The Economics of Climate Change

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Part 1: The economics of climate change: What is the **economics** and how does it depend on the **science**?

Analytic foundations

Climate change is an externality with a difference:

- Global
- Long-term
- Uncertain
- Potentially large and irreversible

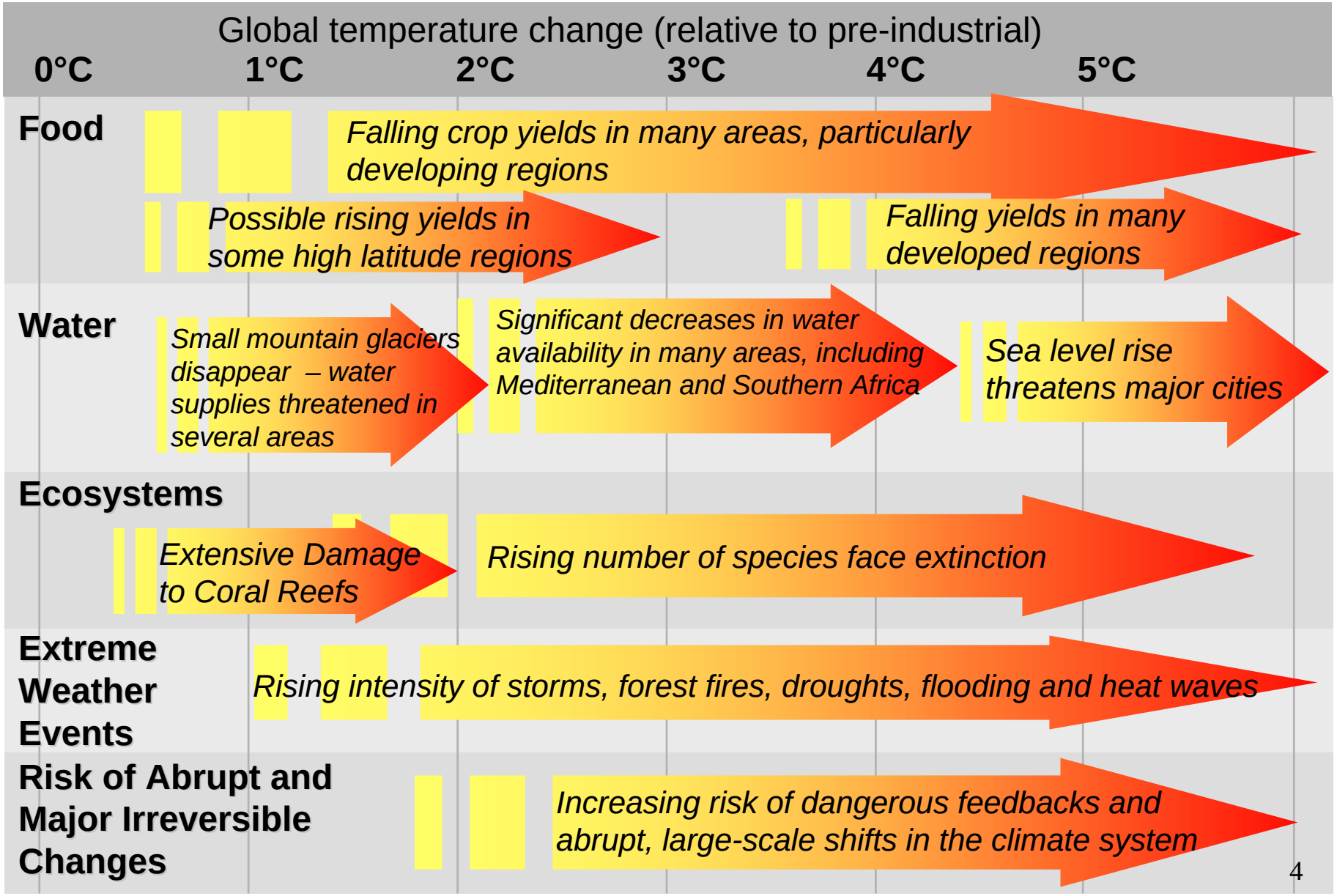
Part 1: The economics of climate change:
Key questions for the Review

- What are the **risks** arising from the impacts of climate change, what are the probabilities, and **on whom do the impacts fall**?
- What are the **options** for mitigation, and what do they **cost**? What do the risks, options and costs imply for the economics of the choice of paths to stabilisation for the world, and for the timing and scale of action?

Policy

- For **mitigation**, what kind of **incentive structures** and policies will be most **efficient** and **equitable**?
- For **adaptation**, what **approaches** are appropriate and how should they be **financed**?
- How can approaches for both mitigation and adaptation work at an **international level**?

