Addressing Climate Change and Sustainable Development Challenges Together: The Role of Statistics

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Analyze how CC affects SD and vice versa 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. Improved data and statistics will play a key role.

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 prepared and progressively improved our understanding of climate change:

1. Climate Change 1990
2. Climate Change 1995
3. Climate Change 2001
4. Climate Change 2007

Fifth assessment report planned during 2008-2013

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

IPCC Fourth Assessment Report (AR4)

Three Main Working Groups:

I. Science of Climate Change

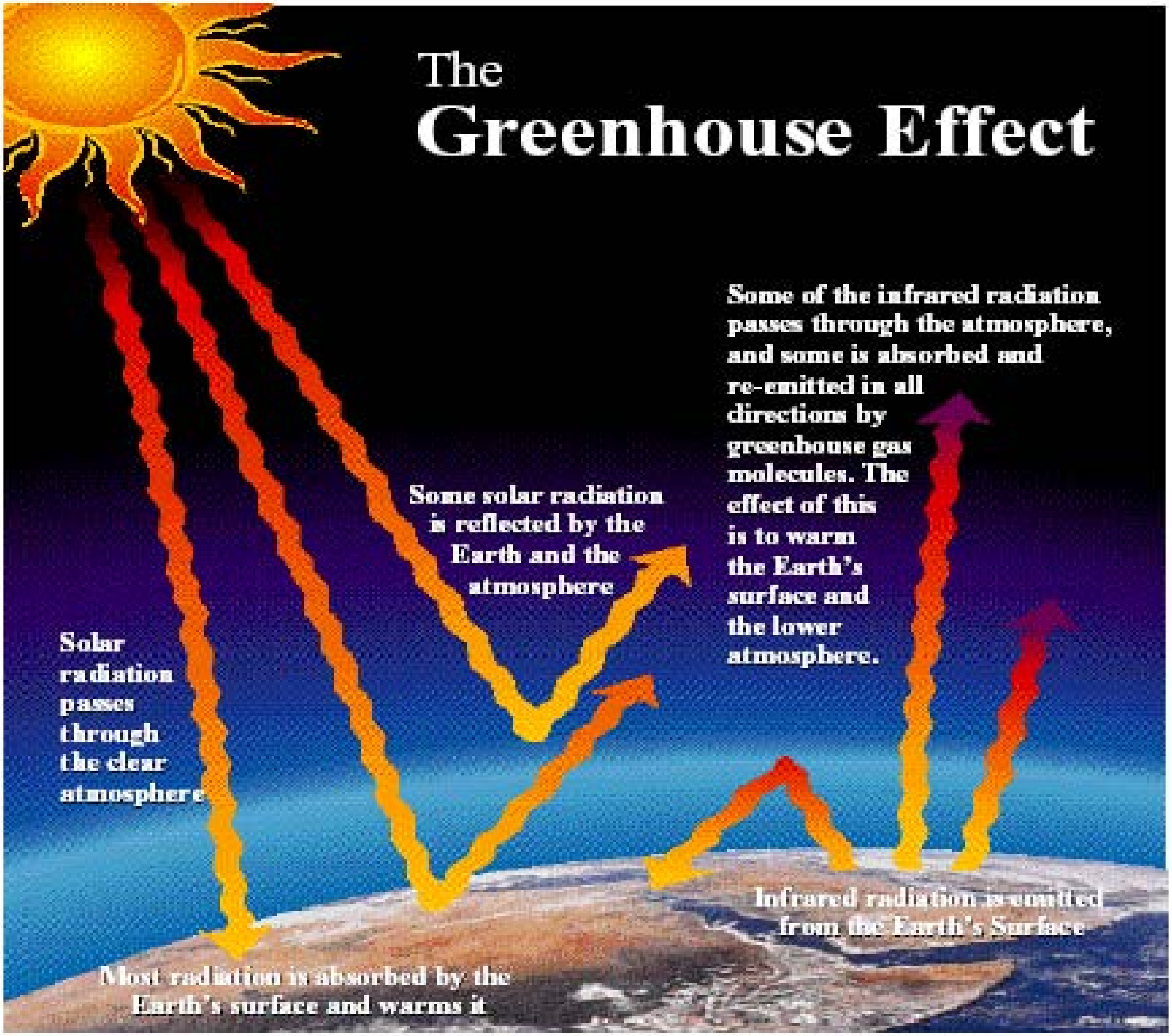
II. Impacts, Adaptation and Vulnerability

III. Mitigation

Synthesis Report

Task Force on National Greenhouse Gas Inventories

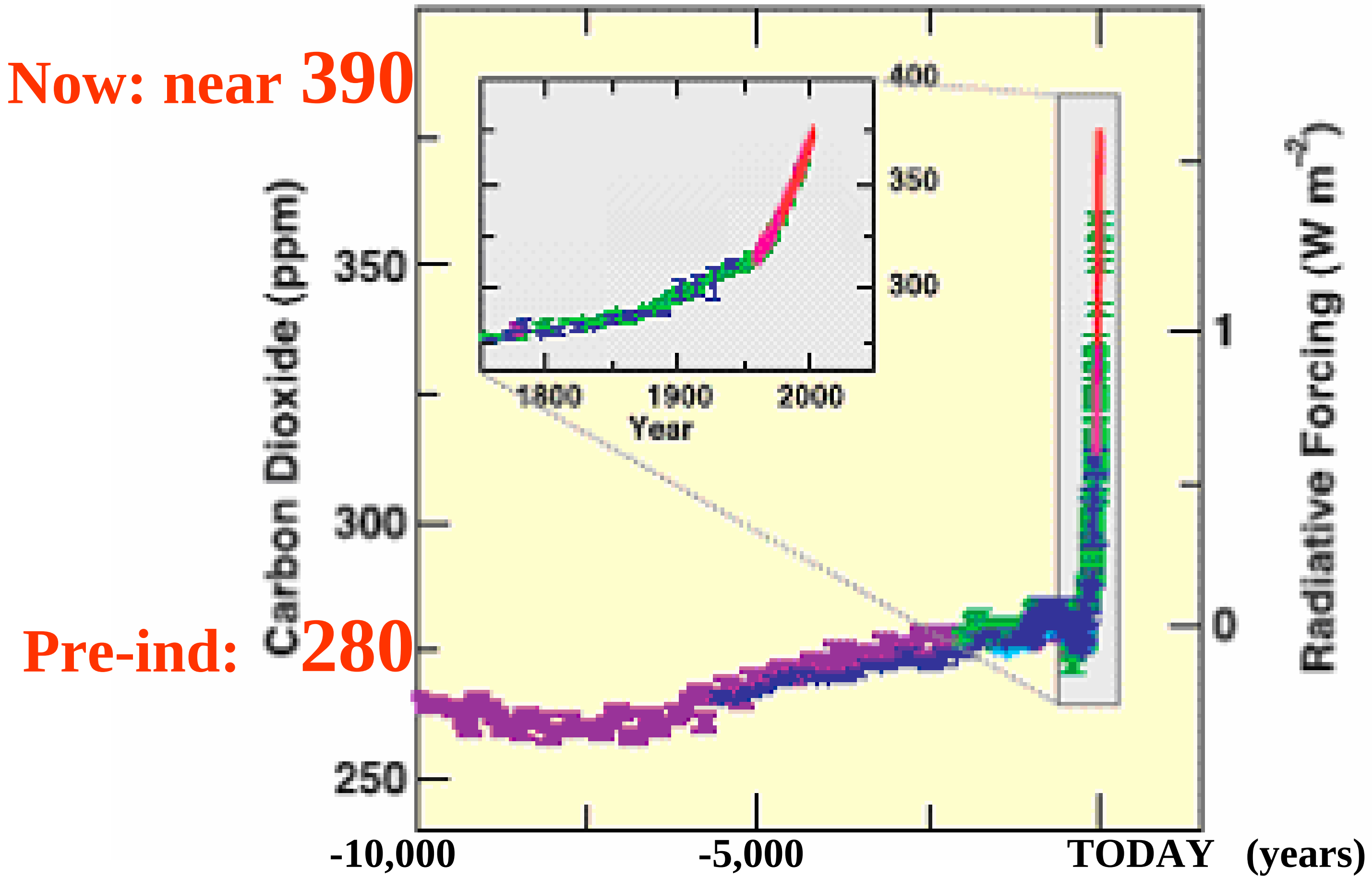
Over 2000 leading scientists worldwide, were involved in writing, reviewing and editing the AR4.


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

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.

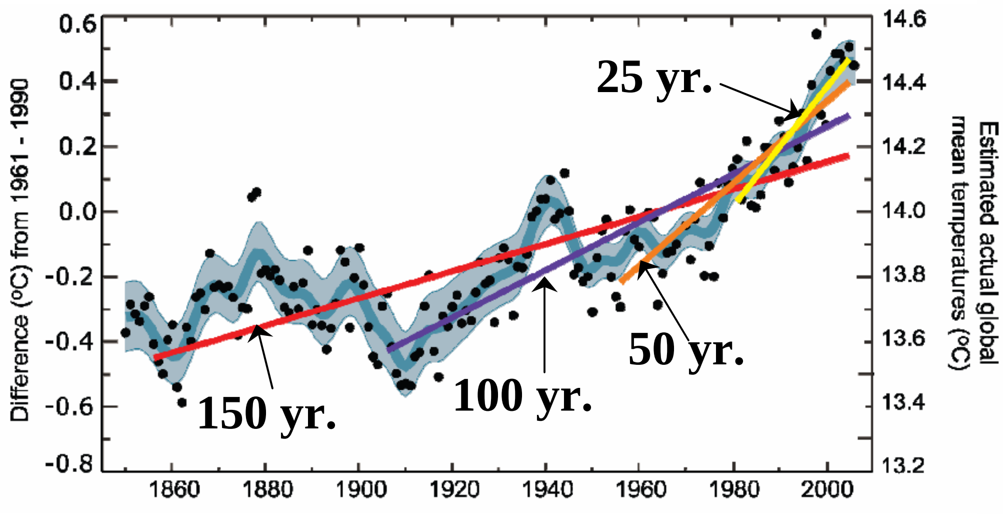
MAIN DRIVER
Changes in CO2 from ice core and modern data



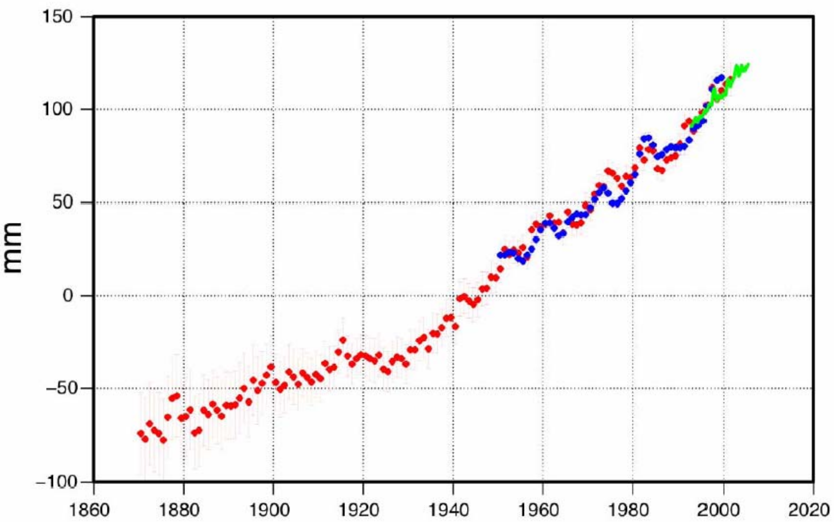
Other drivers include methane, nitrous oxide and aerosols

RESULT: Mean Temp., Sea Level and Ice Cover

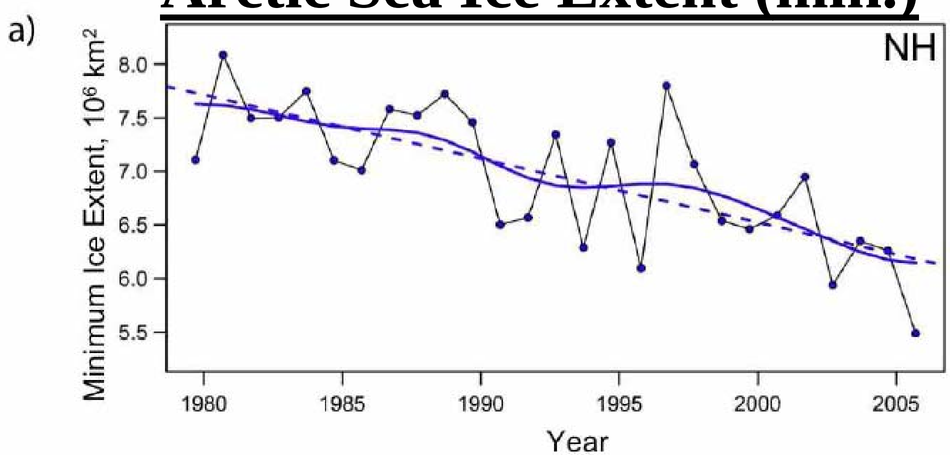
Mean Temperature



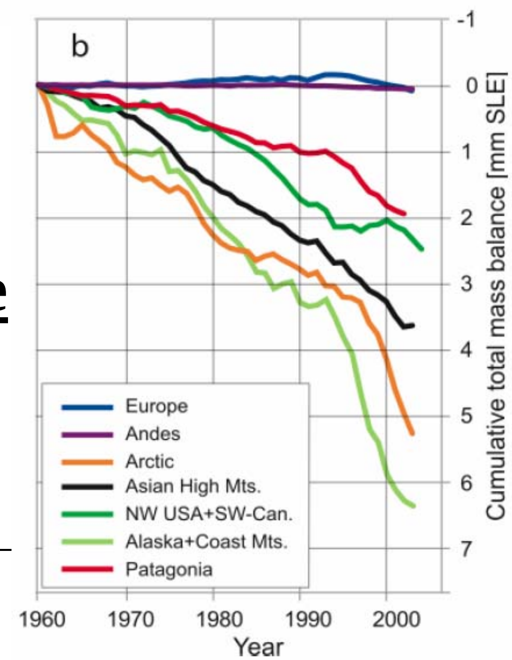
Mean Sea Level



Arctic Sea Ice Extent (min.)



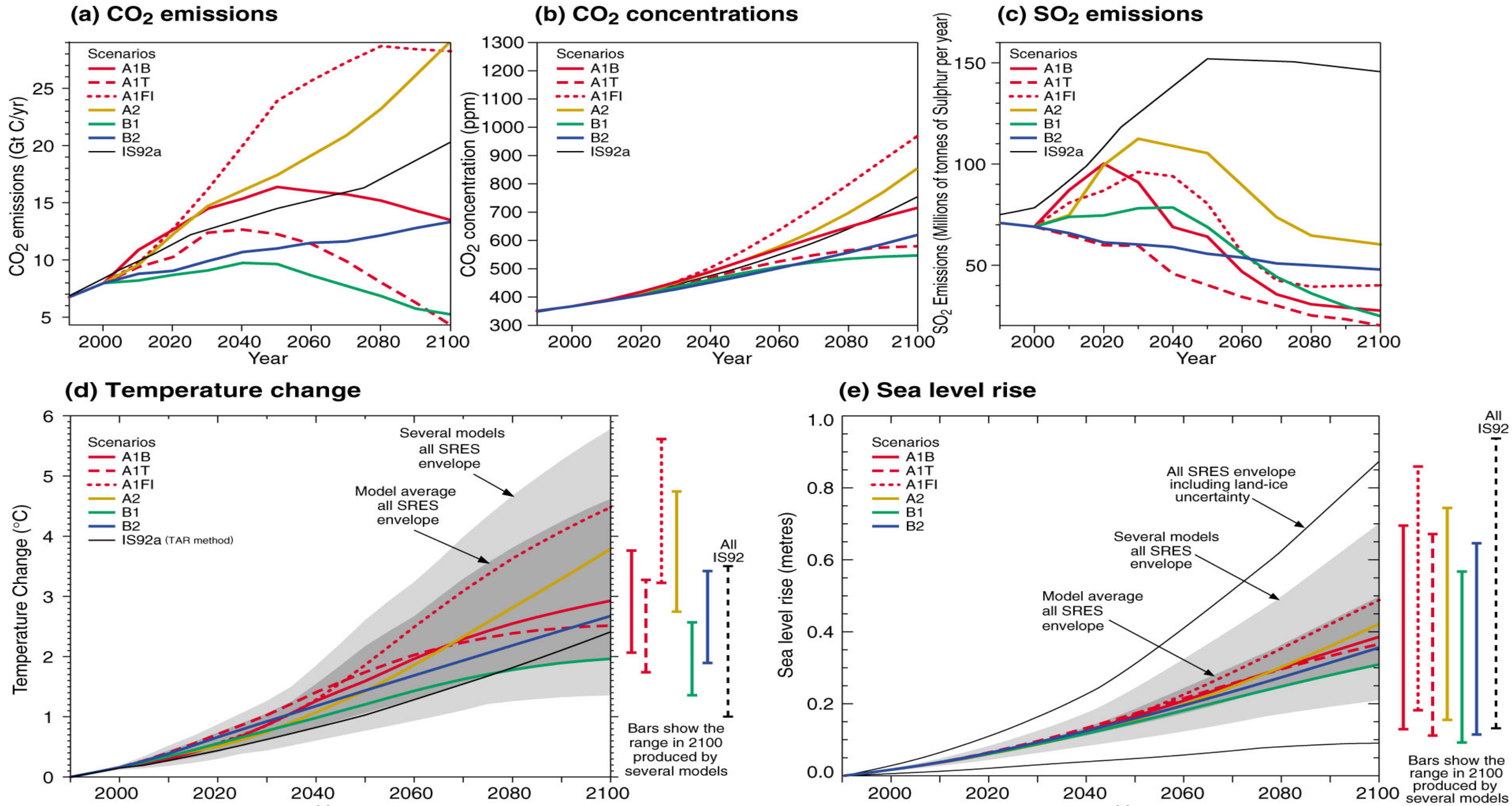
Glacier Mass Balance



Predicting Future Climate Change

The Global Climate of the 21st Century

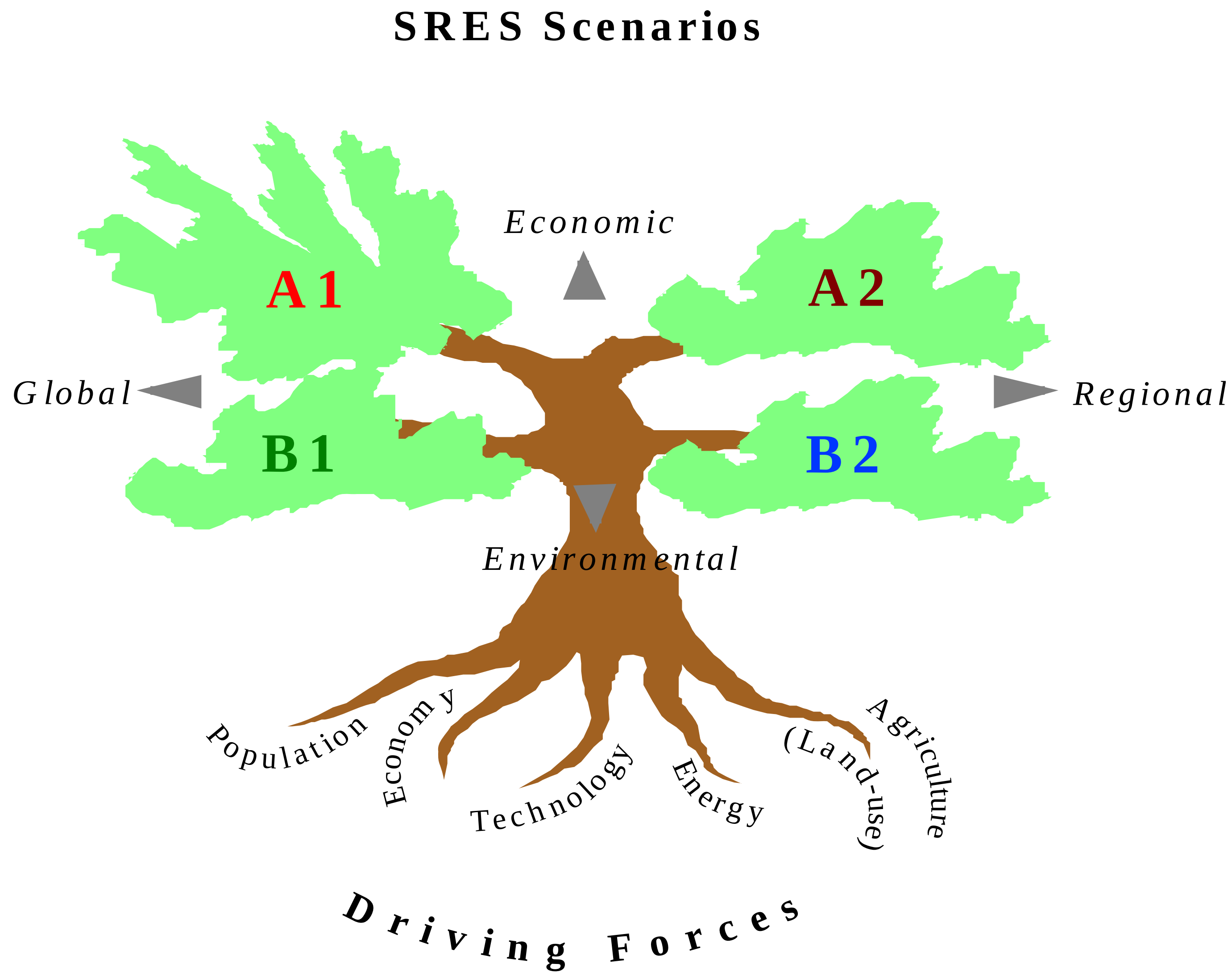
GHG conc. 2-3 times pre-ind. level (280 ppmv) by 2100



Temp. rise ~3C (1.8 to 4) by 2100

Sea level rise ~0.4m (0.2 to 0.6) by 2100

IPCC-SRES scenarios of world development



Future Global Scenario Assumptions

	1990	2100
• Population (billion)	5.3	7.0 - 15.1
• World GDP (10^{12} 1990US$/yr)	21	235 - 550
• Per capita income ratio: developed countries to developing countries	16.1	1.5 - 4.2
• Final energy intensity (10^6J/US$)[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

