Expert Meeting on "Developing visions for a Low-Carbon Society through sustainable development"
Tokyo, 14-16 June 2005

Emissions Scenarios: SRES, post-SRES, MA, UNEP/GEO, and LCA

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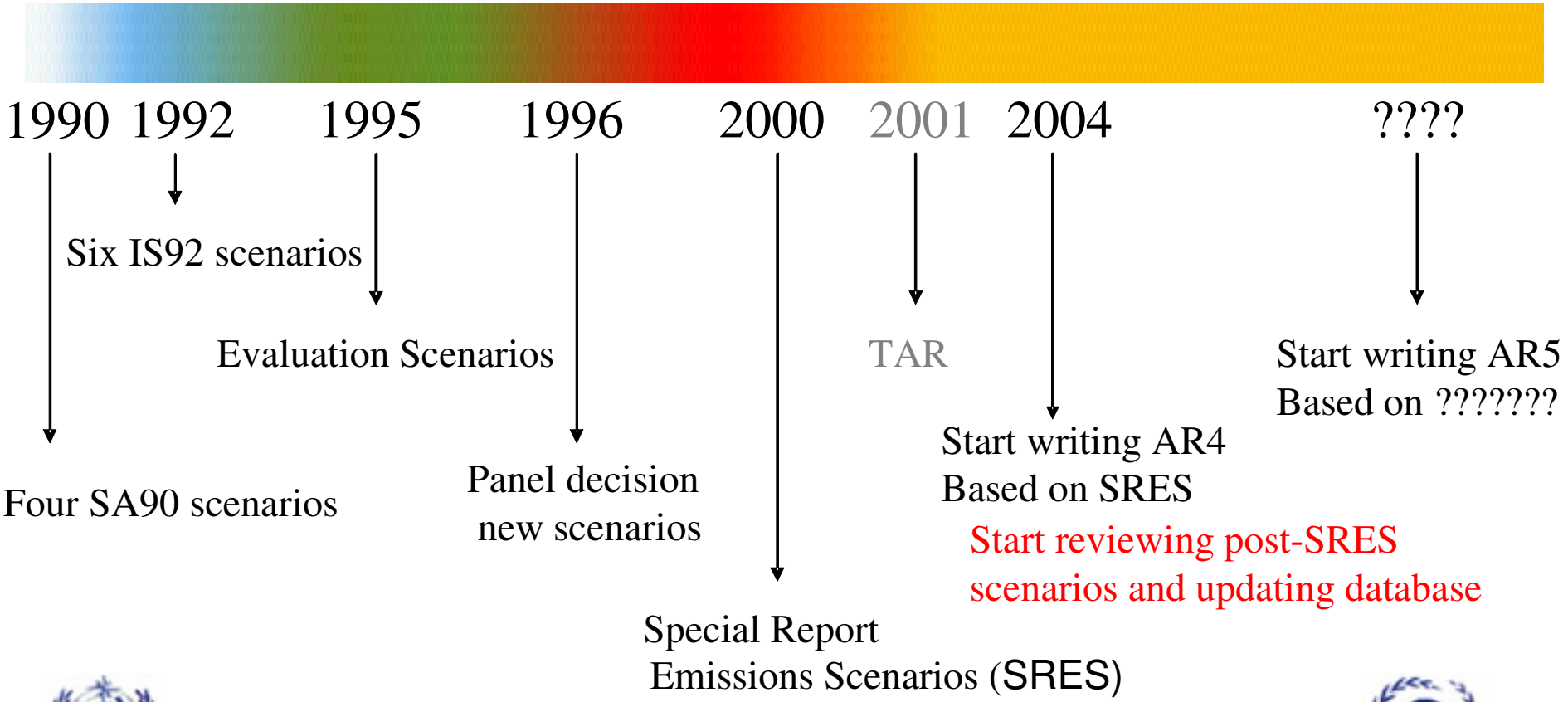
Scenarios

- Provide a framework for decision making which illuminates the impact associated with alternative courses of action
- Facilitate the interpretation of possible future states
- Include elements that cannot be formally modeled
- Aimed at challenging prevailing mind sets

Source: Nakicenovic, 2005

Previous developed and used scenarios by IPCC



Purposes of Emissions Scenarios

- Purpose 1: Evaluate the environmental and climatic consequences of "non-intervention" futures
- Purpose 2: Evaluate the environmental and climatic consequences of "intervention" futures
- Purpose 3: Examine the feasibility and costs of mitigating GHGs from different regions and sectors
- Purpose 4: Negotiate possible emissions reductions for different countries and regions

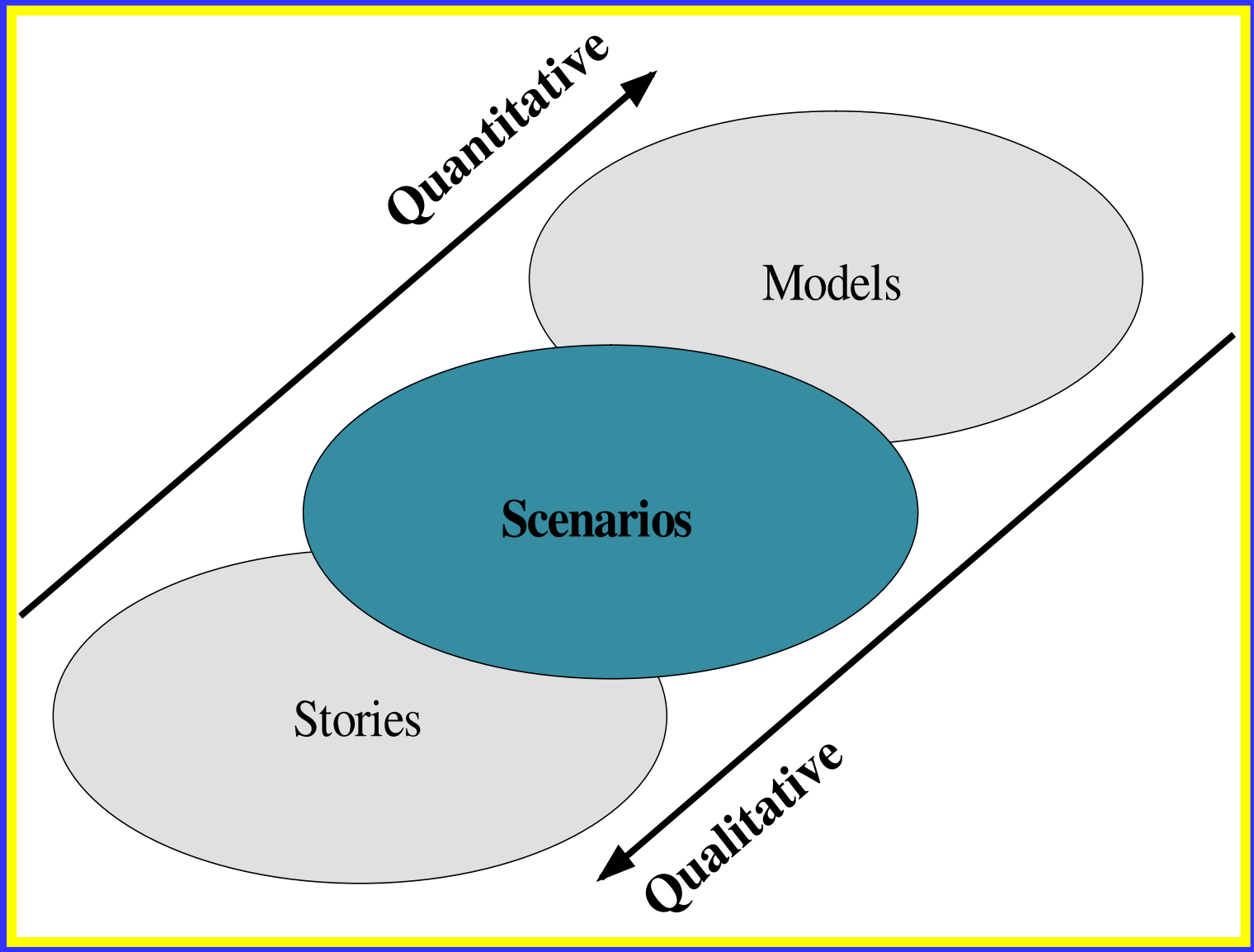
Source: IPCC, 1995

Purposes of Emissions Scenarios
(Together with Climate Projections)

	SA90	IS92	SRES	TAR
Purpose 1 “non-intervention”	Yes	Yes	Yes	No
Purpose 2 “intervention”	Yes	No	No	Yes
Purpose 3 feasibility and costs from different regions and sectors	No	No	No	Yes (?)
Purpose 4 "Negotiation"	No (?)	No (?)	No (?)	No (?)