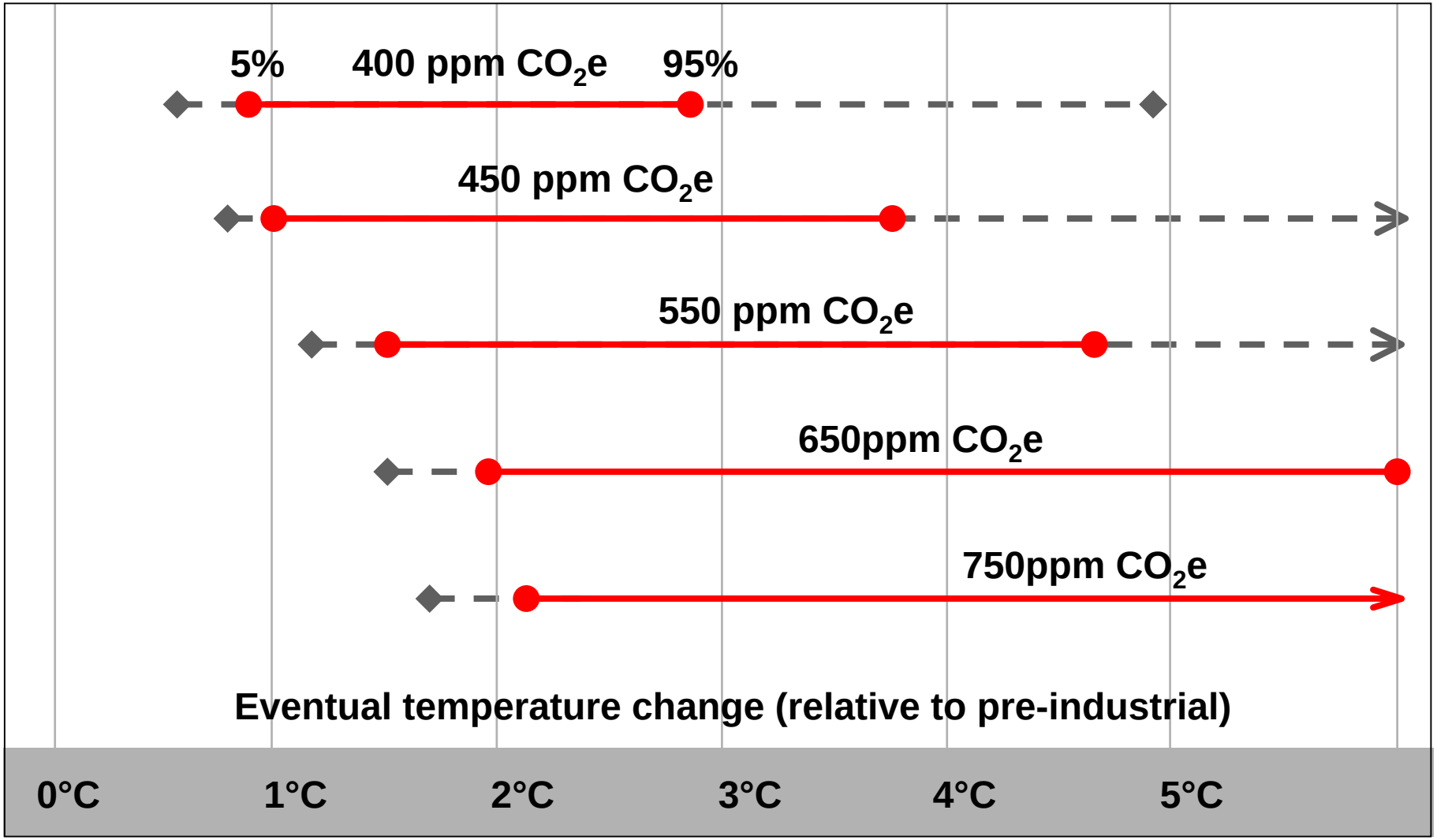
Projected Impacts of Climate Change



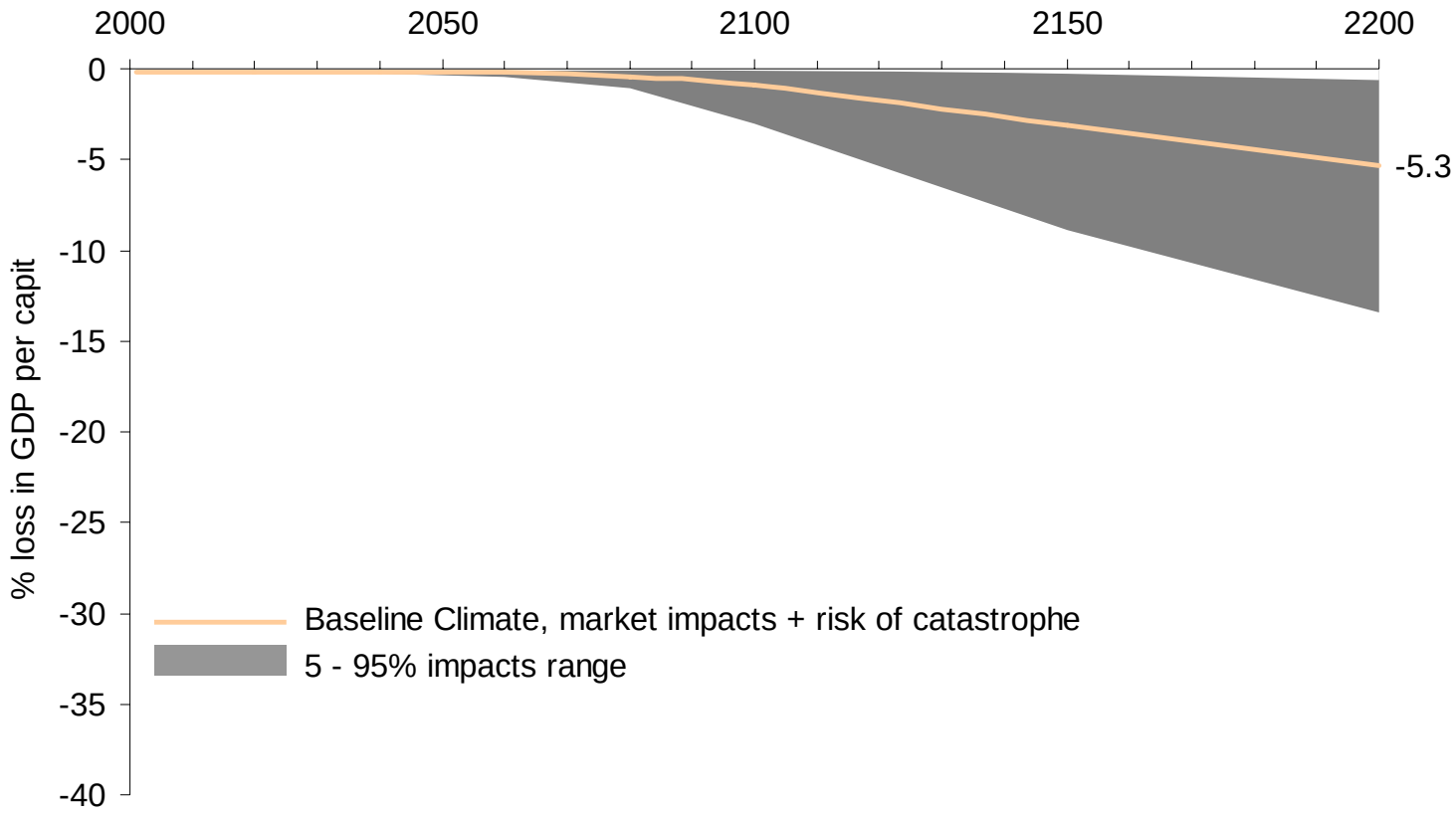
Understanding Disaggregated Impacts

- Developing countries are especially vulnerable
  - Rising water stress in many areas (over one billion people suffer water shortages by the 2080s, many in Africa).
  - Falling farm incomes
  - Malnutrition and disease
  - Pressure for migration and conflict (dislocation, for example, due to desertification and sea level rise)
