



# Revisiting Spaceship Earth: Why is Sustainable Development Important?

## By

R K Pachauri

Director General TERI and Chairman, IPCC

At

The lecture series "Sustainability Dialogue with Leaders and Pioneers"

Zurich

19<sup>th</sup> October 2004



## How is the earth a spaceship?

---

Boulding: Economists have failed to understand open vs. closed earth

“For the sake of picturesqueness, I am tempted to call the open economy the “cowboy economy,” the cowboy being symbolic of the illimitable plains and also associated with reckless, exploitative, romantic, and violent behavior, which is characteristic of open societies. The closed economy of the future might similarly be called the “spaceman” economy, in which the earth has become a single spaceship, without unlimited reservoirs of anything, either for extraction or for pollution.”



# Concept of entropy as applicable to

---

- Matter
- Energy
- Information

Nicholas Georgescu–Roegen (1971)

“Automobiles driven by batteries charged by the sun’s energy are cheaper both in terms of scarce low entropy and healthy conditions – a reason why I believe they must, sooner or later, come about.”



# The global affliction: lacking a paradigm which is

---

Responsible

Ignoring externalities  
Discounting the future

Responsive

Indifference to poverty, hunger  
The choiceless billion plus

Boulding: "It is doubtful whether 200 years ago the richest country had a per capita real income more than five times that of the poorest.... Today the difference between per capita income for the richest countries and for the poorest is of the order of 1 to 50 rather than 1 to 5...."



# The MDGs and the Zedillo Panel

---

- Domestic resource mobilization – Importance of domestic policy
- Private capital flows – Need for domestic initiatives
- Trade – New round of WTO should be a 'development round'; liberalization of agriculture; elimination of trade barriers
- International development cooperation – humanitarian crises; supply of public goods; recovery from financial crises
- Systemic reforms – Economic Security Council of the UN
- ODA – 0.7% of GNP of developed countries

# Zedillo Panel on financing for development estimates additional annual cost for achieving 2015 International Development Goals. This approximates 50 billion dollars

	Billions of dollars
Halving poverty and hunger	20
Halving population without access to safe drinking water	0
Achieving universal primary education	9
Achieving gender equality in primary education	3
Achieving three-fourths decline in maternal mortality	No estimate
Achieving two-thirds decline in under-five mortality	No Estimate
Halting and reversing HIV/AIDS	7-10
Providing special assistance to AIDS orphans	No estimate
Improving lives of 100 million slum-dwellers	4
Total (approximate)	50



# What a distorted world!

---

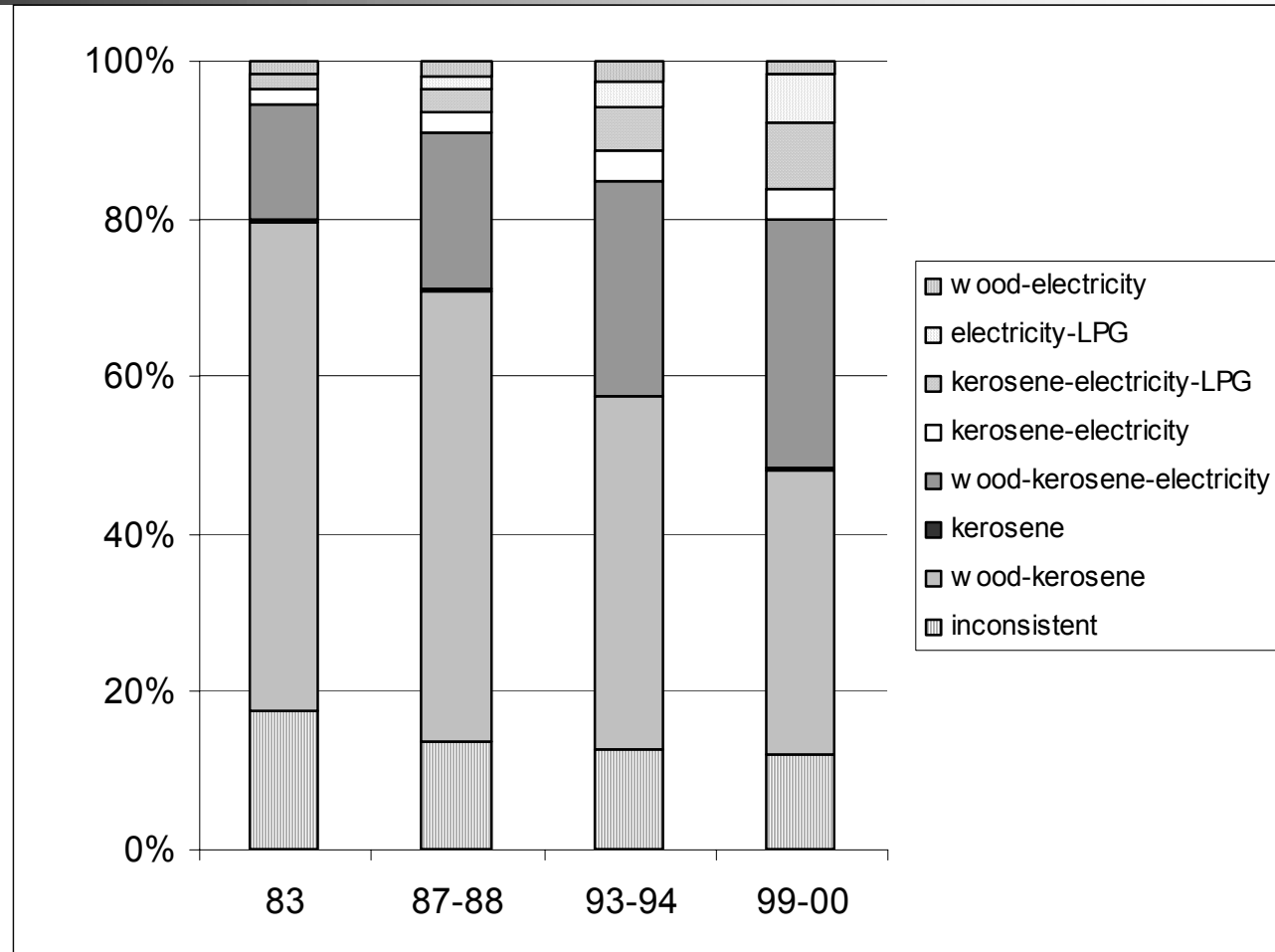
- Total official aid in 2003 - \$68.5 billion (0.25% of donor countries' income)
- Worldwide military expenditures (estimated 2004) - \$950 billion
- USA military expenditure - \$466 billion
- Estimated increase in ODA for meeting MDGs - \$50 billion annually (Zedillo Panel)
- Post cold war transition – swords to ploughshares – a myth
- G-8 Summit, 2004: “poverty is an unacceptable human condition which does not have to be inevitable”

