

The Challenge of Climate Change

Klaus Hasselmann

Max Planck Institute for Meteorology, Hamburg
and
Global Climate Forum
(formally European Climate Forum)

Klimagune Workshop 2011:
Addressing Climate Change through Adaptation
Bilbao, 6th May 2011

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* My 2nd talk in Bilbao. 1st talk: “The Role of Science for Climate Policy – with Lessons from the Financial Crisis”, 2nd Dec 2008

Overview:

- 1. Lessons from Copenhagen and Cancun (a short history of the public and political perception of climate change)**
- 2. The science of climate change (what we are certain of, are still uncertain about, and what we may never know before it is too late)**
- 3. Reframing the climate change challenge: from costs to benefits**
- 4. Responses to the climate change challenge:**
 - Global AND local**
 - Top-down AND bottom-up**
 - Mitigation AND adaptation**

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**Scientific
information**

**Public
awareness**

**Political
response**

1970

1980

1990

2000

2010

Scientific information

(Arrhenius, 1895)

Public awareness

Political response

1970

$2\times\text{CO}_2 \rightarrow 3 \pm 1.5^\circ\text{C}$

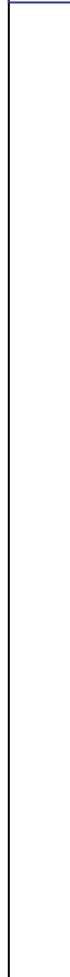
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JOC-GARP

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JOC-GARP; WCRP

1990

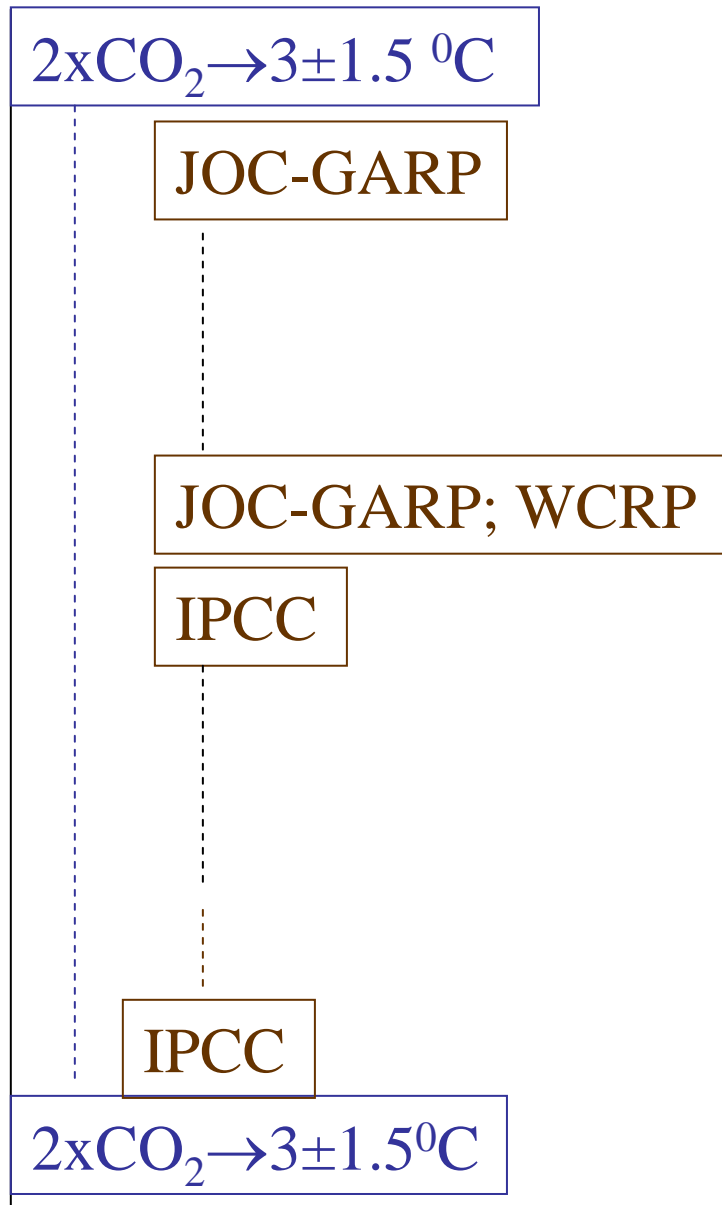
IPCC

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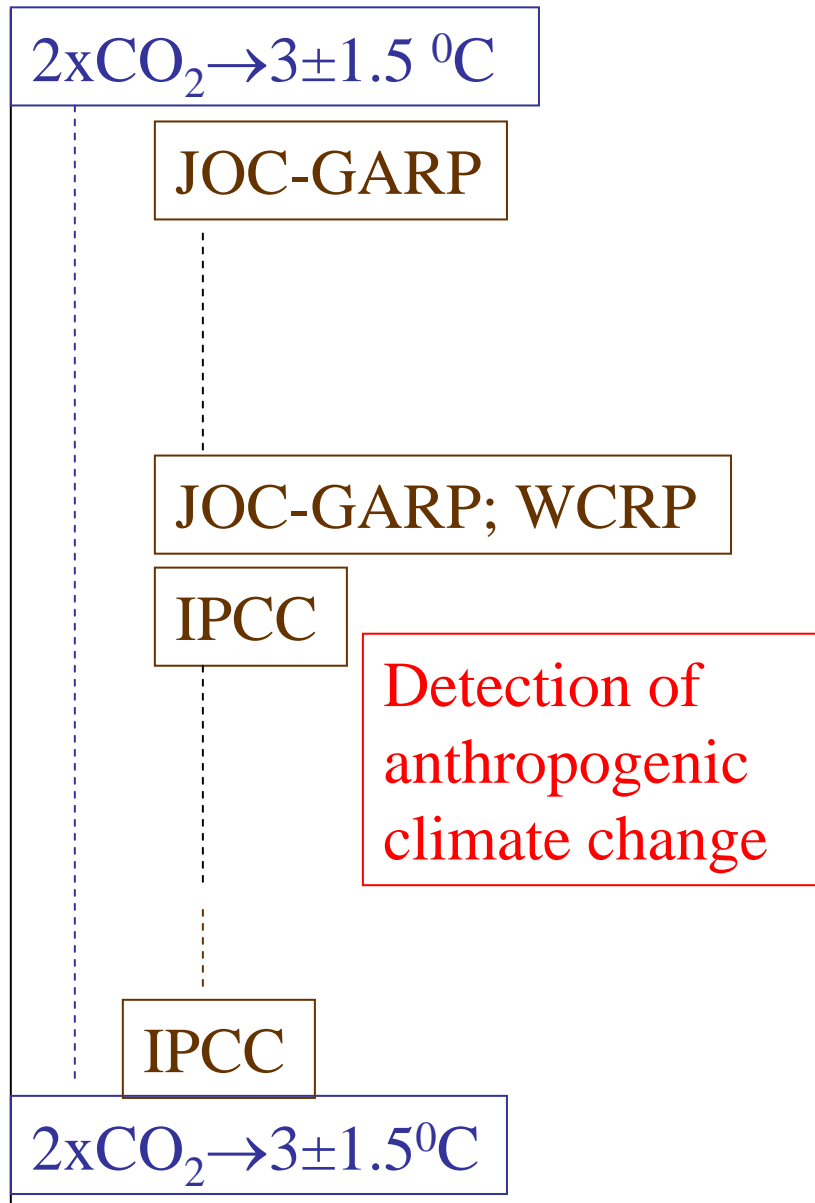
Detection of
anthropogenic
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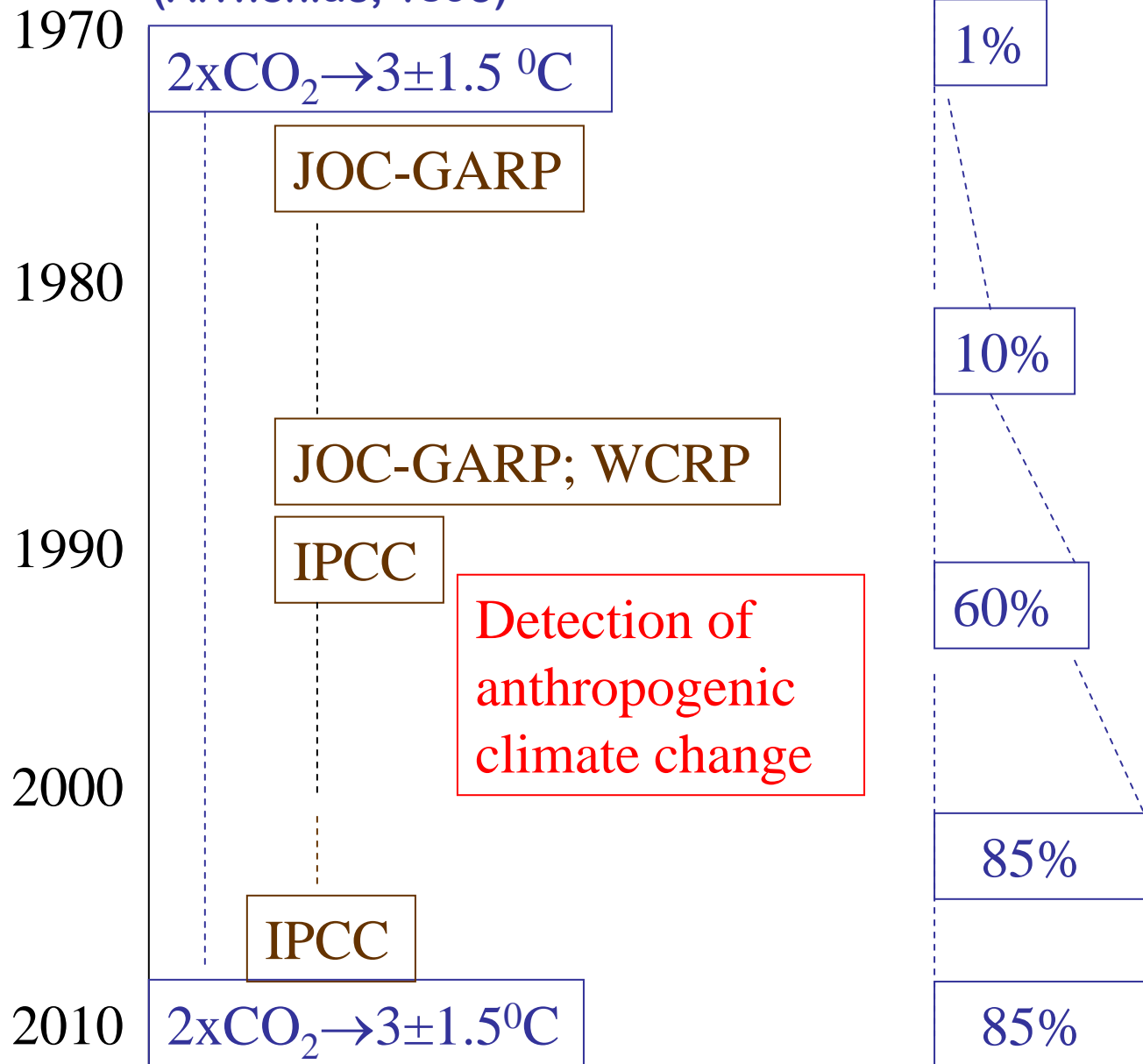


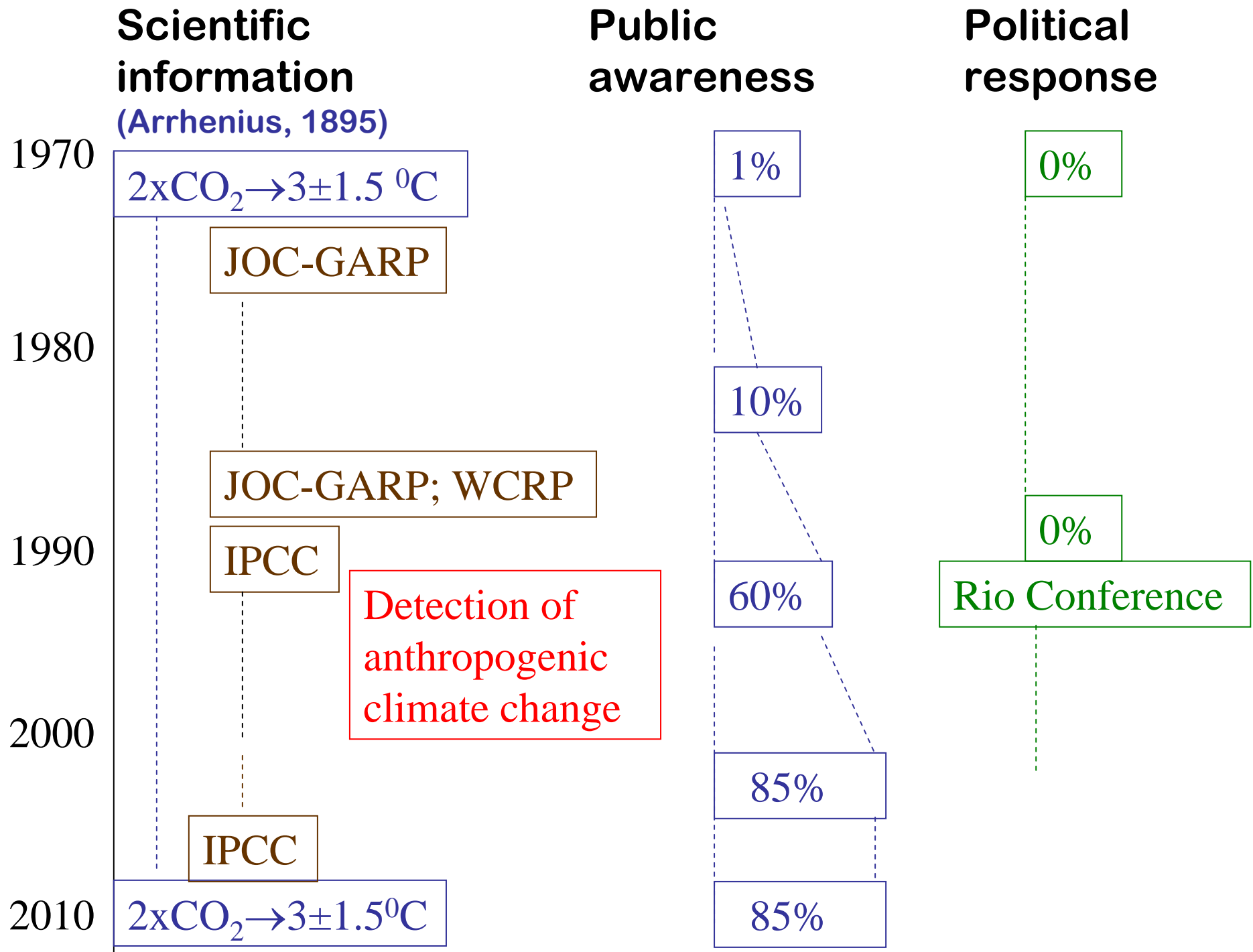
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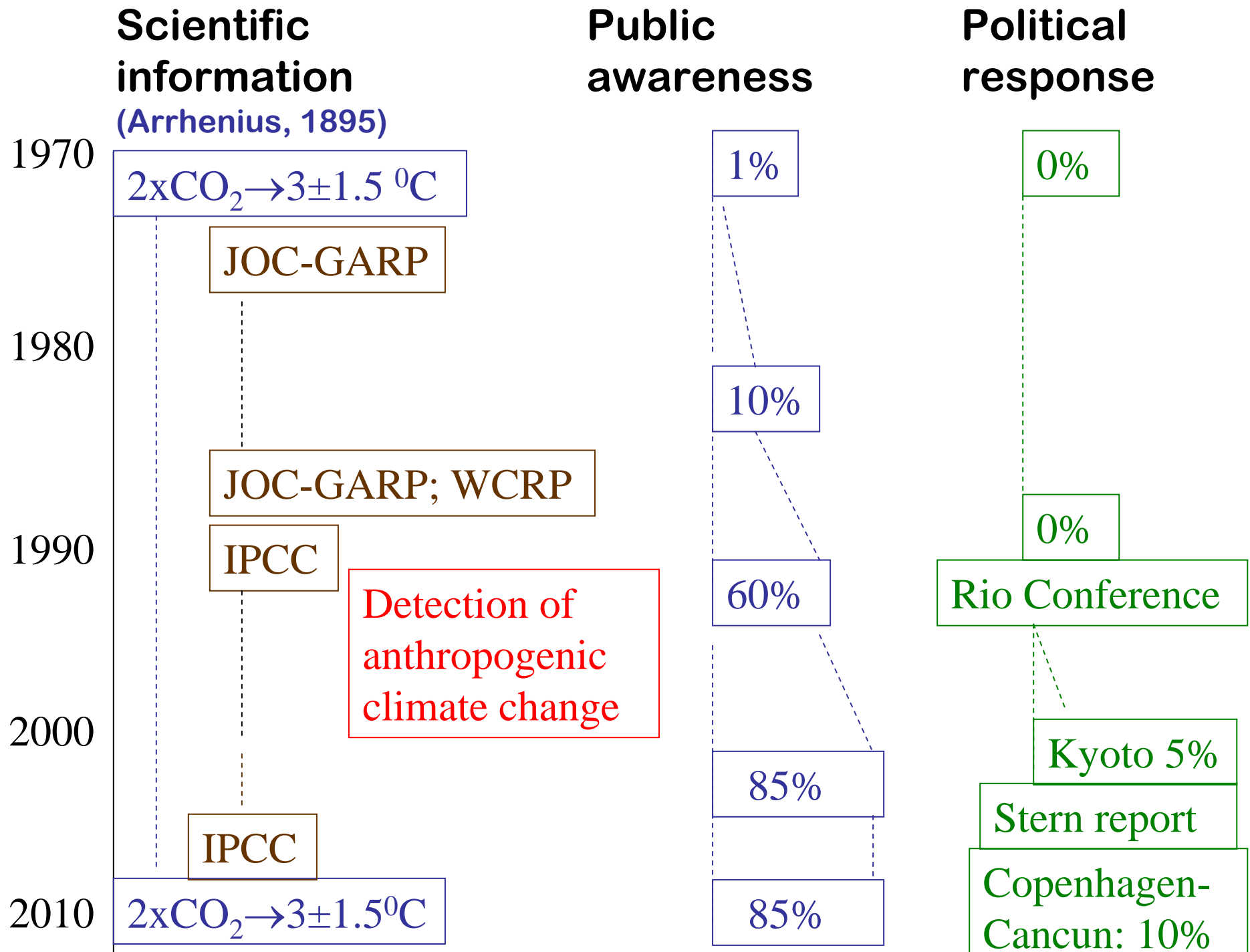
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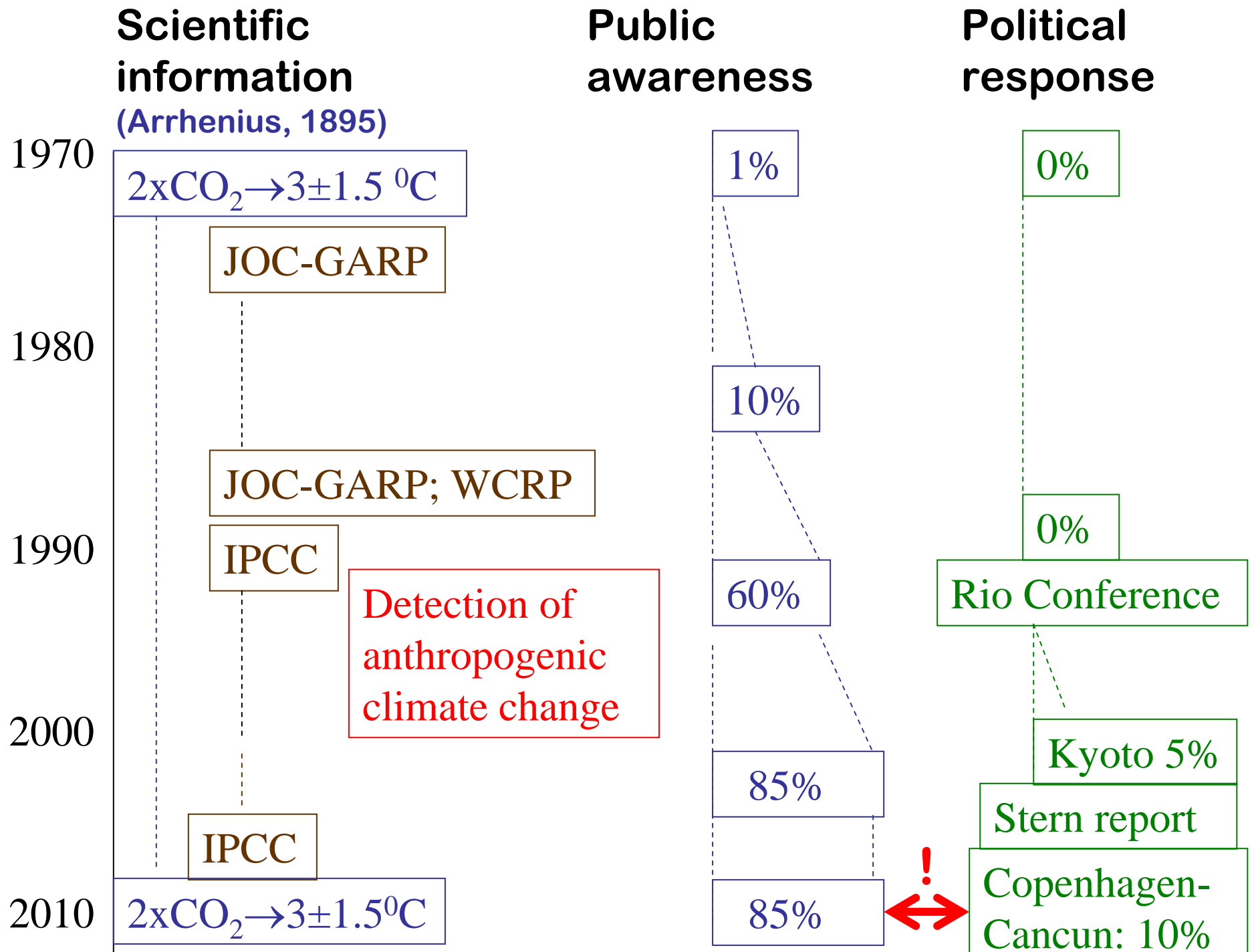
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Political response









How can science, civil society organizations and progressive businesses help overcome the current disconnect between understanding and responding to climate change?

