Preventing Dangerous Climate Change: *Below 2ºC*

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Objective of the UNFCCC (Article 2)

…stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

… within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

What is ‘dangerous’?

What is ‘dangerous’ is a value judgment about the relative importance of various impacts, such as the loss of human life, loss of species and ecosystems, loss of cultures and cultural heritage sites, loss of marketable value or employment.

Paraphrased from Schneider 2002

The precautionary principle

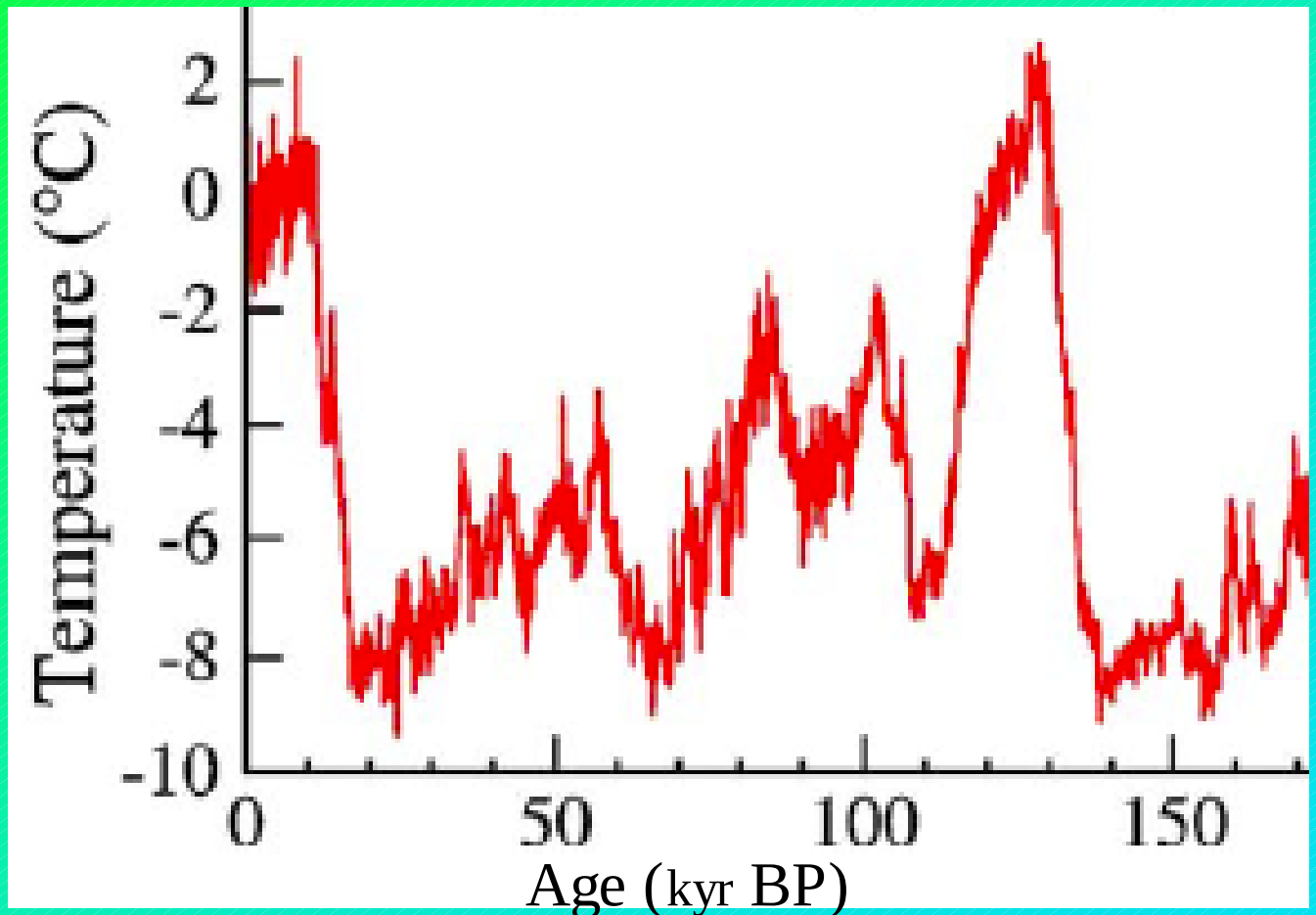
- From Article 3 of the UNFCCC:
  - "Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost."
- Recent scientific work has shown that rapid climate change has occurred in the past. Temperature increases above 2ºC would put us outside the ranges experienced in many millennia

Surprises happen

"…cumulative experience with issues such as DDT pollution, ozone depletion, and the collapse of marine fisheries has led to the understanding that the human perturbation of complex, nonlinear systems can induce outcomes that were not even conceptualized before they actually occurred."