- Developed countries are not immune
  - Water stress in southern Europe and California
  - Costs of extreme weather events (hurricanes, floods and heatwaves)
  - More volatility implies higher costs of insurance, with implications for capital markets

Stabilisation and Commitment to Warming



Aggregate Impacts of Climate Change



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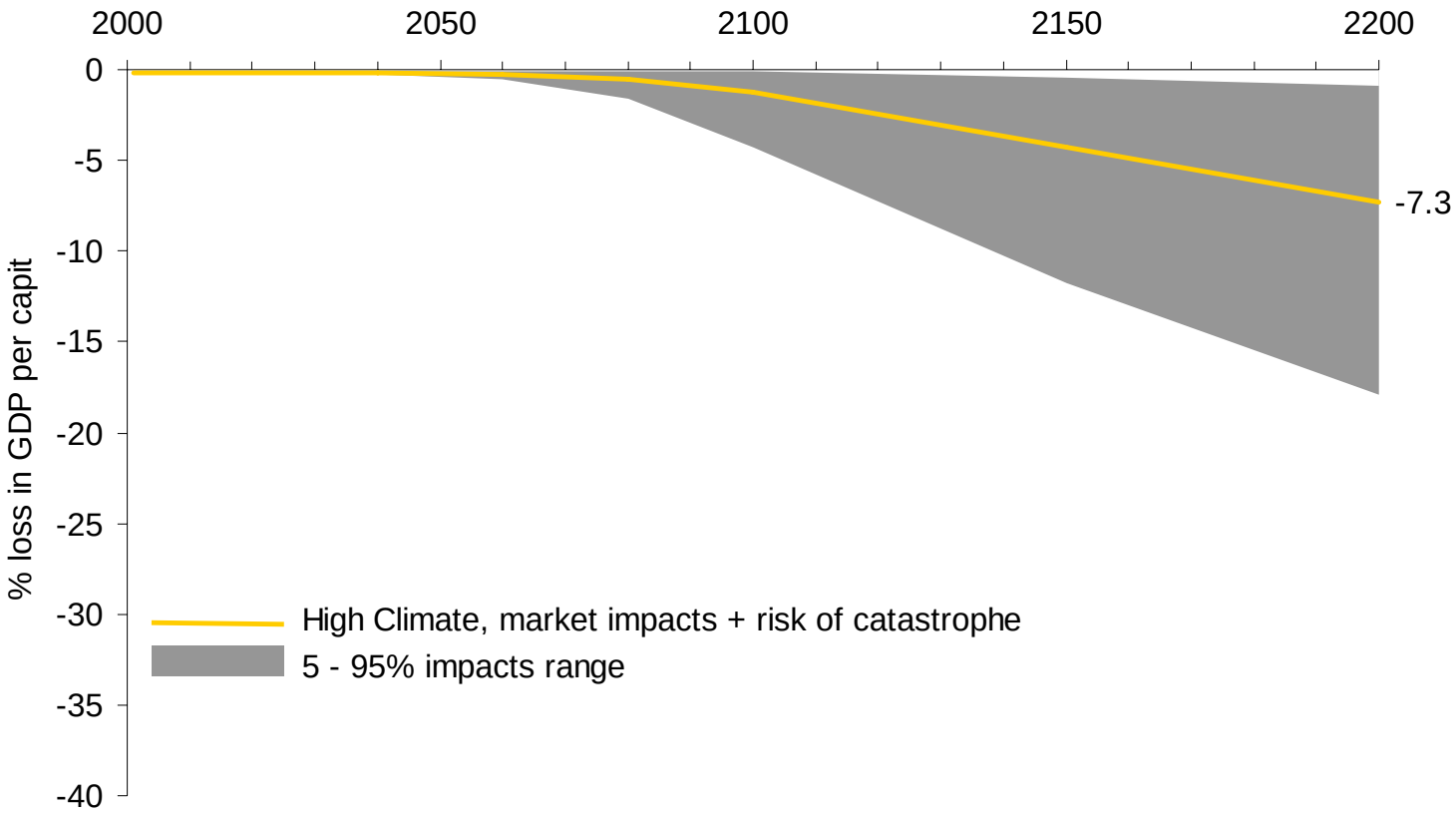