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- By clearly presenting the science (“what are we certain of, what are we still uncertain about, and what may we never know before it is too late”)
- By reframing the challenge of creating a green economy as a unique win-win opportunity, as opposed to a cost burden (the global financial crisis offers an excellent opportunity for demonstrating this point)

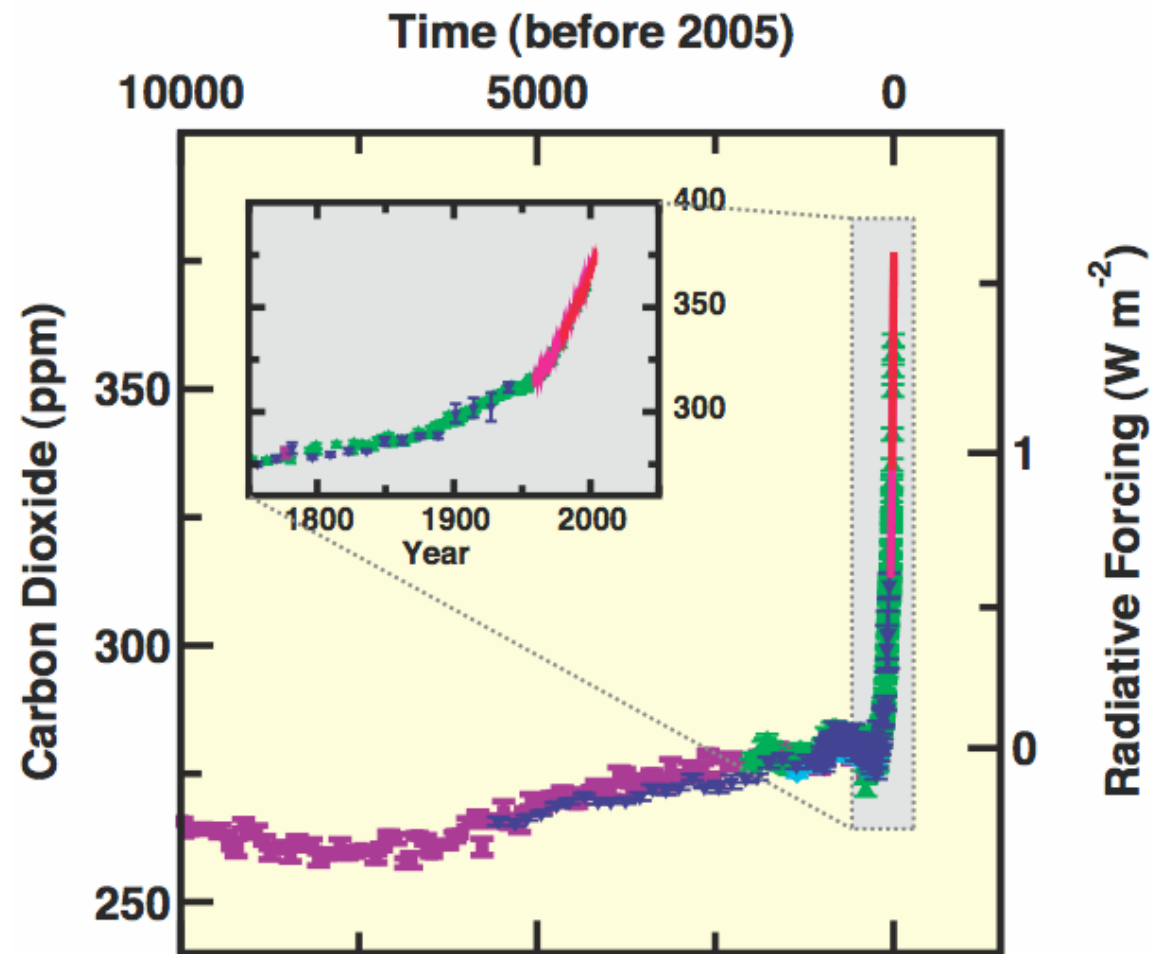
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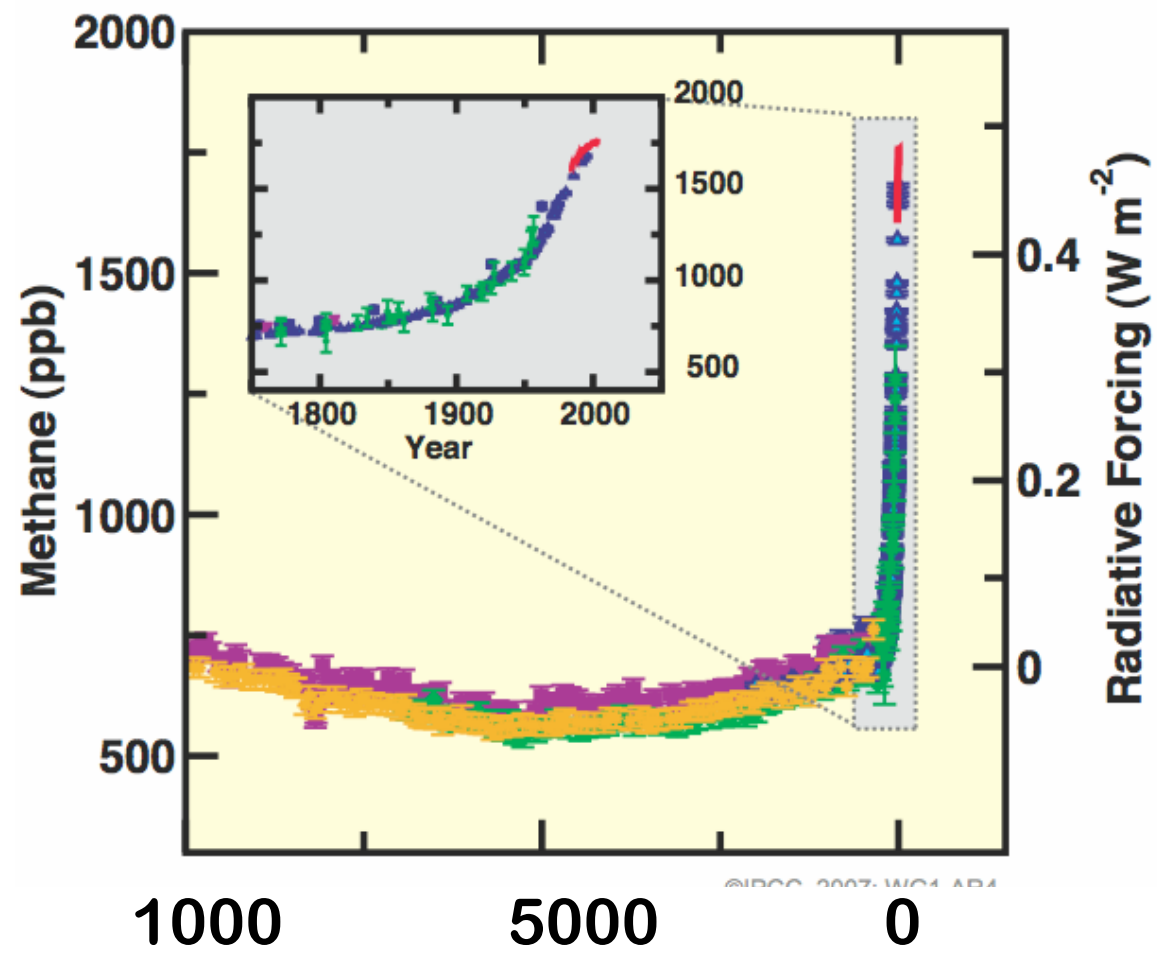
- **By clearly presenting the science (“what are we certain of, what are we still uncertain about, and what may we never know before it is too late”)**
- **By reframing the challenge of creating a green economy as a unique win-win opportunity, as opposed to a cost burden (the global financial crisis offers an excellent opportunity for demonstrating this point)**
- **By combining top-down global mitigation policies with bottom-up local adaptation measures in investment programs that create employment and real growth**

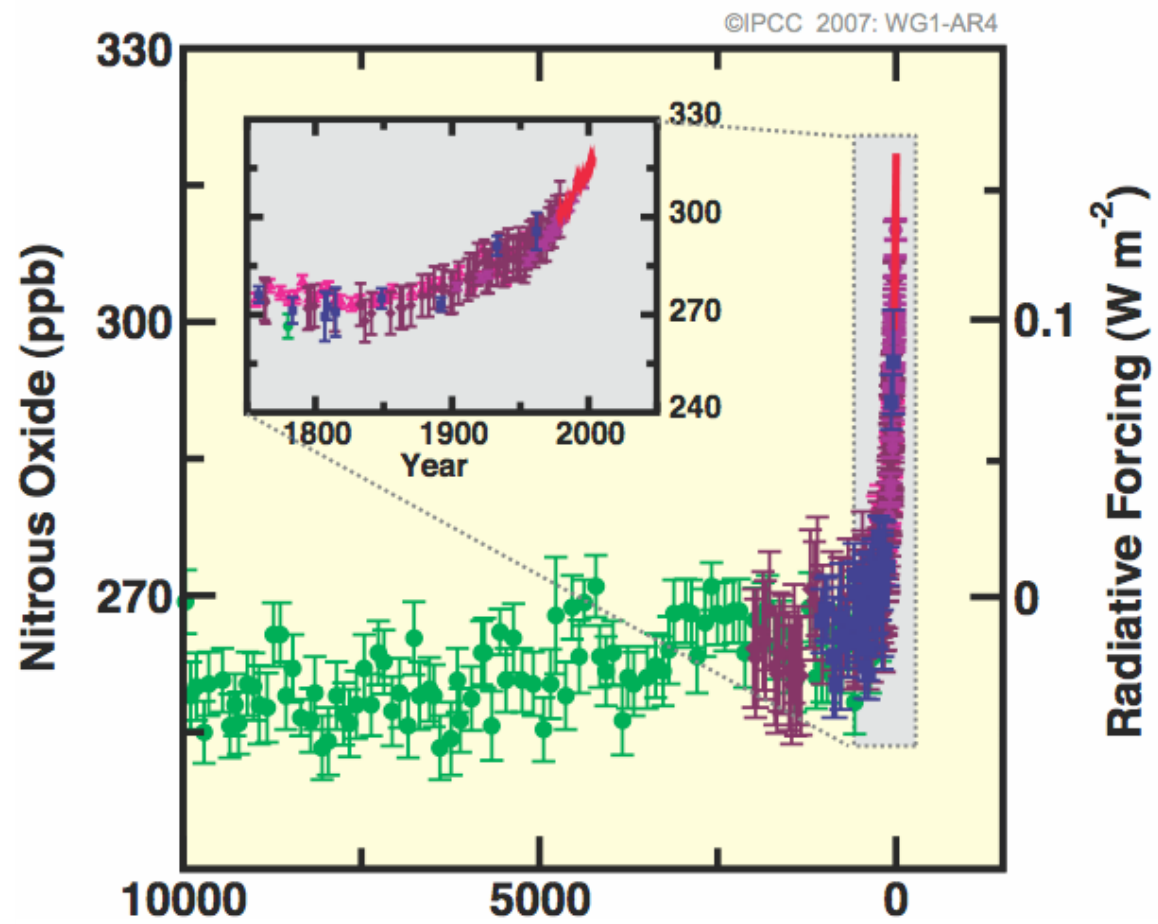
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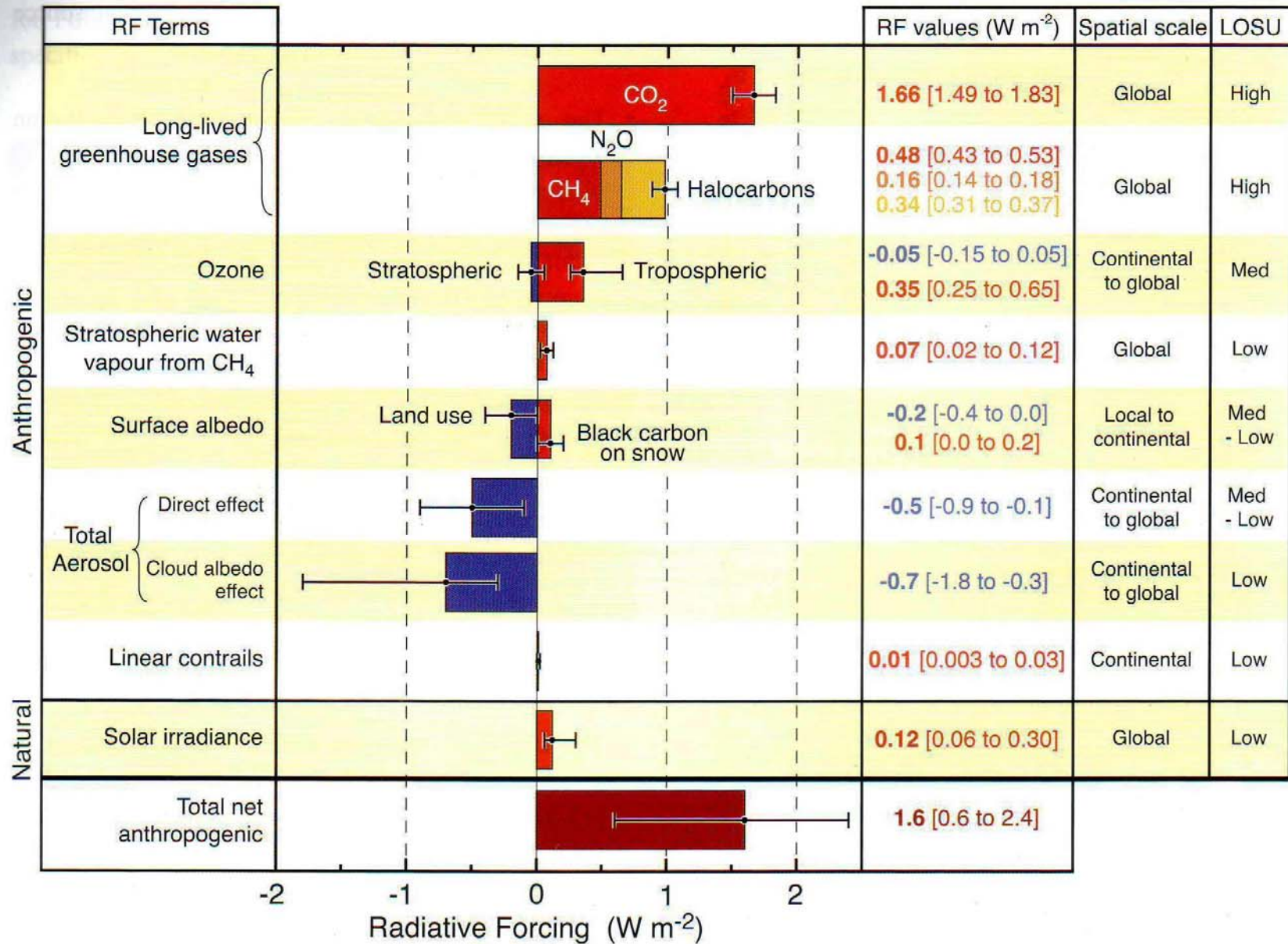
Changes in Greenhouse Gases from ice-Core and Modern Data





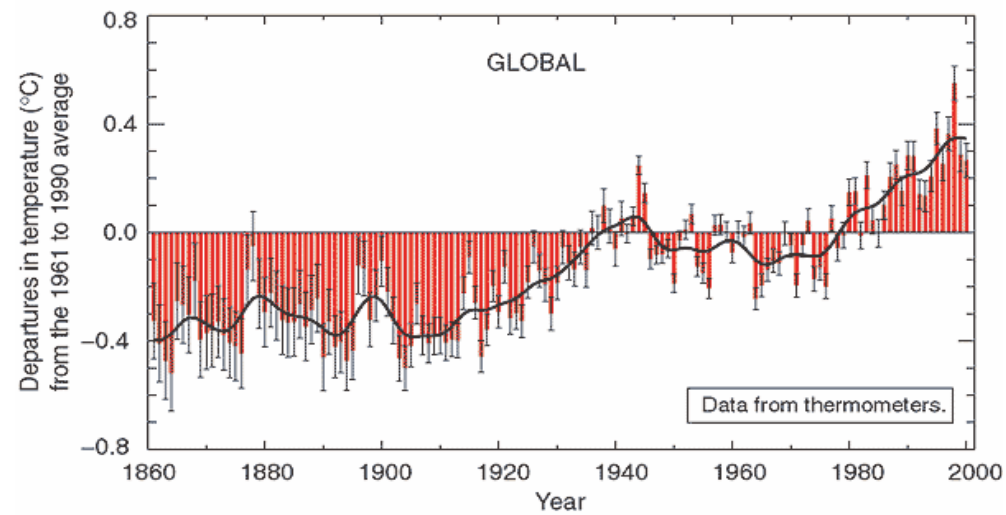


RADIATIVE FORCING COMPONENTS

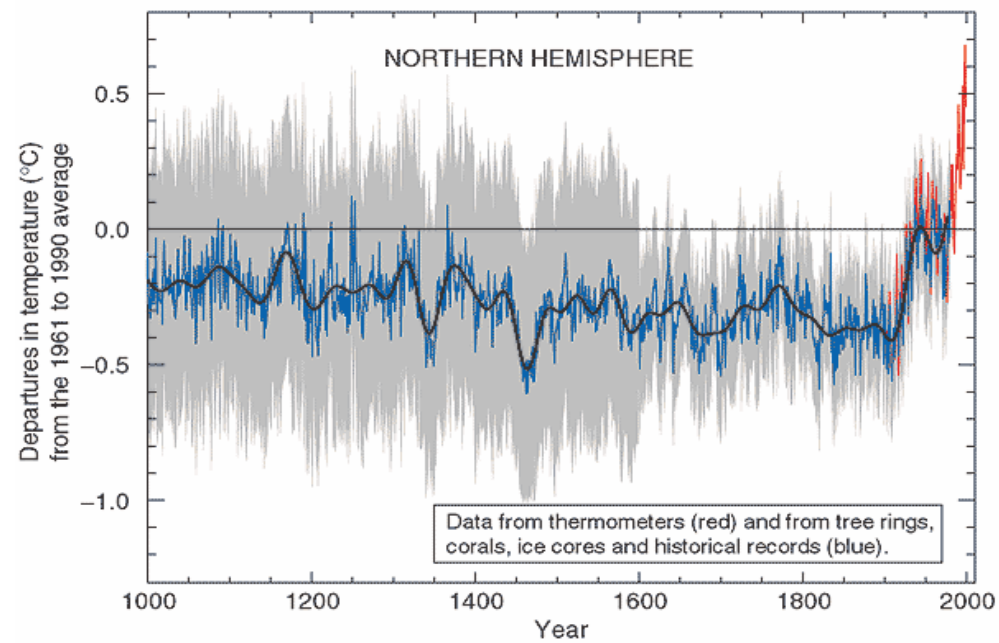


Variations of the Earth's surface temperature for:

(a) the past 140 years



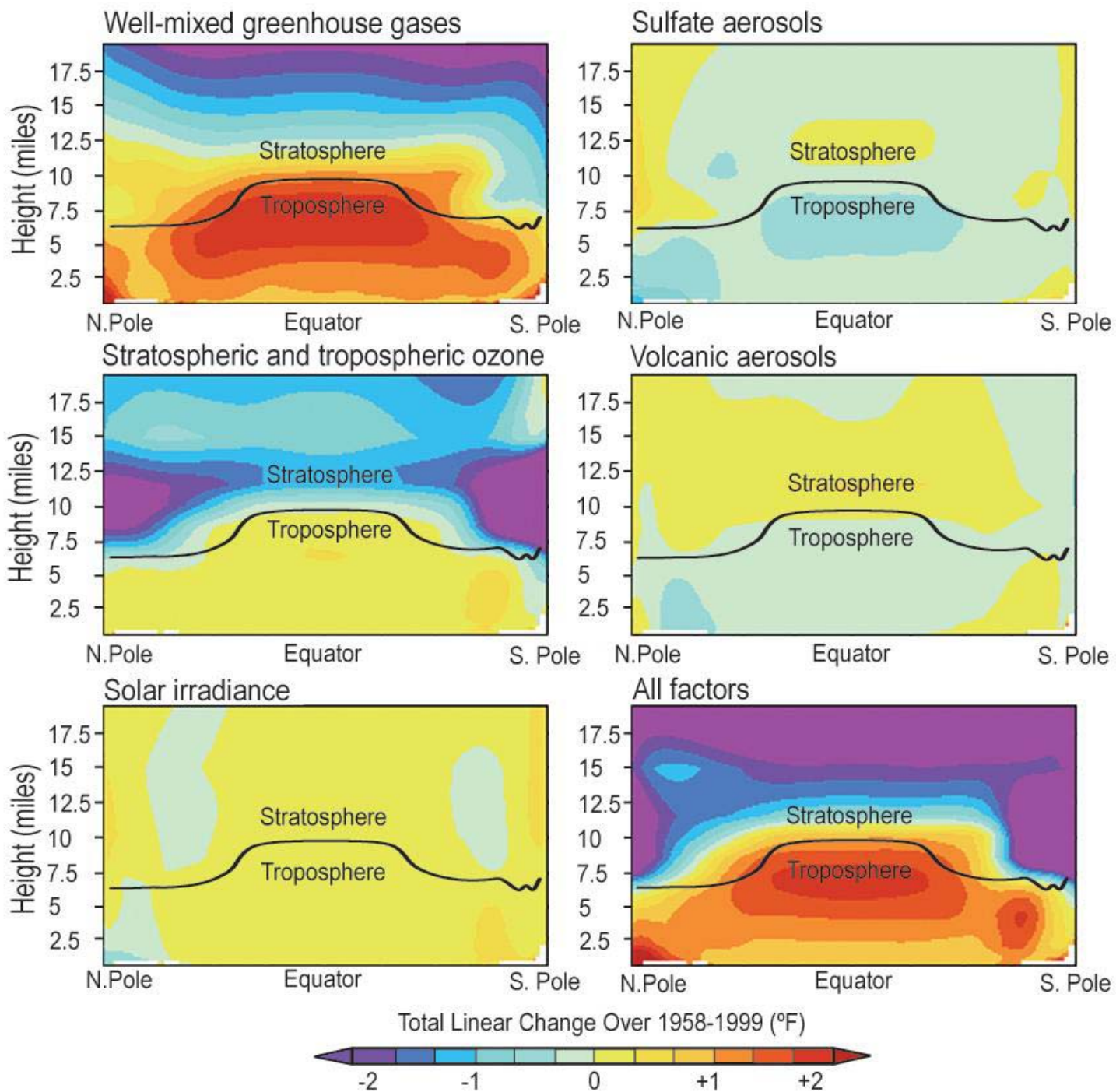
(b) the past 1,000 years



Other evidences of climate change: increases in

- storms**
- floods**
- heat waves**
- droughts**
- hurricanes**
- sea level**
- upper ocean temperatures**
- Arctic summer sea ice melting**
- vertical temperature gradients**
-**

These are consistent with model predictions of the impact of increases in greenhouse gases.



Ben Santer

Testimony for US House Committee on Science and Technology

“Extraordinary claims require extraordinary proof. The **IPCC's** extraordinary claim that **human activities significantly altered both the chemical composition of Earth's atmosphere and the climate system** has received extraordinary scrutiny. This claim has been independently corroborated by the **U.S. National Academy of Sciences**, the **Science Academies of eleven nations** , and.....”

Positive proof of global warming.



**18th
Century**

1900

1950

1970

1980

1990

2006

Other evidences of climate change: increases in

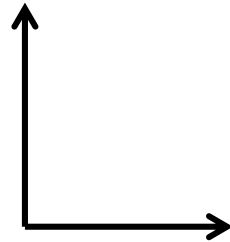
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But how can one rule out natural climate variability as possible cause?

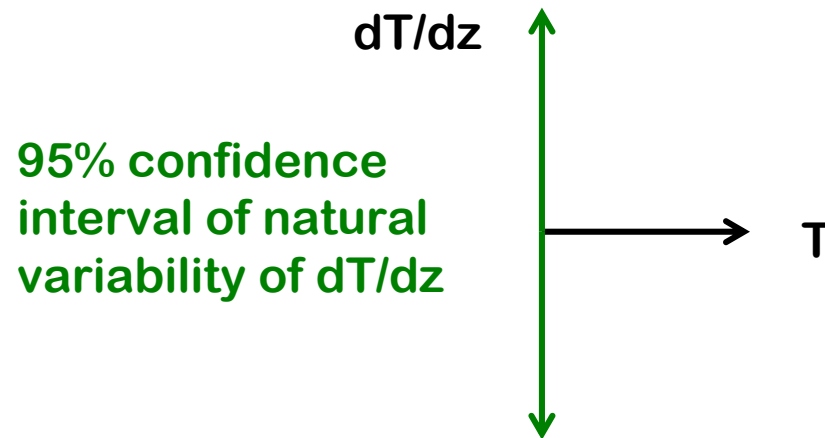
Detection of human induced climate change by the multi-component (fingerprint) method

Vertical atmospheric
temperature gradient dT/dz

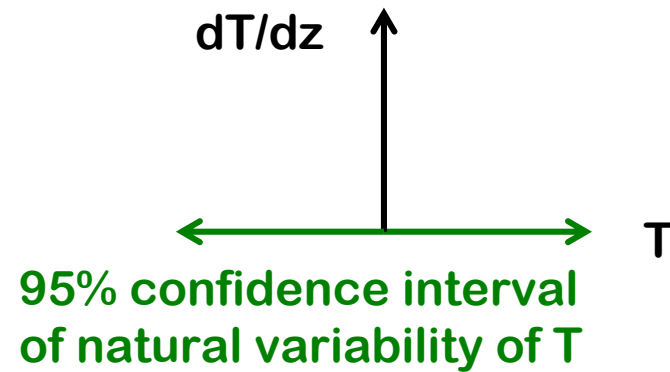


Global mean
surface
temperature T

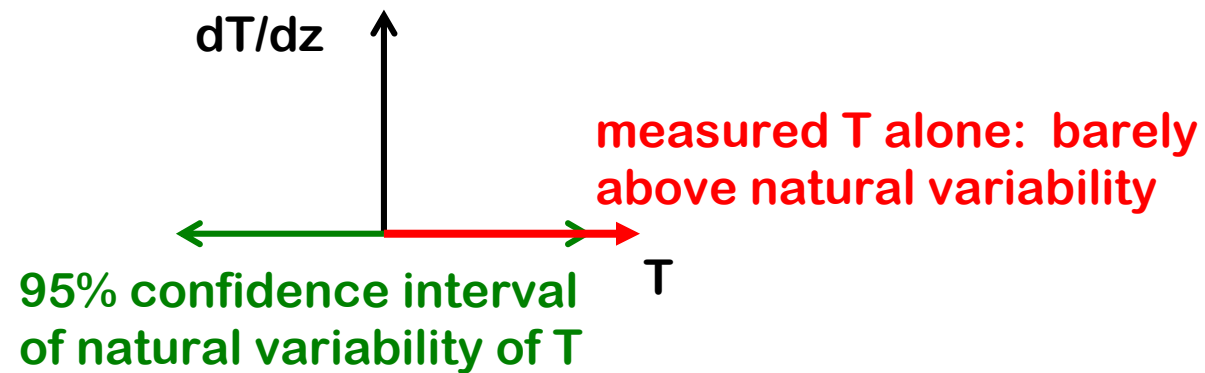
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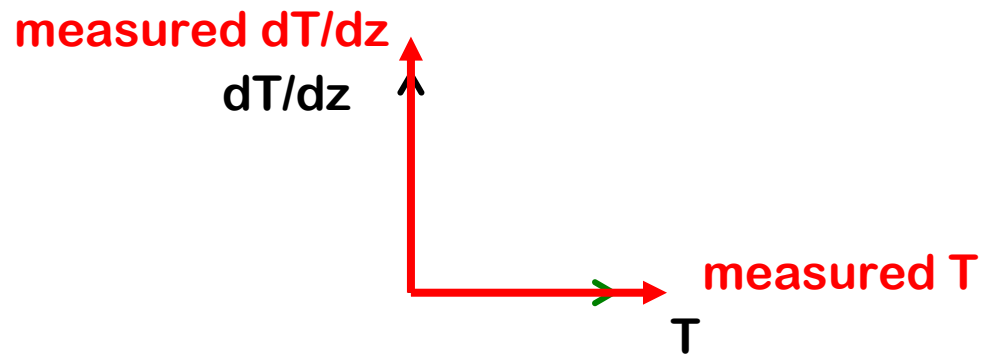
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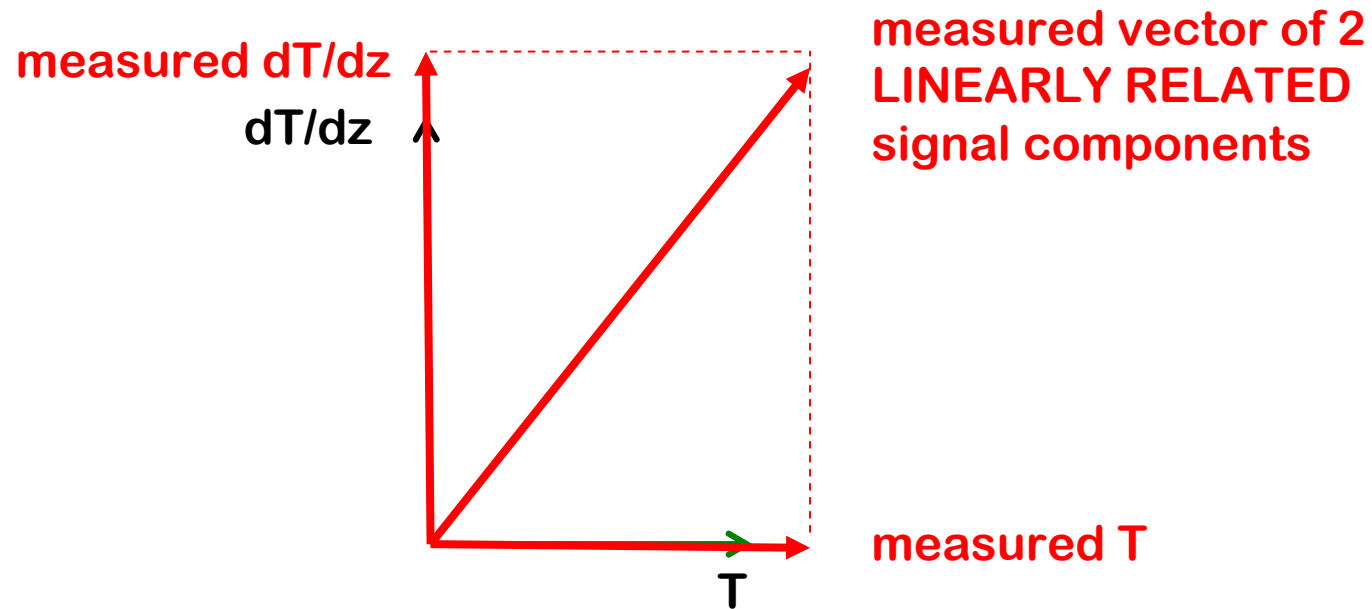
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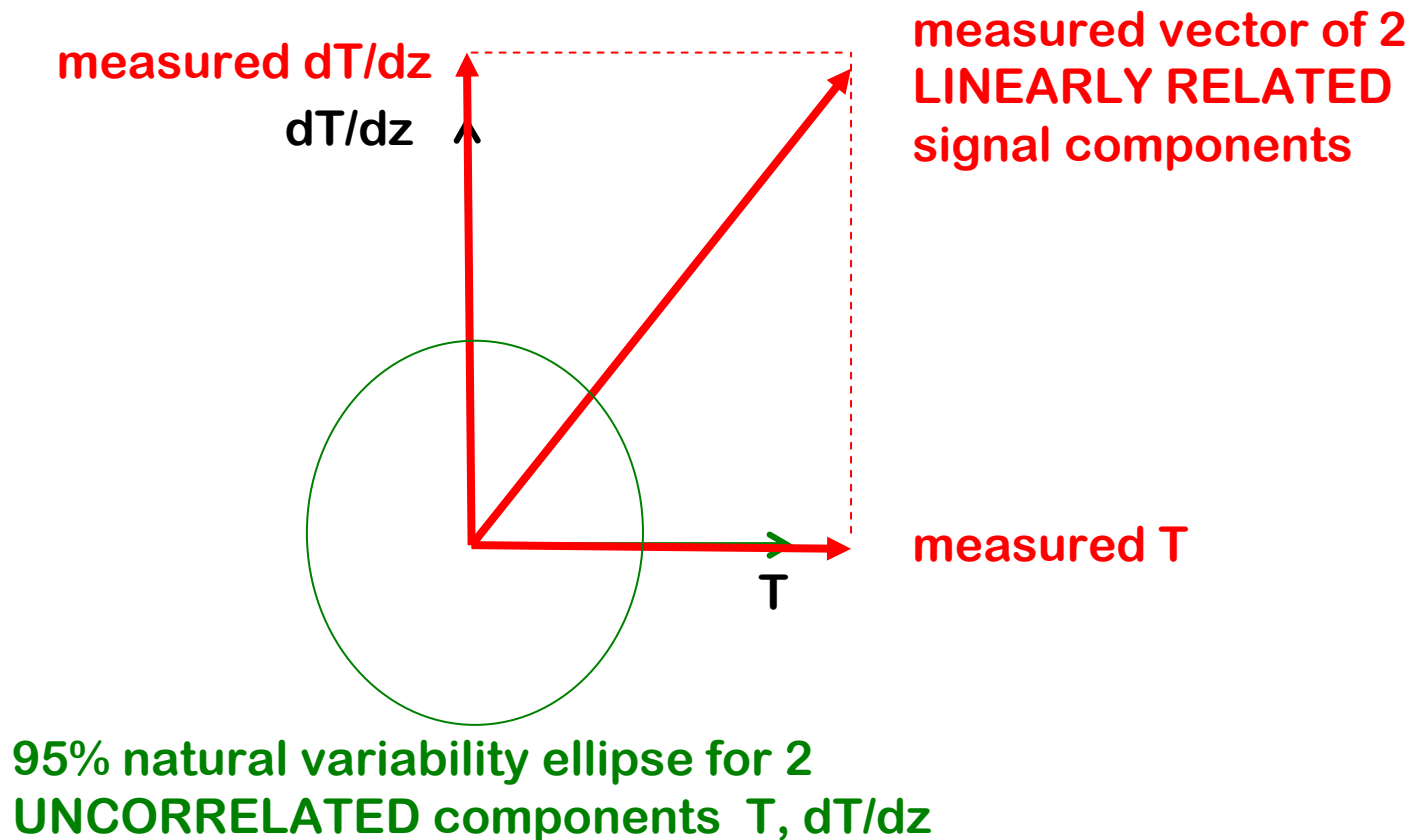
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Detection of human induced climate change by the multi-component (fingerprint) method



Data used by the International Detection and Attribution Group to demonstrate human impact on climate using the fingerprint method:

- surface temperatures**
- tropospheric height**
- ocean heat content**
- sea level pressure**
- rainfall patterns**
- surface humidity**
- atmospheric moisture**
- continental river run-off**
- Arctic sea-ice extent**

However, the problem is not the global warming observed today ($\sim 0.8^{\circ}\text{C}$), but rather the $3\text{-}4^{\circ}\text{C}$ projected global warming in the next decades if no mitigation actions are undertaken.

This is of the same order as the warming since the last ice age, but will occur within 50-100 years, as compared with the 20 000 years warming period since the last ice age.