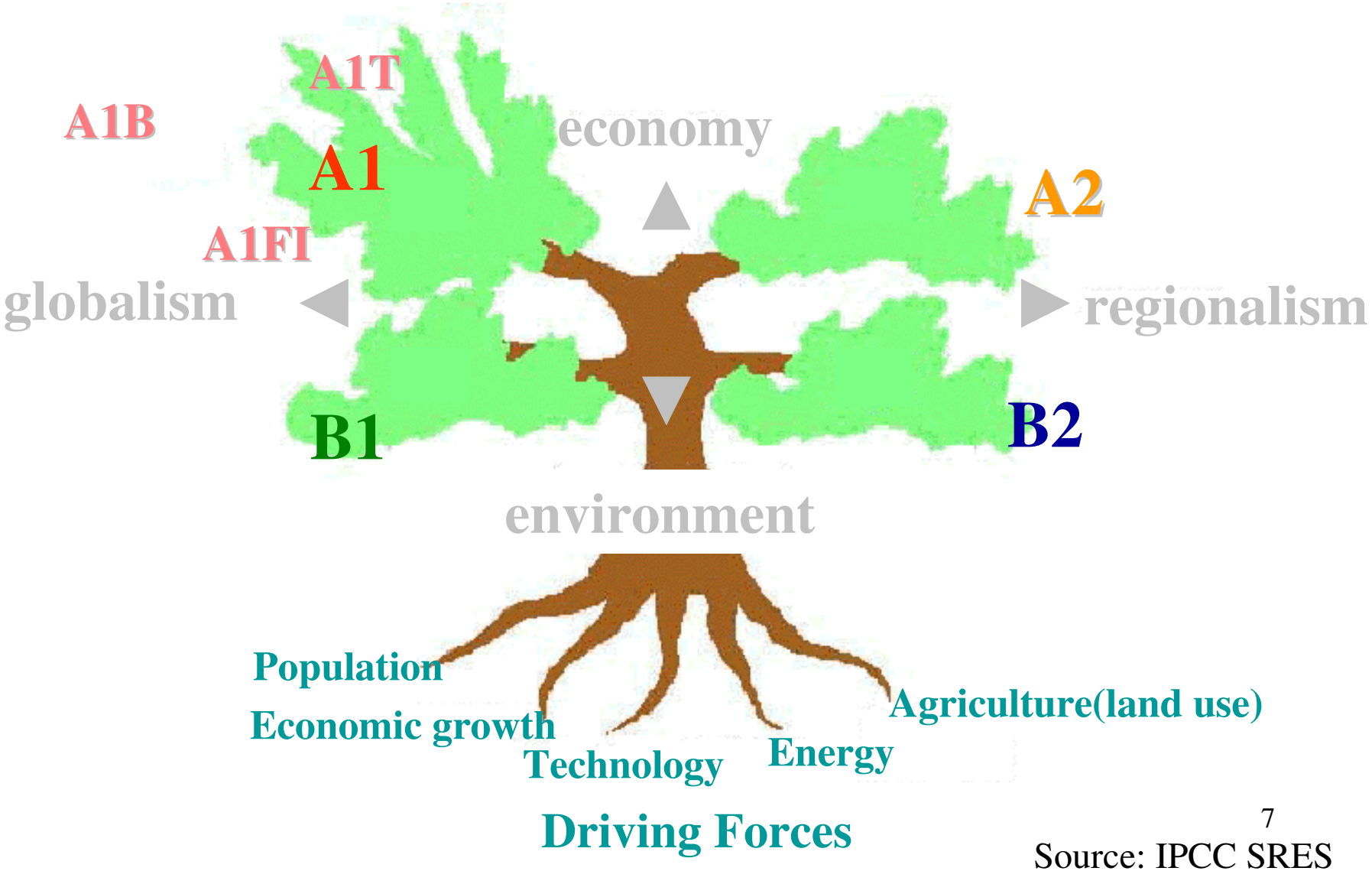
Source: Nakicenovic, 2005

Alternative Scenario Formulations



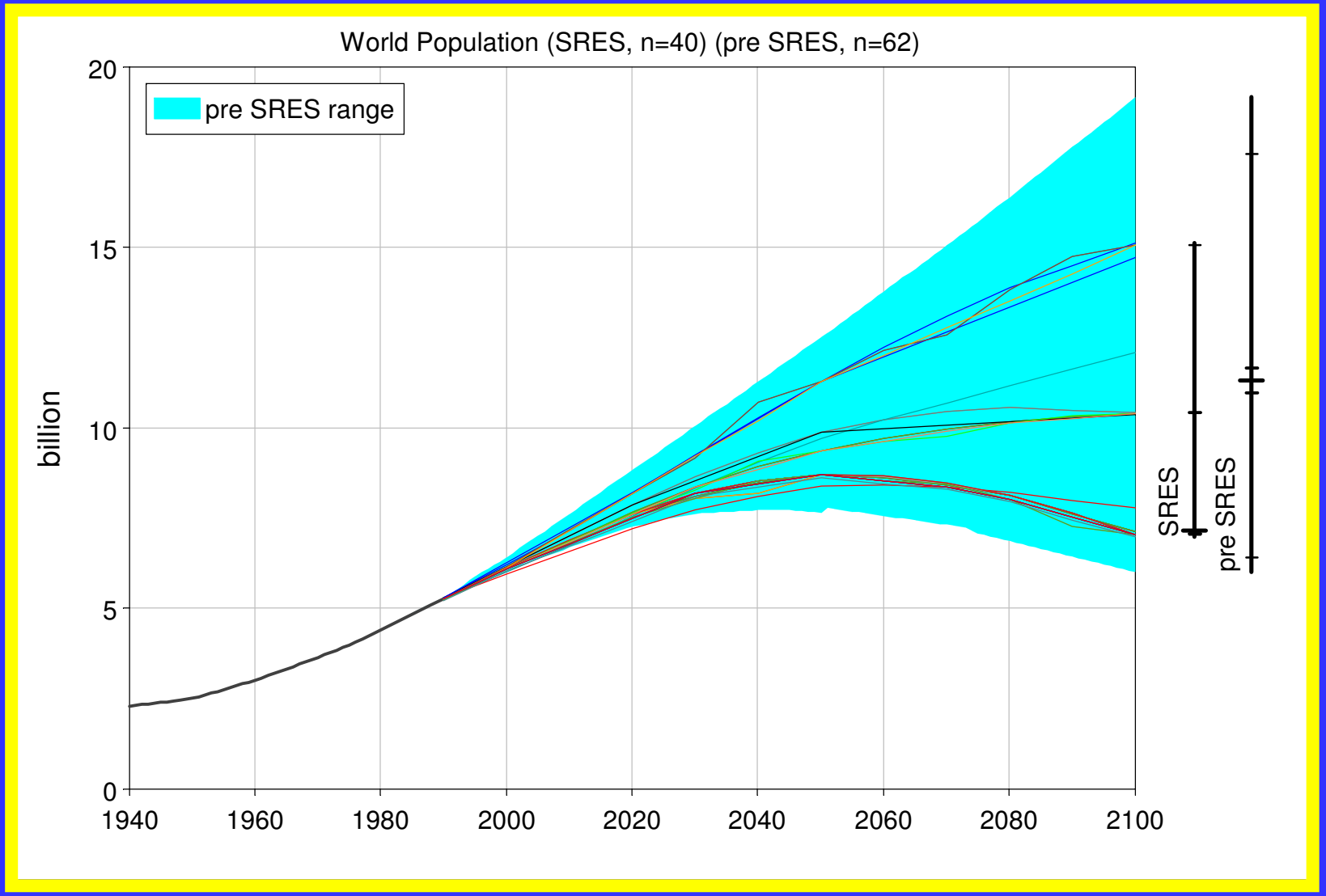
Source: IPCC SRES, 2000

SRES: Socioeconomic development scenarios for climate change prediction



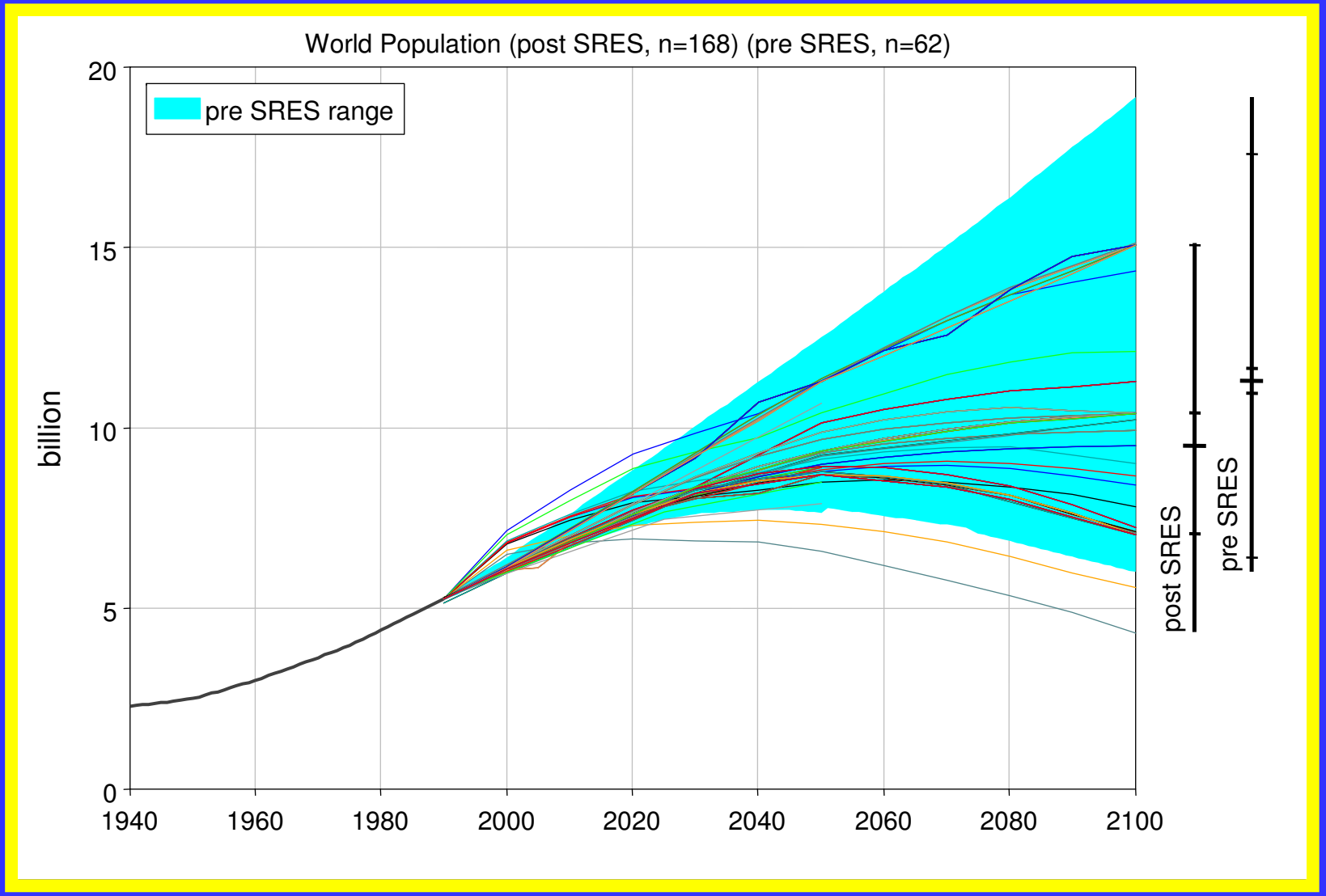
Source: IPCC SRES

Global Population Projections



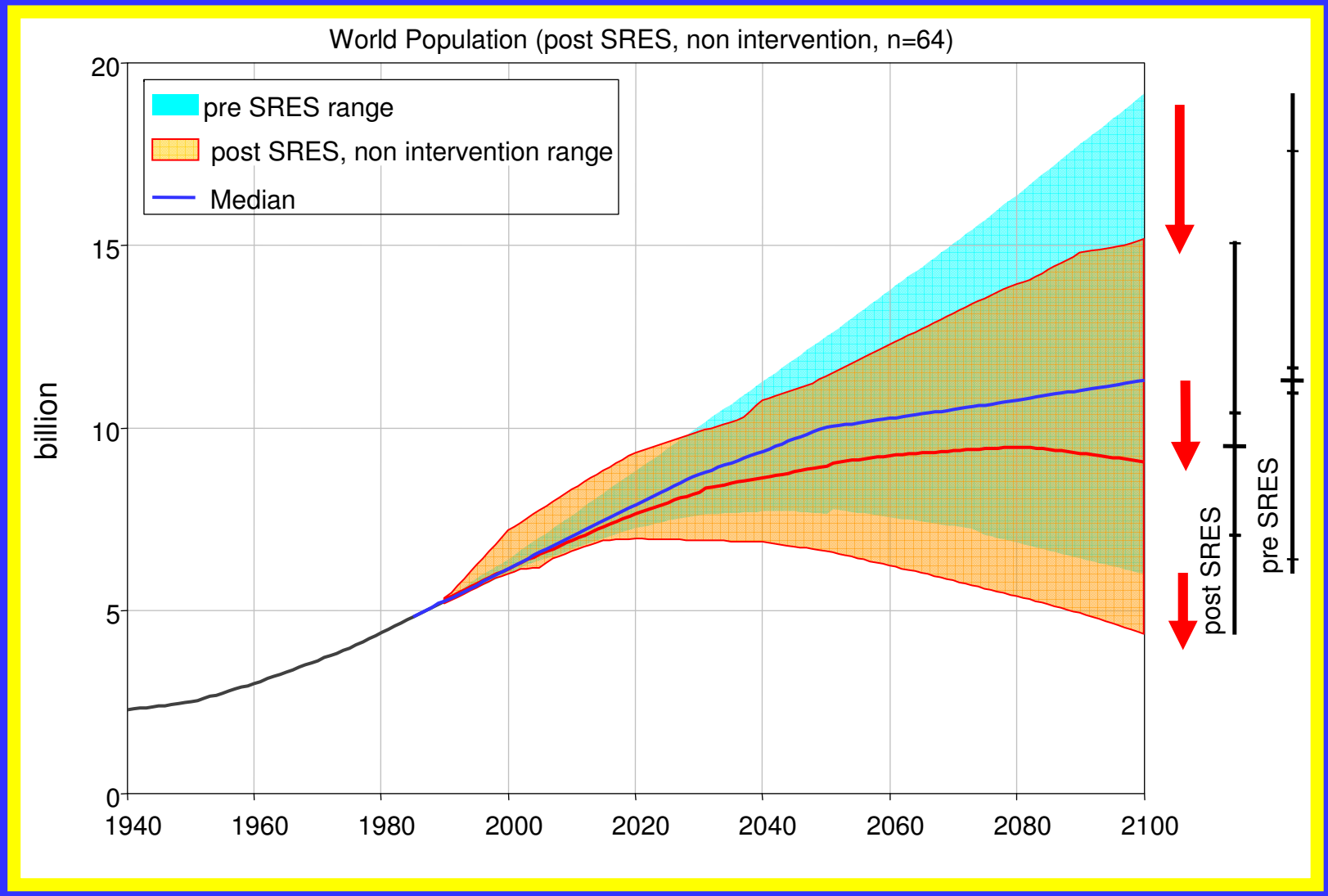
Source: Nakicenovic et al., 2006

Global Population Projections



Source: Nakicenovic et al., 2006