# Headcount indices: percentage of population living below \$1 per day

	Poverty Rate (% below \$1.08/day at 1993 PPP)		
	1981	1990	2001
China	63.8	33.0	16.6
Latin America and the Caribbean	9.7	11.3	9.5
South Asia	51.5	41.3	31.3
Sub-Saharan Africa	41.6	44.6	46.9

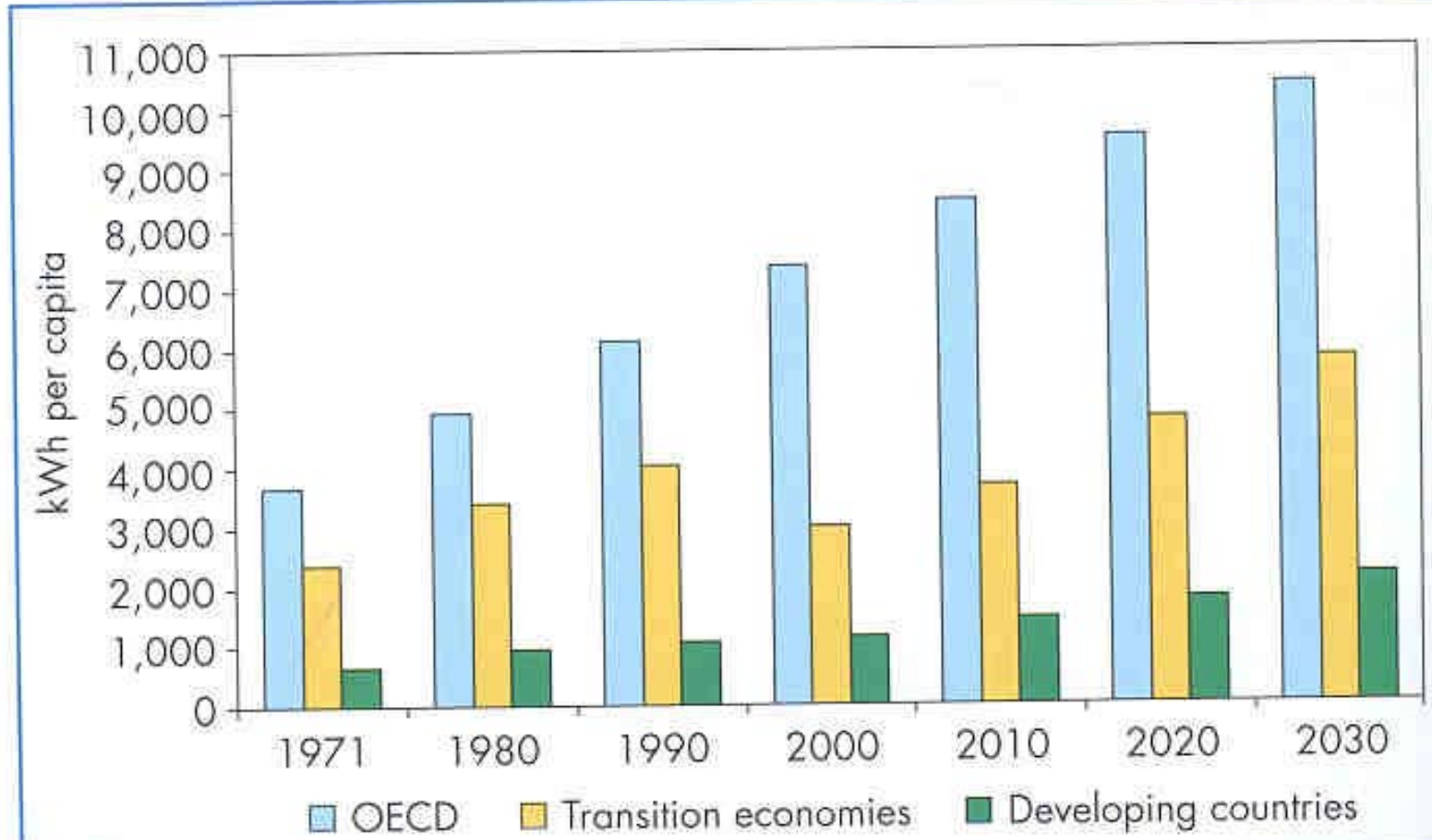
Source: The World Bank

# India study: the distribution of households with access to different energy carriers



Source: S. Pachauri, A Mueller, A. Kemmler. D. Spreng