Atmospheric Carbon dioxide concentrations from the last Ice age until today

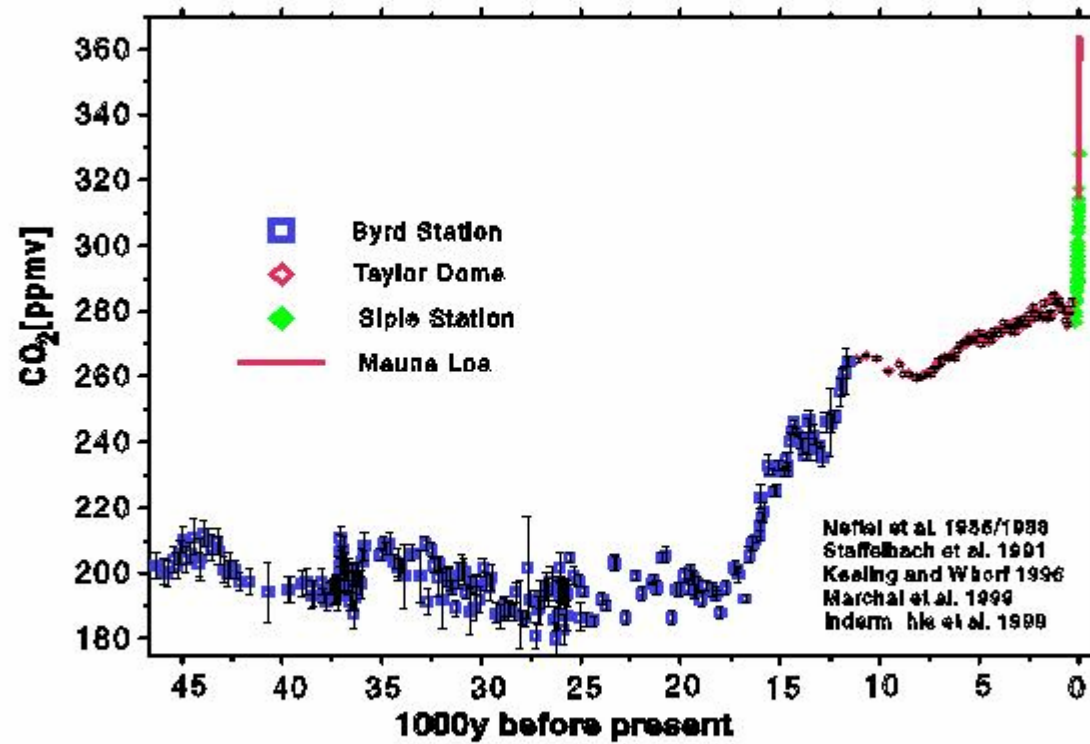
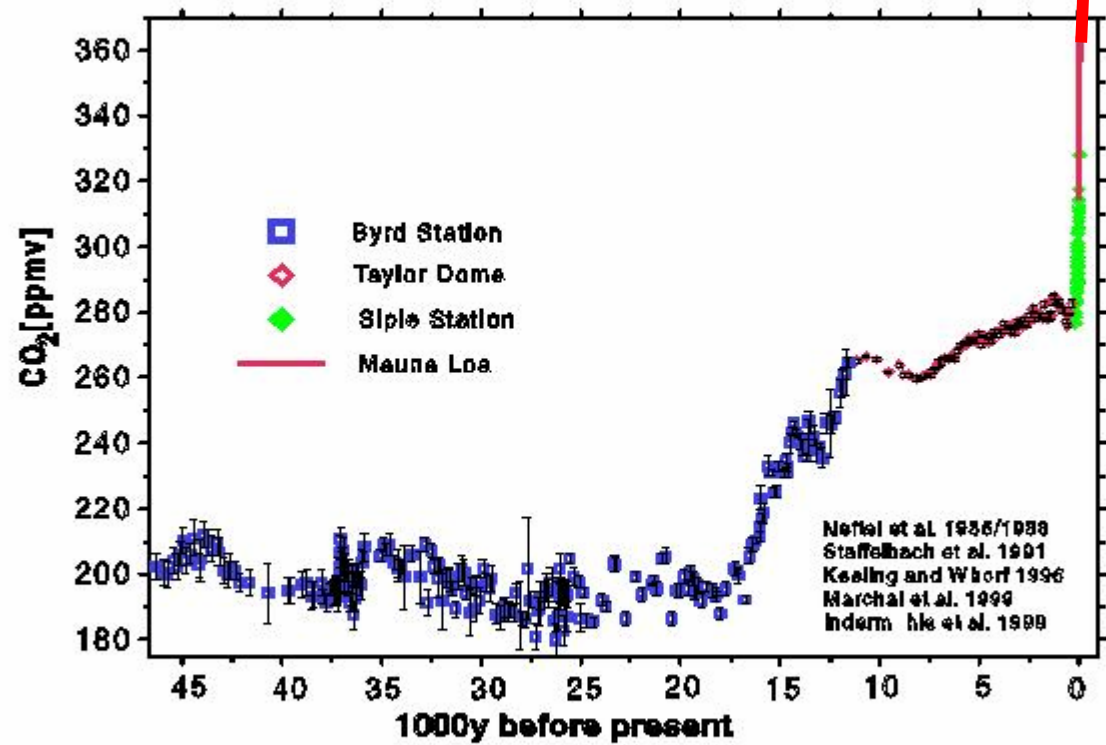


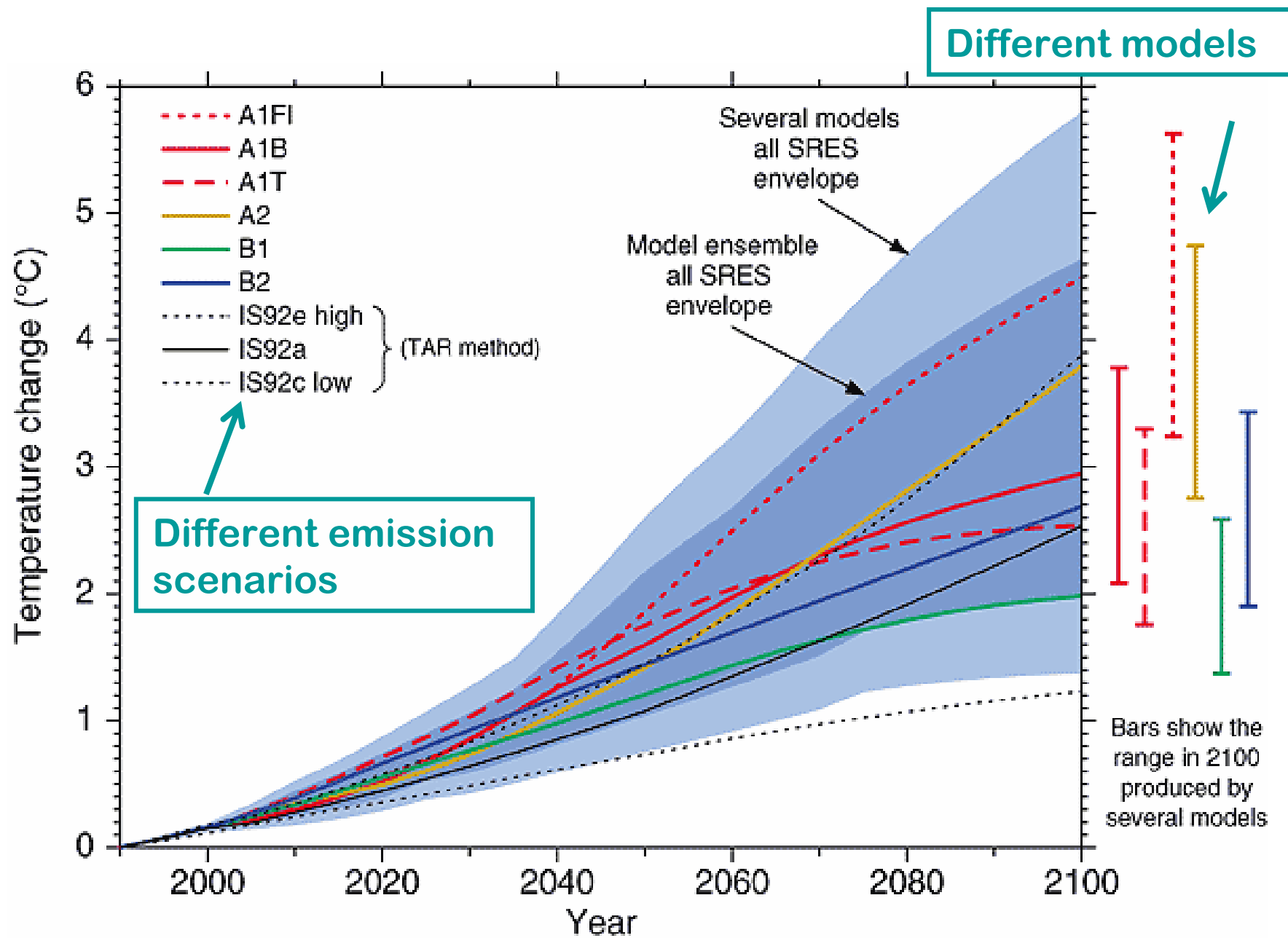
Fig 1b (IPCC)

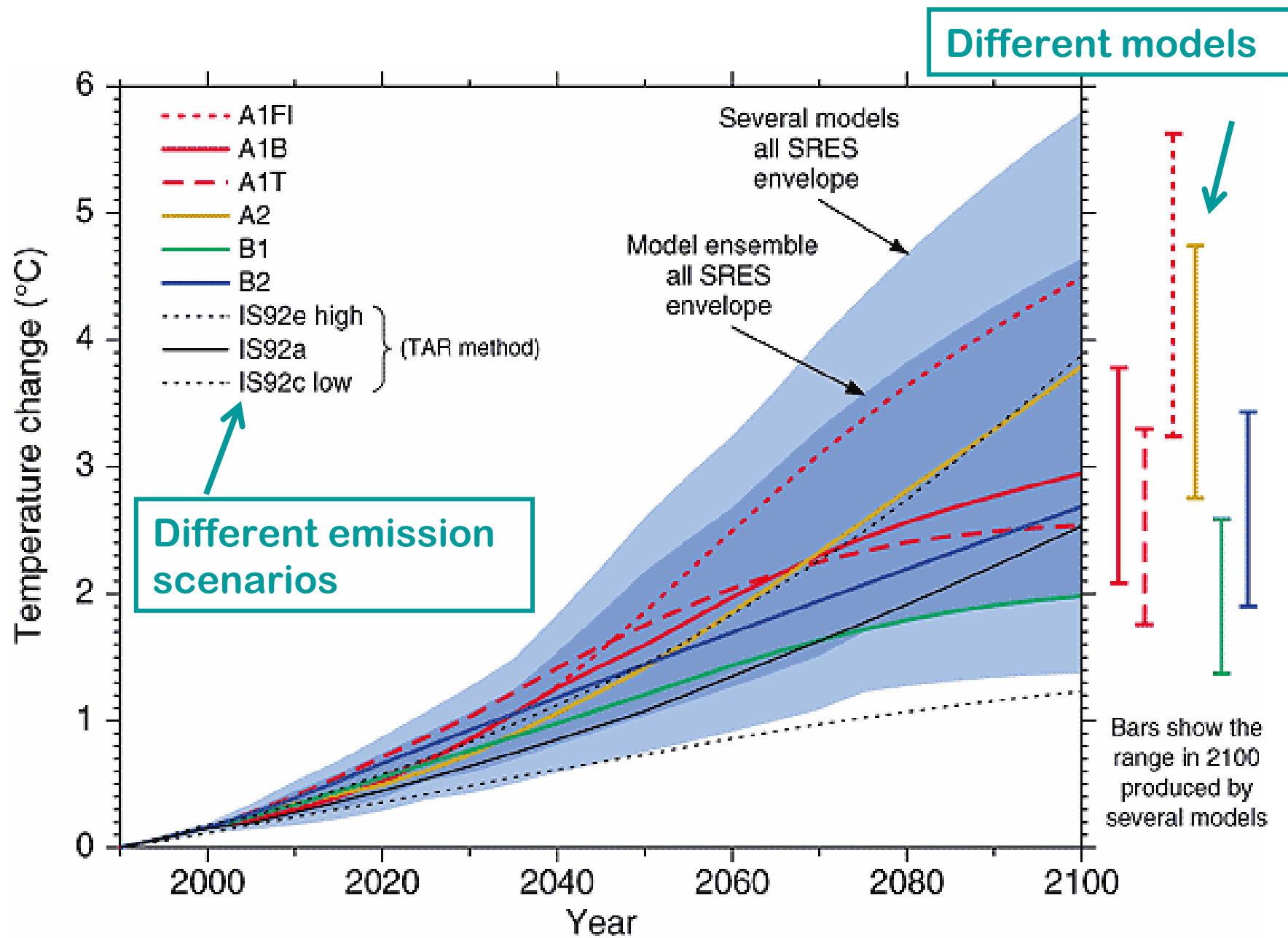
**Atmospheric Carbon dioxide concentrations
from the last Ice age until today**



projection
2100:
~ 1000 ppm

Fig 1b (IPCC)





Latest data show a still stronger global warming rate through the rapid economic growth of China and other emerging economies

Impact of a 3⁰C global warming:

- 0.5 m sea level rise (in 2100, higher in future centuries)
- expansion of deserts
- stronger storms in higher latitudes
- stronger tropical cyclones
- less precipitation in dry areas, more in wet areas
- ice free Arctic Ocean in summer
- melting of permafrost areas
- extension of tropical disease areas
- tipping points (melting of Greenland and/or West-Antartic ice-sheets, methane release, Gulfstream collapse,..)

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How reliable? Qualitatively established, quantitatively more uncertain than global mean values. Thus: climate policy is insurance policy against likely but uncertain events.

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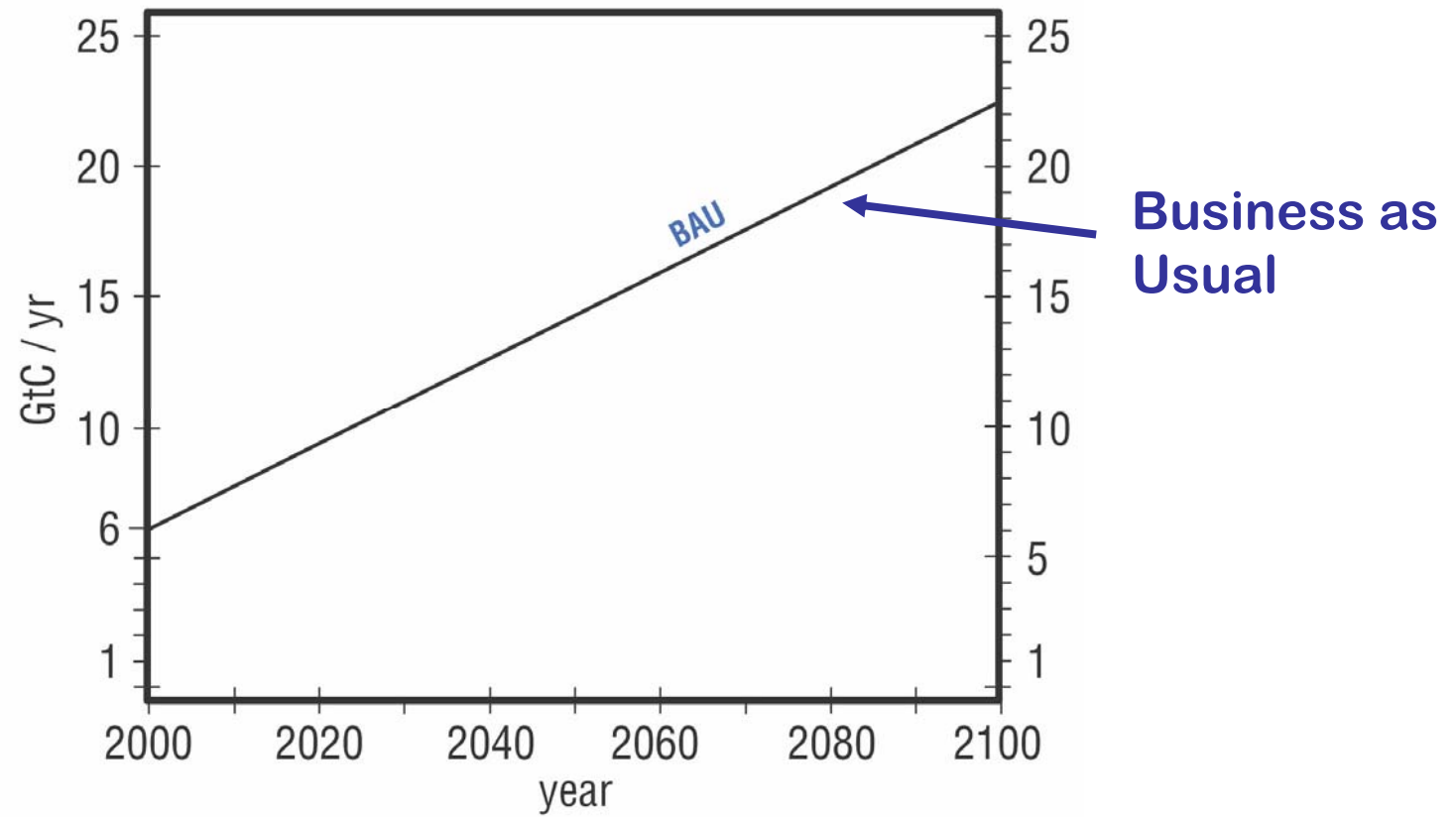
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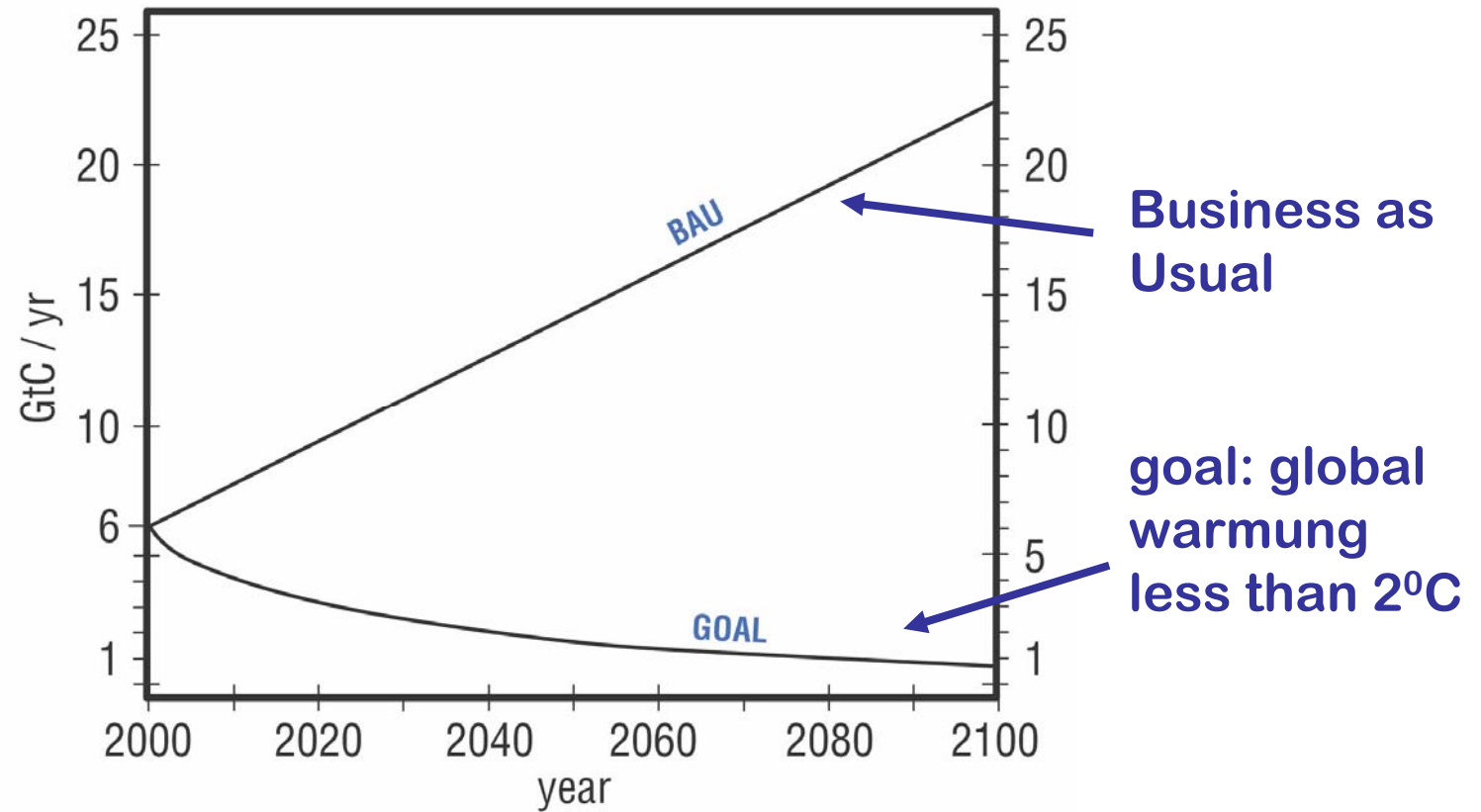
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Mitigation AND adaptation