Green Highlights – ideas for statisticians to pursue further

Data Needs for Better Scenarios

- Internal consistency of variables
- Probability of a given scenario

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

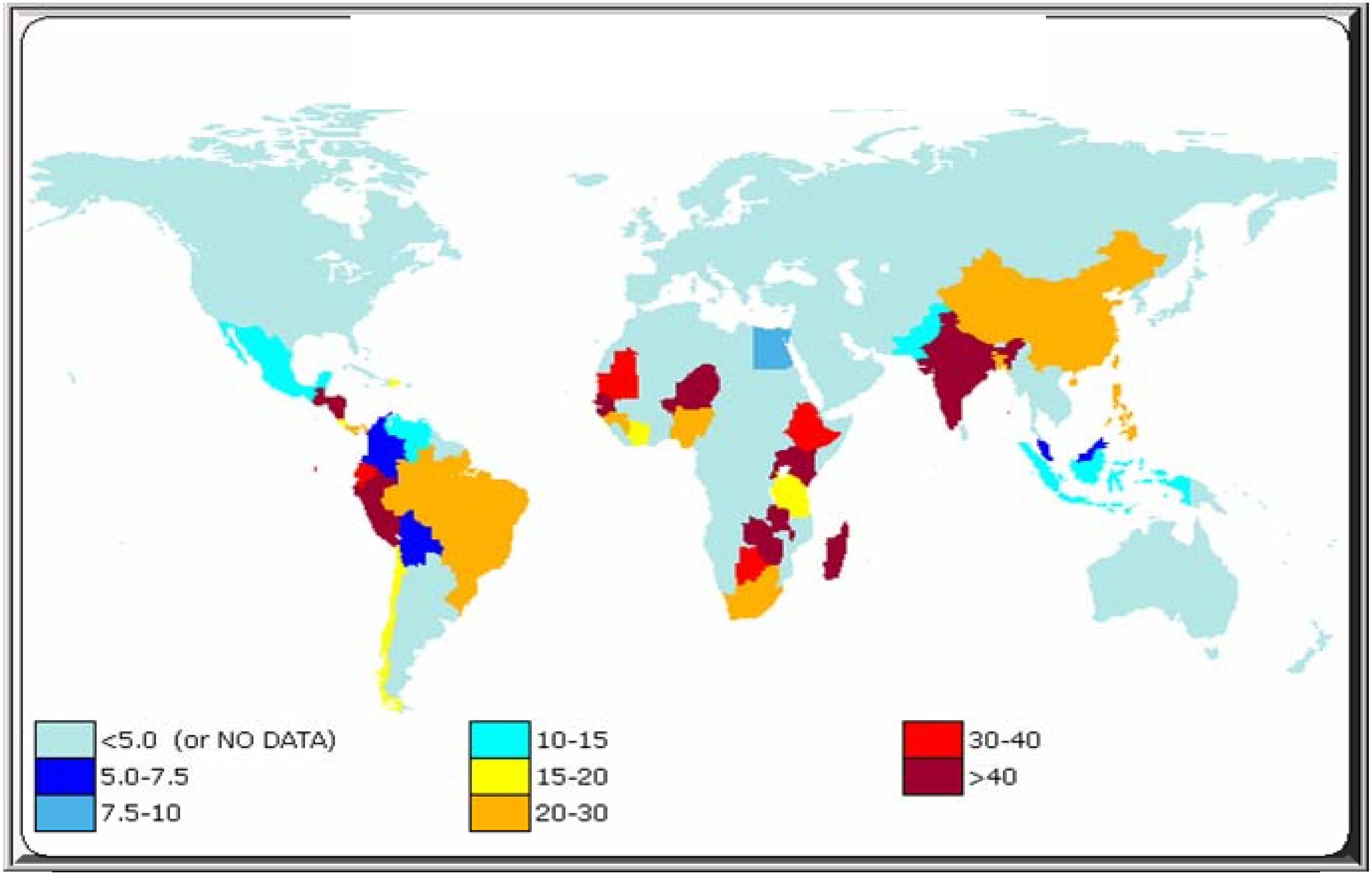
Millennium Development Goals (MDG)

United Nations Millennium Declaration, 2000

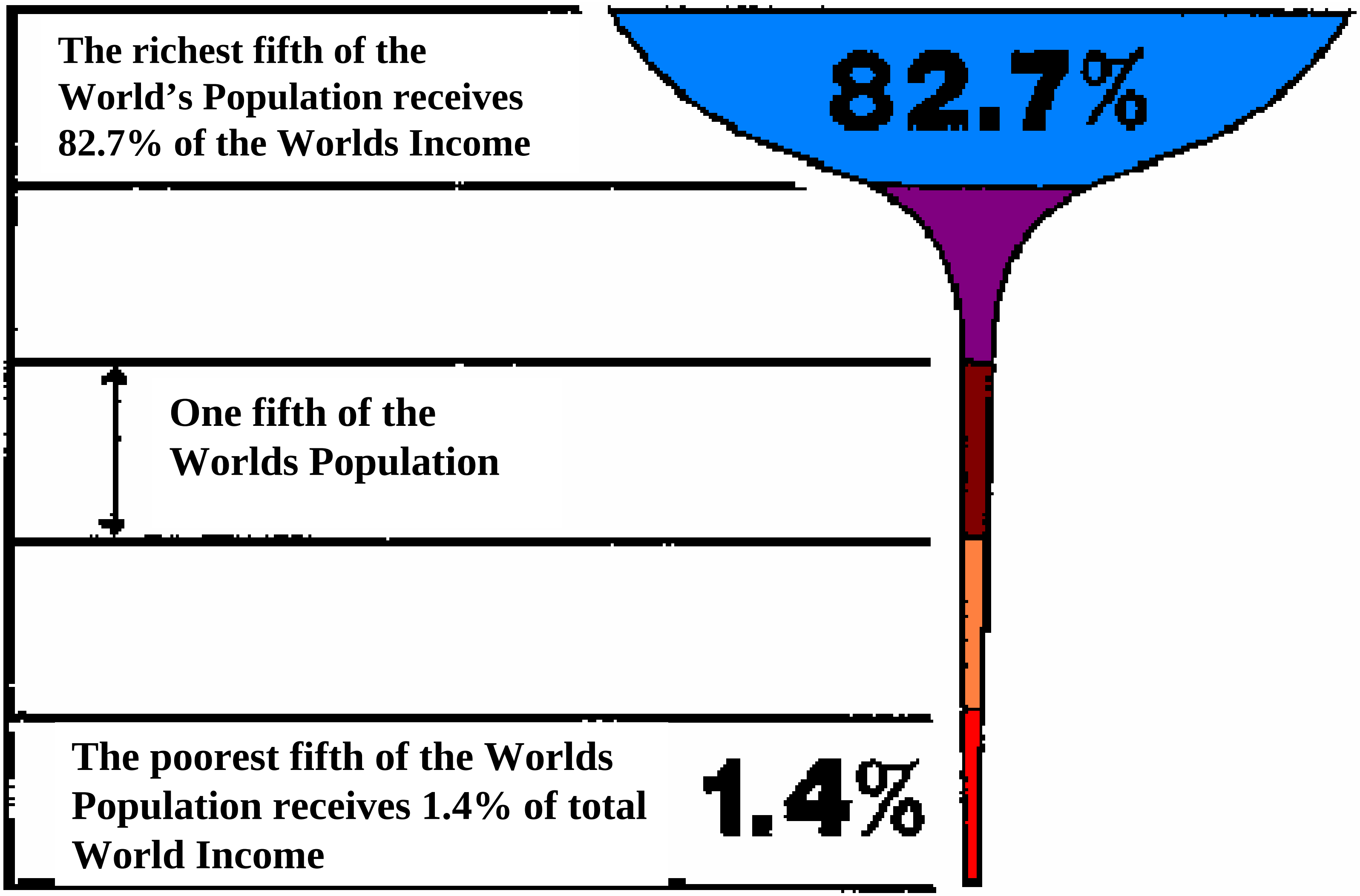
- Eradicate extreme poverty and hunger
- Achieve universal primary education
- Promote gender equality and empowerment
- Reduce child mortality
- Improve maternal health
- Combat HIV/AIDS, malaria and other diseases
- Ensure environmental sustainability
- Develop a global partnership for development

Commendable targets, but will they be met?

Poor living on < $1 per day



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 speaks specifically of **"common but differentiated responsibilities"**

Policy Priorities will drive data needs

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

Relative Priorities:

- **Non-Annex I : Vulnerability/Impacts/Adaptation**
- **Annex I : Mitigation/Emissions**

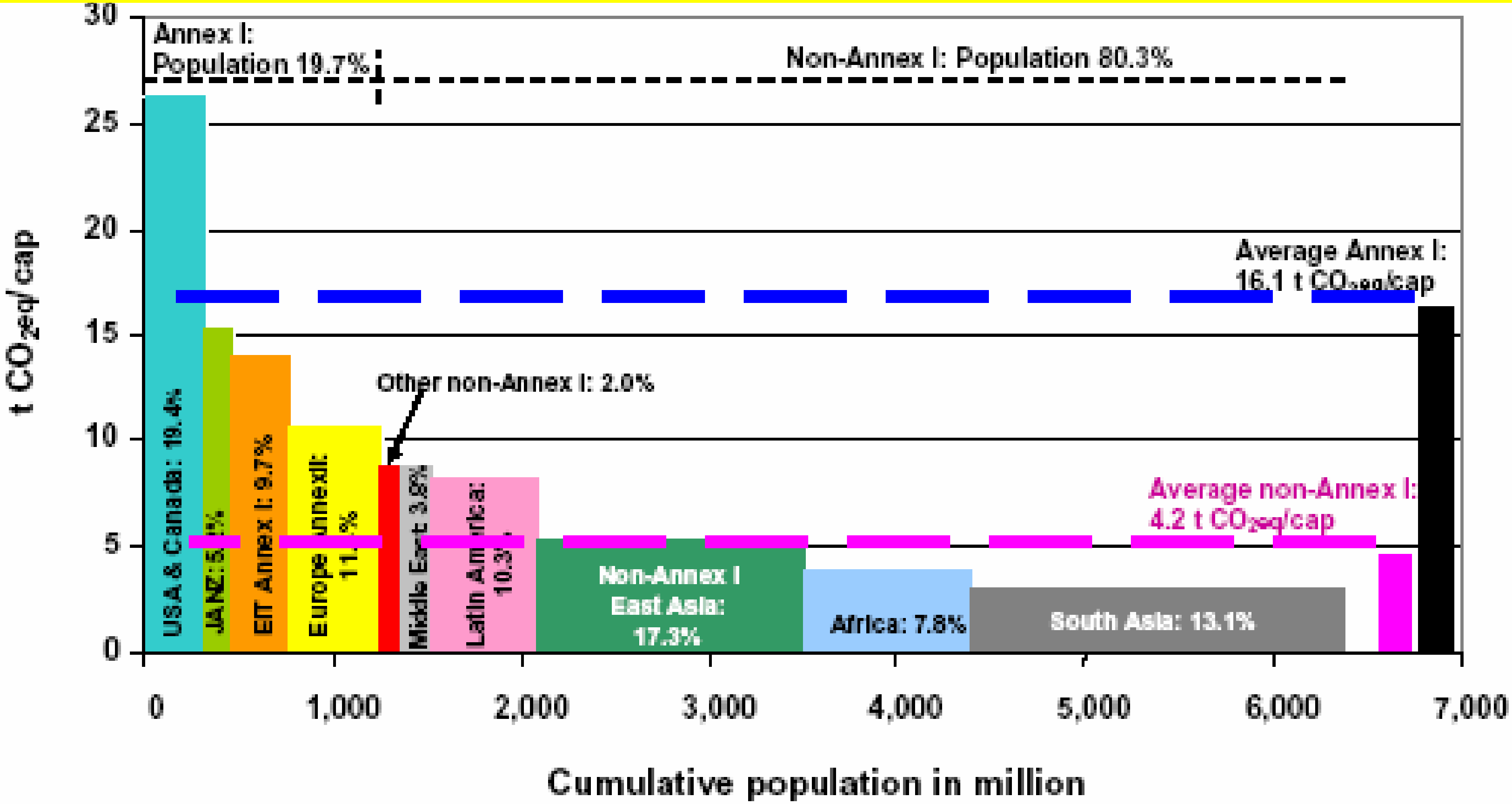
Adaptation Burden & Equity: CC ⟶ SD

Vulnerability/Impacts/Adaptation is first priority of developing countries that are most threatened by 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 main responsibility of industrial 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

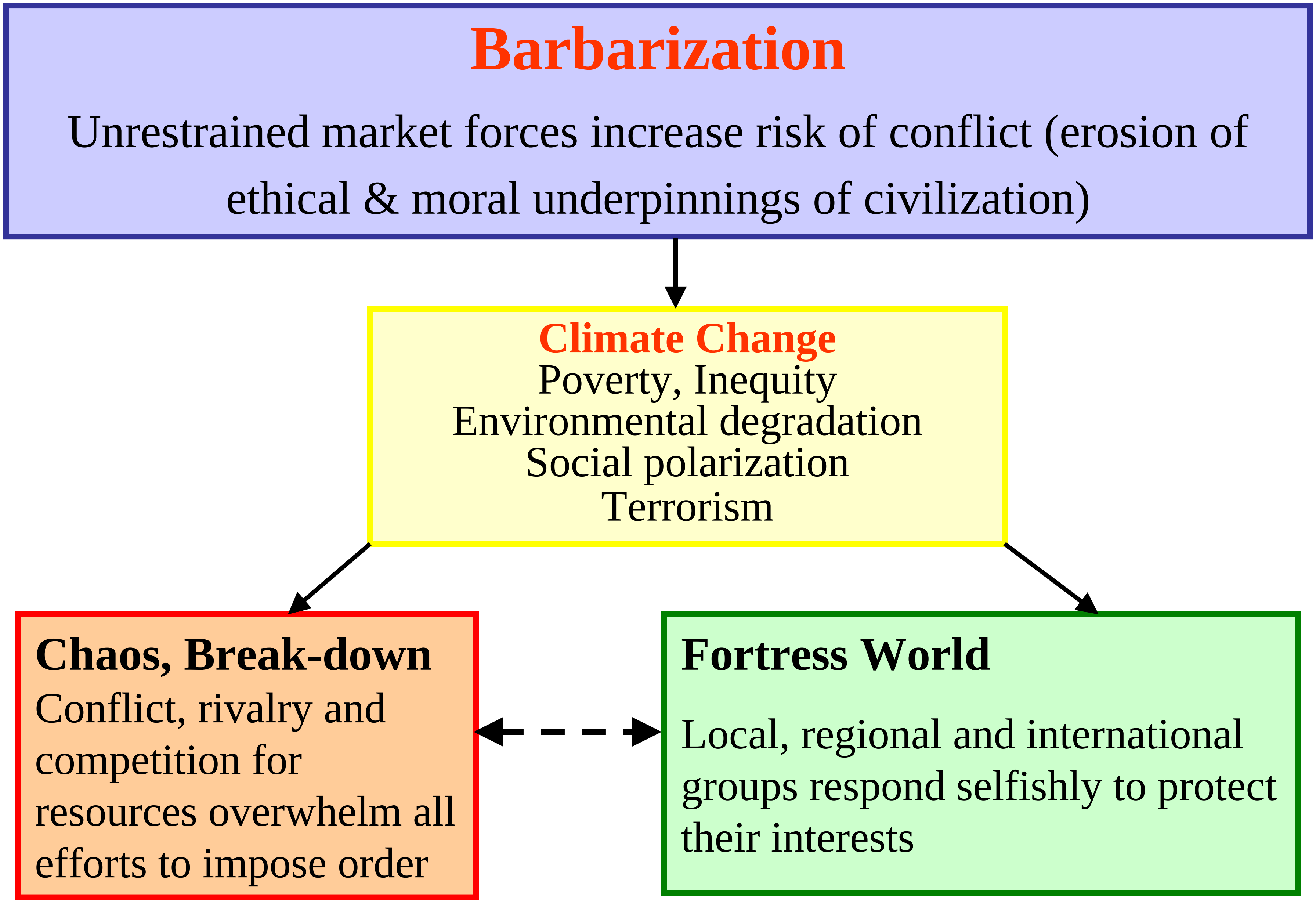
- Saraswati River (India)

  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


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

Influences Underlying Modern Development

- **Economic forces like world trade and comparative advantage in production**
- **Environmental and geographic factors including natural resource availability**
- **Social and institutional aspects including behavioural norms, values and governance**

In practice all the above three elements have shaped and will continue to shape development.

Climate change will affect and be affected by all three.

A Long Term Vision of Sustainable Development

Levels	Indicators	Time	Human Interventions
Main Issues	Poverty, Inequity, Exclusion, Conflict, Environmental Harm (including Climate Change)	Now ←	High risk of unrestrained market forces at work ("Washington consensus", globalisation etc.) – Reactive BAU: mainly 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

MIND

Munasinghe Institute for Development

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

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)

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.

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%.

CO_2 (77% of GHG), has grown by about 80%.

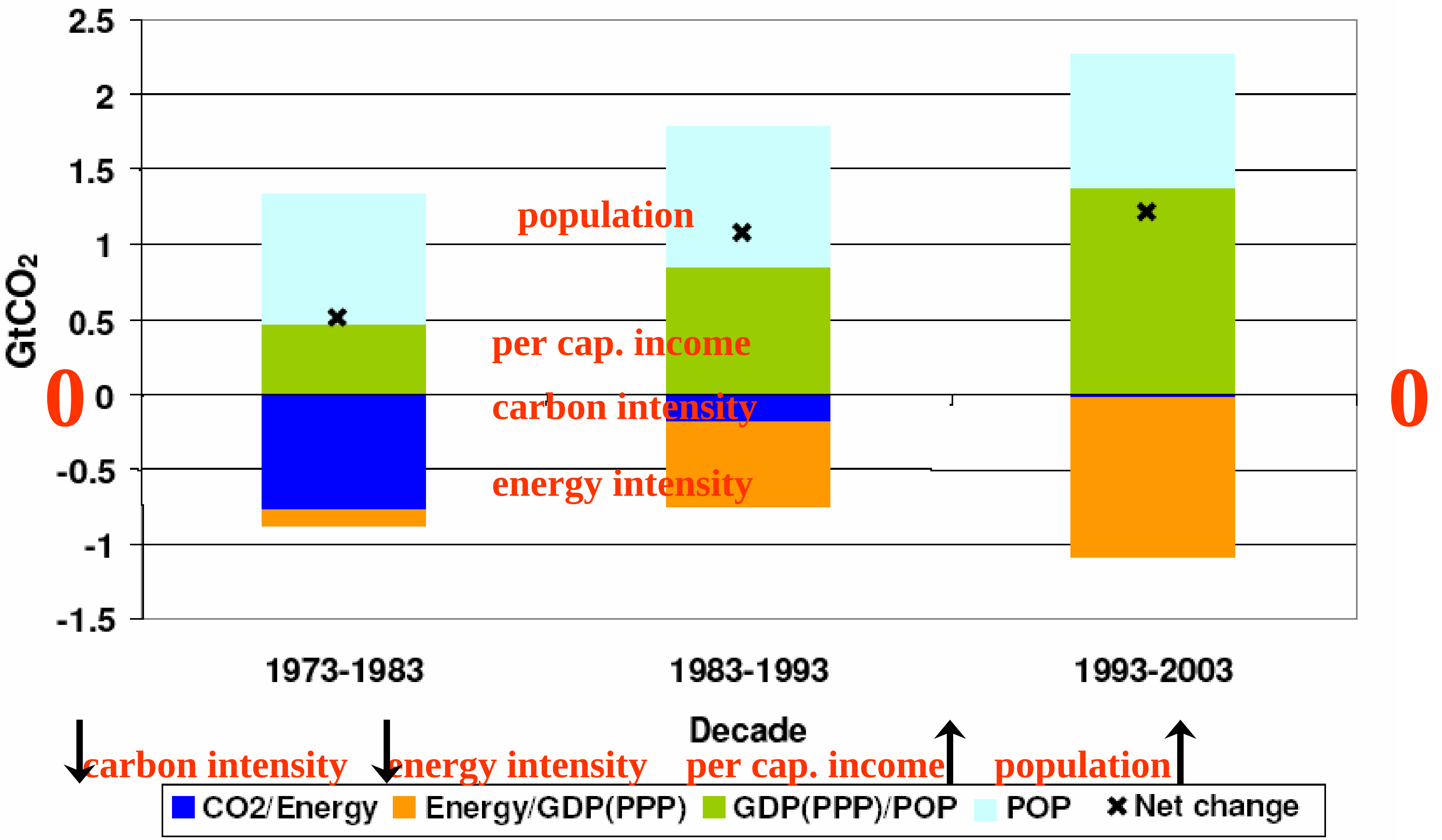
Even after Kyoto 1997, emissions have continued to increase

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 Breakdown – Drivers (1973-2003)

CO_2 = [CO_2/Energy] x [Energy/GDP] x [GDP/Pop] x Pop.



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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 reduction 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_2 equivalent mitigated

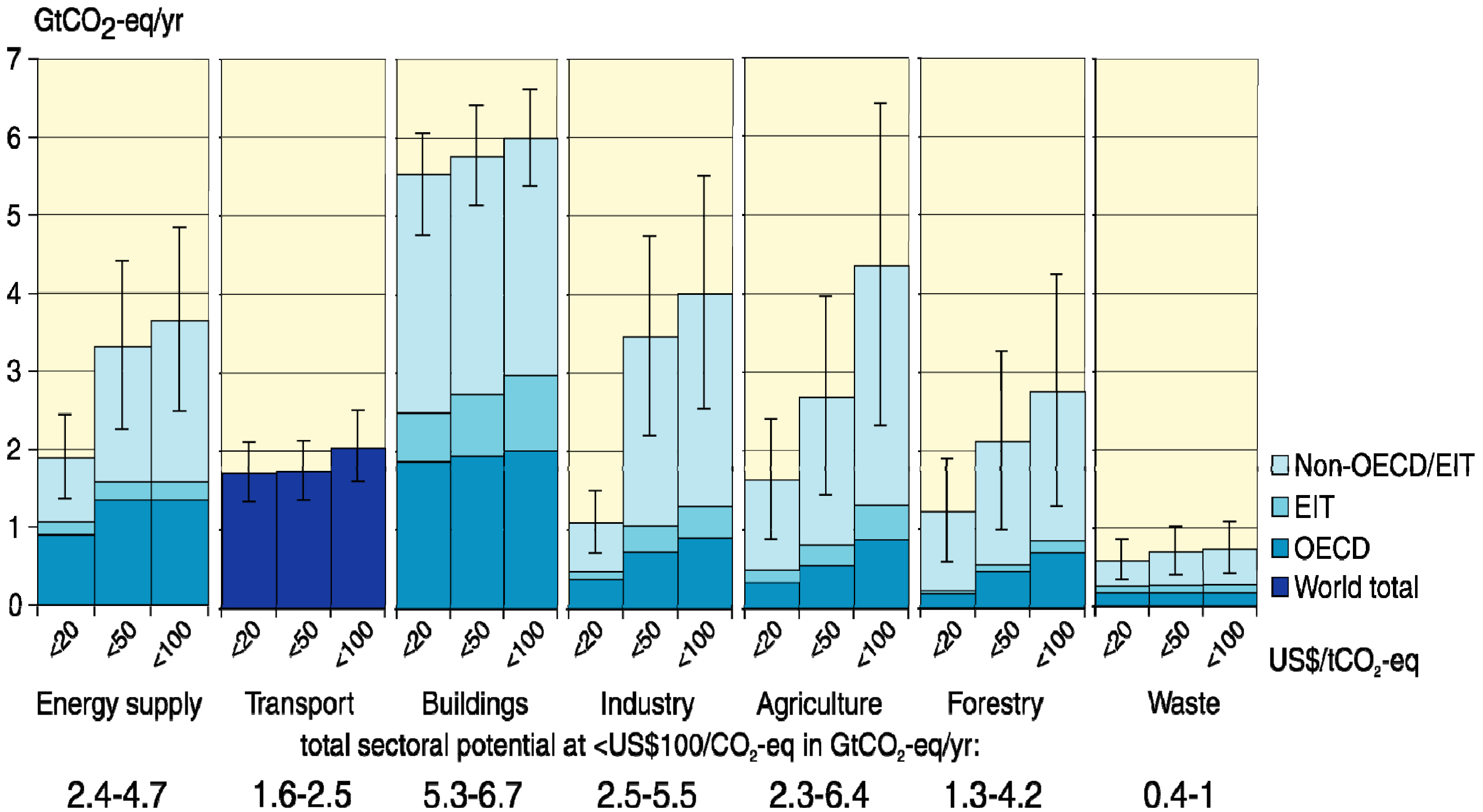
To achieve a 2100 target of 550 ppmv, the costs in 2030 will be US$ 20-80 per tonne mitigated. These costs could fall further to US$ 5-65 with induced technological advanced.