# Per capita electricity consumption



Source: World Energy Outlook 2002

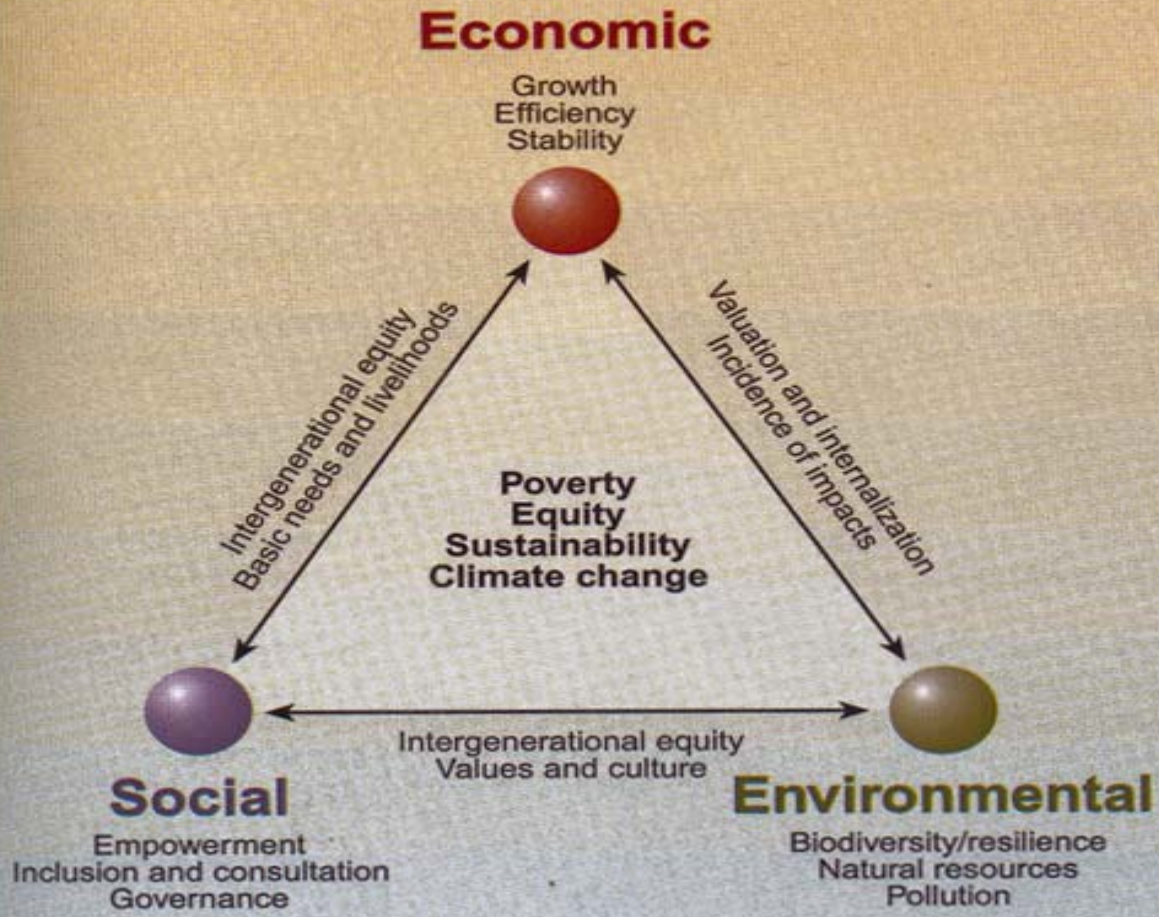


# Transportation energy demand (Mtoe)

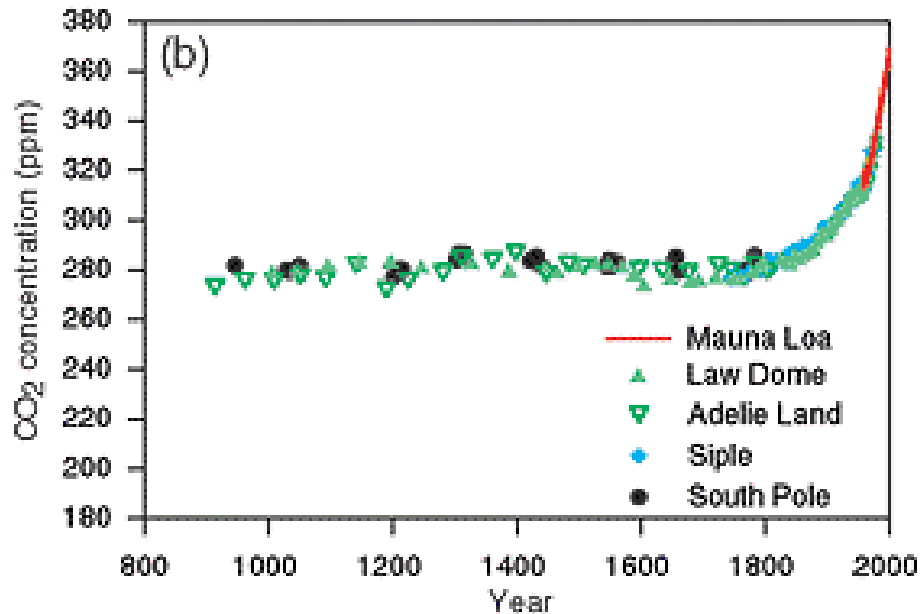
	<b>1971</b>	<b>2000</b>	<b>2010</b>	<b>2020</b>	<b>2030</b>
<b>Total</b>	<b>851</b>	<b>1775</b>	<b>2220</b>	<b>2749</b>	<b>3327</b>
Oil	793	1696	2125	2636	3195
Other fuels	58	79	94	113	131