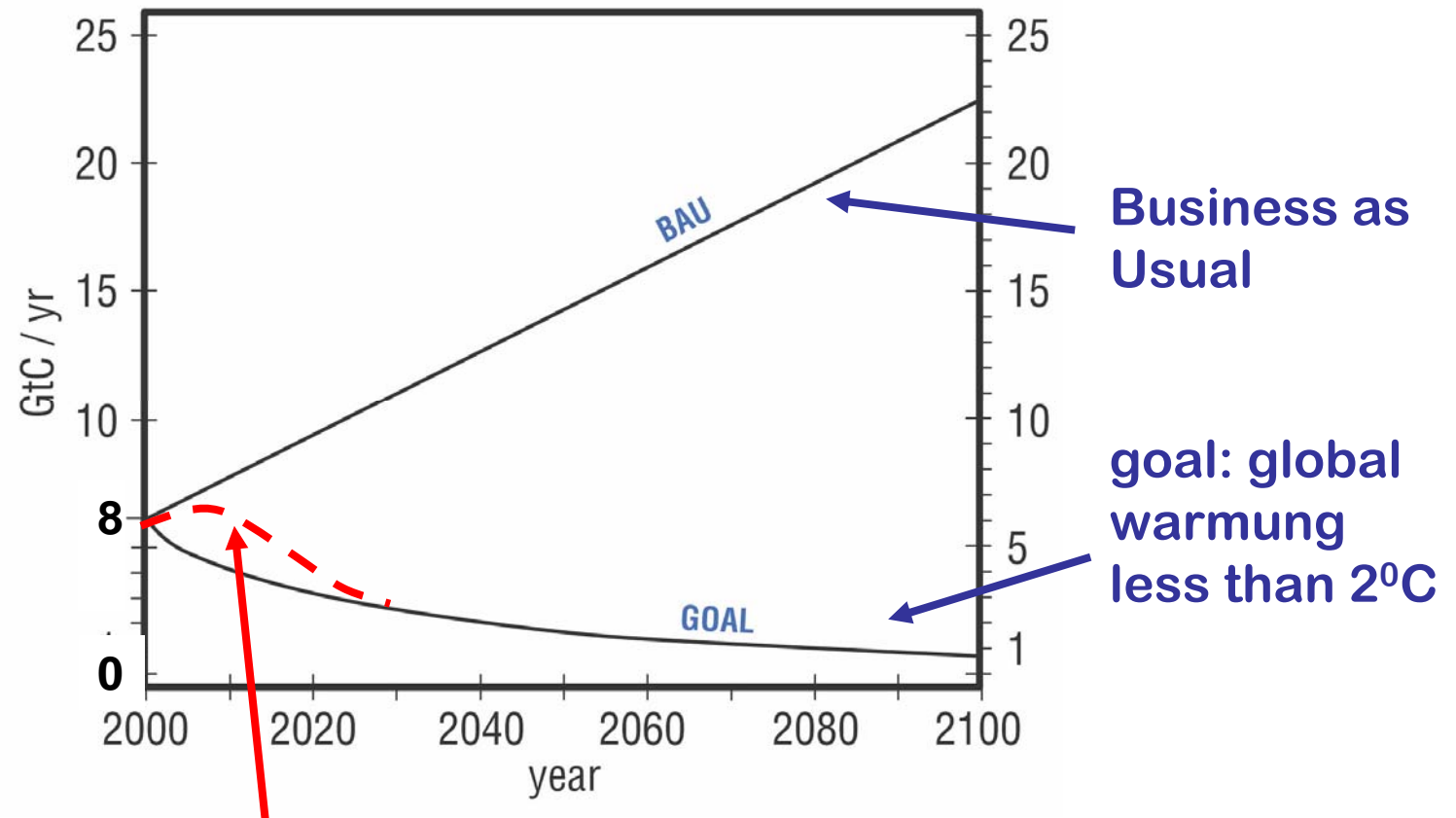
CO₂ Emissionen



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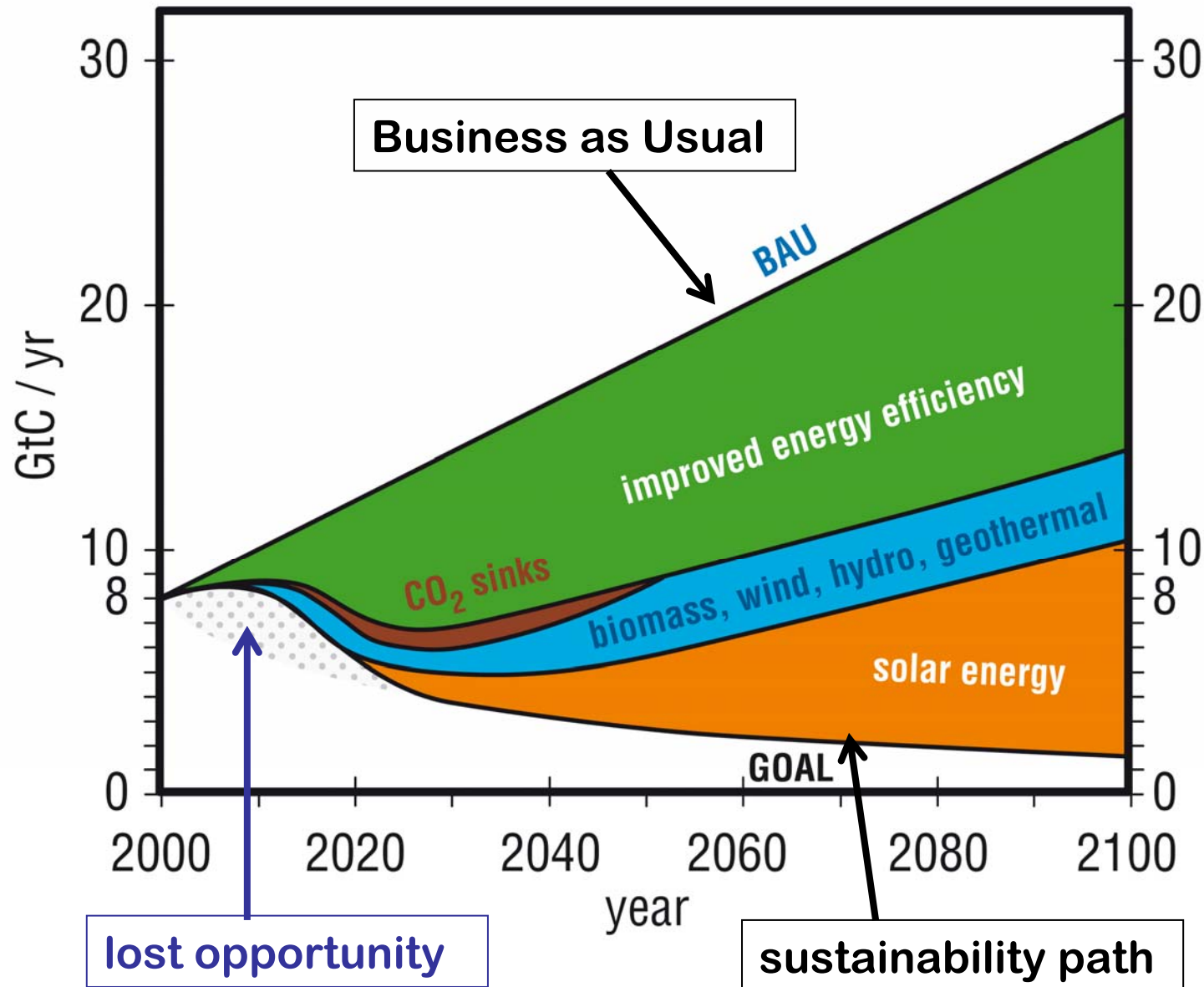


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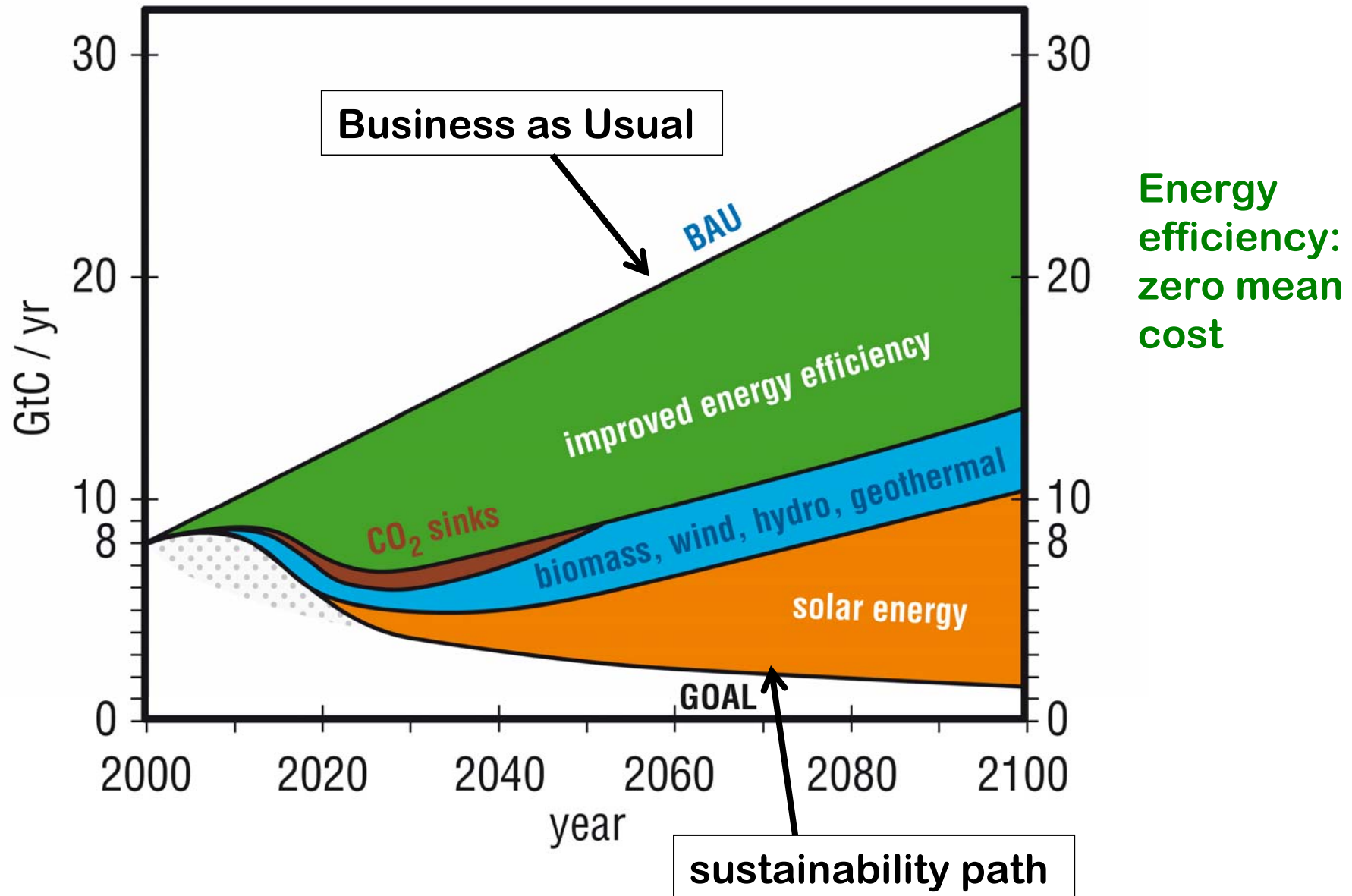


Corrected for time lost since
the Rio World Conference 1992

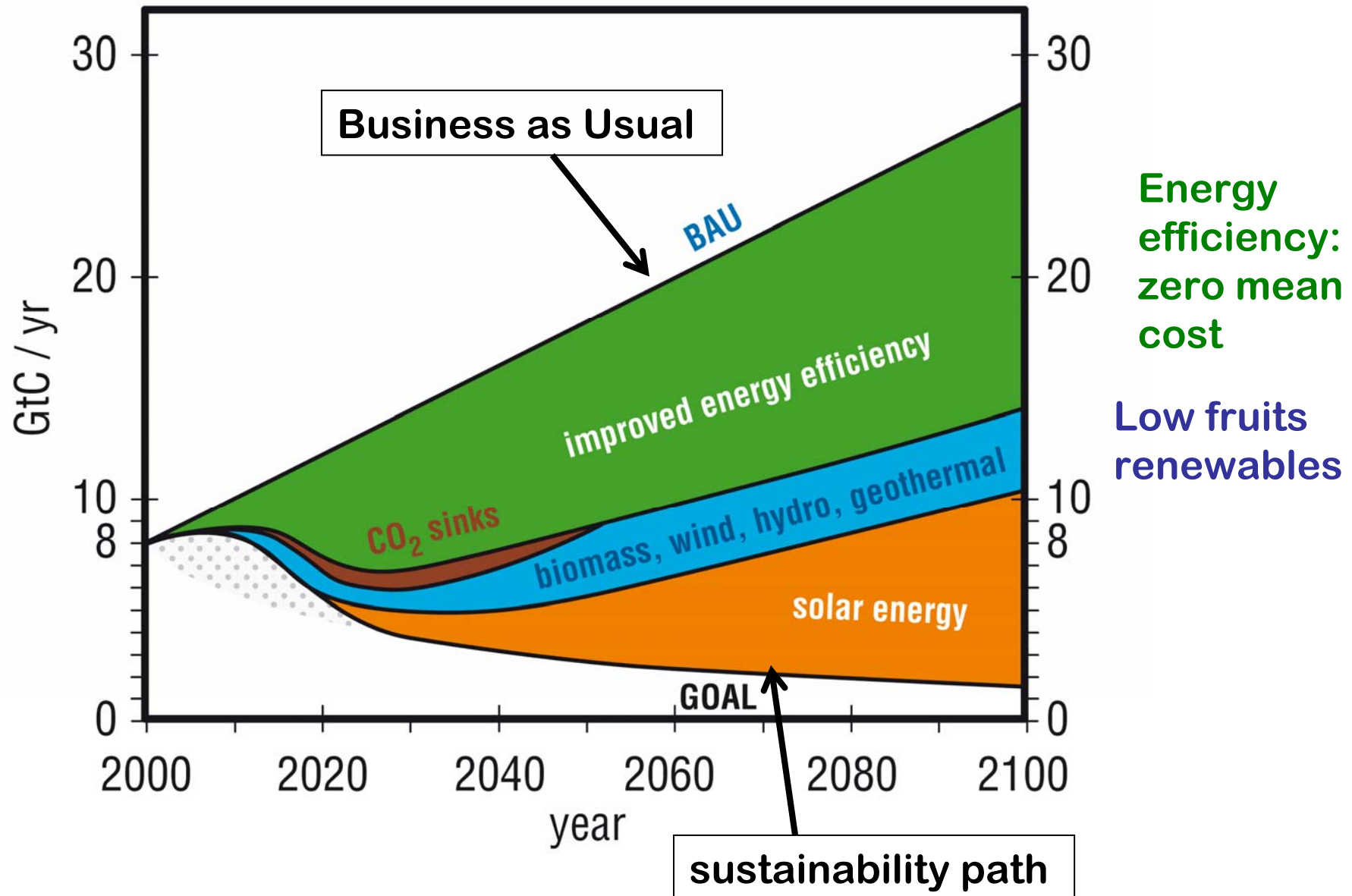
Filling the wedge between projected BAU emissions and a sustainable emissions path ($\Delta T < 2^{\circ}\text{C}$)



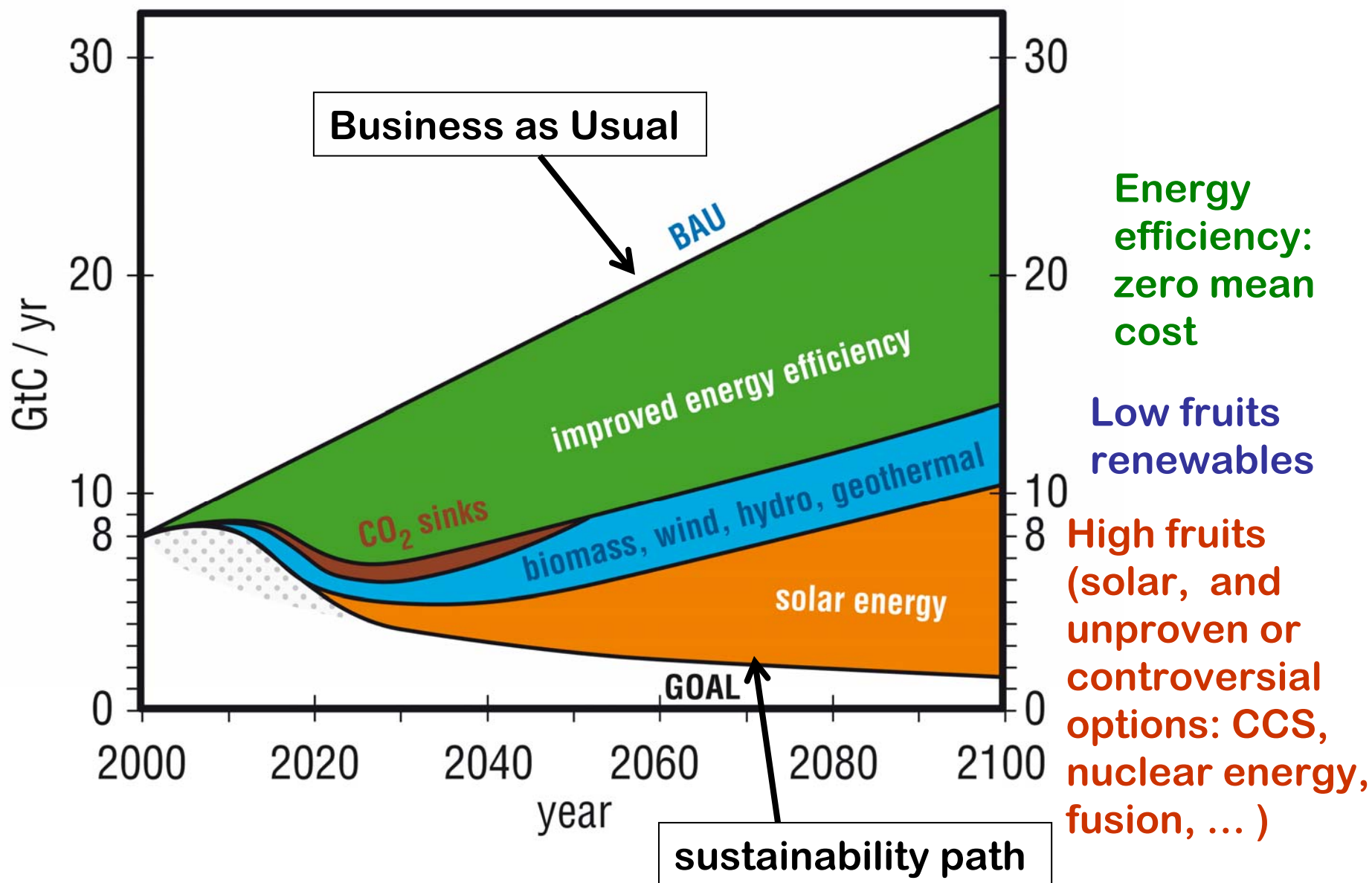
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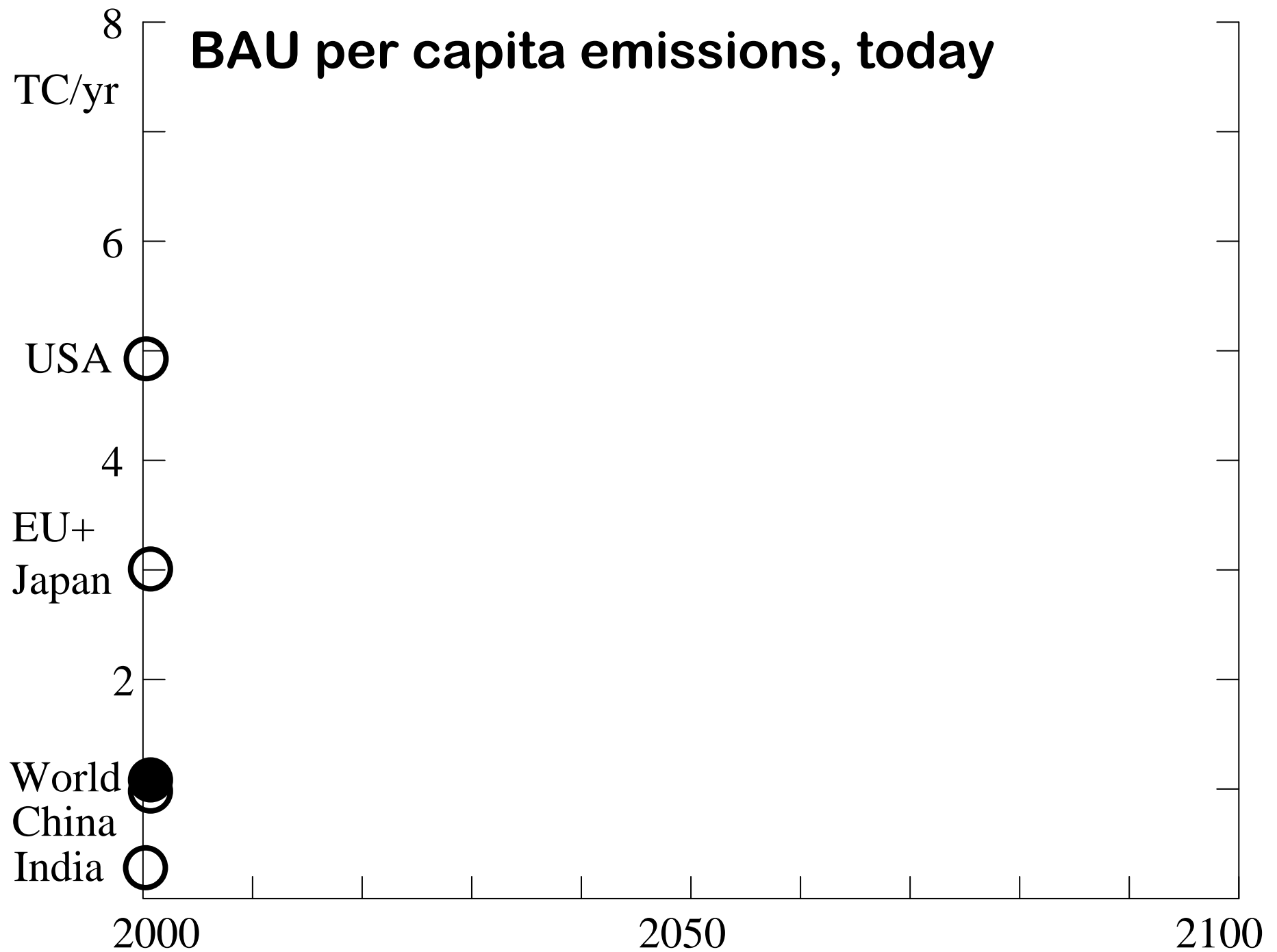
What is the situation if we break the emissions down to individual countries, and the per capita emissions in each country?