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

Mitigation Potential: all sectors and regions can contribute

Better Data is Needed



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

How can emissions be reduced?

Sector	**(Selected) Key mitigation technologies and practices currently commercially available.**
Energy Supply	efficiency; fuel switching; nuclear power; renewable (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; early applications of CO2 Capture and Storage
Transport	More fuel efficient vehicles; hybrid vehicles; biofuels; modal shifts from road transport to rail and public transport systems; cycling, walking; land-use planning
Buildings	Efficient lighting; efficient appliances and airco; improved insulation ; solar heating and cooling; alternatives for fluorinated gases in insulation and aplliances

How can emissions be reduced?

Sector	(Selected) Key mitigation technologies and practices currently commercially available.
Industry	More efficient electrical equipment; heat and power recovery; material recycling; control of non-CO_2 gas emissions
Agriculture	Land management to increase soil carbon storage; restoration of degraded lands; improved rice cultivation techniques; improved nitrogen fertilizer application; dedicated energy crops
Forests	Afforestation; reforestation; forest management; reduced deforestation; use of forestry products for bioenergy
Waste	Landfill methane recovery; waste incineration with energy recovery; composting; recycling and waste minimization

Selected sectoral policies, measures and instruments that have shown to be environmentally effective

Sector	Policies , measures and instruments shown to be environmentally effective	Key constraints or opportunities
Energy supply	Reduction of fossil fuel subsidies	Resistance by vested interests may make them difficult to implement
	Taxes or carbon charges on fossil fuels	
	Feed-in tariffs for renewable energy technologies	May be appropriate to create markets for low emissions technologies
	Renewable energy obligations	
	Producer subsidies	

[1] Public RD&D investment in low emission technologies have proven to be effective in all sectors.

Selected sectoral policies, measures and instruments that have shown to be environmentally effective

Sector	Policies[1], measures and instruments shown to be environmentally effective	Key constraints or opportunities
Transport	Mandatory fuel economy, biofuel blending and CO_2 standards for road transport	Partial coverage of vehicle fleet may limit effectiveness
	Taxes on vehicle purchase, registration, use and motor fuels, road and parking pricing	Effectiveness may drop with higher incomes
	Influence mobility needs through land use regulations, and infrastructure planning	Particularly appropriate for countries that are building up their transportation systems
	Investment in attractive public transport facilities and non-motorised forms of transport	

[1] Public RD&D investment in low emission technologies have proven to be effective in all sectors.

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

Status/Availability of Data on GHG Emissions (evidence from IPCC work on GHG inventories)

Country Group	Energy Emissions	Land Use Emissions
Non-Annex I	OK	Worst
Annex I	Best	Poor

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

Mitigation Data for Policy

Dissaggregate emissions data needed for:

- **Allocation of emissions rights and mitigation burdens (between and within countries)**
- **Identifying, implementing and enforcing most the effective and sustainable mitigation options**
- **Building mitigative capacity**

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

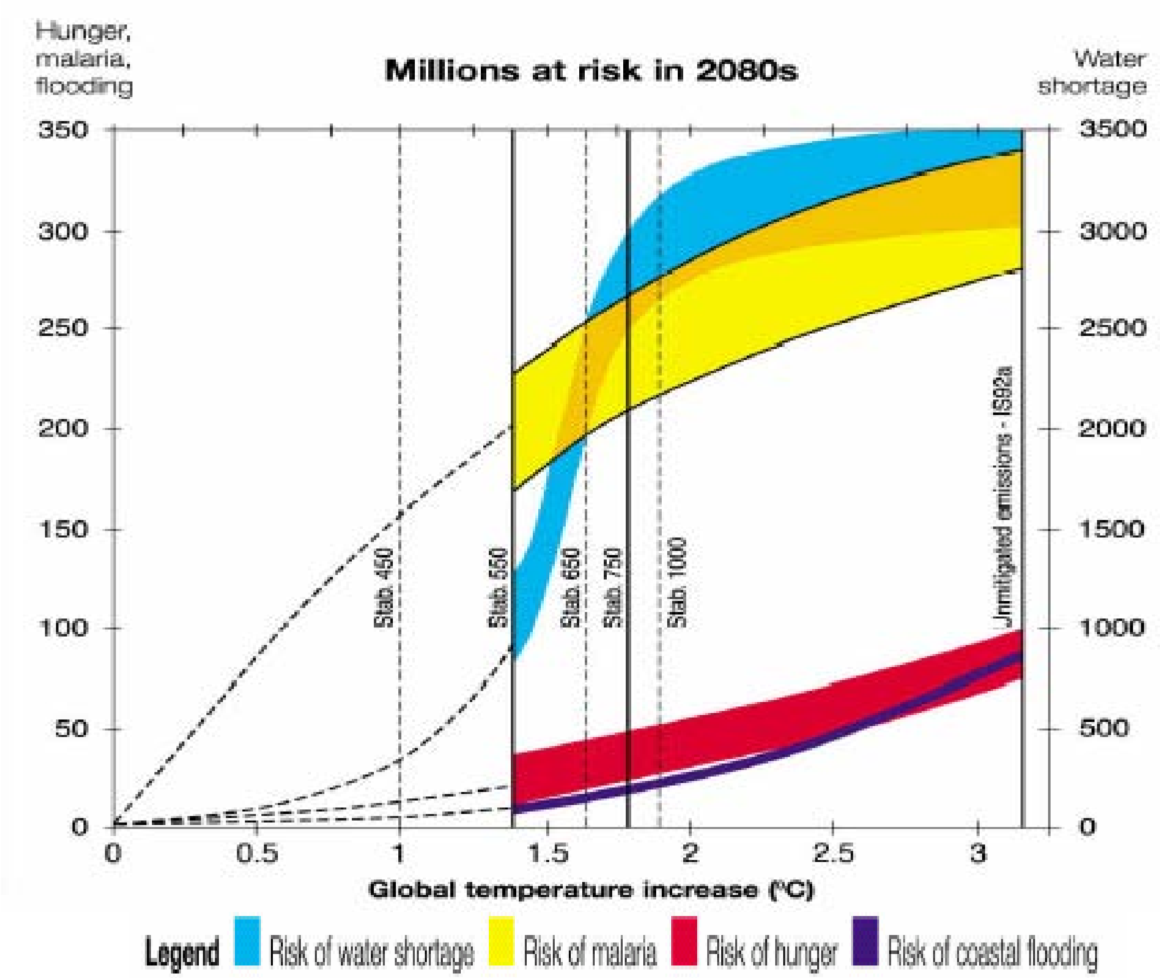
Main impacts on Systems & Sectors: 1

- **Water**
  - increase in number of very wet and very dry areas
  - Saltwater intrusion in coastal areas, salinisation of groundwater
  - Increasing water stress
- **Ecosystems**
  - Some biodiversity loss
  - Forest expansion in northern areas
  - Increased wild fires
  - Loss of corals due to bleaching
  - Oceanic biotic move polewards
- **Food, Fibre and Forest Products**
  - Small beneficial impacts on crops in temperate regions
  - Poleward spread of diseases and pests
  - Warming will decrease livestock productivity
  - Increase in global forest product output
  - Changes in distribution and productivity of fish species

Main impacts on Systems & Sectors: 2

- **Coastal Systems and Low-Lying Areas**
  - Greatest vulnerability expected along coastal strips of S. and S.E. Asia & urbanized coastal areas of Africa
  - Sea level rise impacts and costs are greater in developing countries
- **Industry, Settlements, and Society**
  - Vulnerability higher in those areas which rely on climate sensitive resources
  - Increase in cost of insurance cover
- **Health**
  - Increased mortality mainly from increased vector-borne and diarrheal diseases
  - Increases heat related health problems

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

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**

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.

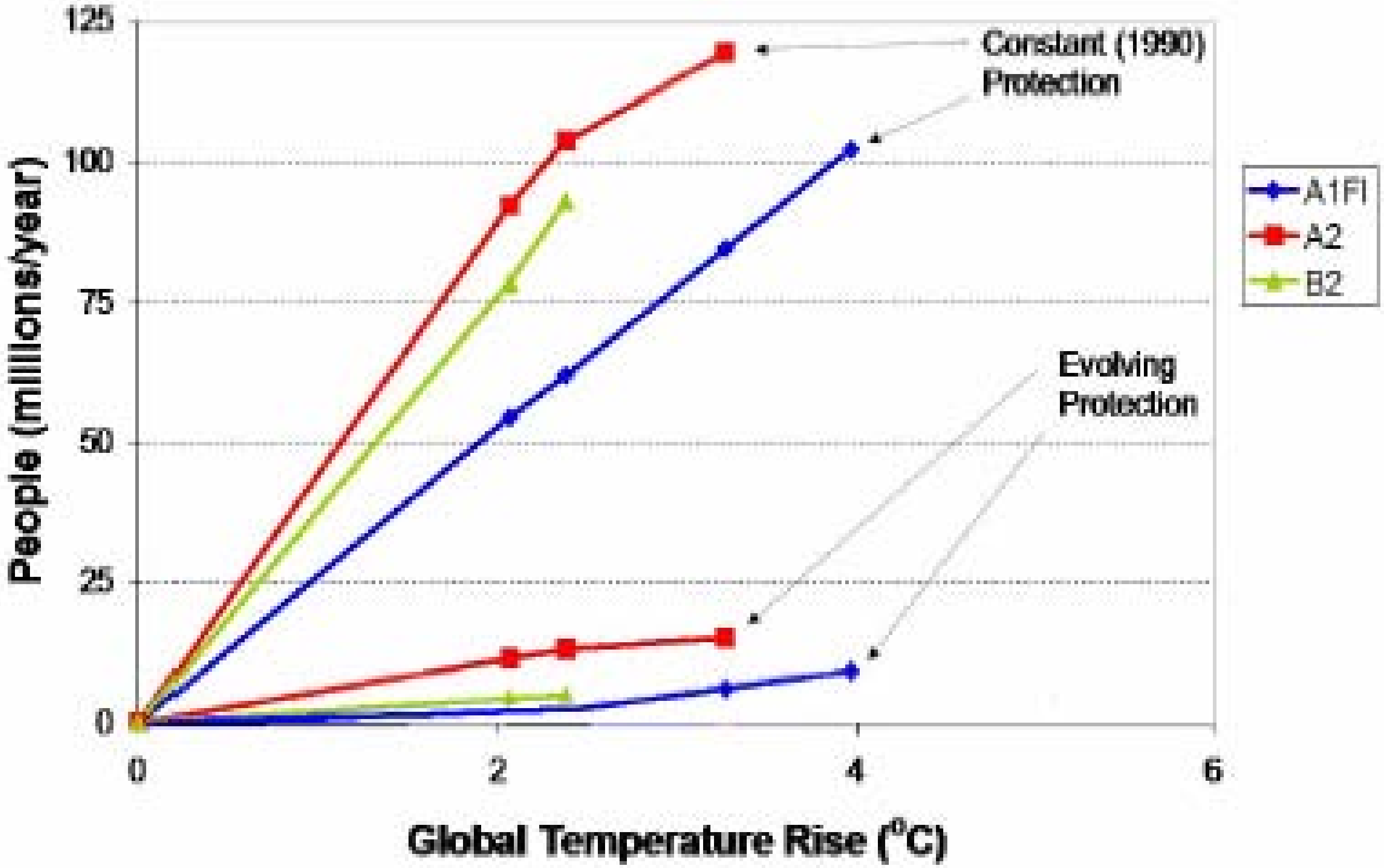
Mean value = US$ 12 per tonne CO_2 (US$ 43 per tonne C) - (present discounted net costs)

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

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



Social Capital plays key role in reducing vulnerability and impacts – Civil Society is Main Source

Contrasting examples of Civil Society Response:

2004 Tsunami - Sri Lanka

2005 Hurricane Katrina - New Orleans, USA

Data on Vulnerability/Impacts/Adaptation: Policy Priorities

Country Group	Socio-economic (human) impact	Environmental impact
Non-Annex I	Highest	Moderate
Annex I	High	High

More Specific Data Requirements

Different data and analysis needed for various purposes

- **Vulnerability assessment – risk management**
- **Impacts and costs**
- **Adaptation capacity and options**

International data needs

Global impact estimates and costs are more useful for setting global mitigation targets.

Attribution – CC vs. non-CC: Polluter Pays principle

National and sub-national data needs

Local impact assessments and adaptation options are more helpful to protect local communities and environment.

Incidence/Distribution – Who receives compensation and how much? : Victim Recompensed principle

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)

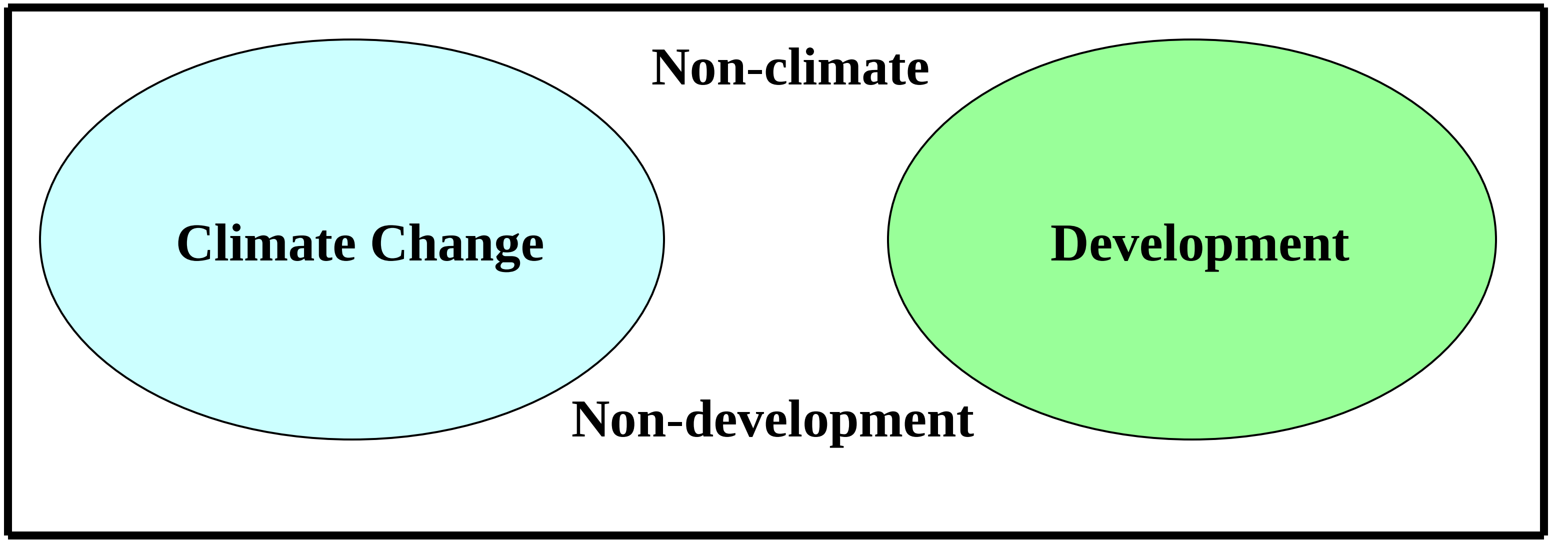
WHY ? is climate a threat to future human development

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

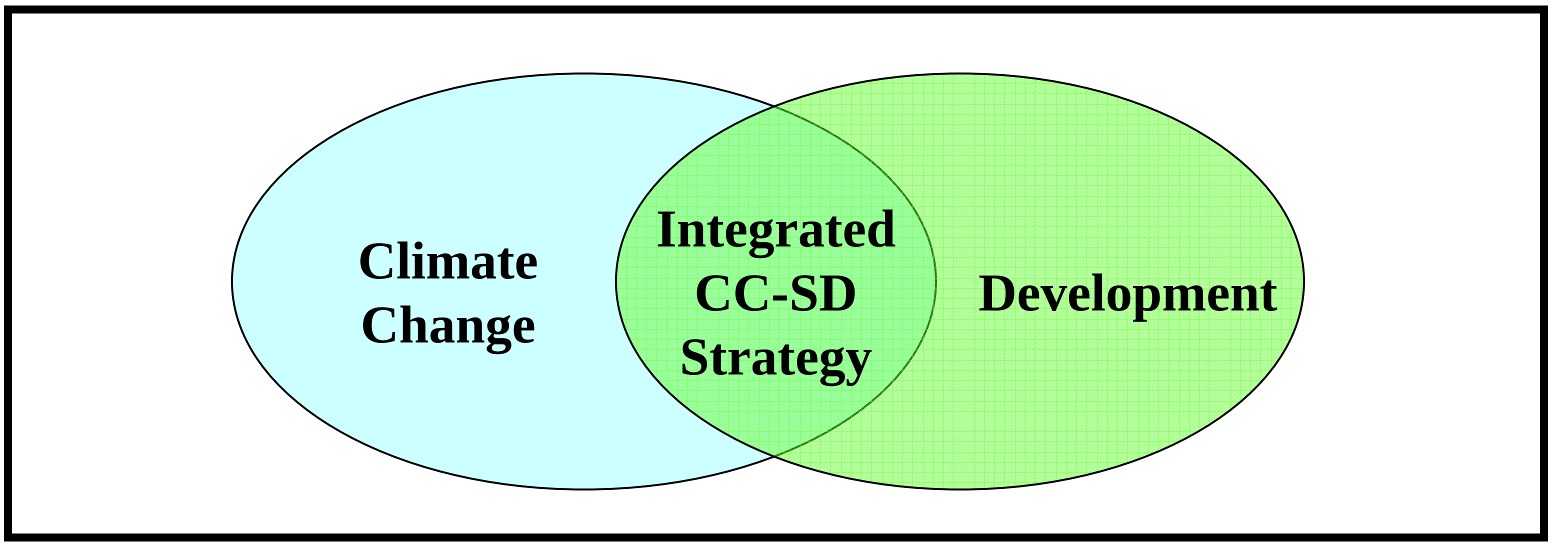
HOW ? can we better understand CC-SD links and identify specific issues

Analyze how CC affects SD and vice versa using the Sustainomics framework

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

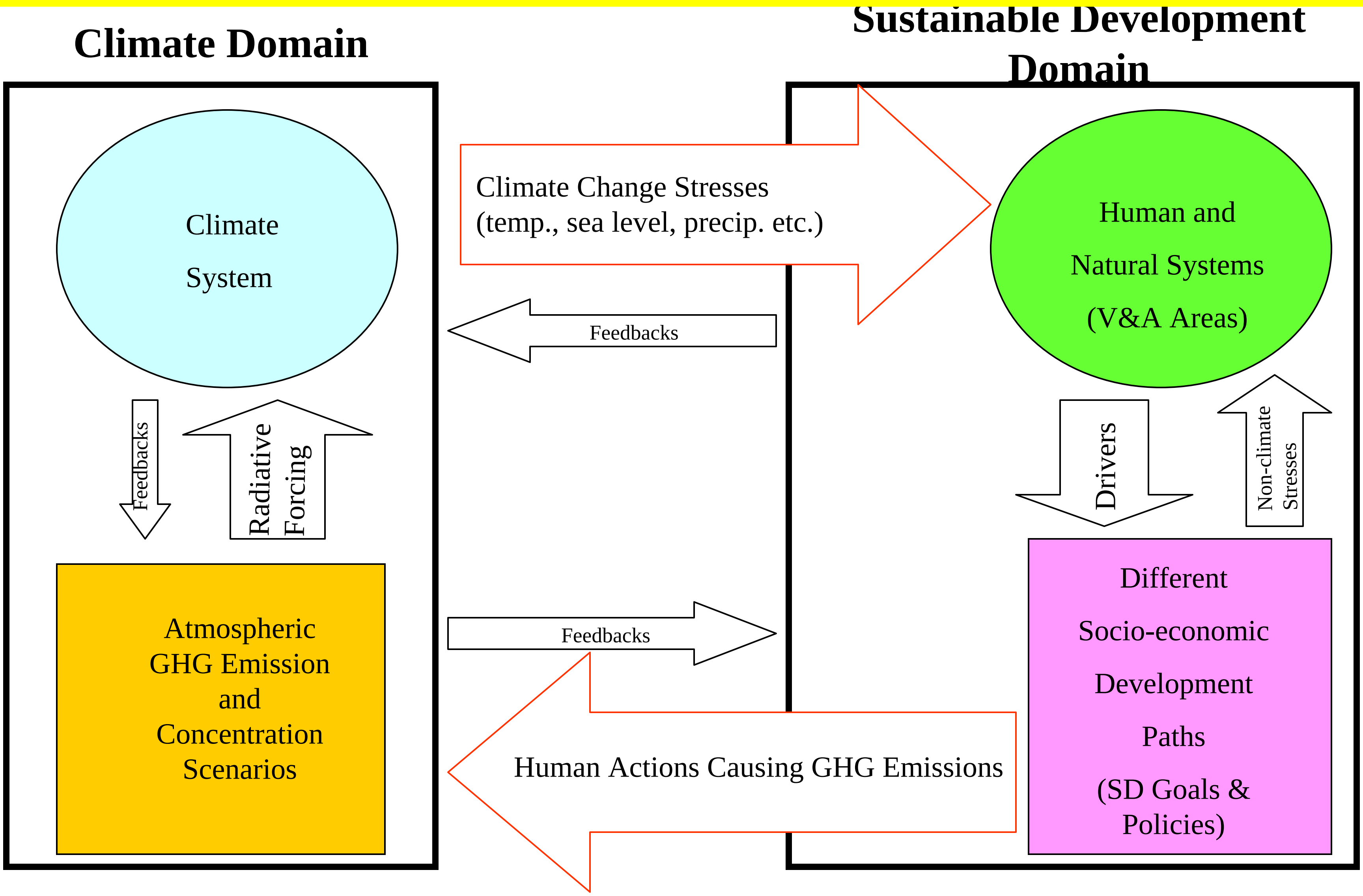


Former Viewpoint – AR1 (1990)