Source: World Energy Outlook 2002

# Key elements of sustainable development and interconnections



# Increasing trend of GHG concentration - CO<sub>2</sub>

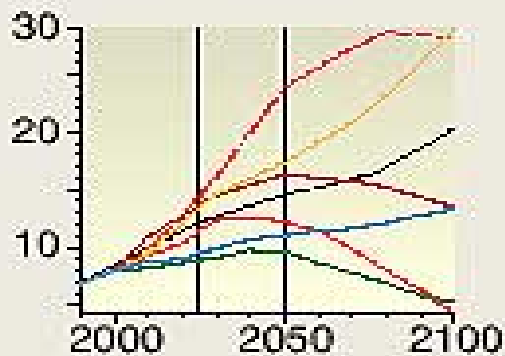


- Atmospheric concentration of CO<sub>2</sub> increased by 31% upto 1999 since the industrial revolution
- Today's concentration has not been exceeded during the past 420,000 years and likely not in the past 20 million years
- The average rate of increase since 1980 has been 0.4% annually

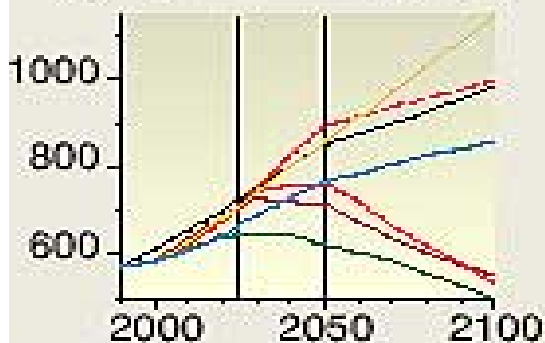
# Emissions

# Concentration

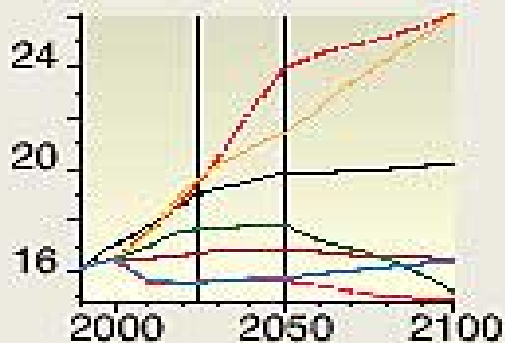
(b) CO<sub>2</sub> emissions (Gt C)



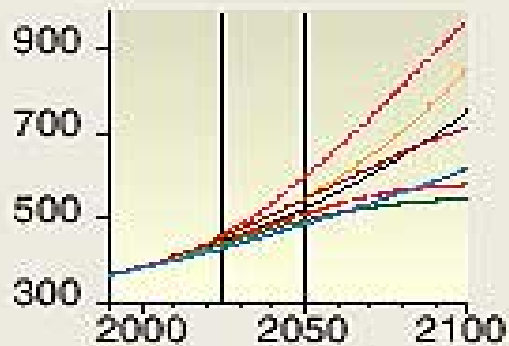
(c) CH<sub>4</sub> emissions (Tg CH<sub>4</sub>)



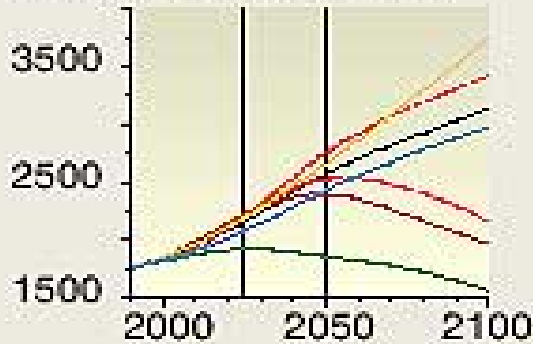
(d) N<sub>2</sub>O emissions (Tg N)



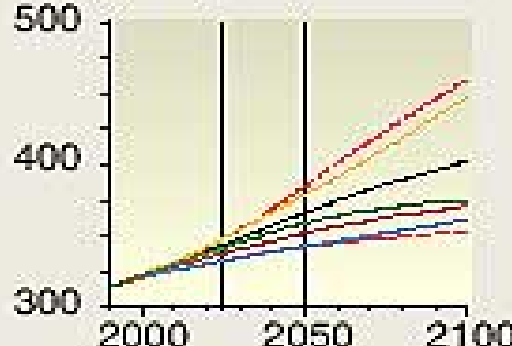
(f) CO<sub>2</sub> concentration (ppm)



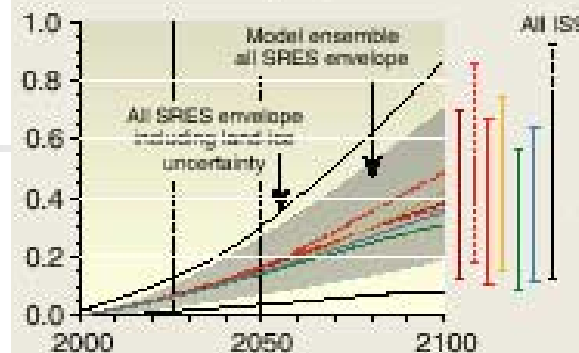
(g) CH<sub>4</sub> concentration (ppb)



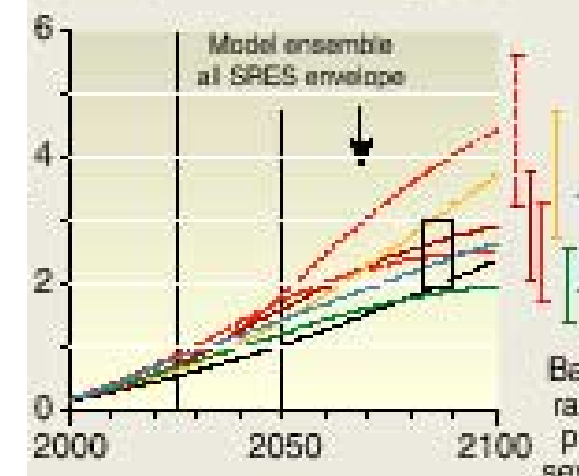
(h) N<sub>2</sub>O concentration (ppb)

