Addressing Climate Change and Sustainable Development Issues Together: The Way Forward with Sustainomics

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Paper (5 pages)

Mohan Munasinghe

Finance and Development, March 2008, pp.37-41

Book

(650 pages)

MAKING DEVELOPMENT MORE SUSTAINABLE (650 pages)

Contents

WHY ? is climate a threat to future human development

Climate Change (CC) undermines Sustainable Development (SD) and unfairly penalizes the poor

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Start making development more sustainable (MDMS) now, using the Sustainomics framework

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WHAT? are the practical solutions and policy options to be implemented that will integrate CC responses into SD strategy (from global to local levels)

Many examples of good practice available;

US has a key role to play

Introduction to Climate Change

Brief Overview of IPCC

AR4 Main Findings:

Risk to Sustainable Development

IPCC Assessment Process

IPCC was created in 1988 by WMO and UNEP

Four assessment reports have been completed already, which have progressively improved our understanding of climate change:

1. **Climate Change 1990**
2. **Climate Change 1995**
3. **Climate Change 2001**
4. **Climate Change 2007 (AR4)**

Several hundred lead authors wrote the AR4 report, while about 3000 leading scientists worldwide, were involved in reviewing and editing it.

IPCC Fourth Assessment Report (AR4)

Three Main Working Groups:

I. Science of Climate Change

II. Impacts, Adaptation and Vulnerability

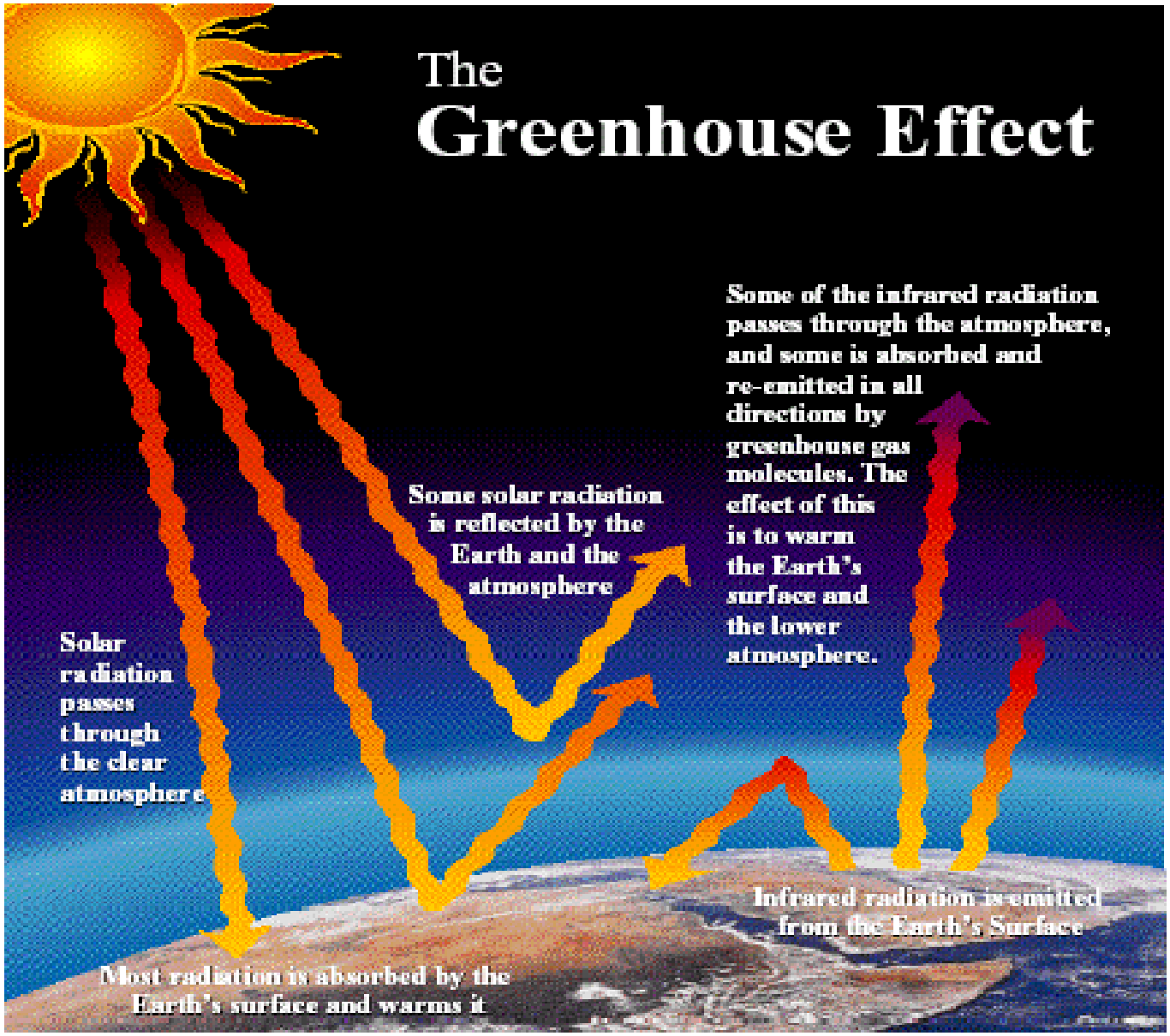
III. Mitigation

Synthesis Report

Task Force on National Greenhouse Gas Inventories

IPCC reports review the most recent and critical scientific information. They are policy relevant but not policy prescriptive.

Evidence of Past and existing Climate Change

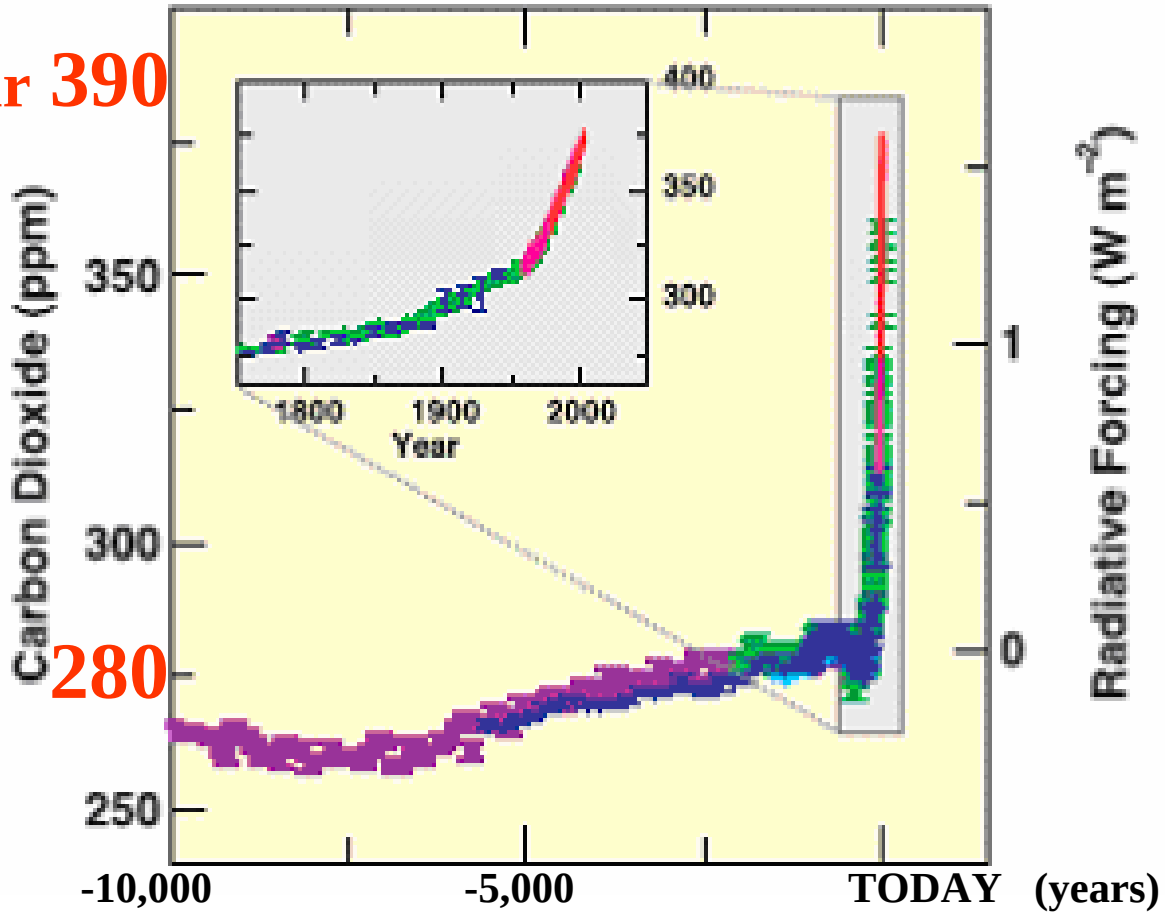

The
Greenhouse Effect
Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Some solar radiation is reflected by the Earth and the atmosphere
Solar radiation passes through the clear atmosphere
Infrared radiation is emitted from the Earth's Surface
Most radiation is absorbed by the Earth's surface and warms it

MAIN DRIVER

Changes in CO2 from ice core and modern data

Now: near 390

Pre-ind: 280



Other drivers include methane, nitrous oxide and aerosols

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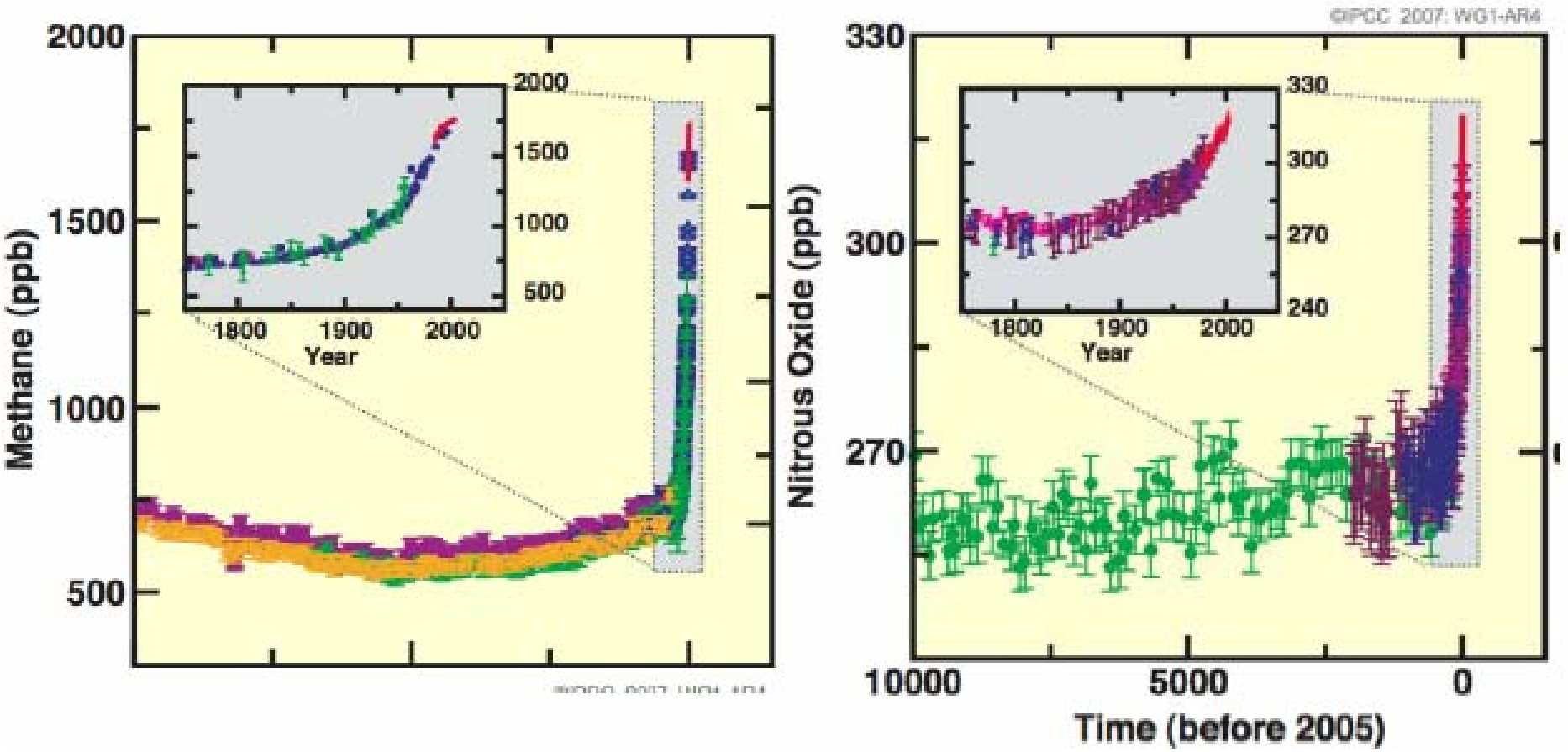
OTHER DRIVERS

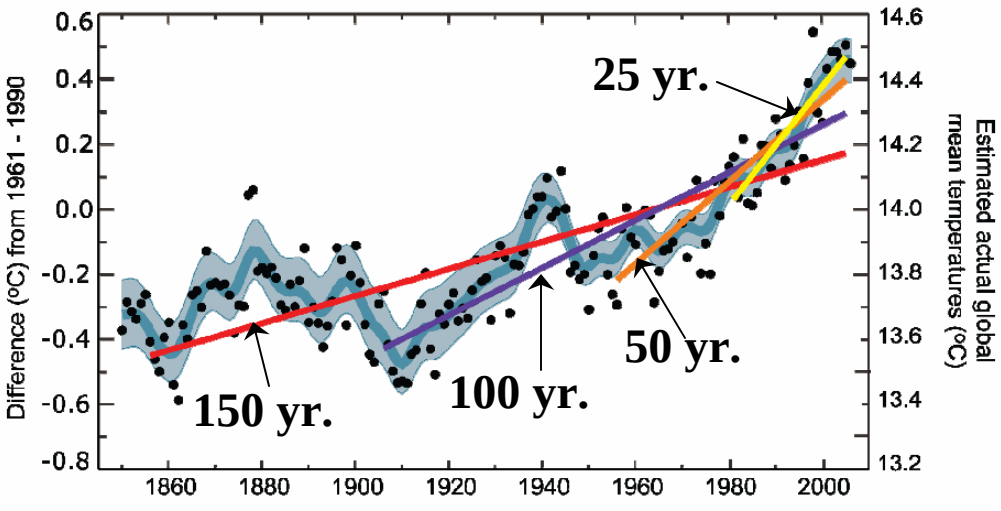
Changes in Methane, Nitrous Oxide & Aerosols



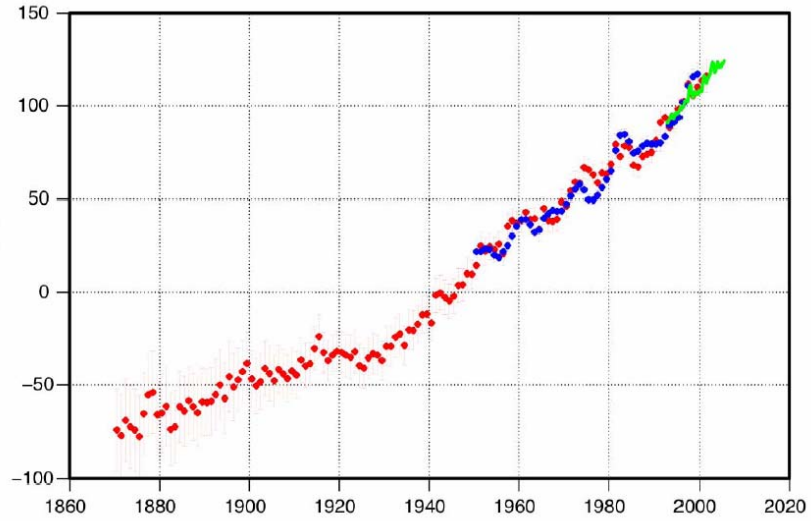
Note: Aerosols provide short term cooling effect

RESULT: Mean Temp., Sea Level and Ice Cover

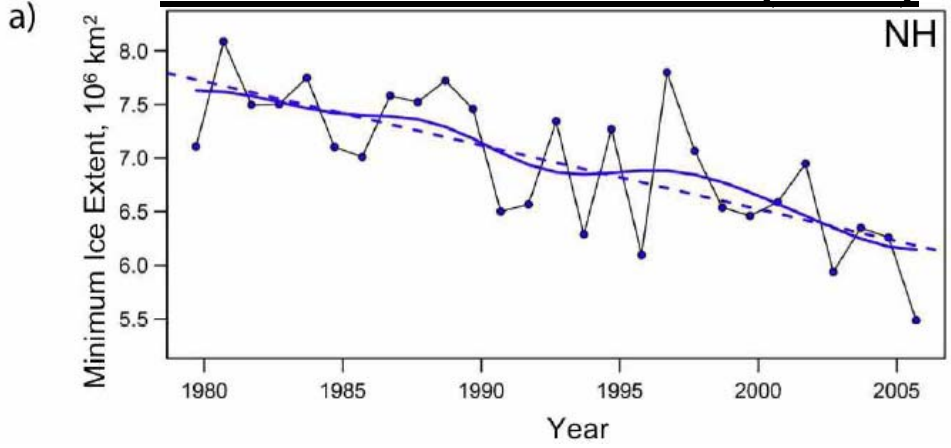
Mean Temperature



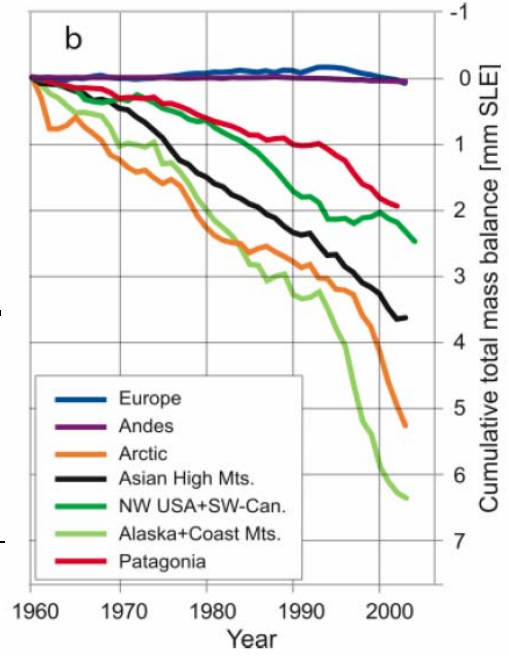
Mean Sea Level



Arctic Sea Ice Extent (min.)



Glacier Mass Balance



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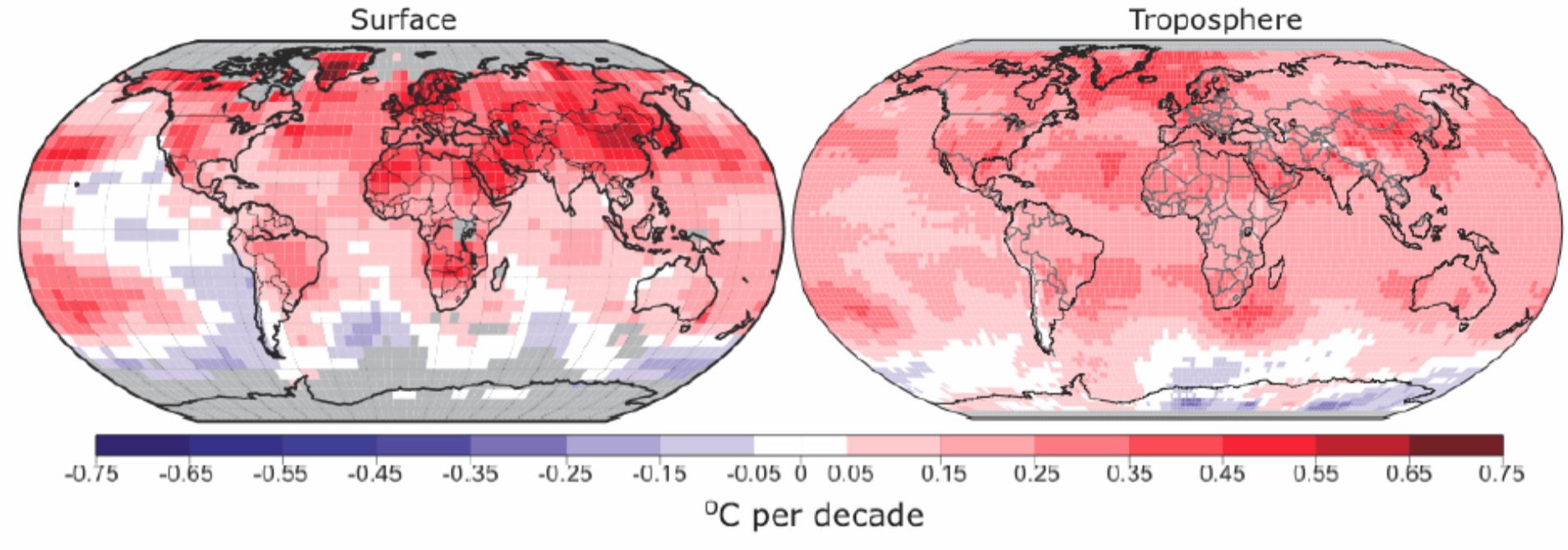
Warming is Worldwide (2005)

Warming trends since 1979 (when satellite measurements started) show:

- Warming everywhere at surface except in eastern Pacific, Southern Ocean and parts of Antarctica;
- Land warming significantly faster than ocean over last 20 years;
- Mid-troposphere warming consistent with that at surface.



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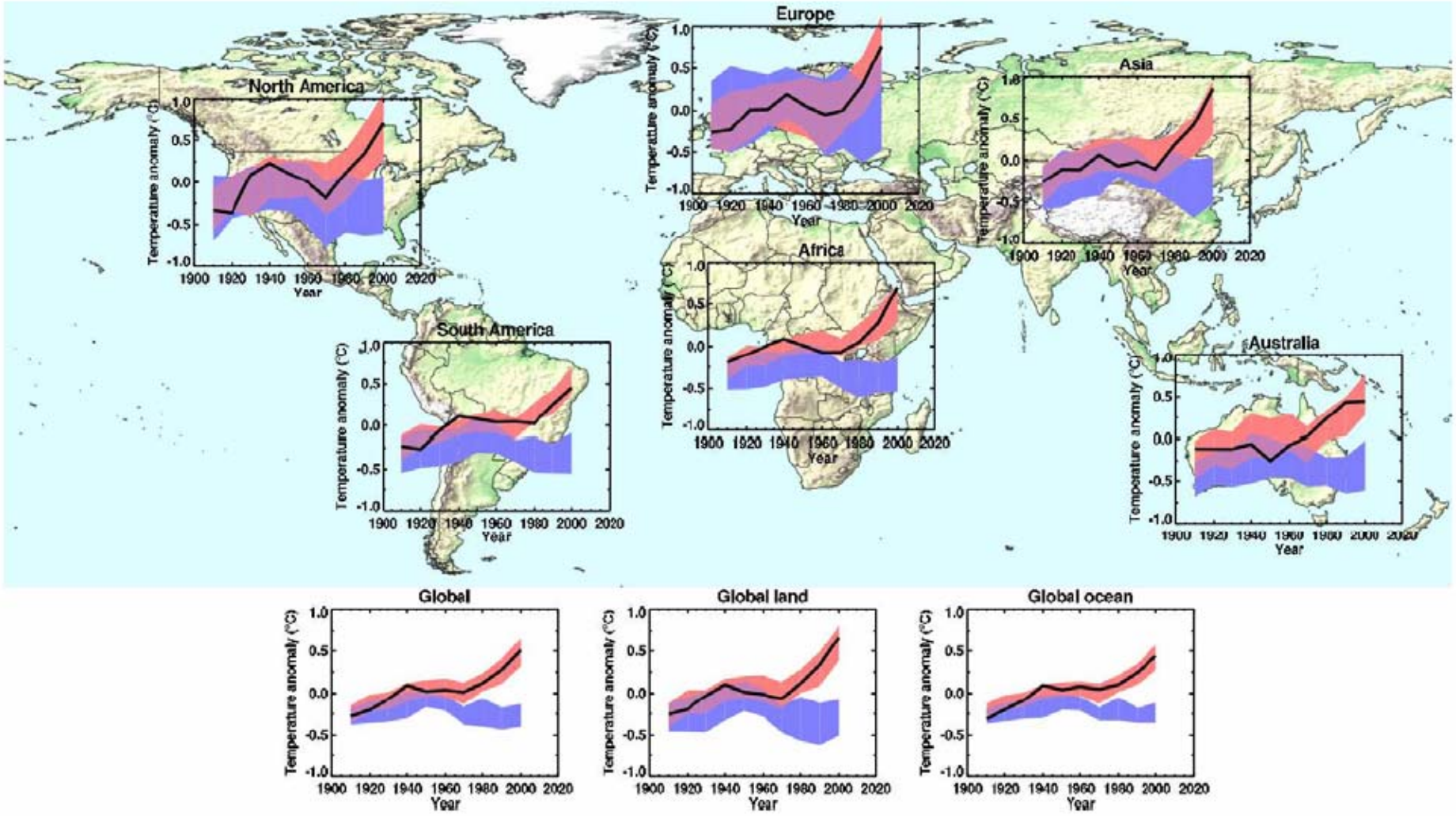
Climate model results (red area) accurately track worldwide actual temperature changes (black line)



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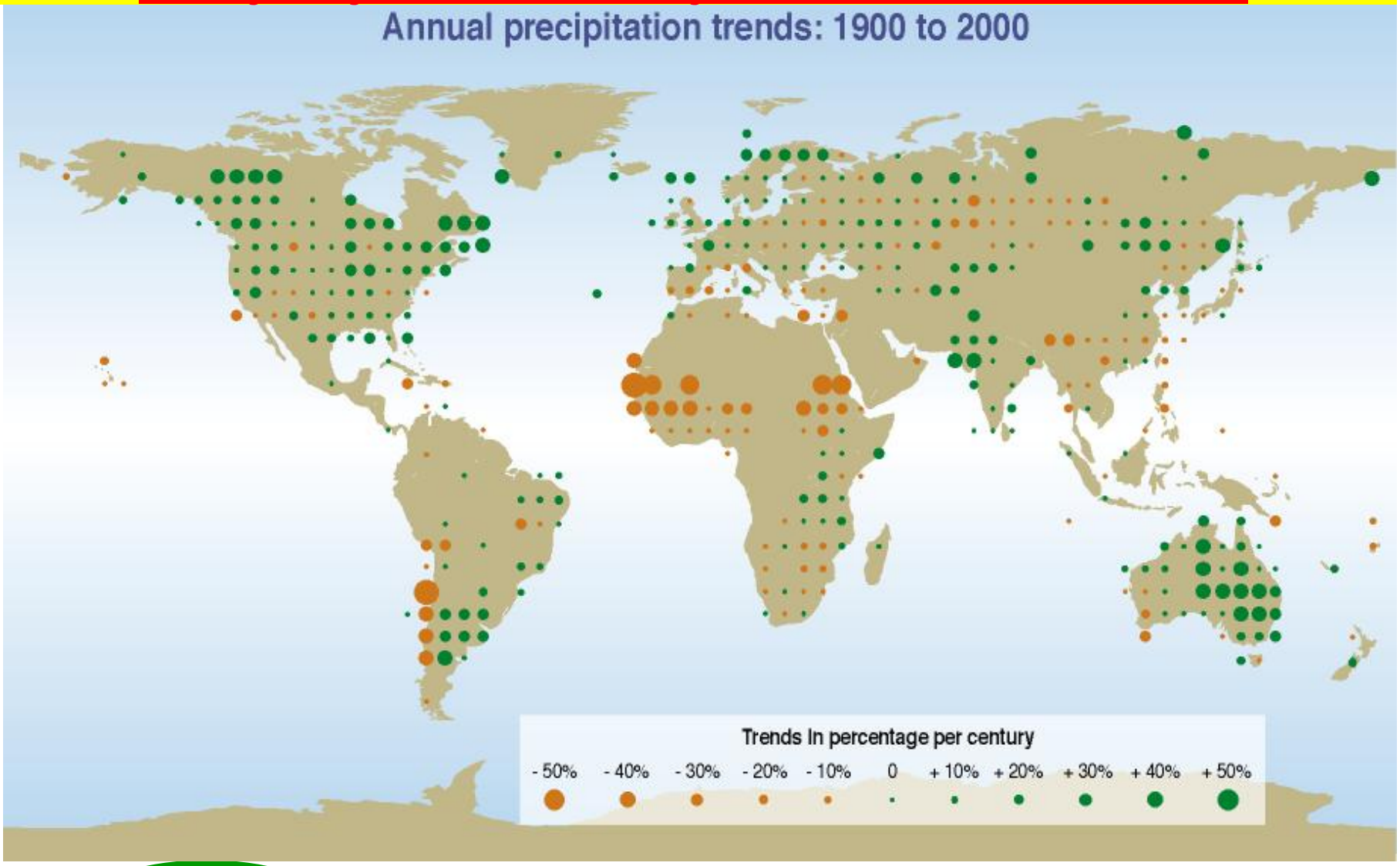
Precipitation patterns have changed
many dry areas are dryer & wet areas wetter



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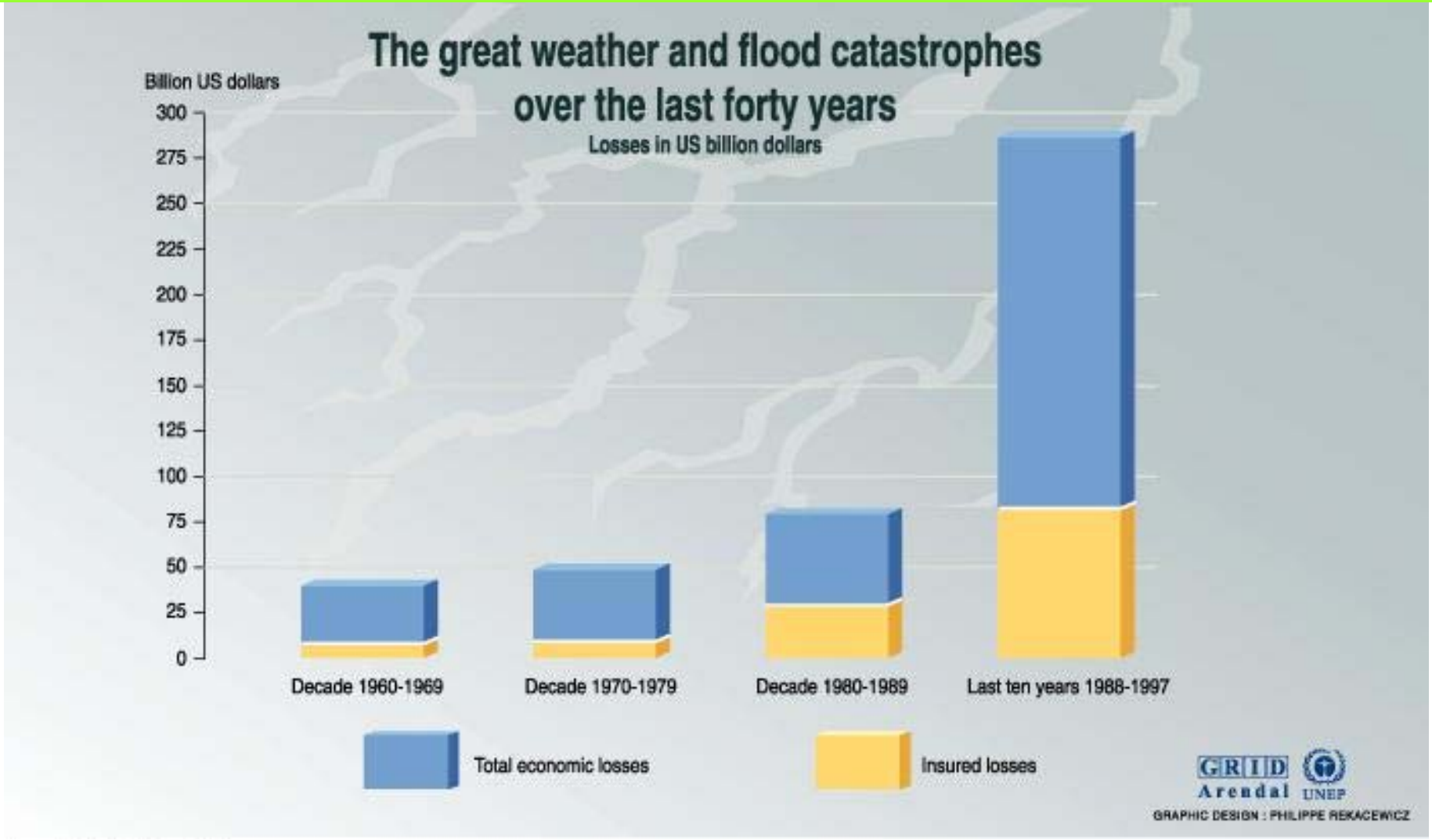
Extreme Weather Events – Economic Damage has Increased



Observed regional changes in climate, and in physical and biological systems

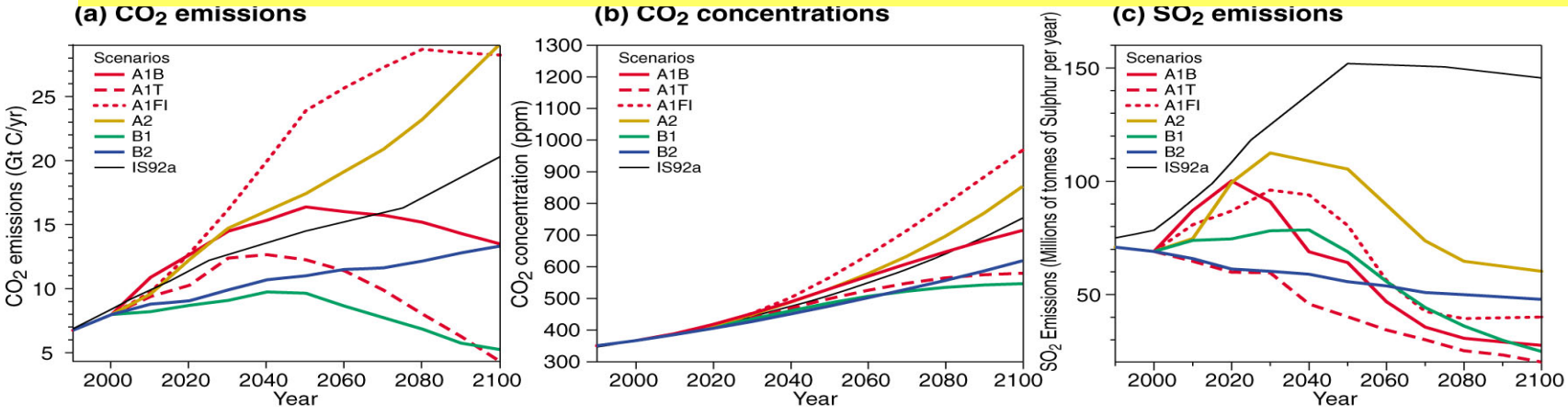
Examples include:

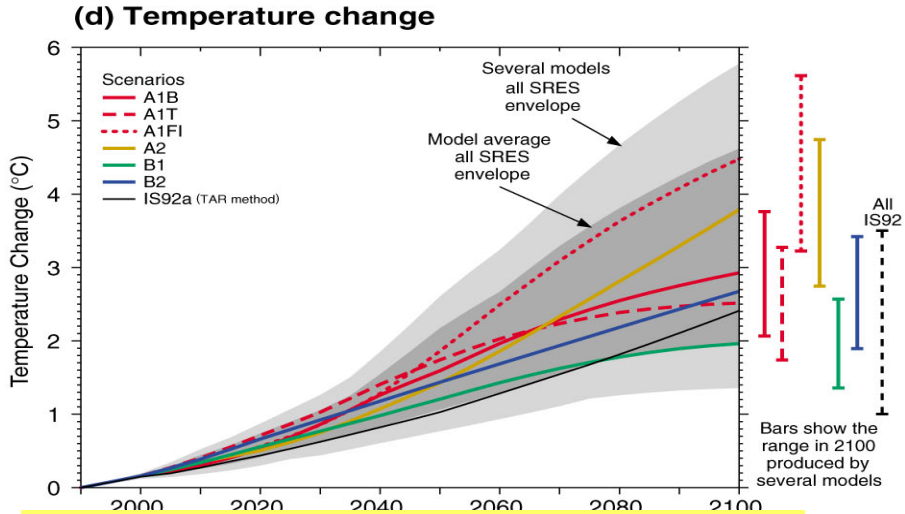
- non-polar glacier retreat
- reduction in Arctic sea ice extent and thickness in summer
- earlier flowering and longer growing and breeding season for plants and animals in N. Hemisphere
- poleward and upward (altitudinal) migration of plants, birds, fish and insects; earlier spring migration and later departure of birds in N. Hem.
- increased incidence of coral bleaching