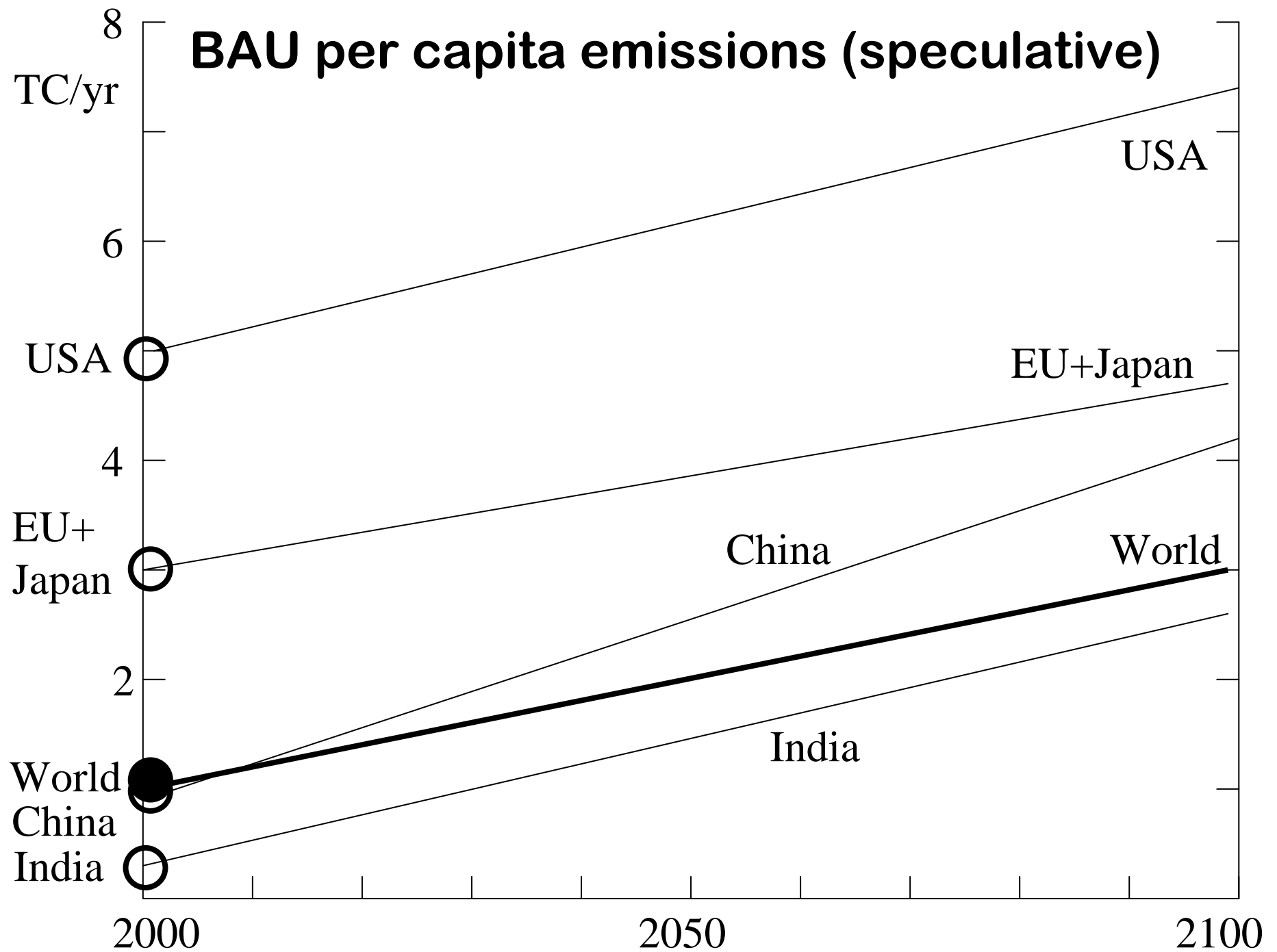
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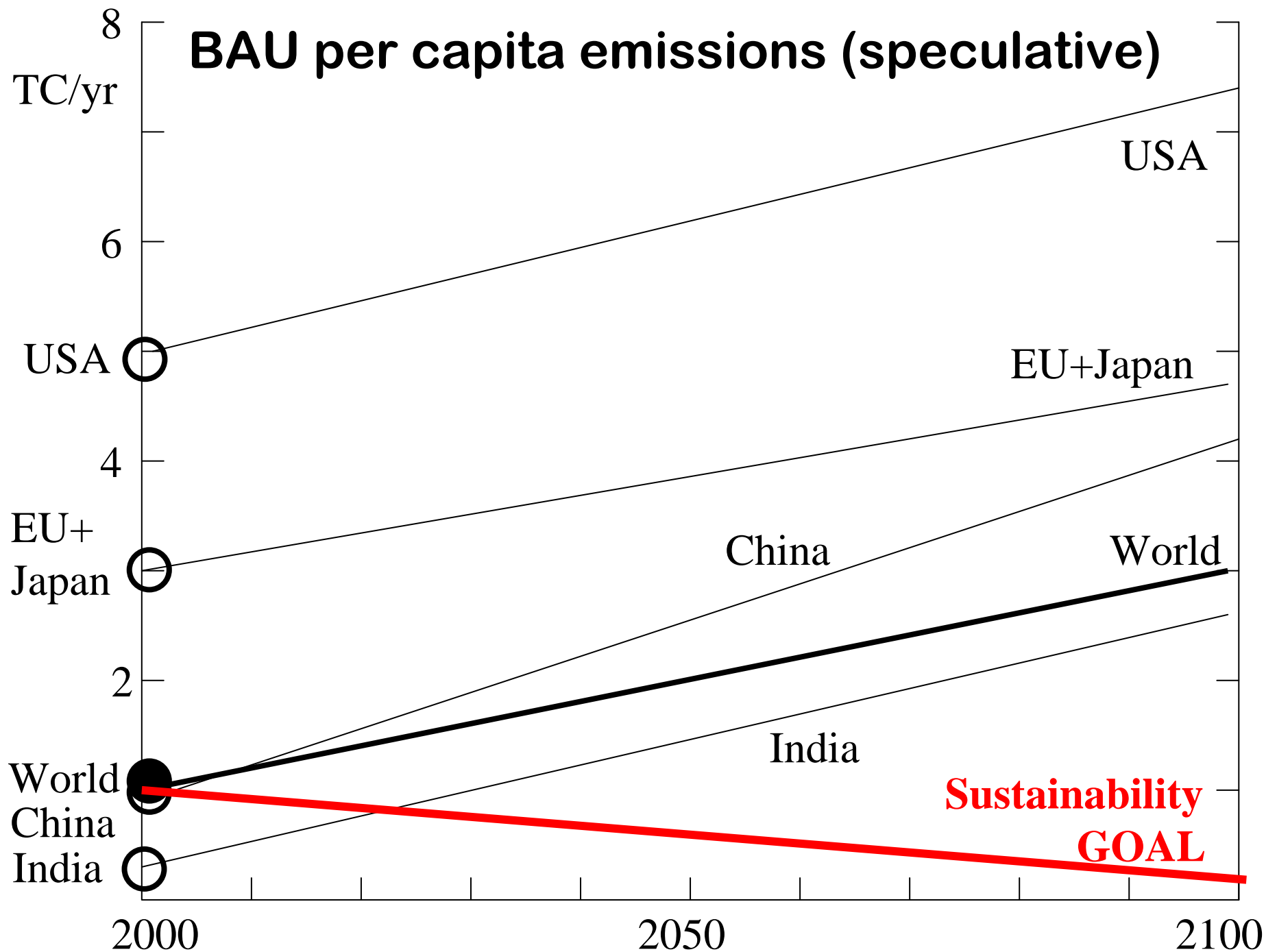
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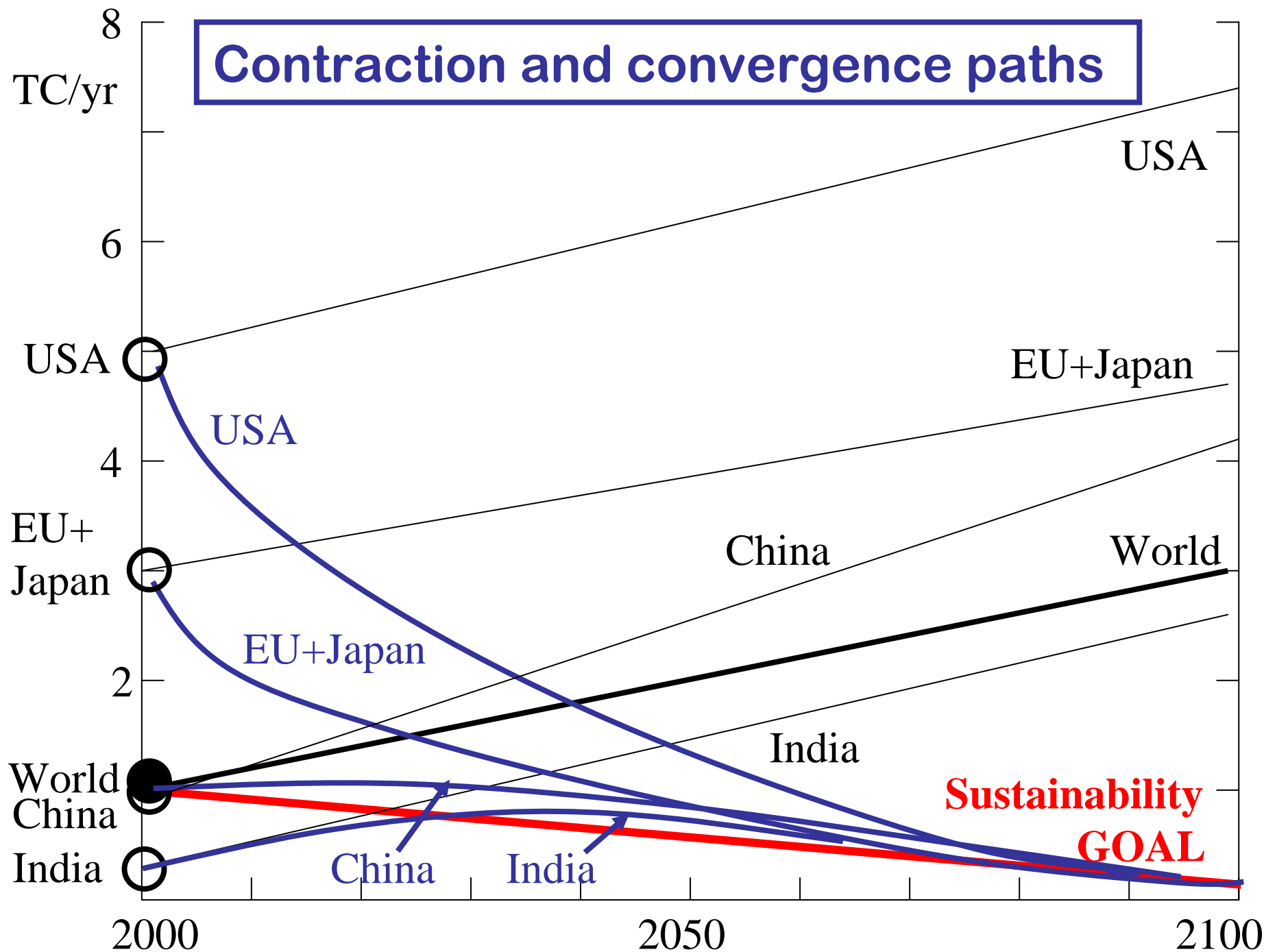
Widely accepted basic human rights principle:

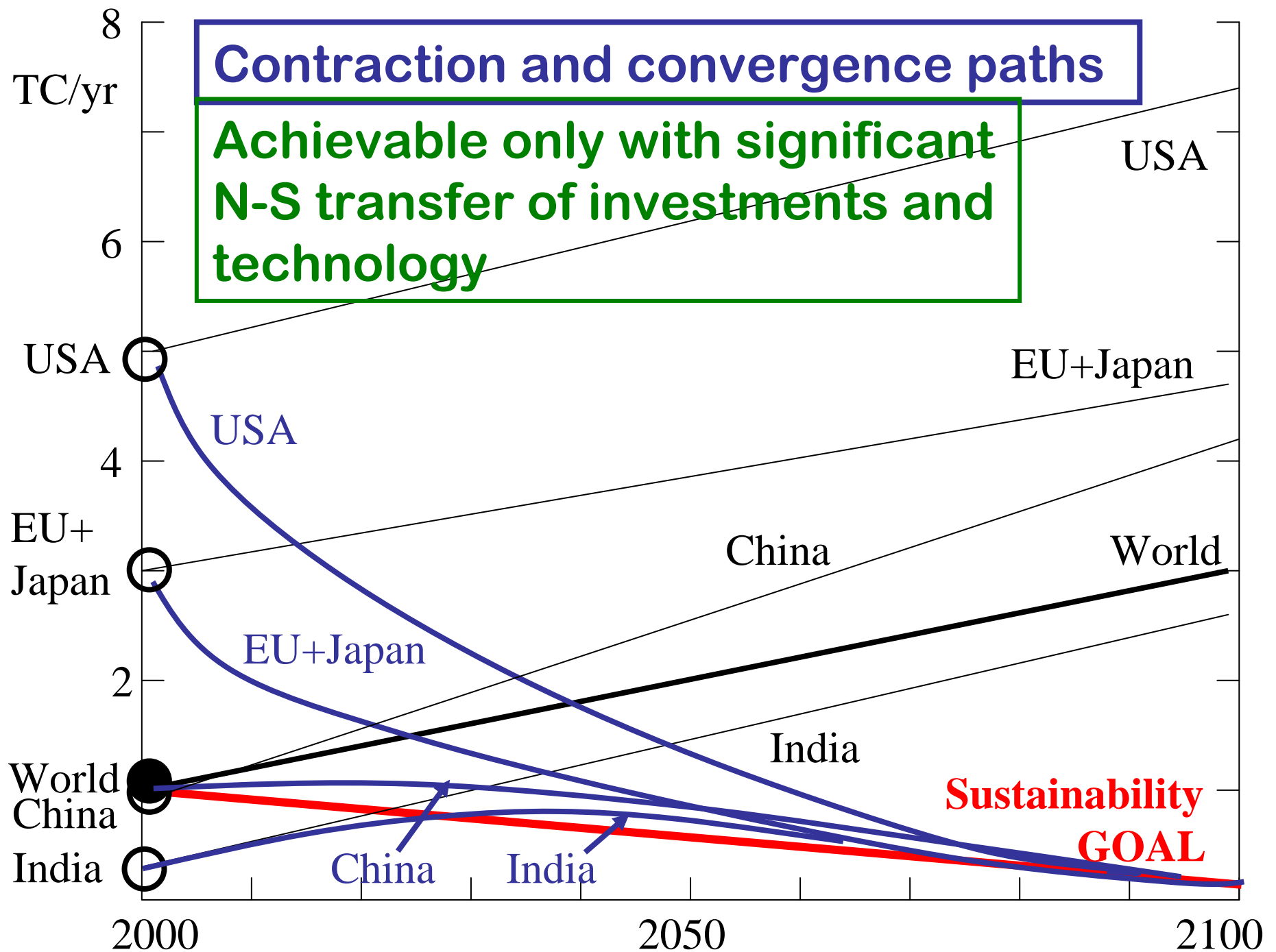
Each human being should have the same rights to the same amount of total greenhouse gas emissions.











A budget approach:

**Average per capita CO₂ emission allowance
under 2°C global warming restriction: 150 tons**

**Accepting equal per capita emission rights, at the
present rate of consumption, this allowance would
be used up after**

7 years in the US,

15 years in Europe and Japan

**30 years in China (corresponds also to world
average person)**

**Thus we can afford no delay in climate mitigation
policies!**

Current emission reduction commitments will lead to 3 – 4°C global warming by 2100.

Why did Copenhagen and Cancun fail?

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Why did Copenhagen and Cancun fail?

A classical “Tragedy of the Commons” dilemma (Garrett Hardin, Nature, 1968) :

Farmers grazing cattle on joint owned fields (the “commons”) must agree to limit the total number of cattle to preserve the commons.

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A classical “Tragedy of the Commons” dilemma (Garrett Hardin, Nature, 1968) :

Farmers grazing cattle on joint owned fields (the “commons”) must agree to limit the total number of cattle to preserve the commons.

Similarly, everybody accepts the need to prevent dangerous global warming, but everybody tries to shift the “burden” of mitigation onto other shoulders.

Garrett Hardin: no solution without means of enforcing compliance with an agreement on emission reductions – therefore no agreement in the first place.