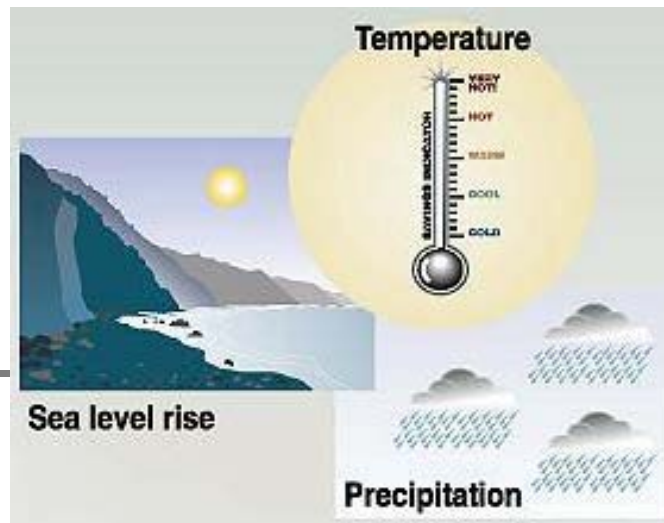


(i) Sea-level rise (m)

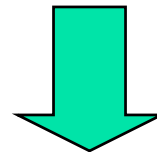


(k) Temperature change (°C)





# Impacts



**Health**



Weather-related mortality  
Infectious diseases  
Air-quality respiratory illnesses

**Agriculture**




Crop yields  
Irrigation demands

**Water resources**



Water supply  
Water quality  
Competition for water

**coastal areas**



Erosion of beaches  
Inundation of coastal lands  
additional costs to protect coastal communities

**Species and natural areas**



Loss of habitat and species  
Cryosphere:  
diminishing glaciers



# Assessing vulnerability

---

'The impacts of climate change will fall disproportionately upon developing countries and the poor persons within all countries, thereby exacerbate inequities in health status and access to adequate food, clean water and other resources'

*IPCC, Third Assessment Report*



# Role of agriculture in the developing world

---

- It is the largest source of employment - 76.17% and 57% of the population involved in agricultural enterprises in China and India respectively (FAO)
- It is the largest contributor to GDP in developing countries (agrarian economies)
- The ultimate role of agriculture in the Asian region is to provide food and fibre to the human population - holds the key to food security of the region



# Halve extreme poverty and hunger

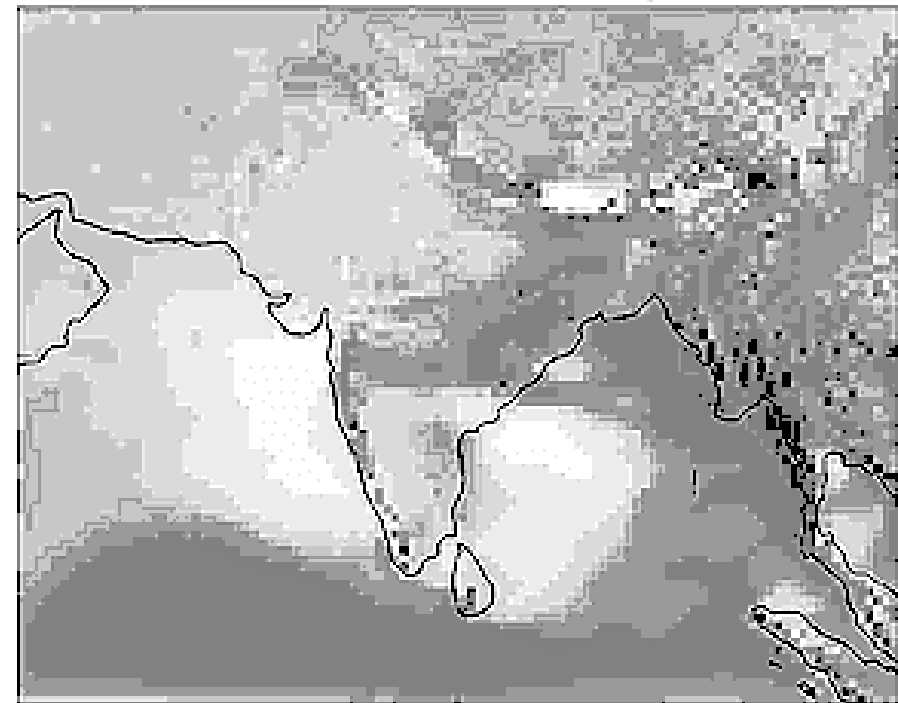
---

- Yield deceleration of rice in Asia (Growth rates have fallen from 2.8% to 1.1 % over the 80s)
- The reasons being water scarcity, inefficient and overuse of chemical inputs, reliance on narrower genetic base
- Impacts of climate change would exacerbate these trends
- Considering that agriculture is the leading source of income for a vast section of the Asian population - such impacts have the potential to adversely affect the poverty levels in this region

# Climate change and water resources

- Much of agriculture in Asia is rainfed
- Increased precipitation intensity, particularly during the summer monsoon - increase flood prone areas in tropical and temperate Asia, drier conditions in arid and semi arid Asia - more severe droughts
- Freshwater availability (temporal and spatial distribution) expected to be highly vulnerable to anticipated climate change
- Significant changes in monthly runoff regimes projected over most of Asia under altered climate