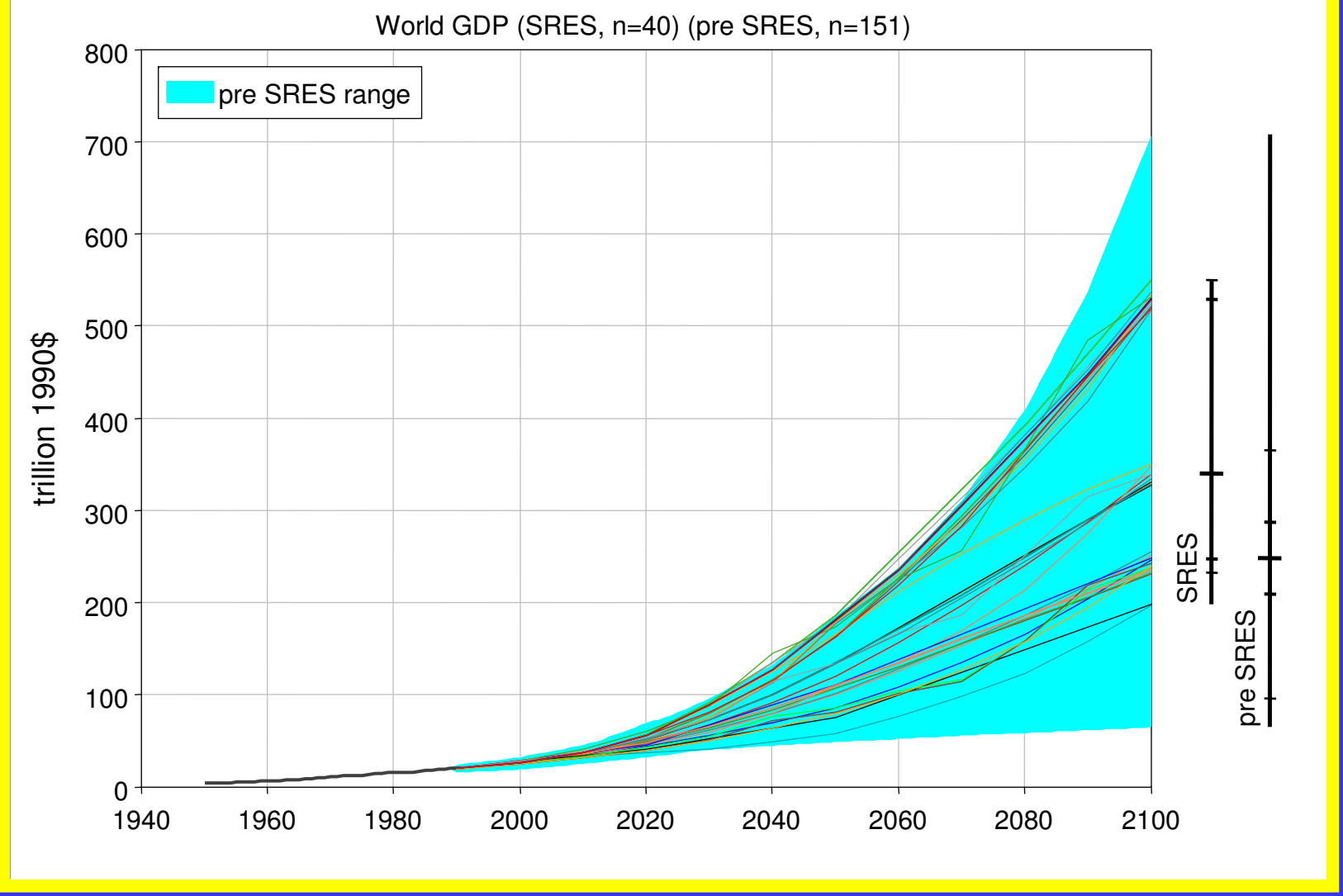
Global Population Projections



Source: Nakicenovic et al., 2006

Gross World Product

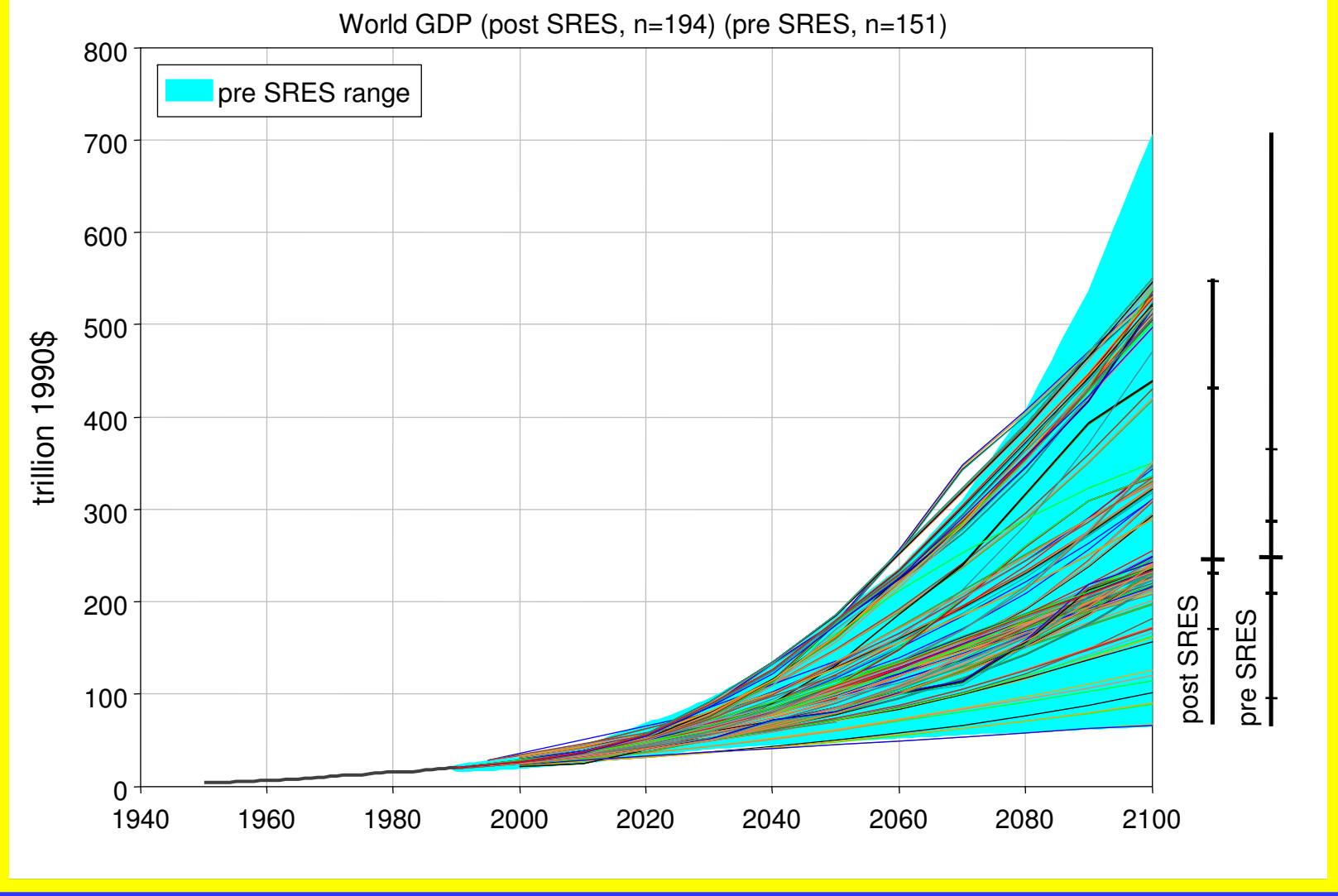
Range Across Emissions Scenarios



Source: Nakicenovic et al., 2006

Gross World Product

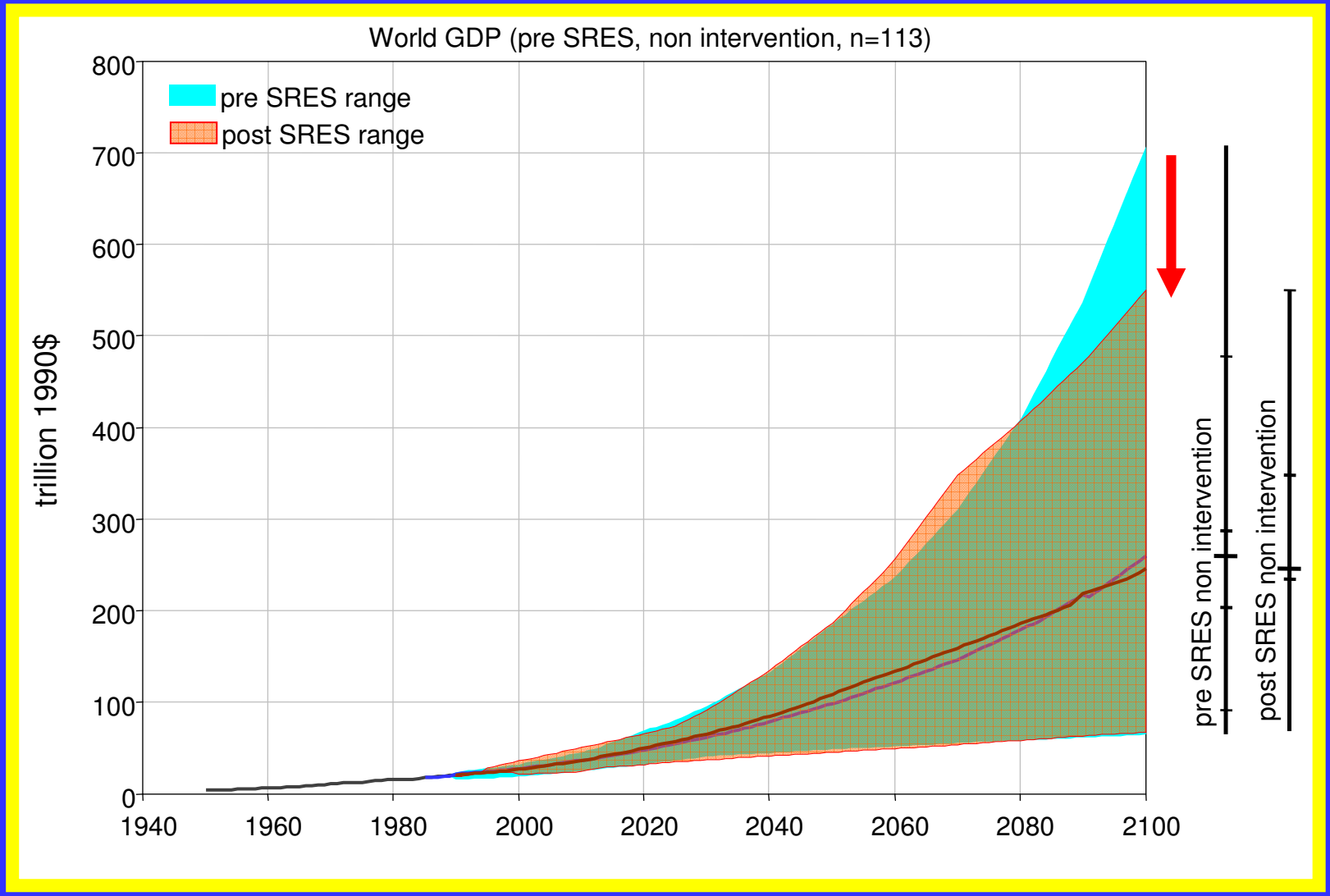
Range Across Emissions Scenarios



Source: Nakicenovic et al., 2006

Gross World Product

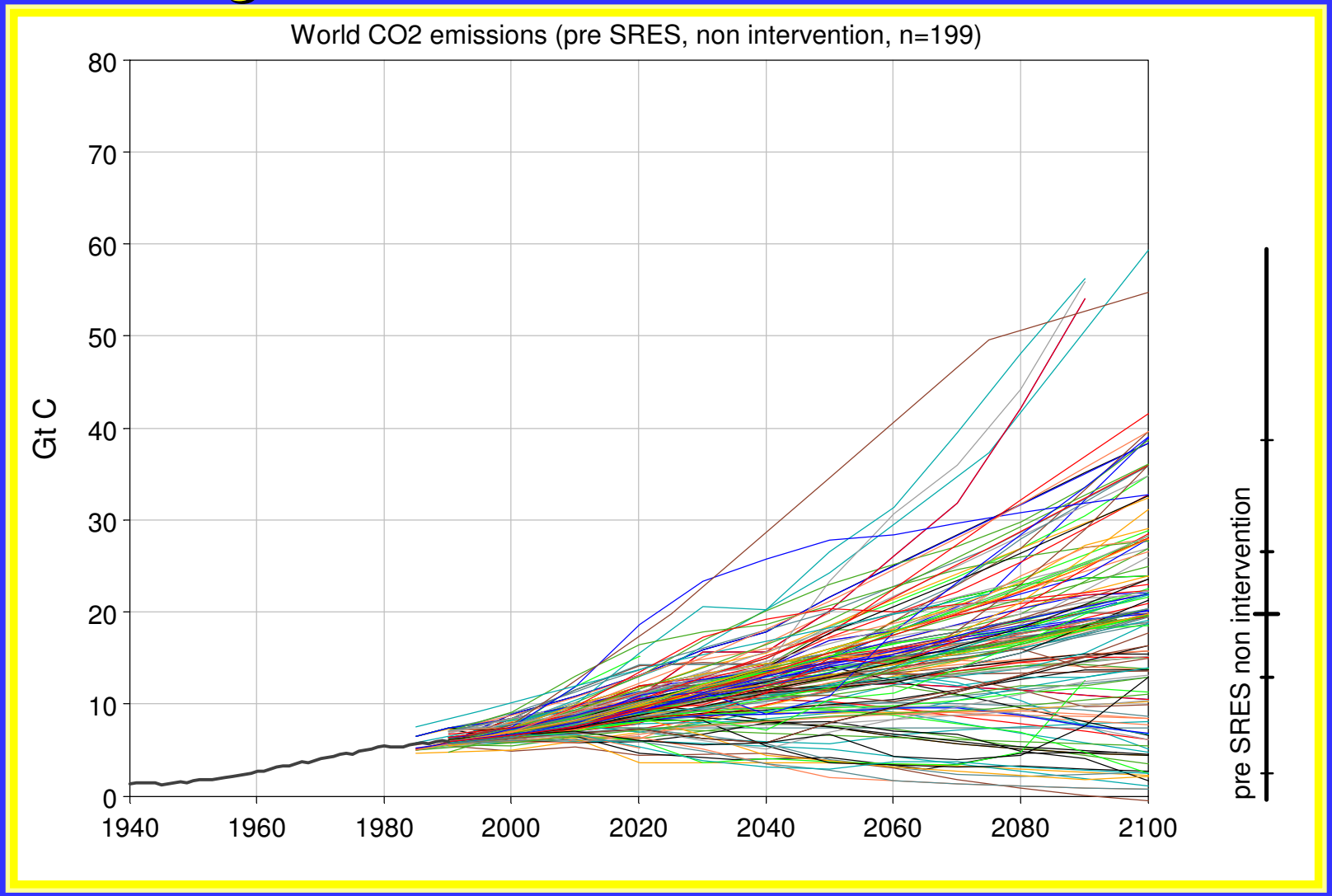
Range Across Emissions Scenarios



Source: Nakicenovic et al., 2006

