Degrees of Risk

Defining a Risk Management Framework for Climate Security

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Background to the Report

- Builds on E3G's climate security work since 2005
- Seminars with climate and security experts in 2009-10
- Joint analysis and drafting process with climate and security experts; Jay Gulledge and Bernard Finel
- Testing ideas: UK National Security Council; Halifax Security Conference; Global Military Advisory Group etc.

The report aimed to open a debate on how to frame national climate change politics and policy

Key Messages

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- Managing climate risk effectively requires incorporation of the full range of uncertainties into decision making at all levels.
- Neither international and national climate change decision making currently manages risk well. It does not incorporating best practice from areas such as security, health or infrastructure planning
- Many under-managed risks come from interdependencies (e.g. food trade) and impacts of climate regime failure on global cooperation
- The 2C goal inside the UNFCCC is a meaningful risk threshold but insufficient to drive international risk management.
- The international climate regime must reform but also needs to be built on much stronger national risk management frameworks and public debates. National mitigation plans must be consistent with 2C under multiple scenarios of climate sensitivity and policy failure.

Why Risk Management?

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- E3G's work on climate security showed the importance of considering the full range of climate scenarios for effective security planning
- Most analysis uses median IPCC scenarios which do not reflect latest science on extreme impacts or analysis on instability
- Public debates unhelpfully equate uncertainty with inaction
- In contrast major security decisions made on far more uncertain data than climate policy; "what threat will China pose in 2050?"

Question: what would climate strategy look like if we treated it as seriously as nuclear proliferation?

Risk Management is…

- Broader than optimisation, cost-benefit, real options….
- A pragmatic approach to making policy decisions under uncertainty
- Built on a long history of success – and failure – in security (and finance, resource management, infrastructure management etc)
- About "who" as well as "what" and "how much"
- A way of framing political debates but not replacing them
- Something we do all the time: deterrence vs disarmament; civil liberties vs terrorism risks; intervention vs isolationism.

How much risk should we take?

Methodology Underpinning the Report

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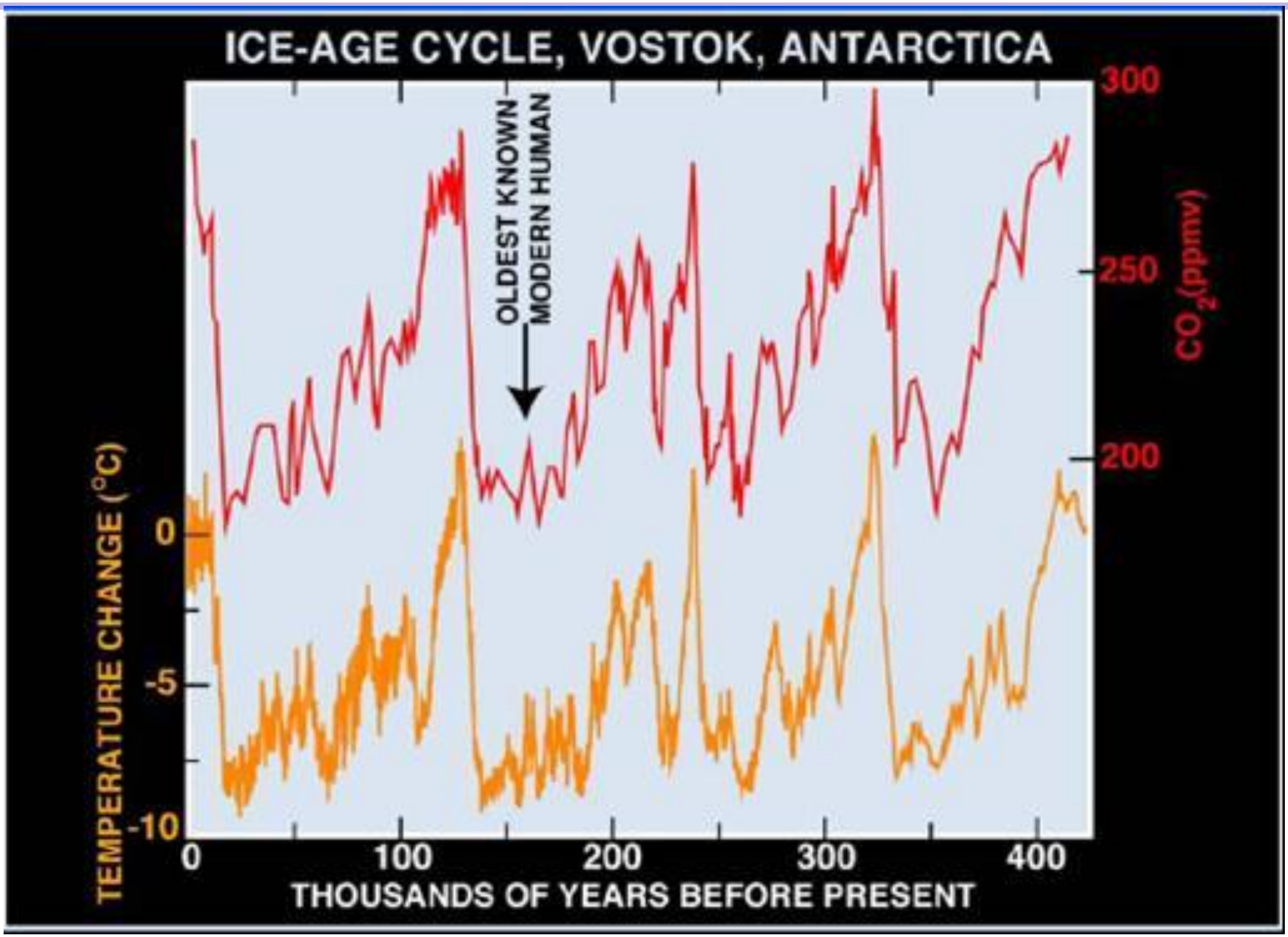
- **Information Gathering**: systematic analysis of major impacts and uncertainties across climate science, impacts and mitigation/adaptation options.
- **Assessment**: of the policy implications of current information, including limits to what we know, what we could know and biases in how we understand issues and threats.
- **Risk Management Analysis**: evaluation of current risk management approaches to assess gaps or flaws in risk management frameworks; risk management instruments; and delivery of risk management

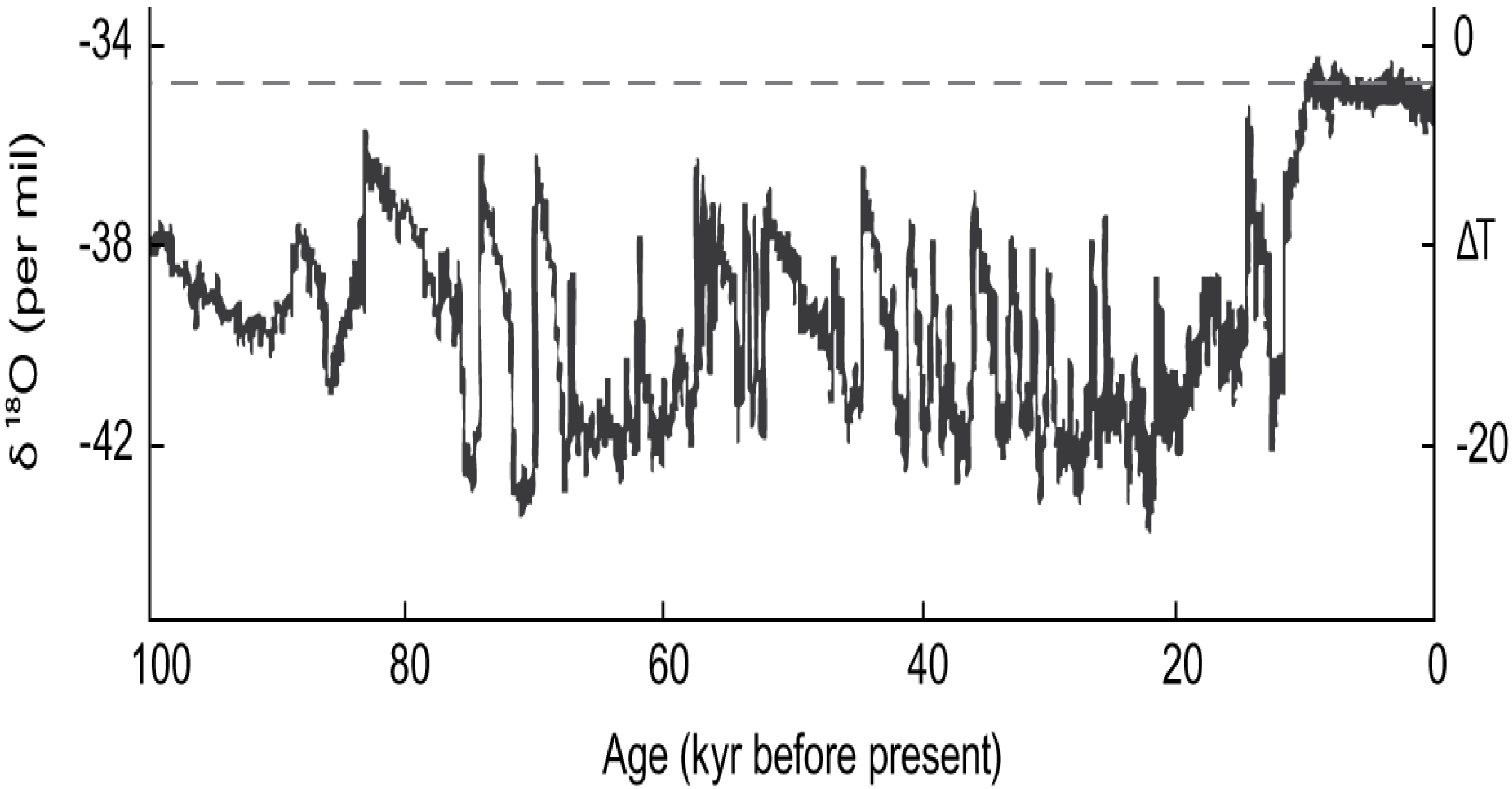
We are not managing any of the risks well!