RCM GHG-Control, JJAS



Source: IPCC TAR, WGII



# For whom the bell tolls

---

- Sea level rise and agricultural changes due to climate change are estimated to result in 150 million environmental refugees by 2050 (Source: Dr Norman Myers)
- Total flood zone refugees in India alone could be anywhere between 20 million and 60 million, with 30 million taken here as a conservative working figure
- 17% of Bangladesh could be permanently lost to sea level rise coupled with land subsidence. Even with engineering works an estimated 15 million would be displaced
- Egypt would lose between 12 and 15 percent of its arable land
- 50 million people globally may be displaced due to climate change-induced famine

Source: Myers, N., Environmental refugees in a globally warmed world



# Extreme events

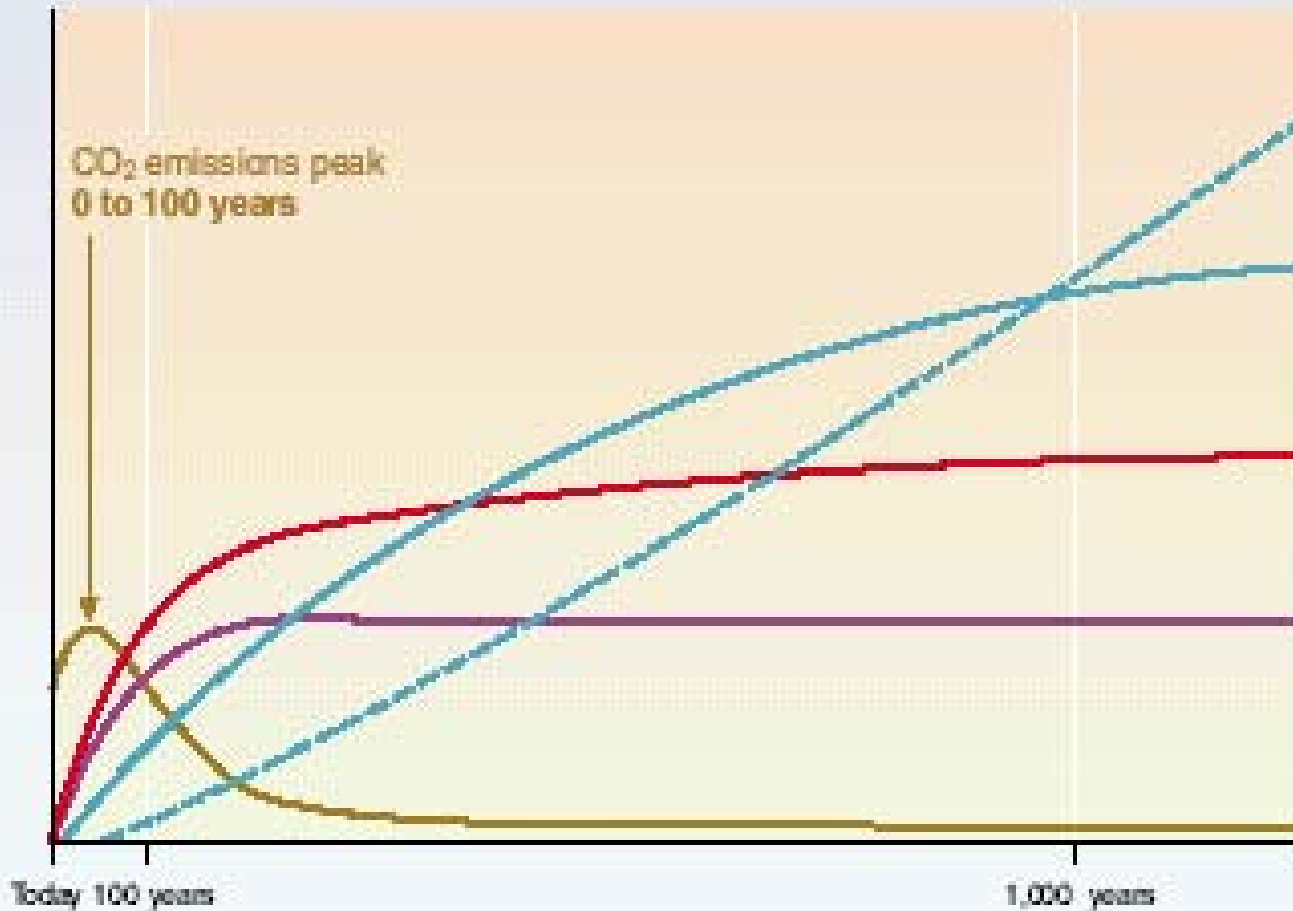
---

The number of disasters of hydrometeorological origin has increased significantly. *(Source: WMO)*

- Increase in precipitation in the mountains along with melting of glaciers - increased incidence of floods, mudslides and avalanches- *Are we already experiencing this?*
- Recurring incidences of floods and droughts is already apparent (temperate Asia)
- Large areas with high population densities are susceptible to floods, droughts and cyclones in Bangladesh and India → vulnerability to extreme weather events are expected to increase in these areas

