The Economics of Steering the Transition to a Low Carbon Economy

Monday 20th October: Understanding Climate Risk		
10.30 – 11.30	**Session 1:**	**A framework for the economics of low-carbon change**
11.30 – 12.00	*Break*	
12.00 – 13.00	**Session 2:**	**Exploring the Apparent Trade-Offs Between Reducing Climate Risk and Fostering Growth**
13.00 – 15.00	*Lunch*	
15.00 – 16.00	**Session 3:**	**The Dynamic Net Economic Costs of Transition**
16.30 – 17.00	**Session 4:**	**Wrap-up and Open Discussion**

A framework for the economics of low-carbon change

Dimitri Zenghelis

Monday 20th October

Session One

A framework for the economics of low-carbon change

Part I: Understanding climate risk

Part II: Working with Uncertainty

Part III: Endogenous growth

Part I: Understanding climate risk

- The next 15 years of investment will also determine the future of the world's climate system
- Climate change caused by past greenhouse gas emissions is already having serious economic consequences, especially in more exposed areas of the world
- Without stronger action in the next 10-15 years, **which leads global emissions to peak and then fall**, it is near certain that global average warming will exceed 2°C, the level the international community has agreed not to cross
- On current trends, warming could exceed 4°C by the end of the century, with extreme and potentially irreversible impacts

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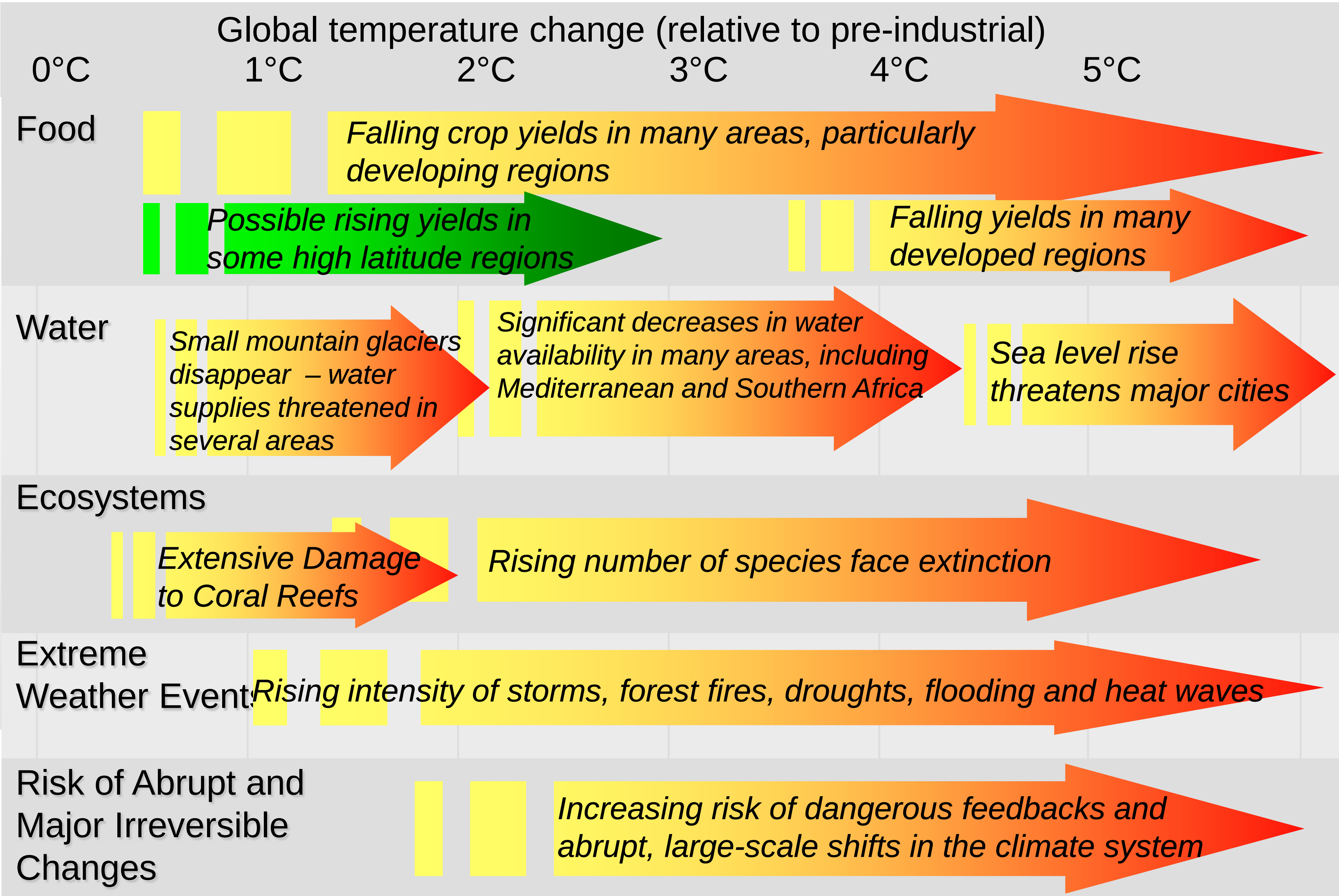
Part I: Understanding climate risk