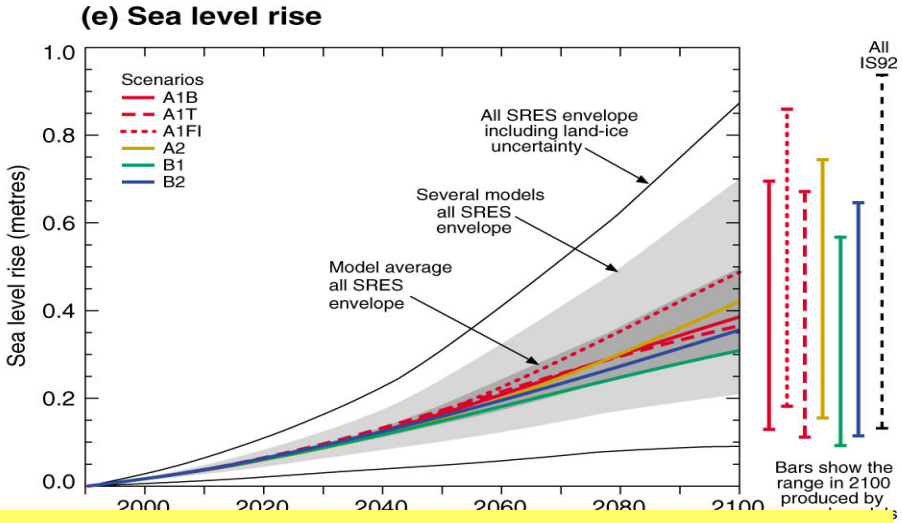
Predicting Future Climate Change

The Global Climate by 2100

GHG conc. 2-3 times pre-ind. level (280 ppmv)







Temp. rise ~3C (1.1 to 6.4)

Sea level rise ~0.4m (0.2 to 0.6)

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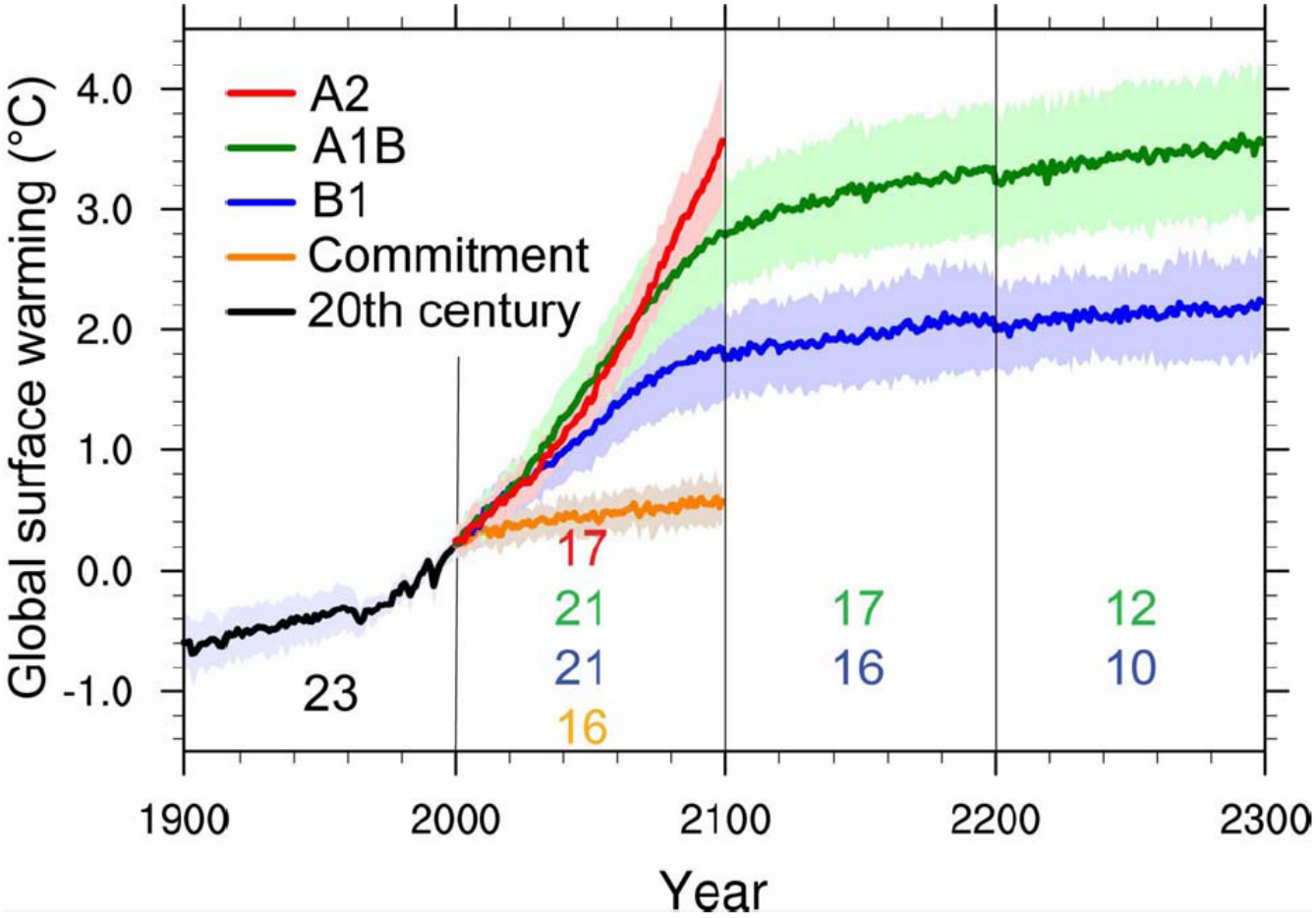
Scenario Assumptions

	1990	2100
• Population (billion)	5.3	7.0 - 15.1
• World GDP (10^{12} 1990US$/yr)	21	235 - 550
• Per capita income ratio: developed countries to developing countries	16.1	1.5 - 4.2
• Final energy intensity (10^{6}J/US$)[a]	16.7	1.4 - 5.9
• Primary energy (10^{18} J/US$)	351	514 - 2226
• Share of coal in primary energy (%)[a]	24	1 - 53
• Share of zero carbon in primary energy (%)[a]	18	28 - 35

Projected Mean Global Temp.

orange = 2000 CO2 level

> 1.5 C temp. rise will occur whatever we do now



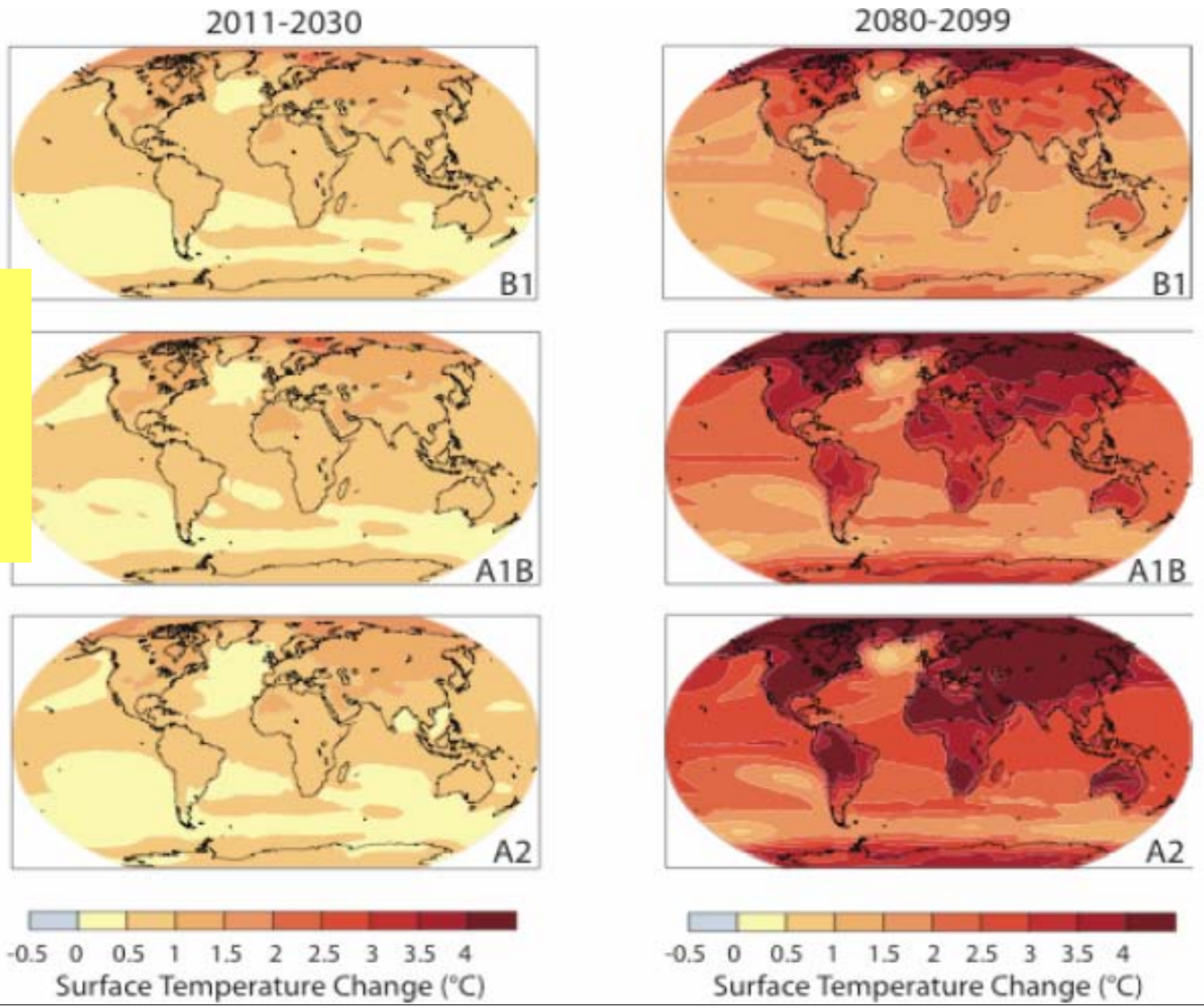
CC ⟶ SD

Developing countries are most vulnerable to climate change

- **Climate change is likely to impact disproportionately upon the poorest countries and the poorest persons within countries**, exacerbating inequities in health status and access to adequate food, clean water and other resources.
- **Net market sector effects are expected to be negative in most developing countries**
- **Impacts will be worse** - many areas already flood and drought prone, and economic sectors are climate sensitive
- **Lower capacity to adapt** because of a lack of financial, institutional and technological capacity and access to knowledge

Global Distribution of Mean Temp

Polar regions worst affected



Scenarios

B1 - Best

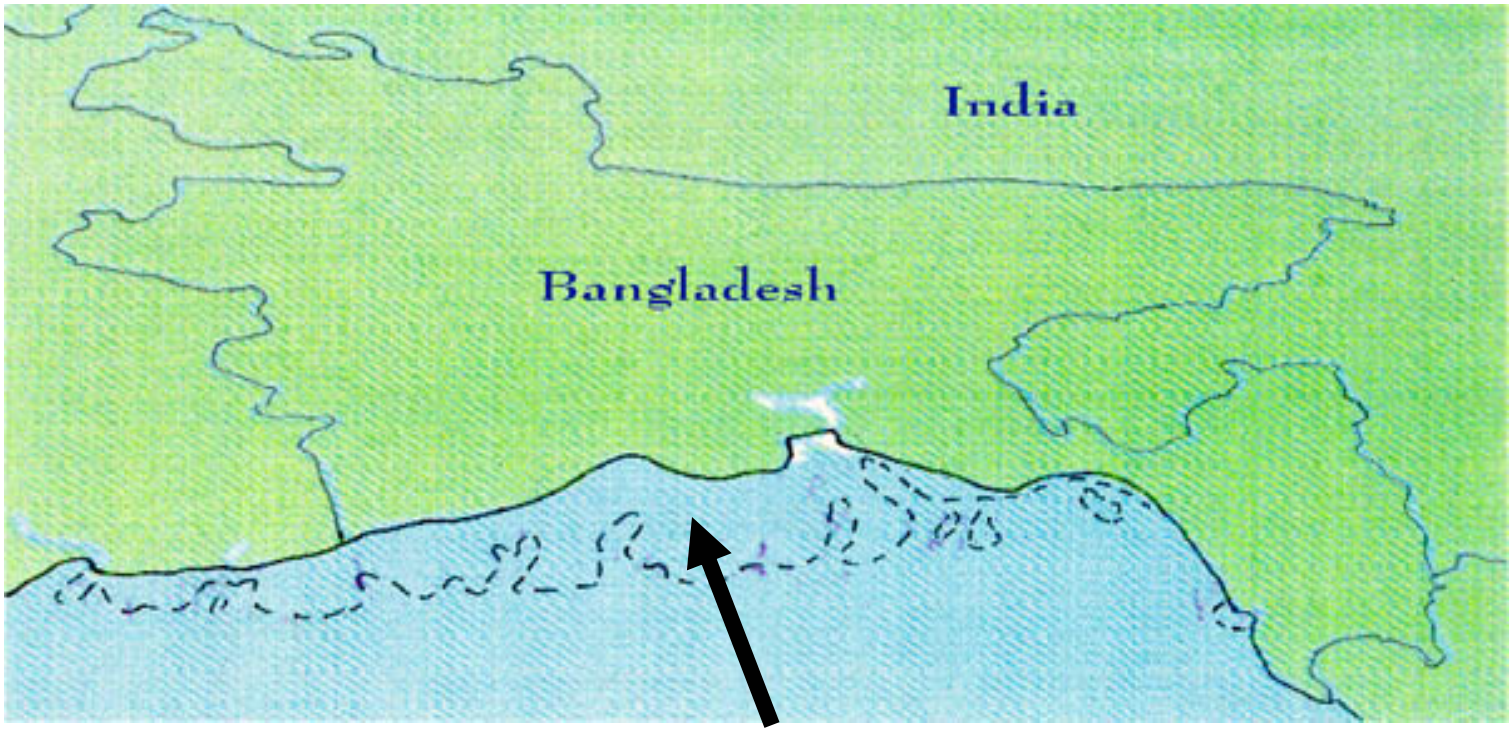
A1B - Medium

A2 - Worst

MEAN SEA LEVEL RISE of 0.4 m (range: 0.2 to 0.6) is projected by 2100 but with significant regional variations

Increased risk of floods, potentially displacing tens of millions of people, due to sea level rise and heavy rainfall events, especially in Small Island States and low-lying deltaic areas.

Bangladesh is projected to lose about 17% of its land area with a sea level rise of one meter - very difficult to adapt due to lack of adaptive capacity

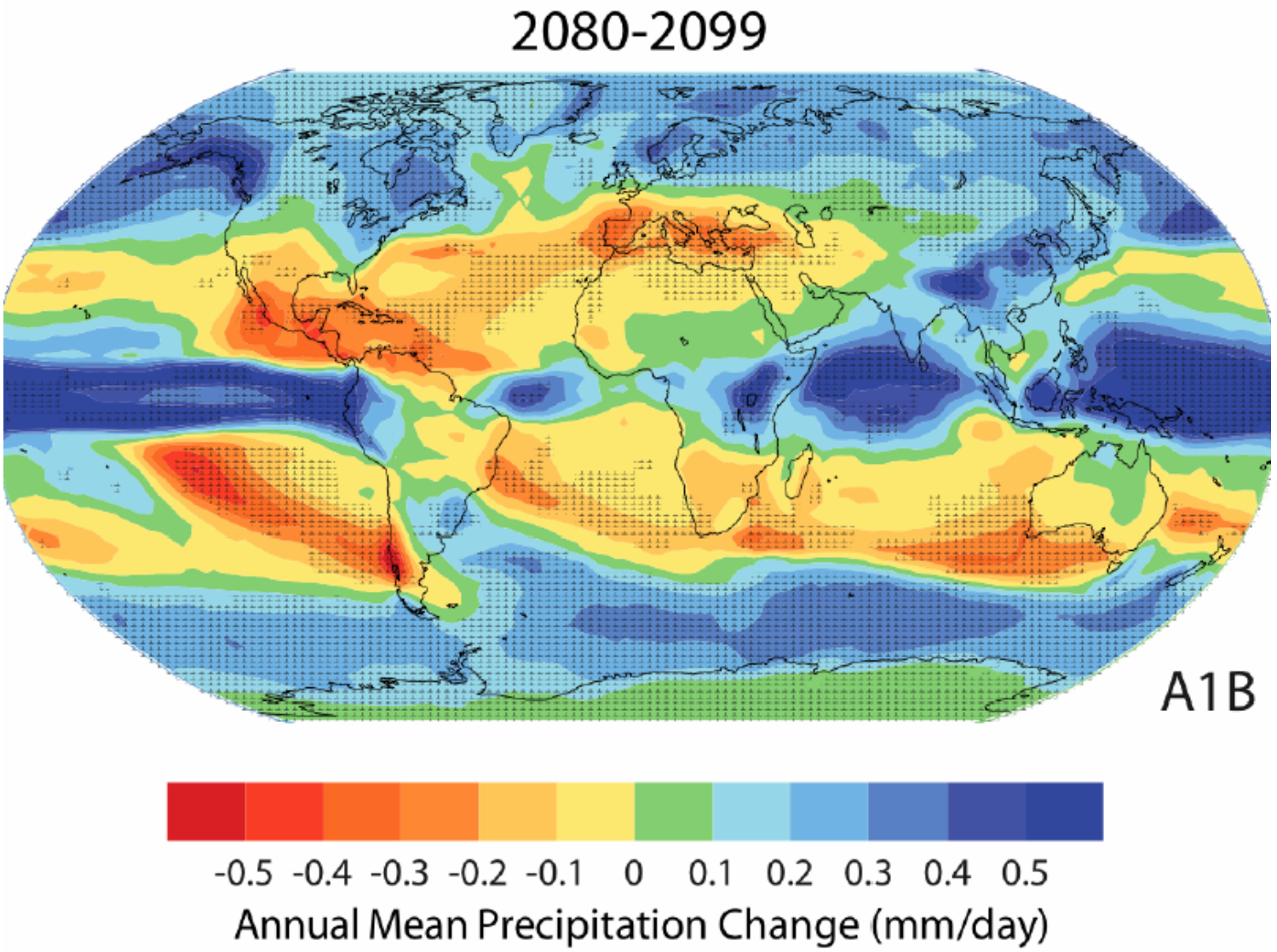


Flooded area

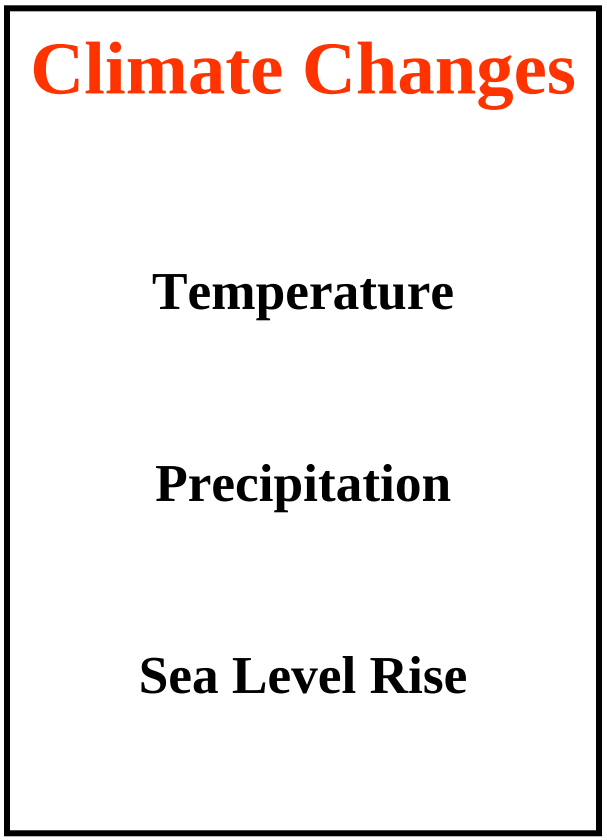
Extreme Weather Events are Projected to Increase

Projected changes during 21st century	Examples of impacts
• Higher maximum temperatures; more hot days and heatwaves over nearly all land areas *(very likely)*	• Increased mortality in old people in urban areas • Damage to crops • Heat stress on livestock
• Higher minimum temperatures; fewer cold days frost days and cold spells over nearly all land areas *(very likely)*	• Extended range of pests and diseases • Loss of some crop/fruit
• more intense precipitation events over many areas (*very likely*)	• Land slides, mudslides, damage to property and increased insurance costs
• increased summer drying over most mid-latitude continental interiors and associated risk of drought *(likely)*	• Reduced rangeland productivity, increased wildfires, decreased hydropower
• increase in tropical cyclone peak wind intensity, mean and peak precipitation intensities *(likely)*	• Damage to various ecological and socioeconomic systems

Dry areas get dryer & wet areas get wetter



OVERALL: More adverse than beneficial impacts on biological and socioeconomic systems



Health Impacts
Weather-related Mortality
Infectious Diseases
Air Quality- Respiratory Illnesses

Agriculture Impacts
Crop Yields
Irrigation Demands

Forest Impacts
Forest Composition
Geographic Range of forests
Forest health and productivity

Water Resources Impacts
Water supply
Water quality
Competition for water

Impacts on Coastal Areas
Erosion of beaches
Inundation of coastal lands
Additional costs to protect coastal communities

Species and Natural Areas
Loss of habitat and species

Key IPCC Findings – A Few Beneficial Impacts

increased agricultural productivity in some mid-latitude regions (only for warming of up to a few degrees C)

increased water availability in some water-scarce regions

reduced winter mortality in mid- and high-latitudes

increase in timber supply (with well managed forests)

Potential Large Scale Impacts - Uncertain

Greenhouse gas emissions in the 21st century might set in motion large-scale, high-impact, non-linear, and potentially irreversible changes in physical and biological systems over the coming decades to millennia

- **Melting of ice sheets** (sustained warming of a few ^{o}C over millennia is projected to lead to an increase in sea level of several meters due to loss of Greenland and Antarctic Ice)
- **Thermohaline circulation**
- **Species extinction and biodiversity loss**
- **Catastrophic climate-development interactions**

IPCC AR4 – Summary of Main Findings

- **Global warming in unequivocal. Total radiative forcing of the climate now is unprecedented in several thousand years, due to rising concentrations of GHG (CO2, CH4 & NO2).**
- **Humans activities since the 18th century are very likely to have caused net warming of Earth's climate, dominating over the last 50 years. More temp. and sea level rise is inevitable, even with existing GHG concentrations.**
- **Long term unmitigated climate change would likely exceed the capacity to adapt, of natural managed and human systems.**
- **Poor countries and poorest groups will be most vulnerable to warming, sea level rise, precipitation changes and extreme events. Most socio-economic sectors, ecological systems and human health will suffer.**
- **Adaptation measures are available, but must be systematically developed**
- **Mitigation technologies are also available, but better policies and measures (PAM) are needed to realize their potential.**
- **Making development more sustainable (MDMS) by integrating climate change policy into sustainable development strategy is most effective solution.**

Why CC is important for SD

Key Motivations for Seeking More Sustainable Development Paths

Motivation 1: Sustainable Development will be set back by Climate Change - developing countries most vulnerable

The sustainable development challenge is to:

- **alleviate poverty** for the 1.3 billion people who live on less than $1 per day and the 3 billion people who live on less than $2 per day
- provide adequate **food**, especially for the 800 million people who are malnourished today—this will require food production to double in the next 35 years without further environmental degradation, e.g., deforestation
- provide **clean water** for the 1.3 billion people who live without clean water and provide sanitation for the 2 billion people who live without sanitation
- provide **energy** for the 2 billion people who live without electricity
- provide a **healthy environment** for the 1.4 billion people who are exposed to dangerous levels of *outdoor pollution* and the even larger number exposed to dangerous levels of *indoor air pollution and vector-borne diseases*
- provide **safe shelter** for those that live in areas susceptible to civil strife due to environmental degradation and those vulnerable to natural disasters

Motivation 2:
CC & SD Major agreements: Poverty/Equity focus

1. UNCED 1992: Rio Earth Summit

- Rio Declaration of Principles
- Agenda 21
- UNFCCC

2. Millennium Development Goals 2000: UN

3. WSSD Goals 2002: Johannesburg Summit

4. Millennium Development Summit 2006: UN

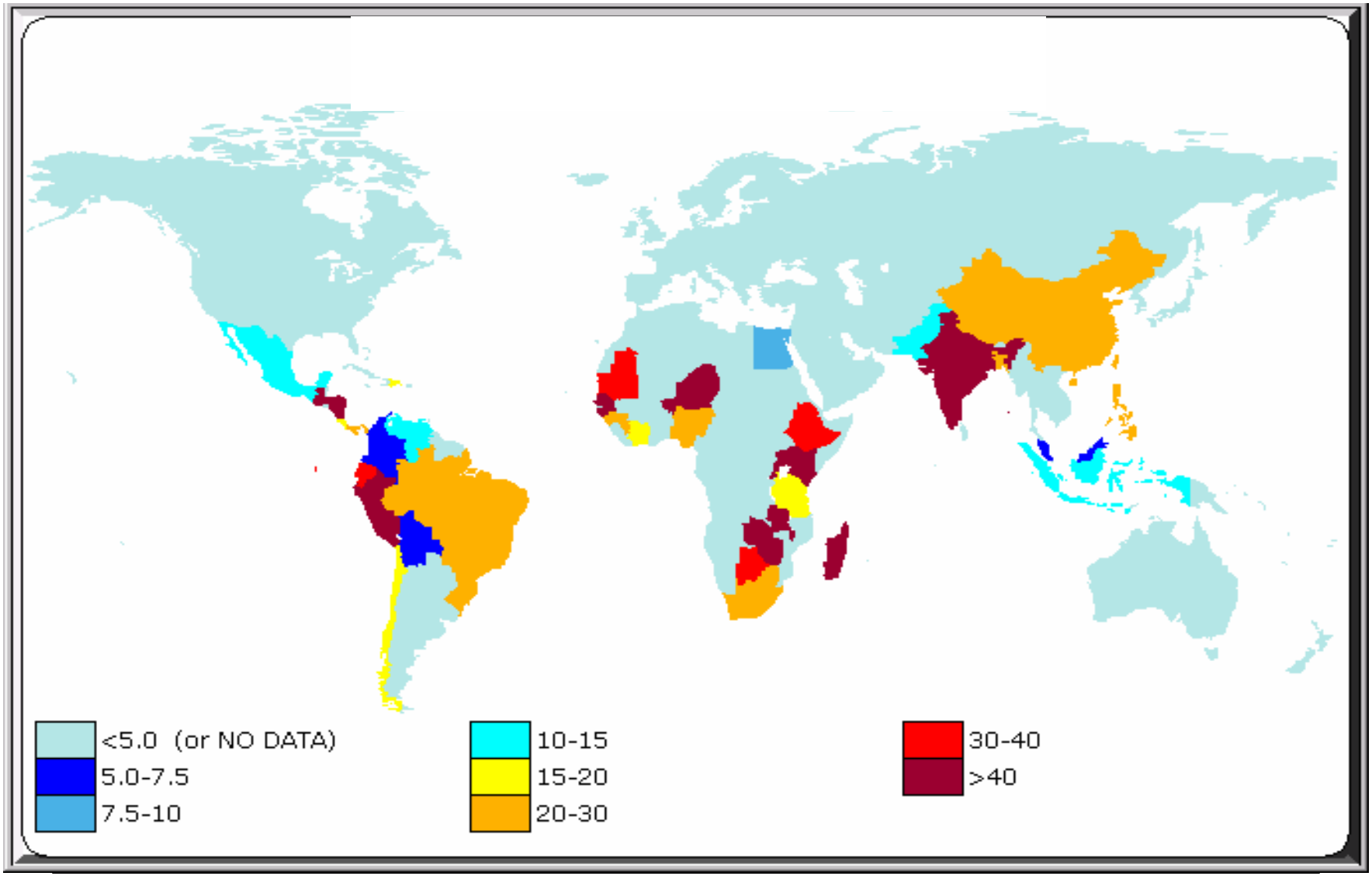
Millennium Development Goals (MDG)

United Nations Millennium Declaration, 2000

- Eradicate extreme poverty and hunger
- Achieve universal primary education
- Promote gender equality and empowerment
- Reduce child mortality
- Improve maternal health
- Combat HIV/AIDS, malaria and other diseases
- Ensure environmental sustainability
- Develop a global partnership for development

Commendable targets, but will they be met?

Poor living on < $1 per day



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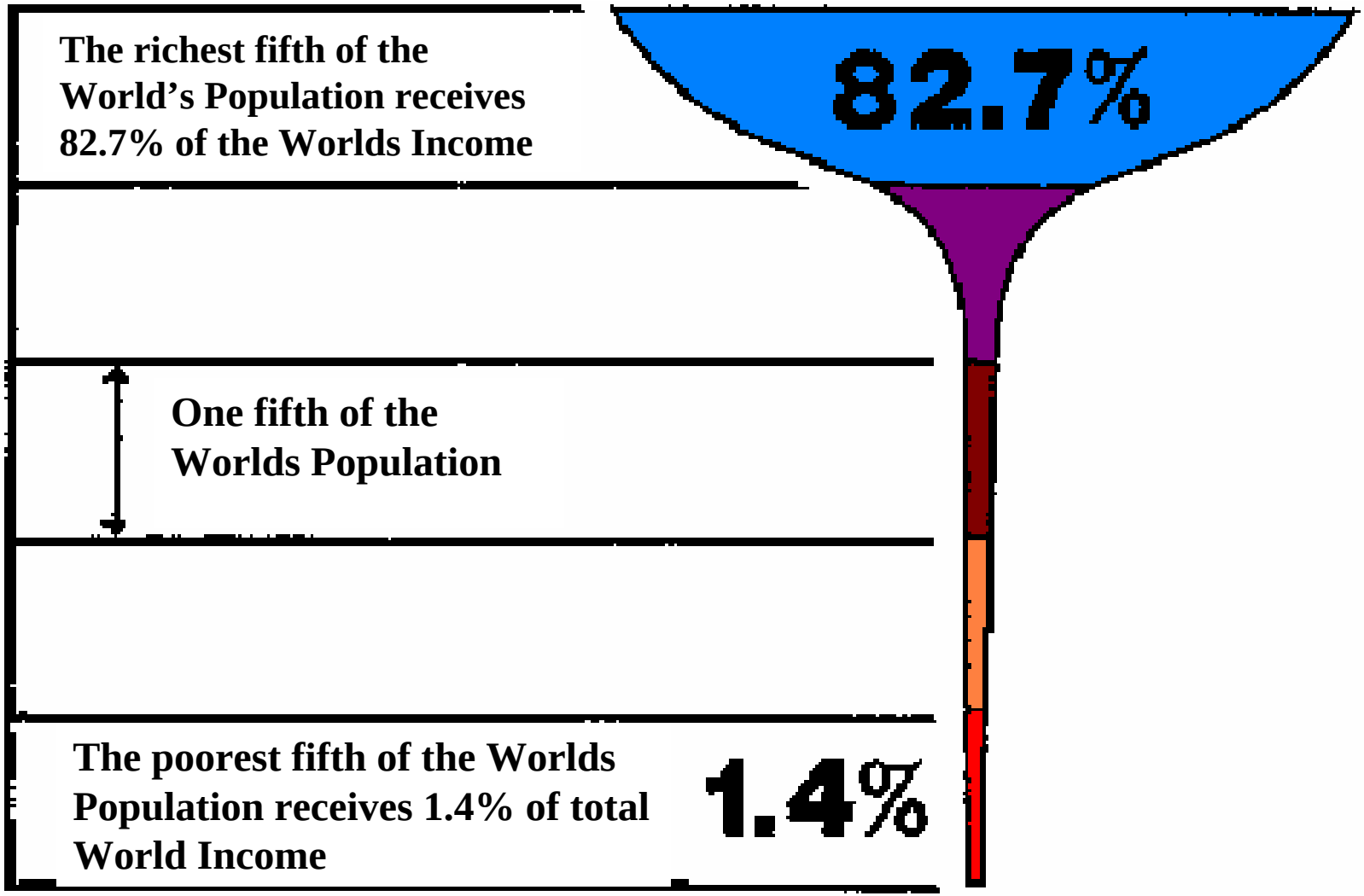
Inequitable World Income Distribution: Champagne Glass



Motivation 3:
UN Framework Convention on Climate Change 1992

Article 2

Stabilize atmospheric GHG concentrations to prevent 'dangerous' anthropogenic inteference in the climate system:

- enable **economic development** to proceed in a sustainable manner
- ensure **food production** is not threatened
- allow **ecosystems** to adapt naturally

UNFCCC also speaks of **"common but differentiated responsibilities"**

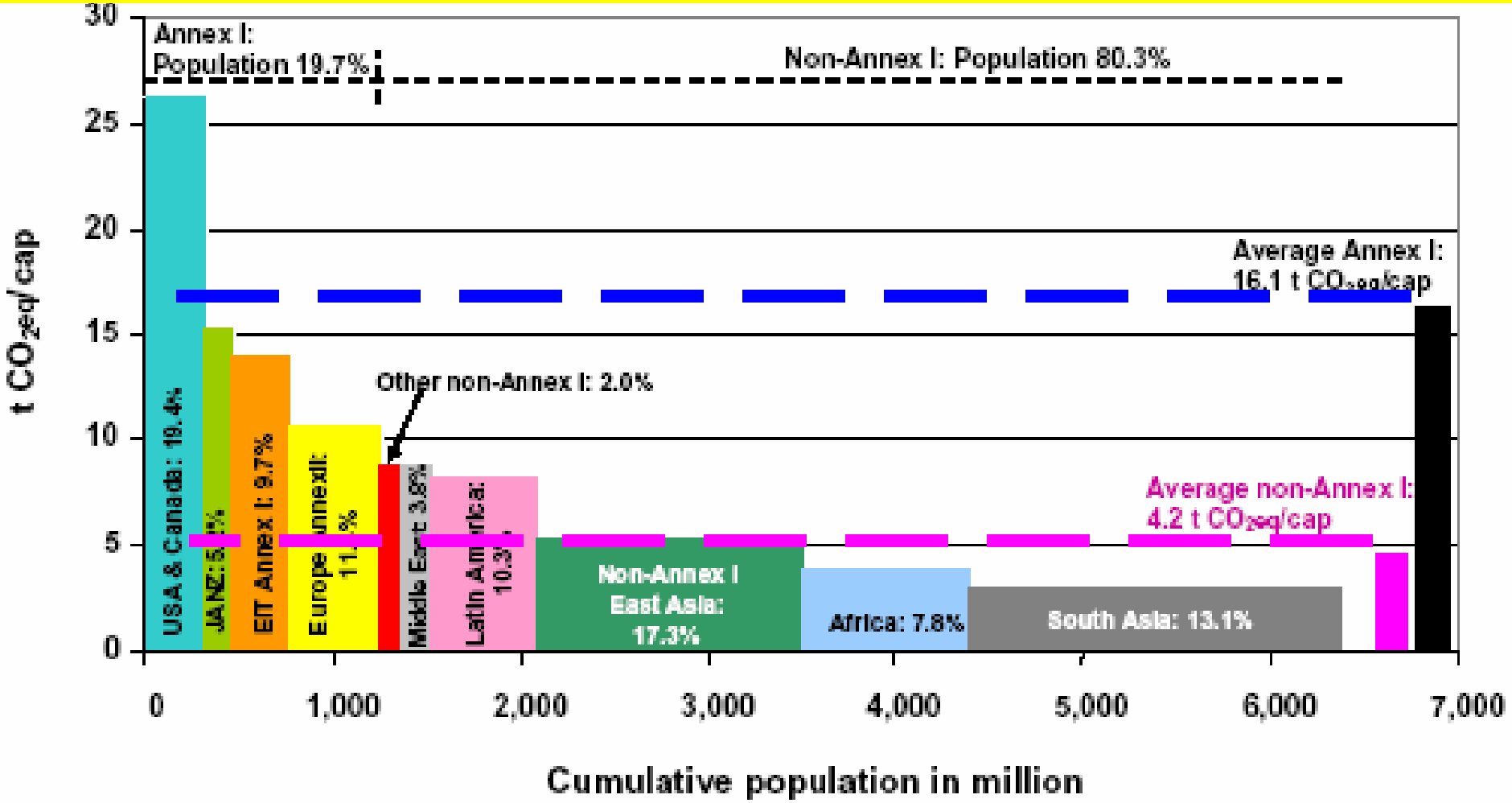
Adaptation Burden & Equity: CC → SD

Adaptation is the first priority of developing countries that are most vulnerable to climate change

- **Climate change is likely to impact disproportionately upon the poorest countries and the poorest persons within all countries**, exacerbating inequities in health status and access to adequate food, clean water and other resources.
- **Net economic effects will be negative in most developing countries**
- **Impacts will be worse** - many areas are already flood and drought prone, and economic sectors are climate sensitive
- **Lower capacity to adapt** because of a lack of financial, institutional and technological capacity, and access to knowledge

Mitigation Responsibility & Equity: SD → CC

Mitigation is the main responsibility of industrial (Annex I) countries with high per capita GHG emissions



Motivation 4:

Global Long Term Perspectives

- **Lessons of History**
- **Future Scenarios**

Sustainability & Resource Use: Historical view

DURABLE USE OF RESOURCES

- Nile Basin (Egypt)

  Pharaonic system lasted over 4000 years, with sustainable resource use and reasonable quality of life

- Yellow River Basin (China)

  Imperial system was stable for many millenia, and supported flourishing society

- Saraswati River (India)

  Hosted a flourishing civilisation for 4000 years. River eventually dried up due to tectonic activity, climate change and desertification, and water piracy.