Funtowicz and Ravetz, 1990

Antarctic ice core temperature record



From Hansen, 2003

Warnings from the past

- At the peak of the previous (Eemian) interglacial period, Antarctic temperatures were only 2ºC higher than the present
- Polar temperature changes are typically twice the global mean
- At that time, global sea level was 5-6 meters higher than present
- Deglaciation can be rapid - as much as 1 meter sea level rise in each 20 years in the period following the peak of the last ice age.

From Hansen, 2003

Climate Action Network position on dangerous climate change

- Climate Action Network calls on Parties to set limits to climate change as a matter of urgency
- Preventing dangerous climate change is an equity issue
- Some communities are already experiencing dangerous changes
- Developing countries will suffer the most from already committed warming
- Climate change should be kept below a peak of 2ºC warming and then reduced as rapidly as possible.

Why a temperature target?

- Best available aggregator of various impacts of concern
- All impacts of direct concern (e.g., sea-level rise, changes in extreme events, damage to ecosystems) can be linked to global temperature change
- Targets closer to emissions level (e.g., atmospheric concentrations) do not adequately constrain impacts

Why below 2ºC?

- Changes greater than 2ºC put us outside range of "recent" experience (last 400,000 years)
- Impacts on many people and ecosystems are already evident and predicted to increase for global temperature increases of 1-2ºC
- Size and certainty of predicted negative impacts for many systems increases with temperature change over 2º
- Some singular/non-linear events (e.g., melting of ice caps, carbon cycle feedbacks, major species extinctions) are increasingly likely at or beyond 2º.

Why peak and drop?

- Sea level rise from thermal expansion will continue as long as increased temperature continues
- Longer durations of increased temperature increase risk of non-linearities (melting ice sheets, carbon cycle feedbacks)
- Keeping peak substantially below 2º seems nearly infeasible unless climate sensitivity is very low

Climate impacts: what we know and how we know it

- Two major sources of knowledge
  - Model studies
  - Historical analogies
- All such knowledge is very uncertain
  - GCMs cannot produce robust predictions at regional or local scales
  - Conditions of affected systems (human, ecological) are unknown at time of impacts
  - Basic understanding of complex systems is very rudimentary

Addressing systemic uncertainty

- Relevant science does not allow traditional statistical estimation of probabilities (mean and standard deviation of a set of model predictions is *not* equivalent to a measured result!)
- Probability estimates depend on scientific judgment in contexts that are different from traditional view of "scientific method"
- Progress is being made - e.g., IPCC TAR's "low, medium, high" levels of confidence.
- Possibility of true surprise is fundamental