Carbon Emissions

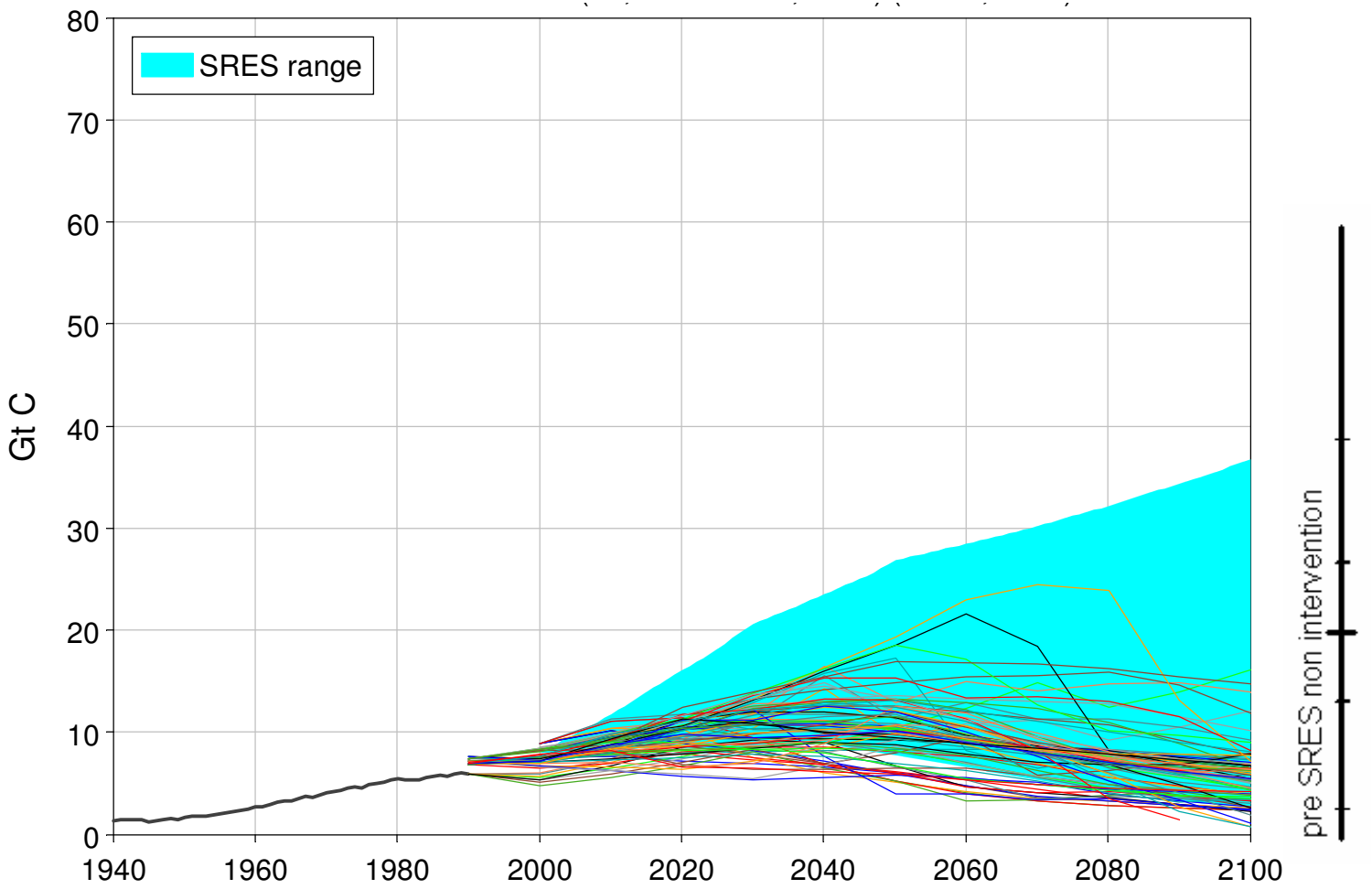
Range Across Emissions Scenarios



Source: Nakicenovic et al., 2006

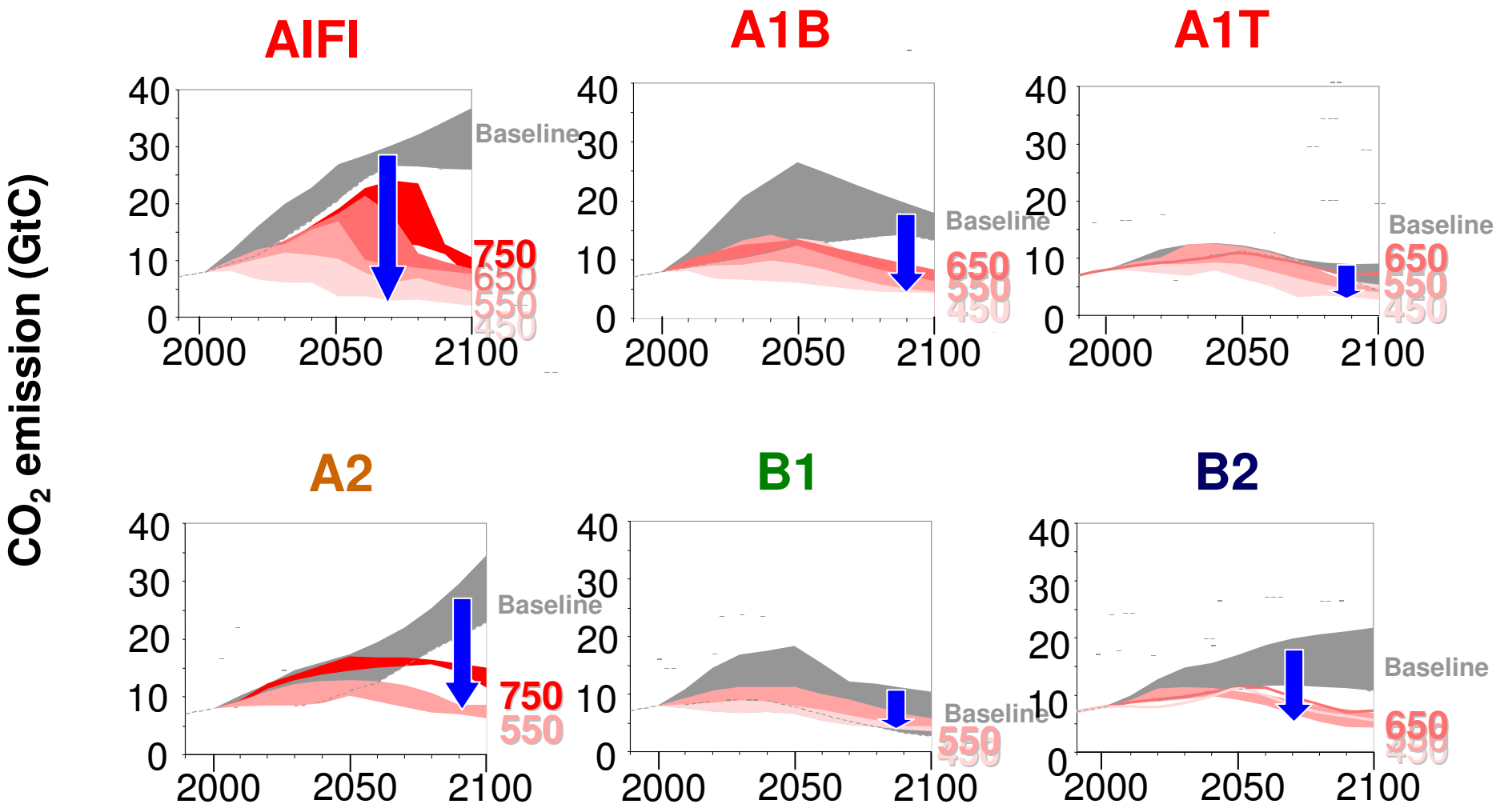
Carbon Emissions

TAR Intervention Scenarios



Source: Nakicenovic et al., 2006

Difficulty of CO2 reduction depends on development path for future world



A1FI and A2 require much larger reduction than A1T and B1

Major findings of Post-SRES