OVEREXPLOITATION OF RESOURCES

- Sahara Desert

  Once green with many animals and hunters. Over-exploitation led to a drier habitat which could no longer sustain these populations

Some Major Current Global Problems

Poverty, inequity and human well-being

billions living on <1 per day without basic needs, unequal income distribution

Scarce resources, conflict and competition

energy, water, land, food, etc.

Environmental damage

degradation of air, land and water, climate change, etc.

Globalisation

high risks, but significant benefits if well-managed

Governance

mis-management, corruption, govt. business and civil society partnership crucial

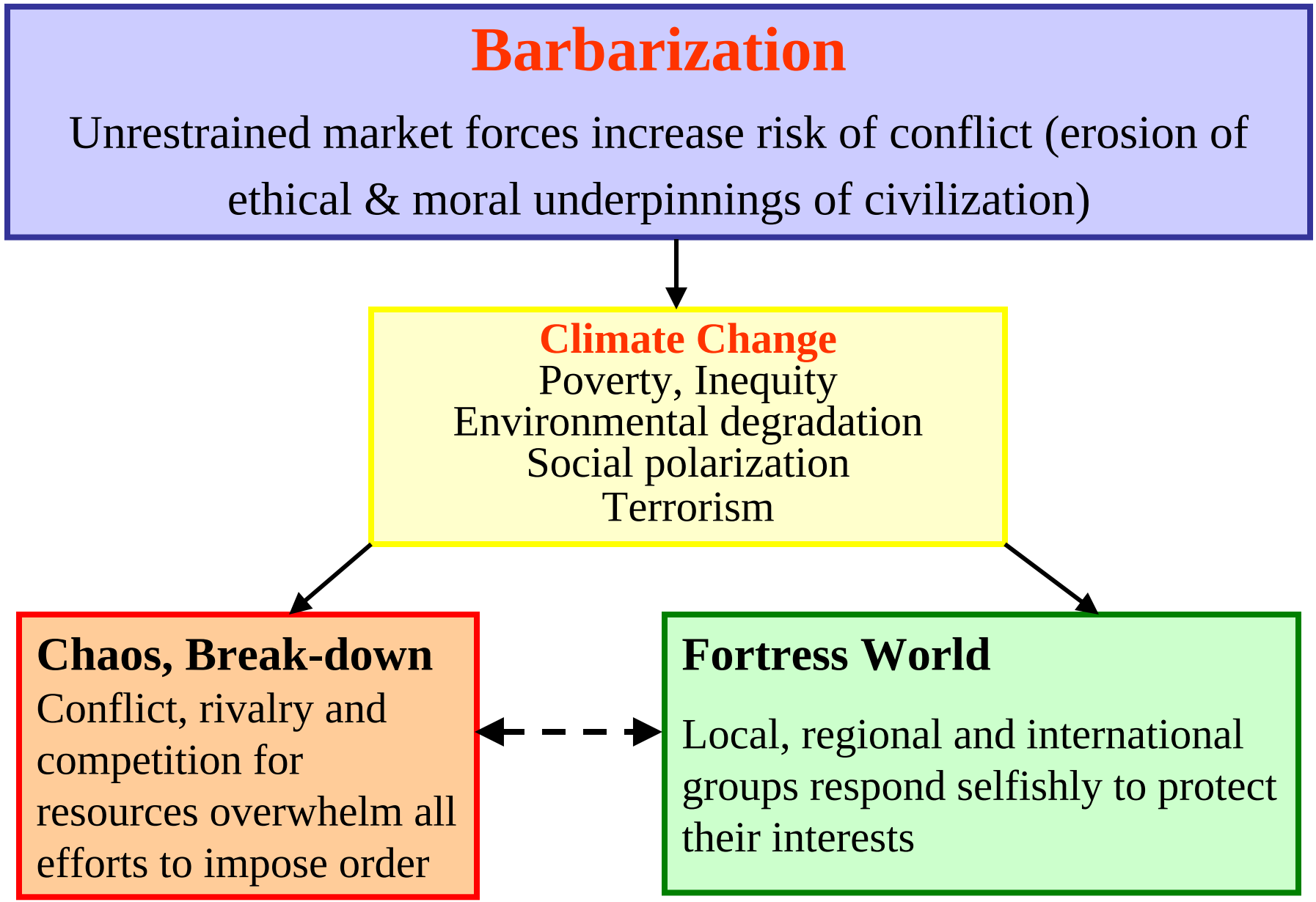
Private-public imbalance

Too much government control and unrestrained markets are both risky extremes

Some Long Term Global Scenarios

MAIN SCENARIOS	VARIANTS
1. Barbarization	Breakdown Fortress World
2. Conventional	Market Driven Policy Reform
3. Transition	New Sustainability Eco-Communalism
Likely Actual Future (BAU)	Mix of above scenarios

Source: Adapted from Global Scenario Group (2000)


Barbarization
Unrestrained market forces increase risk of conflict (erosion of ethical & moral underpinnings of civilization)
Climate Change
Poverty, Inequity
Environmental degradation
Social polarization
Terrorism
Chaos, Break-down
Conflict, rivalry and competition for resources overwhelm all efforts to impose order
Fortress World
Local, regional and international groups respond selfishly to protect their interests

WHY ? is climate a threat to future human development

Climate Change (CC) undermines Sustainable Development (SD) and unfairly penalizes the poor

HOW ? can we move forward to transform risky current trends into a safer and better future

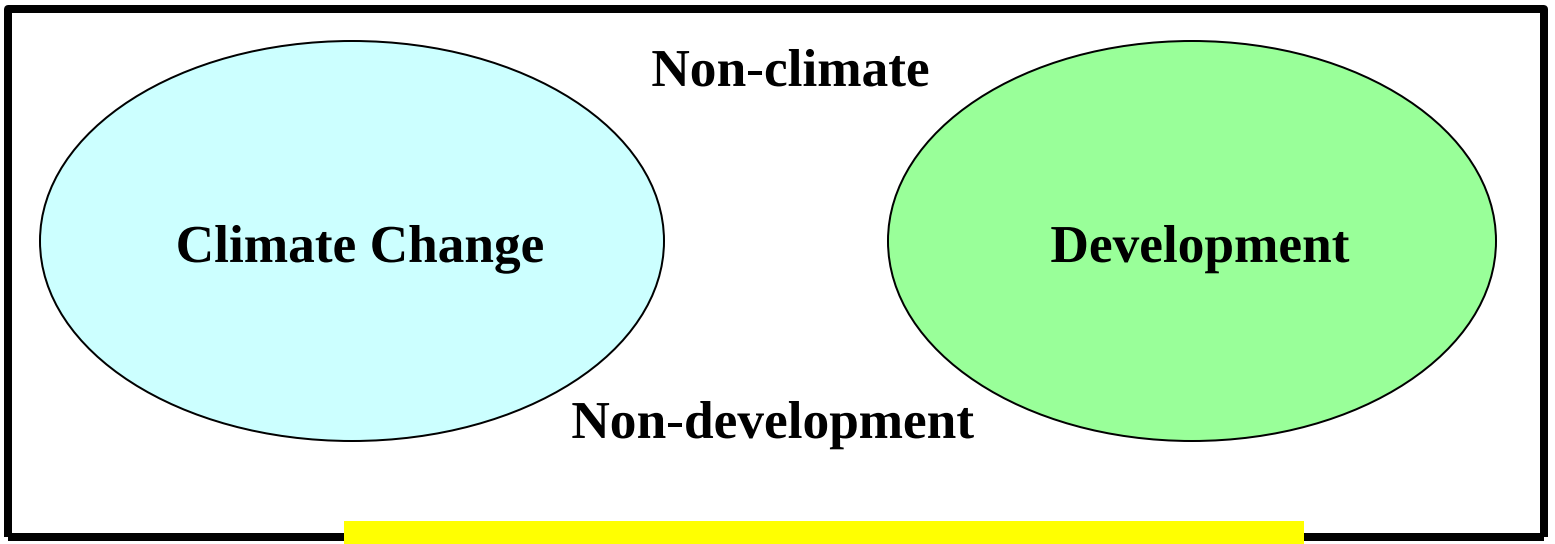
Start making development more sustainable (MDMS) now, using the Sustainomics framework

A Long Term Vision of Sustainable Development

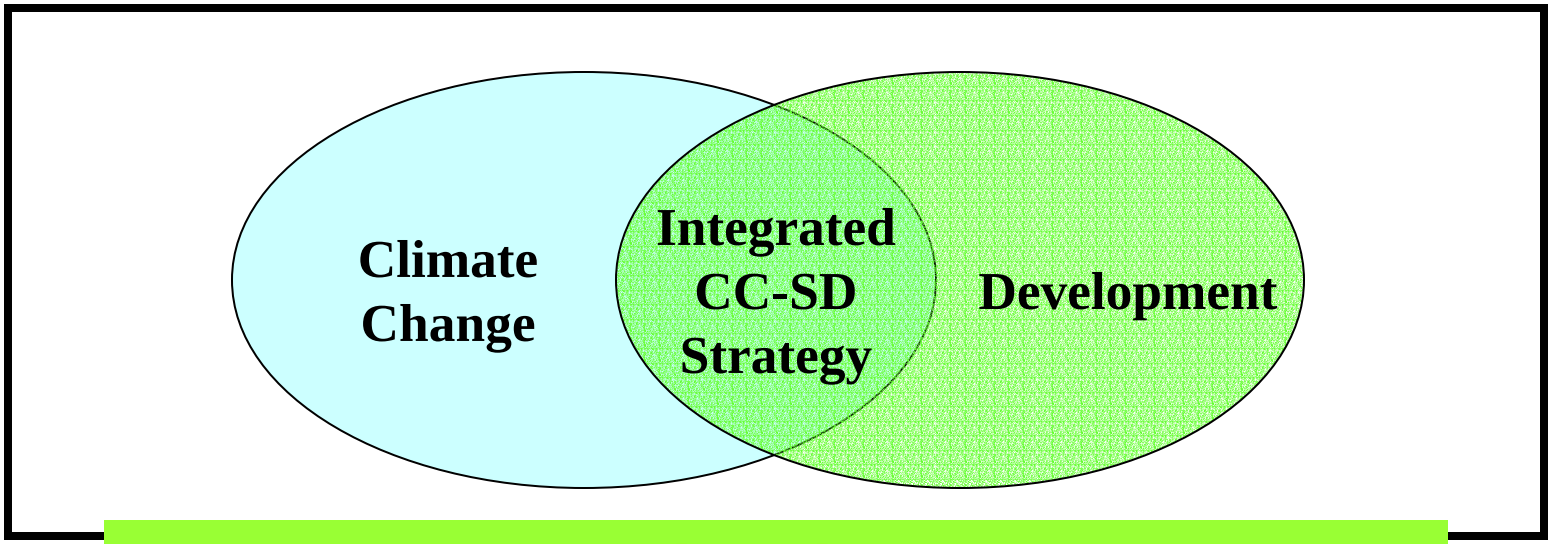
Levels	Indicators	Time	Human Interventions
Main (Surface) Issues	**Poverty, Inequity, Exclusion, Resource Conflicts, Harm to Environment (including CC)**	**Now** ←	**High risk of unrestrained market forces at work ("Washington consensus", globalisation etc.) – Reactive-piecemeal: govt.**
Immediate Drivers	**Consumption Patterns, Population, Technology, Governance**	**Transition** ←	**Making development more sustainable (MDMS) with systematic policy reform to manage market forces (Sustainomics) – Proactive: partnerships - govt., business, civil soc.**
Underlying Pressures	**Basic Needs, Social Power Structure, Values, Perceptions, Choices, Knowledge Base**	**Long Term** ←	**Fundamental global sustainable dev. transition catalysed through grass roots citizens movements, driven by social justice and equity concerns, innovative leadership, policies, tech. (new SD paradigm) – Proactive: civil soc., govt., business**

Source: Munasinghe (2007), IPCC, MA, GTI

Tracing the Links Between Climate Change and Sustainable Development (Sustainomics Framework)

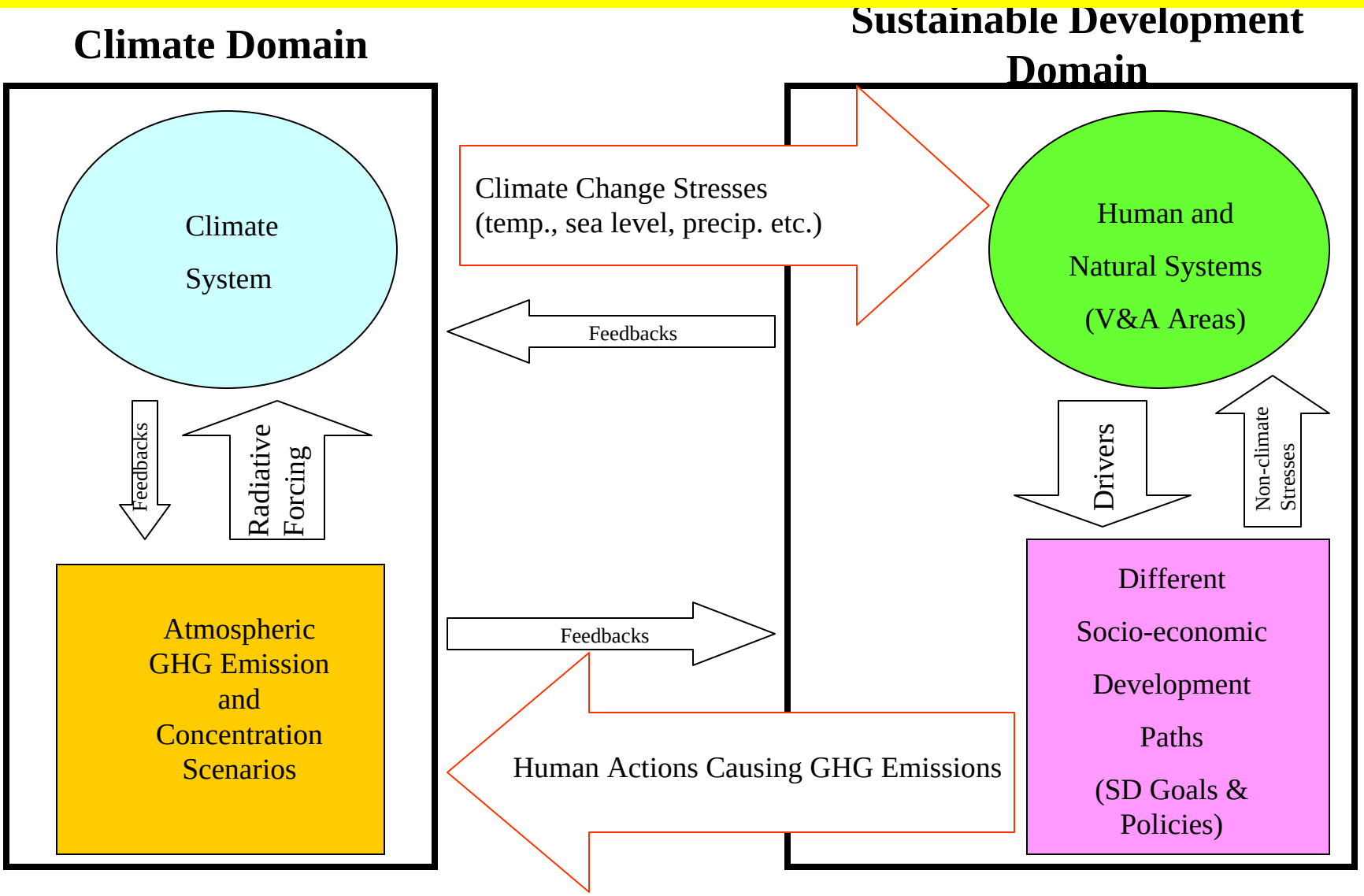


Original Viewpoint – IPCC AR1: 1990

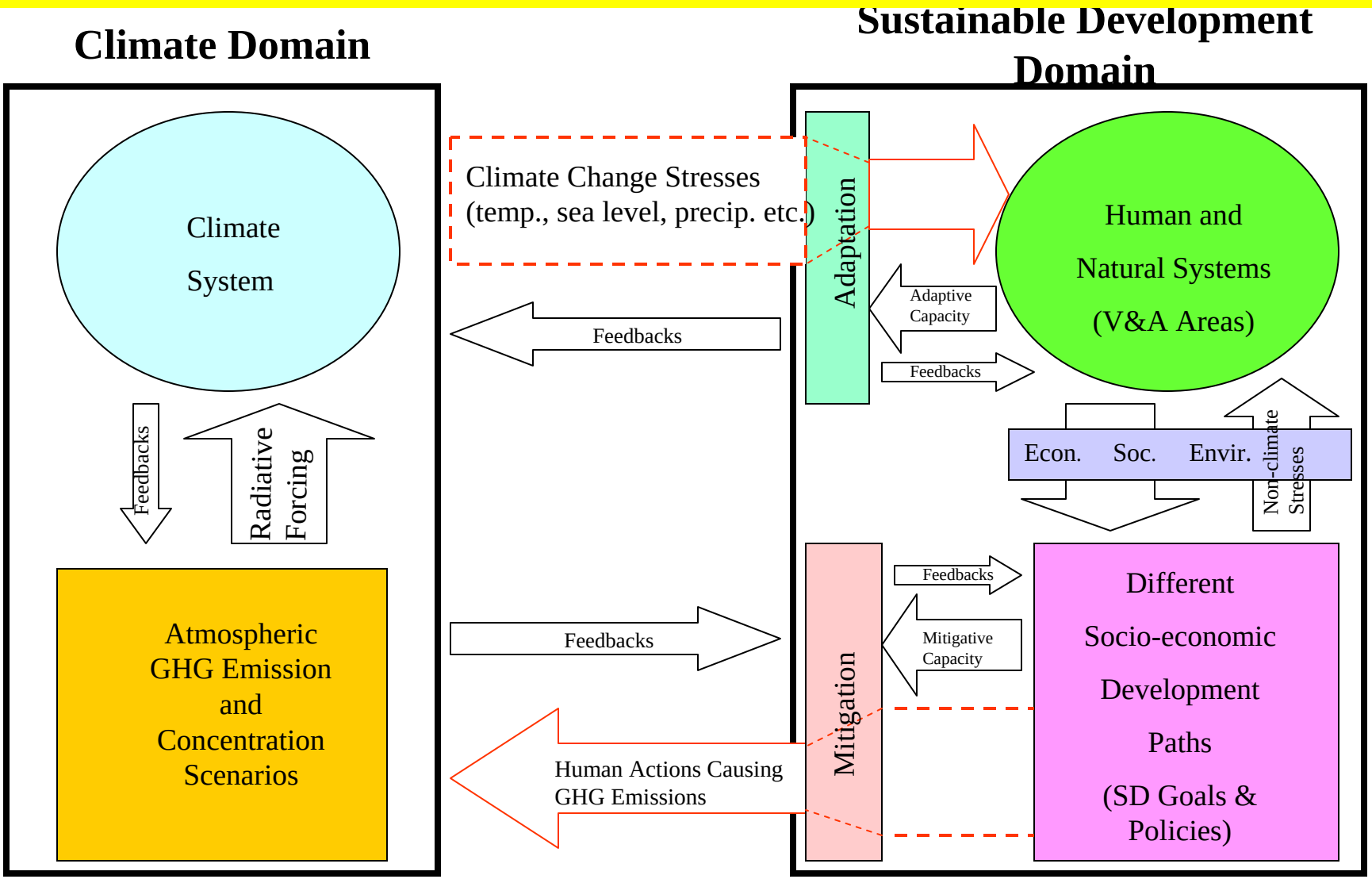


Current Viewpoint (policy relevant) – IPCC AR4: 2007

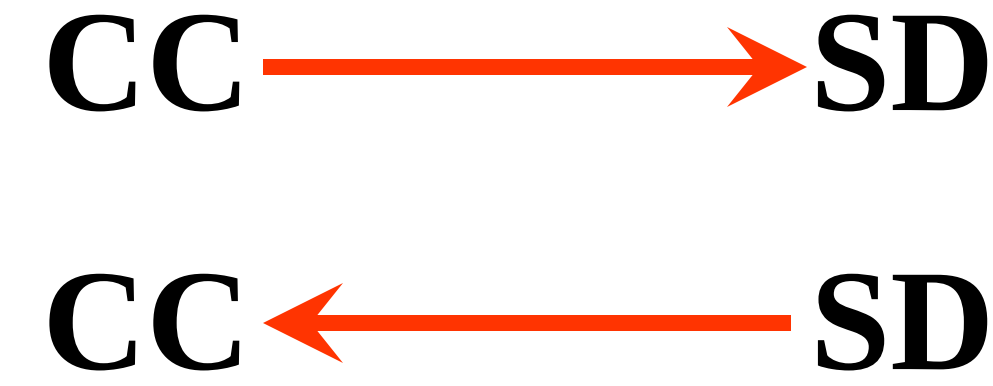
Global Level CC-SD Links 1



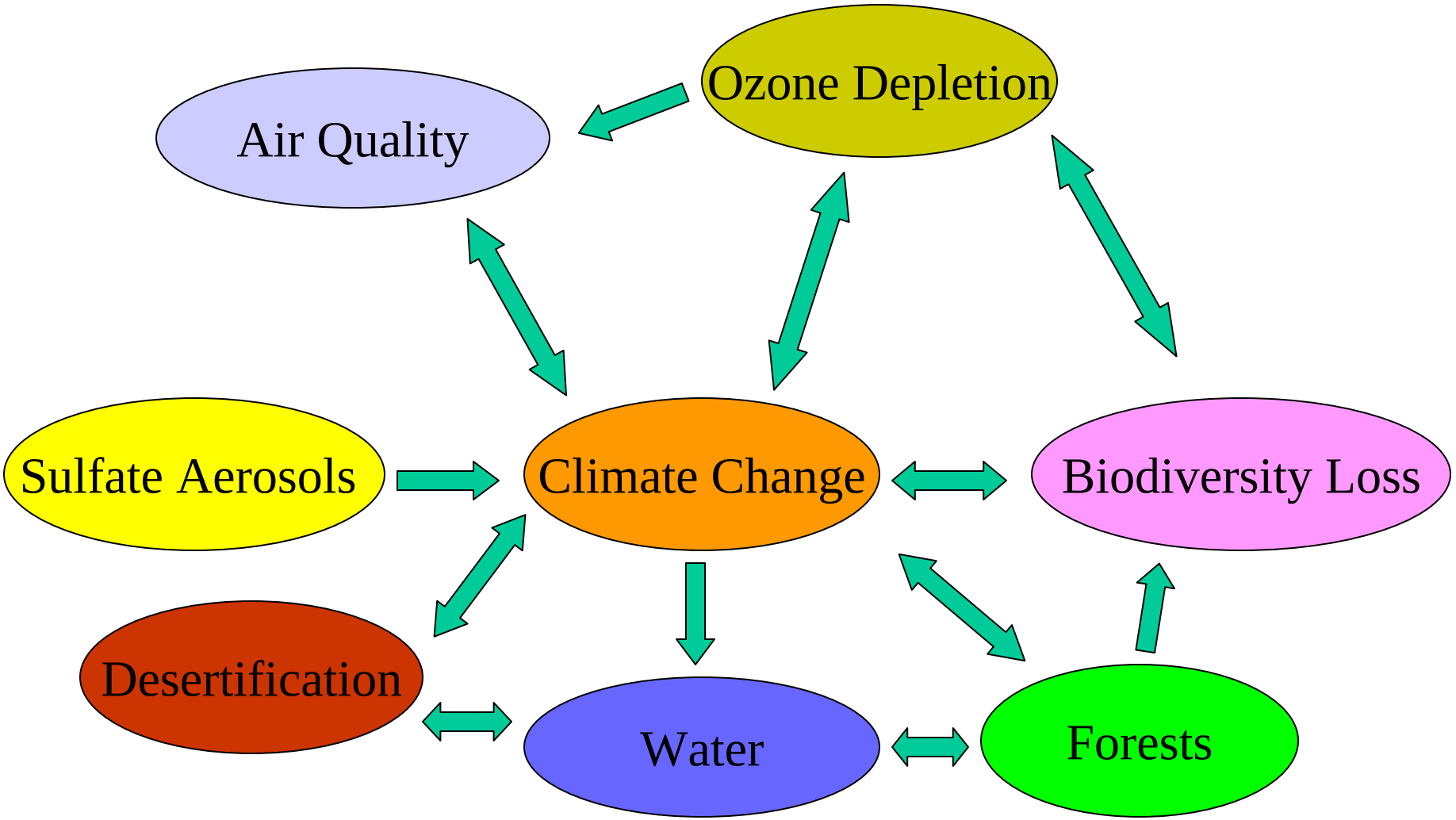
Global Level CC-SD Links 2



TWO-WAY LINKAGES BETWEEN CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT



Further Complexity: Inter-Linkages with Other Environmental Issues



Integrating CC Policies into SD Strategy using Sustainomics

Core concepts and elements

1. Making development more sustainable (MDMS)
2. Sustainable development triangle
3. Transcending boundaries
4. Full cycle application of integrative tools – from data gathering to practical policy implementation

Understanding Sustainable Development: some (ideal) generic definitions

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

Source: Bruntland et al. (1987)

"process for improving the range of opportunities that will enable individual human beings and communities to achieve their aspirations and full potential over a sustained period of time, while maintaining the resilience of economic, social and environmental systems"

Source: Munasinghe (1992, Rio Earth Summit)

Rationale for approach based on Making Development More Sustainable (MDMS)

The precise definition of sustainable development remains an elusive (perhaps unreachable) goal.

Making development more sustainable (MDMS) is a less ambitious strategy based on Sustainomics, that offers greater promise.

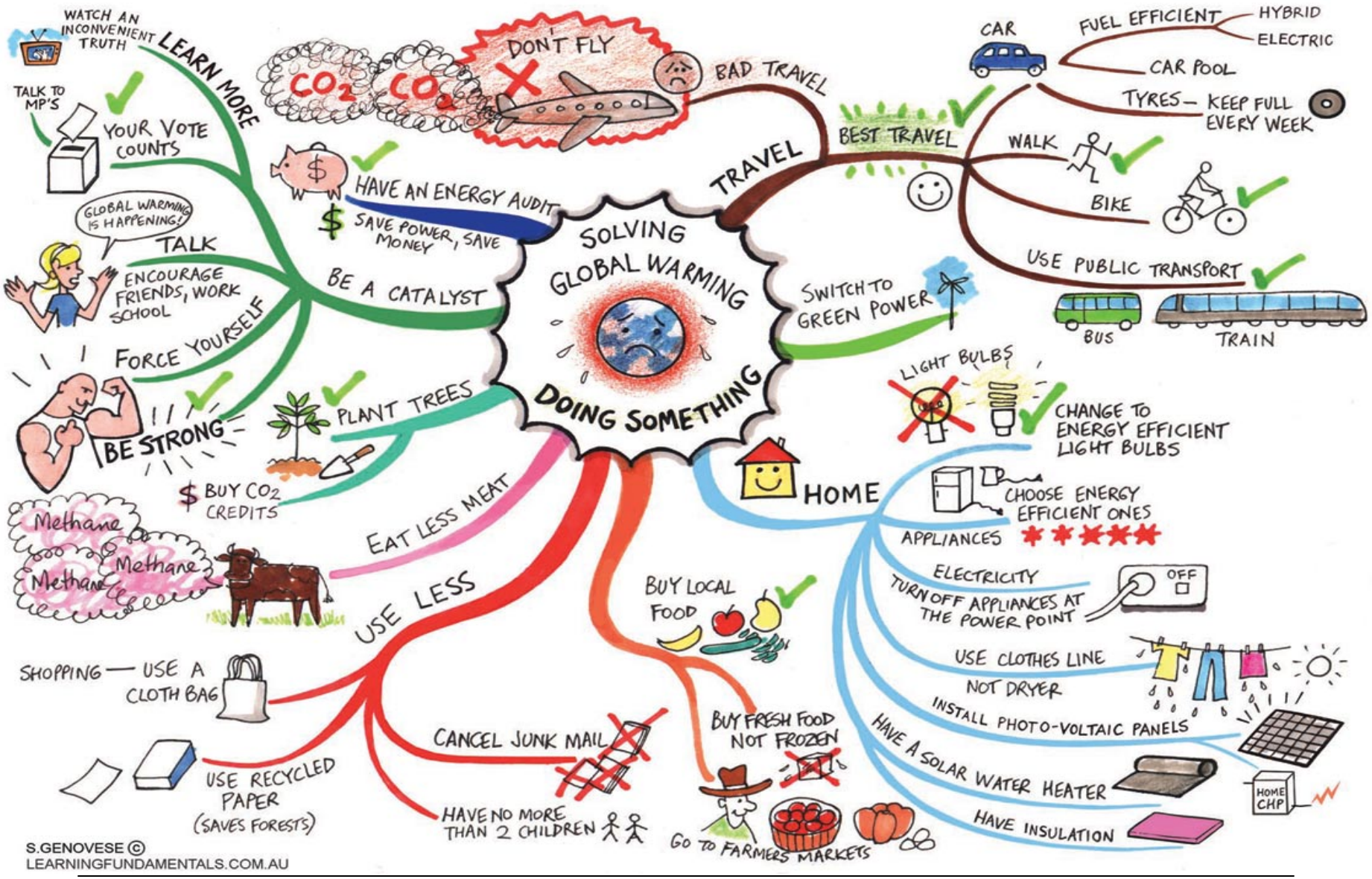
Such an incremental (or gradient-based) method is more practical, because many unsustainable activities are easier to recognize and eliminate.

Furthermore, climate response strategies cannot be expected to address all the problems of sustainable development.

Climate change impacts and response strategies could be assessed more meaningfully based on whether they "make development more (or less) sustainable".

Many obviously unsustainable practices exist today. MDMS encourages us to eliminate them NOW! Examples include energy wastage and deforestation.

Making Development More Sustainable: Personal Lifestyle Changes

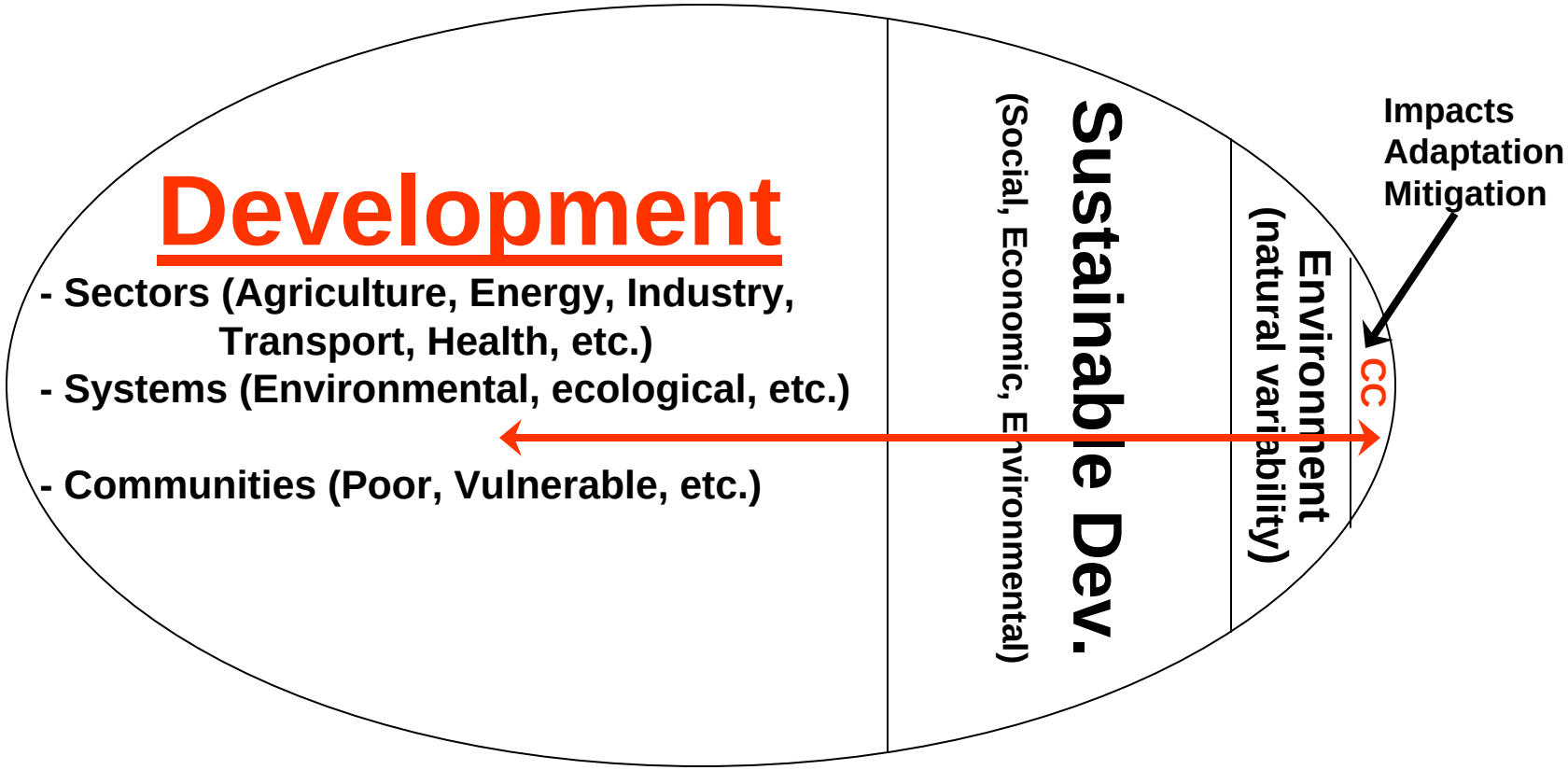


MDMS: Corporate Social Responsibility

- Corporate Social Responsibility (CSR) is a concept whereby organizations consider the interests of society by taking responsibility for the impact of their activities on customers, suppliers, employees, shareholders, communities and the environment in all aspects of their operations.
- This obligation is seen to extend beyond the statutory and conventional obligation to comply with legislation and seek profits. It sees organizations voluntarily taking further steps to improve the quality of life for employees and their families as well as for the local community and society at large.

