
- Kyoto essentially a 2-stage global deal:
  - Developed countries cut GHGs in KP CP1
  - Developing countries cut thereafter
  - US and Australia abrogated the deal, despite signing
  - Australia may come in to KP in future – with trading
- ETS has established a price (and cap) for carbon: currently ~NZ$40 per tonne
- Teething troubles, but the way the world's heading
- A price on C (tax / permit) gives coys more certainty as draw up investment plans

A post 2012 agreement

- US has now agreed to be “in” the UN process (G8 summit)
- Next global agreement likely to require 20-30% cuts by 2020 (v. early 2000s levels)
- Some sectoral agreements e.g. cement?
- ‘No lose’ commitments for developing countries?
- Positions of China et al critical: will be influenced by what developed nations do

NZ policy implications

- Sticking to our treaty obligations important for NZ 'brand'
- It matters what we signal re targets and action measures
- Unclear that it's harder for NZ to cut emissions than other countries

- New Zealand can:
  - Commit to elect'y generation ~100% zero-C by 2030
  - Cut agricultural emissions, with incentives in place e.g. for N reduction – no case for 'shielding'
  - Plan for rapid biological capture of atmospheric carbon

NZ policy implications (2)

- Wise to think ahead so that we can adjust more gradually – lowers costs
- Wise longer-term working target: cuts of 80 - 90% by 2050
- In medium term, ~25% by 2020 (cf. EU)
- Need interim steps & specific measures – e.g. emitters having to buy permits from Kyoto market

NZ policy implications - energy specifically

- Peak oil: not “if” but “when” – an additional strong reason for cutting fossil energy use
- Climate change and fossil energy availability together → compelling case for an energy transition
- European transition thinking provides useful model: “system innovation”
- Government steering, but strong role for markets
- Always keep energy policy within SD frame

Integrated thinking example: transport, urban design and energy

- Will have to adapt more rapidly than comfortable: 35% BAU growth in transport emissions to 2030 unacceptable
- Biofuels, plug-in hybrids, fuel efficiency regulation all help
- But have to also focus on next ‘level’ -- traffic generation
- Firmer strategies for urban growth nodes to avoid sprawl
- Requires mix of price signals, land use regulation, redirection of investment away from motorway building

Case study: food and shopping energy use (UK)

- Externalities: ~12% on top of cost of typical UK food basket
- Most externalities of food transport from energy use (CO_2)
- On £25 food basket cost, externalities (excl. subsidies) add £1.98 (UK estimate):
  - Domestic road transport £0.76
  - Shop to home transport £0.41
  - Farm production externalities £0.81
  - International transport neglig.

Source: Pretty et al, 2005

Case study: food and shopping energy use (2)

- So road transport externalities add to £1.17 or 60% of the environmental externalities of UK food
- Delivery of food from supermarkets could cut shop-to-home transport by as much as 70% (Monbiot) or, realistically, 30%?
- Yet to see a comparable NZ study