Solution:

- 1. Reframe climate mitigation as a win-win opportunity rather than a cost burden.**

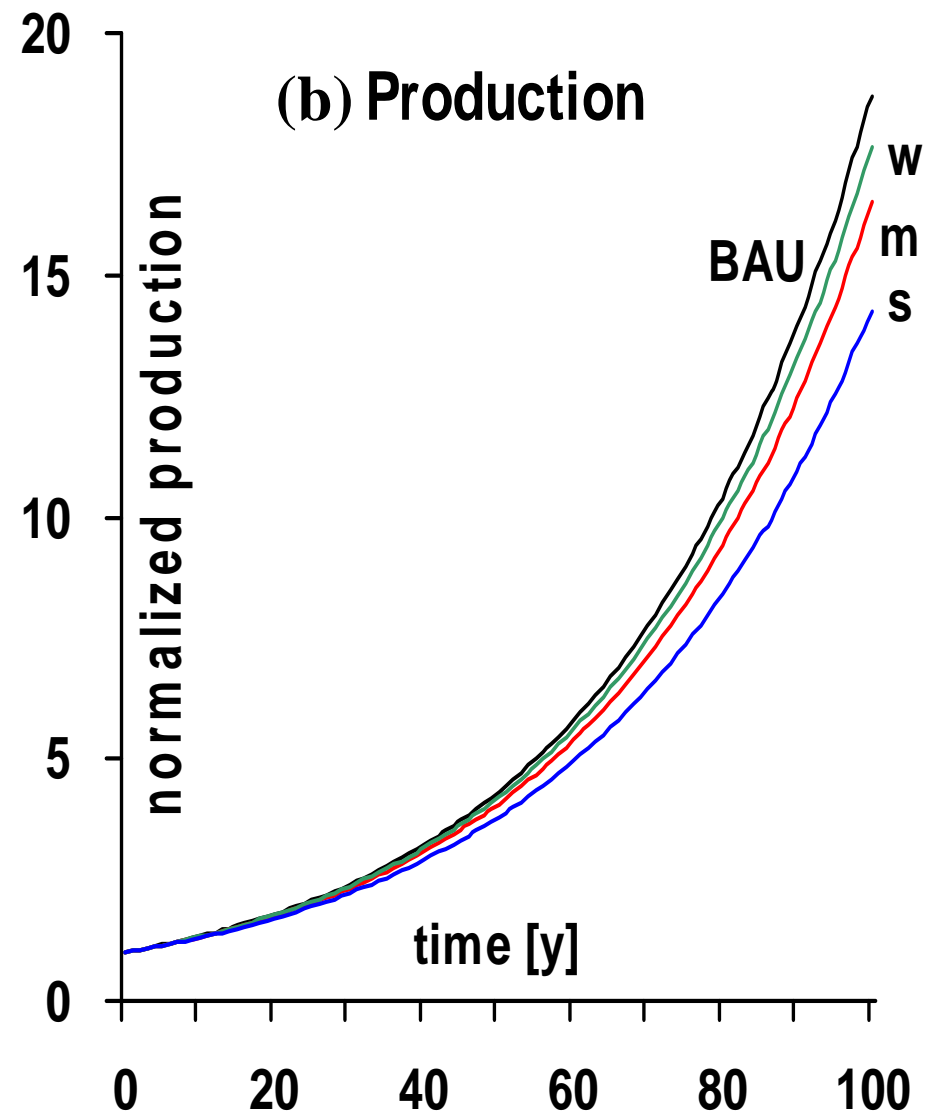
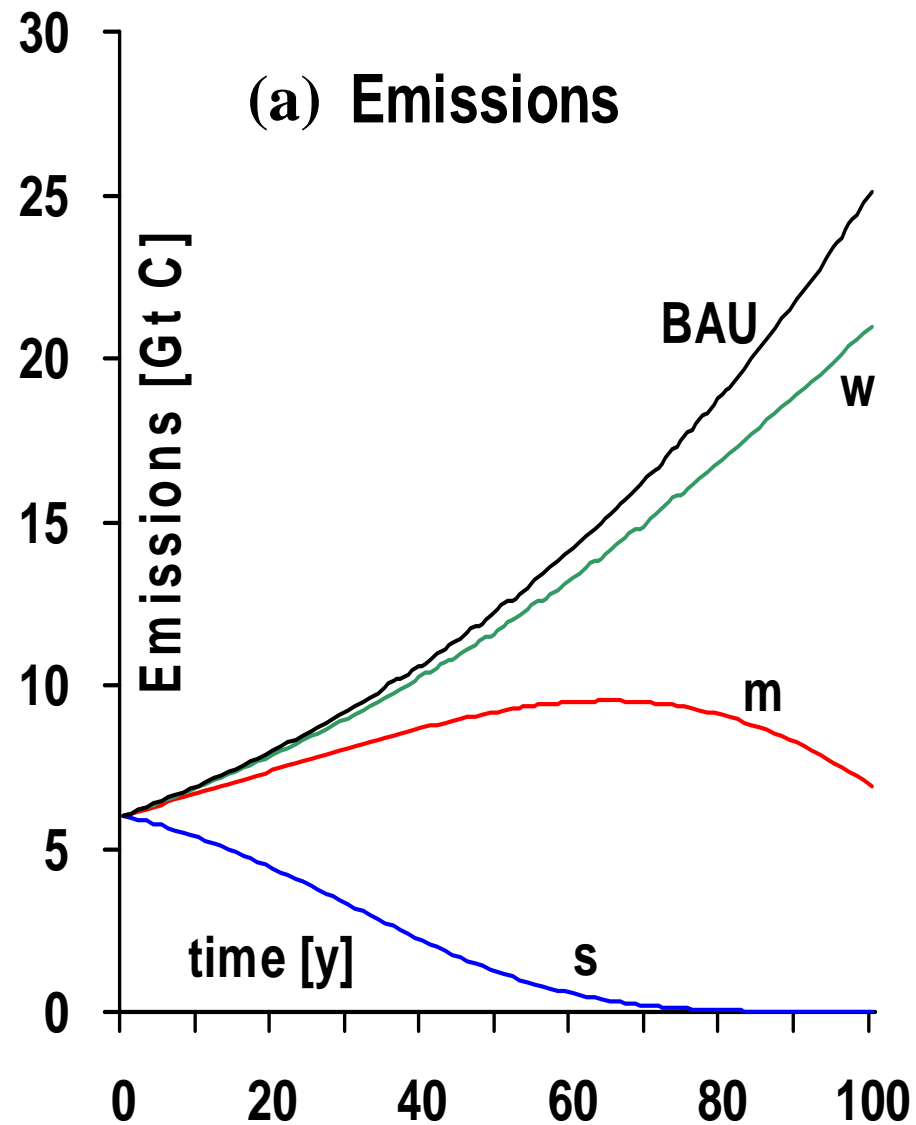
The transformation to a green economy

- creates investment opportunities and economic growth, creating new jobs**
- improves the environment**
- enhances the general quality of life**

Standard cost-benefit approach:

Compute costs of avoiding dangerous climate change, show that these are relatively small compared with the anticipated costs of climate change damages in the Business-As-Usual case.

mitigation measures: w: weak, m: moderate, s: strong



Estimates of the costs of climate change mitigation:

1 % of GDP

Consistent with:

IPCC 4th Assessment Report, 2007

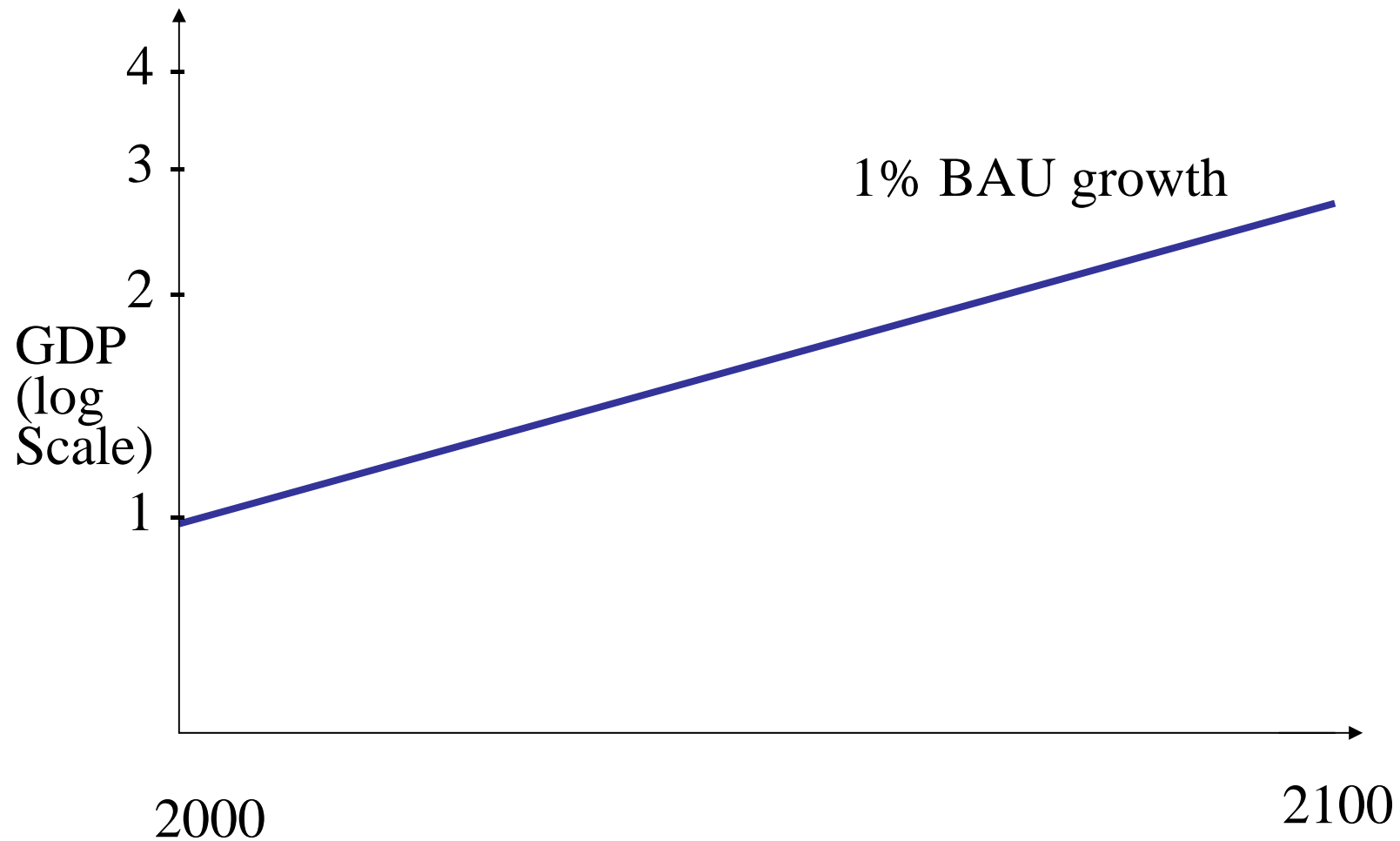
macro-economic model intercomparison, The Energy Journal, Special Issue, 2006

Stern Report, 2007.

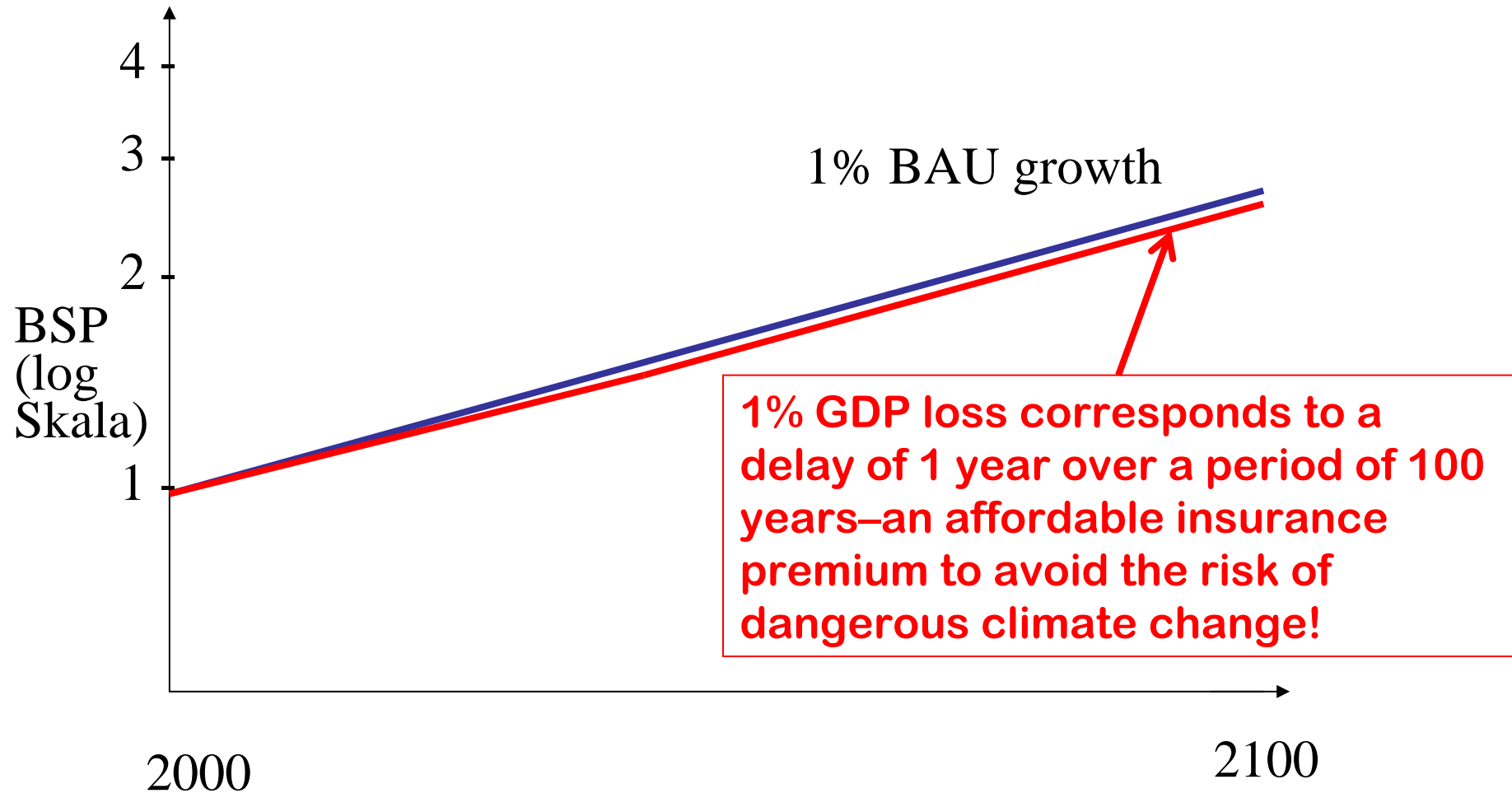
Range of other estimates:

-1 % to + 4% of GDP

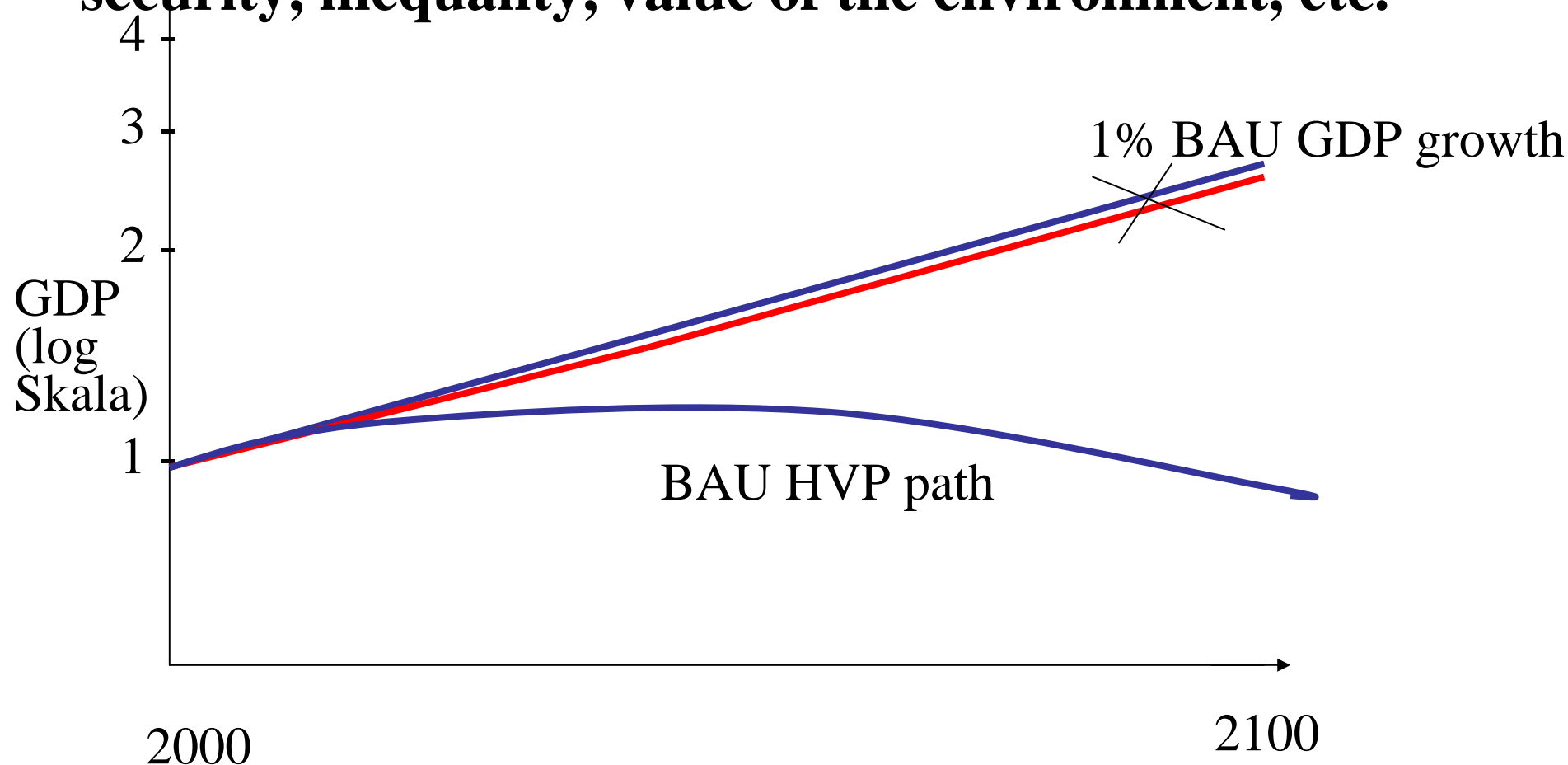
Is climate change mitigation affordable?



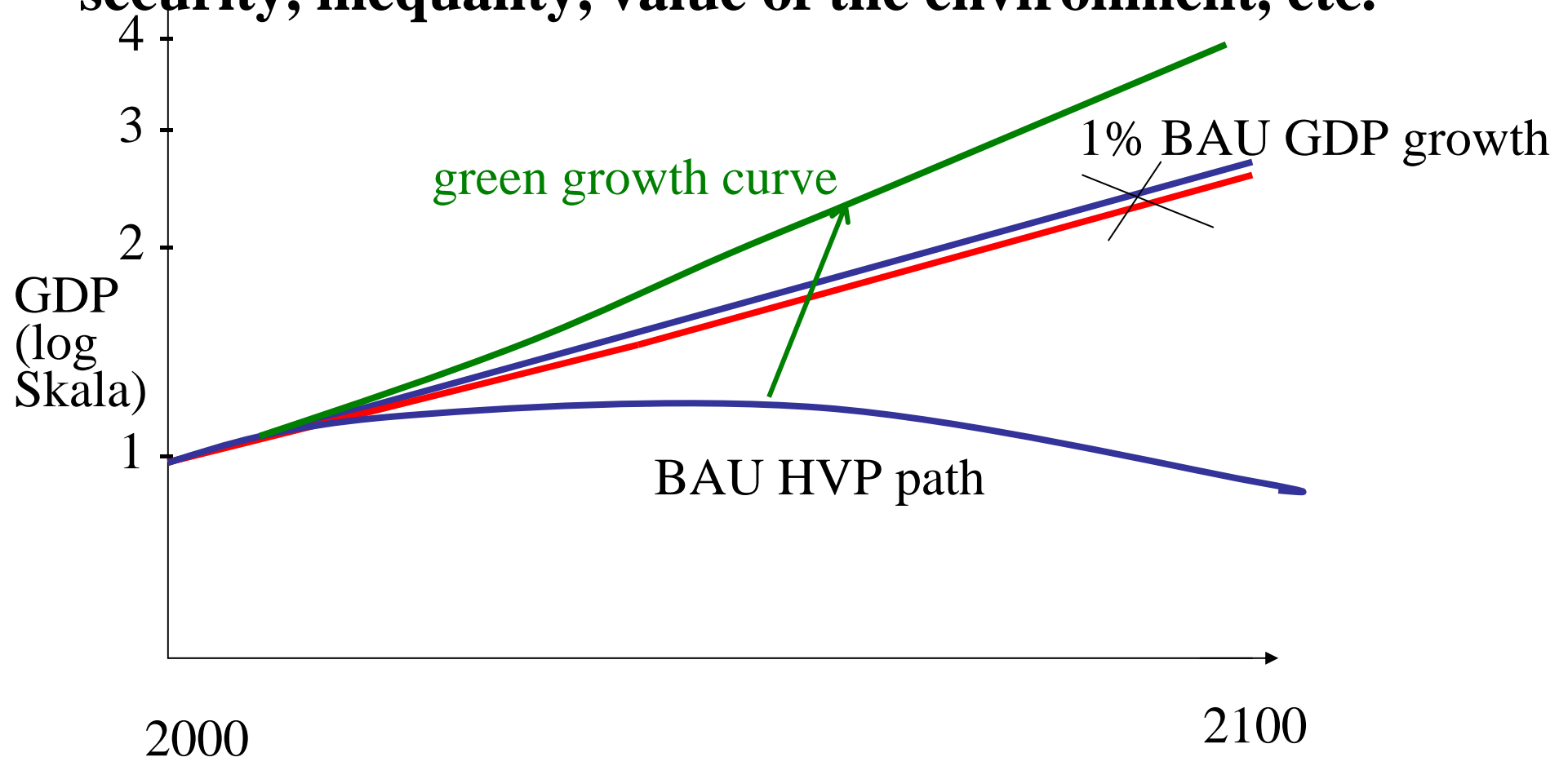
Is climate change mitigation affordable?