The Climate System is Historically Volatile

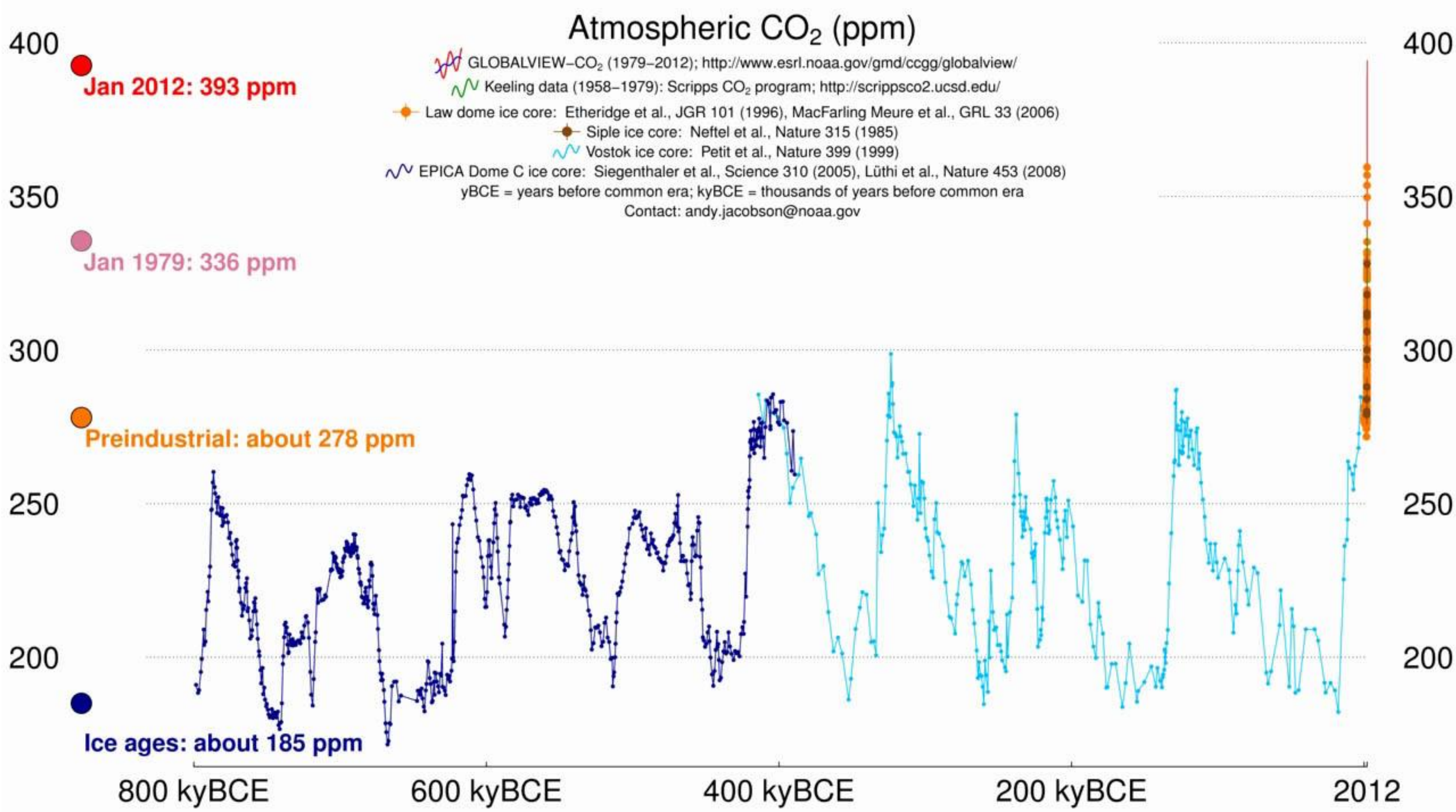


Source: Hansen (2005)

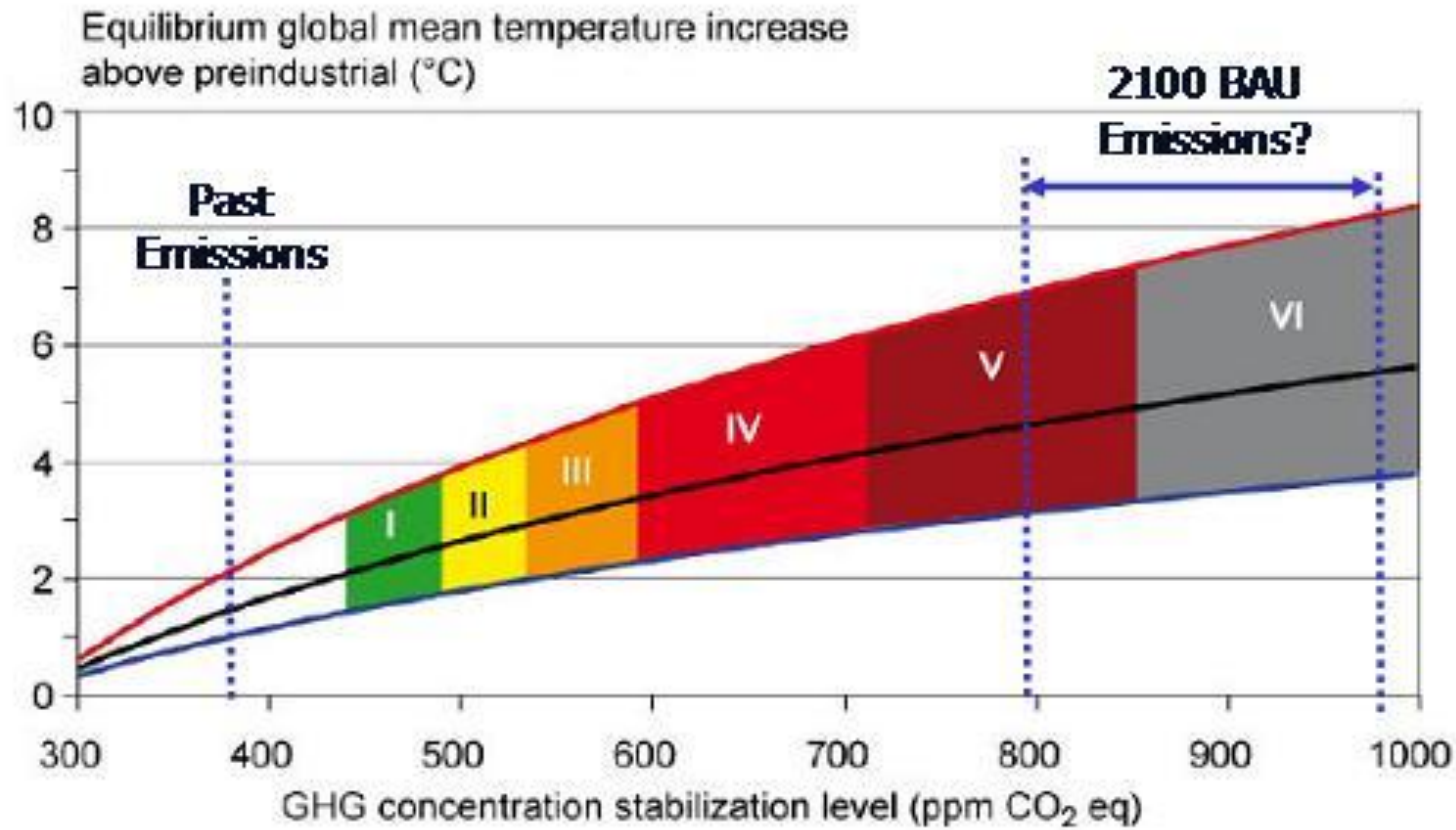
Human civilisation has evolved in an unusually stable climatic period



Rising CO2 emissions are pushing us into unprecedented risk areas

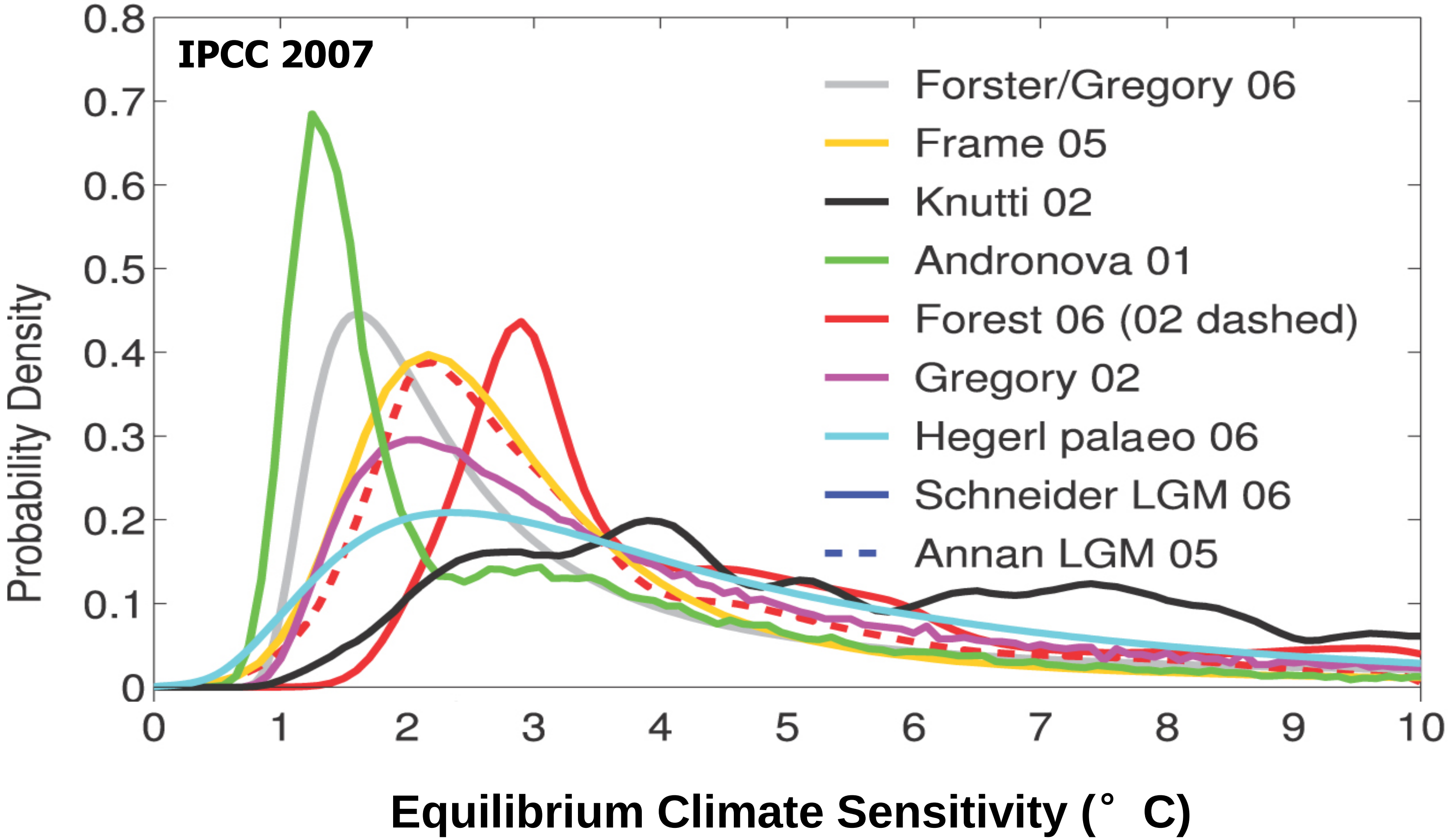


Scientific Uncertainty is Endemic



Source: IPCC, 2007

Modelling actually has greater uncertainty on high impacts than usually presented