- Different development paths require different technology/ policy measures and show different costs of mitigation to stabilize atmospheric CO_2 concentrations
- A portfolio of measures required for timely development, adoption and diffusion of mitigation options; Policy integration across an array of technologies, sectors and regions is the key to successful climate policies
- However, associated socio-economic and institutional changes are required to realize the potential for the above stabilization in practice

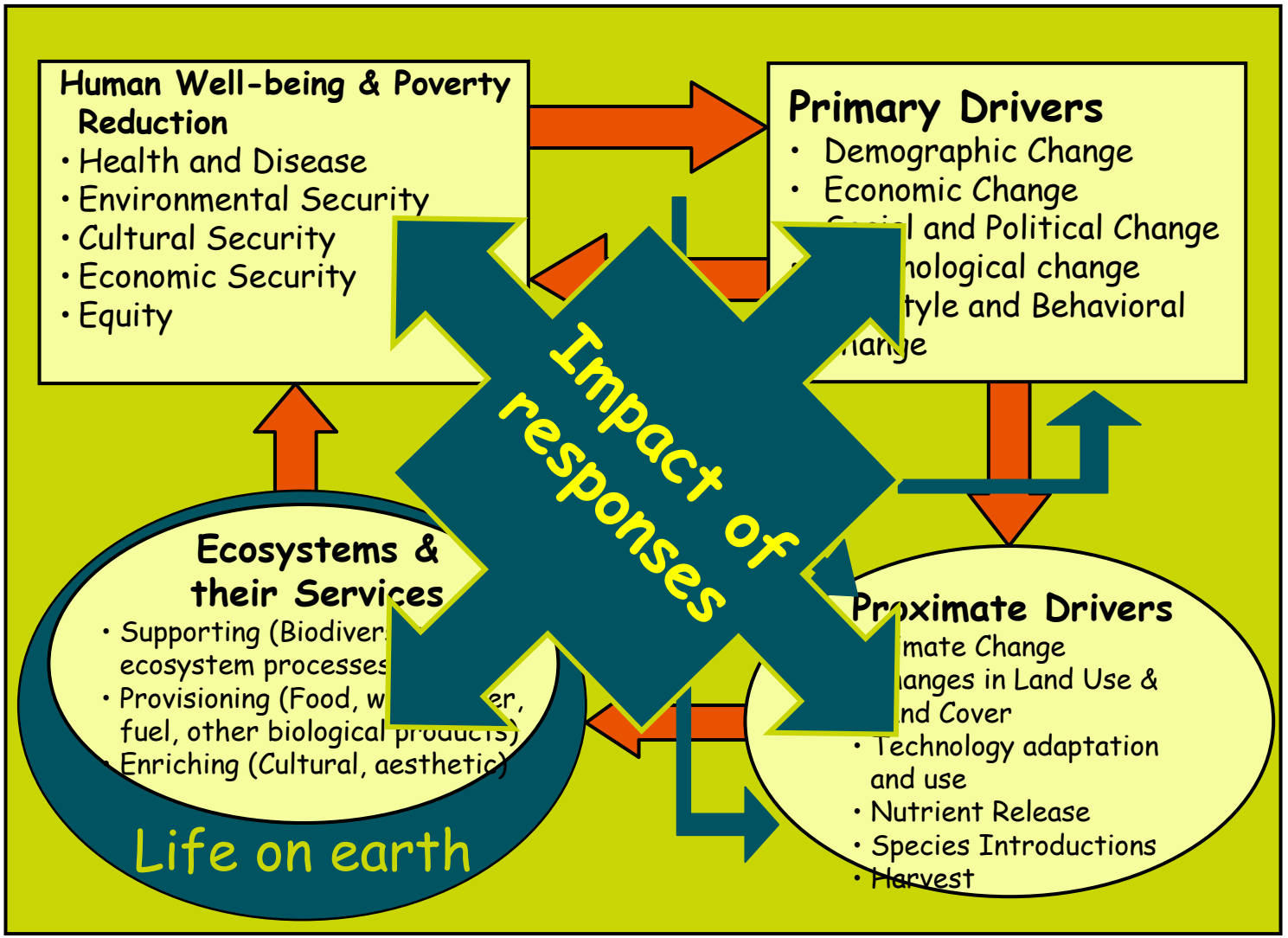
Issues after Post-SRES

- Greater need for the linkage of emission and impact analysis
  - Appropriate criteria of stabilization targets (ex. GHG concentration, radiative forcing, temperature change, rate of temperature change, sea level rise, rate of sea level rise)
  - Timing of mitigation (early vs. late)
- Uncertainty in future technological advances (risks of mitigation in later stage)
- Specific mitigation implementation strategies for achieving targets of 550 ppmv, 450 ppmv, etc.