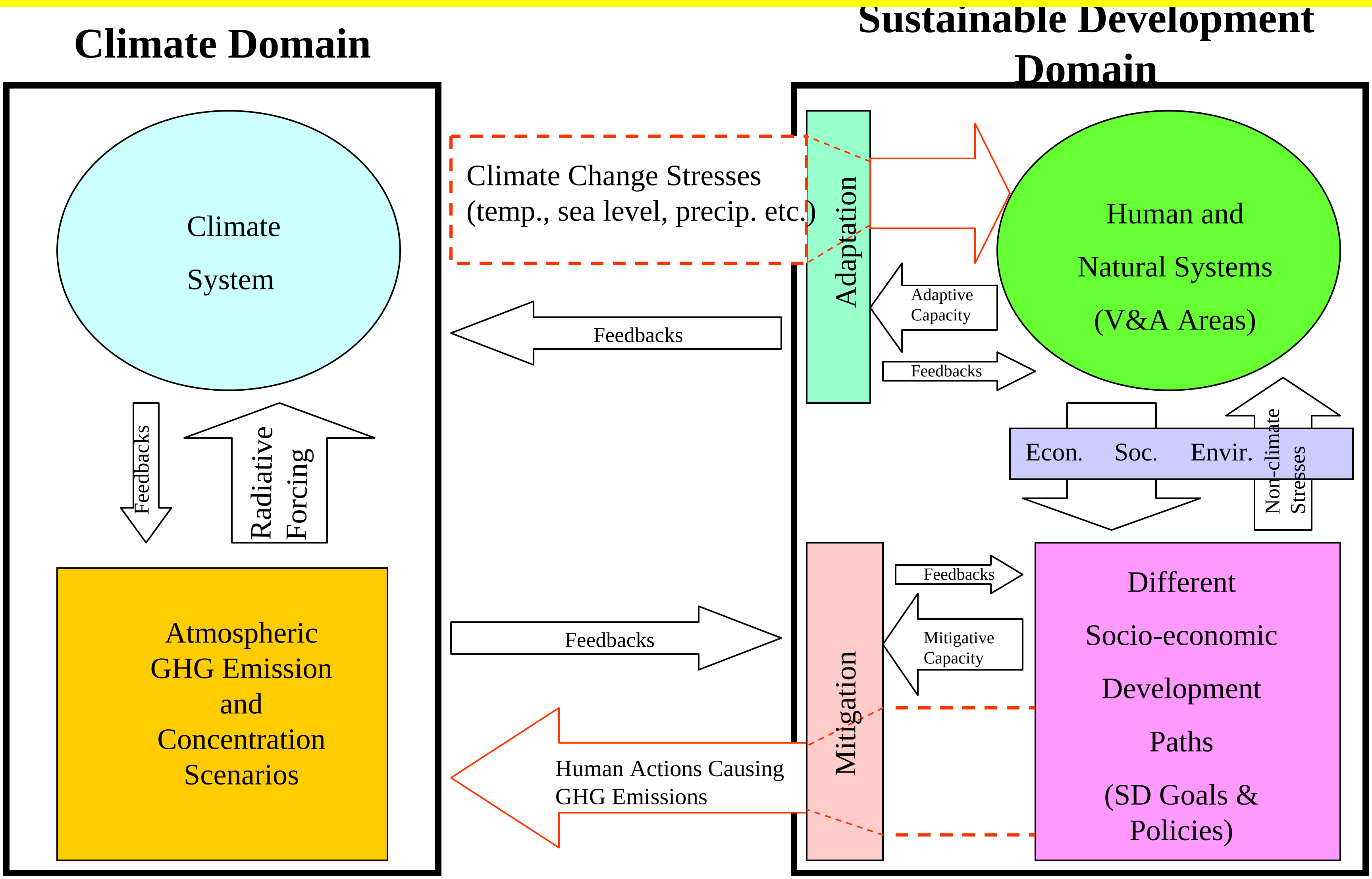


Desirable Viewpoint (policy relevant) – AR4 (2007)

Global Level CC-SD Links 1



Global Level CC-SD Links 2



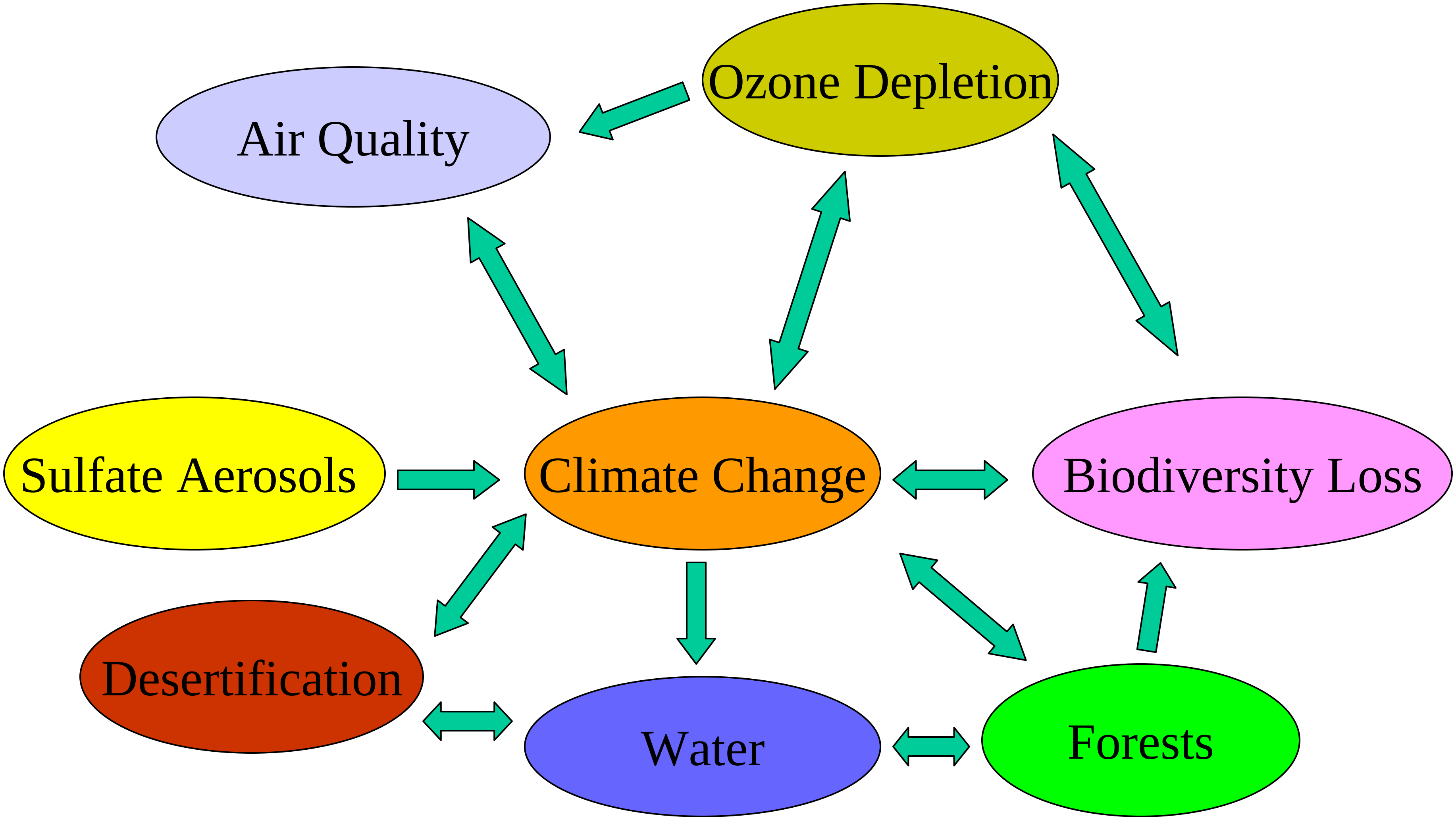
Data must help to better identify and analyze:

TWO-WAY LINKAGES BETWEEN CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

CC → SD

CC ← SD

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)

Practical Target:

Making Development More Sustainable (MDMS)

"An approach that will permit **sustained improvements in the quality of life** at a **lower intensity of resource use**, thereby preserving for future generations an undiminished or even **enhanced stock of productive assets** (manufactured, natural and social capital)"

Source: Munasinghe (1992), Rio Earth Summit

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

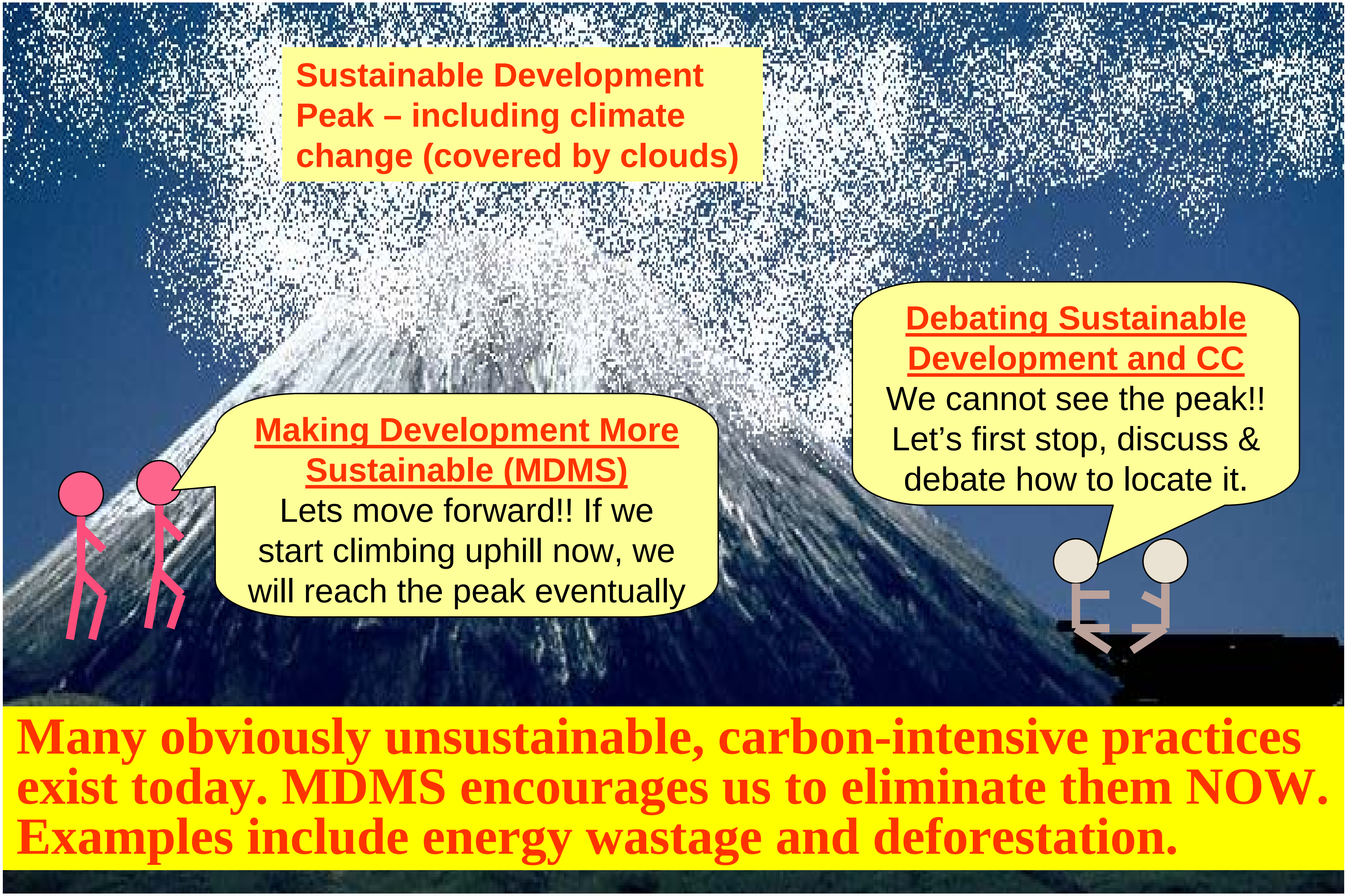
The precise definition of sustainable development remains an elusive (perhaps unreachable) goal.

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

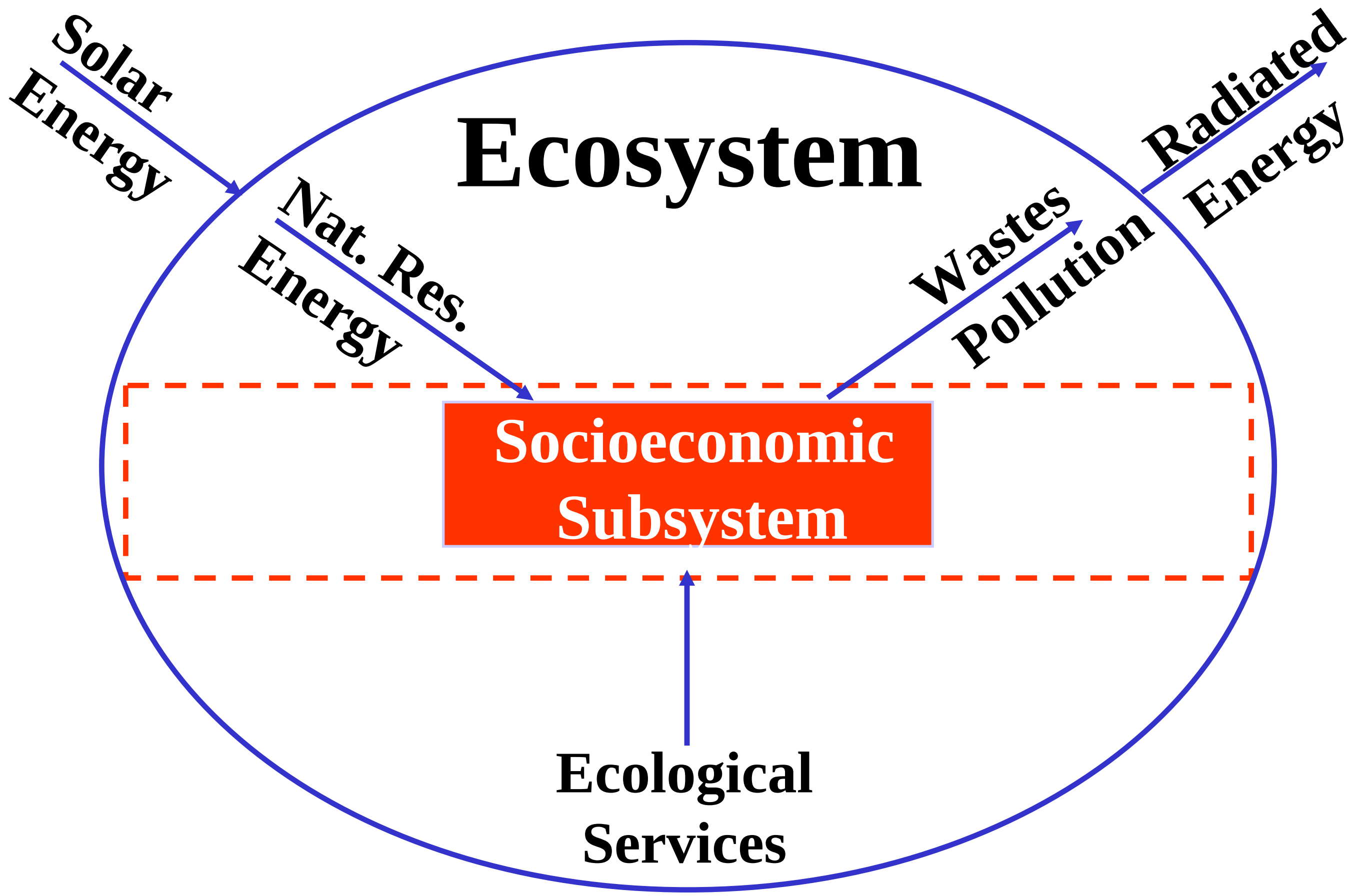
Such an incremental (or gradient-based) method is more practical, because many unsustainable activities are easier to recognize and eliminate.

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". Appropriate data is needed.

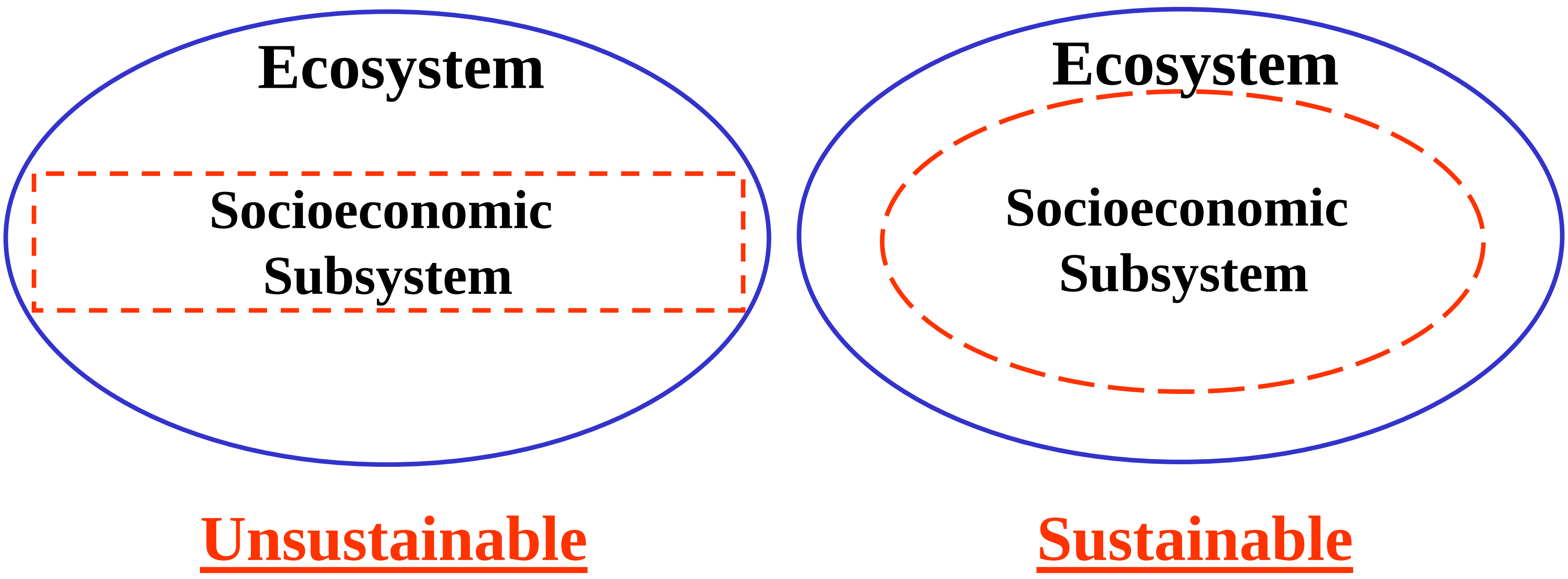

Sustainable Development Peak – including climate change (covered by clouds)
Making Development More Sustainable (MDMS)
Lets move forward!! If we start climbing uphill now, we will reach the peak eventually
Debating Sustainable Development and CC
We cannot see the peak!! Let’s first stop, discuss & debate how to locate it.
Many obviously unsustainable, carbon-intensive practices exist today. MDMS encourages us to eliminate them NOW. Examples include energy wastage and deforestation.

MDMS: Restructuring development and growth I



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

MDMS: Restructuring development and growth II (rounding the rectangle)



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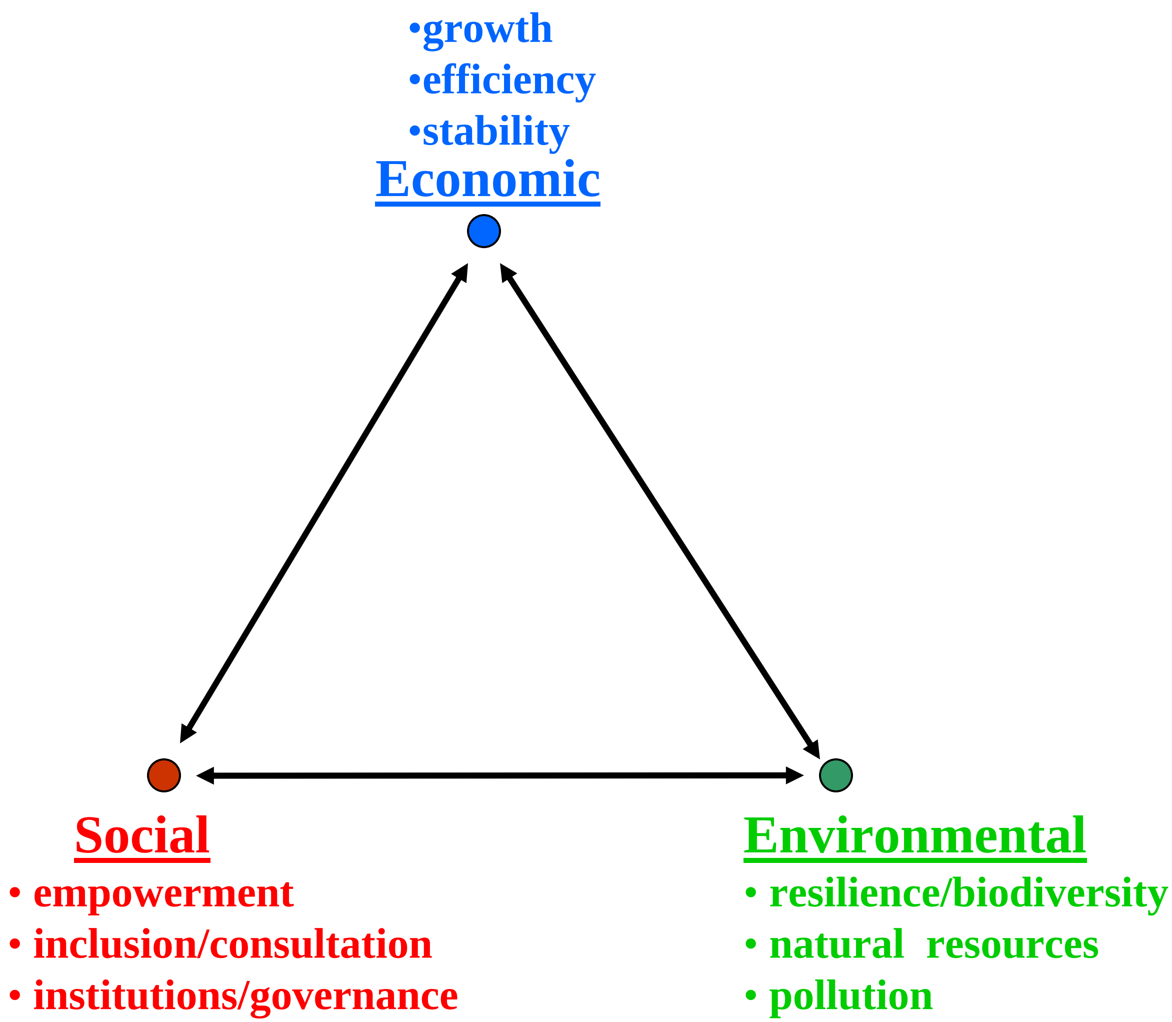
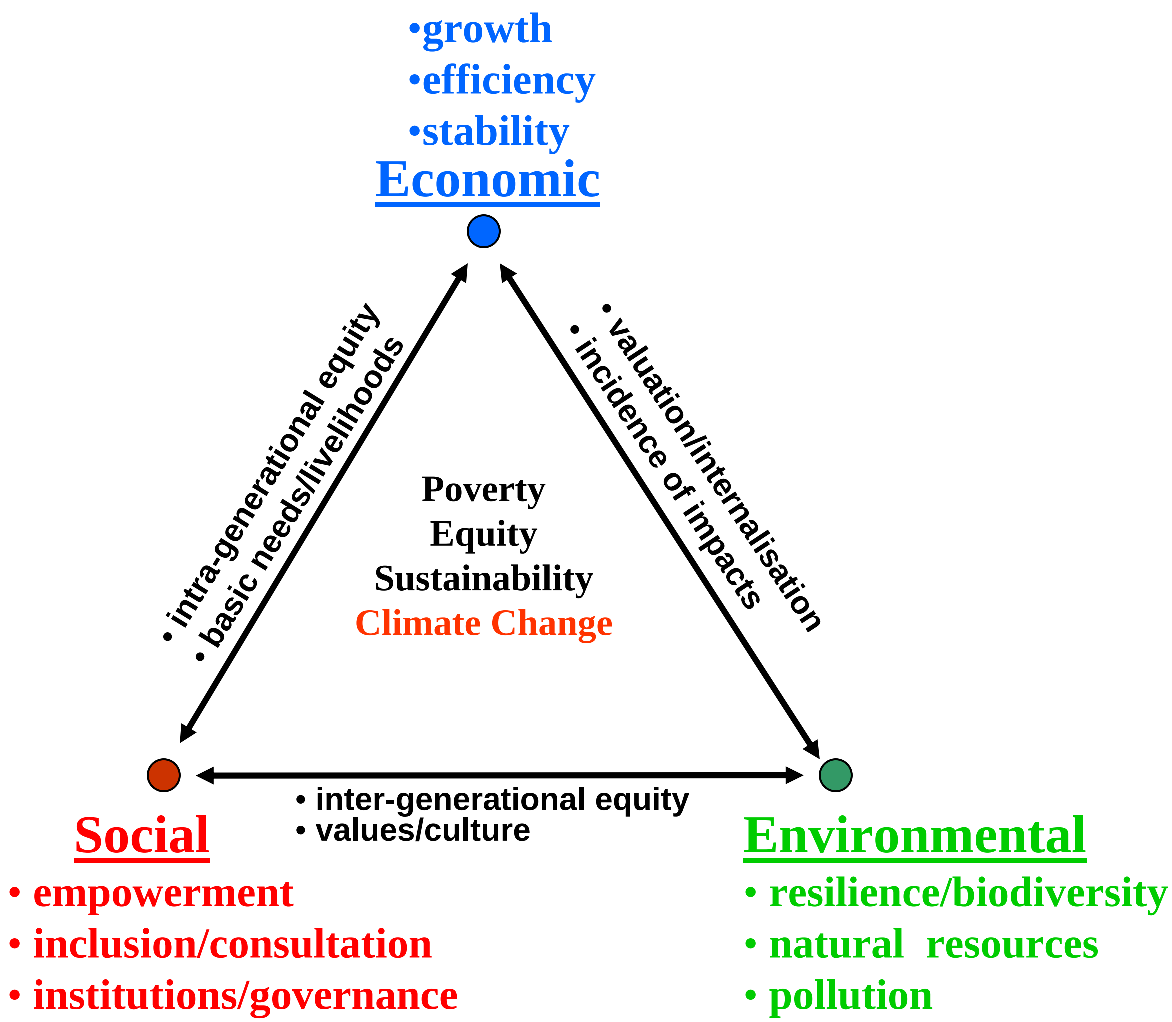