Local opportunities for low-cost action

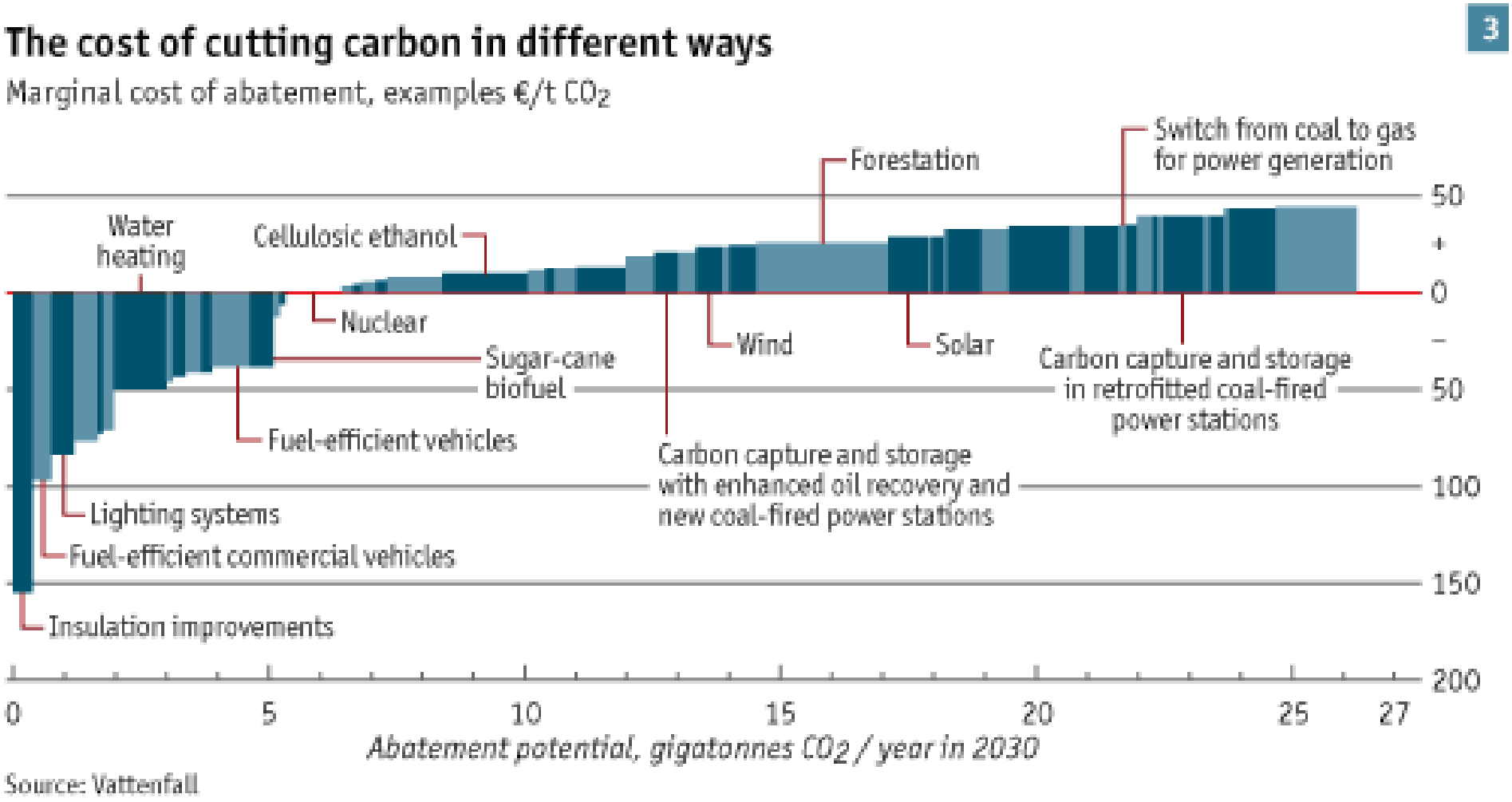
- Insulate houses and buildings
- Improve efficiency & sustainability of heating systems
- Green energy
- Walking and cycling
- Reshape cities to reduce the need for car travel, e.g TOD
- Use and support public transport
- Minimise flying
- Phase out motorway building
- In short, our houses, buildings, transport & energy systems, cities and our ways of life can be more sustainable

Energy transition planning

- Aim for system innovation e.g. in building energy, transport energy, renewables
- Invest in quantifying and valuing the co-benefits with ‘action’ research
  - e.g. housing and health studies (UOO – Wellington)
- Accelerate RD&D into energy measures with wide sustainability paybacks [over]
- Experiment now – e.g. marine energy, sewage algae for biofuel

- Hope to see strategy in NZES this Oct/Nov

Insulation has a very low ‘full cost’ of carbon abatement



Source: Vattenfall, via The Economist

If not NZ, who?

NZ is comparatively wealthy

A clean, green brand and an
aspiration to lead the world in terms of sustainability

For example, we can increase renewables significantly

Not (yet) struggling with the early impacts of climate change

Have a population that understands and supports action, especially if sees market opportunities

Supporting institutional changes needed in NZ

- Transform Treasury into a Ministry of Sustainable Development
- Strengthen strategic capacity, widen brief
- Take climate change lead from MfE to Treasury
- Engage whole of government in transition strategy on energy (MED-led)
- Ensure regional and local authorities, business and civil society fully engaged with energy transition