MDMS: National Level CC-SD Integration

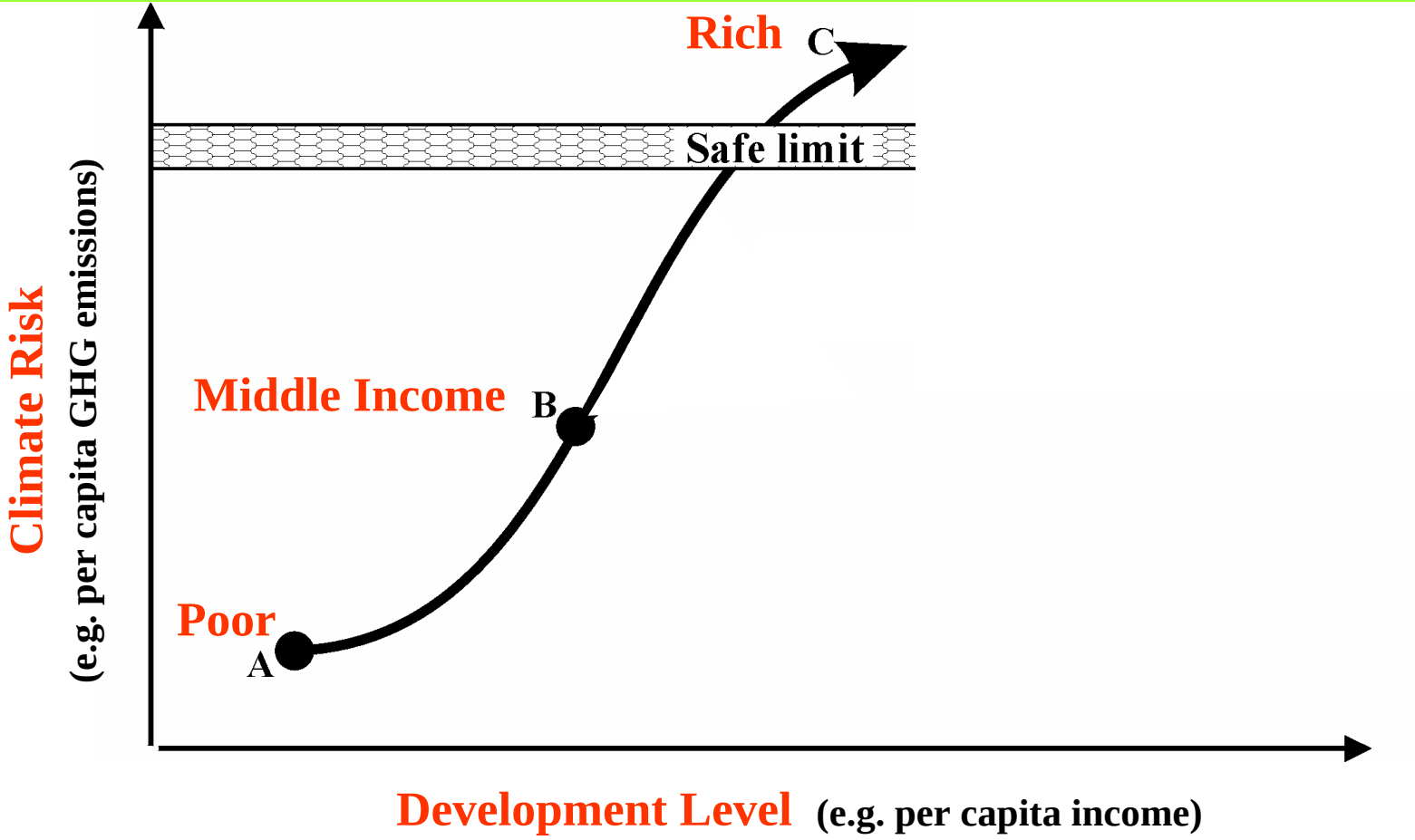
Make decision makers see climate change as a key element of the national sustainable development strategy



Making Development More Sustainable: Global "Tunneling" Framework for Reconciling Mitigation Burden and Right to Develop

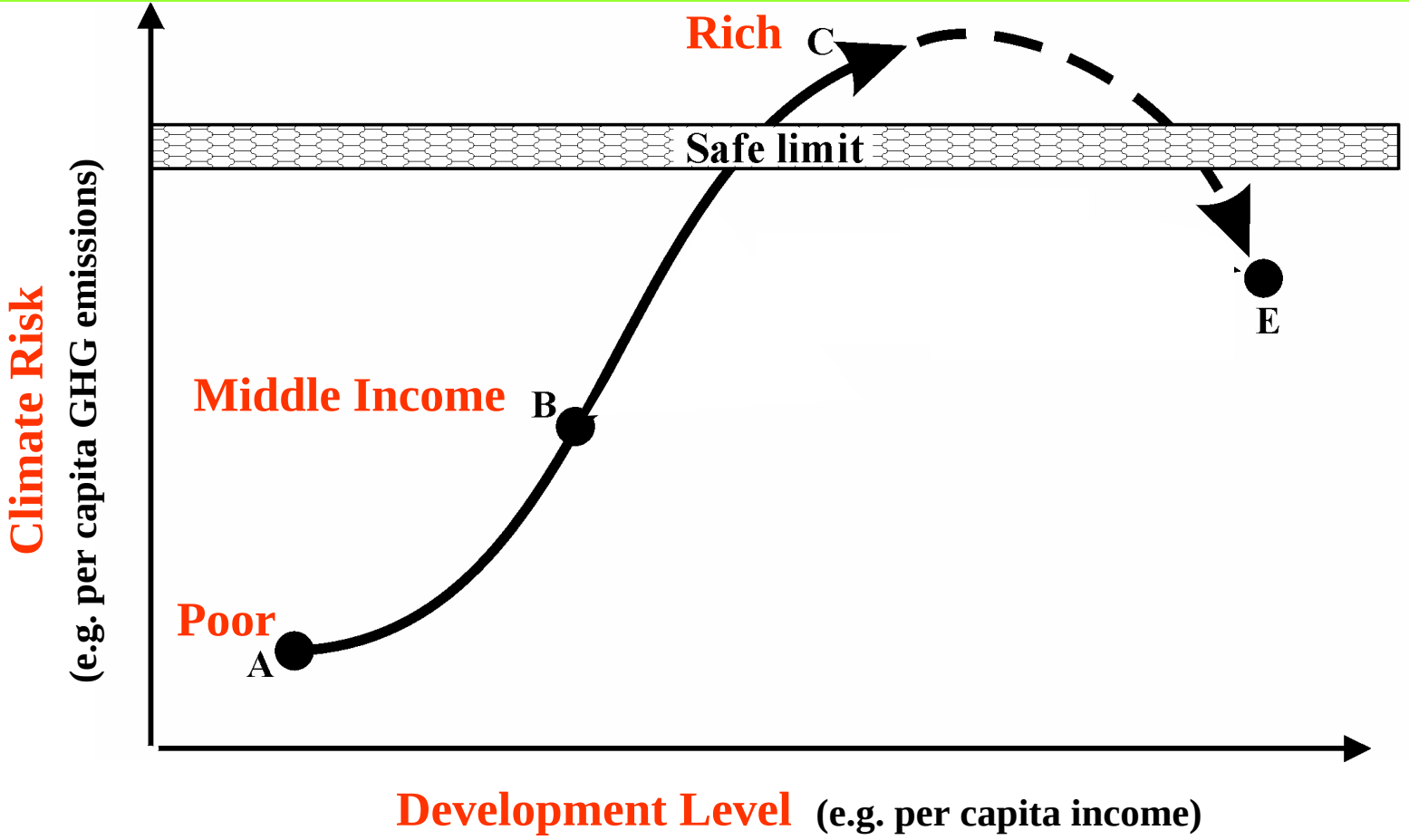
Climate Change Responses and Sustainable Development need not be conflicting objectives

MDMS via "Tunneling": Global Framework for reconciling Climate Risk vs. Development Rights 1



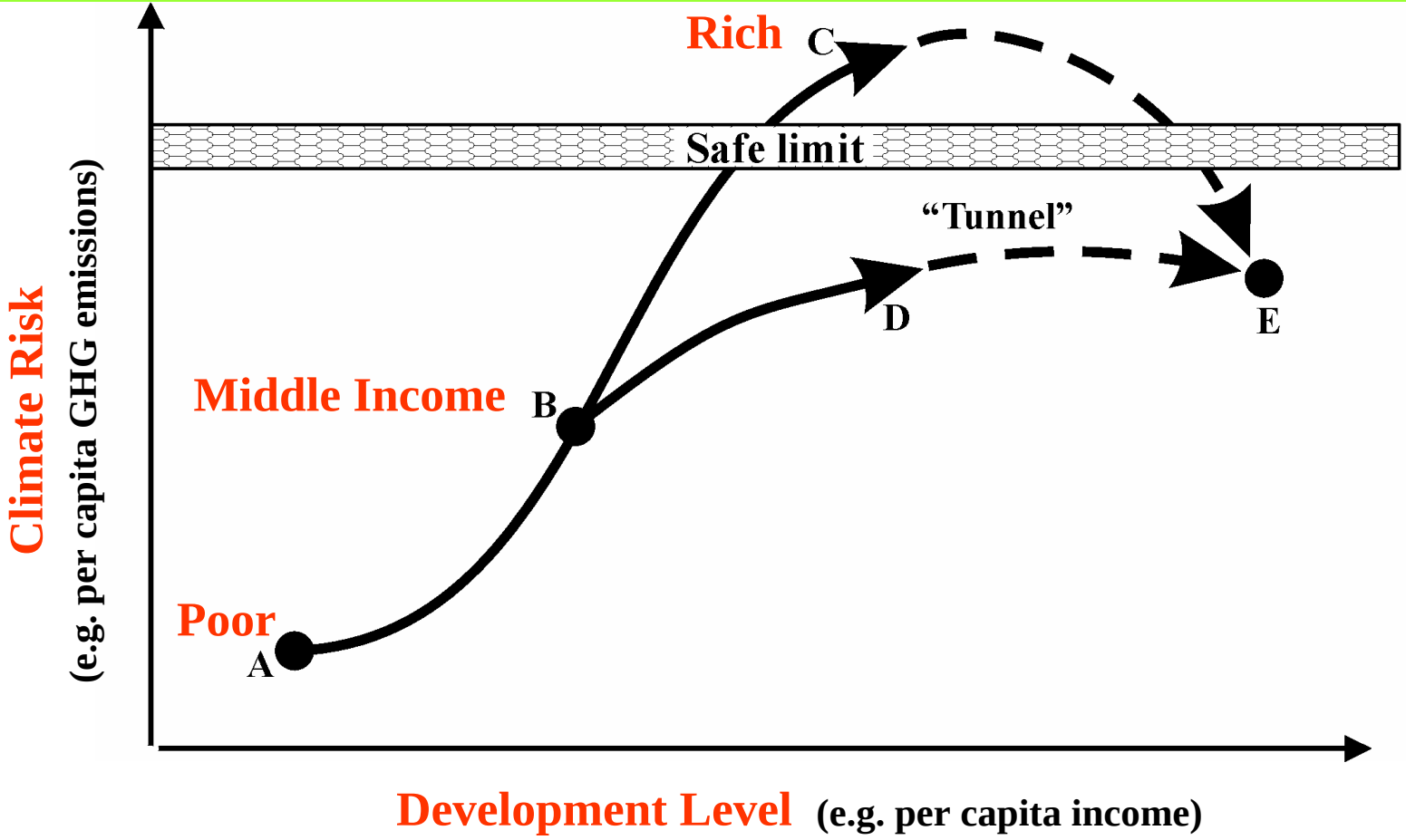
Source: M. Munasinghe (1995) "Making Growth More Sustainable," *Ecological Economics*, 15:121-4.

MDMS via "Tunneling": Global Framework for reconciling Climate Risk vs. Development Rights 2



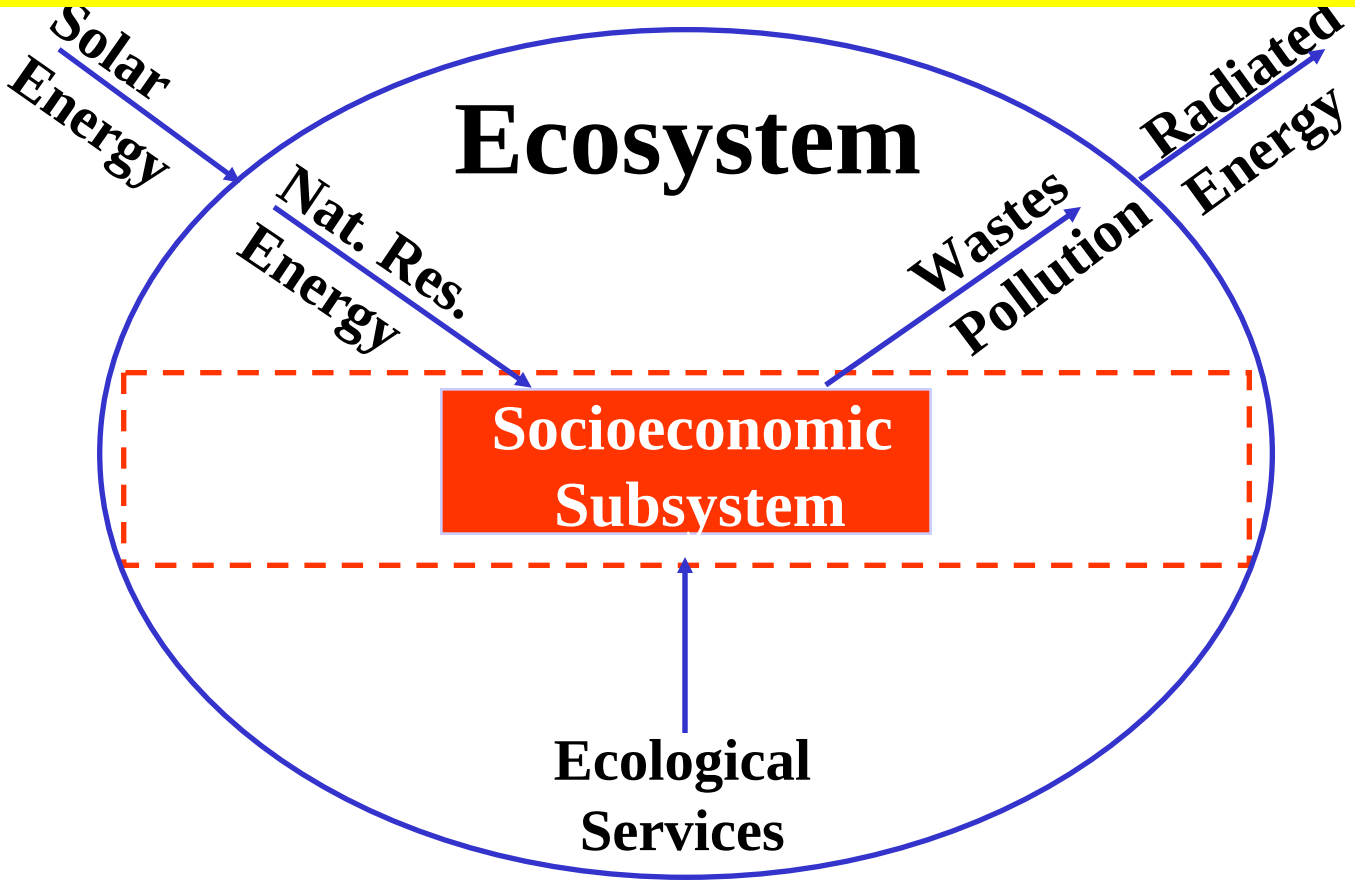
Source: M. Munasinghe (1995) "Making Growth More Sustainable," *Ecological Economics*, 15:121-4.

MDMS via "Tunneling": Global Framework for reconciling Climate Risk vs. Development Rights 3



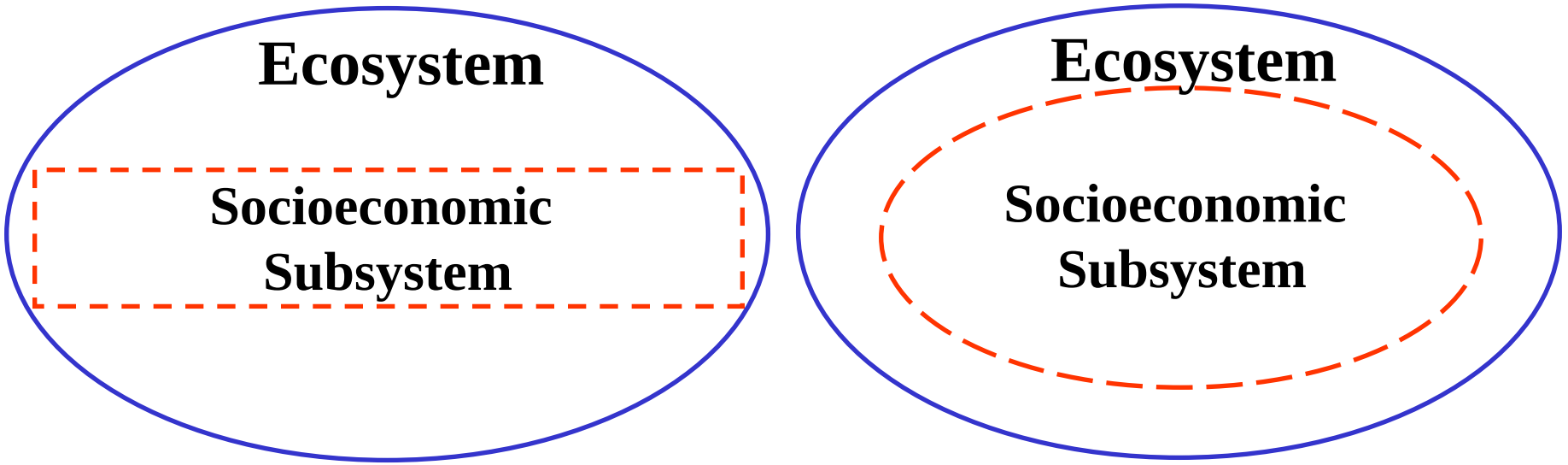
Source: M. Munasinghe (1995) "Making Growth More Sustainable," *Ecological Economics*, 15:121-4.

MDMS: Global Restructuring of development and growth - 1



The capacity of the ecosystem may become overloaded by the growing socio-economic subsystem (broken lines).

MDMS: Global Restructuring of development and growth - 2 (rounding the rectangle)



Unsustainable **Sustainable**

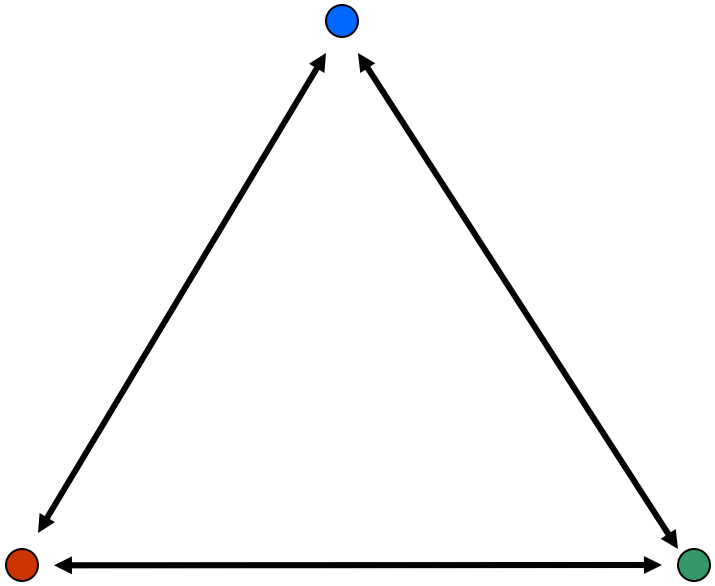
Integrating CC Policies into SD Strategy using Sustainomics

Core concepts and elements

1. Making development more sustainable (MDMS)
2. Sustainable development triangle
3. Transcending boundaries
4. Full cycle application of integrative tools – from data gathering to practical policy implementation

•growth
•efficiency
•stability

Economic



Social

- empowerment
- inclusion/consultation
- institutions/governance

Environmental

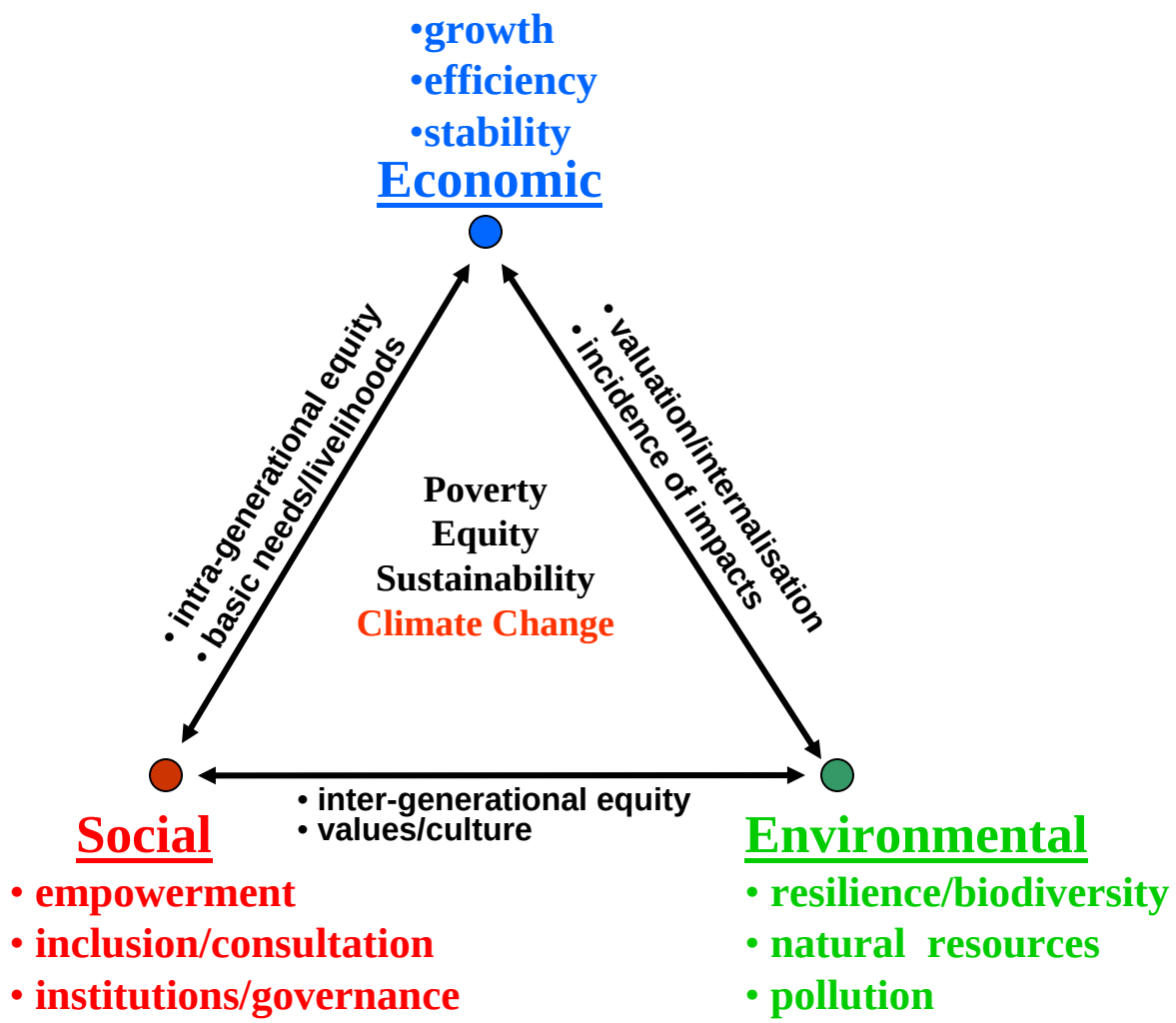
- resilience/biodiversity
- natural resources
- pollution

Sustainable Development Triangle - key elements and interconnections (corners, sides and centre)

Source: Munasinghe [1992], Rio Earth Summit

M I N D

Munasinghe Institute for Development



Sustainable Development Triangle - key elements and interconnections (corners, sides and centre)

Source: Munasinghe [1992], Rio Earth Summit

M I N D

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Integrating CC Policies into SD Strategy using Sustainomics

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Transcending Boundaries for Sustainable Development

- **Disciplinary**
- **Space**
- **Time**
- **Stakeholder**
- **Operational**

Transcending disciplines to address SD issues

SD Issues

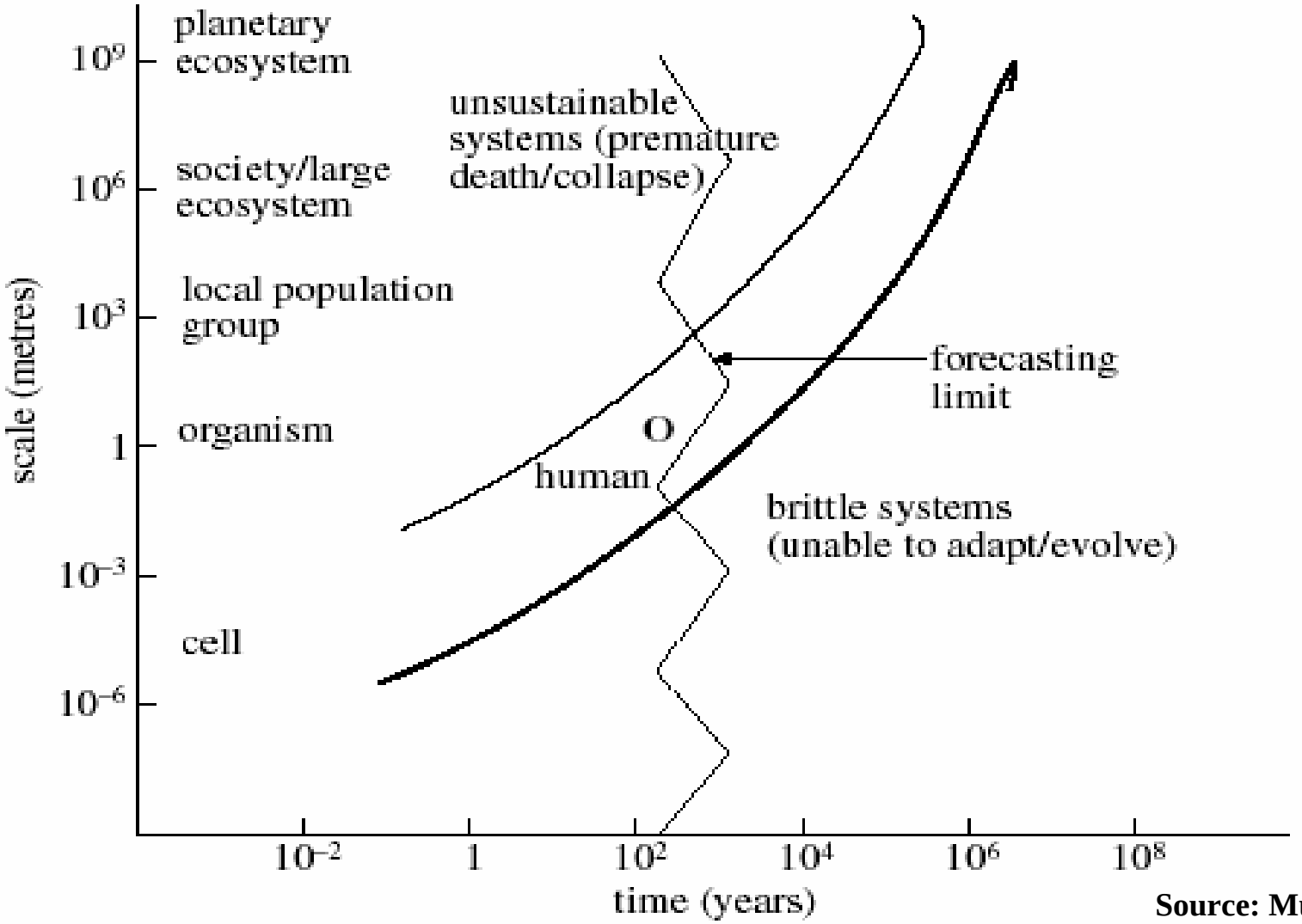
- social justice, equity, values and culture
- institutions and governance
- markets and prices
- technologies and management
- biological and physical resource base

Disciplines

Philosophy
Sociology
Anthropology
Law
Politics
Economics
Finance
Management
Engineering
Ecology
Natural Sciences

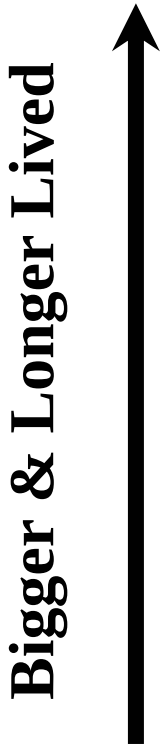
Source: Munasinghe (2002), Int. J. of Sust. Dev.

Transcending Boundaries of Space and Time – Norms for Sustainable Biological and Social Systems



Source: Munasinghe (1994)

Continuity across spatial and temporal scales
Panarchy of Systems Concepts: 1

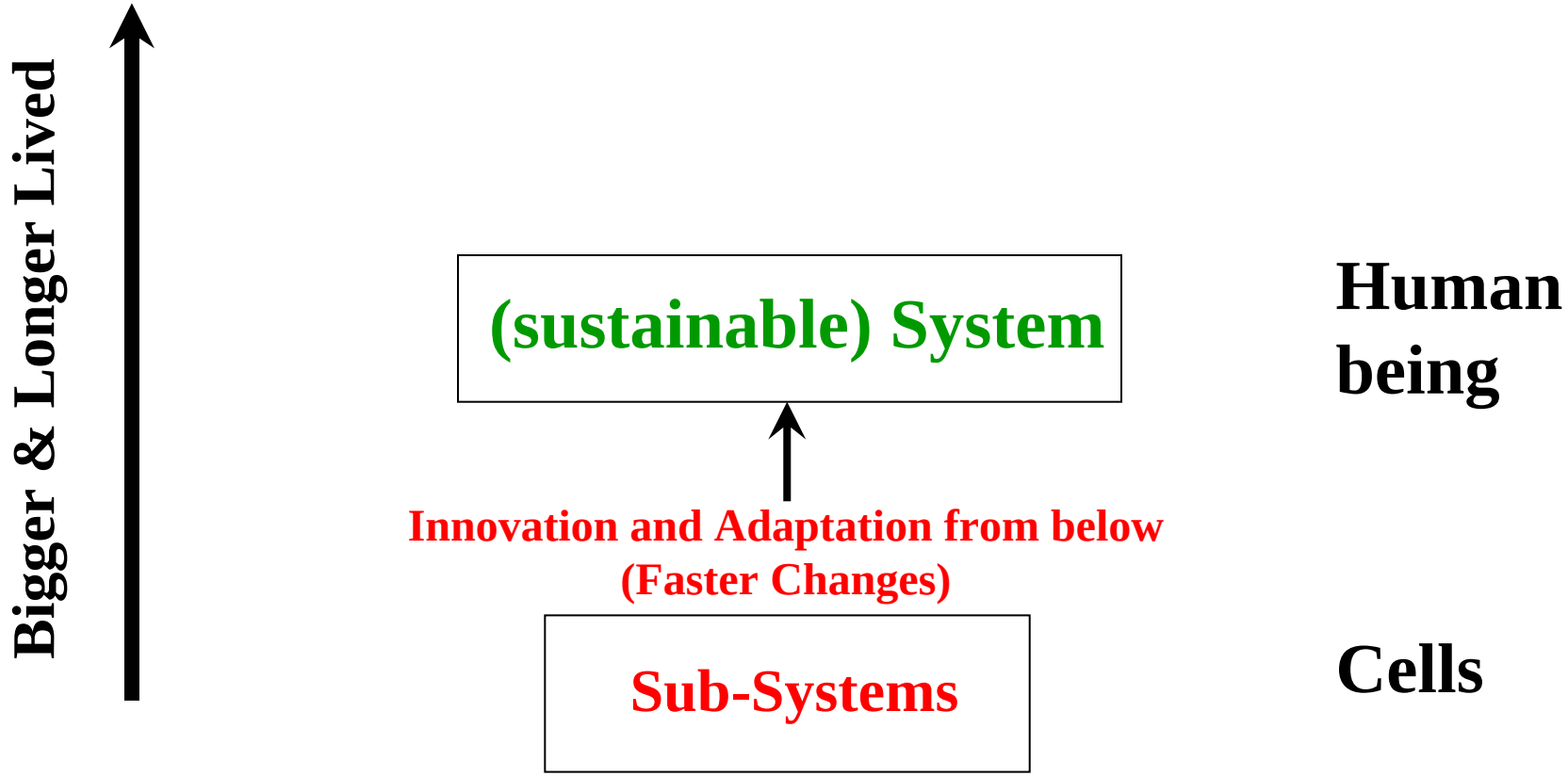


(sustainable) System

Human being

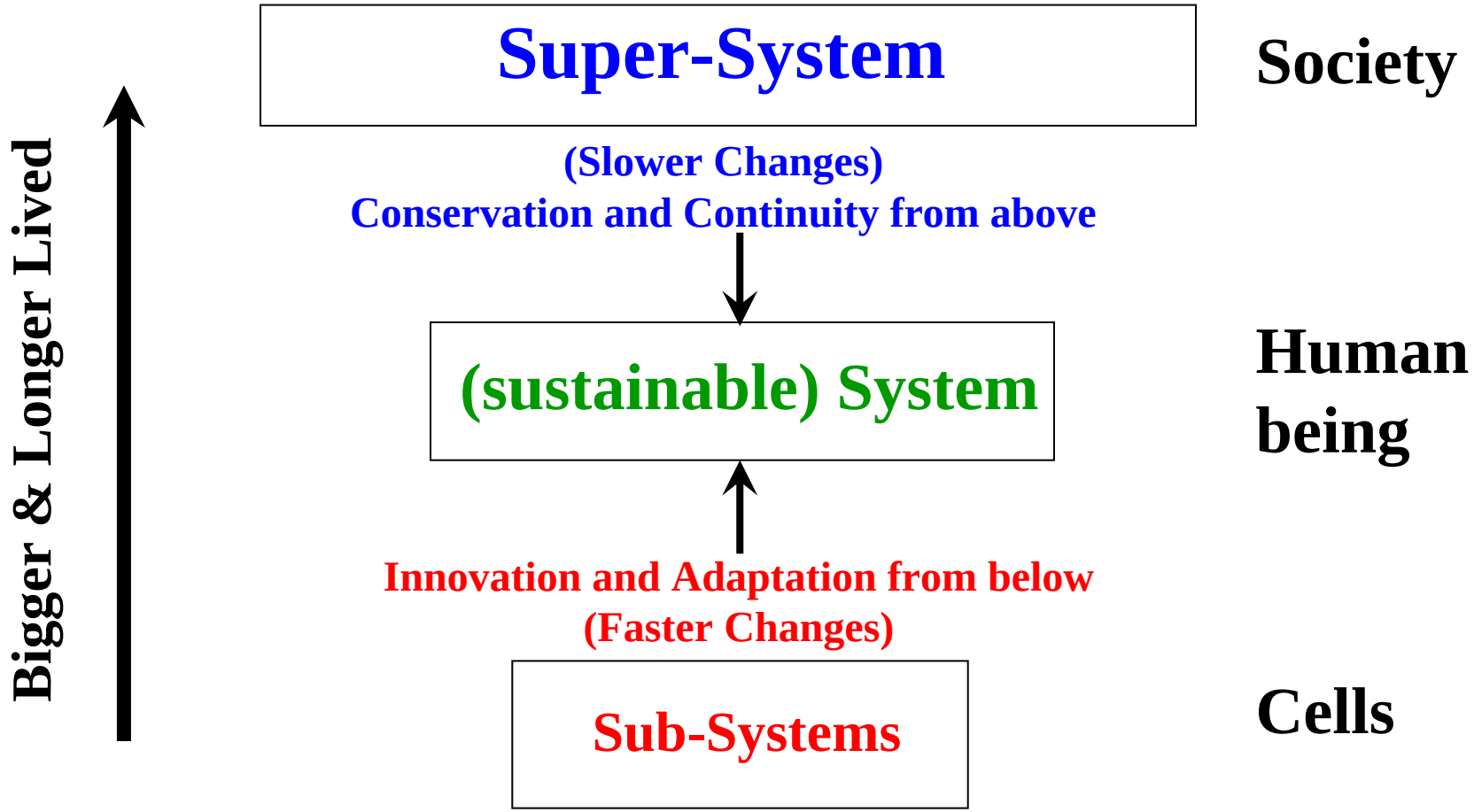
Source: Gunderson and Holling (2002)

Continuity across spatial and temporal scales
Panarchy of Systems Concepts: 2



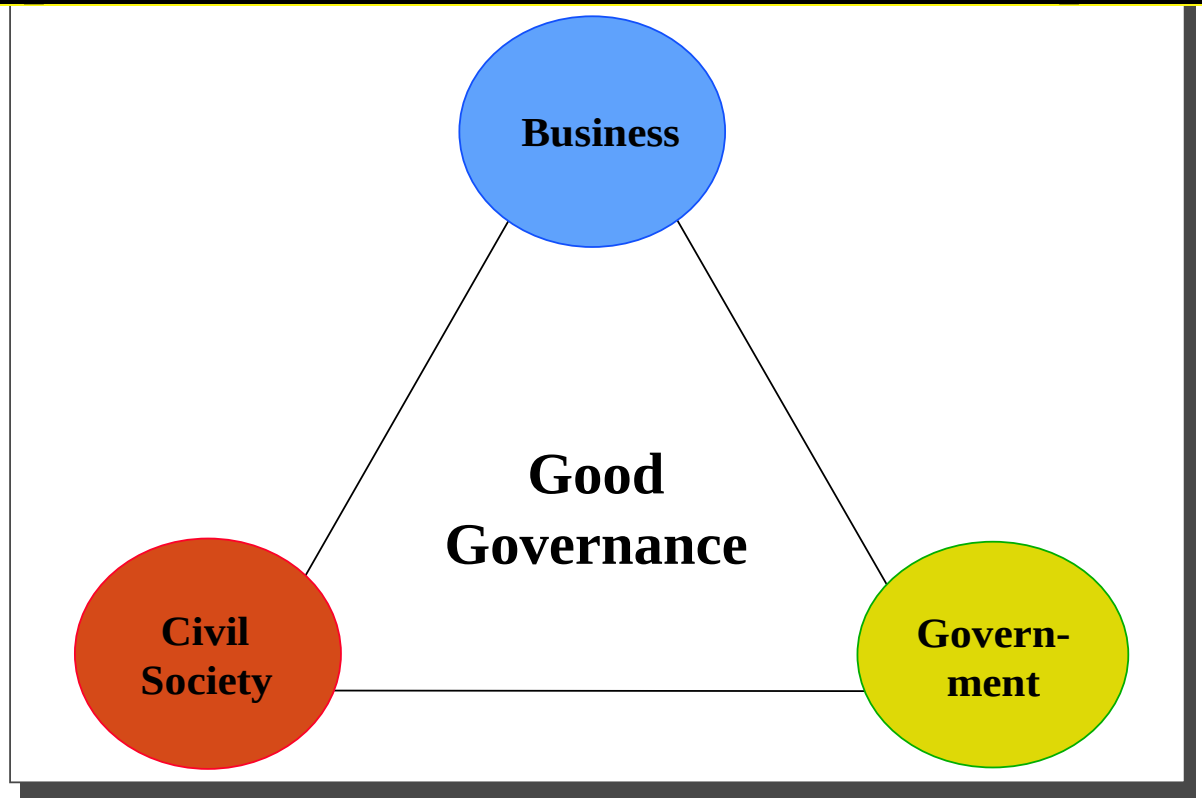
Source: Gunderson and Holling (2002)

Continuity across spatial and temporal scales
Panarchy of Systems Concepts: 3



Source: Gunderson and Holling (2002)

Transcending Stakeholder Boundaries to Ensure Cooperation for Sustainable Development



Not only government, but also civil society and business have a vital and balanced role to play in strengthening local, national and global citizenship

Source: Munasinghe (1992), Rio Earth Summit

Social Capital: Ignored, Undervalued, Invisible

- **At individual level:** is built on personal networks that help us enormously in our private and professional lives.
- **At community and national levels:** is the invisible glue that binds society together, and protected the essence of Sri society through many great difficulties – almost 500 years of forcible colonisation and most recently the 2004 Tsunami. It will play an essential role in resolving the ethnic problem.