Sustainable Development Triangle - key elements and interconnections (corners, sides and centre)

Source: Munasinghe [1992], Rio Earth Summit



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Integrating CC Policies into SD Strategy using Sustainomics

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Data can help Transcend Boundaries to Make Development More Sustainable

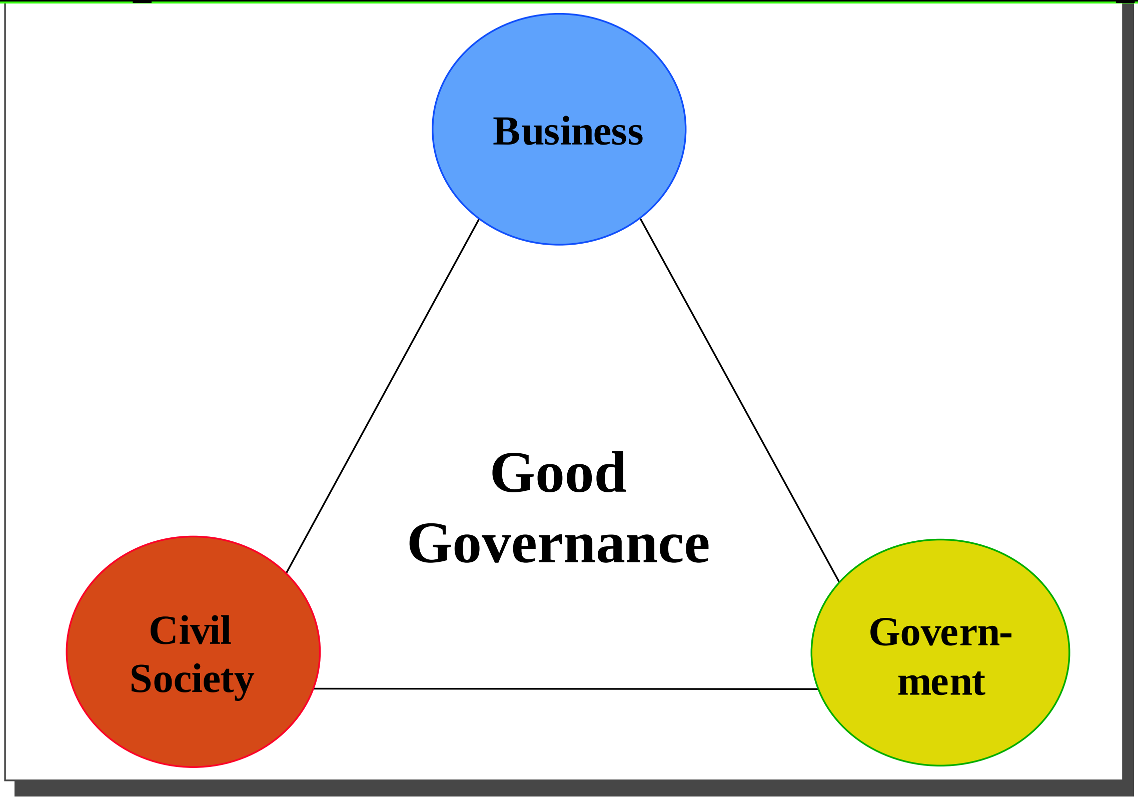
- Disciplinary
- Space
- Time
- Stakeholder
- Operational

Transcending disciplines to address SD issues

SD Issues	**Disciplines**
• social justice, equity, values and culture	Philosophy Sociology Anthropology Law
• institutions and governance	Politics
• markets and prices	Economics Finance
• technologies and management	Management
• biological and physical resource base	Engineering Ecology Natural Sciences

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

Data can help Transcend 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

Data to help Transcend Operational Boundaries

ACTION	ACTOR
Observations and Data	Observers
Concepts and Ideas	Thinkers & Philosophers
Models & Analyses	Scientists & Analysts
Interpretation of Results	Translators & Communicators
Plans & Policies	Decision Makers
Practical Implementation	Implementing Agents

Each stage of activity has a tendency to become compartmentalised

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

Integrating CC Policies into SD Strategy using Sustainomics

Core concepts and elements

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

Integrative analytical tools and practical applications (Data can link 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

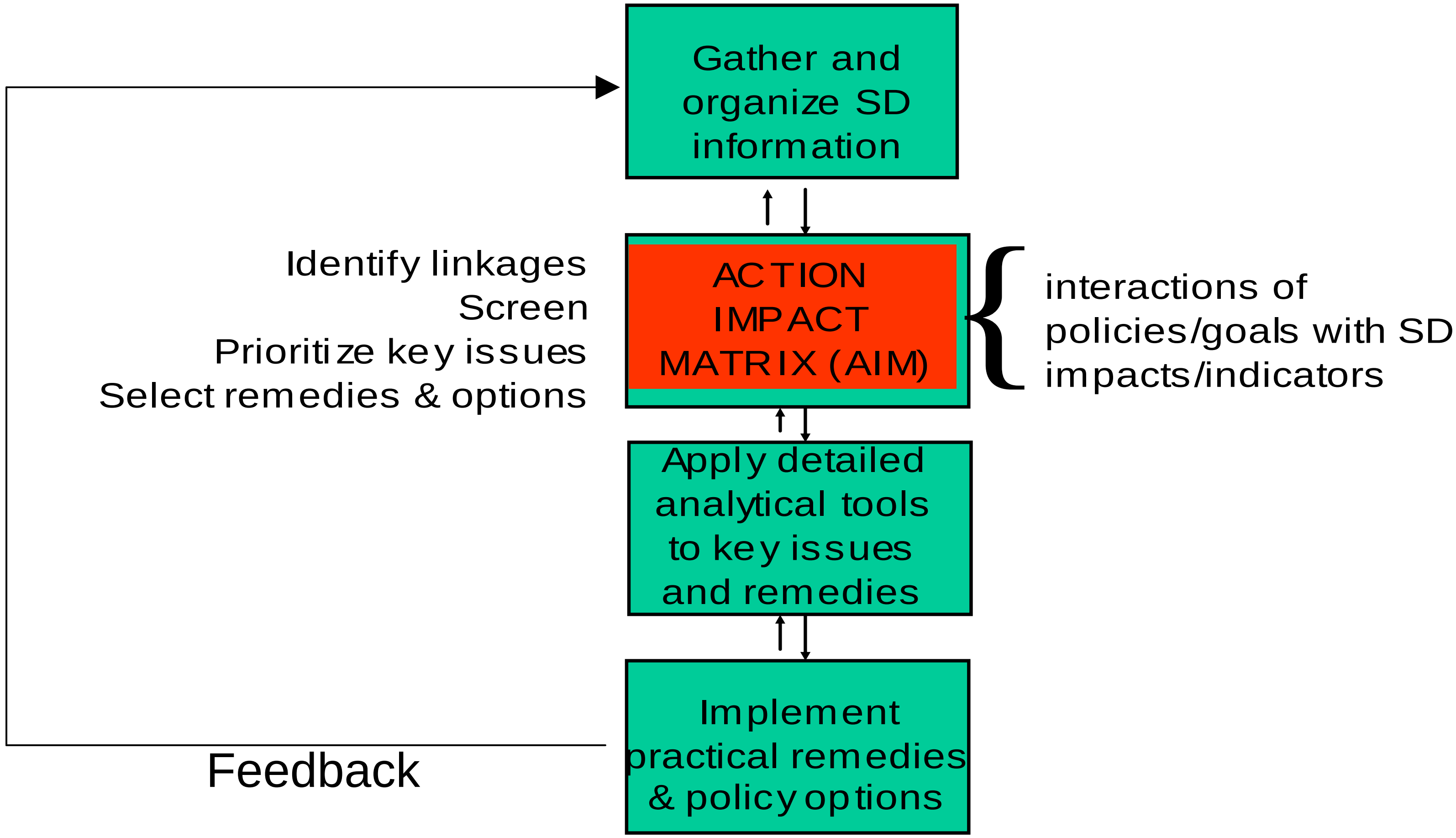
C. Subnational-sectoral

D. Local-project

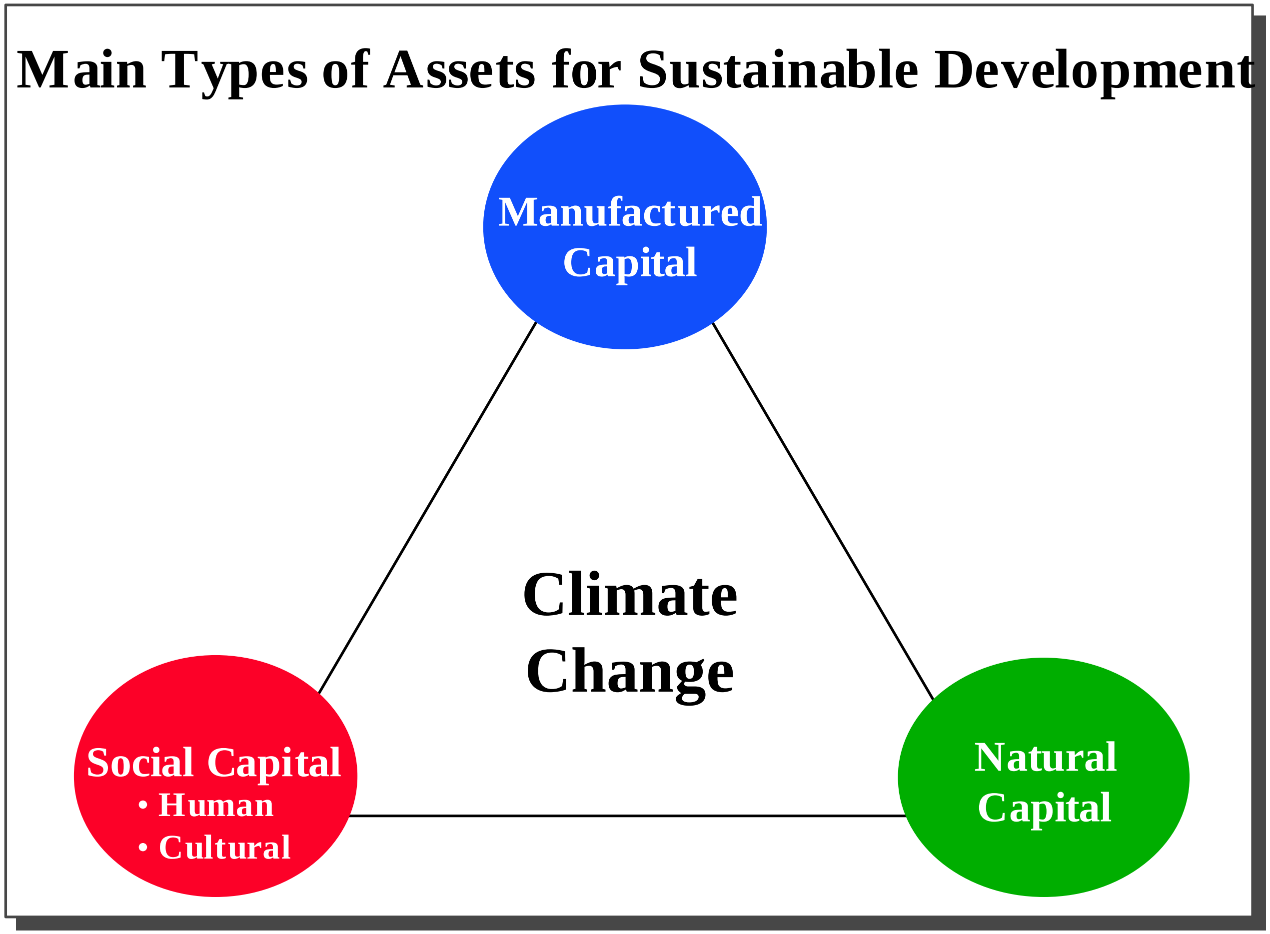
Linkages Across Levels

Integrative tools: Action Impact Matrix (AIM)

Key link from data gathering to practical policy application – requires multidisciplinary data



Solution: Integrating across three dimensions of SD



Economic approach focuses on optimality - maximise growth
Environmental and social approaches rely on durability - 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.**

SD Indicators

- Social
- Environmental
- Economic
- Institutional

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

WHY ? is climate a threat to future human development

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

HOW ? can we better understand CC-SD links and identify specific issues

Analyze how CC affects SD and vice versa 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. Improved statistics will play a key role.

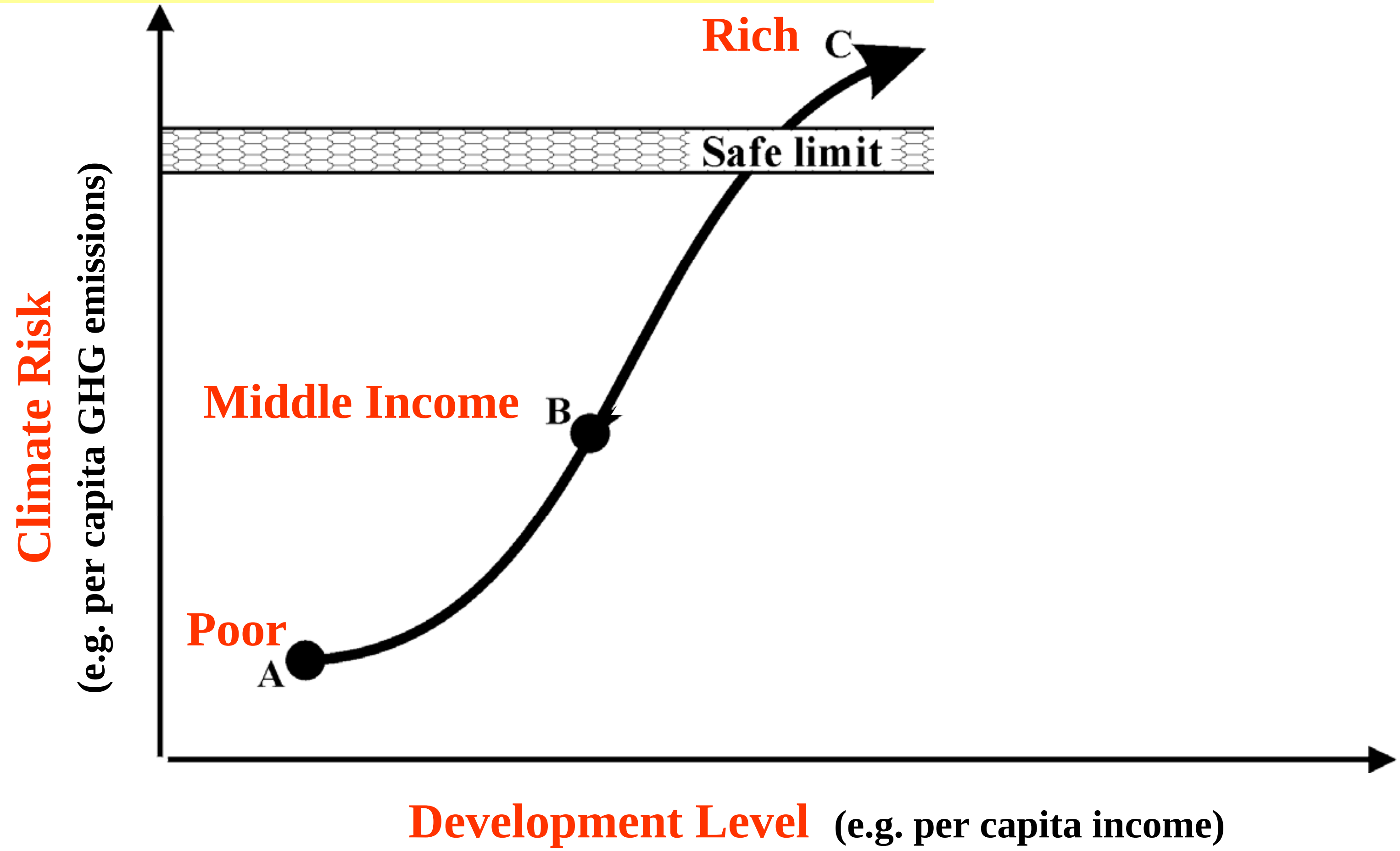
Practical Application of Sustainomics to Complex CC-SD Interactions

Global, National and Project Level Examples

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

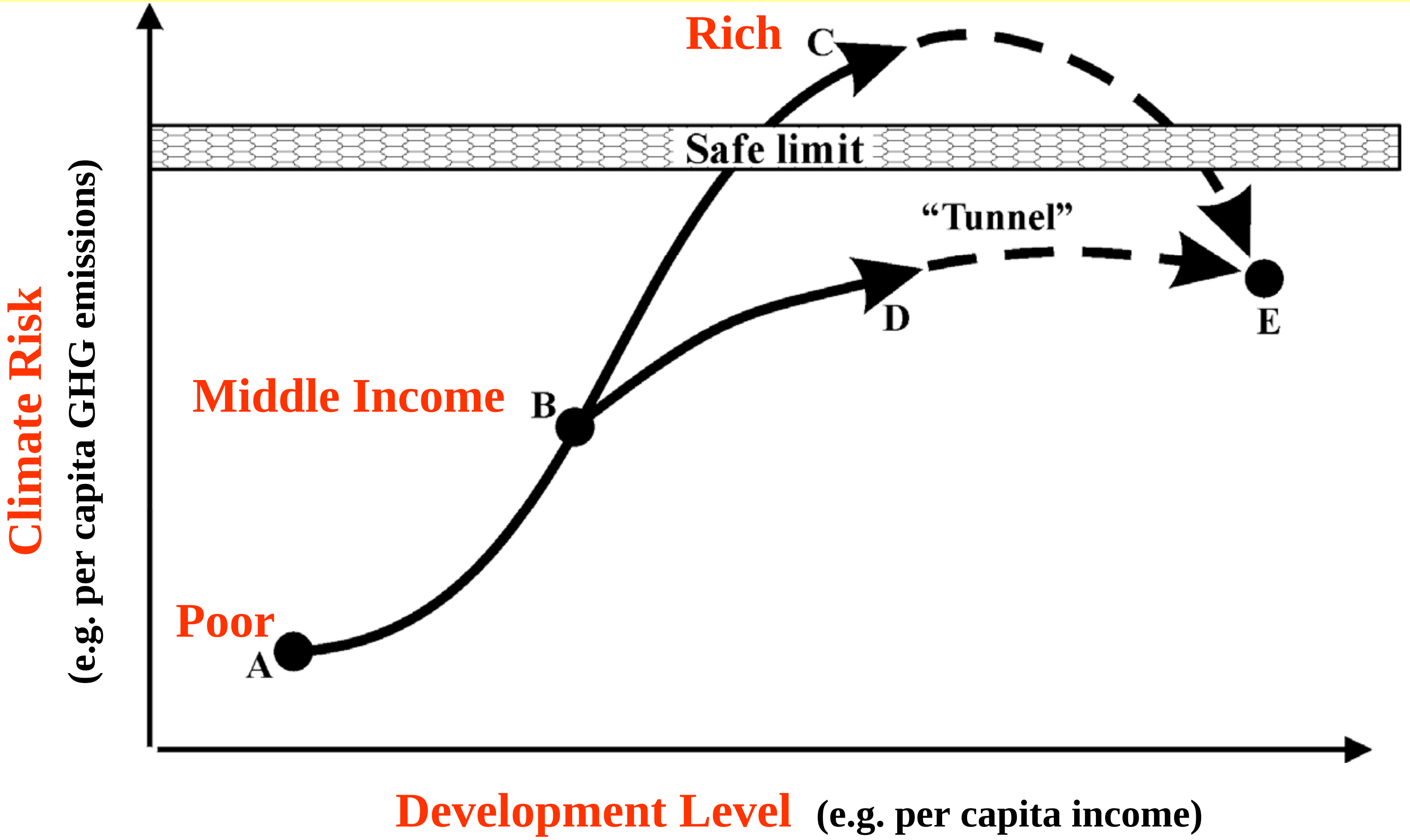
Climate Change Responses and Sustainable Development need not be conflicting objectives

MDMS via "Tunneling" : Framework for Reaching Consensus on Climate Risk vs. Development Rights



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

MDMS via "Tunneling" : Framework for Reaching Consensus on Climate Risk vs. Development Rights

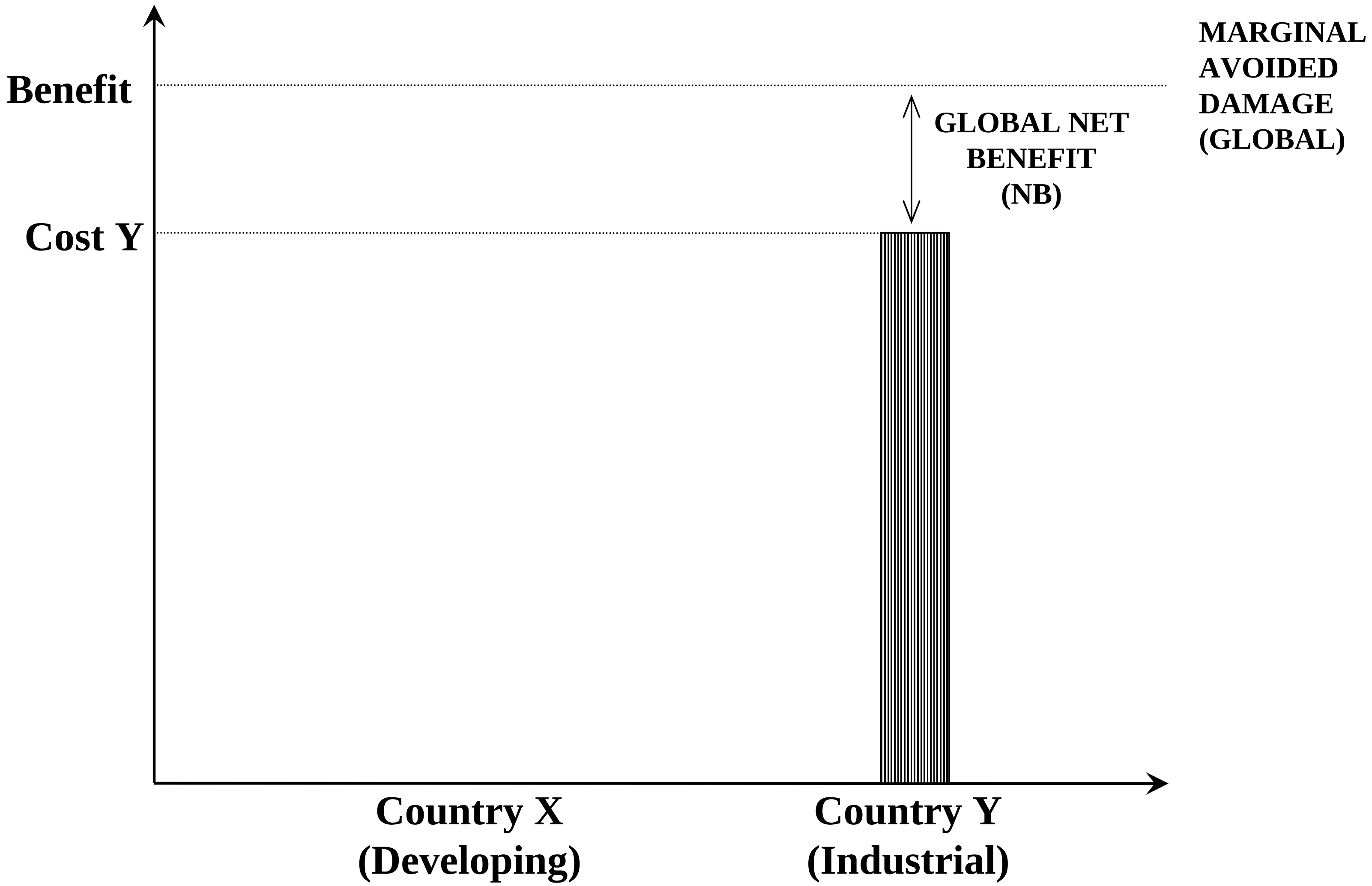


Source: M. Munasinghe (1995) "Making Growth More Sustainable," *Ecological Economics*, 15:121-4.