- **Stocks not flows** of greenhouse gases affect climate
- The Intergovernmental Panel on Climate Change (IPCC)'s review of recent emission projections suggests that if current trends continue, global emissions in 2030 will be around 68 Gt CO_2e, compared with around 50 Gt CO_2e today
- To have a likely (more than two-thirds) chance of holding the average global temperature rise to 2°C, the IPCC suggests that by 2030, global emissions should be no more than 42 Gt CO_2e per year
- Would need to fall thereafter to near 25 Gt CO_2e by 2050 and below 10 CO_2e by end-century (stabilise)

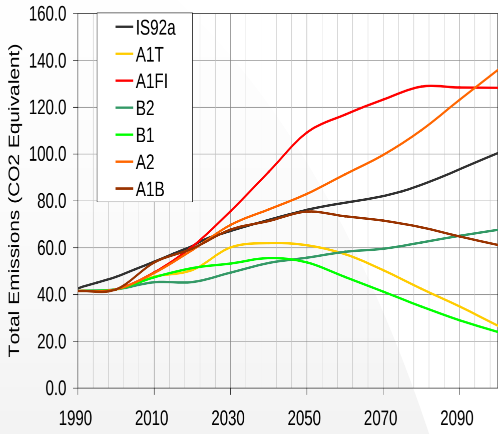
Need to understand uncertainty – how would a business react?

Estimates based on analysis of the IPCC's review of emission scenarios, as shown in Figure SPM.4 and Table SPM.1 in IPCC, 2014. Summary for Policymakers (IPCC *AR5*, Working Group III).

Part I: Understanding climate risk



Part II: Cascade of Uncertainty



Population, technology, production, consumption

Emissions

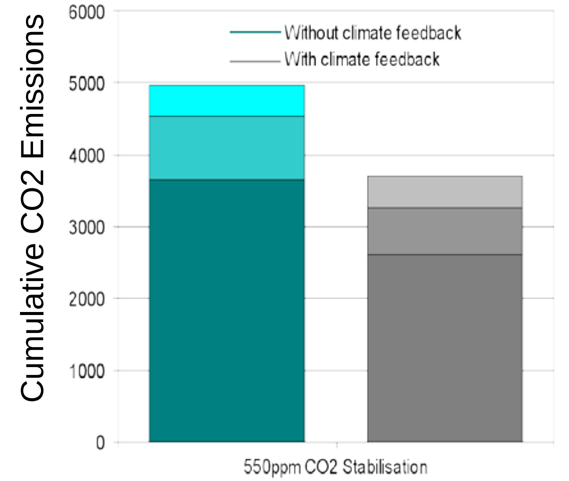
Atmospheric concentrations

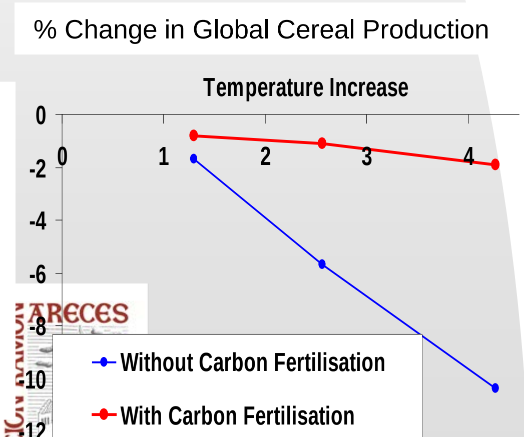
Radiative forcing

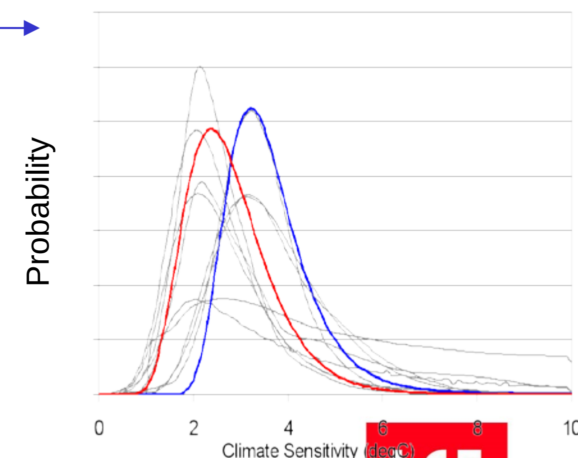
Temperature rise and global climate change