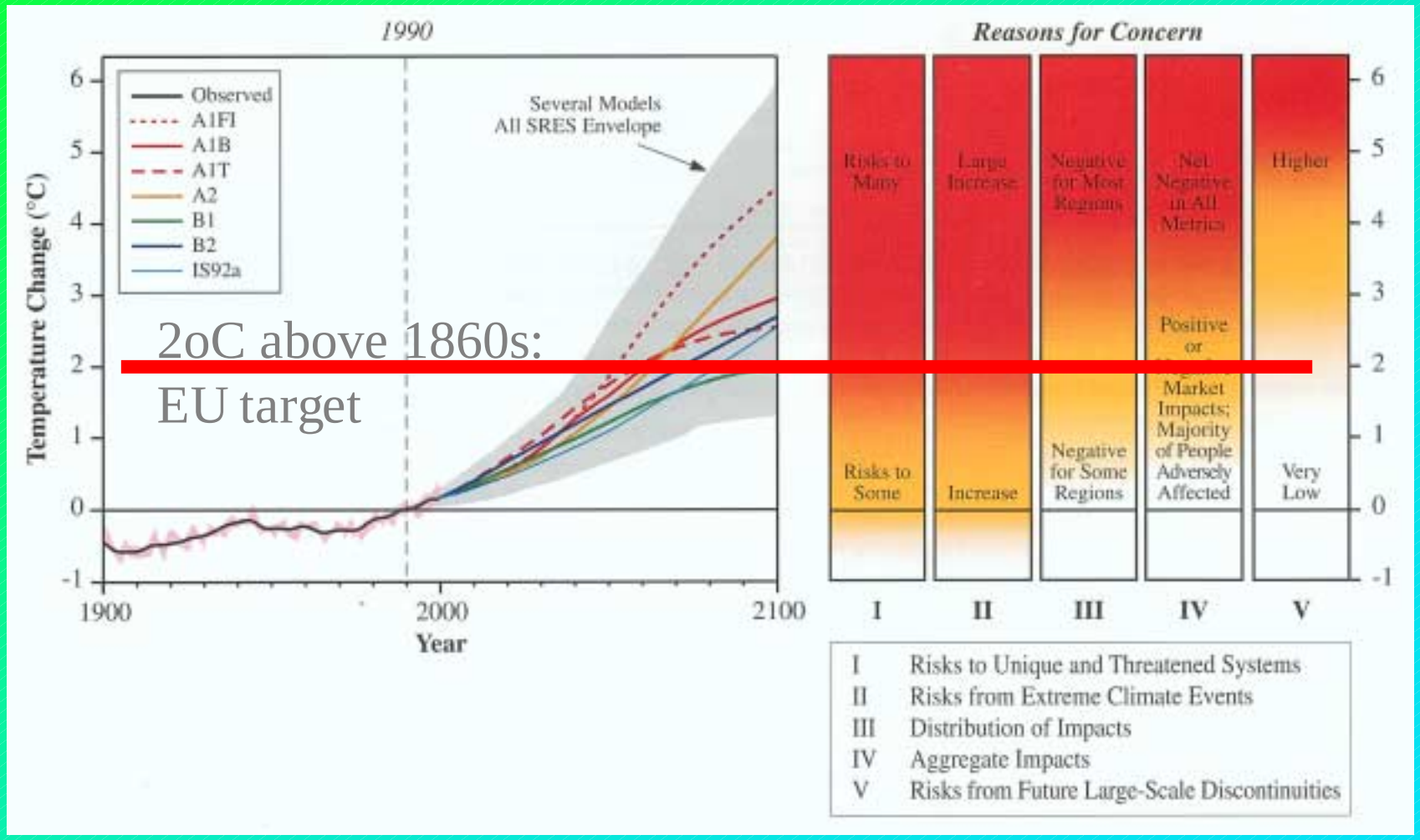
Preventing dangerous climate change is an equity issue

- *"The effects of climate change are expected to be greatest in developing countries in terms of loss of life and relative effects on investment and the economy."*
- *"The projected distribution of economic impacts…would increase disparity in well-being between developed countries and developing countries.."*
  - *IPCC Third Assessment Report, Working Group II*

Some are already experiencing dangerous climate change

- WHO estimated 155,000 climate-change related deaths in 2000
- More than 20,000 deaths in Europe and 1500+ in India in heat waves in 2003
- 562 tornadoes in US in May 2003, causing 41 deaths, exceeding previous high of 399 by 40% (World Meteorological Association)

IPCC TAR Risk vs Temperature



Food security over 2ºC

- With 2.5ºC warming by the 2080s, Parry et al. (1999) indicates 45-55 million extra people at risk of hunger, with the number at risk rising very rapidly with temperature.
- With 3ºC warming by the 2080s, a very large number of people, 3.3-5.5 billion, are projected in the GAEZ study across range of climate models to be living in countries or regions experiencing large losses in crop production potential
- With 3-4ºC warming, 65-125 million people at direct additional risk of hunger.
- No assessments of impacts from changes in extreme events

Food Security

- At all levels of warming, a large group of poor, highly vulnerable developing countries are expected to suffer increasing additional food deficits, which is expected to lead to higher levels of food insecurity and hunger in these countries.
- At 2ºC there increasing risk, with the risk increasing from the 2050s to the 2080s.
  - Agricultural production in developed countries finely balanced between the effects of increased temperature and changes in precipitation.