Social Capital – Civil Society is Main Source

Examples of Civil Society Response: 2004 Tsunami - Sri Lanka versus 2005 Hurricane Katrina - New Orleans, USA

Event	Deaths	GNP/capita
2004 Tsunami – Sri Lanka	~35,000 (1 in every 570 people)	~ USD 1,000
2005 Hurricane Katrina - USA	~1850 (1 in every 200,000 people)	~ USD 35,000

Integrating CC Policies into SD Strategy using Sustainomics

Core concepts and elements

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Integrative analytical tools and practical applications (linking across global, national and local levels)

Integrative Analytical Tools

1. Restructuring Growth to Make Development More Sustainable (MDMS)
2. Optimisation and Durability
3. SD Analysis (Macro Level)
4. Action Impact Matrix (AIM)
5. Green Accounting (SEEA-SNA)
6. Integrated Models (IAM, CGE, etc.)
7. SD Analysis (Micro Level)
8. Multi-Criteria Analysis (MCA), Cost-Benefit Analysis (CBA) and Economic Valuation
9. SD Indicators

Application Levels

A. Global-transnational

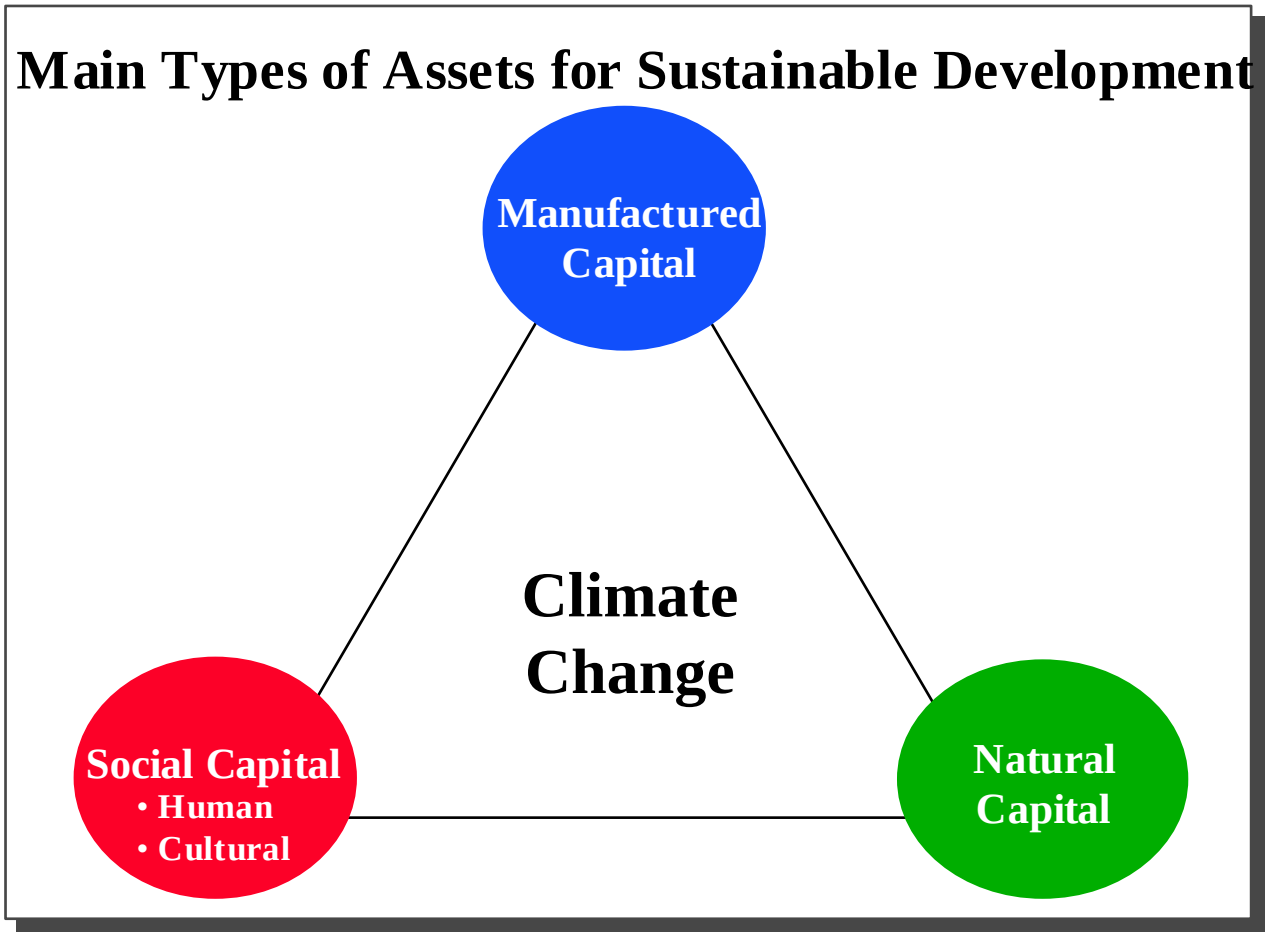
B. National-macroeconomic

C. Subnational-sectoral

D. Local-project

Linkages Across Levels

Integrating across the three dimensions of SD



Economic approach focuses on optimality - maximise growth
Environmental & social approaches use durability – overall system health

Problem: Diverse Definitions of Sustainability

Economic approach focuses on optimality - maximise growth
Environmental and social approaches rely on durability - system health

---

Economic: **Maximum flow of income that could be sustained indefinitely, without reducing stocks of productive assets. Economic efficiency ensures both efficient resource allocation in production and efficient consumption that maximises utility.**

Ecological: **Preserving the viability and normal functioning of natural systems, including system health ability to adapt to shocks across a range of spatial and temporal scales. Defined by a comprehensive, multiscale, hierarchical, dynamic measure describing system resilience, vigour and organization.**

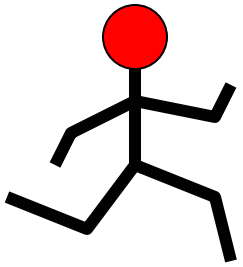
Social: **Maintaining the resilience of social systems and limiting their vulnerability to sudden shocks. Involves building social capital to strengthen cohesion, protecting cultural diversity and values, and improving inclusion and participation - especially of disadvantaged groups.**

Optimality and Durability: Simple Example

Two modes are complementary and depend on situation

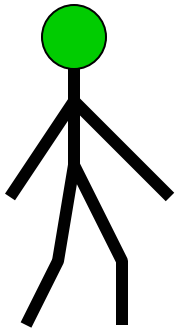
Optimal Mode

Olympic 100m sprinter – willing to take high risk and make extreme effort to minimise running time (single indicator) for a special event



Durable Mode

Middle aged walker – undertakes regular, low risk exercise for overall health (multiple indicators), over many decades



SD Indicators

- Social
- Environmental
- Economic
- Institutional

many indicators are available; thus choice is critical for specific task at hand

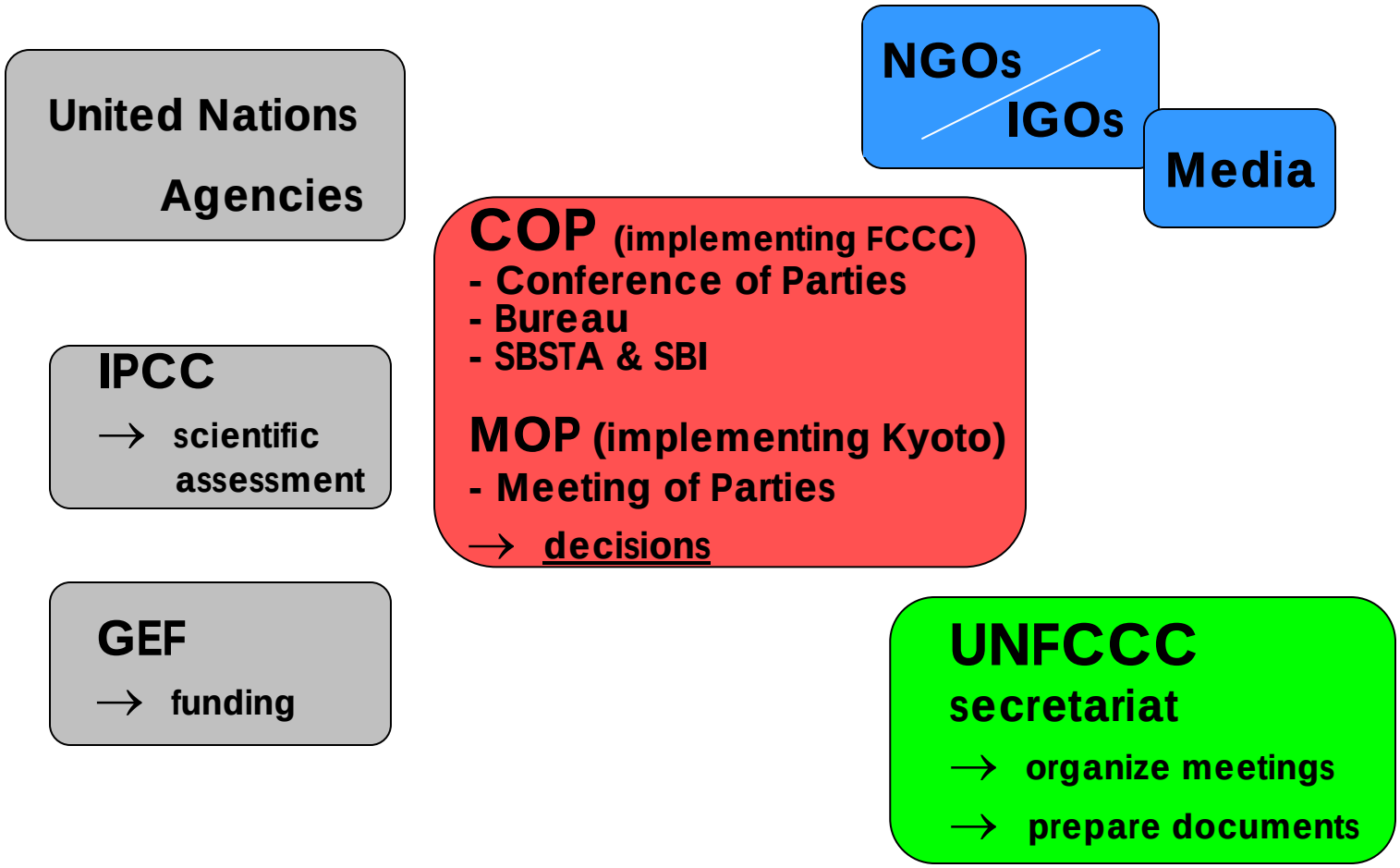
Global Responses to the Climate Change Challenge

- **Mitigation**
- **Adaptation**

MOST DESIRABLE:

CC Policies that Combine Both Adaptation and Mitigation (Win-Win) and also Make Development More Sustainable (MDMS)

International institutional framework for Climate Change



Global Mitigation

Response Options

The Challenge of Mitigation

UNFCCC 1992 – good start. Article 2 specifies stabilization of atmospheric concentrations of GHG concentrations at a level that does not harm the climate system (food security, ecological systems and sustainable economic development).

Kyoto Protocol 1997 – modest target. Annex I countries reduce emissions by 5% relative to 1990, by 2012. Currently in force without USA (largest emitter).

Post-Kyoto Agreement 2012? – Bali road map 2007 is a start. But Parties could agree only on agenda and timetable (NOT even preliminary targets).

Mitigation: Kyoto Protocol (1997) in force in 2005 (without US)

1. **Annex 1 Countries undertake mitigation -- GHG emission reductions (2008-2112) relative to 1990:**

EU	- 8 %
USA	- 7 %
Japan	- 6 %
Australia	+ 8 %
Russian Federation	0 %

all developed countries - 5 %

2. **No obligations for developing countries and economies in transition**

3. **Kyoto Mechanisms: CDM, JI, emissions trading**

Disturbing Near Term Trends in GHG Emissions: 1970-2030

During 1970-2004 (Actual)

GHG emissions covered by the Kyoto Protocol have increased by about 70%.

CO2 (77% of GHG), has grown by about 80%.

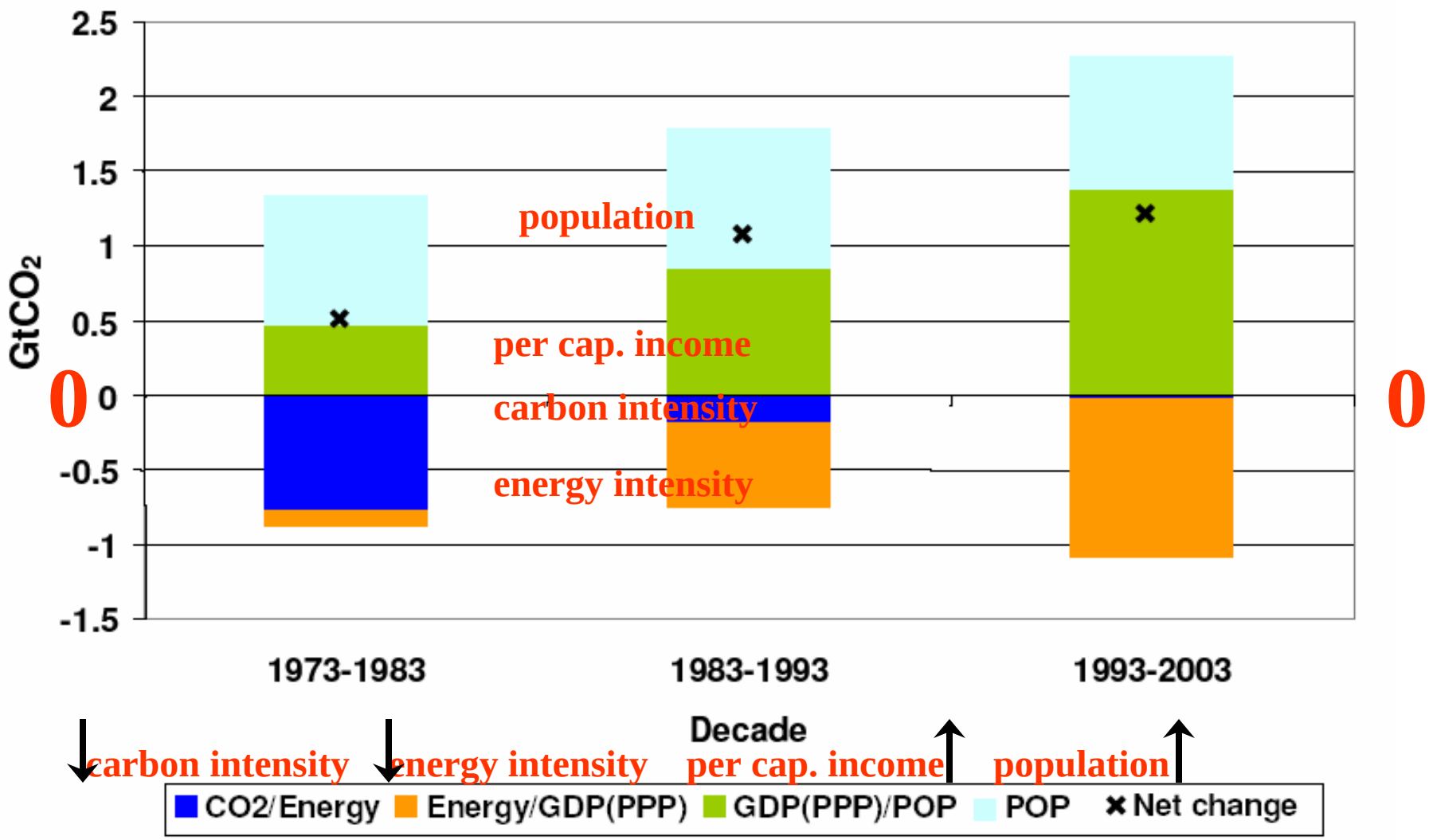
Even after Kyoto 1997, emissions have continued to increase

During 2000-2030 (projected)

GHG emission will rise 45-110% with current policies. Two thirds of this growth will be in developing countries, but per capita emissions in developed countries will remain 3-4 times higher.

Global CO2 Emissions – Drivers (1973-2003)

Total CO2 = [CO2/Energy] [Energy/GDP] [GDP/Pop] [Pop]



MIND

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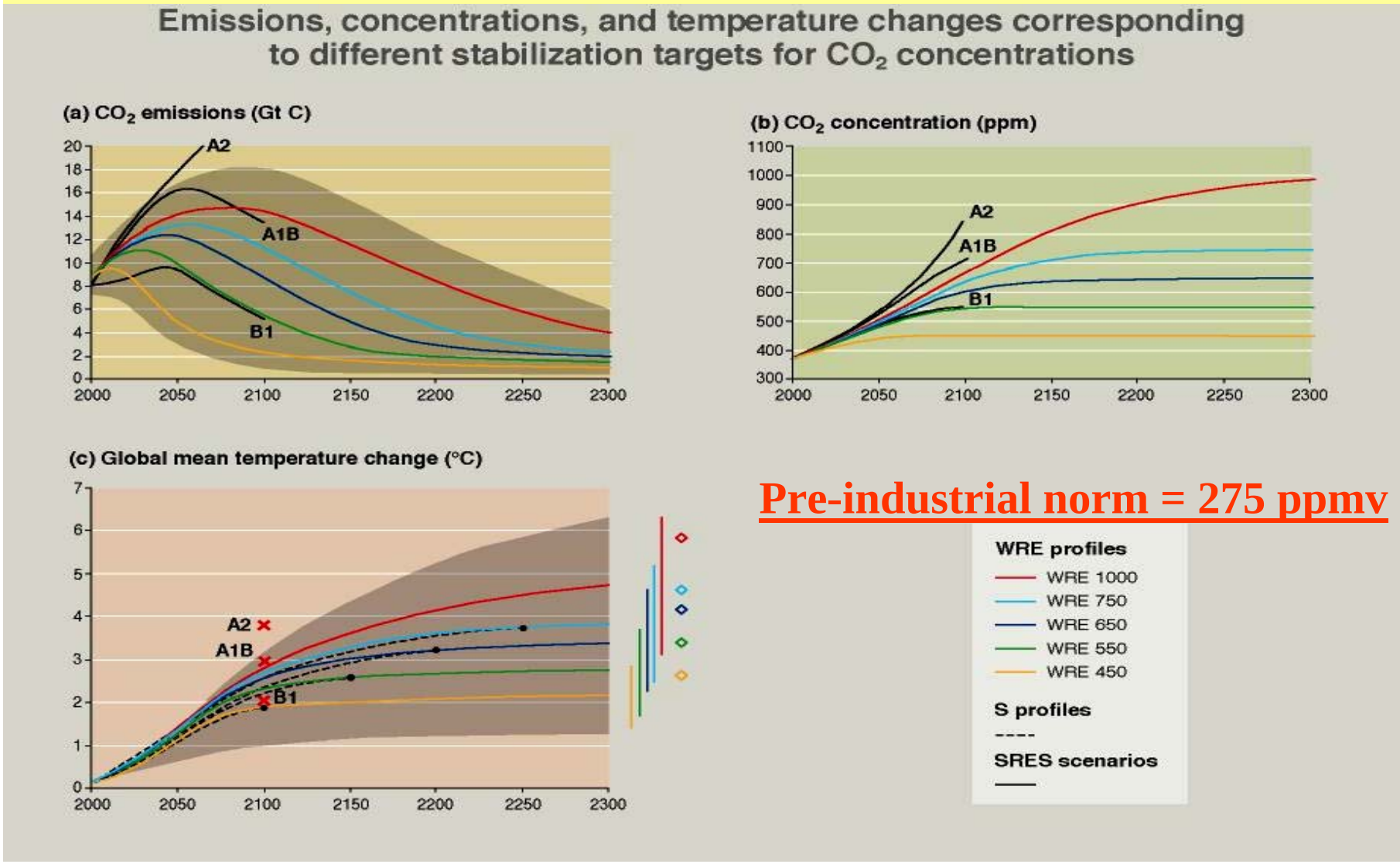
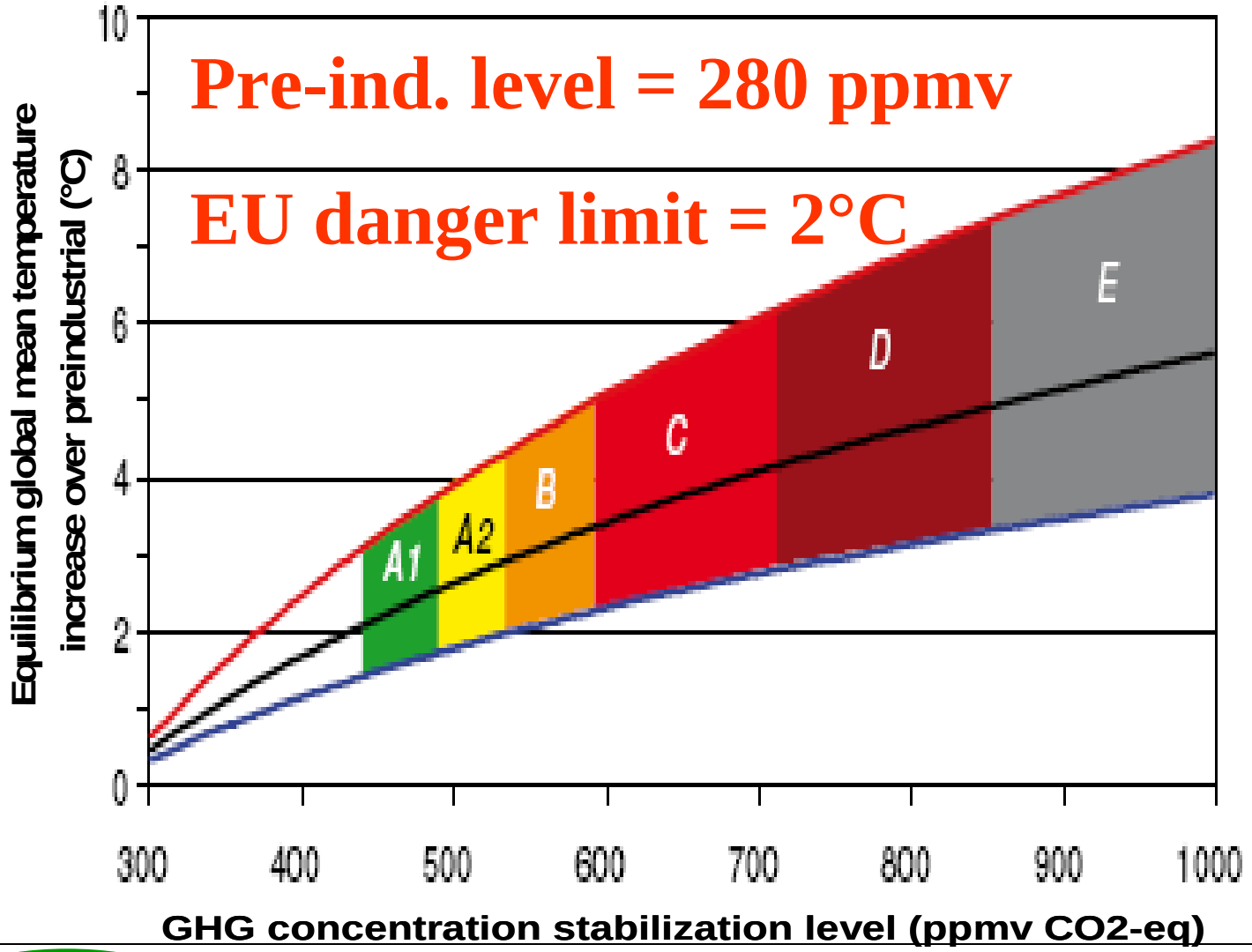
Stabilization of the atmospheric concentration of carbon dioxide will require significant emissions reductions



Stabilisation levels and equilibrium global mean temperatures



Concentrations, mean temp. rise & peak year emissions

The lower the stabilization level, the more quickly emissions would need to peak and to decline thereafter. EU danger limit = 2°C

Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels.

CO_2 stabili-zation	**CO2-Equivalent Stabili-zation level**	**Year CO2 needs to peak**	**GDP reducti on in 2030**	**Reduction in 2050 relative to 2000**	**Global Mean temp. incr. at equilib.**	**Global average sea level rise from thermal expansion**
ppm	ppm	Year	%	Percent	°C	metres
350 – 400	445 – 490	2000 – 2015	< 3	-85 to -50	2.0 – 2.4	0.4 – 1.4
400 – 440	490 – 535	2000 – 2020	< 2	-60 to -30	2.4 – 2.8	0.5 – 1.7
440 – 485	535 – 590	2010 – 2030	0.6	-30 to +5	2.8 – 3.2	0.6 – 1.9
485 – 570	590 – 710	2020 – 2060	0.2	+10 to +60	3.2 – 4.0	0.6 – 2.4
570 – 660	710 – 855	2050 – 2080		+25 to +85	4.0 – 4.9	0.8 – 2.9
660 – 790	855 – 1130	2060 – 2090		+90 to +140	4.9 – 6.1	1.0 – 3.7

GHG Mitigation Costs: 2030 and 2050

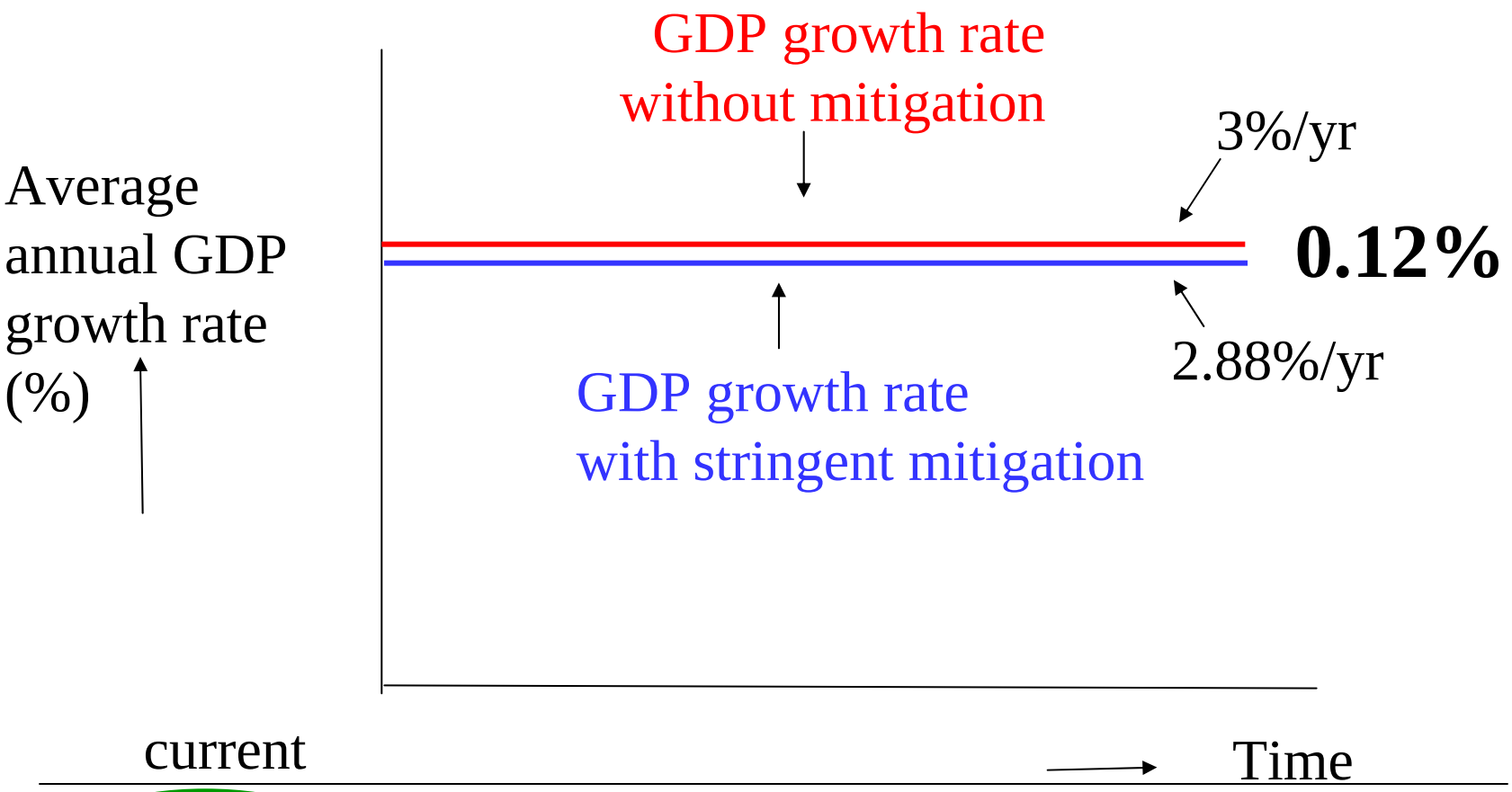
1. GDP reduction costs

Stabilisation levels (ppm CO_2-eq)	Median GDP reduction [a] (%)		Range of GDP reduction [b] (%)		Reduction of average annual GDP growth rates (percentage points) [c], [e]	
	2030	2050	2030	2050	2030	2050
445 – 535 [d]	Not available		< 3	< 5.5	< 0.12	< 0.12
535 – 590	0.6	1.3	0.2 to 2.5	slightly negative to 4	< 0.1	< 0.1
590 – 710	0.2	0.5	-0.6 to 1.2	-1 to 2	< 0.06	< 0.05

2. Costs per tonne of CO_2equivalent mitigated

To achieve a 2100 target of 550 ppmv, the costs in 2030 will be US$ 20-80 per tonne mitigated. These costs could fall further to US$ 5-65 with induced technological advanced.

Illustration of cost numbers



There are also co-benefits of mitigation

- Near–term health benefits from reduced air pollution may offset a substantial fraction of mitigation costs
- Mitigation can also be positive for: energy security, balance of trade improvement, provision of modern energy services to rural areas and employment

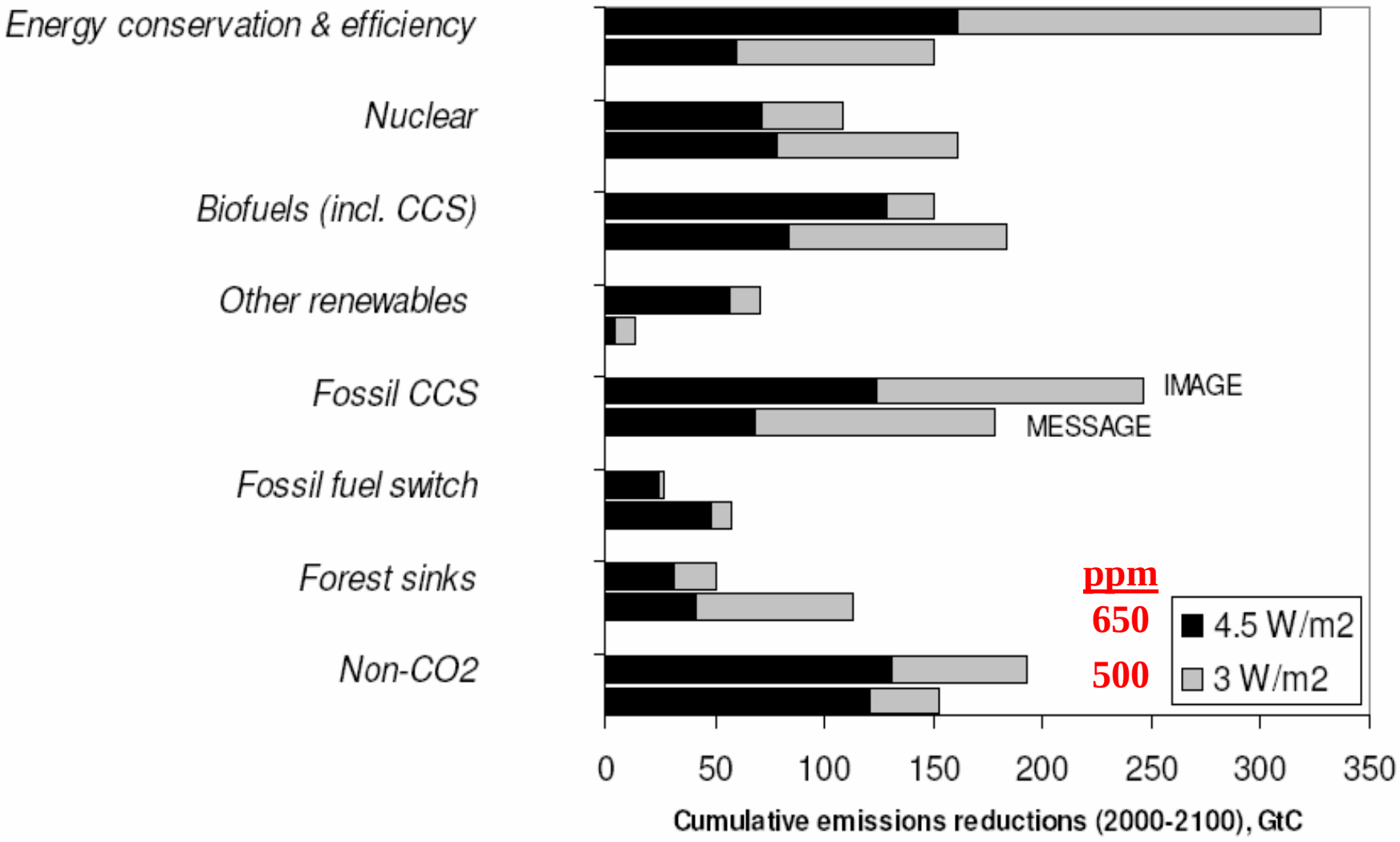
BUT

- Mitigation in one country or group of countries could lead to higher emissions elsewhere (“carbon leakage”) or effects on the economy (“spill-over effects”).