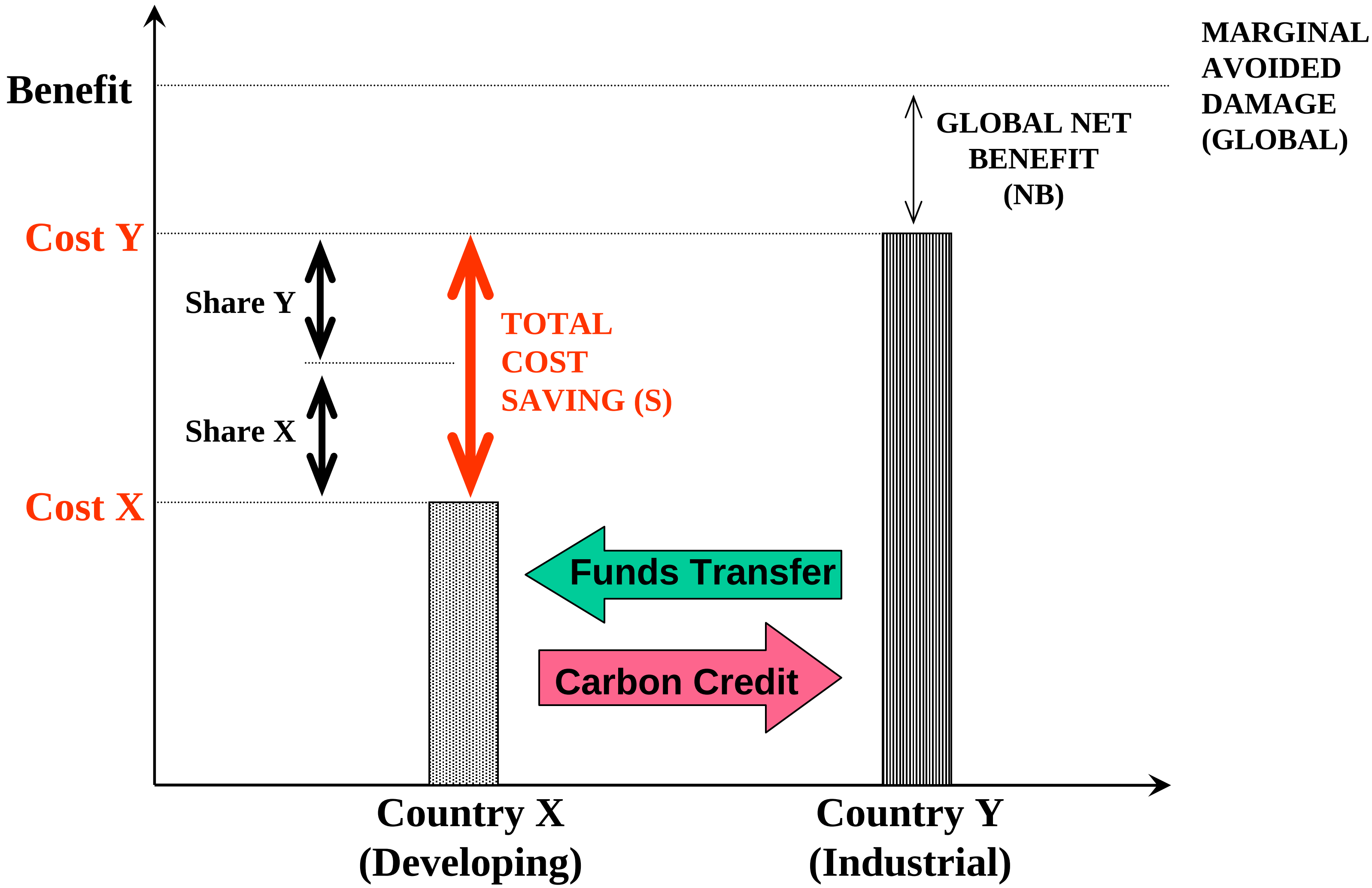
Specific Mitigation Mechanisms

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

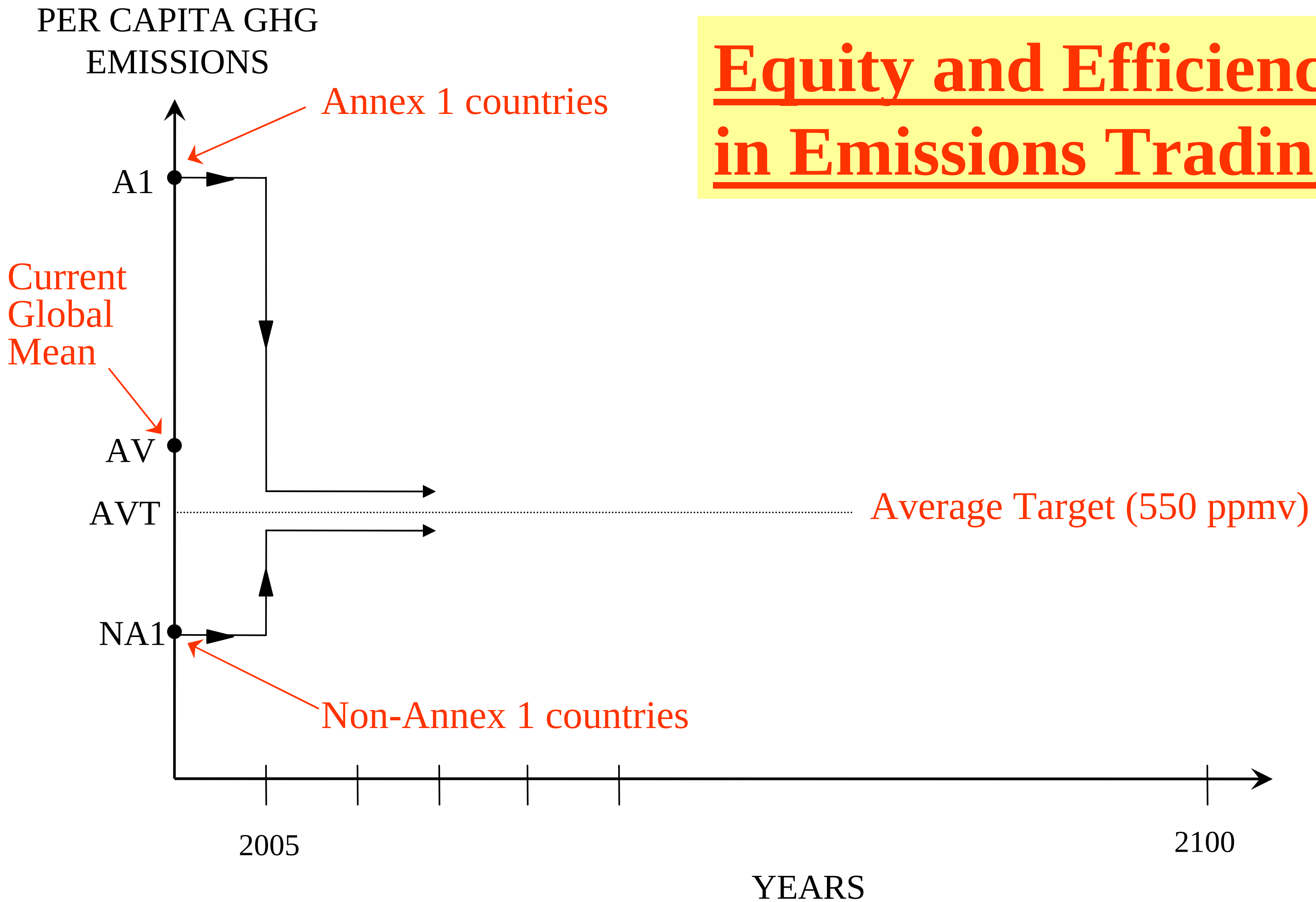
Interplay of Economic Efficiency and Social Equity to Protect Global Environment - CDM & JI: 1



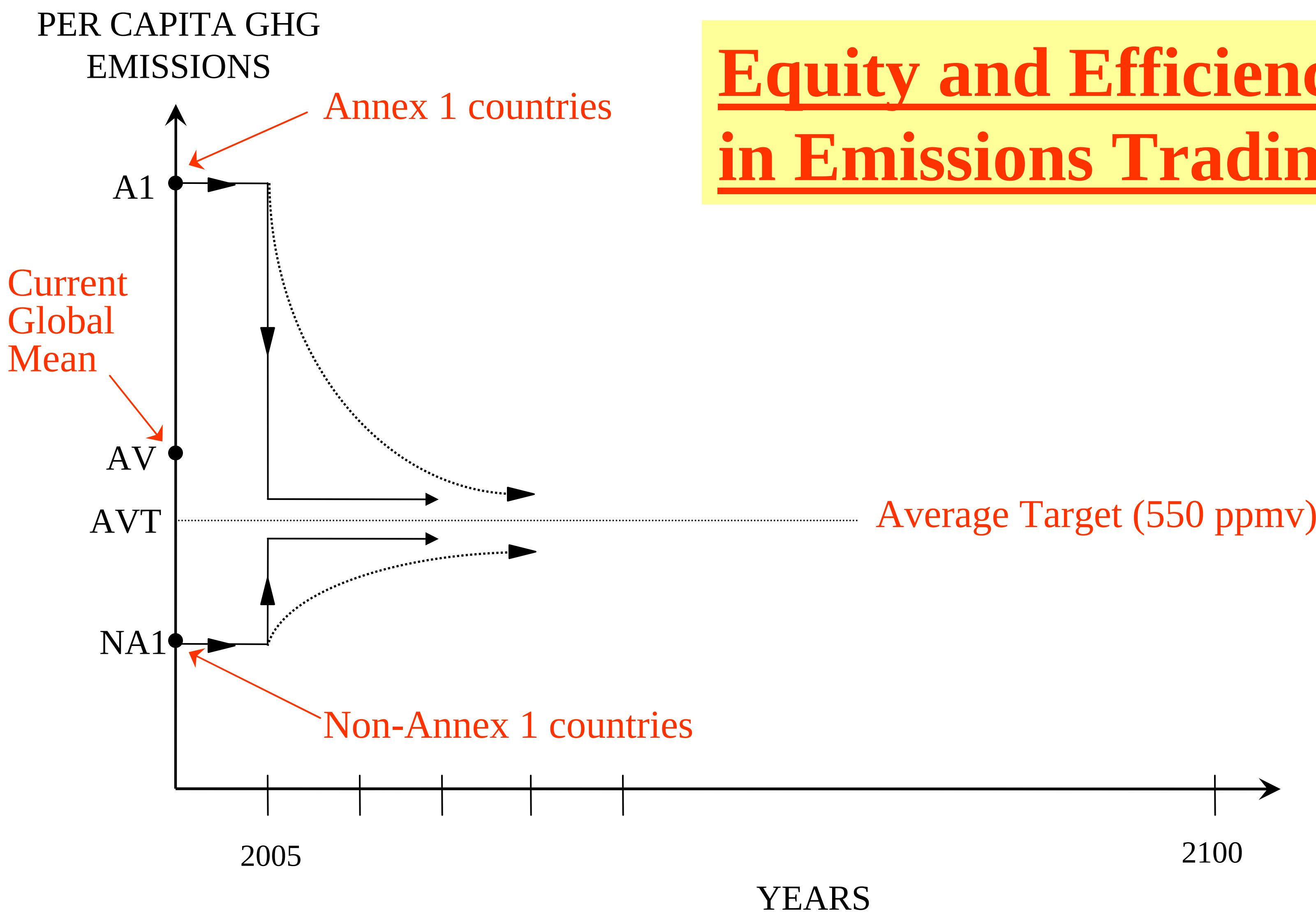
Interplay of Economic Efficiency and Social Equity to Protect Global Environment - CDM & JI: 2



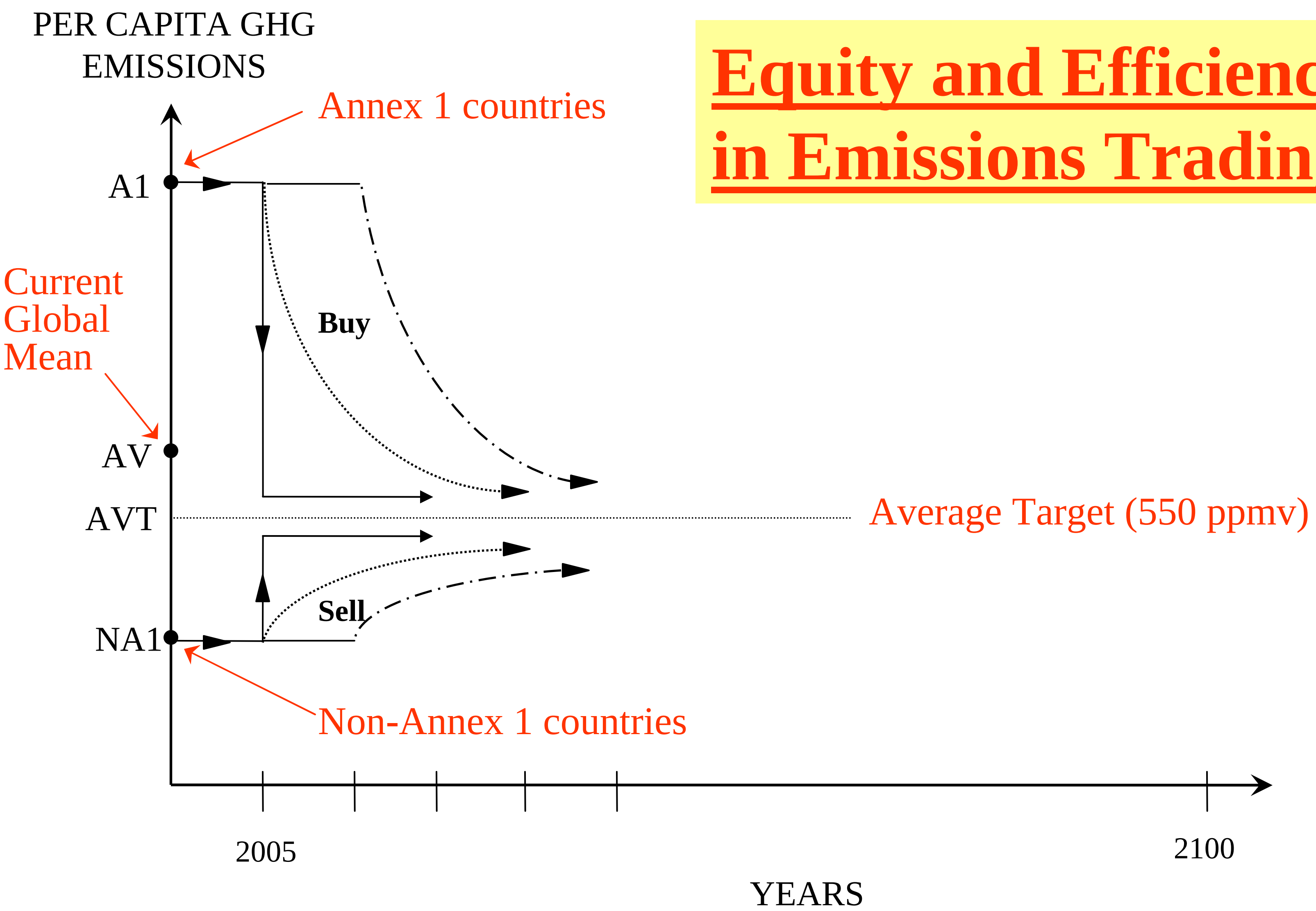
Equity and Efficiency in Emissions Trading 1



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)

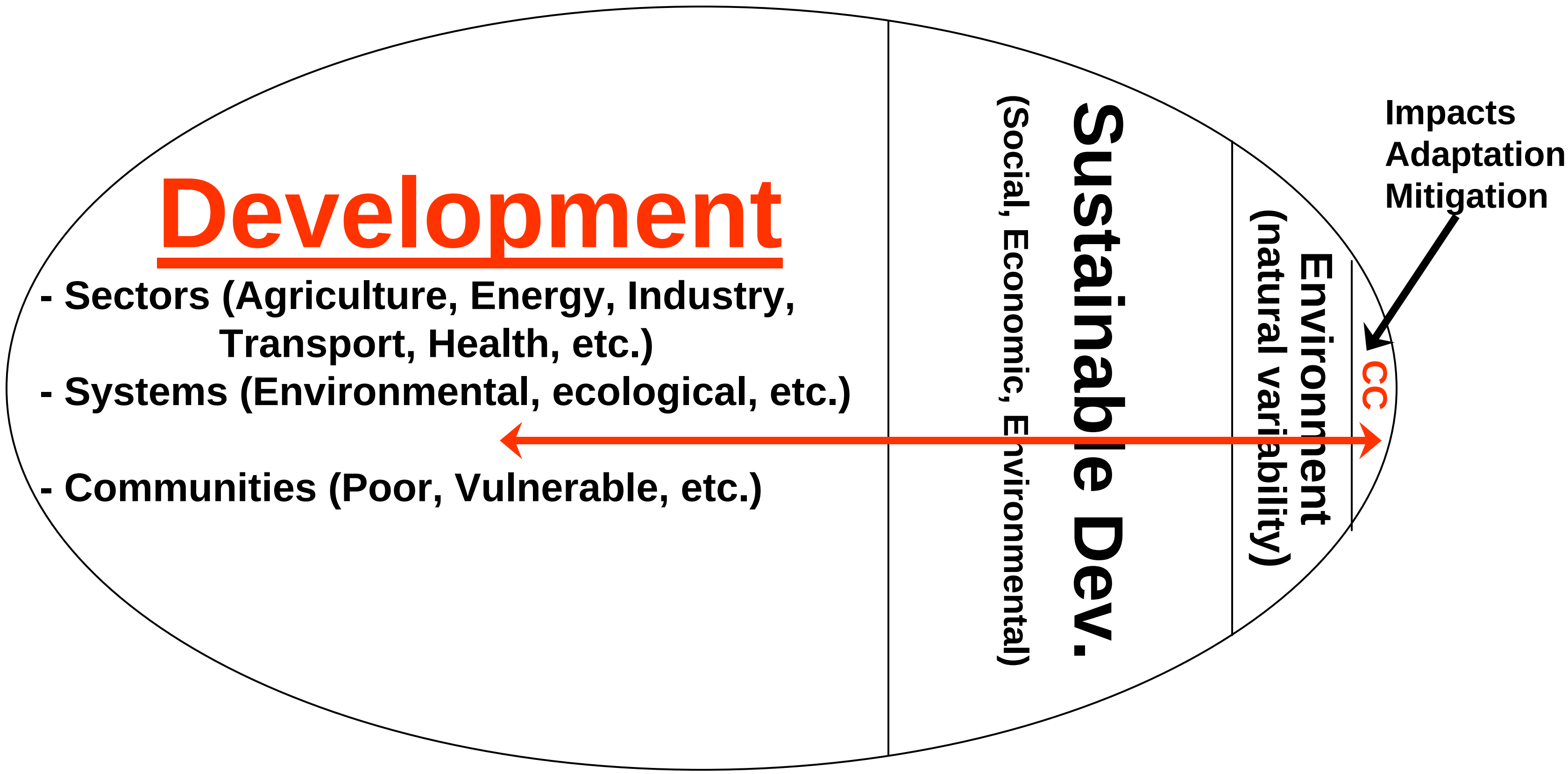
2. Improve adaptive capacity (reduce impacts)

3. Mitigate (FX incentives needed to offset costs)

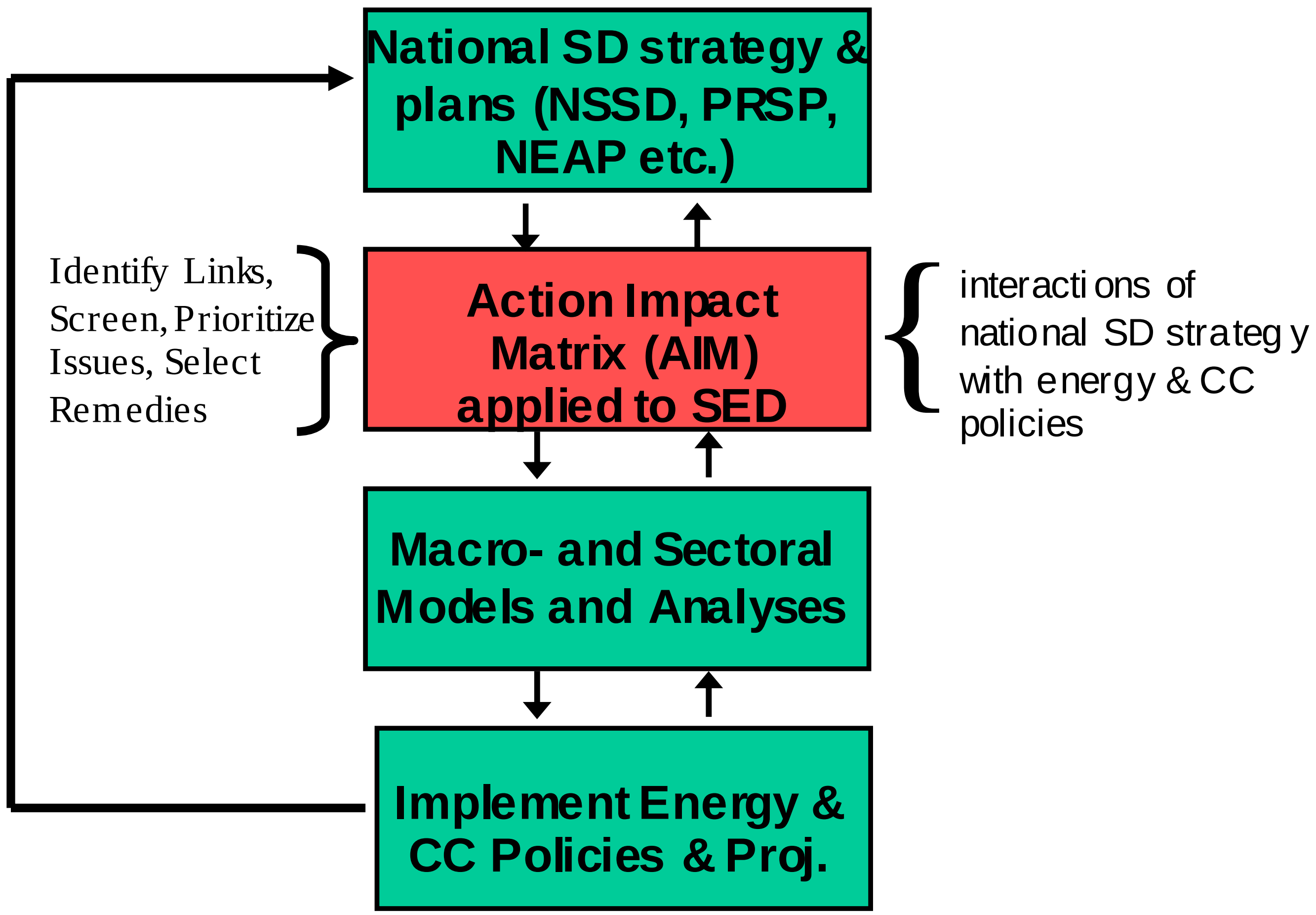
4. Integrate CC-SD strategy by combining 1,2 & 3

National Level CC-SD Links

Decision makers see climate change as a minor element in the national sustainable development strategy



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.