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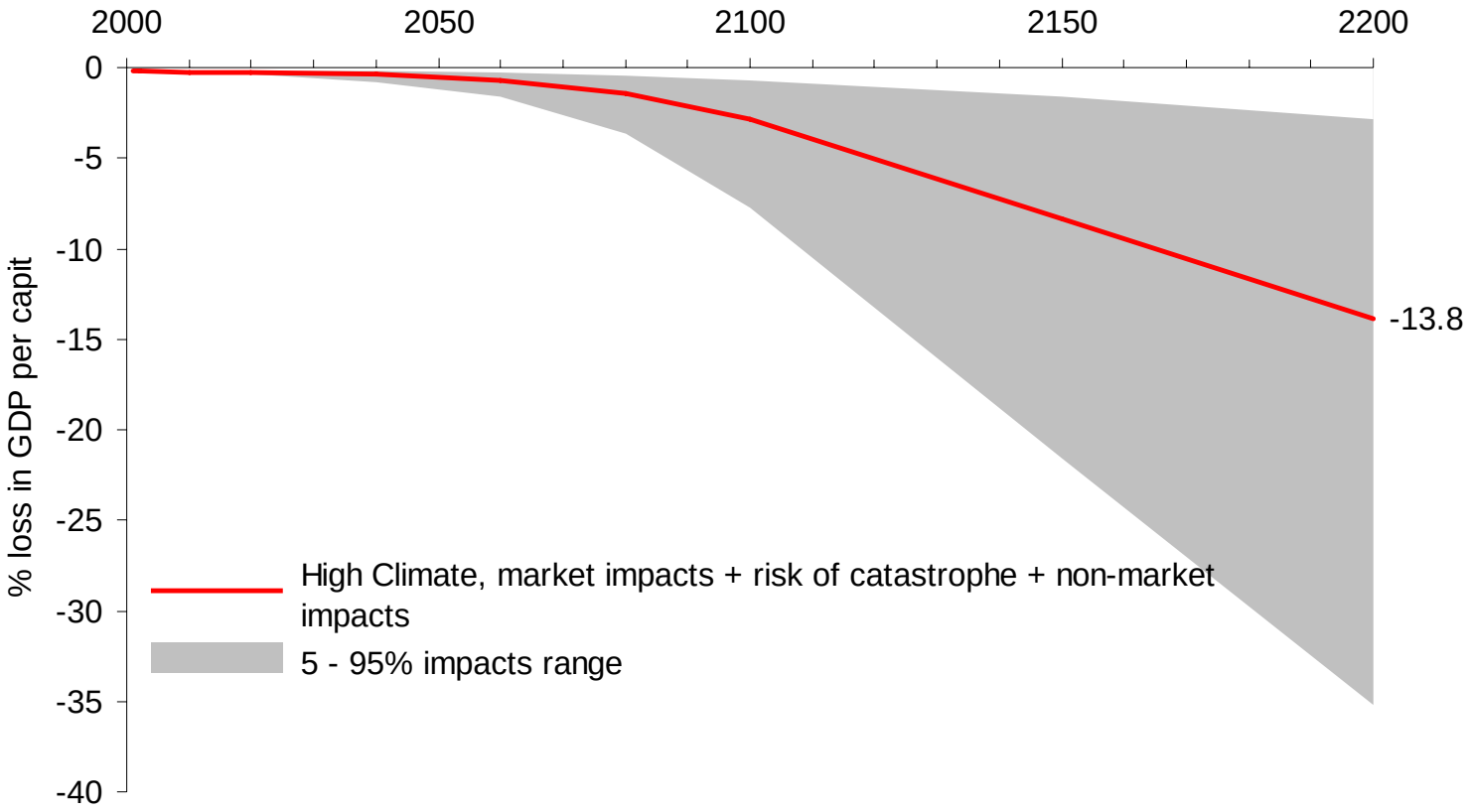