## CO<sub>2</sub> concentration, temperature, and sea level continue to rise long after emissions are reduced

Magnitude of response



Time taken to reach equilibrium

Sea-level rise due to ice melting: **several millennia**

Sea-level rise due to thermal expansion: **centuries to millennia**

Temperature stabilization: **a few centuries**

CO<sub>2</sub> stabilization: **100 to 300 years**

CO<sub>2</sub> emissions

Source: IPCC Syn report

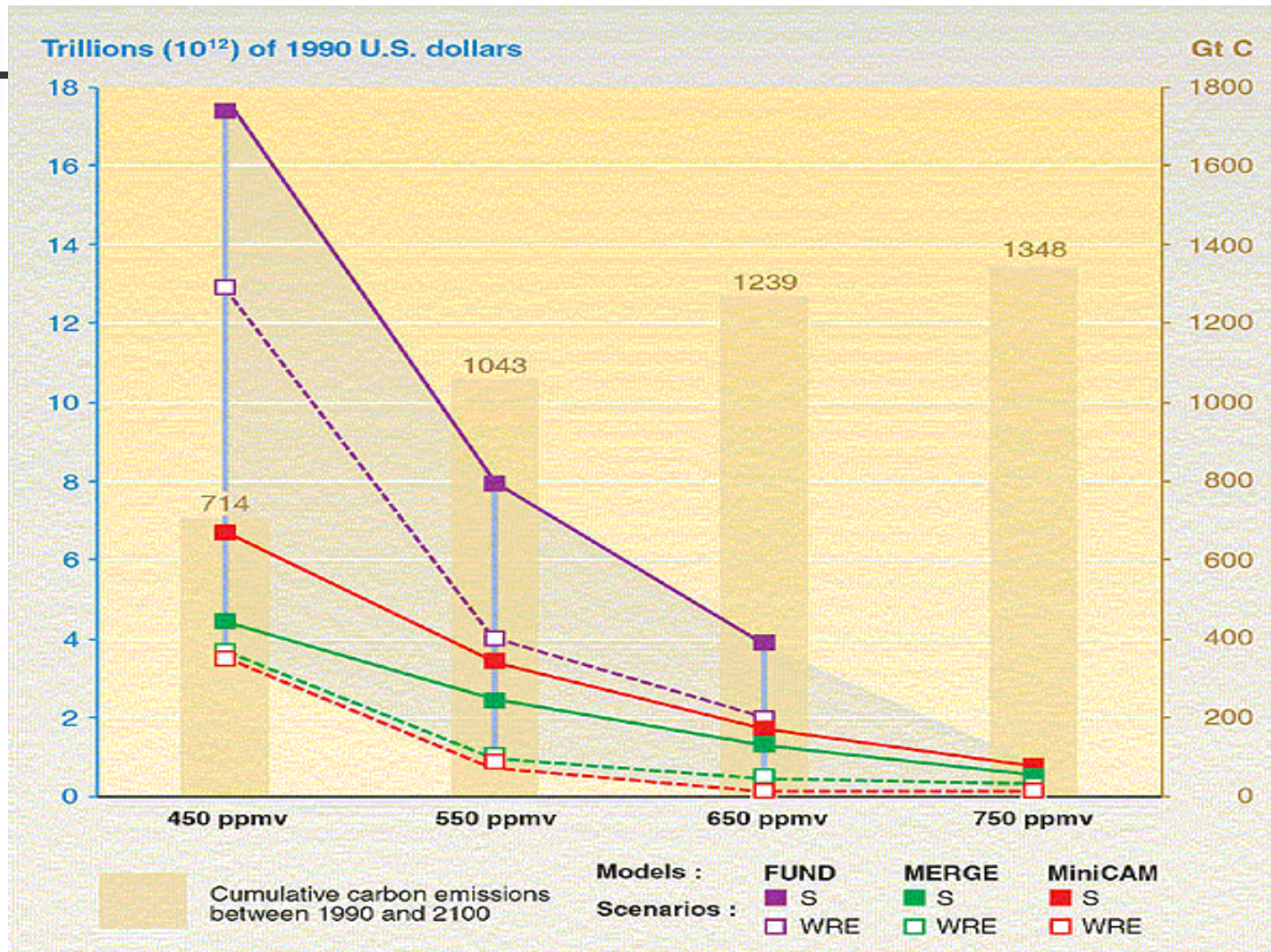


# Adaptation - a necessary response

---

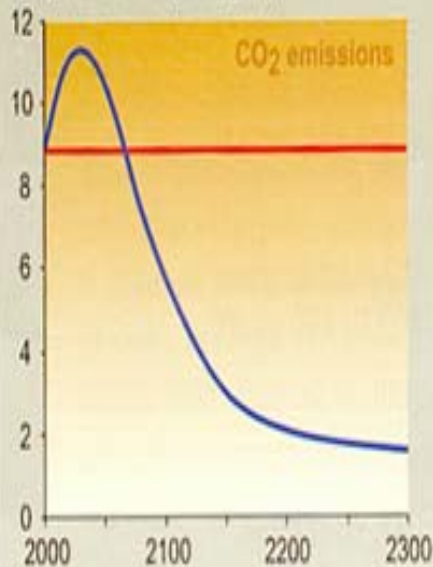
- In the future, food security will be at serious risk in Asian countries because of
  - growing population
  - many direct and indirect effects of climate change
- By the year 2050, about 42% of the world population would be concentrated in India and China (Source: TAR)
- Climatic variability and change will seriously endanger sustained agricultural production in Asia in coming decades