Recent Stabilization Scenarios

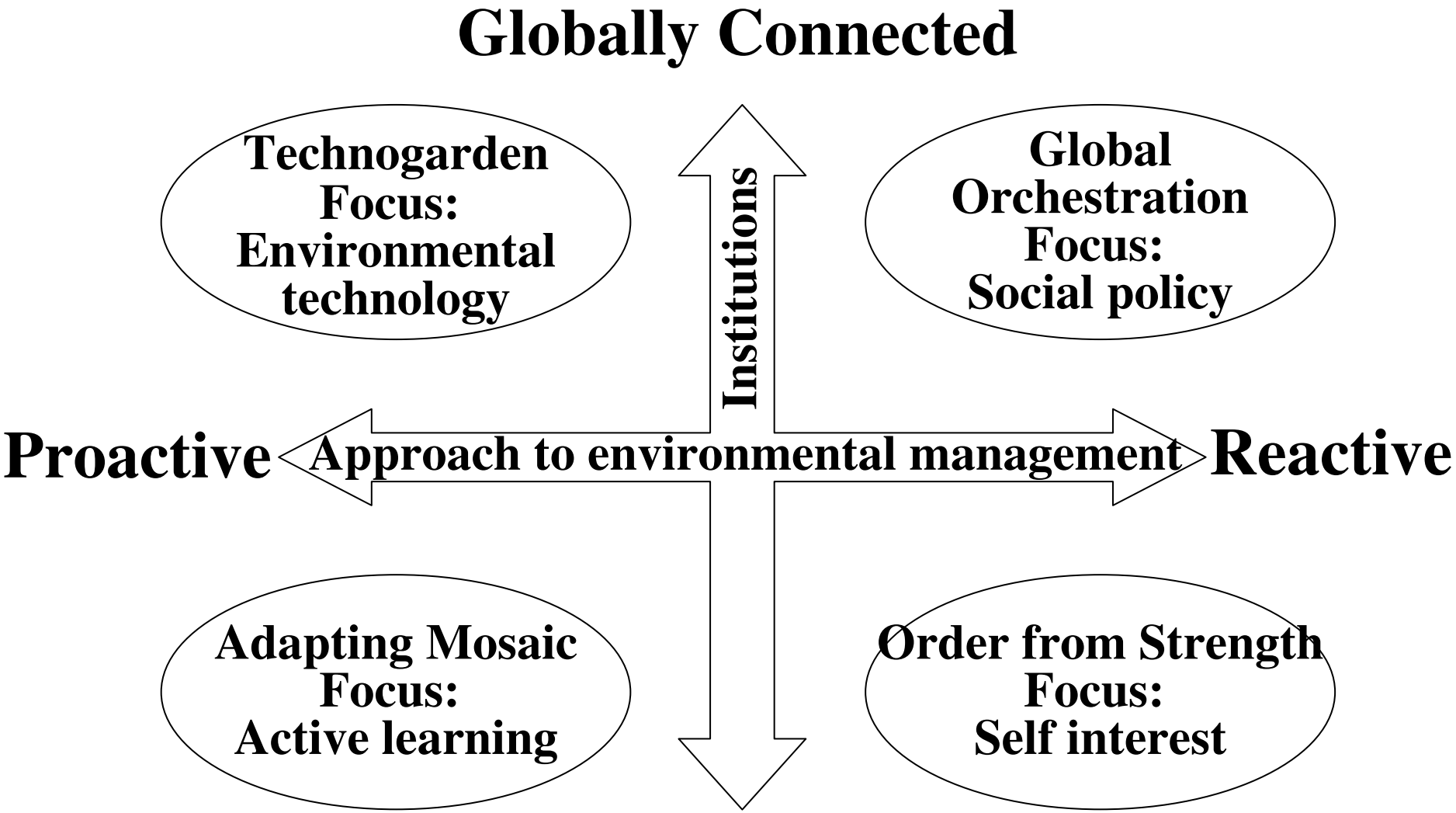
- Global level studies
  - e.g. MA, UNEP/GEO, EMF21, IEA/Energy to 2050,
- Country level studies
  - Each country focusing on its own mitigation targets and ways to achieve them
- Sector focused analysis
  - e.g. OECD/Environmentally Sustainable Transport

Framework of MA (Millennium ecosystem assessment)



= Strategies and Interventions

Frame of MA Scenarios



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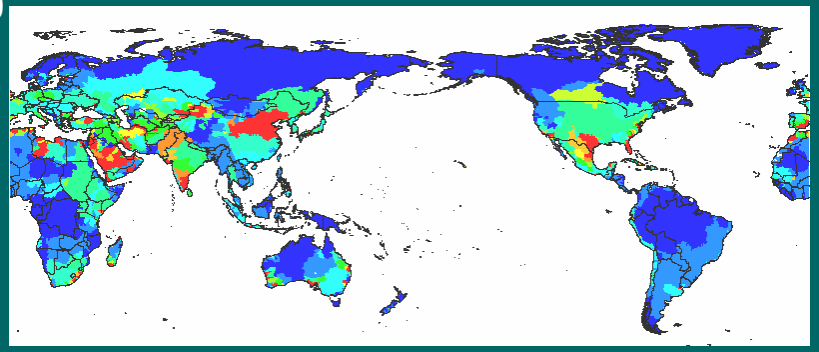
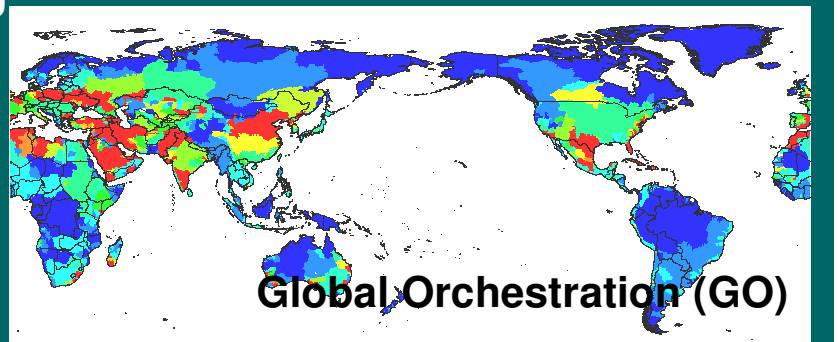
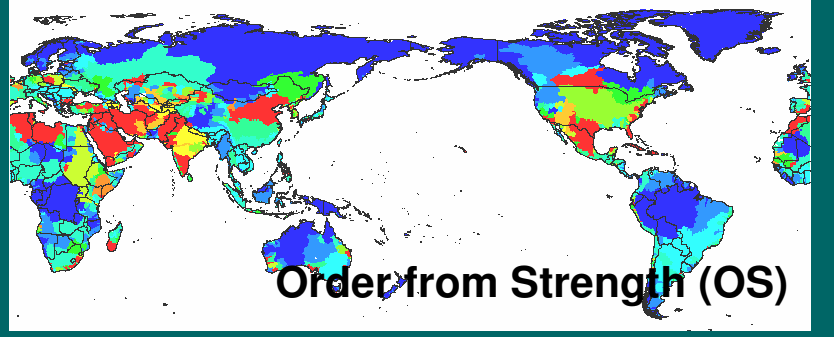
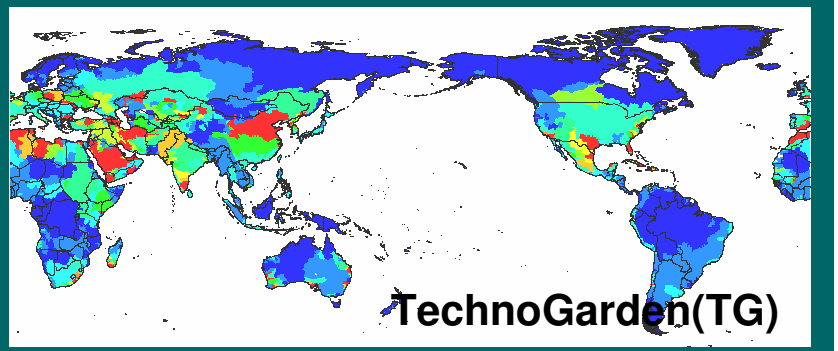
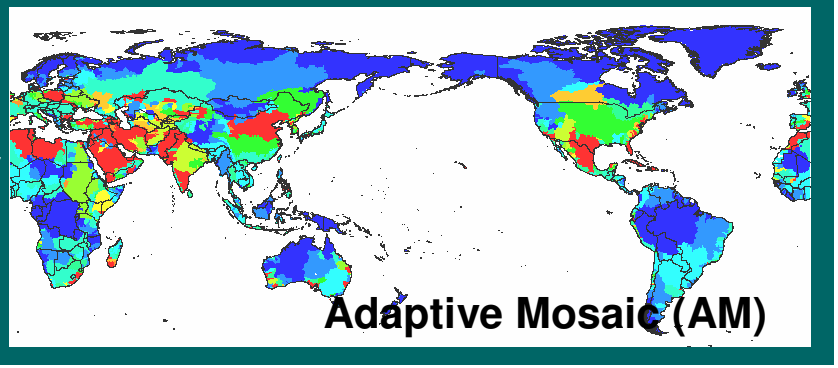