High risks increase faster than mean risks

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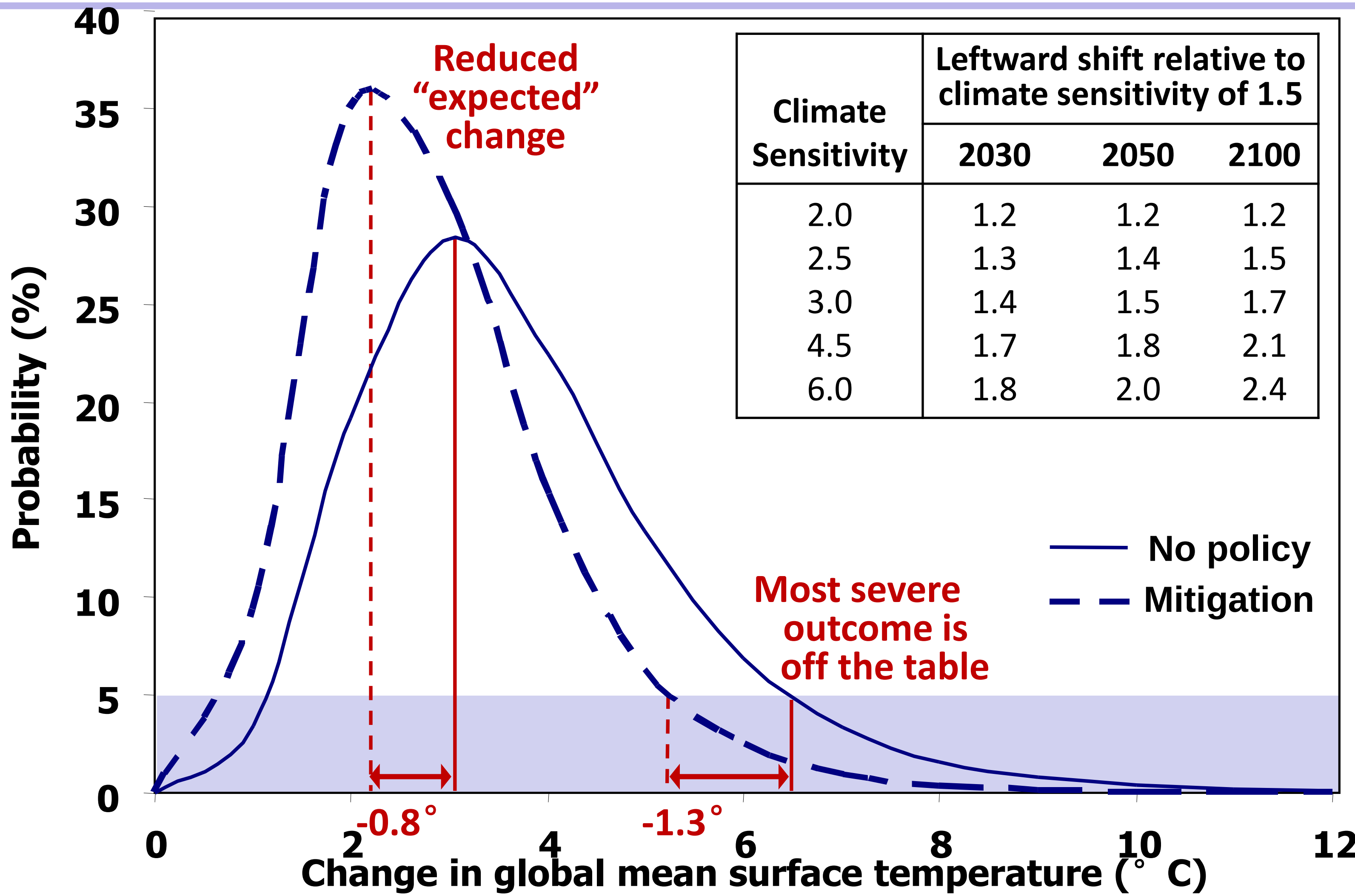
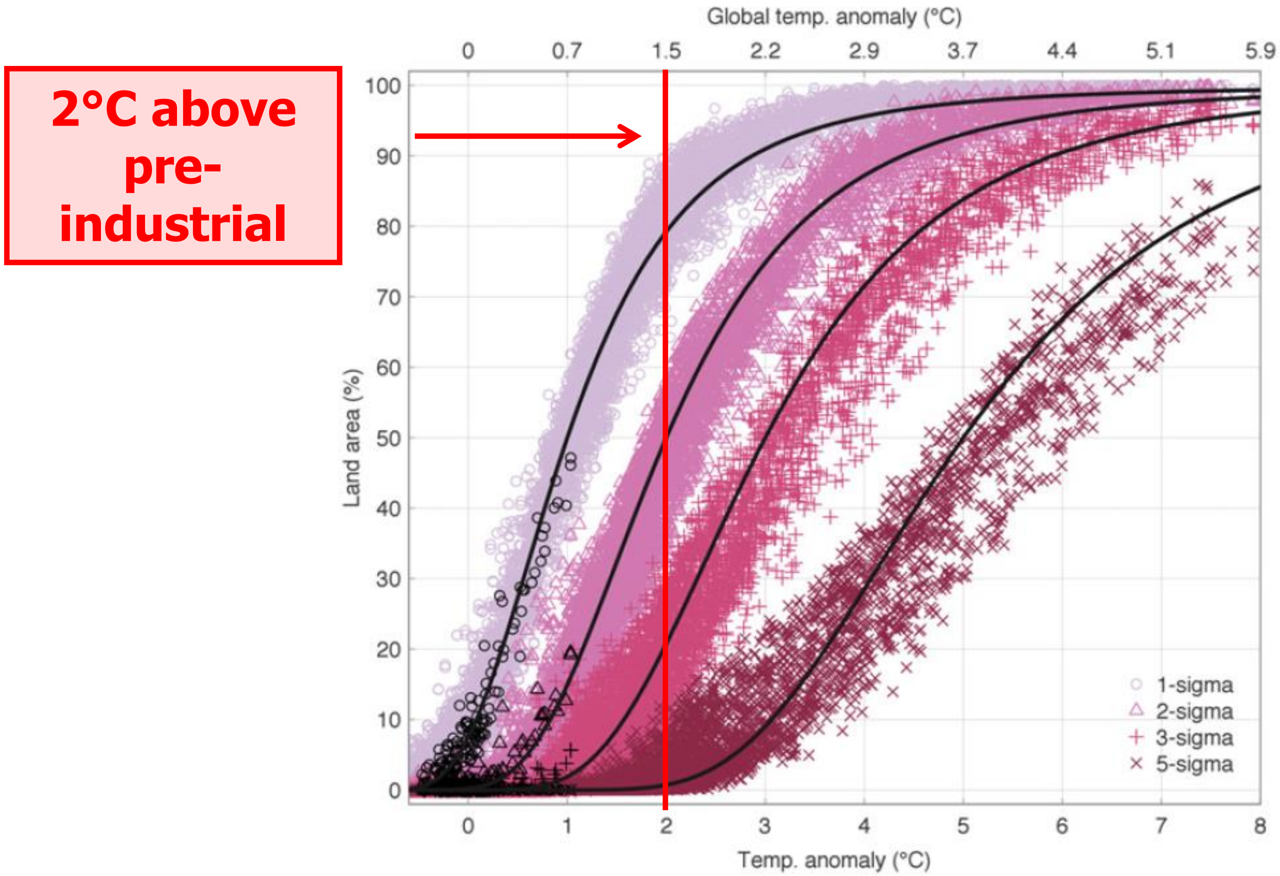


Climate Sensitivity	Leftward shift relative to climate sensitivity of 1.5		
	2030	2050	2100
2.0	1.2	1.2	1.2
2.5	1.3	1.4	1.5
3.0	1.4	1.5	1.7
4.5	1.7	1.8	2.1
6.0	1.8	2.0	2.4

Source: Gulledge, 2010

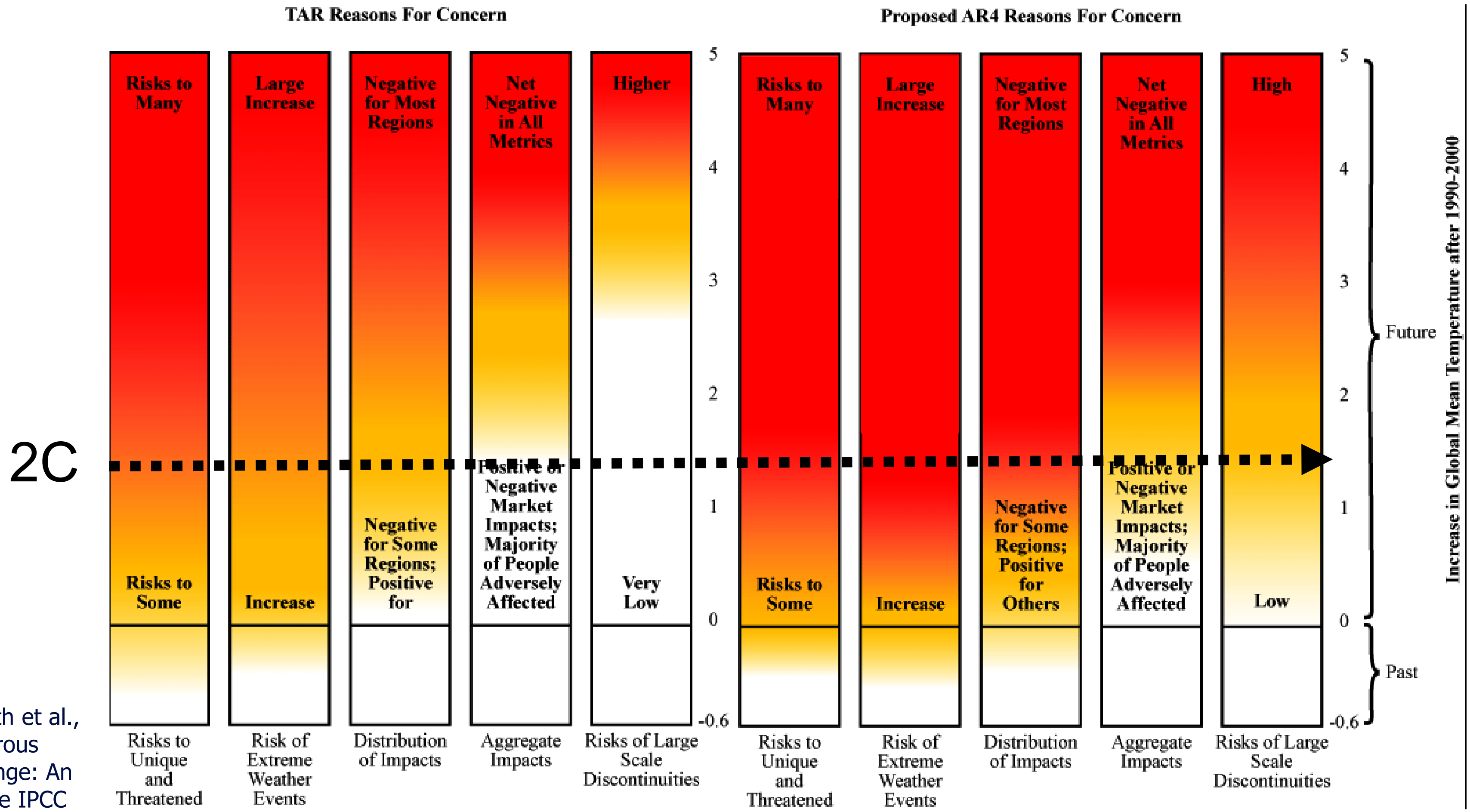
Climate Extremes Rise Non-Linearly

Percentage of Global Land Area impacted by Heatwaves



Source: PIK, 2013

Estimates of impacts at 2C have worsened over time



Source: Smith et al., 2007 Dangerous Climate Change: An Update of the IPCC Reasons for Concern