# What will it cost to stabilize CO<sub>2</sub>

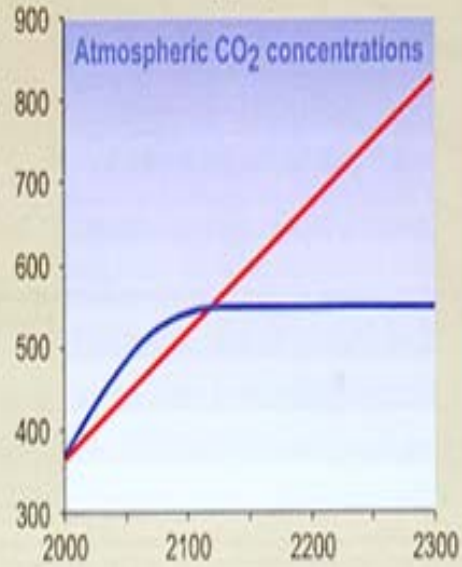


## Impact of stabilizing emissions versus stabilizing concentrations of CO<sub>2</sub>

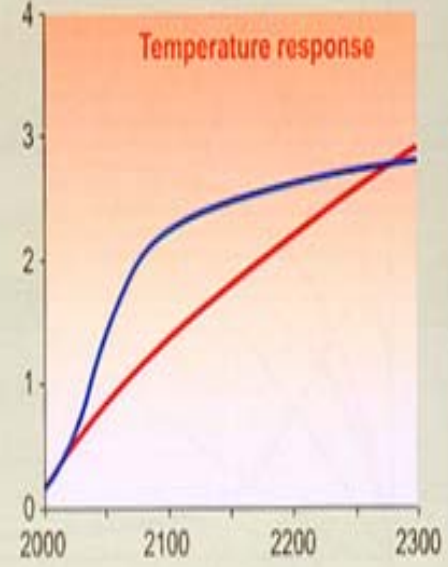
CO<sub>2</sub> emissions (Gt C yr<sup>-1</sup>)



CO<sub>2</sub> concentration (ppm)



Temperature change (°C)

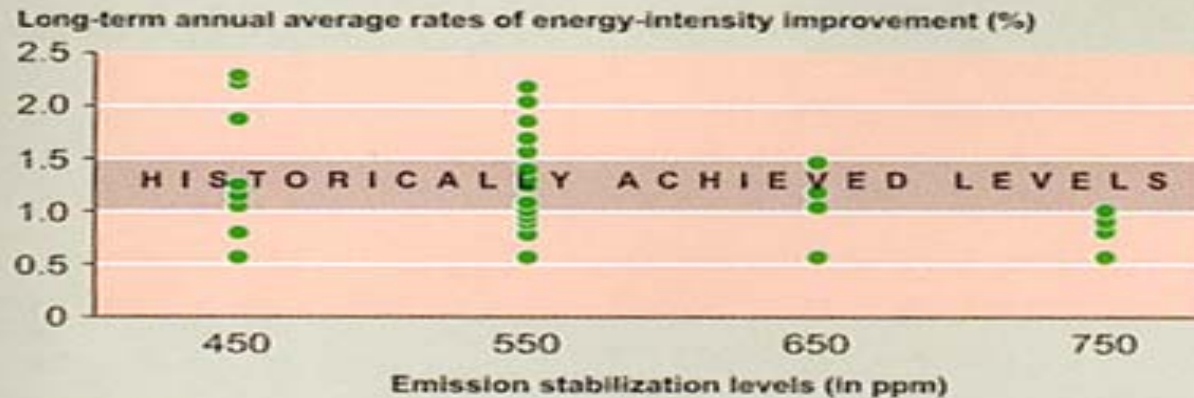


— Constant CO<sub>2</sub> emissions at year 2000 level

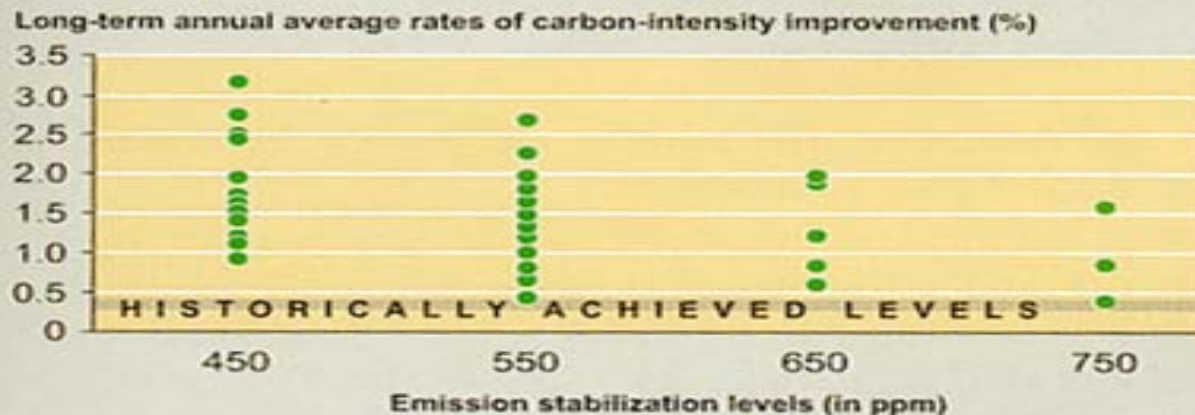
— Emissions path to stabilize CO<sub>2</sub> concentration at 550 ppm

# Acceleration of energy system change

(a) Ranges of rates of energy-intensity change in different mitigation scenarios provided by different models and model runs for 1990-2100



(b) Ranges of rates of carbon-intensity change in different mitigation scenarios provided by different models and model runs for 1990-2100





# Issues of intergenerational equity & justice

---

Five reasons for concern in this context

- Unique & threatened systems
- Global aggregate impacts
- Distribution of impacts
- Extreme weather events
- Large – scale singular events



# The fallacy of unrestricted economic growth

---

What constitutes this fallacy?

- Apart from periodic recessions, continued growth is inevitable
- If non-renewable resources are depleted, built capital can substitute for natural capital as income-generating assets
- Savings from current income are adequate for providing capital investments for expanding income-generating wealth.



# Dispelling the fallacies

---

- The poor, particularly in developing countries derive a large share of goods and services from natural capital
- Natural capital and built capital are generally not substitutes
- Economic phenomena are applicable to relatively smooth changes. Discontinuities challenge substitution possibilities and measures of consistency in the field of economics



Be the change you want to see in the world