Economic Damages

- At 1°C, a significant number of developing countries likely to experience net losses as high as a few % of GDP. Most developed countries likely to experience mix of damages and benefits, with net benefits predicted by a number of models.
- At 2°C net adverse effects projected for developing countries few to several percentage points of GDP. Regional damages particularly in Africa exceed several percentage points of GDP.
- Impacts on several developing regions in the range of 3-5% for a 2.5-3°C warming, if there are no adverse climate surprises. Global damages estimates are in the range of 1-2% for 2.5-3°C warming

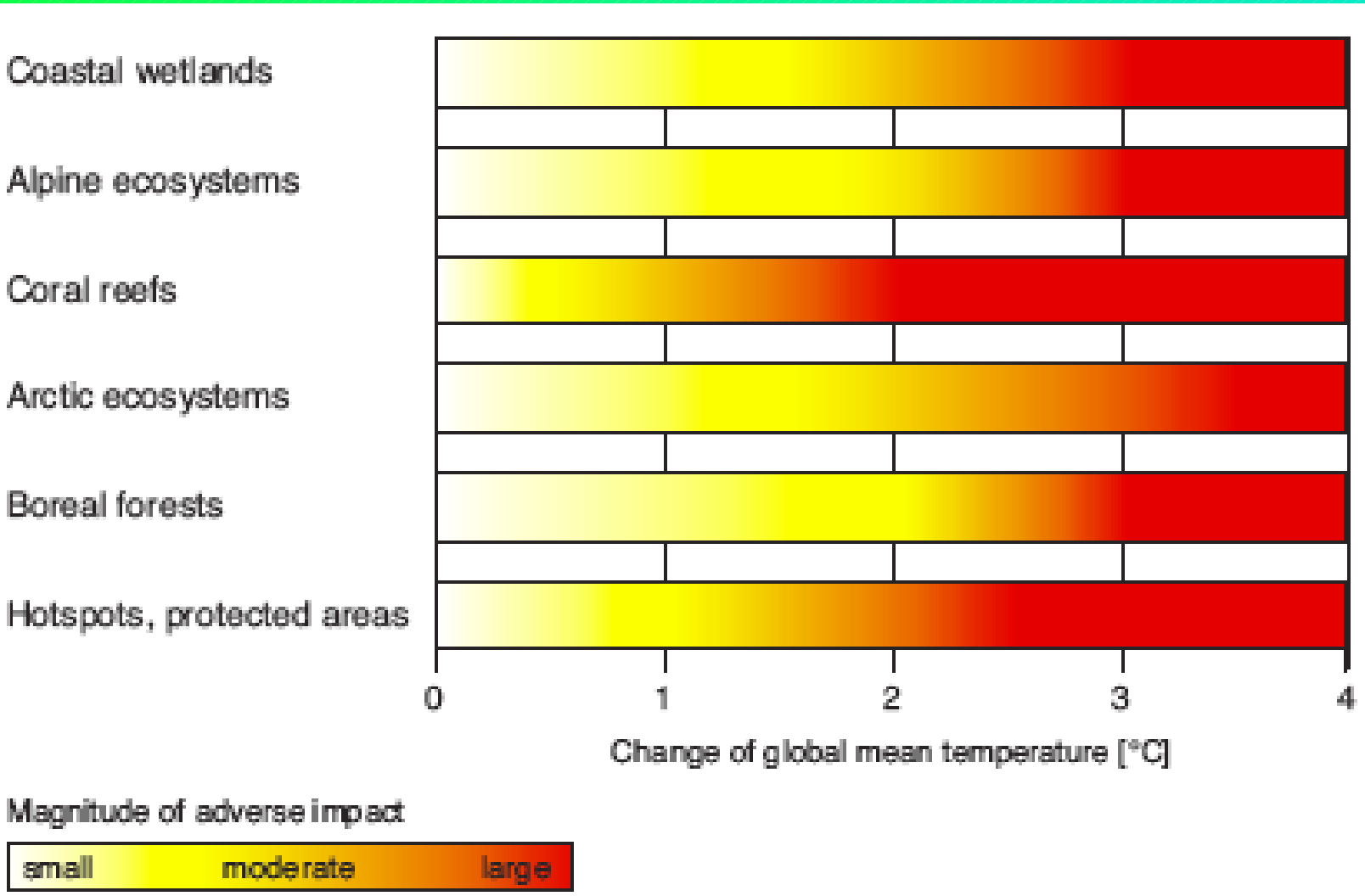
Water Shortage

- Temperature increases of 1ºC or below still yield high levels of additional risk, particularly in the period between the 2020s and 2050s.
- From 1.5ºC to 2-2.5ºC there appears to be a non linear risk threshold. Numbers at risk rise from close to 600 million to between 2.4-3.1 billion, including megacities in India and China.

Risks to ecosystems and species

- Many ecosystems at risk with temperature change between 1-2ºC
  - Coral reefs
  - Arctic and alpine ecosystems
  - Coastal wetlands
- Increasing risks to hotspots and protected areas
- Potential extinction of 15-35% of species with mid-range warming (Thomas et al., *Nature* 2003.)

Risks to Ecosystems (WBGU)



Risk of abrupt change and “non-linearities”

- Carbon cycle feedbacks leading to accelerated warming
- Ocean thermohaline circulation slowdown or abrupt cessation
- Greenland or West Antartic Ice Sheet instability or decay
- Abrupt ecological changes and biodiversity impacts
- Changes in extreme event frequency and severity
  - Increased drought risk, increased monsoon variability
- Abrupt socio-economic impacts
  - Food security in vulnerable developing countries