Global Tipping Points are not included in most assessments

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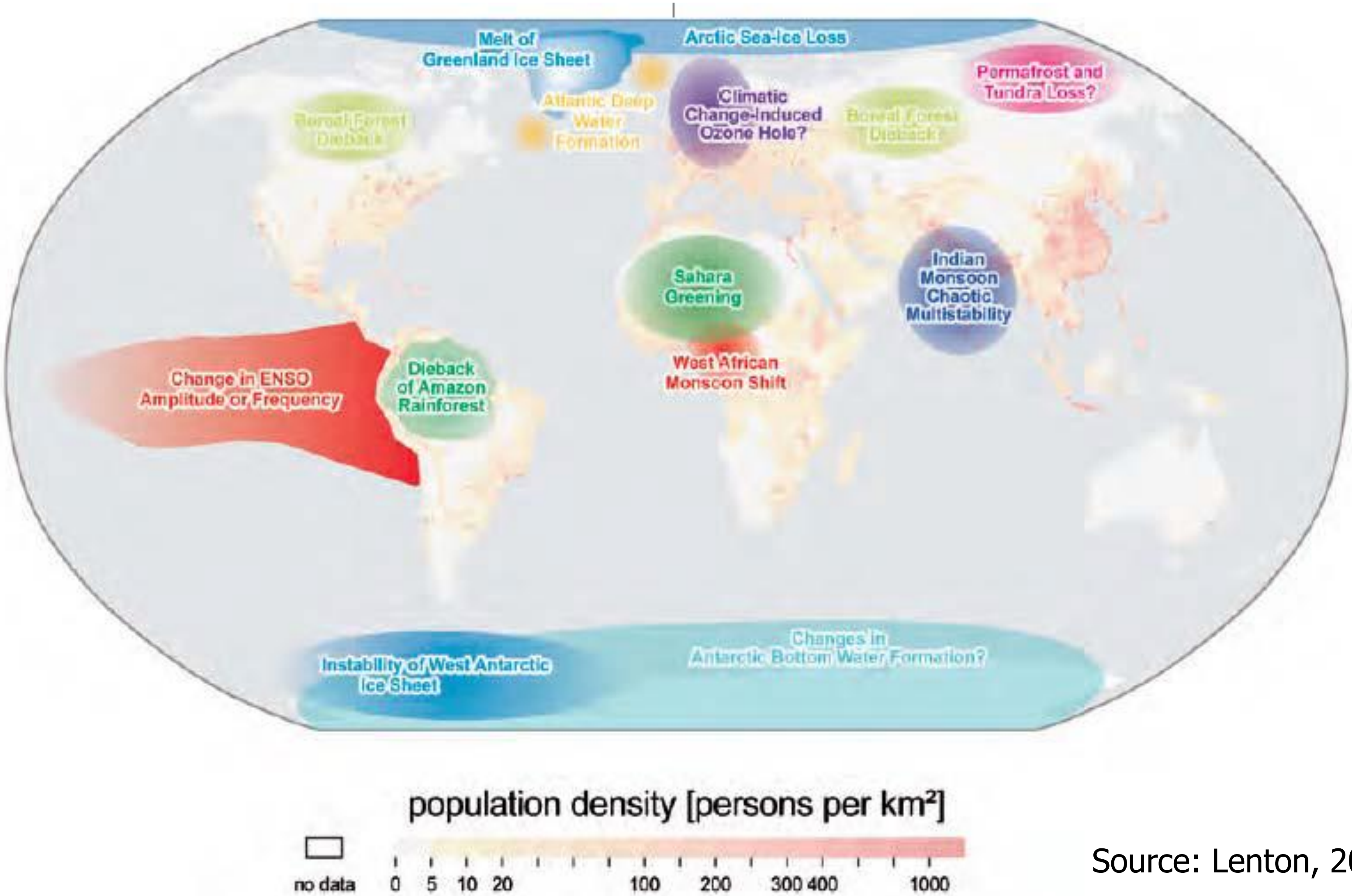
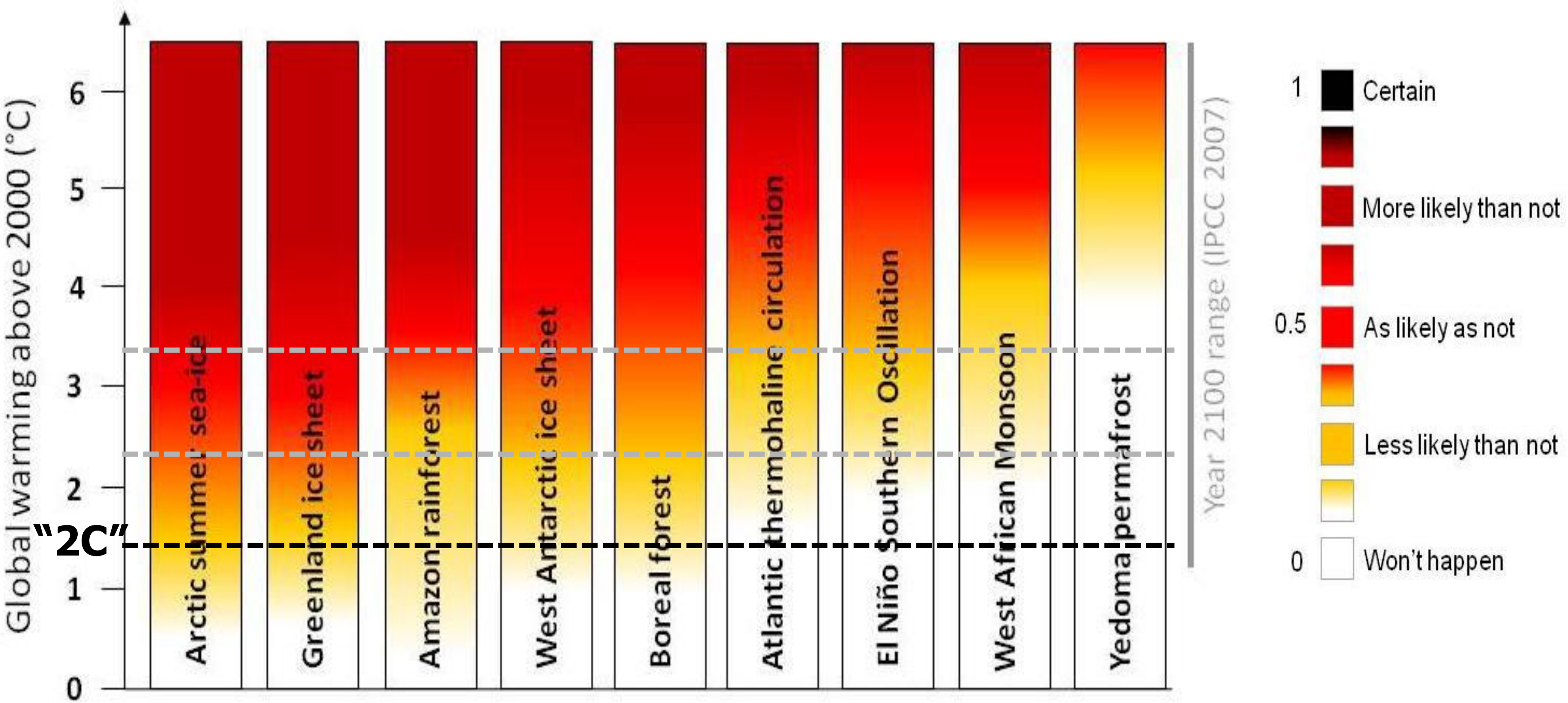


Source: Lenton, 2010

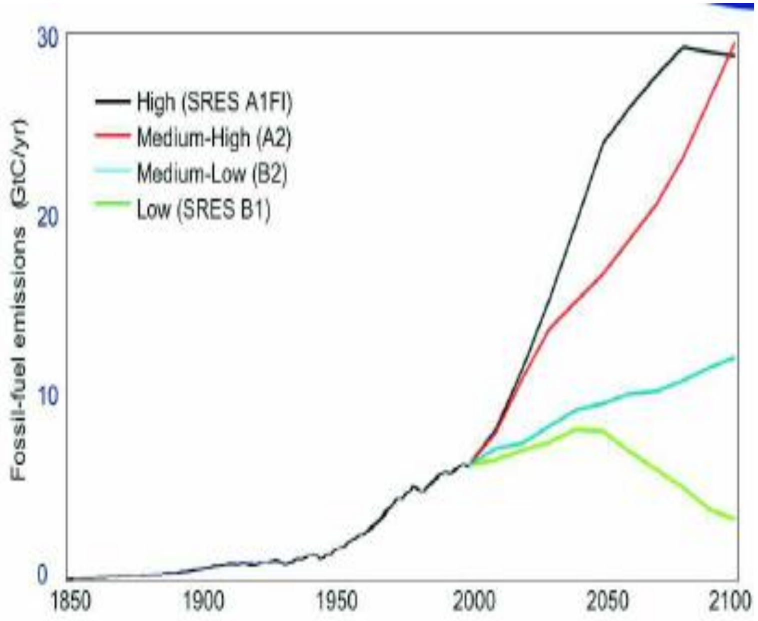
Tipping Point Probabilities?



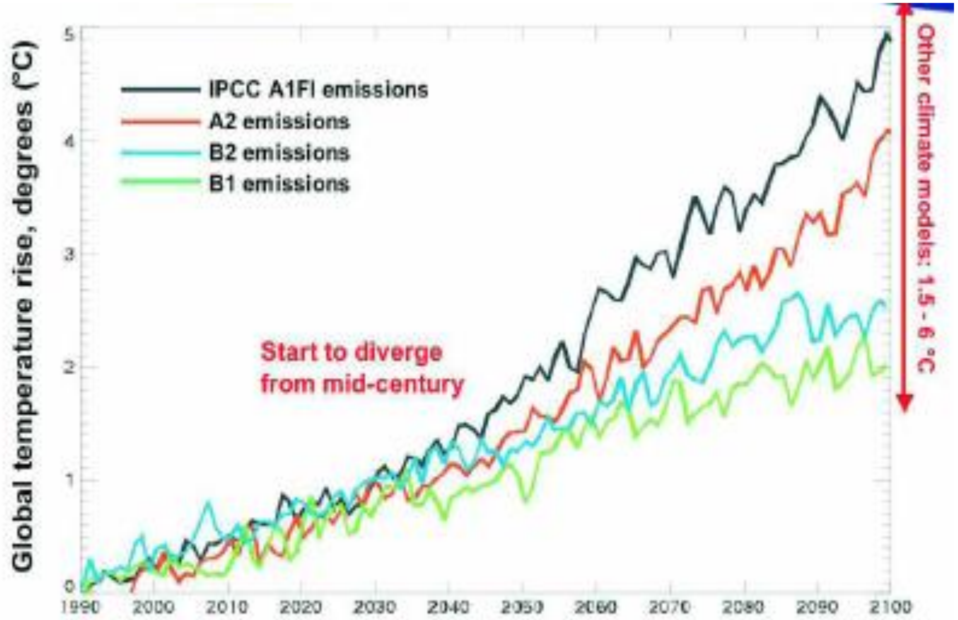
Source: Lenton, 2010

Large scale adaptation is needed for at least 40 years – even with the most aggressive mitigation measures

Emission Scenarios Diverge Radically …



But impacts only begin to slow after 2030-40



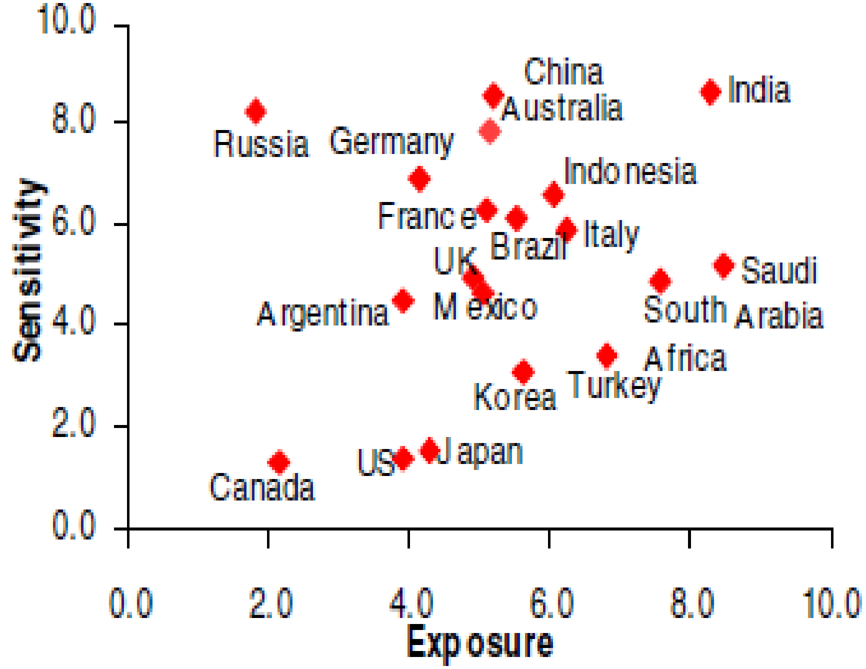
The low emissions scenario is consistent with a 450ppm (CO2 eq) atmospheric concentration

This effort would give a 50% chance of limiting temperature rise to 2C, and requires global emissions to peak by 2020

Source: Hadley Centre (2006)