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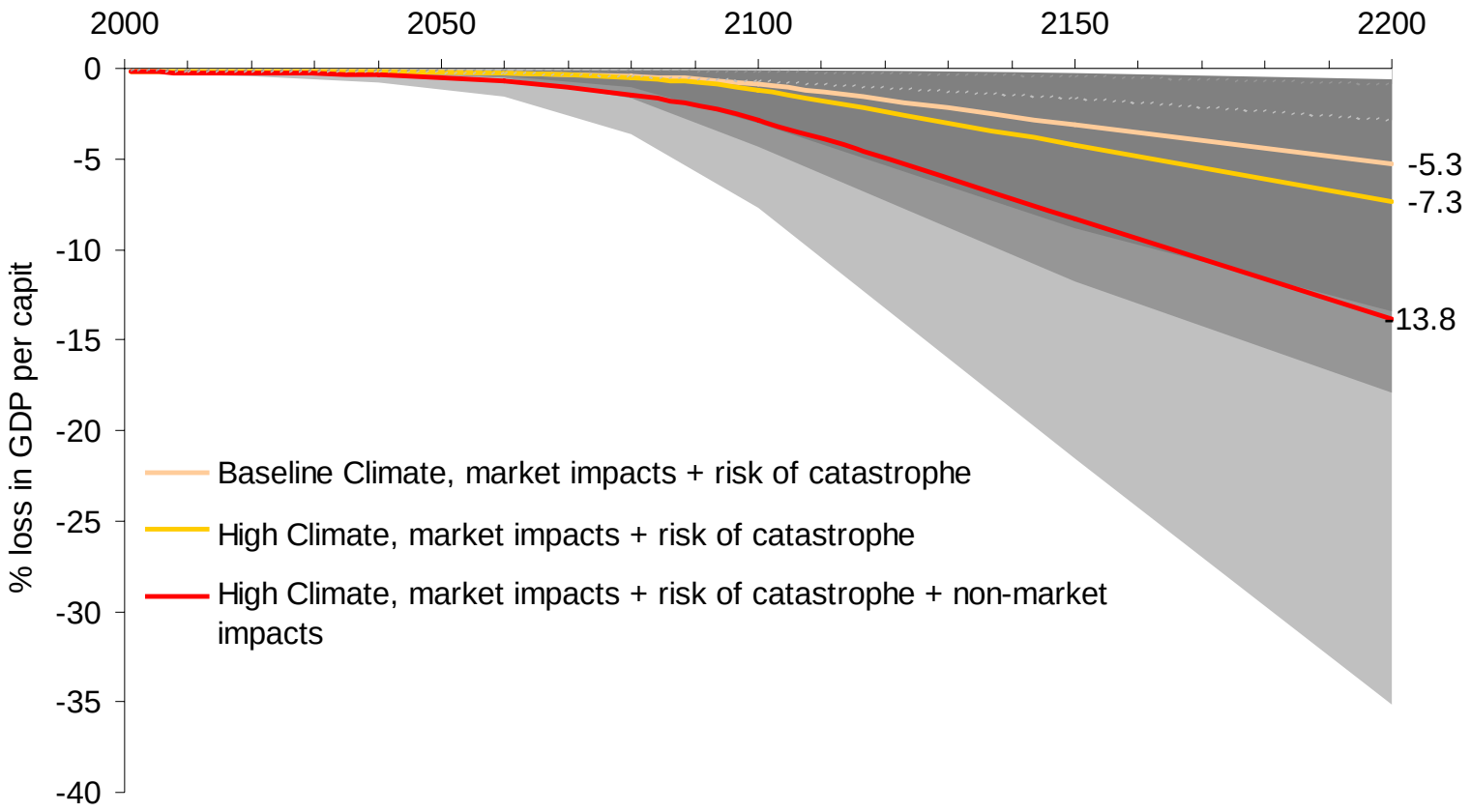
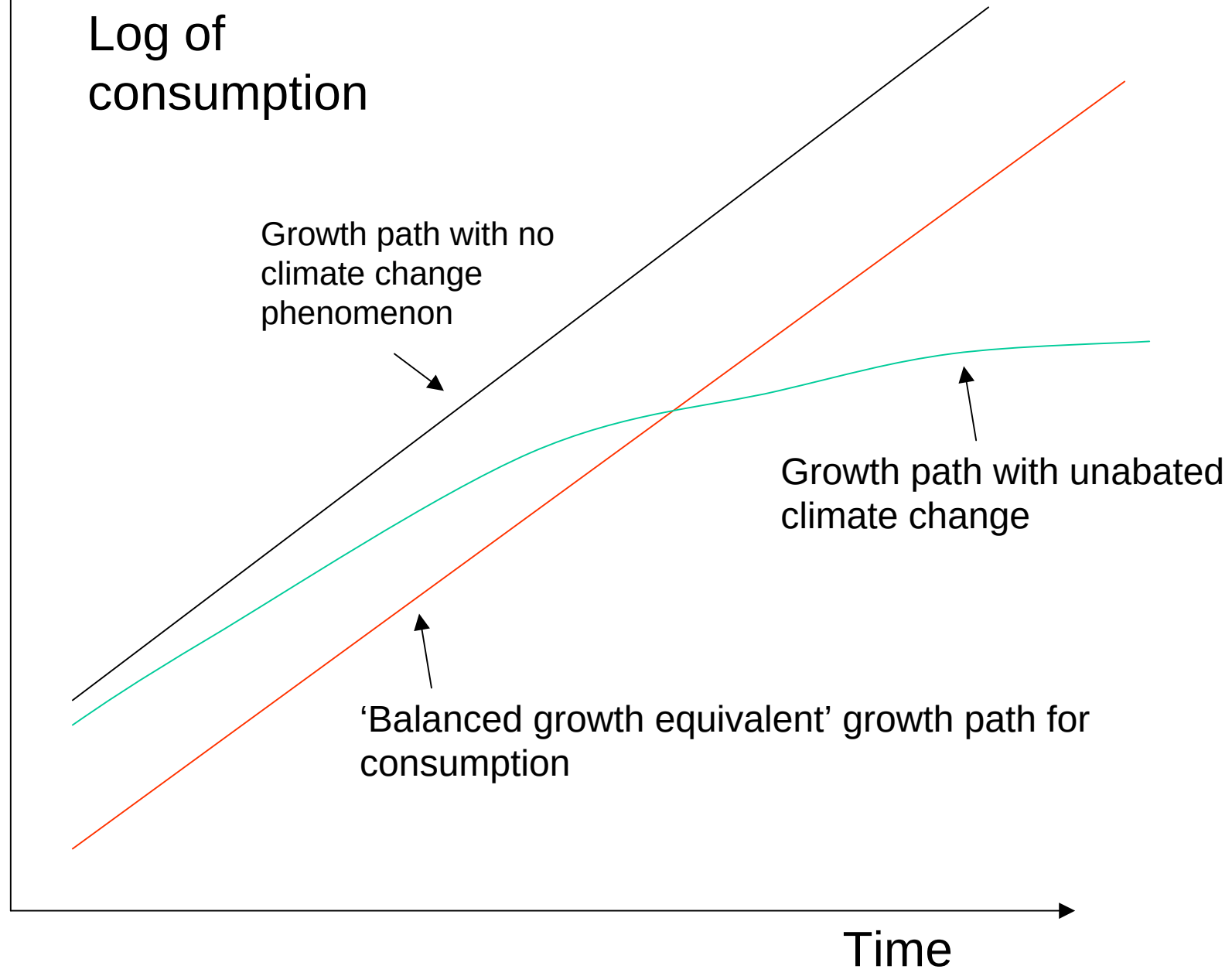