  - Water supply in some regions

Conclusions - 2ºC warming

- Threatens many tens of millions with increased risk of hunger, hundreds of millions with increased malaria risk, millions with increased flooding and billions with risk of water shortage.
- Risk of major ice sheet responses with commitments to many meters of sea level rise over several centuries.
- Threat of major ecosystem damages from the Arctic and Antarctic to the tropics

Why temperatures must peak no higher than 2º warming and drop

- Protection of food, water and health security in developing countries
- Protection of ecosystems and biodiversity including coral reefs, arctic ecosystems, wetlands.
- Prevention of long-term sea level rise
- Reduction of risks to Greenland and West Antarctic ice sheets
- Reduction of risk of positive carbon-cycle feedbacks

How we do and should think about climate change

- Business-as-usual
  - The economic framework
  - The political framework
- The necessary alternatives
  - The sustainability framework
  - The equity framework

The economic framework

- Identifies climate change problem as one of cost-benefit analysis
- Assumption of positive discount rate ensures harm to future generations
- Aggregation of costs and benefits assumes compensation is acceptable and feasible
- Assumes that benefits of life-support commons are infinitely substitutable

The political framework

- Identifies costs and benefits as appropriately measured at national scale
- Combines moral prioritization of national community with pragmatic assumption that politicians are accountable for domestic economic growth
- Accepts lack of international authority to prevent free-riding on the global commons as justification for maximization of domestic consumption and the externalization of costs.