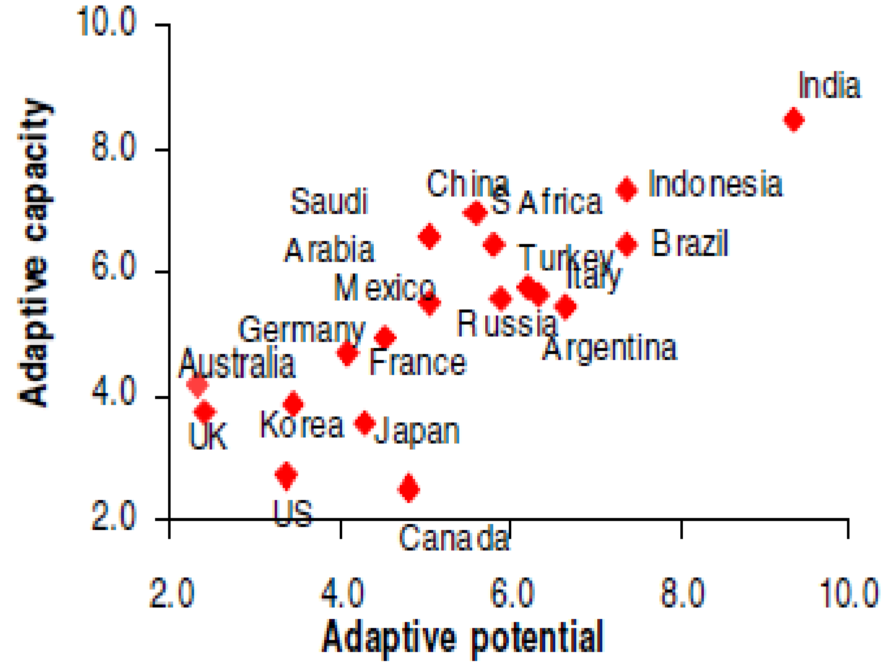
Many Estimates of Relative Climate Impacts have Been Developed

Chart 2: Exposure and sensitivity (top right most vulnerable, bottom left least vulnerable)



Source: HSBC, World Bank, Thomson Reuters Datastream

Chart 3: Adaptive potential and capacity (top right countries most vulnerable, bottom left least vulnerable)



Source: HSBC, World Bank, Thomson Reuters Datastream

Large differences exist between current vulnerability methodologies;

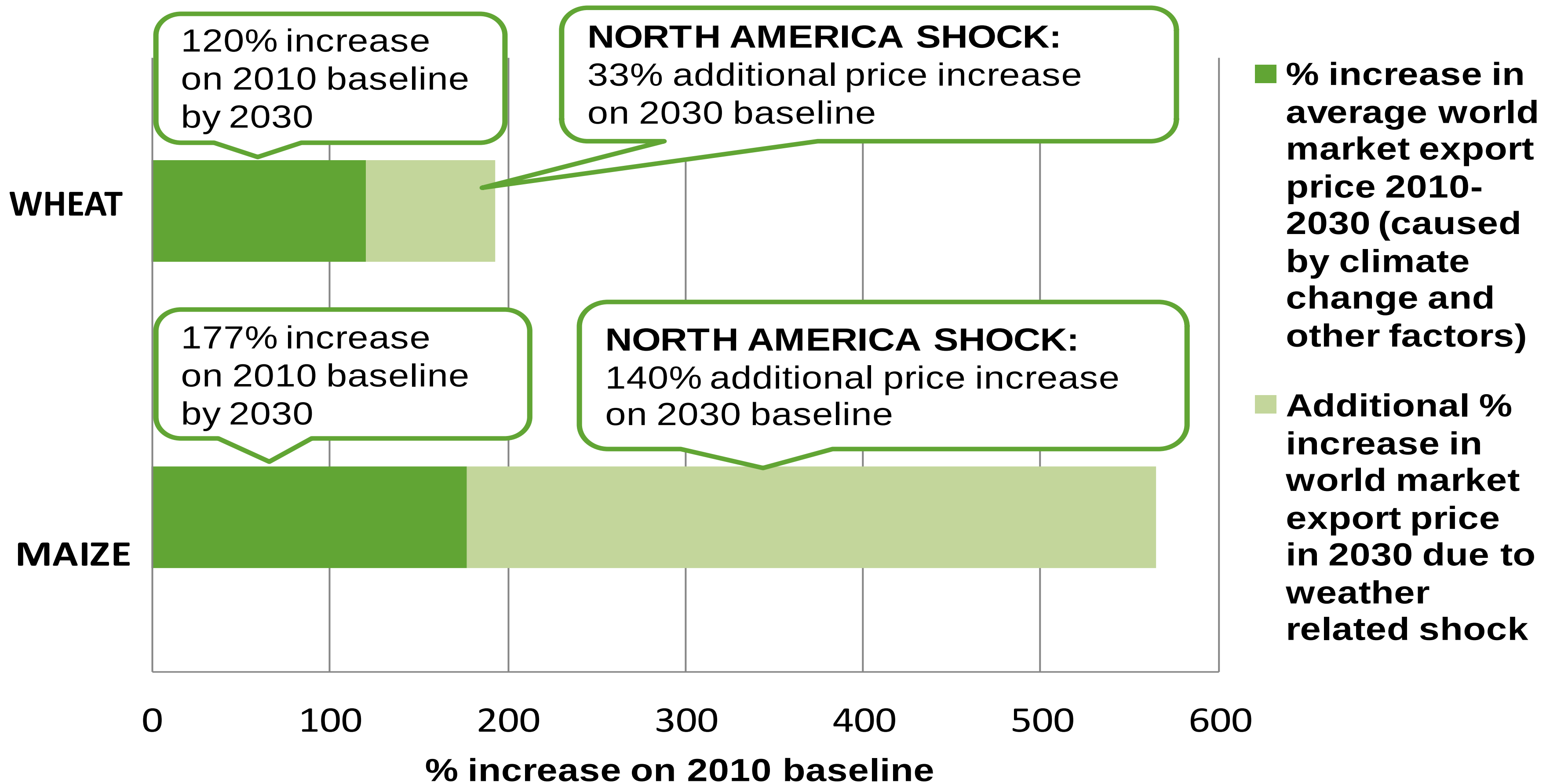
- Equilibrium sea level rise and changes in water supply dominate results
- Capacity to adapt usual assessed in terms of GDP not social systems
- Large differences in rankings of even G20 countries
- US suffered 1.4% GDP losses from extreme climate events in 2012. Four times that of the EU.
- **Rankings do not address dynamic vulnerabilities like food or energy price shocks**

Vulnerability

Country	HSBC Rank	GAIN Order	GAIN Rank
India	1	1	129
Indonesia	2	7	74
Brazil	3	6	75
South Africa	4	2	118
China	5	8	70
Saudi Arabia	6	3	95
US	7	16	16
France	8	19	2
Australia	9	13	24
Japan	10	12	48
South Korea	11	4	86
Italy	12	15	17
Mexico	13	9	69
Canada	14	11	53
Germany	15	18	5
UK	16	17	10
Argentina	17	14	20
Russia	18	5	81
Turkey	19	10	65

HSBC Rank 1 is most vulnerable for 19 of the G20 countries
Gain Rank 1 is least vulnerable out of 182 countries
Gain Order is most to least for G20 on the GAIN Rank

Food Price Volatility Estimates 2030



Source: Oxfam 2012

Emissions on 4.0-6C trajectory; probability of delivering 2C mitigation pathway falling

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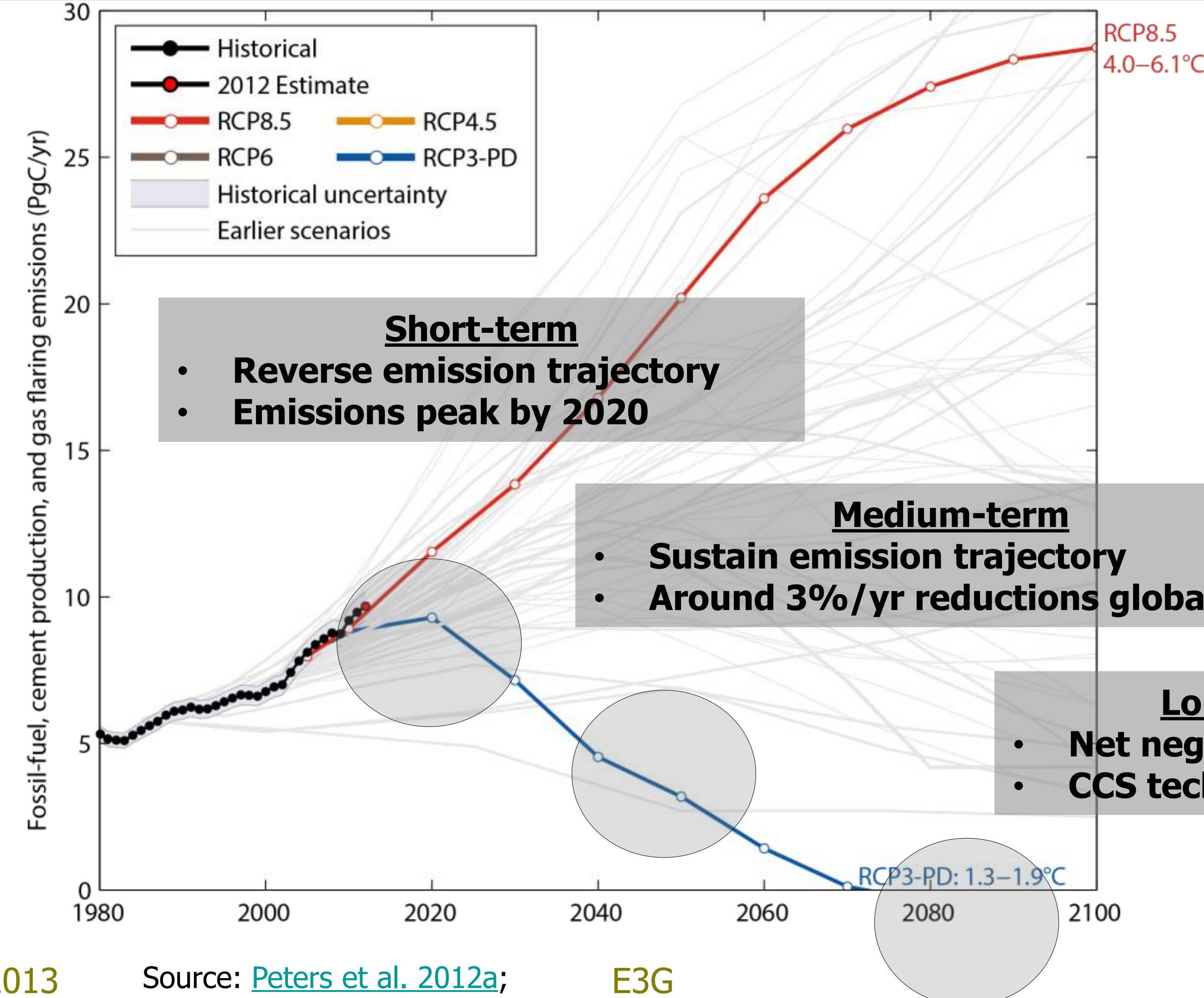


Short-term

- **Reverse emission trajectory**
- **Emissions peak by 2020**

Medium-term

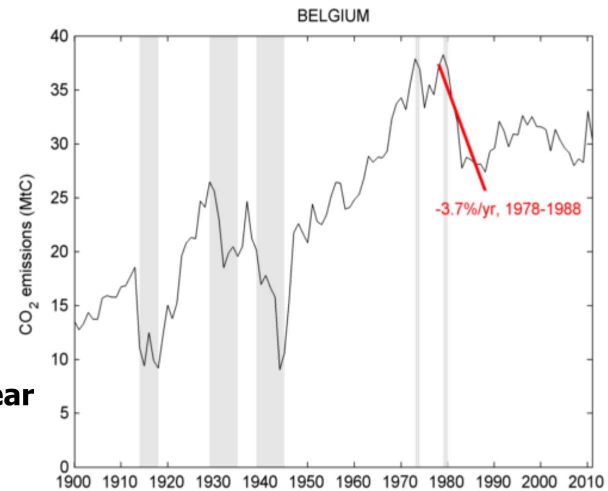
- **Sustain emission trajectory**
- **Around 3%/yr reductions globally**