Direct impacts (e.g. crops, forests, ecosystems)

Socio-economic impacts







	Market	'Non - Market'	Socially contingent
Projection	Limit of coverage of some studies, including Mendelsohn	Some studies, e.g. Tol	None
Bounded risks			None
System change/ surprise	Limited to Nordhaus and Boyer/Hope	Stern	None

Models only have partial coverage of impacts

Values in the literature are a sub-total of impacts

Source: Watkiss, Downing *et al*. (2005)

Part III: Endogenous growth (i)

- Thomas Malthus posited that finite resources would constrain humans' ability to supply rising demand
- But every mouth is born with a brain and knowledge and innovation weightless; helped us do more with resources we have
- Recent **endogenous-growth theory** has focused on the factors that drive technology in an attempt to understand its role in economic growth
- Knowledge has the potential to positively impact capital productivity
- The concept of **"knowledge capital"** ~ similar to physical capital, but is dependent on a number of factors such as cumulative R&D expenditures and physical and human capital investment
- Even in a materially stationary state, indefinite growth in well-being is possible because of progress in the intellectual economy
- Not new: Adam Smith argued that the division of labour is limited by the extent of the market (Smith, 1776), and economic growth enlarges markets and permits greater specialisation and variety; increasing returns to scale stimulate economic growth (Young, 1928)

Part III: Endogenous growth (ii)

- New equipment enables new ideas and innovation in technologies.
- E.g. investing in computers induces bright ideas on how to use them.
- Investment in physical and knowledge capital drives **increasing returns to scale in production**, where more knowledge begets increased output and liberates resources for further investment (Romer 1990/1994 Solow 1999*)
- A virtuous growth spiral in which future output becomes **"path-dependent.**" It's what Malthus (and many others) missed
- This lecture examines the impact of endogenous growth on assessing the transition to a low carbon economy

*Romer P.M. (1990), "Endogenous Technical Change,"Journal of Political Economy, 98:S71-S102. Romer P.M. (1994), "The Origins of Endogenous Growth," Journal of Economic Perspectives, 8:3-22. Solow, R.M. (1999), "Neoclassical Growth Theory," Taylor J.B. and Woodard M., eds., "Handbook of Macroeconomics," vol. 1A (North-Holland, Amsterdam).

Part III: Endogenous Growth and Climate

Dietz and Stern (2014) use Nordhaus‘ static 'DICE' models.
Take more strongly into account three essential elements of the climate problem

- the endogeneity of growth, relaxed underlying drivers of economic growth are exogenous and unaffected by climate change
- the convexity of damages,
- and climate risk

To facilitate comparison with Nordhaus' work, all of the analysis is conducted with a high pure-time discount rate

Main innovation: ***the damages from climate change affect the drivers of long-run growth****, not just current output.* Cant just add/subtracts levels impacts off a pre-determined trend*.

They find business-as-usual trajectories of greenhouse gas emissions give rise to potentially large impacts on growth and prosperity in the future, especially after 2100.

*See also Daniel et al, ‘Applying Asset Pricing Theory to Calibrate the Price of Climate Risk: A Declining Optimal Price for Carbon Emissions’ American Economic Association Meetings, January 2015.

Key reading

Ackerman, F. and Daniel, J., 2014. *(Mis)understanding Climate Policy: The role of economic modelling*. Synapse Energy Economics, Cambridge MA. Prepared for Friends of the Earth and WWF-UK. Available at: https://www.foe.co.uk/sites/default/files/downloads/synapse-misunderstanding-climate-policy-low-res-46332.pdf.

Aghion, P.; Howitt, P.; (2009) *The economics of growth*. Massachusetts Institute of Technology (MIT) Press: Cambridge, US. http://discovery.ucl.ac.uk/17829/

Aghion, P., Hepburn, C., Teytelboym, A.~~,~~ and Zenghelis, D., (2014). *Path-dependency, innovation and the economics of climate change*.

Simon Dietz & Nicholas Stern, (2014). *Endogenous growth, convexity of damages and climate risk: how Nordhaus' framework supports deep cuts in carbon emissions*, GRI Working Papers 180, Grantham Research Institute on Climate Change and the Environment. http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/06/Working-Paper-159-Dietz-and-Stern-2014.pdf

Global Commission on the Economy and Climate, 2014. *Better Growth, Better Climate: The New Climate Economy Report,* Chapter 5, Available at http://newclimateeconomy.report

Mazzucato, M. (2011), *The Entrepreneurial State*, London: Demos.

Stern, N (2007): *The economics of climate change*, Cambridge University Press, Cambridge