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) Agric. Output	(2) Hydro Power	(3) Deforestation	(4) Bio-div. (flora & fauna)	(5) Wet-lands & coastl ecosystems	(6) Water resources	(7) Poor communities	(8) Human health	(9) Infra-struct.	(10) Industries & 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

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

Social Accounting Matrix (SAM)

Economic Links Basic Input-Output Table	**Environmental-Economic Links** Satellite Environmental Accounts (Impacts/Loads)
Economic-Social Links Distribution of Income	**Envir.-Social Links** Distribution of Environmental Impacts/Loads

Source: Munasinghe (2001), Macroeconomics and Environment

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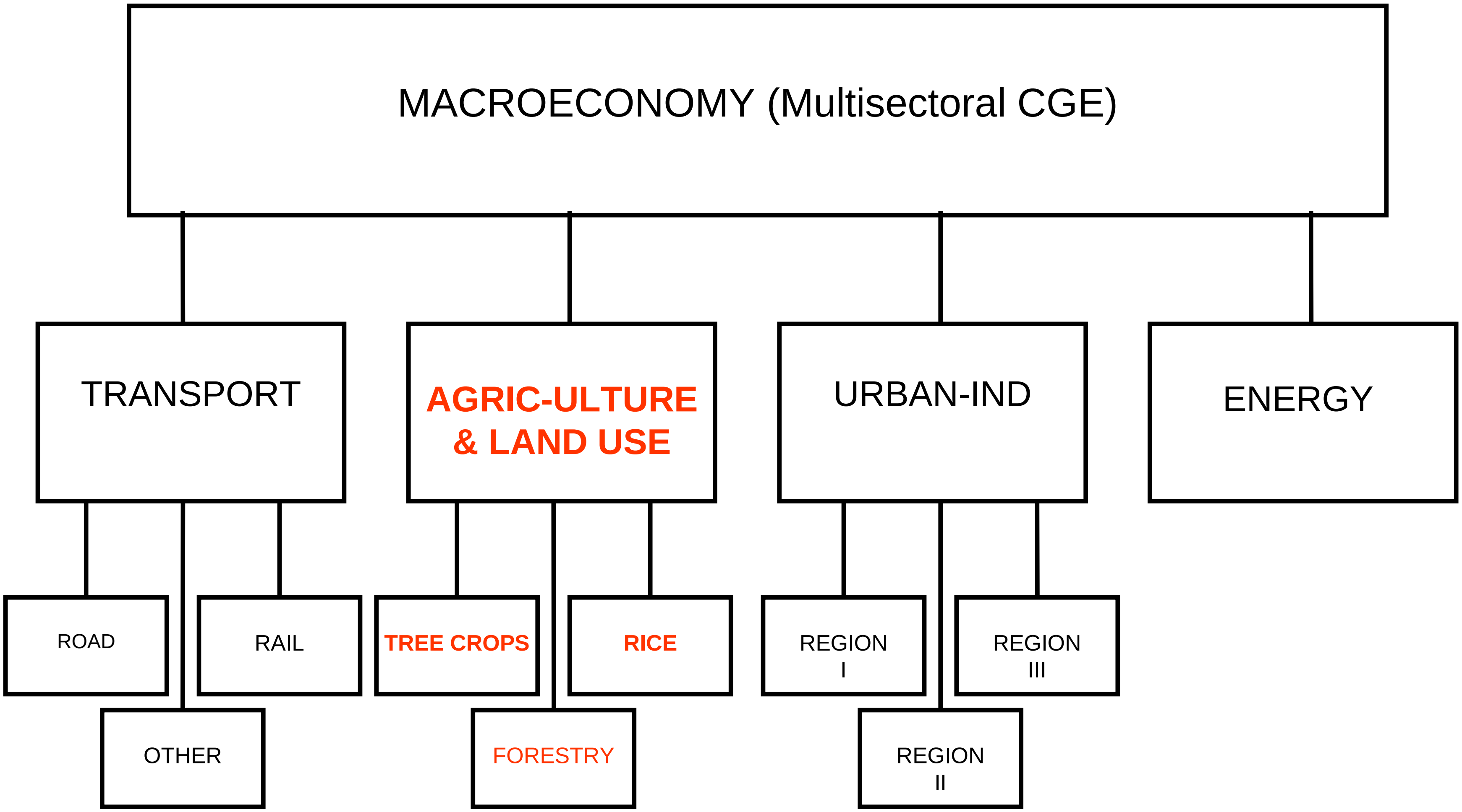
AIM Detailed Follow-up Study: Sector Example

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

Source: M. Munasinghe and S. Perera (1996)

Sri Lanka Integrated CC-SD Assessment Model



Climate Model Predictions for Sri Lanka in 2050 (Downscaled GCM)

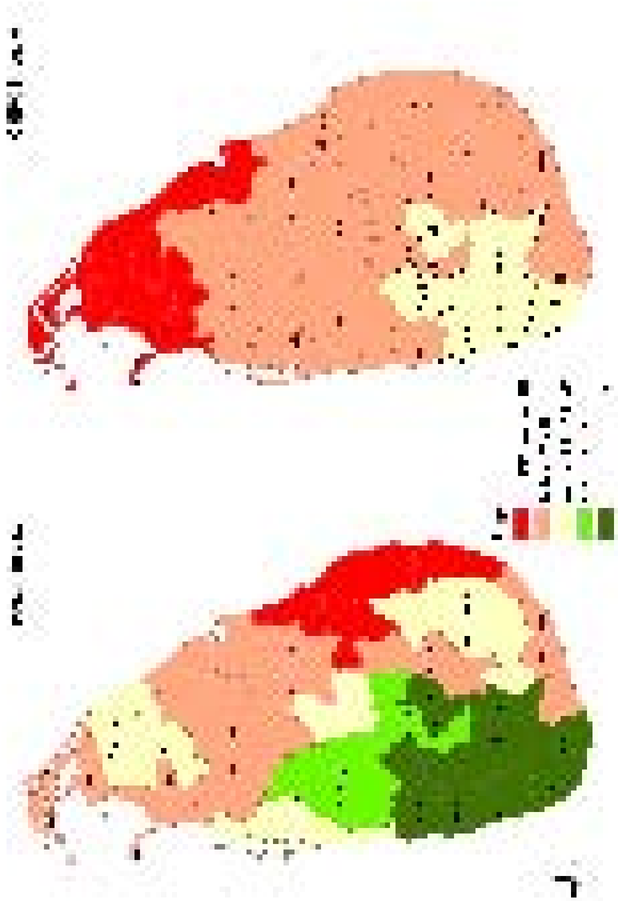
Global Scenario	Period	Rainfall	Temperature
B1	NEM	Increase by 50 mm over the baseline	Max. temperature: increase by 0.8^0 C Min. temperature : increase by 1.0^0 C
B1	SWM	Increase by 350 mm over the baseline, especially over the Western slopes of the central hills	Max. temperature: increase by 0.8^0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

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



Some Key Policy Implications for Sri Lankan Decision Makers

1. **Overall impact** on agricultural output and national economy is modest, but some effects will emerge within next two decades
2. **Food impact:** potential risk to food security (rice)
3. **Poverty impact** on small farmers
4. **Equity impact:** losers - small rice farms in dry zone, gainers - large export crop plantations in wet zone)
5. **Demographic impact:** potential migration from dry to wet zone

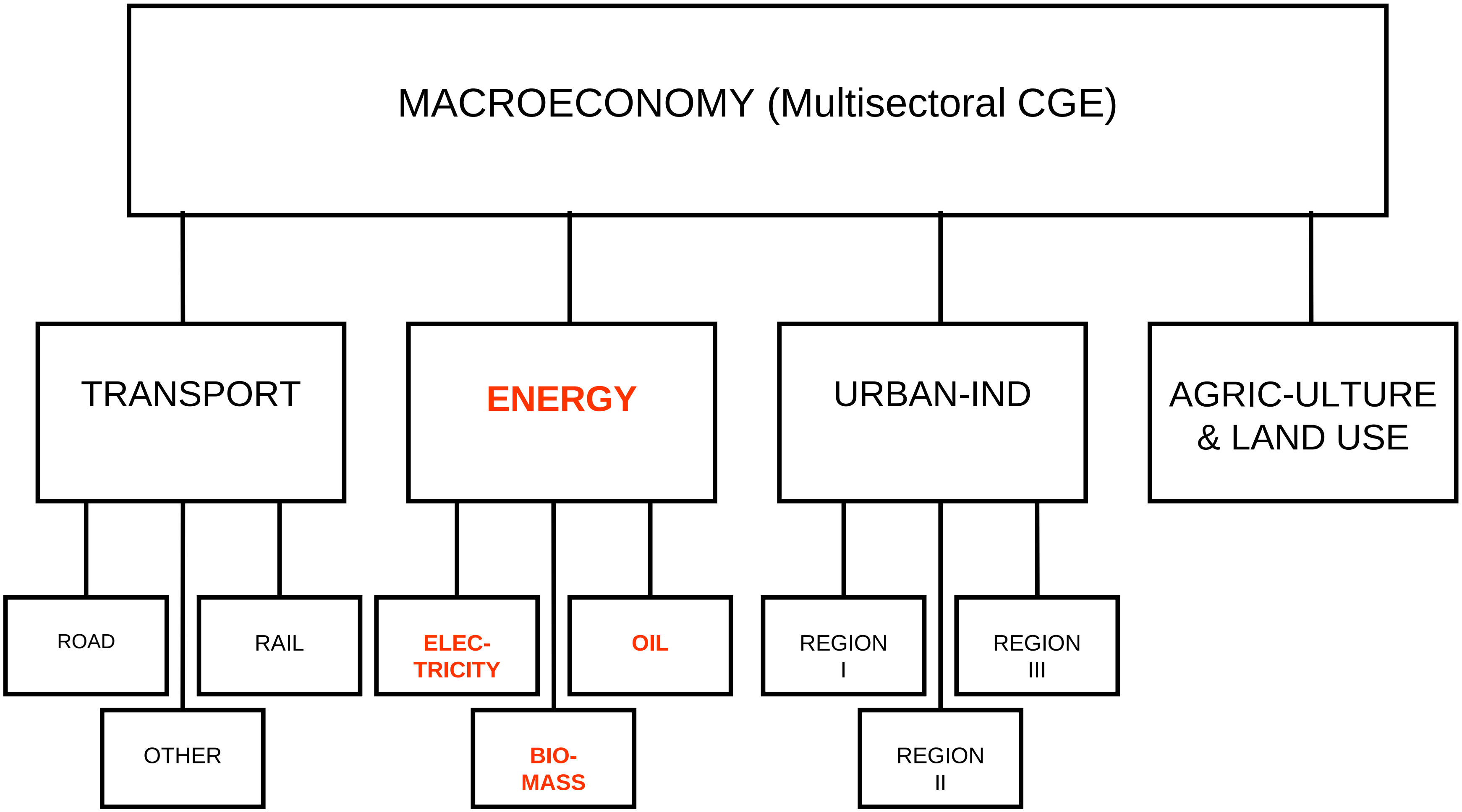
Change in net agriculture income: Results of various Ricardian models

Country	Temperature rise (^{0} C) plus 7% rainfall increase	Change in net income (percent)	Source
Sri Lanka	2.0	-27	Basic model – Analysis 1 (this paper)
Sri Lanka	3.5	-46	Basic model – Analysis 1 (this paper)
Sri Lanka - Paddy	2.0	-10	Improved agricultural data - Analysis 2 (this paper)
Sri Lanka – Plantation crops	2.0	+39	Improved agricultural data - Analysis 2 (this paper)
Sri Lanka - Paddy	Temp.= +1.1 to 1.2 ^{0}C & Rainfall = +70 to 520 mm	- 11.4	Improved agricultural and climate data - Analysis 2 (this paper)
Sri Lanka - Plantation crops	Temp.= +1.1 to 1.2 ^{0} C & Rainfall = +70 to 520 mm	+ 3.5	Improved agricultural and climate data - Analysis 2 (this paper)
United States	2.0	-3 to +3	Mendelsohn, Nordhaus, and Shaw (1994)
India	2.0	-3 to -6	Sanghi, Mendelsohn, and Dinar (1998)
India	3.5	-3 to -8	Sanghi, Mendelsohn, and Dinar (1998)
India	2.0	-7 to -9	Kumar and Parikh (1998a)
India	3.5	-20 to -26	Kumar and Parikh (1998a)
Brazil	2.0	-5 to -11	Sanghi (1998)
Brazil	3.5	-7 to -14	Sanghi (1998)

National Level Example

Energy Sector Policy and Pricing

Integrated Sustainable Energy Development Model



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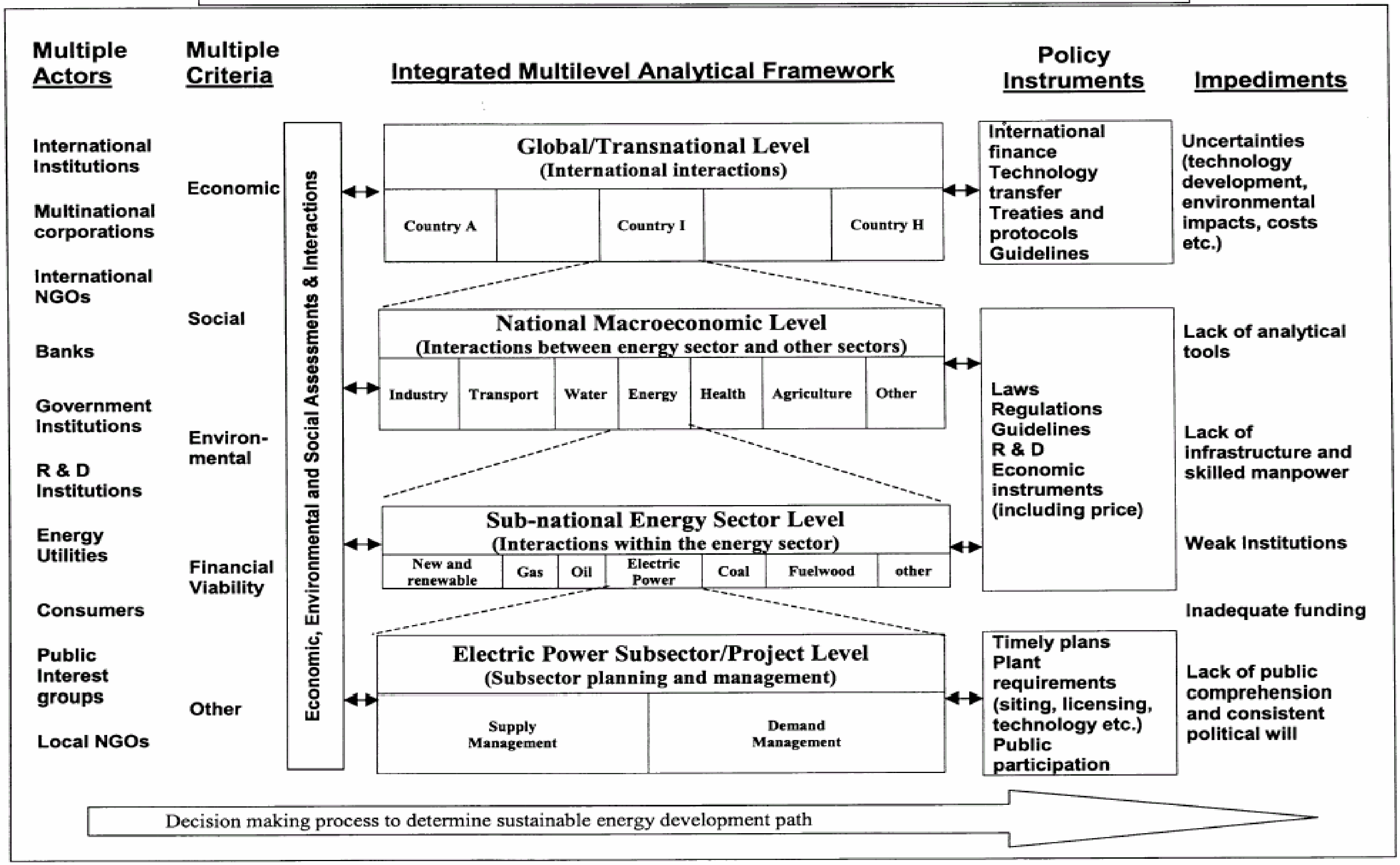
Sustainable Energy Development and Mitigation

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



Sustainable Energy Pricing: incorporates Economic, Environmental and Social Goals

(requires variety of corresponding data)

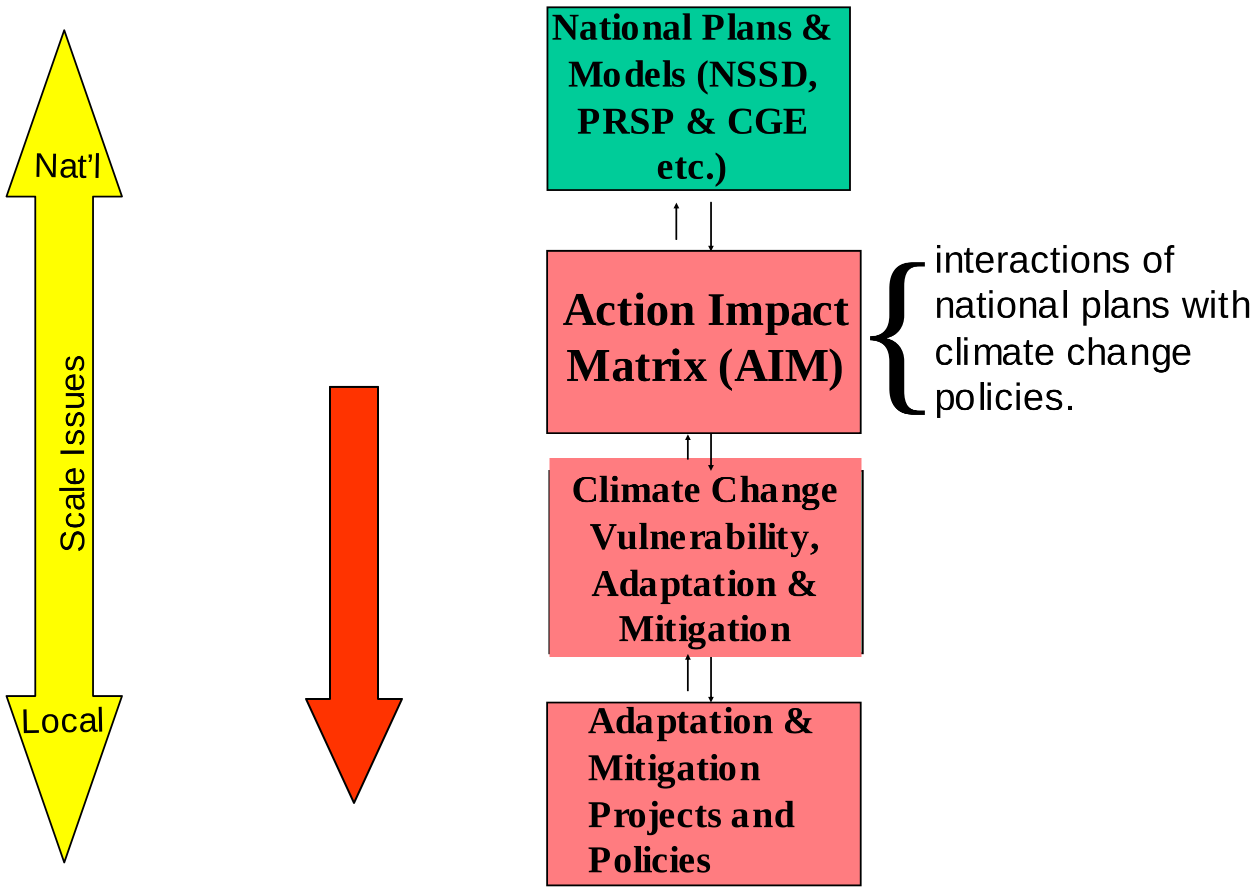
1. **Economic efficiency: prices based on long-run marginal cost to reflect scarcity**
   e.g., rising oil prices

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

Subnational-Sectoral and Local-Project Level Examples

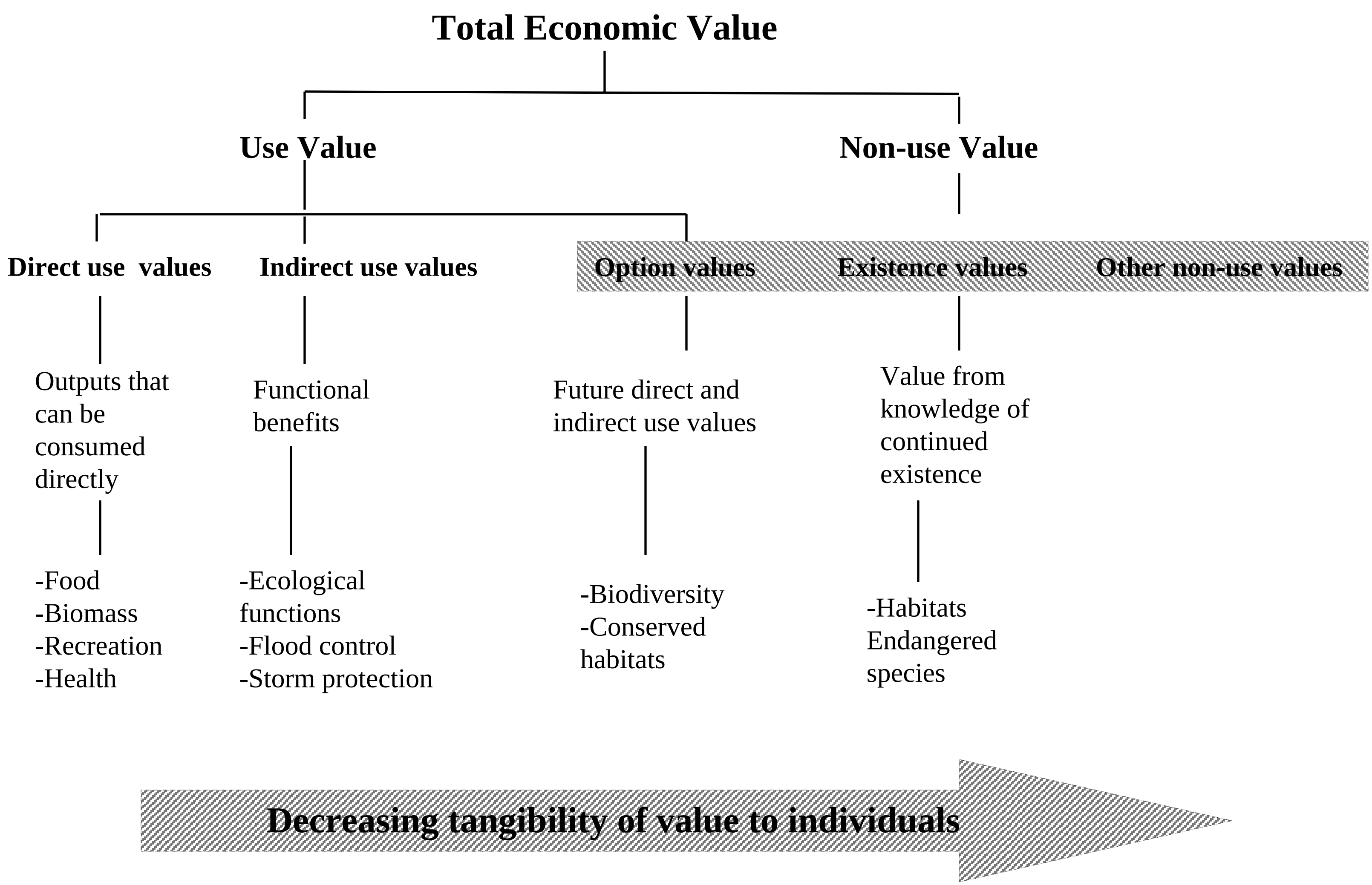
Assessing links between development plans and adaptation and mitigation: AIM-Micro/Project Linkage Downwards



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



Categories of economic values attributed to environmental assets (examples from a tropical rain forest).