Long-term

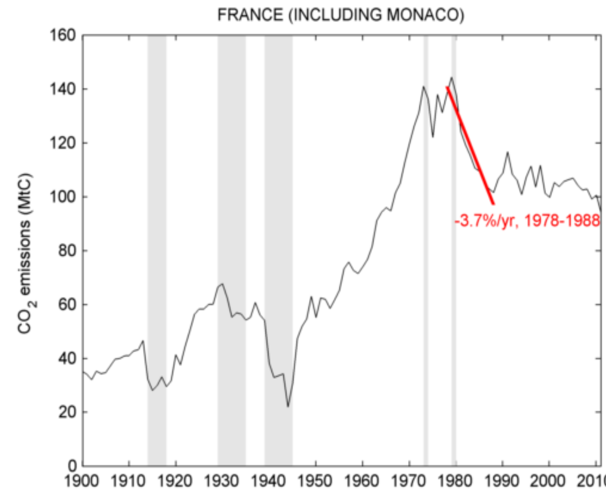
- **Net negative emissions**
- **CCS technologies**

Source: Peters et al. 2012a; Global Carbon Project 2012

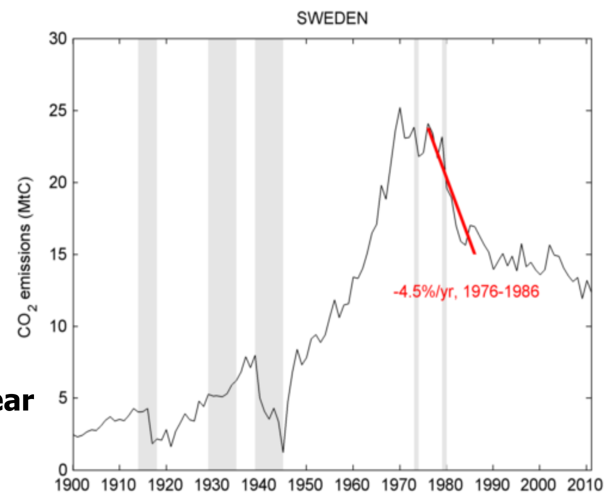
History shows that this is possible



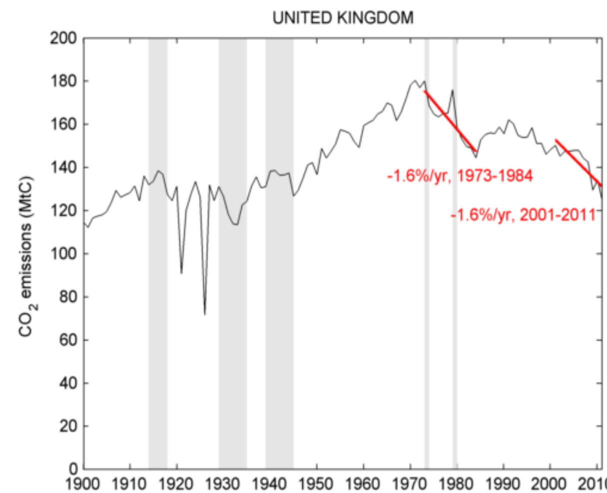
Belgium
Increased Nuclear
Reduced Oil



France
Increased Nuclear
Reduced Oil & Coal

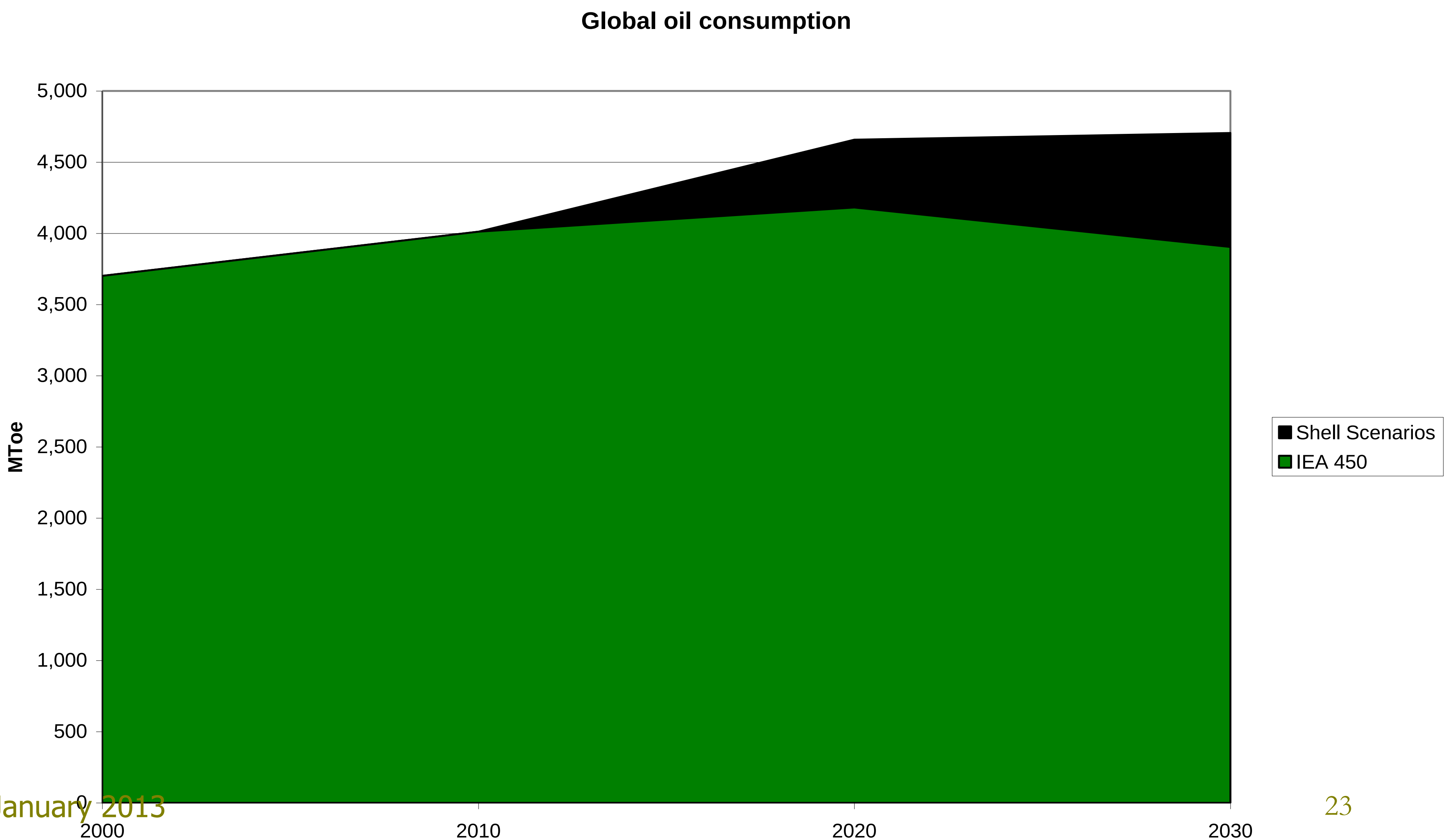


Sweden
Increased Nuclear
Reduced Oil

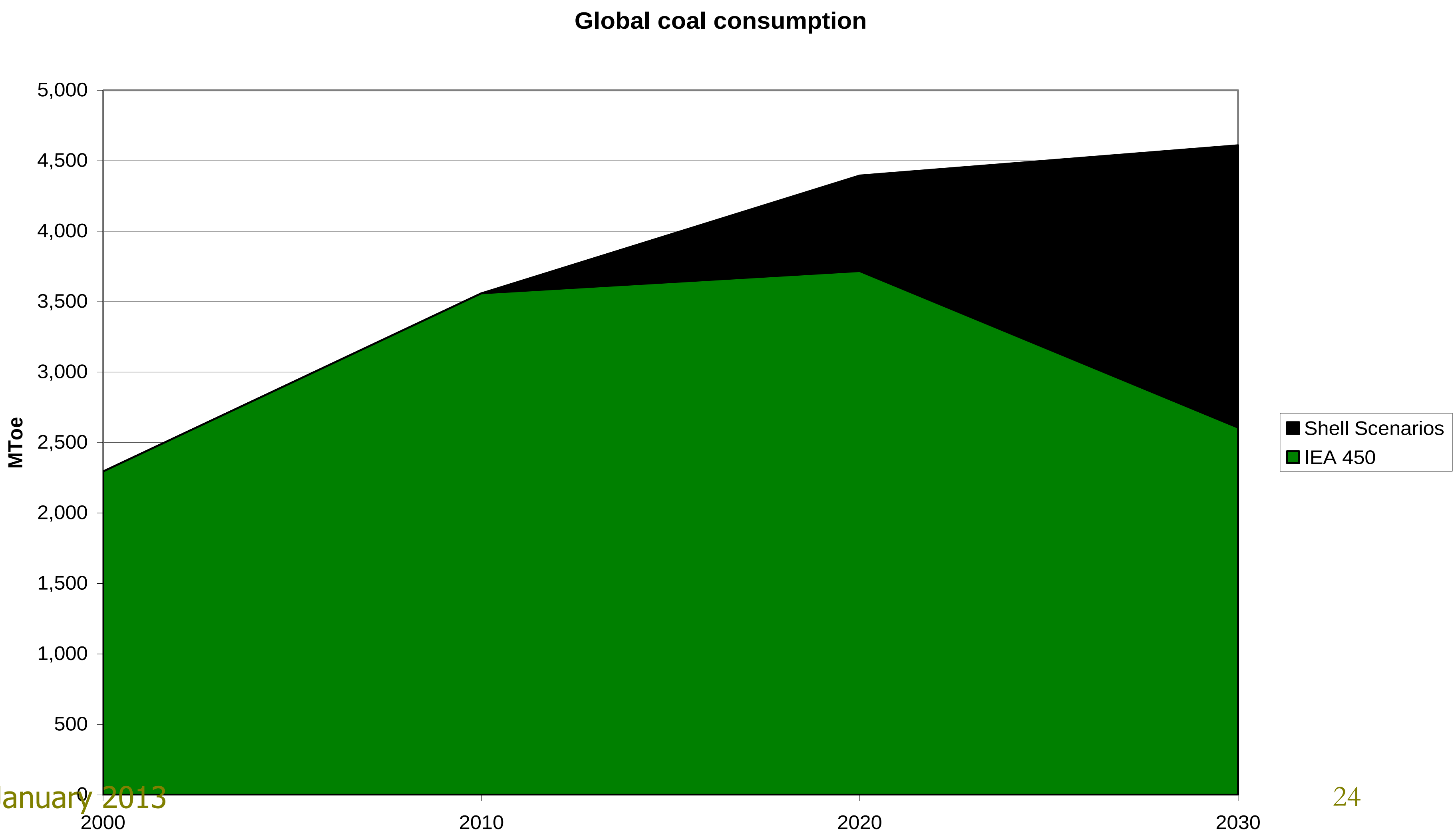


United Kingdom
Coal to gas
Reduced Oil
Increased Nuclear

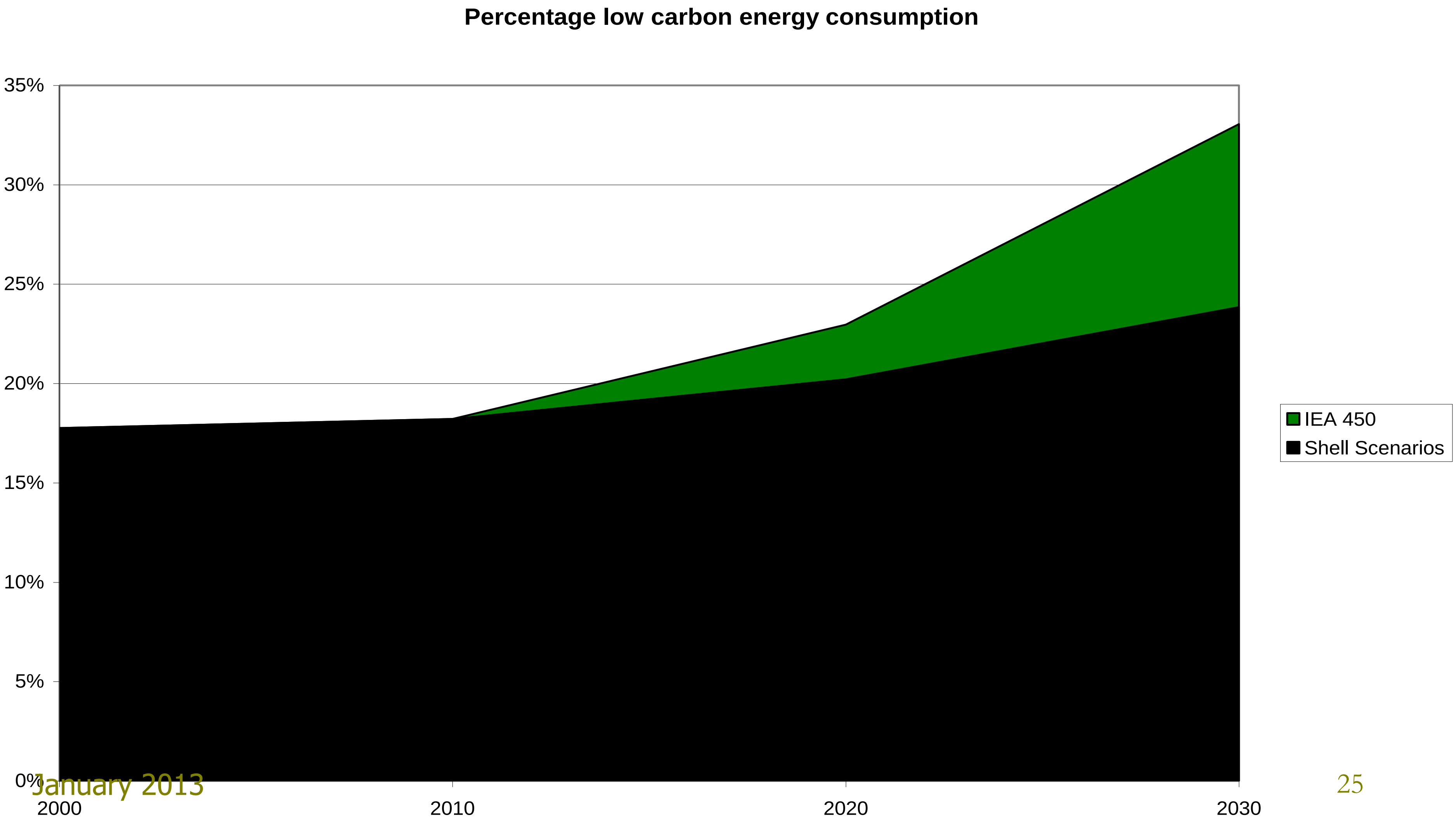
Transformation means: driving peak oil demand around 2020



a sharp decline in coal consumption



… and a progressive increase in the proportion of low carbon energy consumption



Key Mitigation Uncertainties

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- Ability to agree co-operative climate regime covering most emissions
- Shift $25 trillion from high to low carbon sectors to 2030
- Double current rate of global technology diffusion
- 50% of carbon savings from additional energy efficiency per unit GDP by 2050
- 100ppm from avoiding deforestation by 2030
- CCS and nuclear makes up 20-30% of "standard mitigation paths" – technology and accident uncertainties
- **But** current modelling also underestimated falls in solar, wind and LED costs by 20-30 years and assumed oil would be below $100 bbl

Mitigation uncertainty as important as science

Consistent Biases in Treatment of Climate Risk

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- **Climate Sensitivity**: Even with high mitigation actions the world could face higher climate change. 2C is a meaningful risk threshold for extreme damage – chance of overshoot should be minimised.
- **Vulnerability**: Impact analysis is immature and tends to underestimate the impacts of growing volatility, extreme weather events, system interdependencies, and security/stability impacts.
- **Mitigation Uncertainties**: Mitigation pathways are highly uncertain and prone to technological disruption. Technology cooperation, global supply chains and international finance can radically raise diffusion rates
- **International Cooperation:** Analysis ignores consequences of mitigation failure for resilience and growth through the erosion of co-operation, globalisation and rules-based international systems.

Risk scenarios assuming agreement to keep global temperatures below 2C

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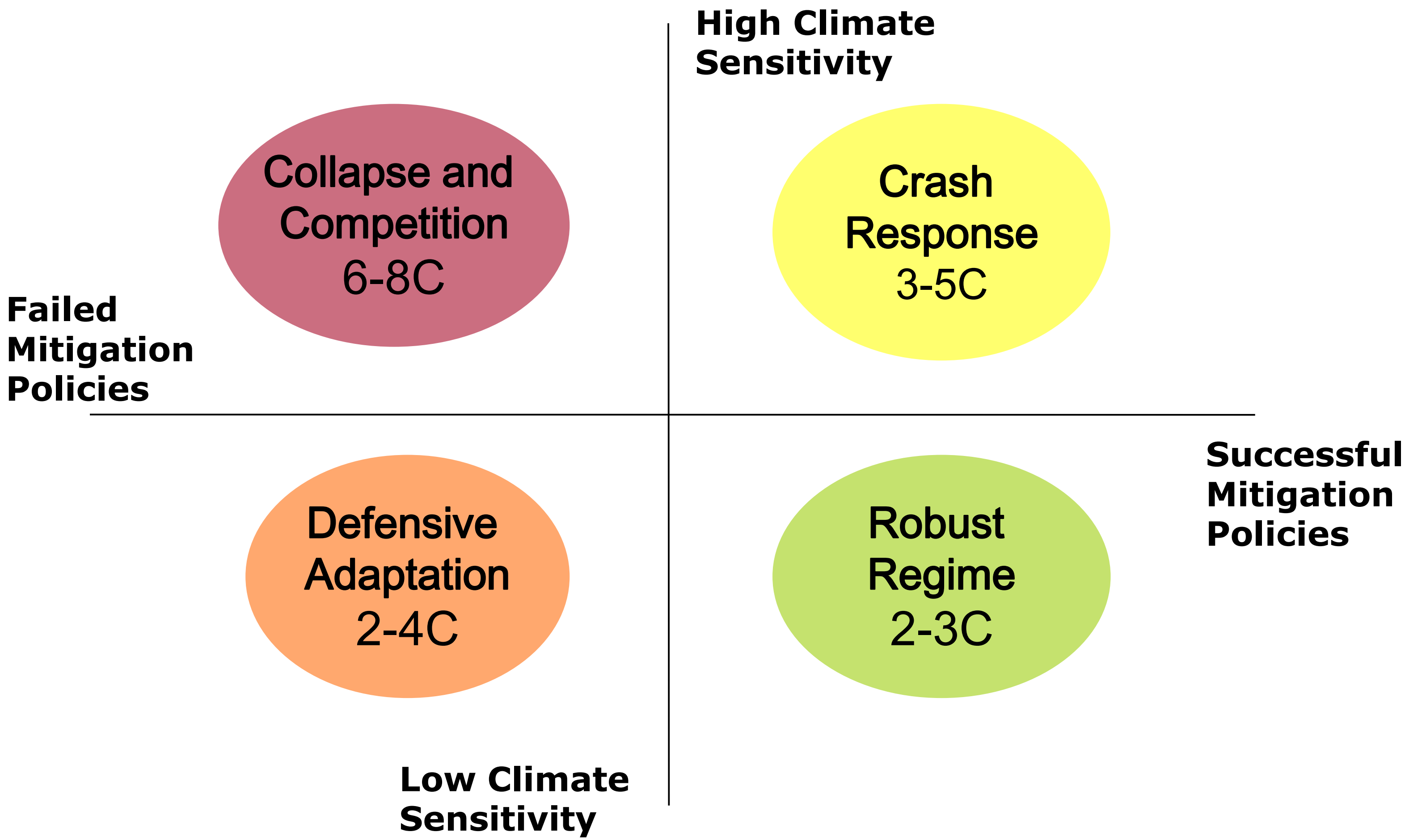

Could breach tipping points even if mitigation policy is successful

The “**ABC**” Risk Management framework

- **Aim** to mitigate to stay below 2° C;
- **Build** and budget for resilience to 3-4° C;
- **Contingency** plan for capability to respond to 5-7° C

Elements same for all countries/actors but goals will differ; there is no universal risk management approach

Ten Steps to implement a Risk Management Framework

Aim to stay below 2°C	
	Sufficient mitigation goals
	Increased investment in transformational RD&D
	Resilient and flexible global climate regime
	Independent national climate security risk assessment
Build and budget for 3-4°C	
	Adaptation strategies for "perfect storms" and interdependent impacts
	Improved cooperation on preventive and humanitarian intervention
	Increased resilience of international resource management frameworks