Long-term stabilization (2100 and beyond) of GHGs concentrations is possible with SD

- Known technological options could achieve stabilization of carbon dioxide at levels of 450-550 ppm over the next 100 years
- Technology development and diffusion are important components of cost-effective stabilization
- The SD pathway to stabilization and the stabilization level itself are key determinants of mitigation costs

Cumulative GHG Mitigation Methods (2000-2100)



Sustainable development paths will facilitate climate change mitigation

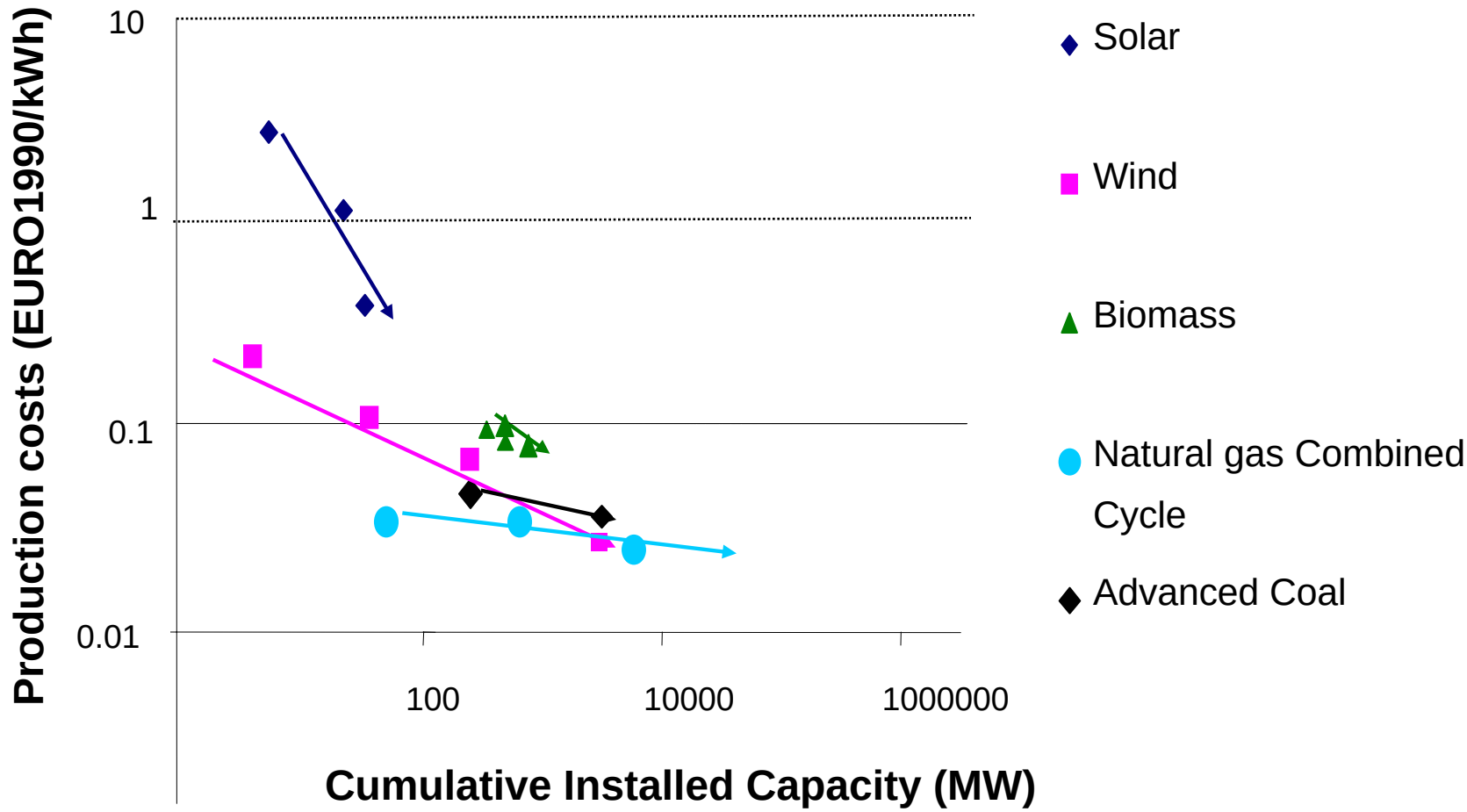
- Making development more sustainable by changing development paths can make a major contribution to climate change mitigation
- Macroeconomic policy, agricultural policy, multilateral development bank lending, insurance practices, electricity market reform, energy security policy and forest conservation can significantly reduce emissions.
- Implementation may require resources to overcome multiple barriers.
- Possibilities to choose and implement mitigation options to realise synergies and avoid conflicts with other dimensions of sustainable development.

Technologies and policies exist to reduce near term (2010-2020) GHG emissions: Energy and Land Use offer best potential

- **Energy:** significant technical progress has been made in the last 5 years and at a faster rate than expected (wind turbines, elimination of industrial by-products, hybrid engine cars, fuel cell technology, underground carbon dioxide storage)
- **Land Use:** good potential for carbon sinks and reduced GHG emissions from both better management of existing land cover, and transformation of land use

New energy technology costs have declined steeply, but costs of conventional technologies have also declined at a slower rate

Carbon Reducing Electric Technologies, EU 1980-1995 (Source: IEA)



Key Policy Elements

- **Policies for "carbon price"-** can create incentives for producers and consumers to significantly invest in low-GHG products, technologies and processes. Higher carbon prices could impose significant burdens on the poor, unless targetted relief policies are implemented to ensure basic energy needs are met.
- **Technology Policies** - Deployment of low-GHG emission technologies and RD&D would be required for achieving stabilization targets and cost reduction
- **International Agreements** - achieving the UNFCCC/Kyoto Protocol targets may stimulate a global response to the climate problem, an array of national policies, the creation of an international carbon market and new institutional mechanisms. Future agreements will help reduce global costs of mitigation(eg: emission trading, Joint Implementation and CDM) and improve environmental effectiveness

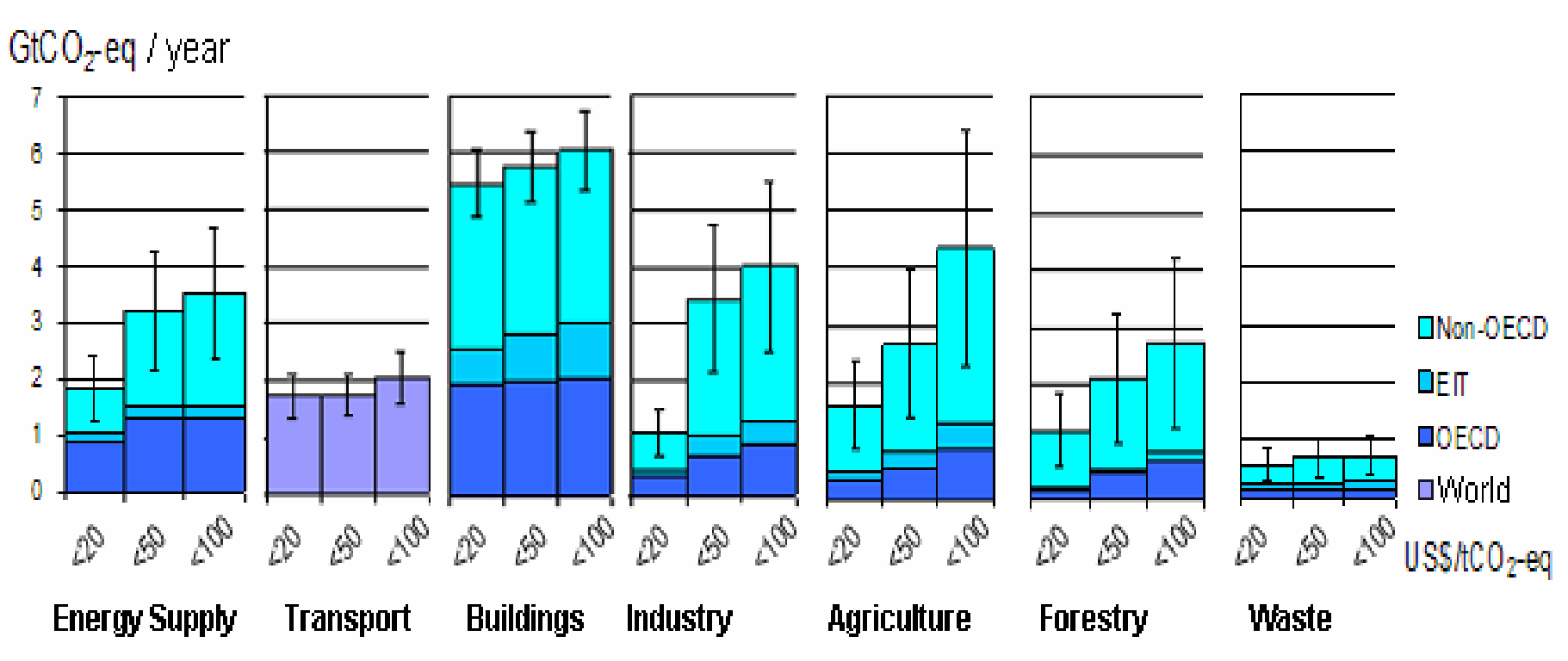
Policies are available to governments to realise mitigation of climate change

- Effectiveness of policies depends on national circumstances, their design, interaction, stringency and implementation
  - Integrating climate policies in broader development policies
  - Regulations and standards
  - Taxes and charges
  - Tradable permits
  - Financial incentives
  - Voluntary agreements
  - Information instruments
  - Research and development

Changes in lifestyle and behaviour patterns can contribute to climate change mitigation

- Changes in occupant behaviour, cultural patterns and consumer choice in buildings.
- Reduction of car usage and efficient driving style, in relation to urban planning and availability of public transport
- Staff training, reward systems, regular feedback and documentation of existing practices in industrial organizations

All sectors and regions can contribute to mitigation



Note: estimates do not include non-technical options, such as lifestyle changes.

Global Adaptation

Response Options

Most Vulnerable People

Children

Elderly

Poor

Most Vulnerable Regions

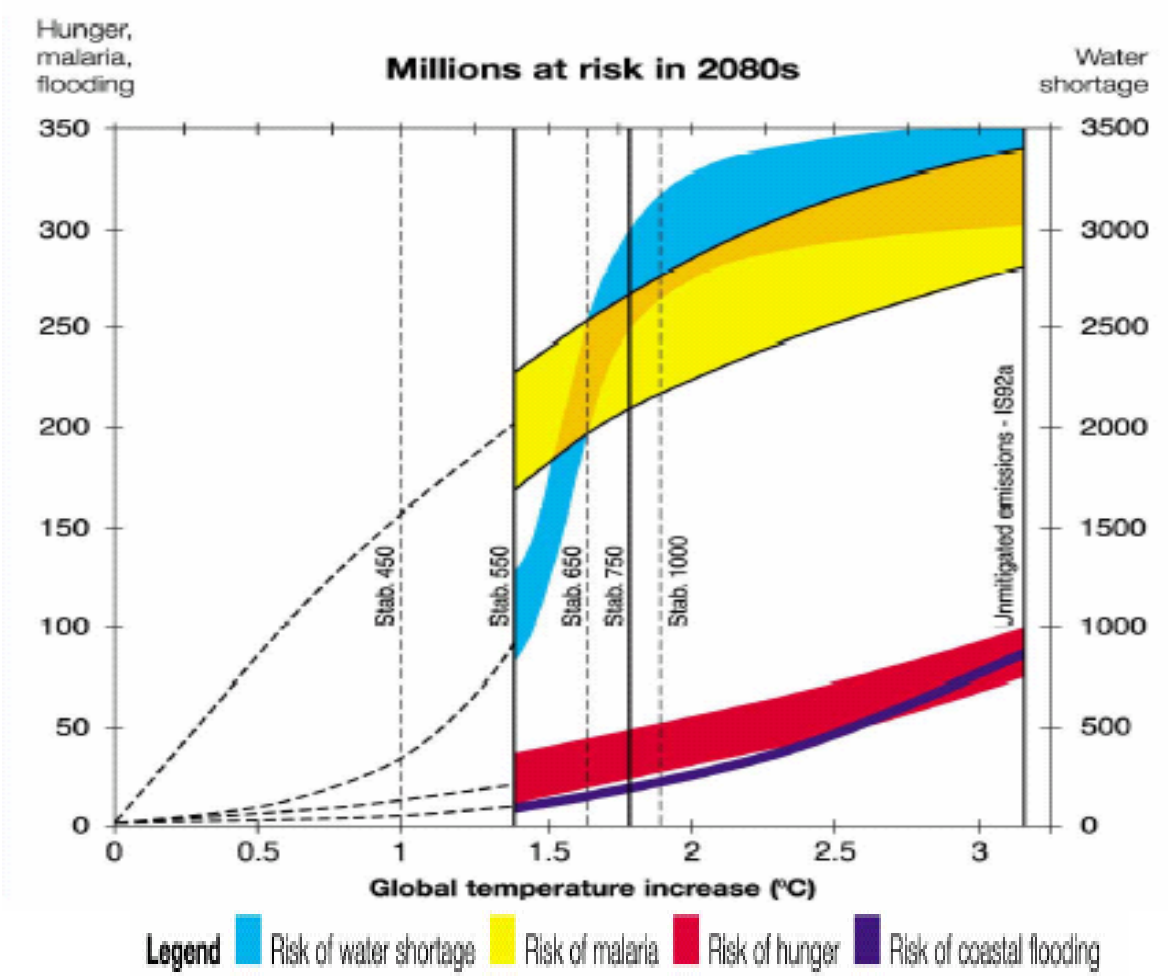
Most Vulnerable Systems and Sectors

- Some ecosystems:
  - Coral reefs; sea-ice regions
  - Tundra, boreal forests, mountain and Mediterranean regions
- Low-lying coasts, mangroves & salt marshes
- Water resources in mid-latitudes & dry Tropics
- Low-latitude agriculture
- Human health where adaptive capacity is low

Hundreds of Millions at Risk by 2080 –

Malaria, Hunger, Water Shortage and Flooding

Note: EU Risk Threshold is 2 degrees C



Extreme Events

- *Very likely* that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent
- *Likely* that future tropical cyclones will become more intense, with larger peak wind speeds and more heavy precipitation
  - **less confidence in decrease of total number**
- Extra-tropical storm tracks projected to move poleward with consequent changes in wind, precipitation, and temperature patterns

Source: IPCC

Ecosystems Vulnerability

A temperature increase of 1.5°C - 2.5°C over present, would put 20% - 30% of higher plants and animals at high risk of extinction

Potential Benefits (damage avoided) of Adaptation and Vulnerability Reduction are large – Long term global aggregate economic damages need to be better defined

Range = US$ 3 to 95 per tonne CO_2 for 100 estimates

Large variation is due to uncertainties and deliberate choices regarding climate sensitivity, response lags, discount rates, valuing non-market impacts (including ecosystem impacts), and the treatment of inter-regional equity and catastrophic losses.

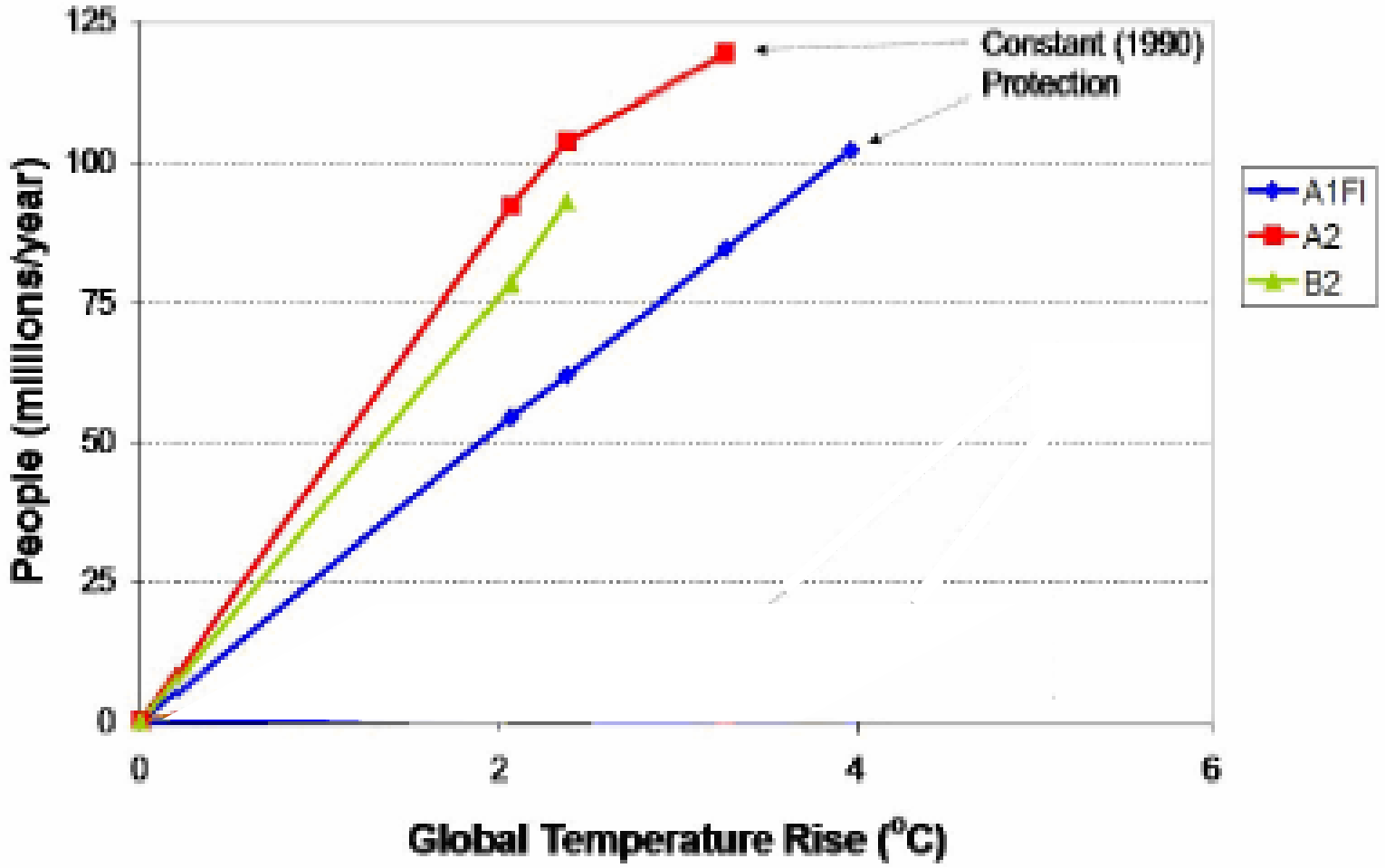
Mean value = US$ 12 per tonne CO_2 (US$ 43 per tonne C) - (present discounted net costs)

Potential Adaptive Responses Available to Human Societies

- Technological - (e.g. sea defenses, new crops)
- Behavioral – (e.g. new food and recreational choices)
- Managerial – (e.g. altered farm practices)
- Policy – (e.g. planning and regulations)

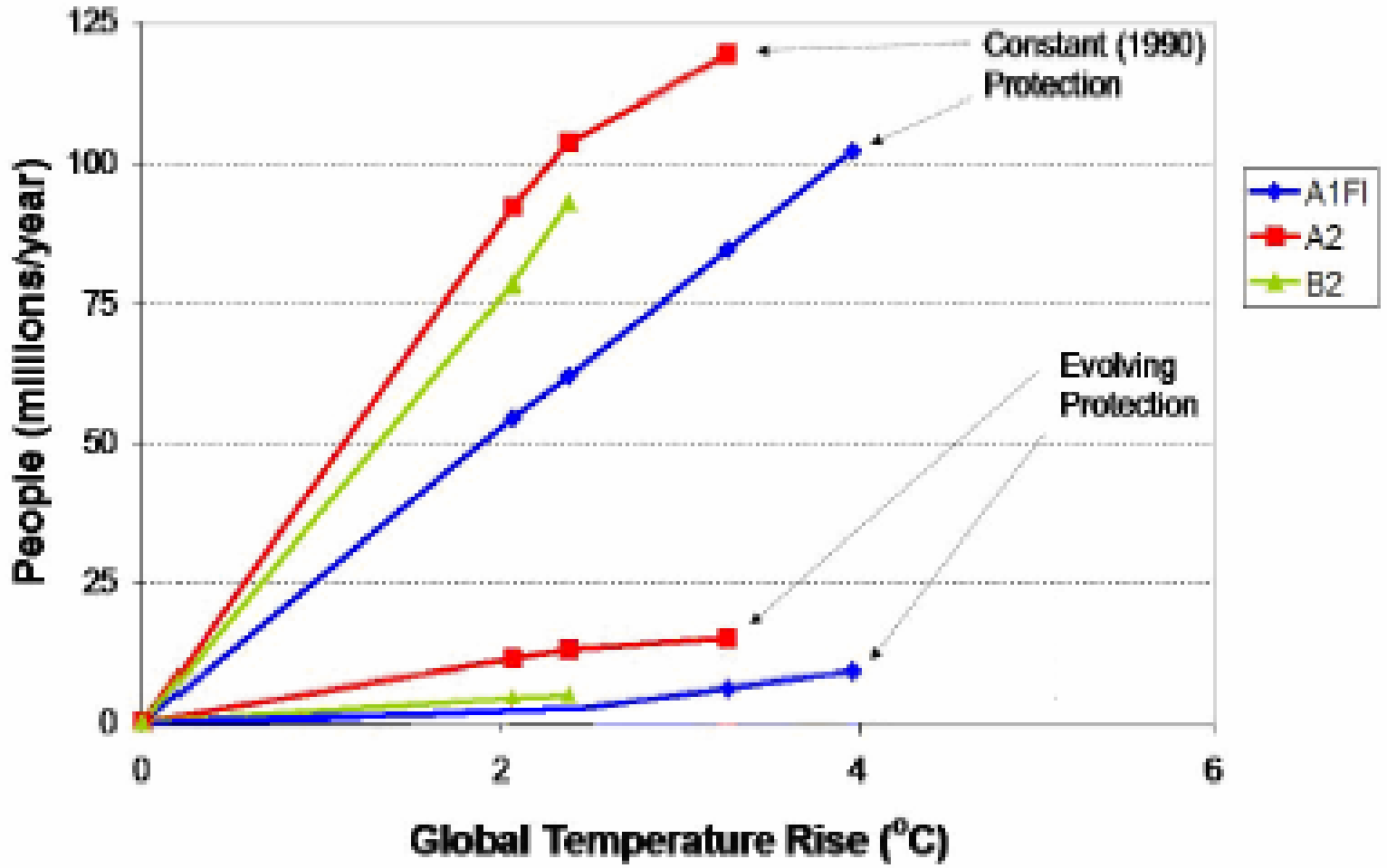
Adaptation Example: People flooded in coastal areas 2080

Constant protection = spending maintained at 1990 levels.



Adaptation Example: People flooded in coastal areas 2080

Constant protection = spending maintained at 1990 levels.
Evolving protection = spending increases at same rate as GDP.



Key IPCC Findings – Adaptation

- **Adaptation is a high priority to address impacts resulting from the warming which is already unavoidable due to past emissions**
- **Numerous adaptation options have been identified that can reduce adverse impacts of climate change and enhance beneficial ones , but will not prevent all damages**
- **Greater and more rapid climate change would increase adaptation costs and pose greater challenges**
- **Inertia is a widespread characteristic of the interacting climate, ecological and socio-economic systems which means that large scale impacts may not be observed for decades to centuries and mal-adaptations may occur**

Sustainable Development strategies can positively affect Mitigation and Adaptation

MOST DESIRABLE:

CC Policies that Combine Both Adaptation and Mitigation (Win-Win) and also Make Development More Sustainable (MDMS)

WHY ? is climate a threat to future human development

Climate Change (CC) undermines Sustainable Development (SD) and unfairly penalizes the poor

HOW ? can we move forward to transform risky current trends into a safer and better future

Start making development more sustainable (MDMS) now, using the Sustainomics framework

WHAT? are the practical solutions and policy options to be implemented that will integrate CC responses into SD strategy (from global to local levels)

Many examples of good practice available;

US has a key role to play

A Long Term Vision of Sustainable Development

Levels	Indicators	Time	Human Interventions
Main (Surface) Issues	**Poverty, Inequity, Exclusion, Resource Conflicts, Harm to Environment (including CC)**	**Now** ←	**High risk of unrestrained market forces at work ("Washington consensus", globalisation etc.) – Reactive-piecemeal: govt.**
Immediate Drivers	**Consumption Patterns, Population, Technology, Governance**	**Transition** ←	**Making development more sustainable (MDMS) with systematic policy reform to manage market forces (Sustainomics) – Proactive: partnerships - govt., business, civil soc.**
Underlying Pressures	**Basic Needs, Social Power Structure, Values, Perceptions, Choices, Knowledge Base**	**Long Term** ←	**Fundamental global sustainable dev. transition catalysed through grass roots citizens movements, driven by social justice and equity concerns, innovative leadership, policies, tech. (new SD paradigm) – Proactive: civil soc., govt., business**

Source: Munasinghe (2007), IPCC, MA, GTI

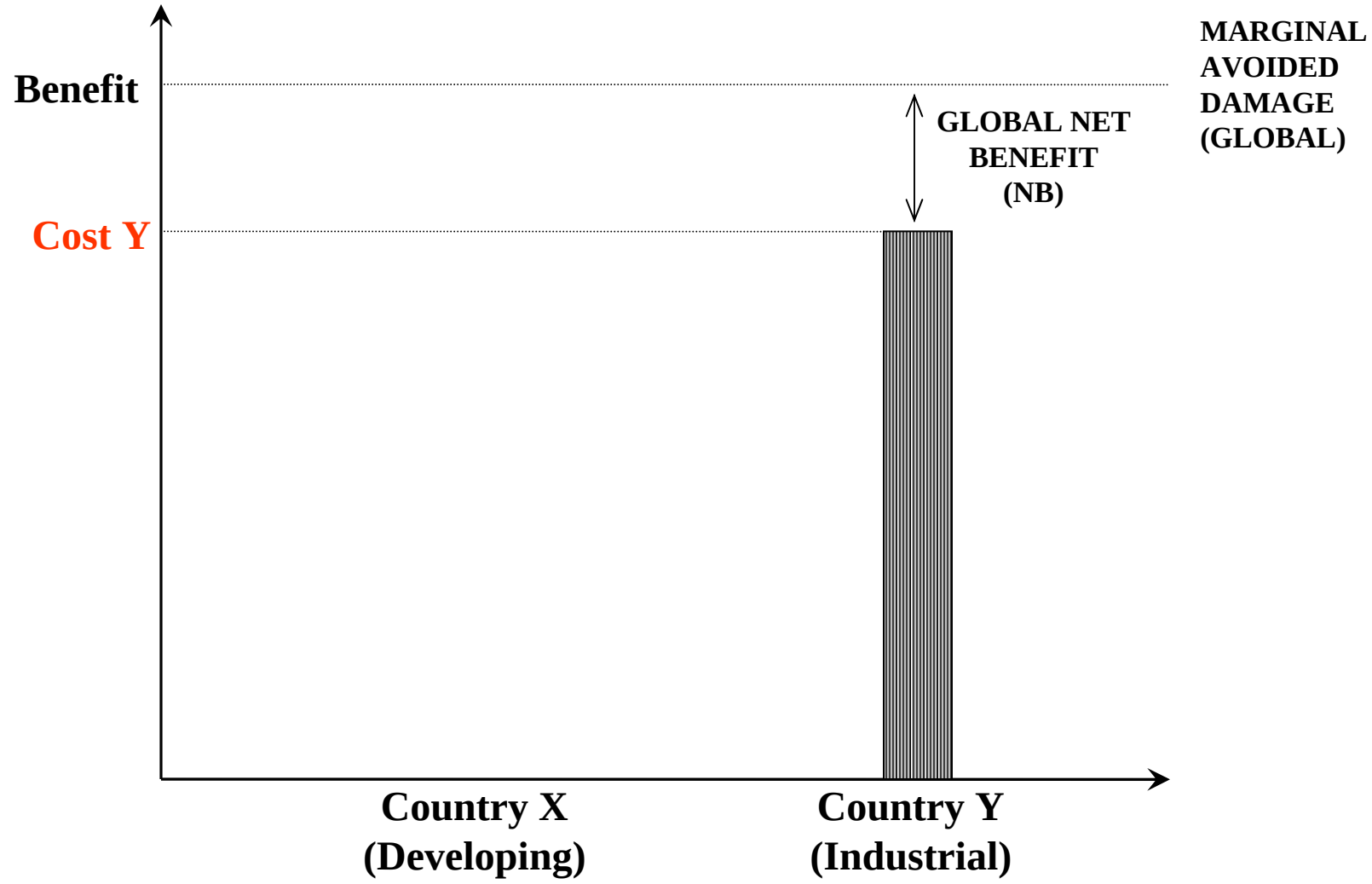
Practical Application of Sustainomics to Complex CC-SD Interactions

Global, National and Project Level Examples

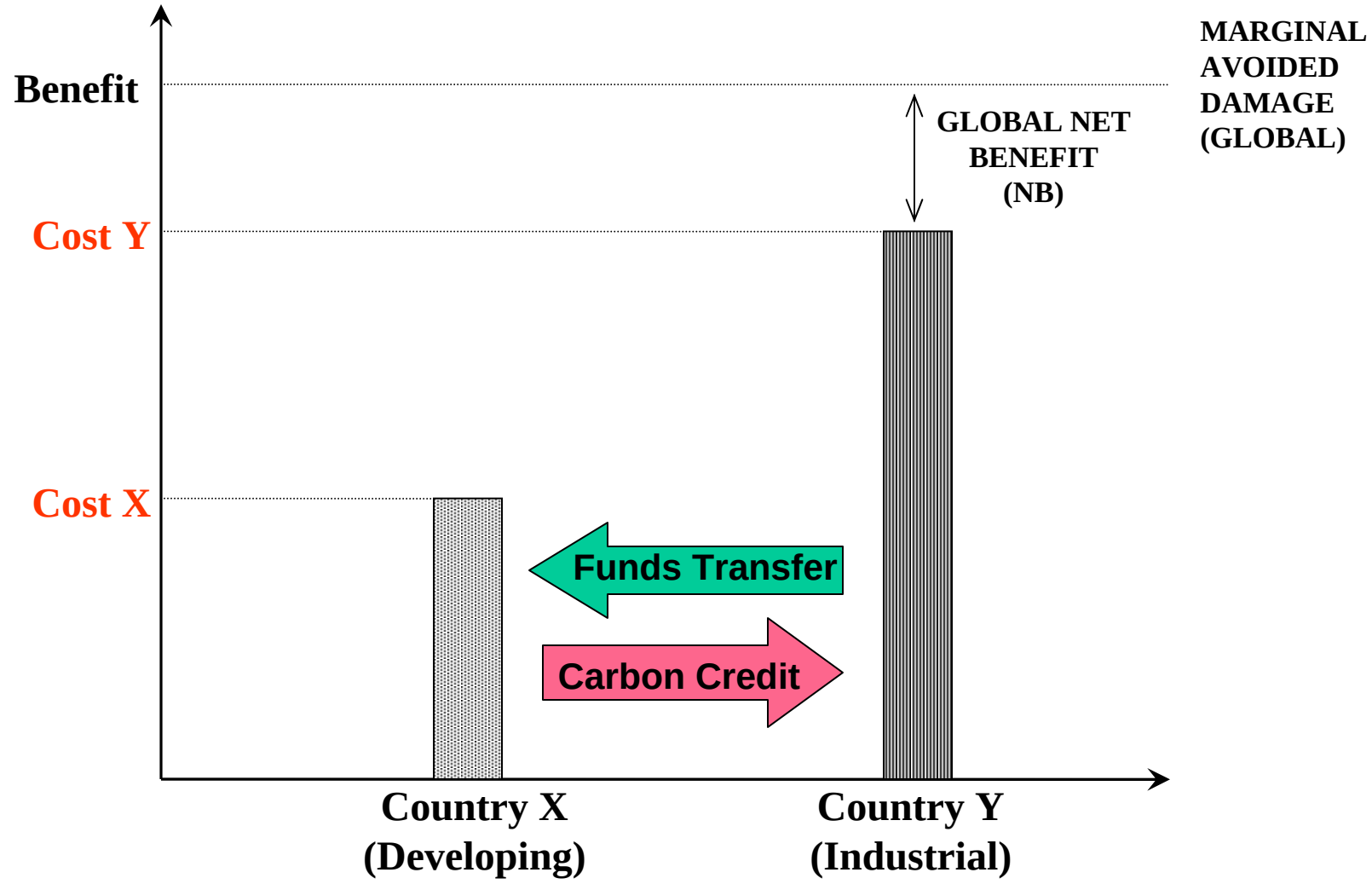
Specific Mitigation Mechanisms

Interplay of Economic Efficiency and Social Equity to Protect the Global Environment - Flexibility Mechanisms: Clean Development Mechanism (CDM), JI & Emissions Trading

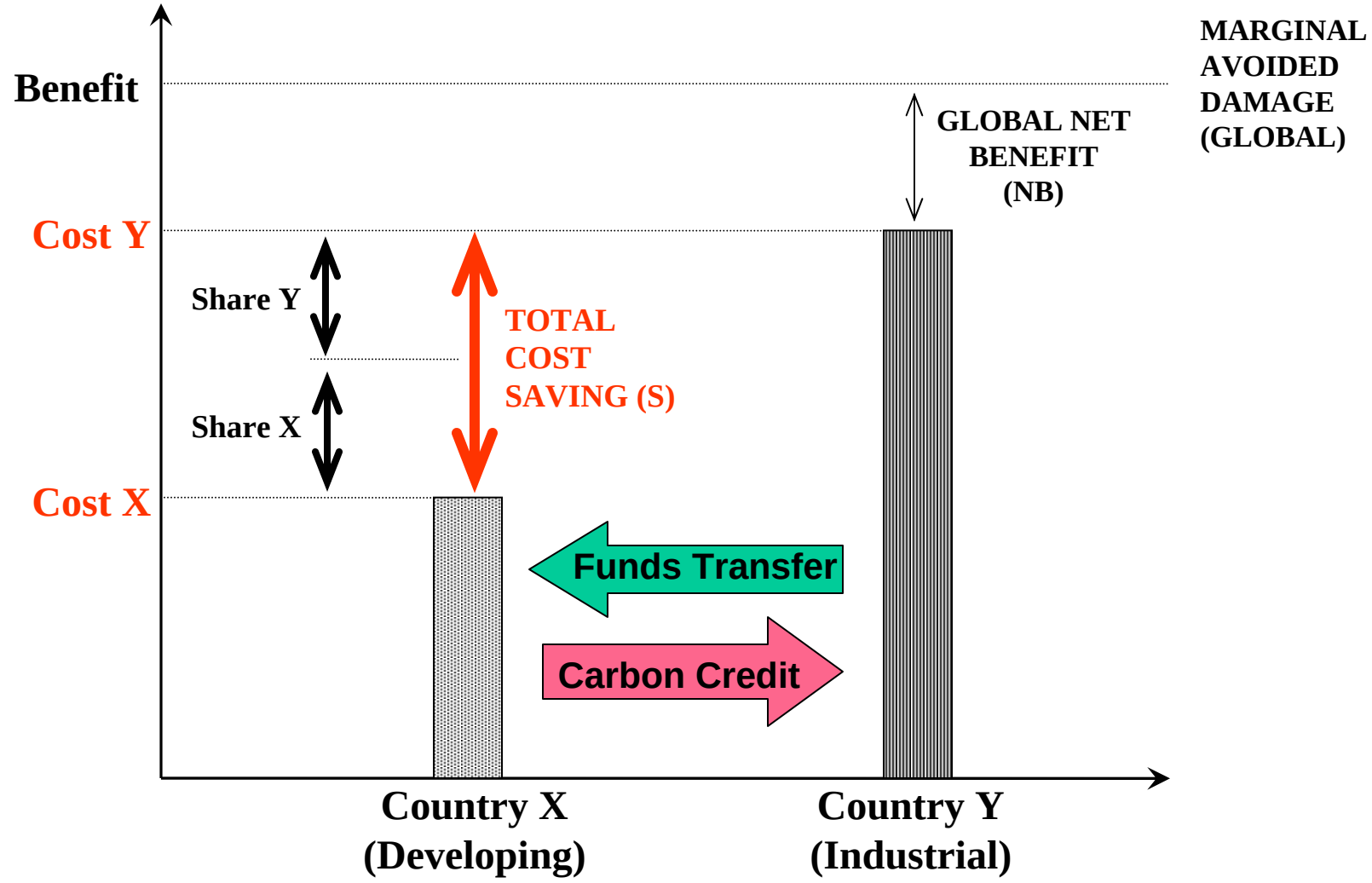
Interplay of Economic Efficiency and Social Equity to Protect Global Environment - CDM & JI: 1