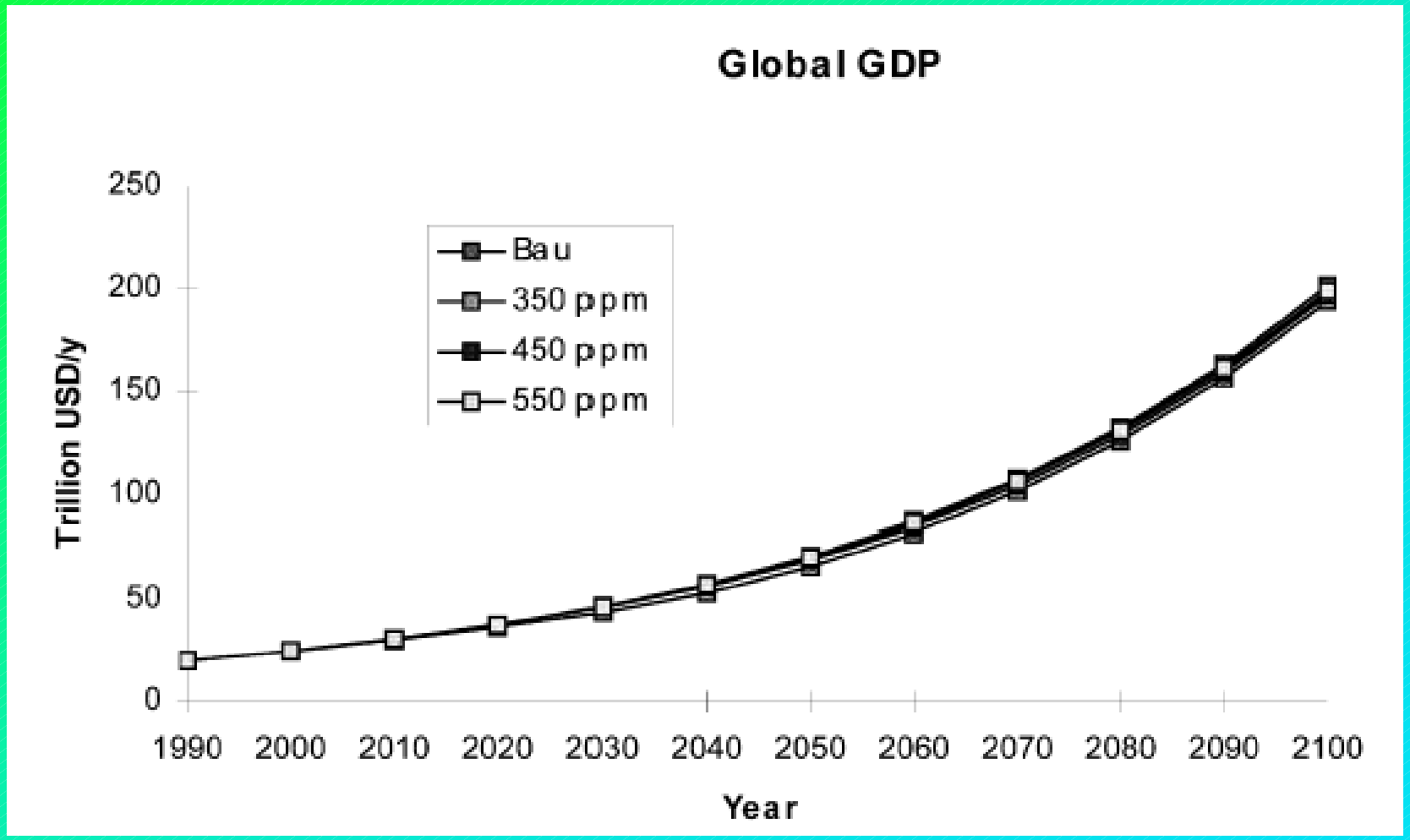
Sustainability framework

- Identifies value of ecosystems, species and life-support commons outside their contribution to GDP
- Emphasizes precaution in face of uncertainty regarding importance and resilience of system functions

Equity framework

- Emphasizes right to protection from harm by activities of others
- Requires equal participation from all feasible affected parties and representation for future generations and non-human species
- Requires compensation be agreed to and implemented

The so-called high costs of climate stabilization



From Azar and Schneider 2002

The (low!) cost of climate insurance

- Top–down models typically suggest that the cost of a 50% reduction of global CO2 emissions from baseline by 2050 would cost some 1–4% of global GDP, and a 75–90% reduction by 2100 would cost some 3– 6%
- If the cost by the year 2100 is as high as 6% of global GDP and income growth is 2% per year, then the delay time is 3 years, whereas as the delay time is only 1 year if income grows by 3% per year and the abatement cost is 3% of GDP. (Azar and Schneider, 2002)

Conclusion

- Thinking of the problem in business-as-usual terms - in the economic and political frames - ensures that the problem will not be solved, and that future generations and the poorest people in the present generation will bear the (possibly catastrophic) costs
- Preventing dangerous climate change requires us to accept costs because it is necessary for equity and sustainability, not because it is in our short term self interest, and to develop institutions capable of sanctioning those who seek to continue to abuse the commons

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