	Provision of data and tools decision-makers need
Contingency plan for 5-7 °C	
	Contingency 'crash mitigation" planning'
	Systematic monitoring of tipping points

Aim to stay below 2°C
Build and budget for 3-4°C
Contingency plan for 5-7 ℃

Building a credible climate risk mitigation strategy

1. **Sufficient Mitigation Goals**: Globally governments have agreed to keep average temperatures "below 2C" as the ultimate objective of the UNFCCC. A 66% likelihood of achieving long term below 2C stabilisation requires all countries to reach "net zero" emissions between 2050 and 2070. **National plans must be consistent with this goal and capable of "flexing" to achieve faster reductions under high climate sensitivity**.

2. **Increased transformational RD&D**: Nations should increase their clean energy RD&D spending by five times by 2020, and designate a share – at least 10-20 percent – of increased RD&D spending to cooperative activity with developing countries.

3. **Resilient International Climate Regime**: As in arms control, the principle of "trust and verify" is a good foundation for control of greenhouse gas emissions. If it is not possible to determine whether a nation knowingly missed a target or made a good-faith effort but failed, there is a high potential for mistrust. The global climate regime must include strong rules for reporting, and should promote a high level of transparency to help distinguish between intentional freeloading and honest failure.

National UNFCCC positions should reflect these risk management principles

Aim to stay below 2°C
Build and budget for 3-4°C
Contingency plan for 5-7 °C

Sustainable global response relies on National Climate Risk Assessments

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4. National Climate Risk Assessments

- A clear view on national interests is the necessary foundation on which to build an effective global regime to manage climate change. Most countries have yet to develop clear goals which reflect their core national interests e.g. effectively eliminating the chance of 4° C? a 1% chance of materially shifting the Indian Monsoon?
- Current assessment is dominated by ministries in charge of implementing policy; need to separate the assessment and policy functions.
- Actors responsible for areas of economy, infrastructure and security most impacted by climate change ("climate takers") do not yet have as strong an input on the effectiveness and scale of domestic and international climate mitigation policy as fossil energy industries ("climate makers")

Without a "whole of government" risk assessment countries cannot effectively define their national interests

Examples of Defining National Climate Risk Goals

- **UK Climate Risk Goal**: UK Climate Change Committee sets overall UK goal: "Central estimates of global temperature increase by 2100 should be limited to as little above 2°C over pre-industrial levels as possible, and the **likelihood of a 4°C increase should be kept to very low levels (e.g. less than 1%)"**

- **Key UK climate impacts:** domestic floods; heat waves; global food price rises; international stability and security risks

- **Japanese climate risk goal? Key Japanese impacts?**
  - Minimise risk of 1-2m sea level rise and storm surges?
  - Impacts on domestic rice production and food imports?
  - Risks of domestic extreme weather events?
  - Impacts on manufacturing supply chains?