**More appropriate view point: replace GDP by HVP
(Human Value of Production) – including social
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The transformation to a green economy

- creates investment opportunities and economic growth, creating new jobs**
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- 2. Combine global climate mitigation (top-down) and local adaptation (bottom-up) measures. “Think globally, act locally.”**

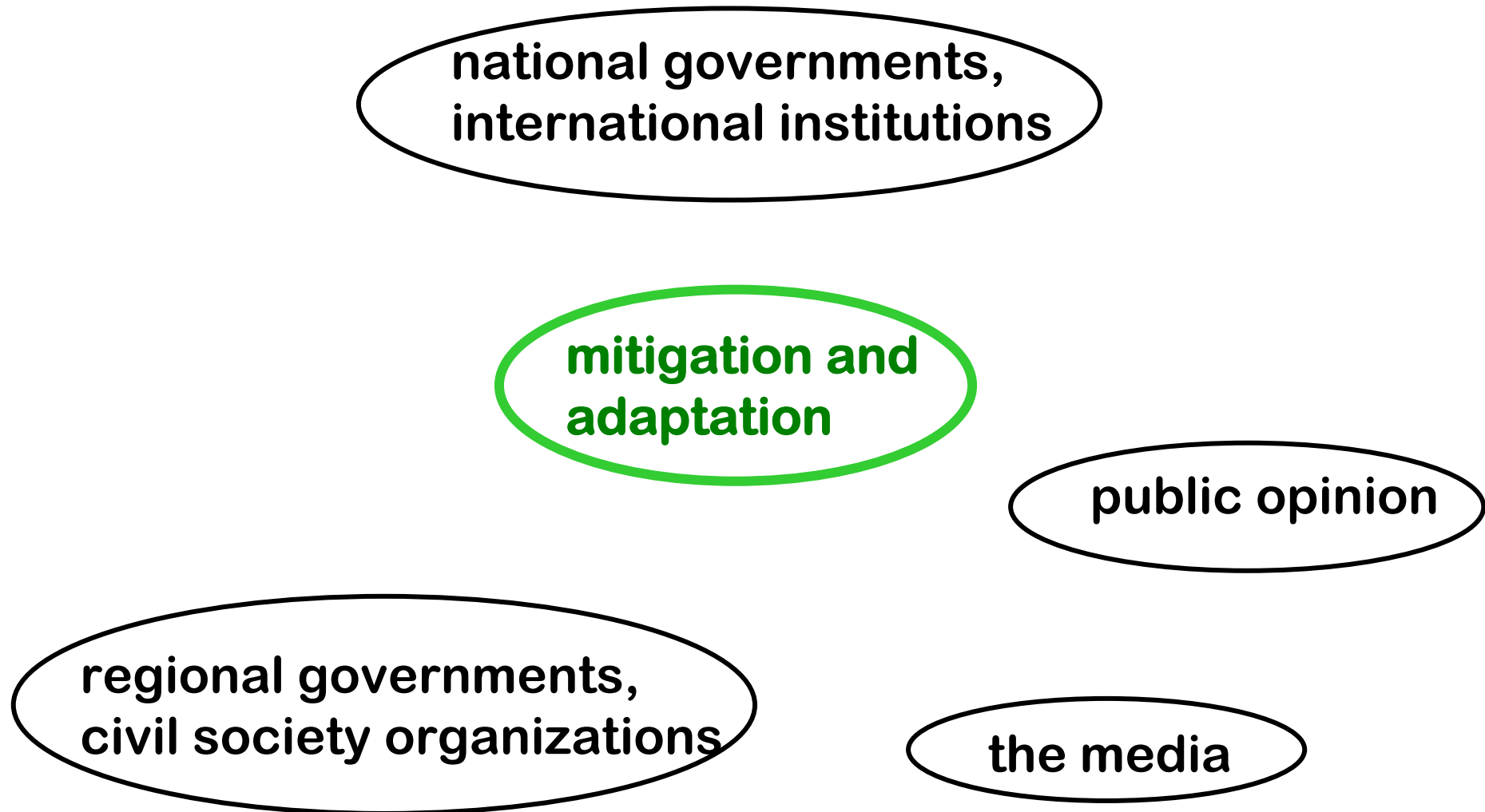
A combined approach embeds climate policy in global issues (water scarcity, land use, forest preservation, energy security, migration, conflict resolution,)

- and applies pressure from the local level to seek truly global solutions!

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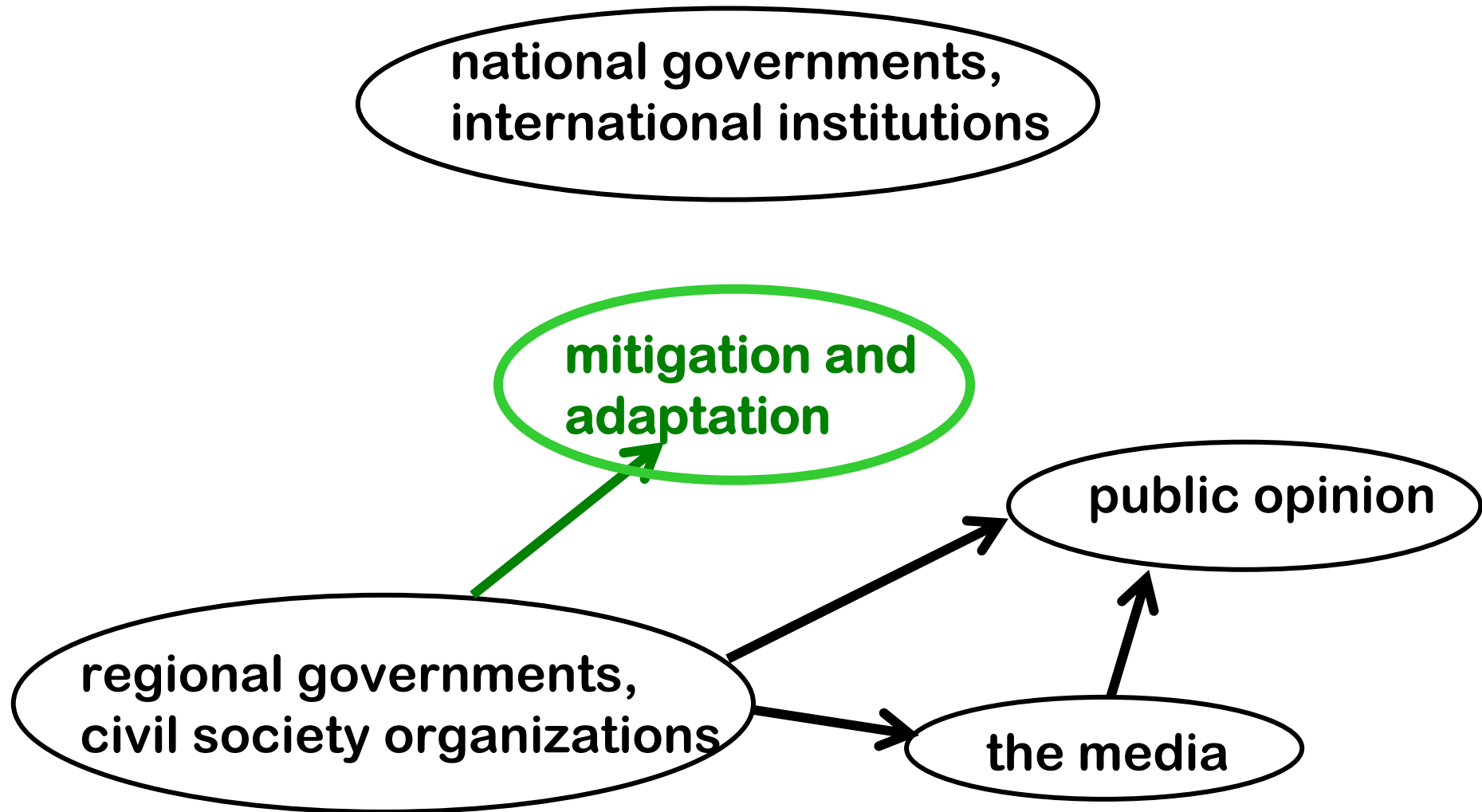
A multi-actor, bottom-up/top-down view of the creation of a Green Economy (model needed!)



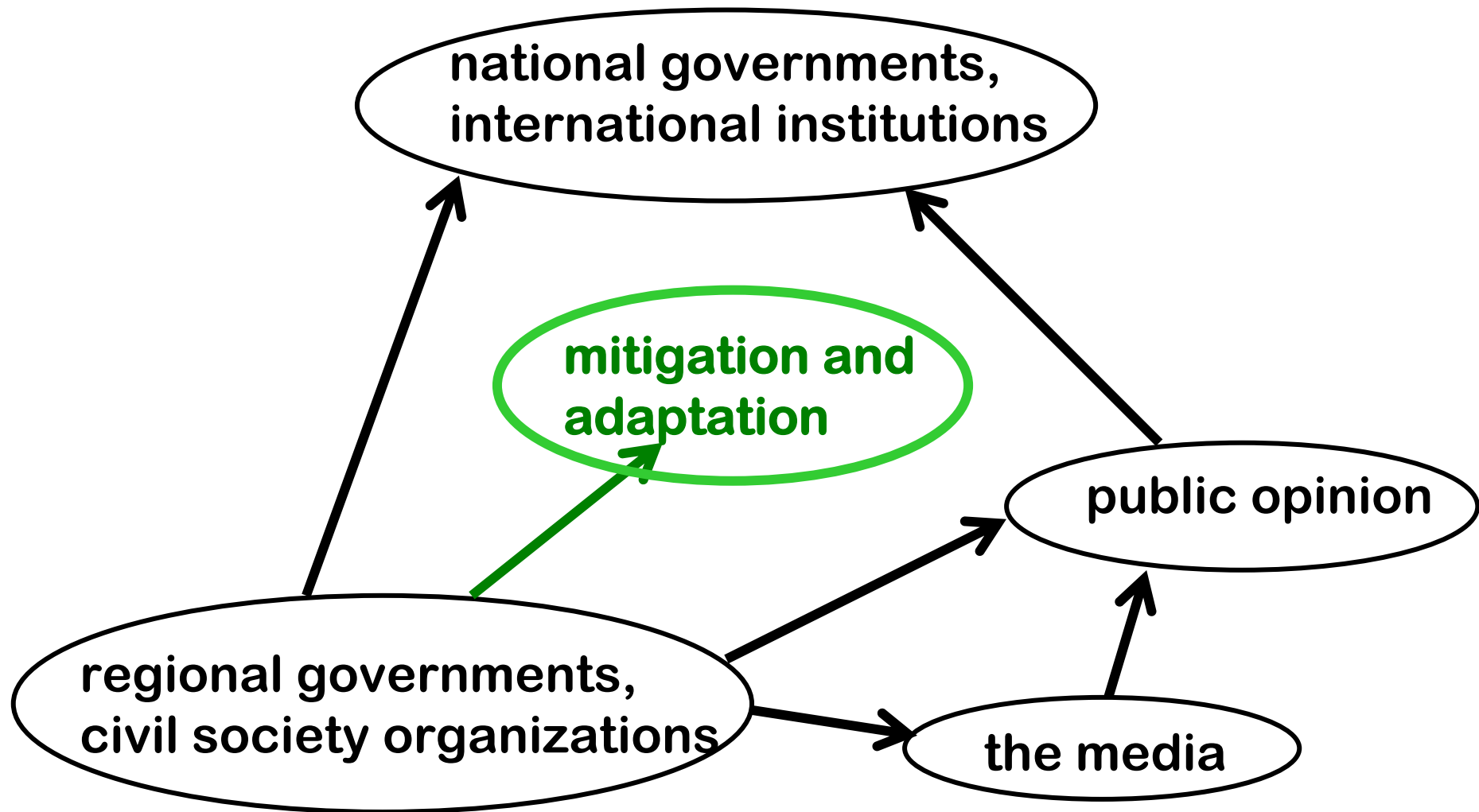
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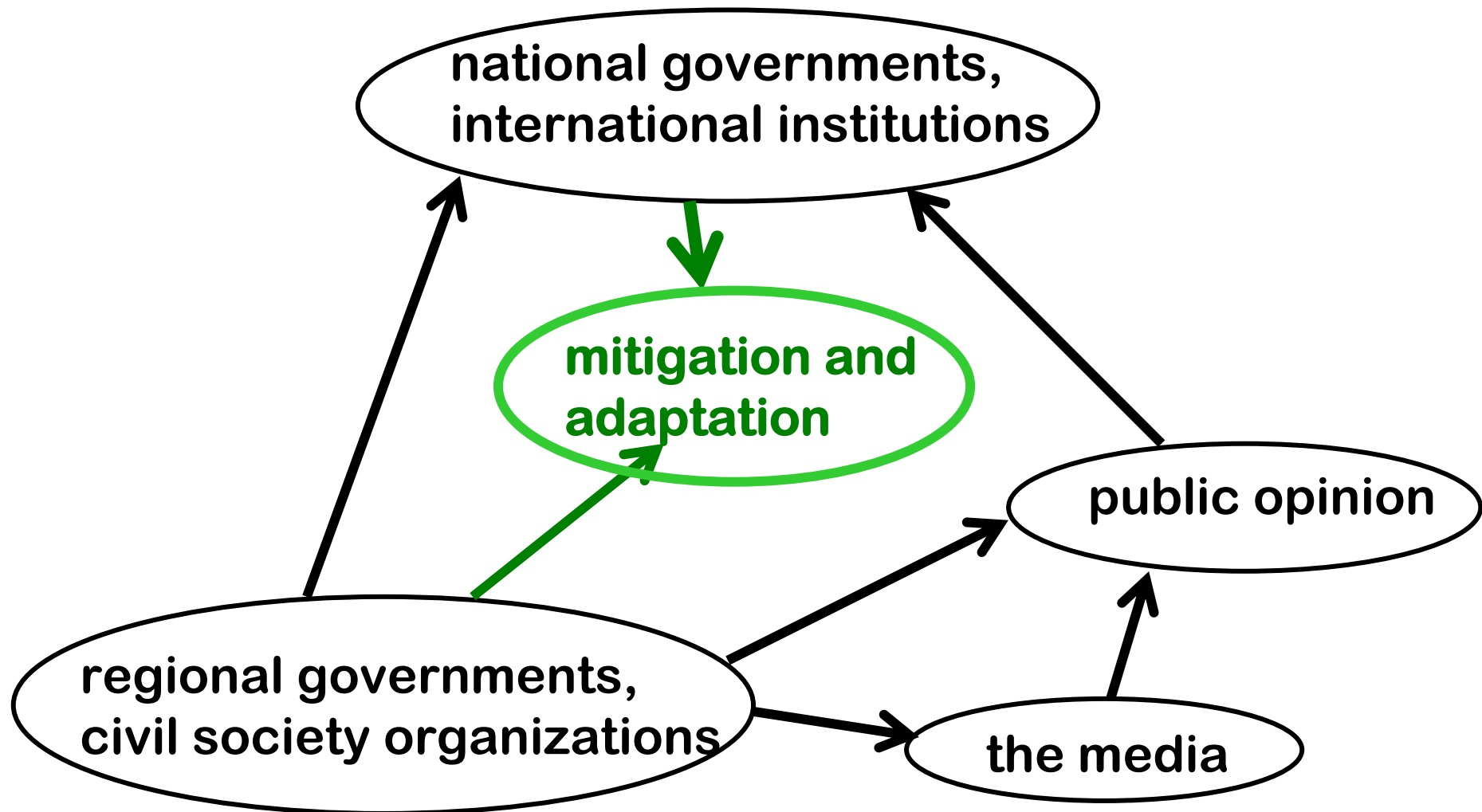
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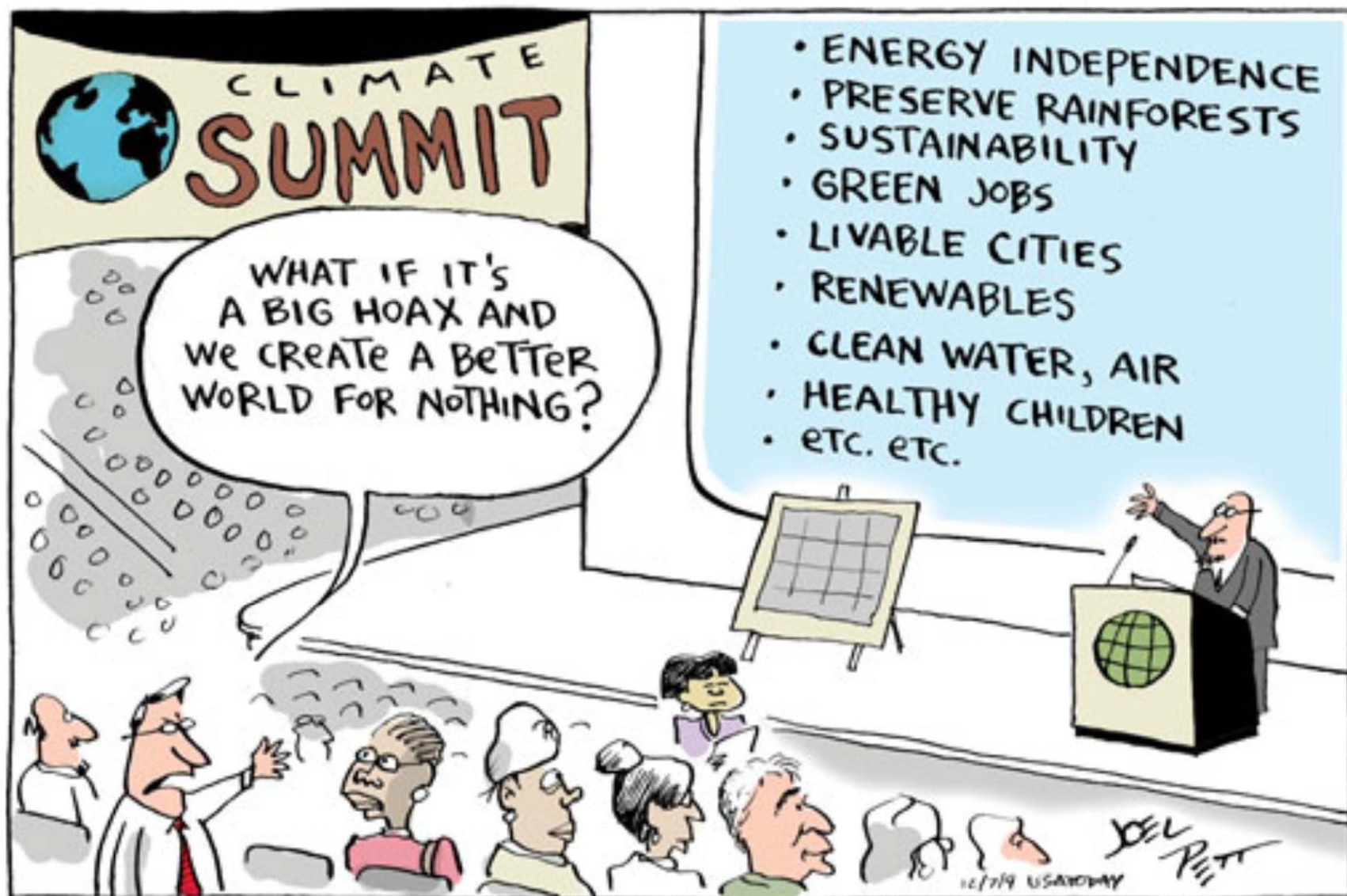
Summary:

A reframing of the climate change challenge as a unique win-win opportunity to create a green economy would overcome the present financial crisis, reduce widespread unemployment and would create a better world for everyone – independent of the need to prevent and adapt to climate change!

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A reframing of the climate change challenge as a unique win-win opportunity to create a green economy would overcome the present financial crisis, reduce widespread unemployment and would create a better world for everyone – independent of the need to prevent and adapt to climate change!

(And would take the wind out of climate change denialists)



Thank you for listening!