Techniques for economically valuing environmental impacts

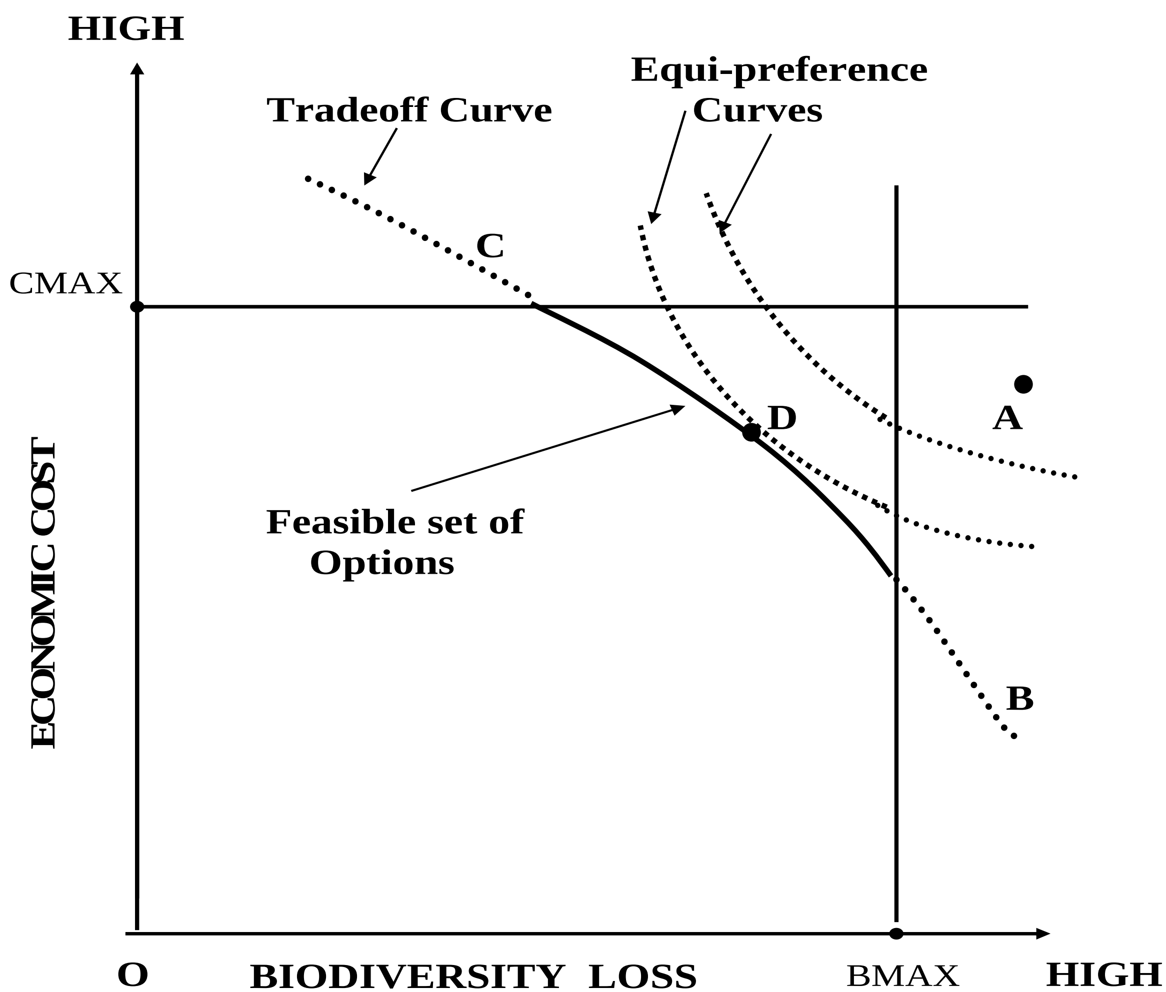
Valuation of multiple, interdependent environmental services across a range of stakeholders, is the most useful, but also more difficult.

	TYPE OF MARKET		
BEHAVIOUR TYPE	**Conventional market**	**Implicit market**	**Constructed market**
Actual Behaviour	Effect on Production Effect on Health Defensive or Preventive Costs	Travel Cost Wage Differences Property Values Proxy Marketed Goods Benefit Transfer	Artificial market
Intended Behaviour	Replacement Cost Shadow Project		Contingent Valuation

Source: **Munasinghe (1992), Rio Earth Summit**

Simple Multi-criteria Analysis (MCA)

Source: Adapted from Munasinghe (1992).



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.

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:

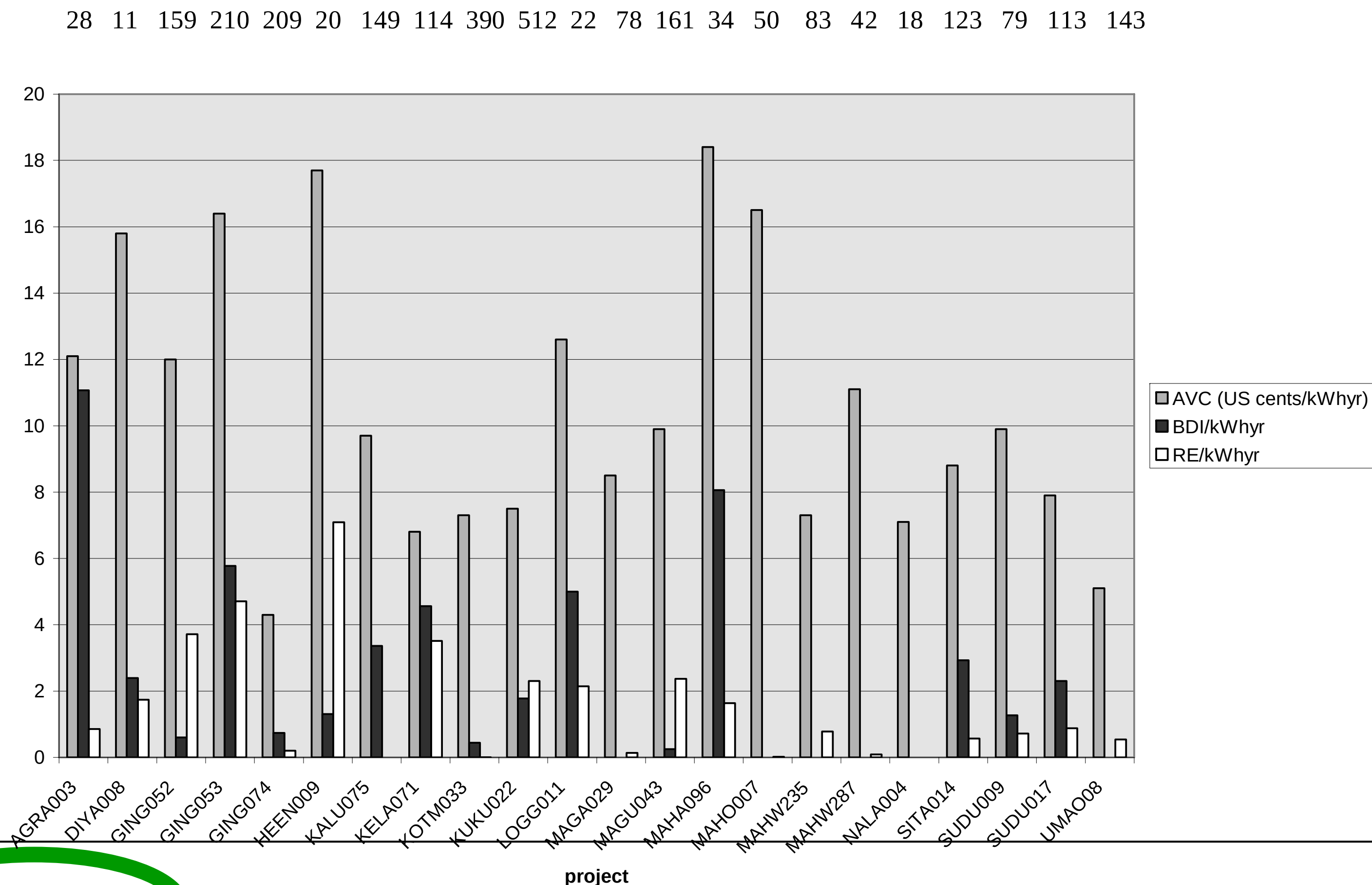
  Economic - electricity supply costs,

  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.

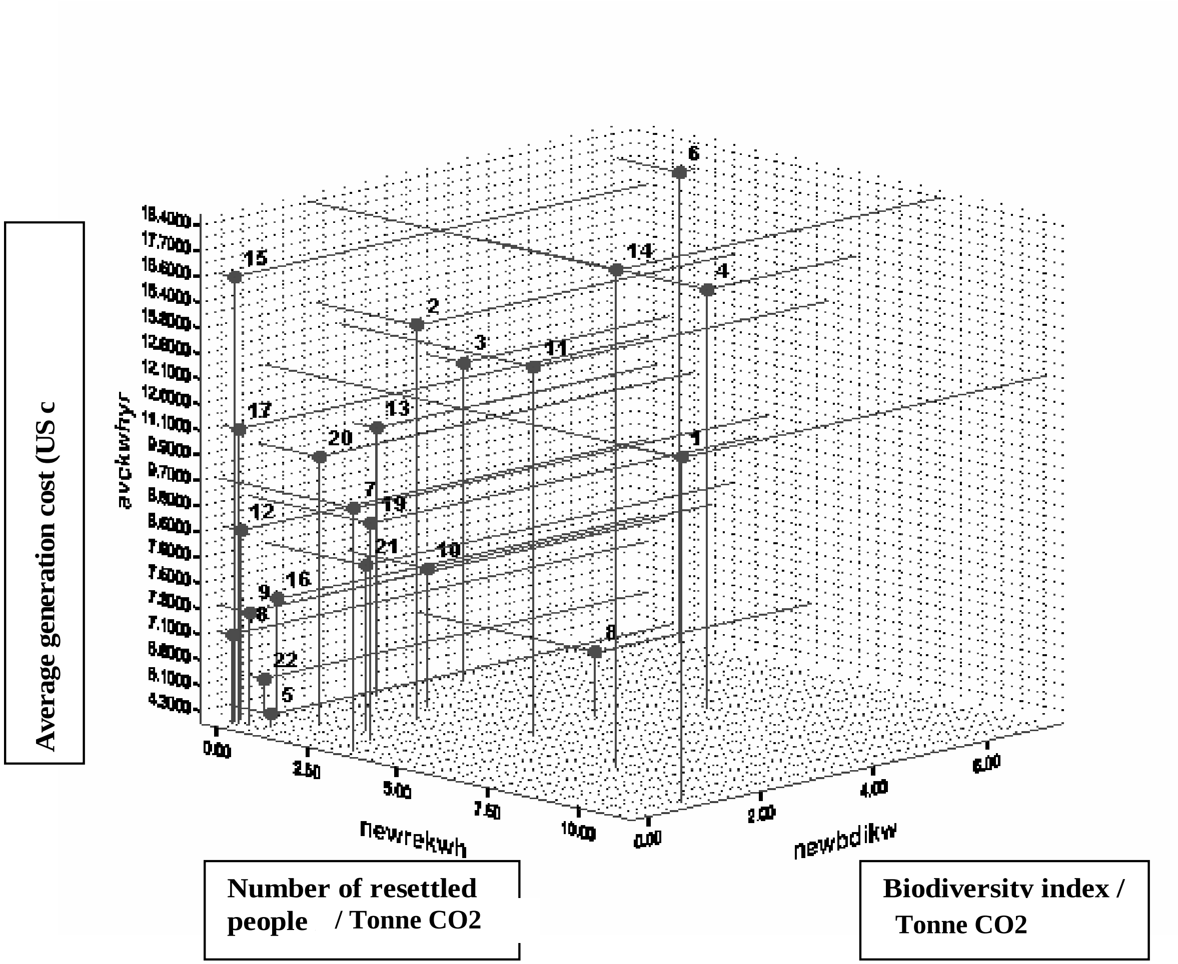
Project Level:
Economic, social and ecological indicators for small hydro in Sri Lanka

Average generation costs (AVC), biodiversity index (BDI), and number of resettled people (RE) by hydroelectric project. All indices may be scaled per tonne of CO_2 mitigated per year. Numbers of people resettled and the biodiversity index are scaled for convenience (by the multipliers 10^{-5} and 10^{-9} respectively). Values at the top of the graph indicate the annual energy generation in gigawatt hours (GWh).



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 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

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)

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
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→
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- Freshwater Systems
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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

WHY ? is climate a threat to future human development

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

HOW ? can we better understand CC-SD links and identify specific issues

Analyze how CC affects SD and vice versa 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. Improved statistics will play a key role.

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 !

Data experts and statisticians can play a key role in the CC-SD transition - mobilising data, identifying & framing the issues, finding solutions, and implementing them.

Ancient Pali Blessing from Sri Lanka about Making Development More Sustainable

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

"May the rains come in time,
May the harvests be bountiful
May the people be happy and contended
May the king be righteous"

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.

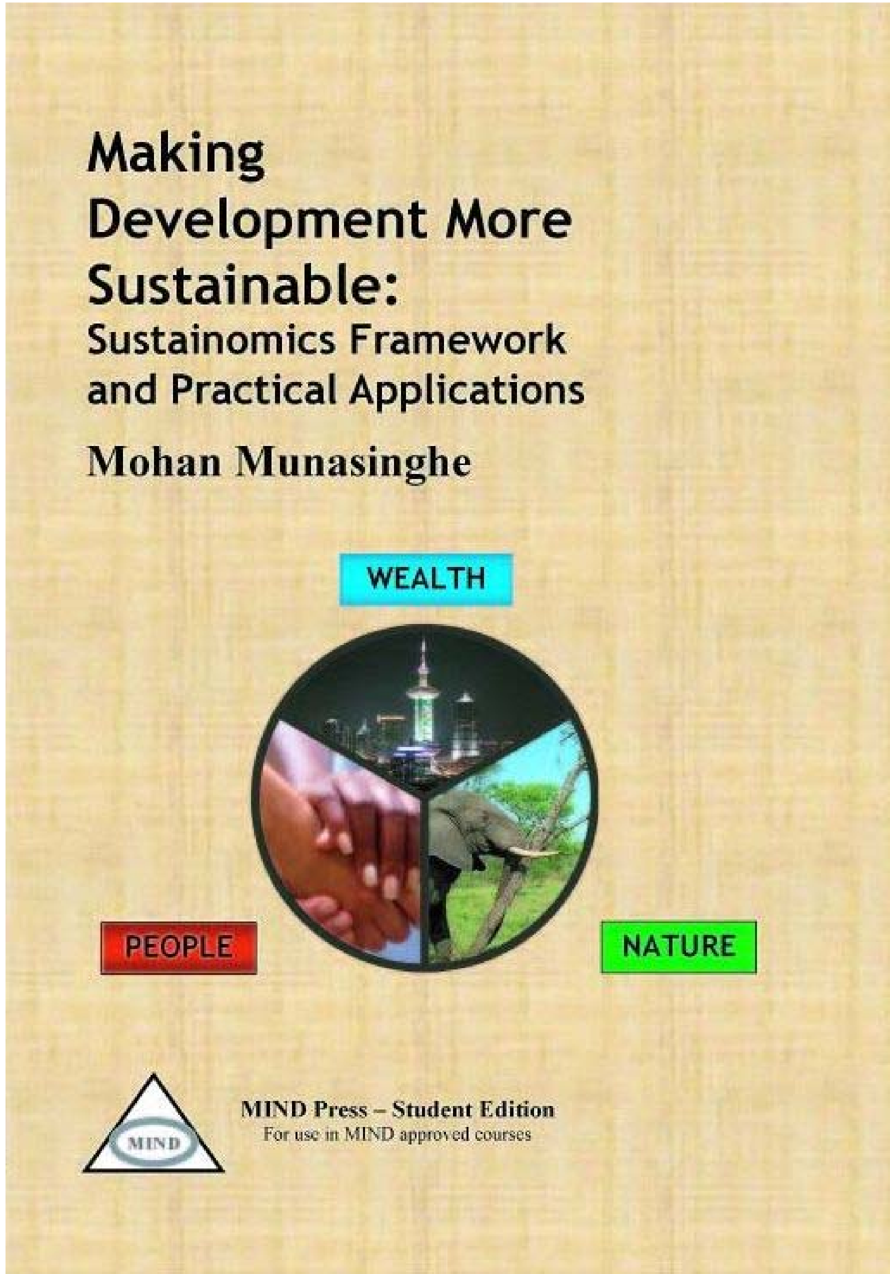
Suggestions for Further Information

1. **Munasinghe, M. (2007)** ***Making Development More Sustainable: Sustainomics Framework and Practical Applications*****, MIND Press, Munasinghe Institute for Development, Colombo.**

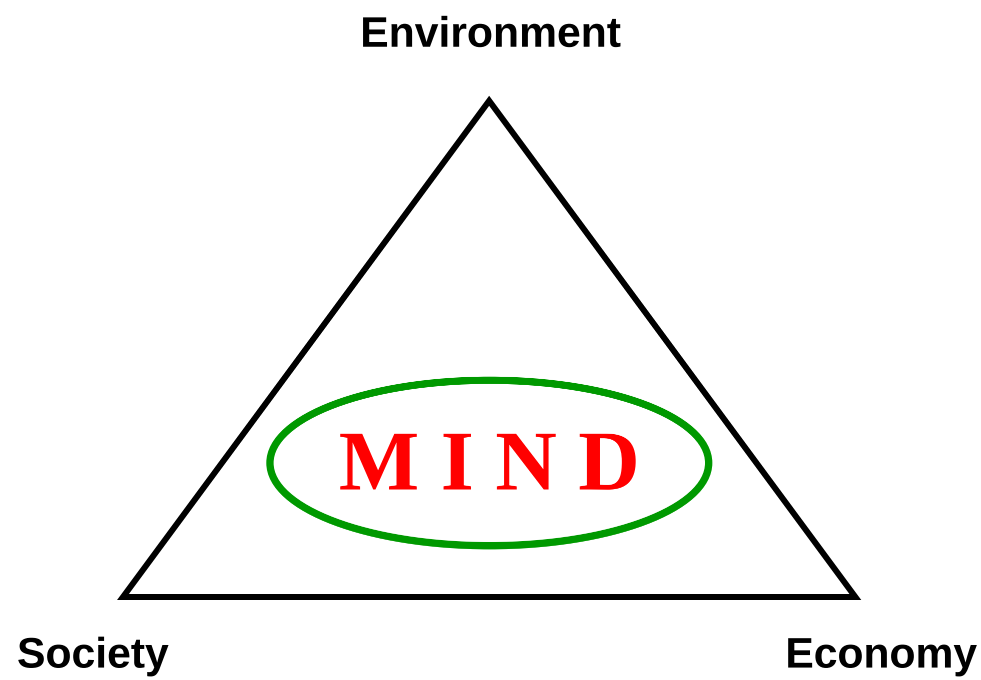
2. **Munasinghe, M., and Swart, R. (2005)** ***Primer on Climate Change and Sustainable Development*****, Cambridge University Press, UK. –translated into Chinese**

3. **MIND (2005)** ***Action Impact Matrix (AIM) Application to Climate Change - Users Guide*****, Munasinghe Institute for Development, Colombo.**

4. **Website URL: <www.mindlanka.org>**


Making
Development More
Sustainable:
Sustainomics Framework
and Practical Applications
Mohan Munasinghe
WEALTH
PEOPLE
NATURE
MIND
MIND Press – Student Edition
For use in MIND approved courses

An Introduction



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MIND was established in the new millennium as a private, non-profit organization, to play a key role in nurturing communities of stakeholders and scholars to address major issues of **Sustainable Development (SD)** world-wide. MIND aims to explore viable means of achieving this goal in Sri Lanka and elsewhere without compromising social, economic, and environmental integrity.

MIND PROGRAMMES

- **Awards**

  Research fellowships, Scholarships, MIND 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 SD Course, Delhi, Feb. 2007

25 Senior Indian Civil Service Officers

MIND

Munasinghe Institute for Development

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

24 Graduate Students

Thank You Very Much