Aim to stay below 2°C
Build and budget for 3-4°C
Contingency plan for 5-7 °C

Need to plan for "Perfect Storm" and Policy Failure Scenarios

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5. Planning for High and Interdependent Impacts

- Effective investment in national resilience requires clear identification of planning scenarios (2, 3, 4° C or higher). Long lived infrastructure design must assess probability of mitigation failure and high climate sensitivity
- In the near term highest risks come from the combination of climatic volatility, resource scarcity, poor governance and high energy prices.
- 2008 energy and food price shocks showed the impact of interdependencies. The Thailand floods resulted in large re-evaluation of global supply chains.
- Planning must go beyond the technical to address the impact of instability on adaptation e.g. in Pakistan post-flood reconstruction and post-Arab Spring stability investment programmes

Remove divide between national and international impacts

Aim to stay below 2°C
Build and budget for 3-4°C
Contingency plan for 5-7 °C

Building international resilience

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6. **Improved cooperation on preventive and humanitarian intervention:** The impacts of climate change will require larger and more frequent humanitarian and preventive missions by the international and regional organizations. These will require better coordination, higher levels of civilian capability, and greater investment in preventive approaches to natural disasters.

7. **Increased resilience of international resource management frameworks:** peaceful resolution of resource tensions created by climate change will necessitate updating international management efforts in order to preserve a rule-based global order. The time to strengthen international mechanisms to reduce resource conflict is now, when the impacts of climate change are still at relatively low levels, by action to reform a range of international, regional and bilateral agreements.

8. **Providing the data and tools that decision-makers need :** Specific information gaps - particularly in the likely response of social and economic systems to climate change - are a significant source of uncertainty in managing strategic security risks, including climate risk. Projections that provide actionable information on relevant social and landscape scales are required to enable more focused risk management.

Large potential for cooperative action in building resilience, and developing better tools and decision support systems

Aim to stay below 2°C
Build and budget for 3-4°C
Contingency plan for 5-7 °C

Preparing Crash Programmes

9. Preparing Contingency Crash Programmes

- In the case of policy failure and/or high climate sensitivity there will be strong political pressure (panic?) for "crash responses"

- Many technological options are available, but some have high climatic, security and feasibility risks e.g. proliferation risks of a global crash nuclear fission programme. Prudent now to develop contingency plans – and international controls – over major geo-engineering and technological options

10. Monitoring Tipping Points

- Currently there is no systematic monitoring of climate system tipping points. This removes the opportunity to anticipate approaching thresholds and respond with "crash" mitigation.

No sensible risk management framework should ignore the worst case scenarios

Risk management gives an opportunity to reframe the public debate

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- Current debates – especially in US – split into climate "sceptics" and "believers"; has led to an under-emphasis of both scientific uncertainties and extreme scenarios
- This debate alienates the majority of people who do not identify with either camp; undermining effective policy making
- Risk management allows a debate where all information can be used and assessed; a pragmatic not a belief based approach
- Need to reframe debate to a public conversation

"How much climate risk are you prepared to take?"

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Thank You!

Please visit www.e3g.org to see our recent work on risk management

If you would like to know more please contact Nick.Mabey@e3g.org

Annex: Background Analysis of Elements of a Risk Management Approach

1. Defining Risks?
   - Intrinsic uncertainty or scenario-based
   - Impacts
   - Reversibility/threshold effects
2. What likelihood?
3. Visibility and monitoring strategies
4. Current risk management strategy
   - What?
   - Who?
   - Consequences/effectiveness
5. Alternative risk management strategy

Key Climate System Uncertainties

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Normal Uncertainty?

- Rate of GHG accumulation in Atmosphere
  - Terrestrial and oceanic sinks

- Radiative forcing impact of GHGs
  - Ozone, CH4 and Ch2 Forcing
  - Aerosol Forcing

- Climatic impact of radiative forcing
  - Cloud behaviour
  - Albedo effects

} Climate Sensitivity?

Extreme Impacts

- Tipping point positive feedback loops
  - Methane hydrates
  - Permafrost methane
  - Boreal and Tropical Forest dieback

Risk Management Table

Risk	Impact	Dynamics	Likelihood	Visibility	Current Risk Mgt	Alt. Risk Management
Sinks	Double CO2 accumulation rate	Gradual and irreversible	?	Immediate impact on GHG rates	2C target	Crash GHG reduction Artificial sinks
Climate Sensitivity	2-3 C?	NA	NA	Modelled quantity	2C target	Crash GHG reduction Geoengineering 4C Adaptation
Methane Hydrates	Catastrophic	Threshold and irreversible; gradual impact?	Unknown threshold	Thresholds not monitorable	2C target	?
Forest Dieback	2C additional?	Gradual and irreversible	From 2-3C onwards?	Early signs observable	2C target	Crash GHG reduction Geoengineering 4C Adaptation
Permafrost Methane	Low	Gradual and irreversible	Occurring now?	Observable	2C target	

Key risk management conclusions

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- Need to redefine "climate sensitivity" to make this useful for decision makers. Minimising risk of triggering tipping point effects is critical for maintaining security objectives. Need for "post-IPCC" structure to drive science?
- Monitoring of key tipping points events is very unsystematic giving little early warning of approaching thresholds. Cooperative action could improve this.
- Underlying instability of climate system suggests that emission cuts will need to be far steeper than current trajectories
- Significant probability of a crash GHG reduction programme in next decades.
  - Need for contingency planning to make this feasible, including geo-engineering.
  - The implications of rapid global nuclear fission build for proliferation and safety need immediate consideration.
- Need to sensitise decision makers to the reality of different scenarios beyond reports and studies; immersive gaming is probably the best way to engage at a deep level and challenge implicit assumptions on climate stability

Key Climate Impact Uncertainties

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Normal Uncertainty?

- River basin hydrological cycles
- Glacial melting changing major river flows
- Speed of Greenland ice-shelf melting
- Frequency of extreme weather events
- Ocean acidification/ecosystem impacts
- Impact of maladaptation and climate driven conflict

Tipping Point Impacts

- Indian Monsoon weakening/increased volatility
- Arctic Sea Ice Melting
- West Antarctic Iceshelf melting
- Atlantic circulation shifting

Risk Management Table

Risk	Impact	Dynamics	Likelihood	Visibility	Current Risk Management	Alt. Risk Mgt
Hydrological cycles	High and variable	Gradual and unpredictable	High	Volatility masks shifts	Water management adaptation	
Glacier Melt	Reduction in river flows	Threshold and irreversible	High	Retreat monitorable	?	
Greenland Icesheet	1-2m rise by 2100; max 7m	Threshold and irreversible	High after 1.5C warming	Melting rate monitorable	Additional sea defences Migration	
Extreme weather events	High impacts	Gradual and irreversible	?	Volatility masks shifts	Preventive disaster relief planning	
Ocean ecosystem disruption	High but variable on fish stocks	Gradual and irreversible	High	Volatility masks shifts	None	Fisheries adaptation Migration
Climate driven conflict	High	Gradual	High but regional	Poor monitoring of impacts	None	Investment in resilience

Risk Management Table II

Risk	Impact	Dynamics	Likelihood	Visibility	Current Risk Management	Alt. Risk Manage ment
Indian Monsoon	Unclear		High above 3-4C?	Volatility mask shifts	?	
Arctic Sea Ice	Positive?	Gradual with possible threshold	High	Ongoing measuremen t	Resource agreements between Arctic powers	
West Antarctic Ice Shelf	1m by 2100? Maximum 7m	Threshold and irreversible?	High above 3-4C?	Unclear	2C limit	
Atlantic circulation	Large cooling in Europe	Threshold and irreversible?	High above 3-4C?	Weakening could be monitored	2C limit	

Key Risk Management Conclusions

- Current approach of fragmenting impacts does not capture the elements of most interest of security actors; there is a need for new analysis frames.
- For near term security planning critical interest is "perfect storm" events where climate stresses/extreme events combine with water, food, energy and governance issues to drive emergencies and instability
- For the longer term analysis understanding resilience in response to multiple shocks is critical; especially in developed countries where resilience is overestimated.
- There is a gap in practical tools to guide investment in resilience to climate change/resource pressures in unstable regions. Risk that adaptation funds will drive hard engineering response and may ignore or heighten instability e.g. on transboundary waterways
- Critical to understand how to reduce risk that countries will shift their adaptation strategies from a reliance on interdependence (e.g. food trade) to a focus on resource capture? Need for pre-emptive investment in cooperative frameworks.

Climate Mitigation Challenges

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- Current goal of stabilisation at 450ppm CO2eq gives 50:50 chance of 2C rise, and a 20% chance of 4C rise
- Under higher climate sensitivities there will be a need for zero net emissions by 2050 and negative emissions for the next century
- Developed country emission must peak now; developing countries starting from 2025 onwards?
- 450ppm scenario requires around $1.3 trillion in low carbon investment annually to 2030
- Additional cost of this is 1-2% GDP but costs fall to zero when oil price sustained at $100-140 bbl
- Diffusion rate of new technologies needs to double to meet 450 trajectory

Preserving Climate Security: Understanding Mitigation Policy Risks

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Normal Risks?

- Slower energy efficiency increases (reducing the 50% of planned reductions by 2050)

- Higher BAU projections (20-50% higher emissions)
  - Global GDP growth
  - Oil price/energy security politics
  - Transportation use in developing countries

- Slower reduction in deforestation rates (10-20% of emissions cuts)

- Underperformance/failure of new low carbon technologies
  - CCS (20% of 2050 reductions?)
  - Biofuels (10-20% of 2050 reductions?)
  - Nuclear (10% of 2050 reductions?)

Tipping Point Impacts

- Collapse in integrity of the climate change control regime
- Impact of serial nuclear accidents/terrorism
- Positive impact of development of surprise low carbon technologies (e.g. cheap solar)

Risk Management Table

Risk	Impact	Dynamics	Likelihood	Visibility	Current Risk Mgt	Alt. Risk Mgt
Efficiency	High – 50% abatement to 2050	Gradual	Medium	Visible but monitoring poor	Weak	Increased low carbon energy
BAU	High	Gradual	High	Monitored	Annex I caps	Increased low carbon energy
Deforestation	Move to 550ppm trajectory	Gradual except food /oil shock	High	Monitored but shocks not modelled	None	Increased low carbon energy
Technology failure	CCS failure 70% cost increase	Gradual	Medium	Unclear due to commercial interests	None	Increase RD&D/TAPs
Integrity of Climate regime	10 year mitigation delay	Threshold	Medium		UN monitoring	
Nuclear accidents/ profliferation	Low on most scenarios	Shock	?	Only after event	NPT regime IAEA system	NPT review Gen IV

Key Risk Management Conclusions

- Mitigation risks are less examined than scientific risks, but are of similar or larger scale. General complacency among policy makers on the expected delivery of fundamental changes, especially in energy efficiency and forestry.
- There will be a need for more low carbon energy technologies much earlier than on current plans. Increased cooperative international RD&D is a vital risk management tool but track record of success is low.
- Pre-emptive investment in infrastructure (e.g. advanced grids) would give flexibility to quickly increase mitigation rates but this is difficult under current regulations in most countries.
- Energy security and resilience benefits of new energy systems should be a major driver for early deployment; though cybersecurity risks need to be better managed.
- UNFCCC system is critical to set goals and monitor and verify progress. Need for effective and independent verification of country actions to make system resilient in face of shocks. Mixed record of trust in UN: IAEA vs Bioweapons
- Large oil price rises could stimulate more use of clean tech or a retreat to unabated coal; carbon capture and storage is a critical technology to hedge this eventuality. Understanding the real potential for nuclear energy is critical for understanding proliferation risks.