Discounting

Pure time discount rate (%) δ	Probability of human race surviving 10 years	Probability of not surviving 10 years	Probability of human race surviving 100 years	Probability of not surviving 100 years
0.1	0.990	0.010	0.905	0.095
0.5	0.951	0.049	0.607	0.393
1.0	0.905	0.095	0.368	0.632
1.5	0.861	0.139	0.223	0.777

Discount Rate: η x growth rate + δ

‘Balanced growth equivalents’



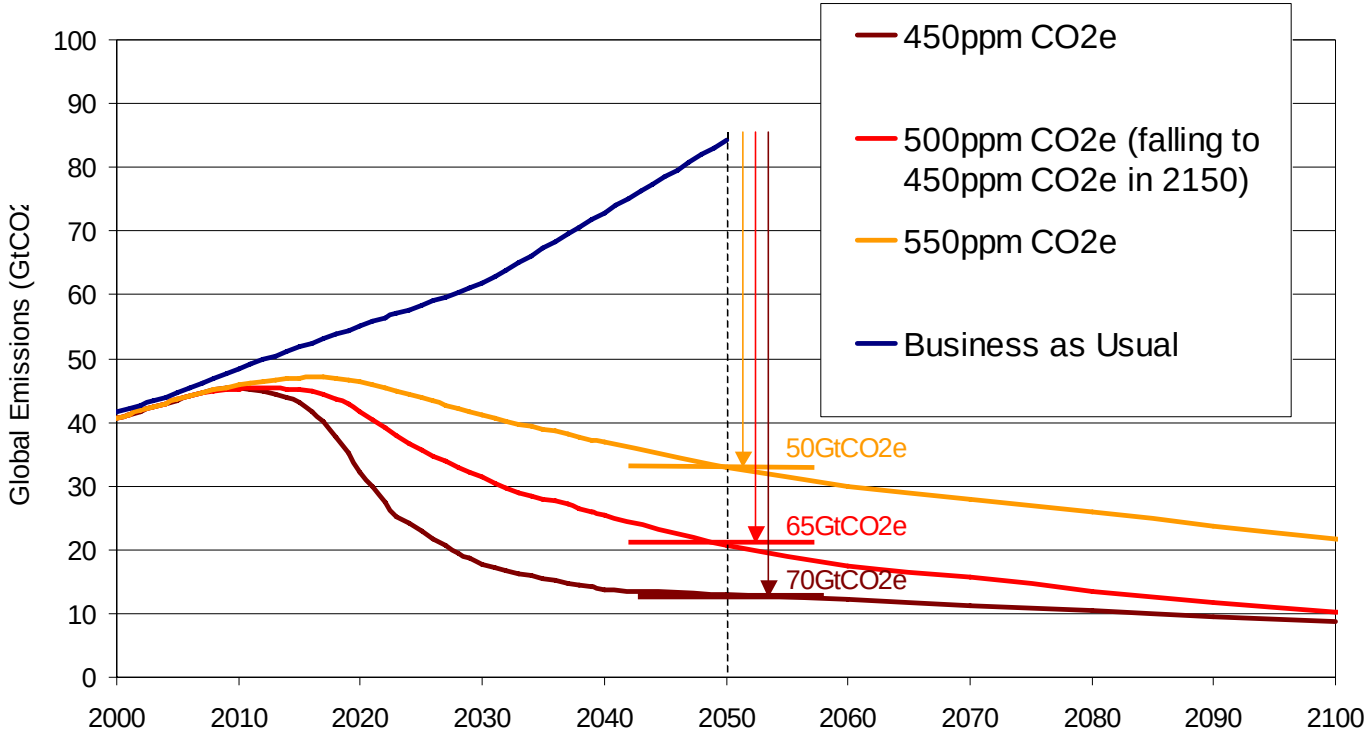
Losses in per capita consumption

Scenario		Balanced growth equivalents: % loss in current consumption due to climate change		
Climate	Economic	Mean	5th percentile	95th percentile
Baseline Climate	Market impacts + risk of catastrophe	5.0	0.6	12.3
	Market impacts + risk of catastrophe + non-market impacts	10.9	2.2	27.4
High Climate	Market impacts + risk of catastrophe	6.9	0.9	16.5
	Market impacts + risk of catastrophe + non-market impacts	14.4	2.7	32.6

Varying the assumptions

- Increasing the **pure rate of time preference** would reduce the BGE loss
- Increasing the coefficient of relative **risk aversion** from 1 to 2 would reduce the BGE loss for some runs, but increase for the worst runs
- Increasing the rate of economic growth would increase both emissions growth and the discount factor
  - net effect depends on the convexity of the damage function compared with that of the utility function
- Allowing climate change to continue unabated **beyond 2200** would increase the BGE loss
- Disaggregated analysis and possibility of very high temperatures under 'business as usual' suggest these models may be underestimating damages

Part 3: Economics of stabilisation



Stabilising below 450ppm CO2e would require emissions to peak by 2010 with 6-10% p.a. decline thereafter.

If emissions peak in 2020, we can stabilise below 550ppm CO2e if we achieve annual declines of 1 – 2.5% afterwards

A 10 year delay almost doubles the annual rate of decline required

Costs of mitigation

Expected cost of cutting emissions consistent with a 550ppm CO2e stabilisation trajectory is 1% of GDP in 2050. This is the result of two approaches to costing:

- Resource cost: 1% of GDP in 2050, in range –1% to +3.5%.
- Macroeconomic models: 1% of GDP in 2050, in range +/- 3%.

But impact on standard of living is slight (OECD economies expected to grow over 200% by 2050 and developing country economies by 400% or more).

Cost estimate differs according to when we start cutting emissions, how we cut emissions, and how much technology costs fall over time.

Growth, change and opportunity

Strong mitigation is fully consistent with the aspirations for growth and development in poor and rich countries. Business as usual is not.

Costs will not be evenly distributed:

- Competitiveness impacts can be reduced by acting together.
- New markets will be created. Investment in low-carbon electricity sources could be over $500bn a year by 2050.

Mitigation policy can also be designed to support other objectives:

- energy - air quality, energy security and energy access
- forestry - watershed protection, biodiversity, rural livelihoods