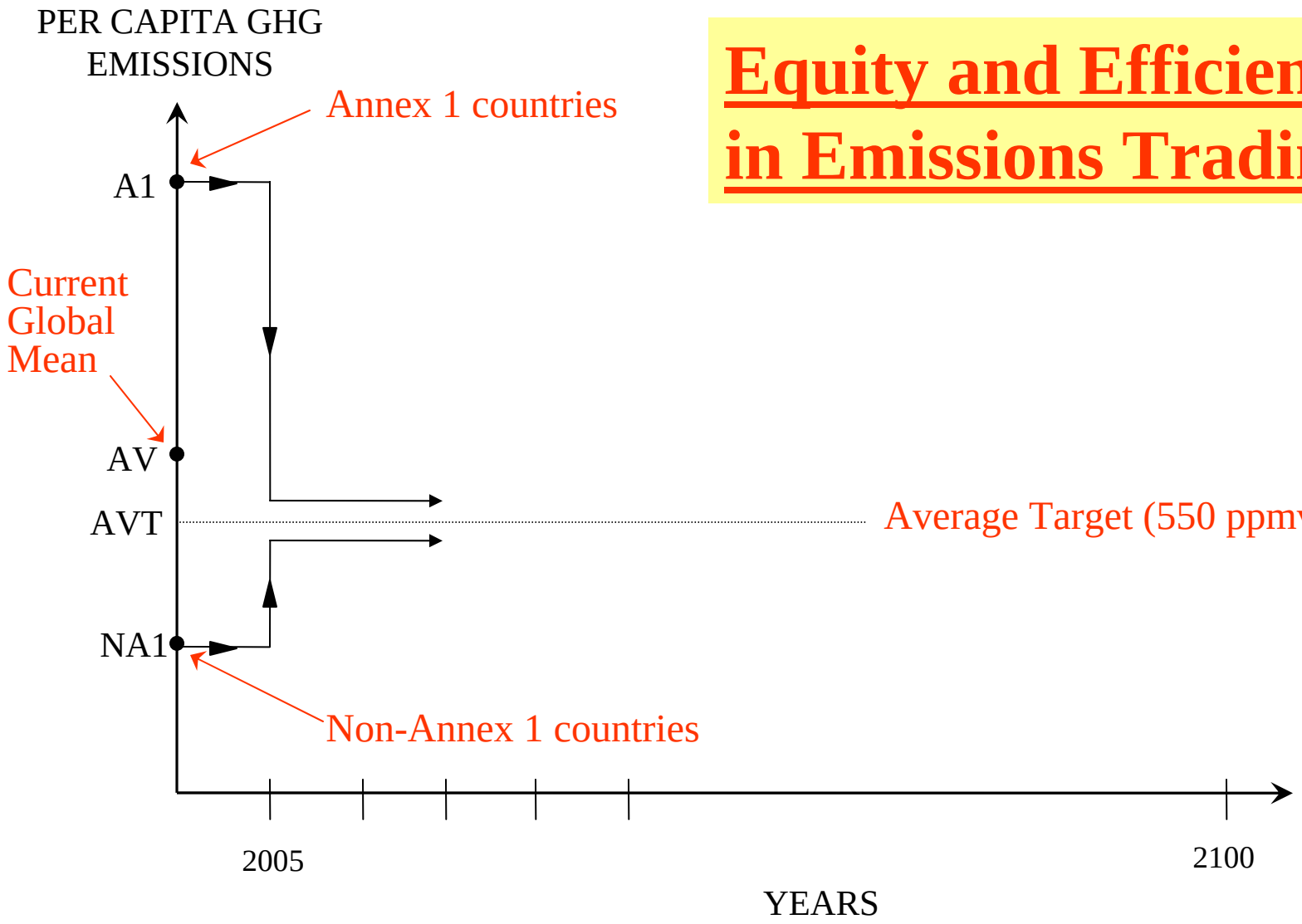
Interplay of Economic Efficiency and Social Equity to Protect Global Environment - CDM & JI: 2



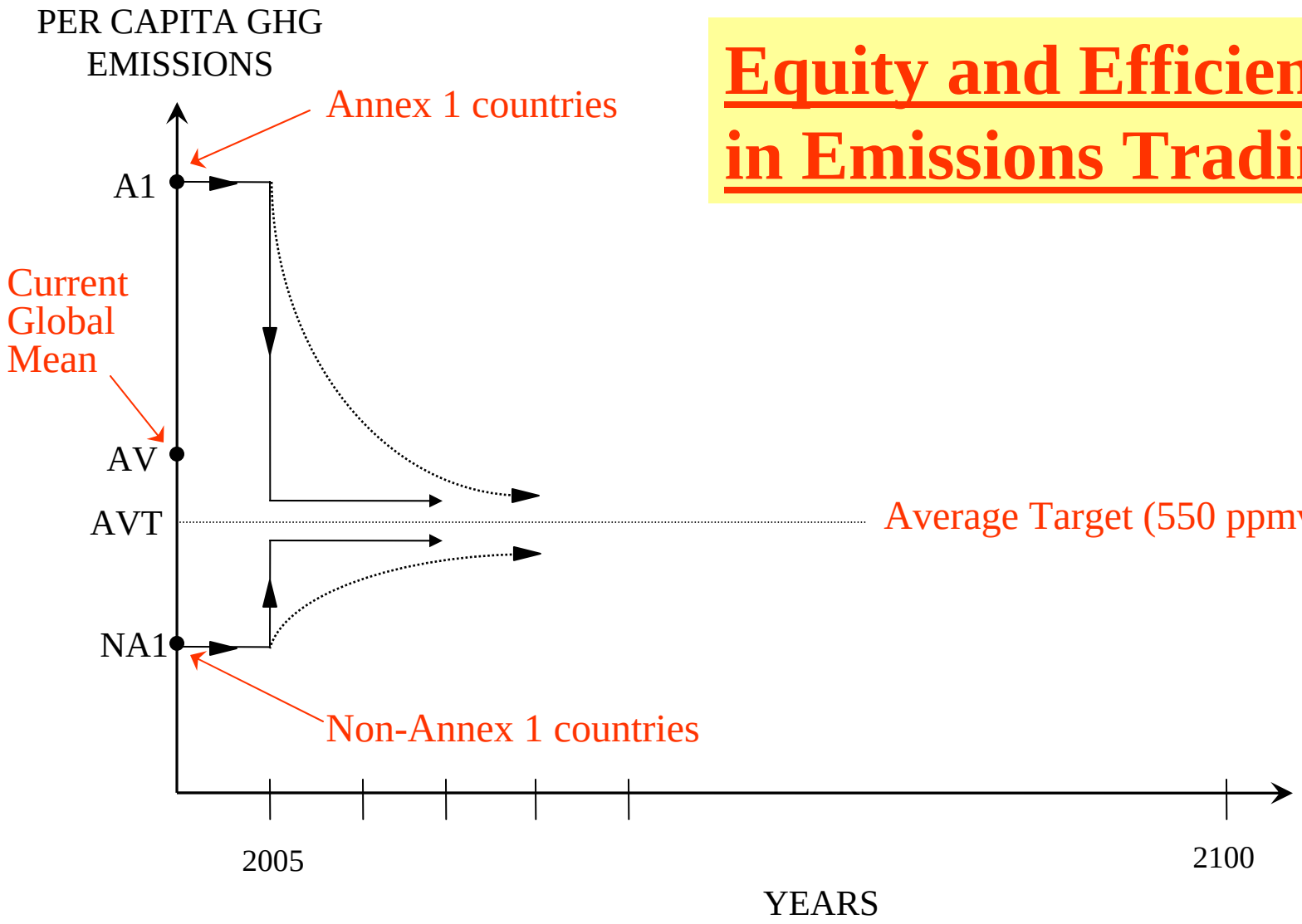
Interplay of Economic Efficiency and Social Equity to Protect Global Environment - CDM & JI: 3



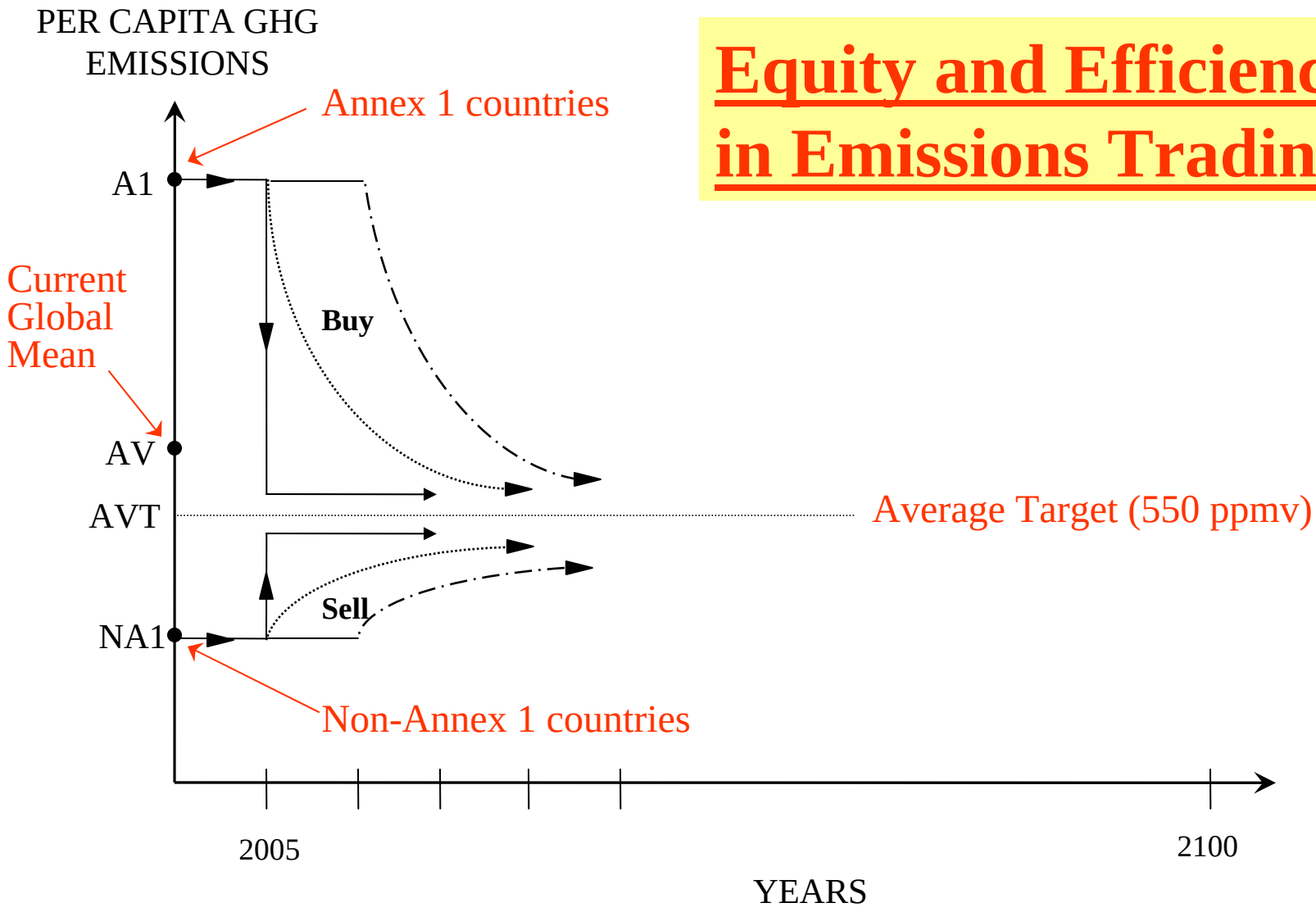
Equity and Efficiency in Emissions Trading 1



Equity and Efficiency in Emissions Trading 2



Equity and Efficiency in Emissions Trading 3



Country Level Actions

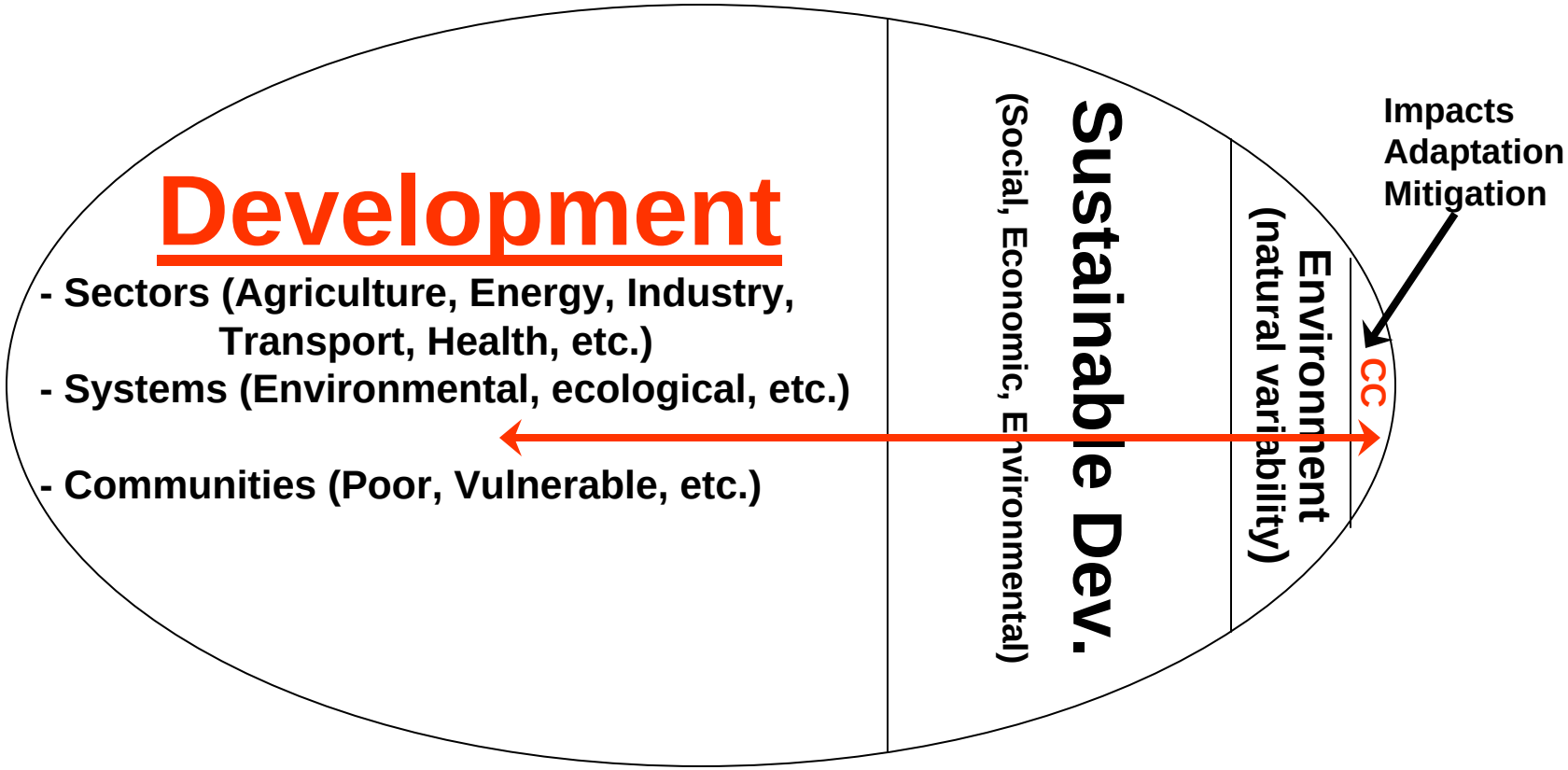
Integrating Climate Change Policies into National Sustainable Development Strategy

Typical Response Options for a National Climate Change Strategy

1. Grow Fast (reduce vulnerability to CC)
2. Improve adaptive capacity (reduce impacts)
3. Mitigate (FX incentives needed to offset costs)
4. Integrate CC-SD strategy by combining 1,2 & 3

Integrating CC Policies into National SD Strategy

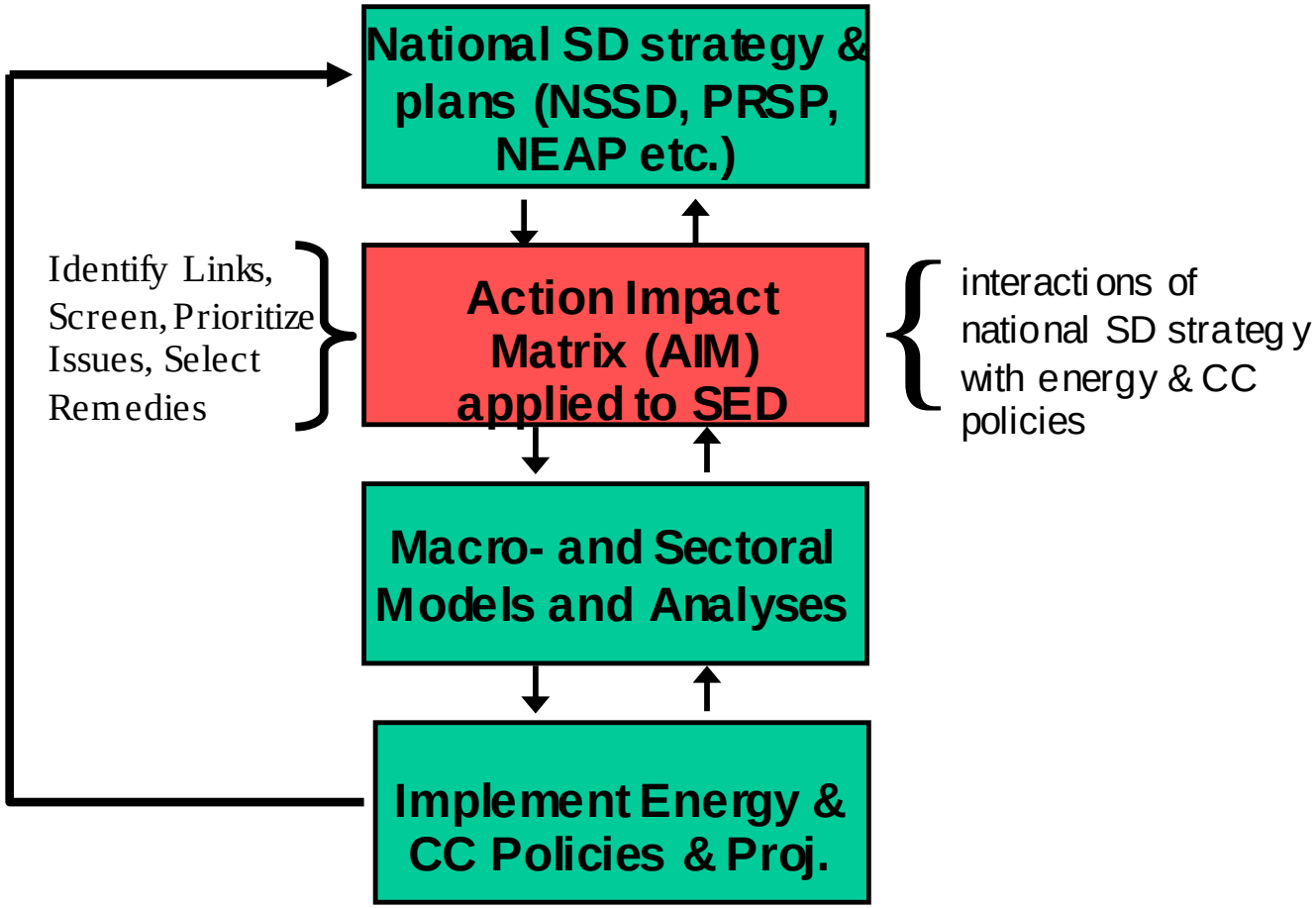
Make decision makers see climate change as a key element in the national sustainable development strategy



Action Impact Matrix Applications

Adaptation

Analysing SD-CC Interactions using the Action Impact Matrix (AIM) to Link Macro & Micro Levels



Action Impact Matrix (AIM) Methodology

The AIM methodology may be used to better understand interactions among key elements, at the country-specific level:

(a) national development policies and goals;

(b) climate change adaptation (or mitigation) options.

First, the impacts of (a) on (b) are explored, in the context of both natural climate variability and additional effects of climate change. Then the reverse impacts of (b) on (a) are studied.

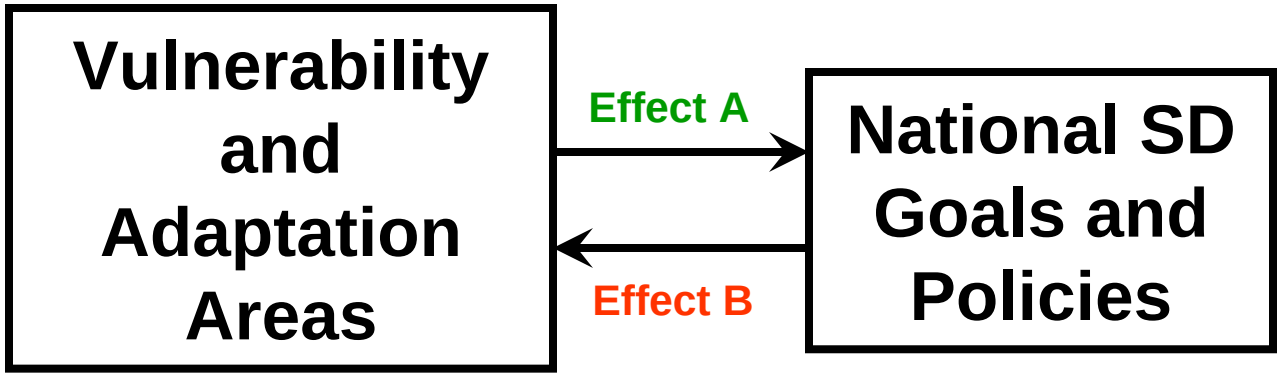
The AIM approach analyses key economic-environmental-social interactions to identify potential barriers to making development more sustainable (MDMS) - including climate change. It also helps to determine the priority macro strategies and micro policies in the economic, social and environmental domains, that facilitate implementation of adaptation and mitigation measures to address the impacts of climate change.

Thus, the AIM helps to integrate CC within SD. It has been used since the early 1990s to link macroeconomic policies and environment.

AIM Process

The AIM methodology relies on a fully participative stakeholder exercise to generate the AIM itself. Up to 50 experts are drawn from government, academia, civil society and the private sector, who represent various disciplines and sectors relevant to both sustainable development and climate change. In the initial exercise, they usually interact intensively over a period of about two days, to build a preliminary AIM. This participative process is as important as the product (i.e., the AIM), since important synergies and cooperative team-building activities emerge. The collaboration helps participants to better understand opposing viewpoints, resolves conflicts, and ultimately facilitates implementation of agreed policy remedies. On subsequent occasions, the updating or fine-tuning of the initial AIM can be done within a few hours by the same group, since they are already conversant with the methodology.

Action Impact Matrix (AIM) for Analyzing SD-CC Adaptation Links: 1



Step 1: DEV-AIM = Effect B

(Development Effects on Vulnerabilities)

Step 1: VED-AIM = Effect A

(Vulnerabilities Effects on Development)

Action Impact Matrix (AIM) for Analyzing SD-CC Adaptation Links: 2

Step 2: DEV-AIM = Impact C + Effect B

(Development Effects on Vulnerabilities)

Step 2: VED-AIM = Impact C + Effect A

(Vulnerabilities Effects on Development)

Building the AIM – Step 1: Identify Rows and Columns

Row Headings: key national macro-economic goals and policies.

Column Headings: key vulnerable areas (VA), and associated economic, environmental and social indicators.

		Vulnerable Areas (VA)			
		Economic		Environmental	Social
		(1) Agricultural output	(2) Industrial Activity	(3) Water Resources	(4) Health
Dev. Goals/Policies					
(A)	Growth				
(B)	Poverty alleviation				
(C)	Food Security				
(D)	Employment				

Adaptation Effects on Development (VED-AIM) in Sri Lanka – CC Impacts and Effects of VA on Development Goals/Policies

Notation

+ Beneficial
- Harmful
3 High
2 Moderate
1 Low

Key Vulnerabilities, Impacts and Adaptation (VIA)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Agric. Output	Hydro Power	Defore station	Bio-div. (flora & fauna)	Wet-lands & coastl ecosy stems	Water resour ces	Poor comm unities	Human health	Infra-struct.	Indust ries & Tour-ism
(S0)	Status (Nat. Variability)	-1	0	-2	-1	-1	-2	-1	0	2	2
(S1)	Status (+CC Impacts =>)	-2	-1	-2	-2	-2	-3	-2	-1	-1	-1
Dev. Goals/Policies (+CC Impacts)											
(A)	Growth	-1	-1	-1	-1	-1	-2	-2	-1	-1	-1
(B)	Poverty alleviation	-2	0	-1	-1	-1	-2	-2	-2	-1	-1
(C)	Food Security	**-3**	0	-1	-1	-1	**-3**	-1	-1	0	0
(D)	Employment	-1	0	-1	0	-1	-2	-1	-2	-1	-2
(E)	Trade & Globalisation	-2	-1	0	0	0	-1	-1	0	-2	-1
(F)	Budget Deficit Reduction	-1	-1	0	0	0	0	0	-2	0	-1
(G)	Privatisation	0	1	1	0	0	1	0	0	-1	-1

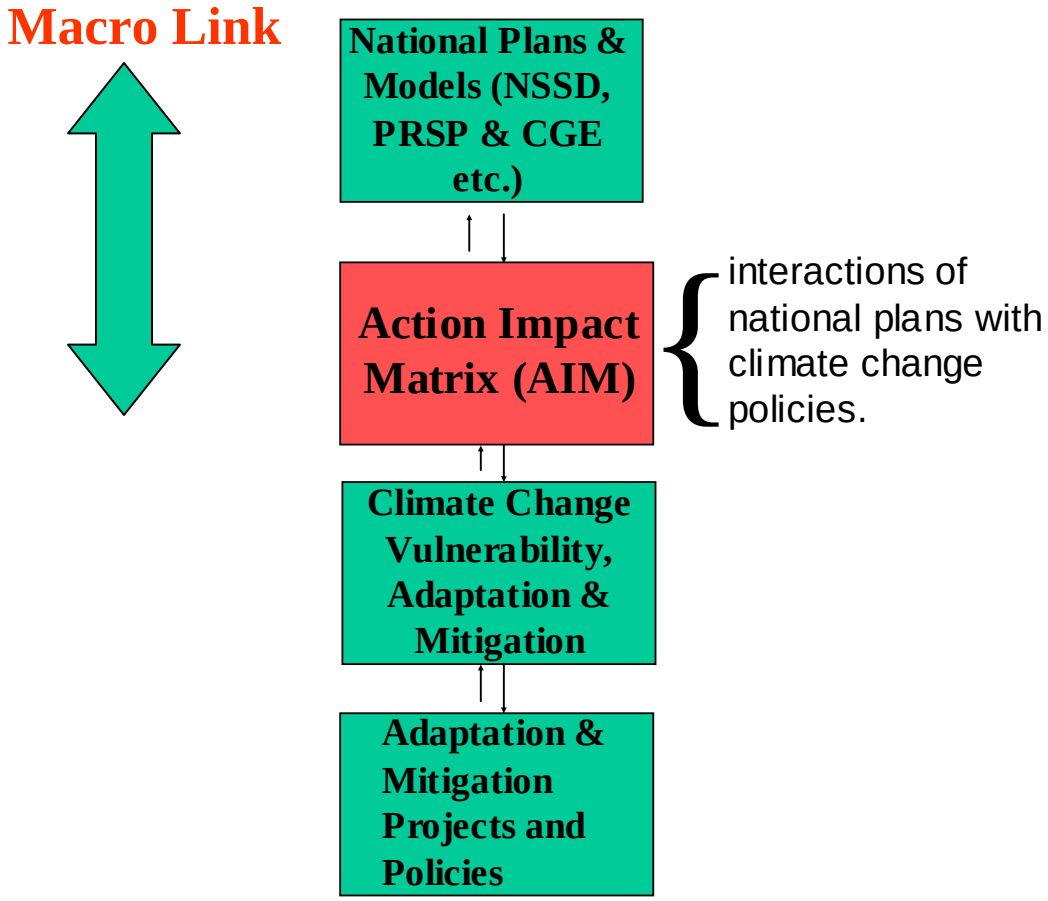
AIM Follow-up: Analyzing Macro- and Micro- Linkages

Examples:

1. CC-Macroeconomic analysis

2. Adaptation assessment

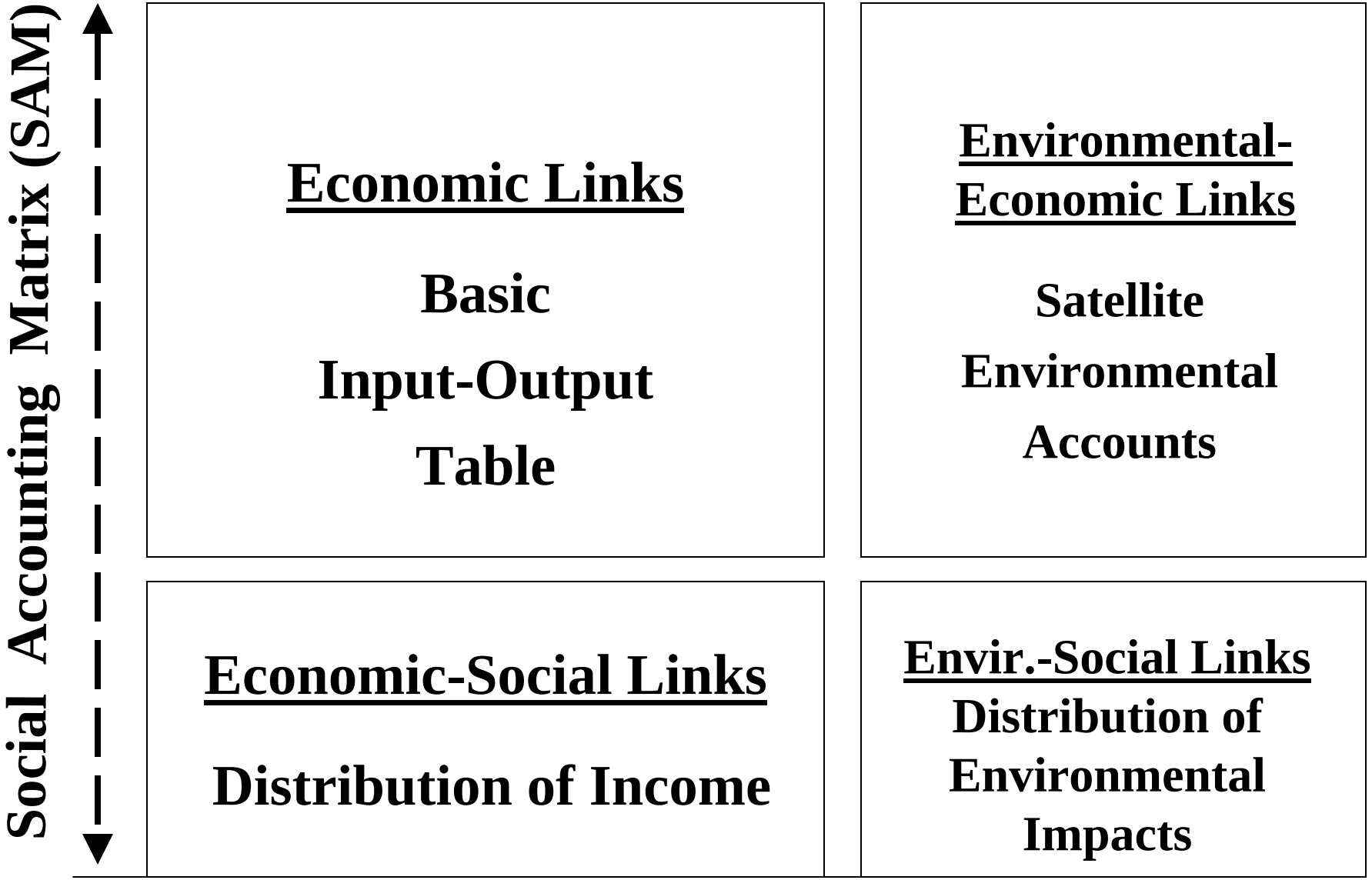
Assessing links between development plans and adaptation and mitigation – Macro and Sector Linkages



Integration via SD Analysis at the Macroeconomic/Sectoral Level (general equilibrium analysis)

1. Macroeconomic/Sectoral Modeling
2. Environmental and Macroeconomic Analysis
3. Poverty/Income Distributional Analysis

Expanded Green National Income Accounts for SD



Source: Munasinghe (2001), Macroeconomics and Environment

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Sectoral Level Example:

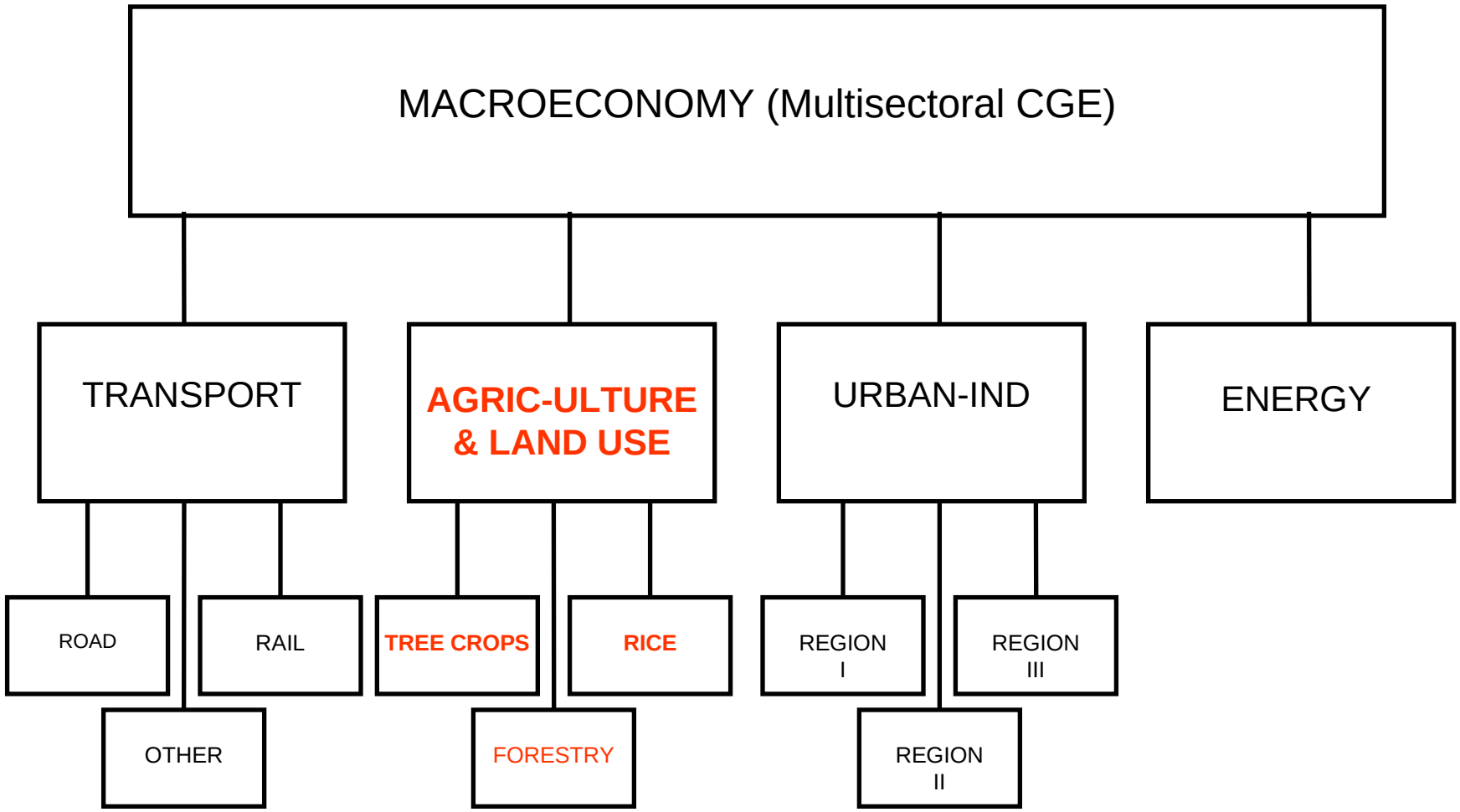
Analysing Climate Change Impacts on Agriculture in Sri Lanka Using a Ricardian Model

Source: Munasinghe, Perera and Seo (1996)

Range of Climate Change Predictions for Sri Lanka in 2050 (Downscaled GCM)

Global Scenario	Period	Rainfall	Temperature
B1	NEM	Increase by 50 mm over the baseline	Max. temperature: increase by 0.8^0 C Min. temperature : increase by 1.0^0 C
B1	SWM	Increase by 350 mm over the baseline, especially over the Western slopes of the central hills	Max. temperature: increase by 0.8^0 C Min. temperature : increase by 0.8^0 C
A1F1	NEM	Increase by 70 mm over the baseline, especially over the Eastern slopes of the central hills	Max. temperature: increase by 1.1^0 C Min. temperature : increase by 1.4^0 C
A1F1	SWM	Increase by 520 mm over the baseline, especially over the Western slopes of the central hills	Max. temperature: increase by 1.1^0 C Min. temperature : increase by 1.2^0 C

Sri Lanka Integrated CC-SD Assessment Model



Sri Lanka - National level impact on Agric. Revenue in 2050 – temp/rain & equity

(A1F1 scenario based projection)

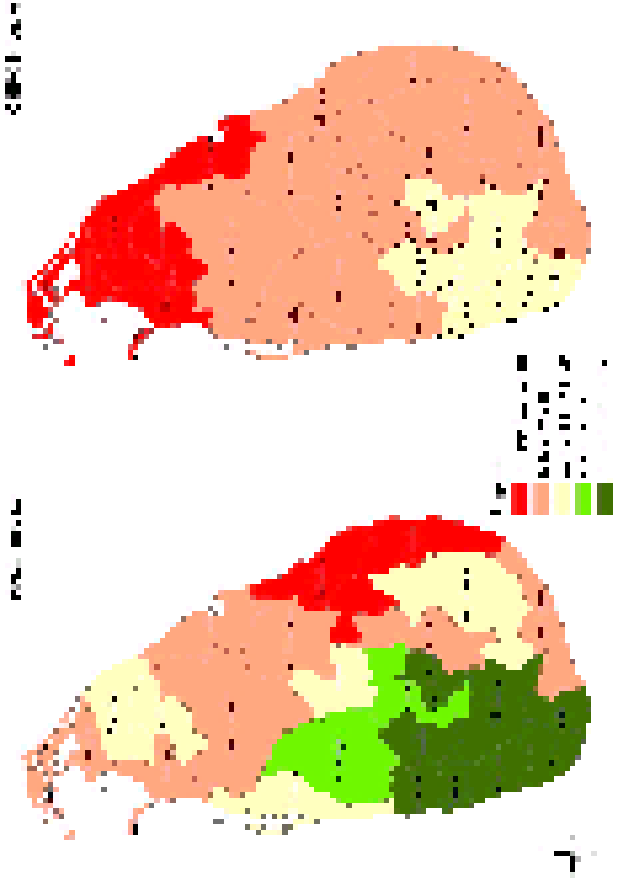
Crop	Temperature Effect	Rainfall Effect	Temp. Plus Rainfall Effect
Paddy (Rice) (dry zone – poorer)	-3.5%	-7.8%	-11.4%
Plantation Crops (wet zone – richer)	+1.5%	+2.0%	+3.5%

Impact on Sri Lanka national economy in 2050* - GDP effect small BUT equity effect larger

Crop	Change of Total GDP in 2050 (%)	Change Agriculture GDP in 2050 (%)
Rice (dry zone – poorer)	-0.36	-2.46
Plantation Crops (wet zone – richer)	+0.10	+0.70
Rice + Plantation Crops	**-0.26**	- 1.76

*Note: Assuming the same economic structure in 2050

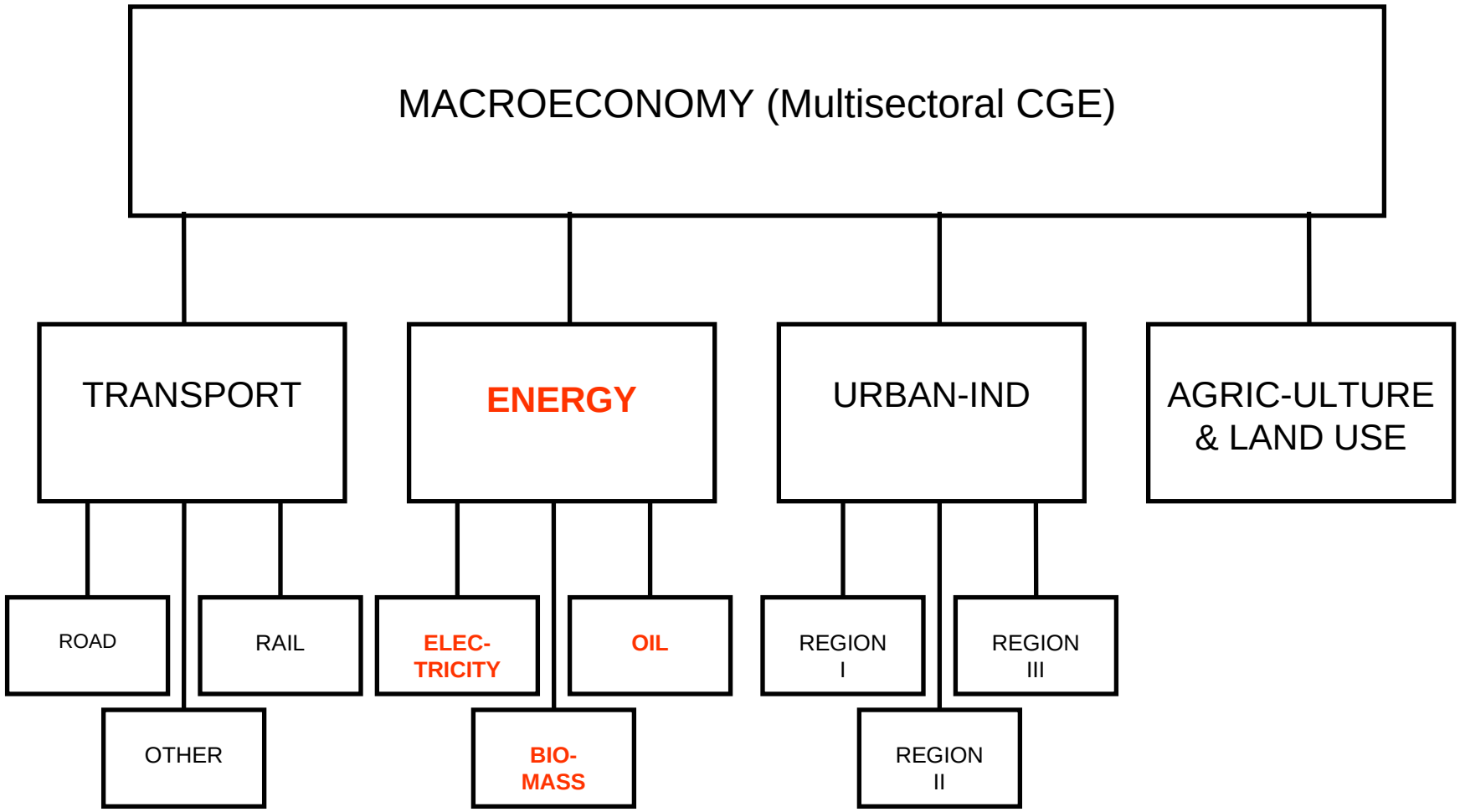
Sri Lanka Impacts: HAD3 and CSIRO models



National Level Example

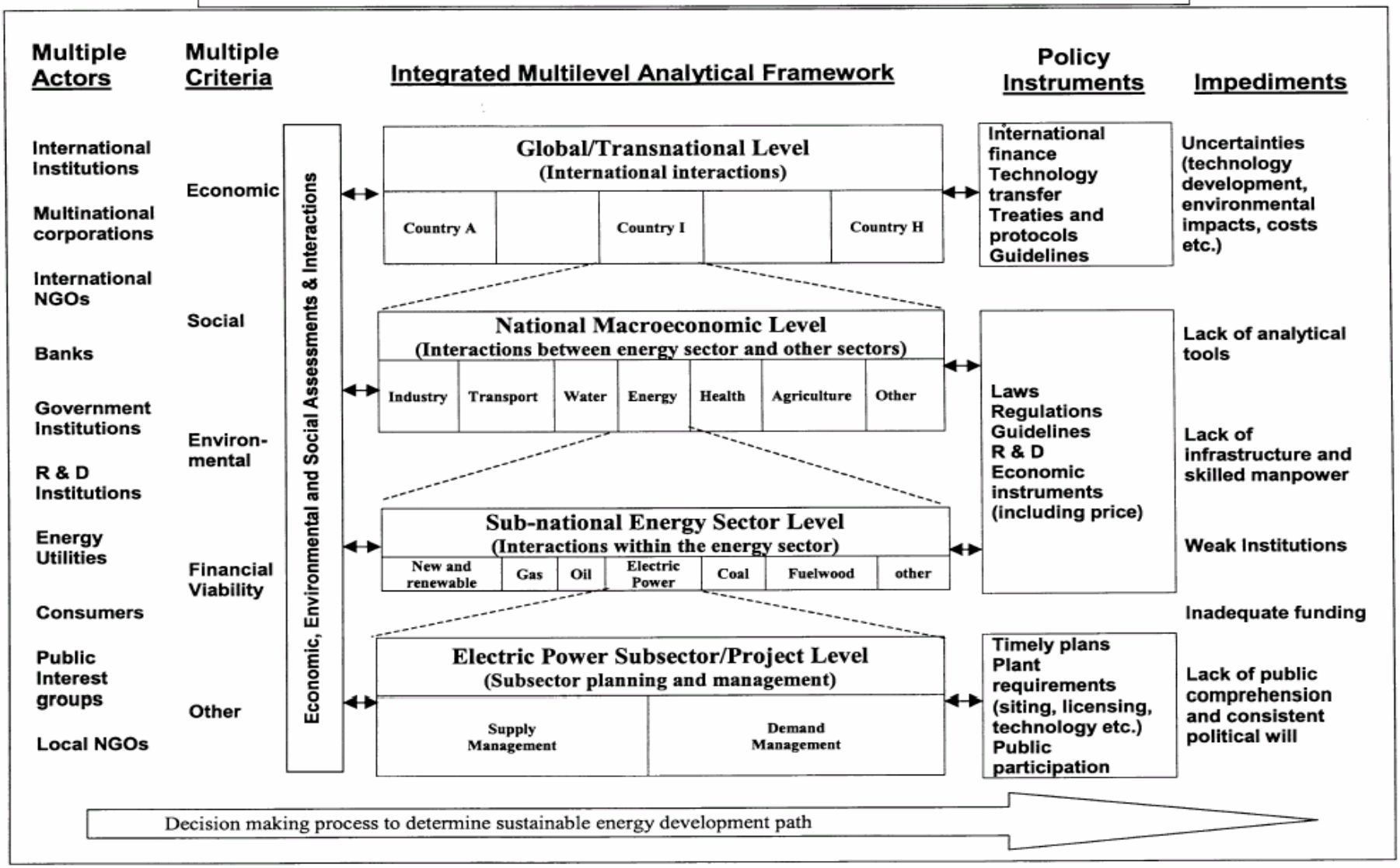
Energy Sector Policy and Pricing

Integrated Sustainable Energy Development Model



Sustainable Energy Development and Mitigation

Figure 8. Framework for sustainable energy development Source: adapted from Munasinghe [1990].



Sustainable Energy Pricing: incorporates Economic, Environmental and Social Goals

1. **Economic efficiency: prices based on long-run marginal cost to reflect scarcity**
   e.g., rising oil prices

2. **Environmental protection: prices incorporate (internalise) externalities**
   e.g., add air pollution taxes, carbon taxes, etc.

3. **Social equity: subsidised prices to meet basic energy needs of the poor**
   e.g., reduced or lifeline prices for minimum use by poor

Project Level Example

Assessing economic, social and ecological indicators for small hydro in Sri Lanka

Primary Source: **Morimoto R., and Munasinghe M. (2005) "Small hydropower projects and sustainable energy development in Sri Lanka", *Int. Journal of Global Environmental Issues*, Vol.4.**

Summary: **Munasinghe, M. (2002) "The sustainomics trans-disciplinary meta-framework for making development more sustainable: applications to energy issues", *Int. J. of Sustainable Dev.*,Vol.4, No.2, pp.6-54.**

Sustainable Development Assessment (SDA)

(partial equilibrium analysis at sector/project level)

1. **Economic/Financial Assessment (CBA)**
2. **Environmental Assessment (EA)**
3. **Social Assessment (SA)**
4. **Poverty Assessment (PA)**
5. **Technical Assessment (TA)**

Choice of appropriate SD indicators is vital for SD Assessment

Overview of study

- Energy affects all three dimensions of sustainable development.
- Reviews linkages between potential impacts of energy production and consumption on sustainable development,.
- Multi-criteria analysis used to assess the role of small hydroelectric power projects in sustainable energy development.
- 3 key variables:

  Economic - electricity supply costs,

  Social - numbers of people resettled,

  Environmental - biodiversity loss
- Analysis helps policy-makers compare and rank project alternatives more easily and effectively.
- The multi-criteria analysis, which includes environmental and social variables, supplements cost benefit analysis which is based on economic values alone.

Economic indicator used

Average generation costs per unit generated per year **[Ci/Qi]**

where

Ci = total economic cost of project i

Qi = quantity of electricity generated from project i

This measure is equivalent to using net benefits per unit of generation: NBi/Qi

where

NBi = (Bi – Ci) = net benefit from project i ;

Bi = total benefit from project i ;

and we assume that the total benefit per unit generated is the same for all projects compared: Bi/Qi

Another related measure would be the average generation costs per unit of GHG emissions reduced, assuming that each unit of hydro-electricity produced would reduce a unit of thermal generation and associated GHG emissions.

Environmental Indicator used

Average biodiversity index value per unit of energy produced per year:

Gi = Ei / [Hydroelectricity generated per year at site i]

where Ei is the biodiversity index

$$Ei = \sum_{j} wj.\ Aij$$

where Aij is the area (hectares) of ecosystem of type j at site i,

wj is relative biodiversity value of ecosystem type j

Another useful indicator is average biodiversity index value per hectare of affected land

$$Fi = Ei / [\sum_{j} Aij] = Ei / [\text{Total land area affected at site i}]$$

Social Indicator used

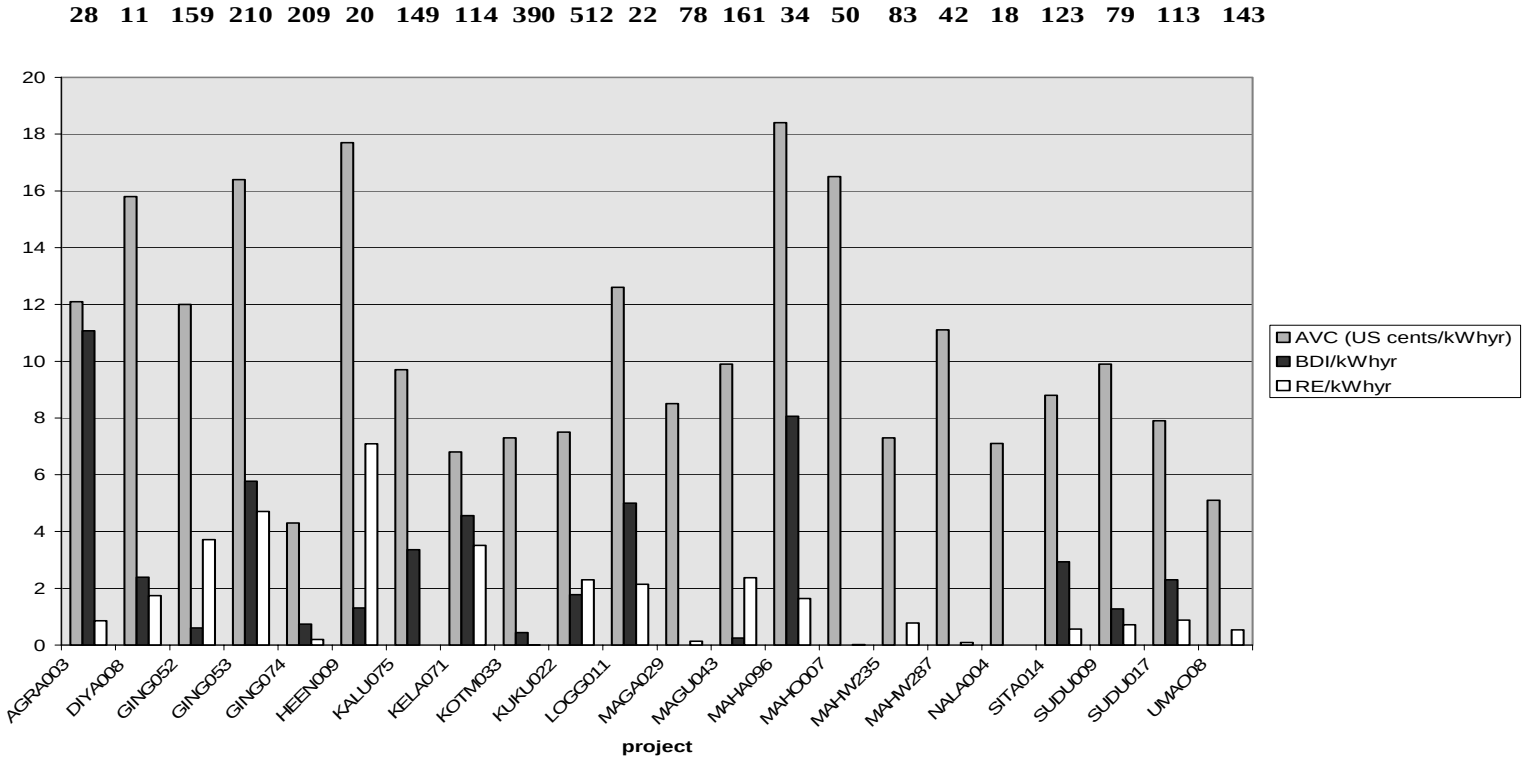
Resettlement = Number of people resettled per unit of electricity generated per year

Minimising the number of people resettled due to dam construction is an important social objective.

Project Level:

Economic, social and ecological indicators for small hydro in Sri Lanka

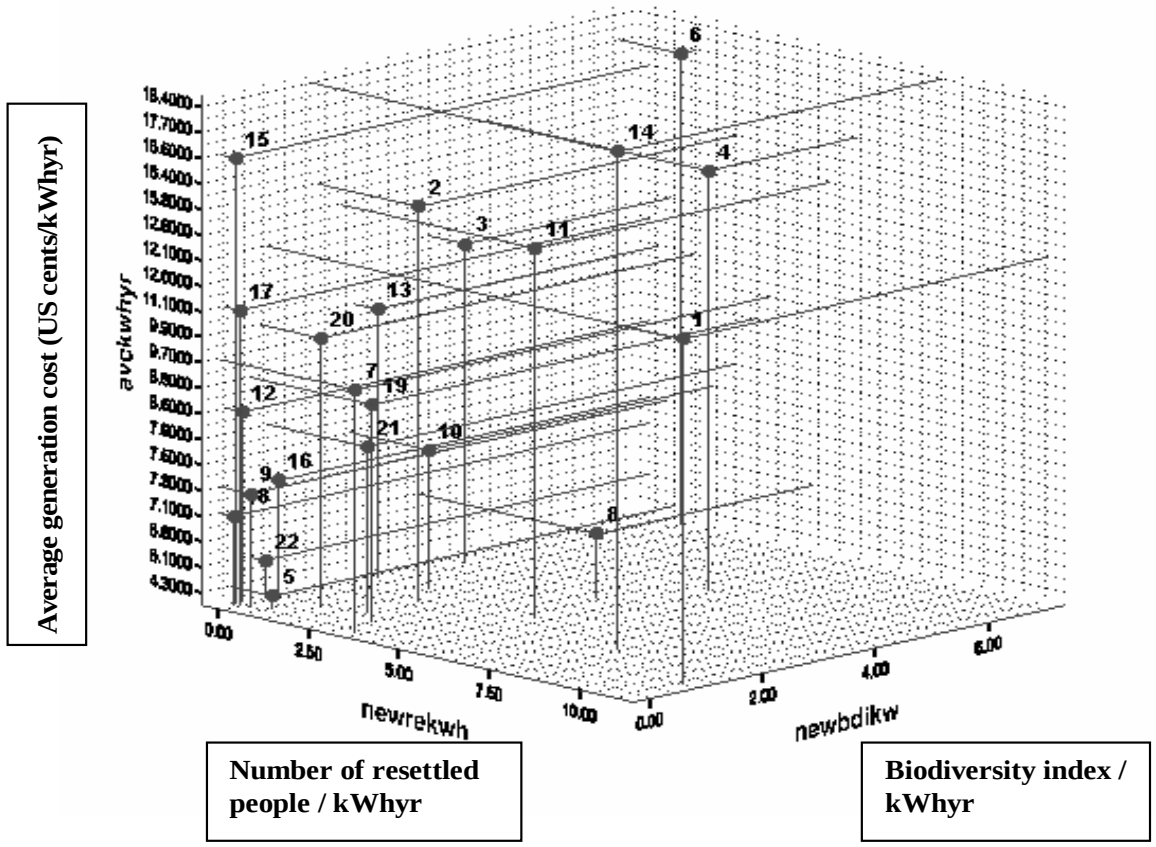
Figure 4. Average generation costs (AVC), biodiversity index (BDI), and number of resettled people (RE) by hydroelectric project. All indices are per kWh per year. Numbers of people resettled and the biodiversity index are scaled for convenience (by the multipliers 10^{-5} and 10^{-9} respectively). The values at the top of the graph indicate the annual energy generation in gigawatt hours (GWh).



Source: CEB (1987); CEB (1988); Meier and Munasinghe (1994)

Three dimensional MCA of SD indicators of small hydro

Figure 5. Three dimensional MCA of sustainable development indicators for various hydropower options.
Source: Morimoto, Munasinghe and Meier [2000]

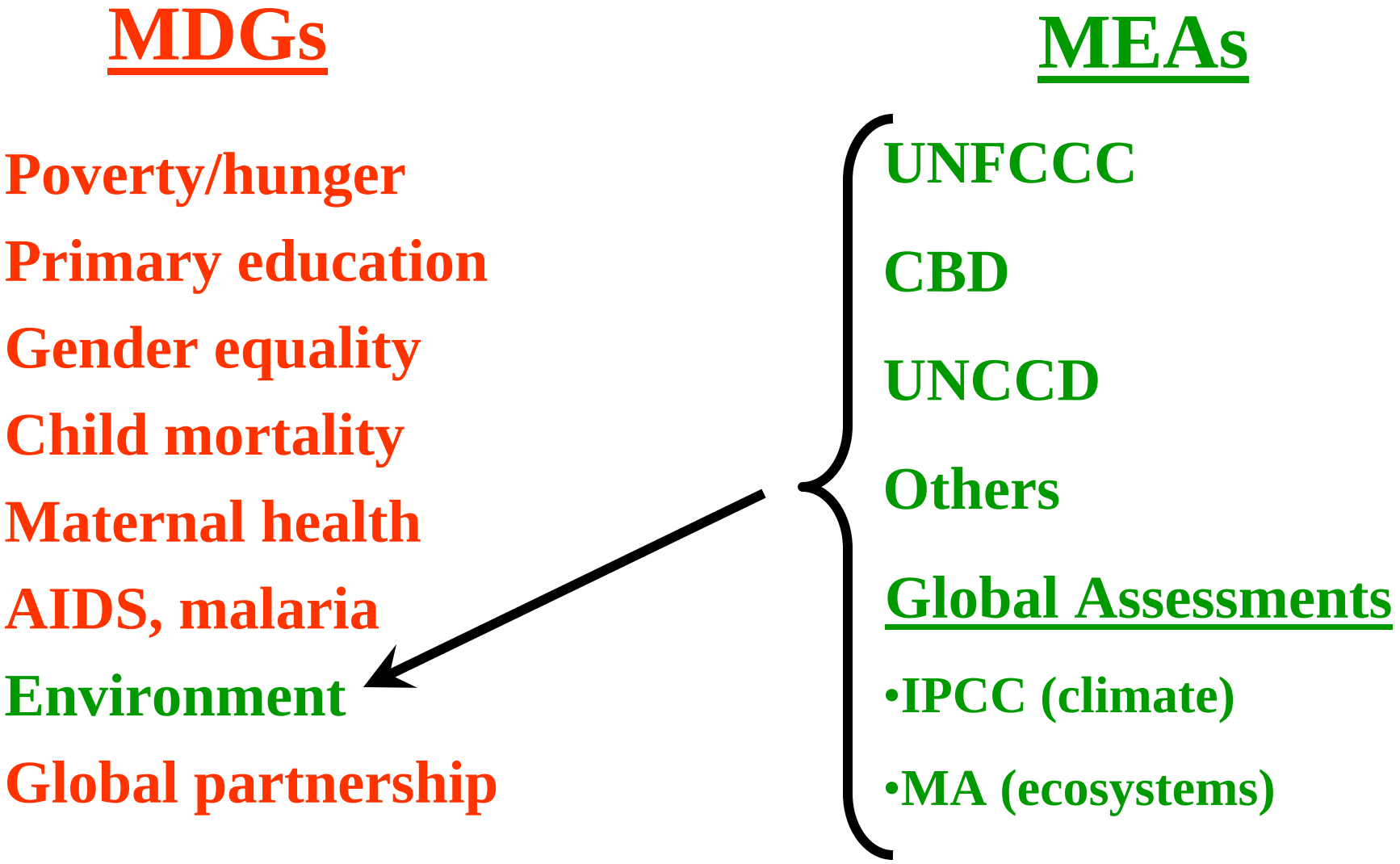


Conclusions of Small Hydro Study

- MCA helps policy-makers compare project alternatives more easily and effectively
- Looks at all aspects of project (social, environmental and economic) unlike CBA which emphasises economic aspects.

Linking and Coordinating the Millennium Development Goals (MDG) with Multilateral Environmental Agreements (MEA) & Issues

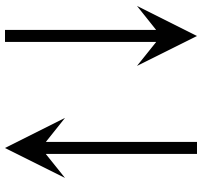
Misperception: Multilateral Environmental Agreements (MEAs) map into only one MDG



All MEAs & MDGs interact multiply, both ways

MDGs

Poverty/hunger
Primary education
Gender equality
Child mortality
Maternal health
AIDS, malaria
Environment
Global partnership



MEAs

UNFCCC
CBD
UNCCD
Others

Global Assessments

- IPCC (climate)
- MA (ecosystems)

Misperception: Ecosystems map into only one MDG

MDG

Poverty/hunger
Primary education
Gender equality
Child mortality
Maternal health
AIDS, malaria
Environment
Global partnership

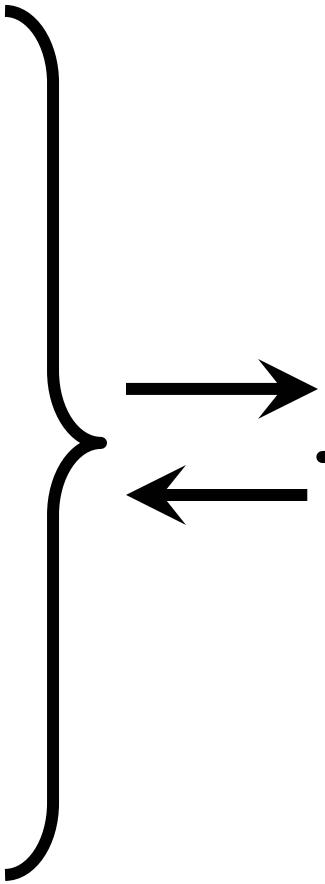
Millenium Ecosystem Assessment (MA)

Freshwater Systems
Marine and Coastal Systems
Forests and Woodlands
Drylands
Island Systems
Mountain Systems
Polar Systems
Cultivated Systems
Urban Systems
Other Systems

All Ecosystems & MDGs interact multiply, both ways

MDG

Poverty/hunger
Primary education
Gender equality
Child mortality
Maternal health
AIDS, malaria
Environment
Global partnership



Millenium Ecosystem Assessment (MA)

Freshwater Systems
Marine and Coastal Systems
Forests and Woodlands
Drylands
Island Systems
Mountain Systems
Polar Systems
Cultivated Systems
Urban Systems
Other Systems

Sri Lanka AIM: Impact of Dev. Policies on Critical Ecosystems

		Critical Ecosystems and Services					
		(1)	(2)	(3)	(4)	(5)	(6)
		Forests	Managed Ecosyst. 1 (grain)	Managed Ecosyst. 2 (tree crops)	Coastal & Marine Systems	Wetlands	Water Resources
	(S) Status	-2	-1	0	-1	-1	-1
Dev. Goals/Policies							
(A)	Growth				-2		
(B)	Poverty alleviation	+2					
(C)	Food Security						
(D)	Employment					+1	
(E)	Trade & Globalisation						
(F)	Budget Deficit Reduction						
(G)	Privatisation						

KEY: 3 = High; 2 = Moderate; 1 = Low; Minus (-) = negative impact/status; Plus (+) = positive impact/status

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WHY ? is climate a threat to future human development

Climate Change (CC) undermines Sustainable Development (SD) and unfairly penalizes the poor

HOW ? can we move forward to transform risky current trends into a safer and better future

Start making development more sustainable (MDMS) now, using the Sustainomics framework

WHAT? are the practical solutions and policy options to be implemented that will integrate CC responses into SD strategy (from global to local levels)

Many examples of good practice available;

US has a key role to play

A Key Role for the US: Leadership in Making Development More Sustainable

The US has taken a back seat for too long! It must collaborate better with other nations in meeting the challenges of the 21st century !

Economic: technology, resources and skills

Social: commitment to social progress and peace

Environmental: respect for nature

Optimistic Take Home Message

Climate change and sustainable development are interlinked problems posing a serious challenge to us all.

Although the issues are complex and serious, both problems could be solved together, provided we begin now.

We know enough already to take the first steps towards making development more sustainable, that will transform the risky "business-as-usual" scenario into a safer and more secure future.

Governance and political systems worldwide must also ADAPT to CC !

We need to re-energise and re-organise to play a key role in the CC-SD transition - mobilising resources, framing the issues, identifying solutions, and implementing them.

Ancient Pali Blessing - MDMS

“DEVO VASSATU KALENA
SASSA SAMPATTI HETU CA
PHITO BHAVATU LOKO CA
RAJA BHAVATU DHAMMIKO”

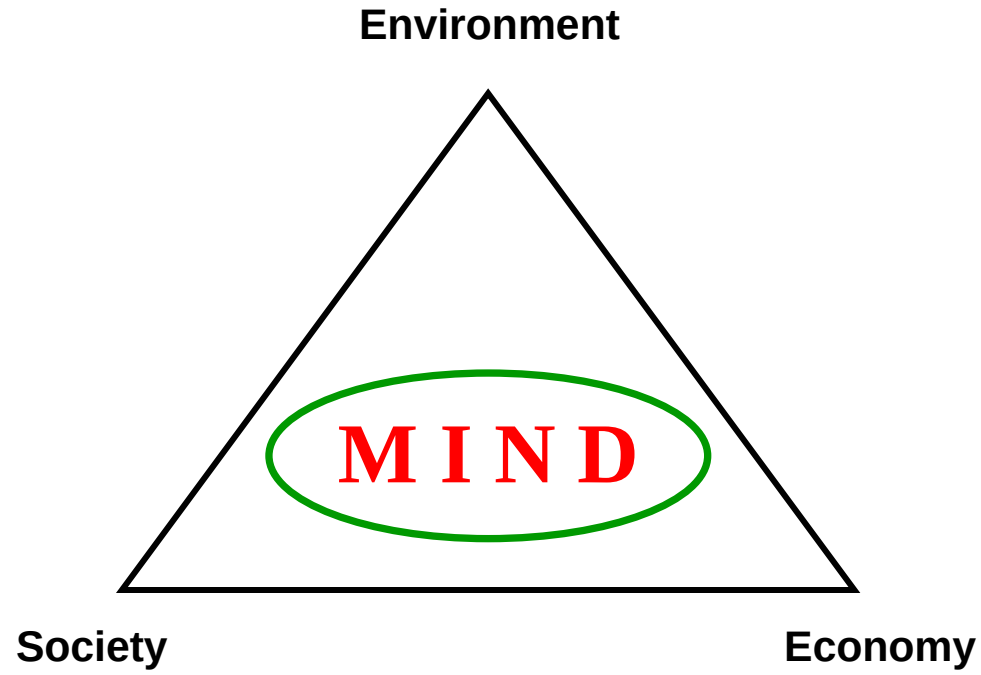
“May the rains come in time (environment)
May the harvests be bountiful (economy)
May the people be happy and contended
May the king be righteous (society)”

Even in ancient times, a favourable environment, economic prosperity, social stability, and good governance, were well recognised as key factors for making development more sustainable.

Suggestions for Further Information

1. **Munasinghe, M. (2007)** ***Making Development More Sustainable: Sustainomics Framework and Practical Applications*****, MIND Press, Munasinghe Institute for Development, Colombo.**
2. **Munasinghe, M., and Swart, R. (2005)** ***Primer on Climate Change and Sustainable Development*****, Cambridge University Press, UK. –translated into Chinese**
3. **MIND (2005)** ***Action Impact Matrix (AIM) Application to Climate Change - Users Guide*****, Munasinghe Institute for Development, Colombo.**
4. **Website URL: <www.mindlanka.org>**

An Introduction



Munasinghe Institute for Development

"making development more sustainable - MDMS“

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PROGRAMMES

- **Awards**

  Research fellowships, Scholarships, Sustainable Support Service (MS3), Book donations

- **Research & Training**

  Training workshops/expert meetings

  Applied research studies and evaluations

  UN “Centre of Excellence” for Asia in the Climate Change Capacity Development (C3D) network of the United Nations Institute for Training and Research (UNITAR).

MIND CC-SD Training Course, CMA, Beijing, July-Aug, 2006
270 Senior Chinese Officials

MIND

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MIND SD Course, Delhi, Feb. 2007

25 Senior Indian Civil Service Officers

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MIND-ERC CC-SD Training Course, University of Cape Town, October 2007, for 30 Senior Decision Makers from Government, Business and Civil Society

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SD Full Course, FES, Yale University, New Haven, 2004-5

24 Graduate Students

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Thank You

Very Much