Part 4: Policy for mitigation:
Establishing a carbon price

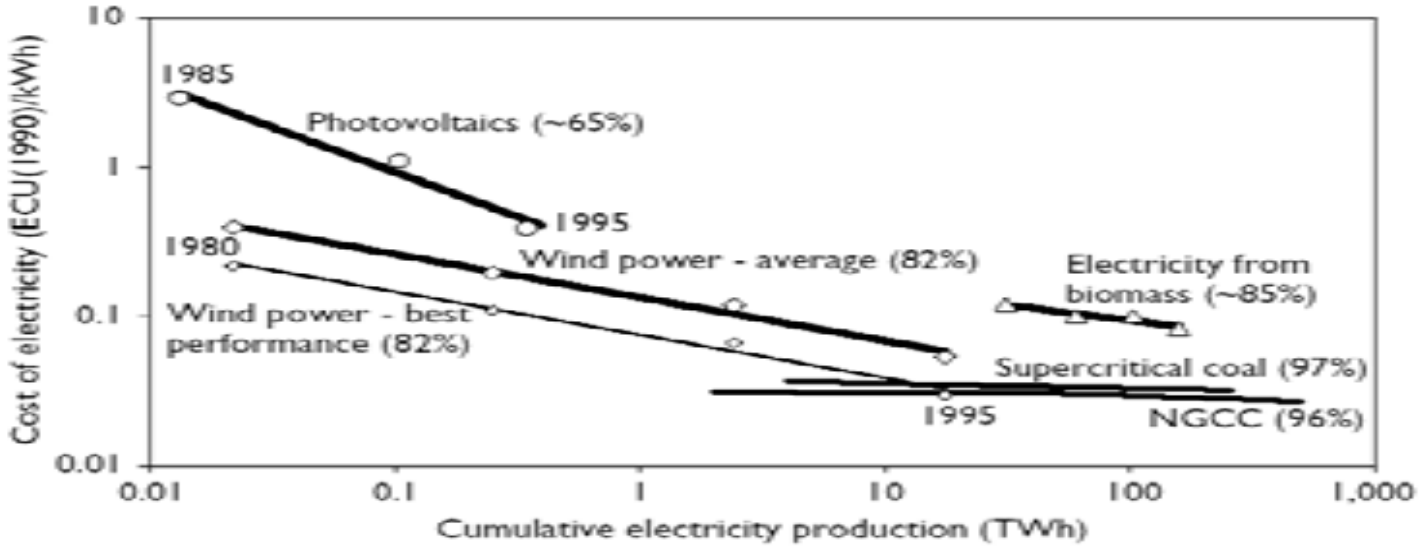
Price signals can be established in different ways: greenhouse gas taxes; capping emissions and setting up a market in permits; or implicitly through regulation.

The economics of risk points to long-term goals for stabilisation of concentrations.

The economics of cost points to short-run flexibility over time, sector and country. Policy makers and markets should be able to respond to new information on impacts and costs.

Credibility, flexibility and predictability are key if policy is to influence investment decisions by companies.

Policy for mitigation:
Technology



Carbon price alone not enough to bring forward the technologies we need

Costs come down with scale and experience, so policies (incentives and regulation) should support markets for these technologies

Technologies at earlier stages of development need more support than more mature technologies.

Policy for mitigation:
Beyond pricing and technology

- **Regulation** has several important economic roles: supporting implicit prices for carbon, accelerating technology, overcoming other barriers.

- **Information** important to help people make sound decisions.

- Promote a **shared understanding of responsible behaviour** across all societies – beyond sticks and carrots

Research & development

- Important role for innovation policy to bring down costs of low emission technologies.
- Government should create incentives for market to develop a portfolio of low emission technologies.
- One way of doing this is through global public funding for technologies:
  - R&D funding should double, to around $20 bn
  - Deployment incentives should increase 2 to 5 times, from current level of $34 bn

Part 5: Adaptation

Adaptation is inevitable: climate change is with us and more is on the way. Adaptation mainly driven by actions in private sector but public policy has crucial role.

Adaptation cannot be a substitute for mitigation. It can only reduce the costs of climate change; for severe impacts there are limits to what adaptation can achieve.

Extra costs of weather-related impacts, associated with climate change, are rising rapidly. Investment is required to reduce damage.

Adaptation in developing countries

- Impacts will be felt earliest and strongest by the most vulnerable, including in developing countries.
- Development itself enhances capacity and flexibility – crucial for adaptation.
- Adaptation will put strong pressure on developing country budgets and ODA.
  - Increase in investment costs across the economy by tens of billions p.a. (World Bank).
  - Better information and appraisal tools can drive effective risk management and planning.
- International action has a key role in supporting
  - Disaster response
  - Crop varieties and technology
  - Forecasting climate and weather

Part 6: Where does this analysis lead?
International action: goals

Unless emissions are curbed, climate change will bring high costs for human development, economies and the environment

- Concentrations of 550ppm CO_2e and above are associated with very high risks of serious economic impacts
- Concentrations of 450ppm CO_2e and below will be extremely difficult to achieve given where we are now and given current and foreseeable technology

Limiting concentrations within this range is possible. The costs are modest relative to the costs of inaction.

Action is urgent: delay means greater risks and higher costs

Where does this analysis lead?
International action: principles

The key foundations for action include:

- A common understanding of the scale of the problem;
- Transparency and mutual understanding of actions and policies;
- Structures that sustain cooperation

Effective action requires:

- Long-term quantity goals to limit risk; short-term flexibility to limit costs
- A broadly comparable global price for carbon
- Equitable distribution of effort
- Cooperation to bring forward technology
- Moving beyond sticks and carrots

Where does this analysis lead?
International action: financing

International finance flows should be scaled up for effective and equitable mitigation :

- Arrangements such as the Clean Development Mechanism must be transformed to support much larger flows.
- The IFIs can play a very strong role in shaping investment frameworks and piloting new approaches
- Increased resources are required for technology cooperation and transfer

The climate is already changing and will change further:

- All countries will face significant costs of adaptation, but developing countries will be hit earliest and hardest
- Development itself must be central to the response
- Crucial to deliver on commitments from Monterrey 2002 and Gleneagles 2005


STERN
review
ON THE ECONOMICS
OF CLIMATE CHANGE