2100









-In general, the order of stress is OS > AM > GO > TG

Withdrawal: driven by socio-economic factors

Water resource: driven by climate factors

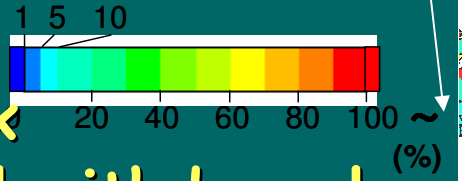
General trend of stress index change can be explained by demand side.

-Middle East and North Africa

High drought risk ← water demand increase derived from population increase and economic development. Mitigated in TG ← high efficiency of water use.

-East Europe

High draught risk inGO ←high rate increase of industrial water withdrawal which cannot be compensated with the water use efficiency improvement.



Water Stress Index (ratio between total withdrawal and renewable water resource)

The Background of UNEP/GEO

- The UNEP GEO project was initiated in response to
  - Environmental reporting requirements of *Agenda 21*
  - UNEP governing council decision of May 1995
- The coordinated global network of collaborating centers (CCs) is at the core of the GEO process
- Reports are produced using regional and participatory approach

Key Questions and Elements

The Outlook

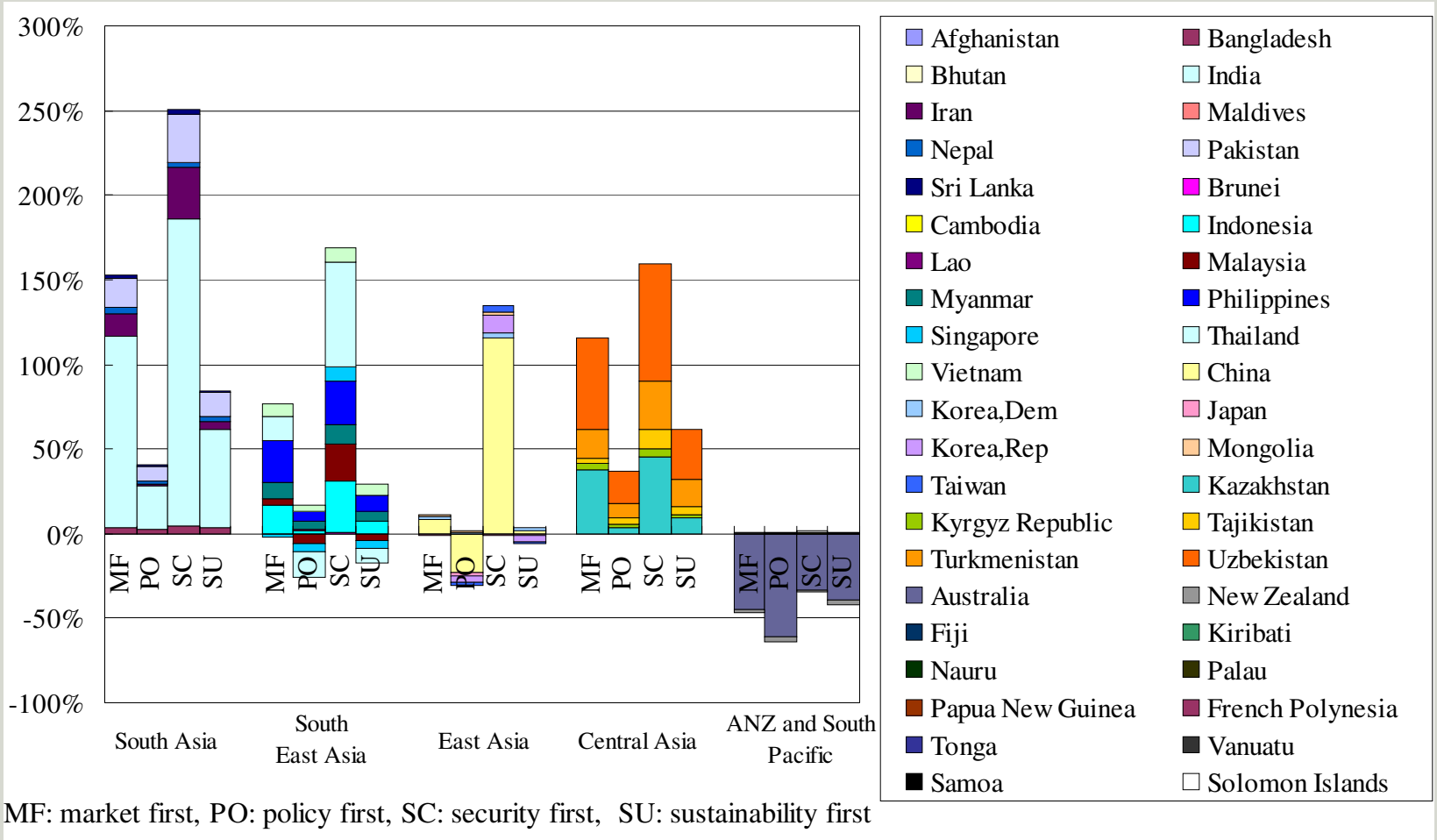
- The extent and direction of opportunities (actions) would determine different out looks for the future.
- GEO 4 will explore possible futures
  - Markets first, Policy first, Security first, Sustainability first
- Regional differentiation and regional and global implications to be explored
- Implications of decisions made today

Proposed Plan for the Outlook Component of GEO-4

Proposed Purpose and Key Questions

- Where does each scenario stand in relation to specific goals?
- What are intermediate and long-term implications of current (and already taken) actions?
- What are the contrasting 'costs' (in a broad sense) for achieving particular sustainability goals under the scenarios?
- How, and how well, can different actors/regions respond to a future shock/disturbance/new insight/concern under the different scenarios?

Some GEO 3 Outlook Results

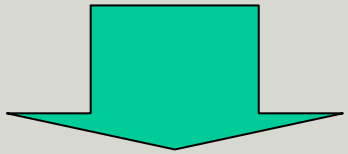


MF: market first, PO: policy first, SC: security first, SU: sustainability first

Change in energy-related SO_2 emissions by 2032 relative to 2002 (%)

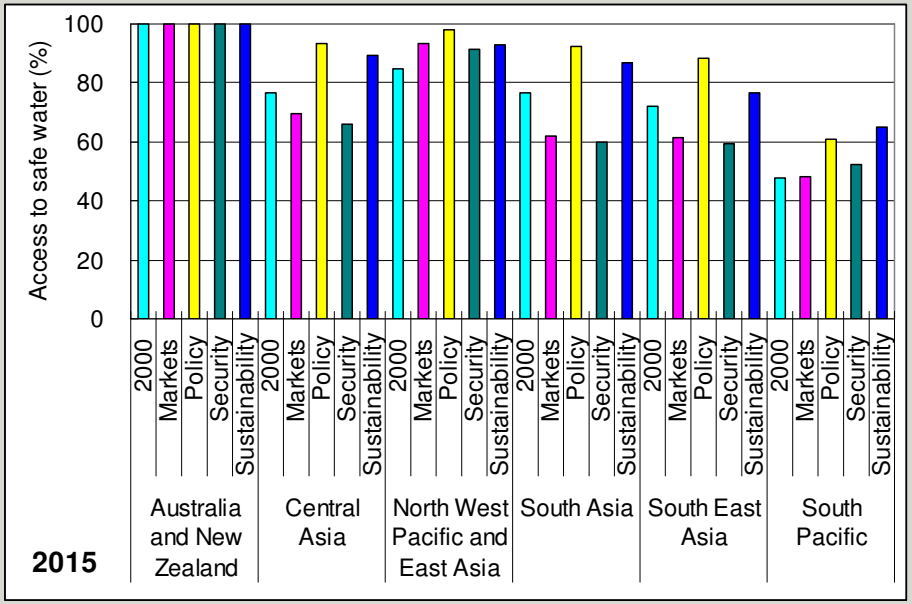
Example: Access to safe water/sanitation by AIM/Water

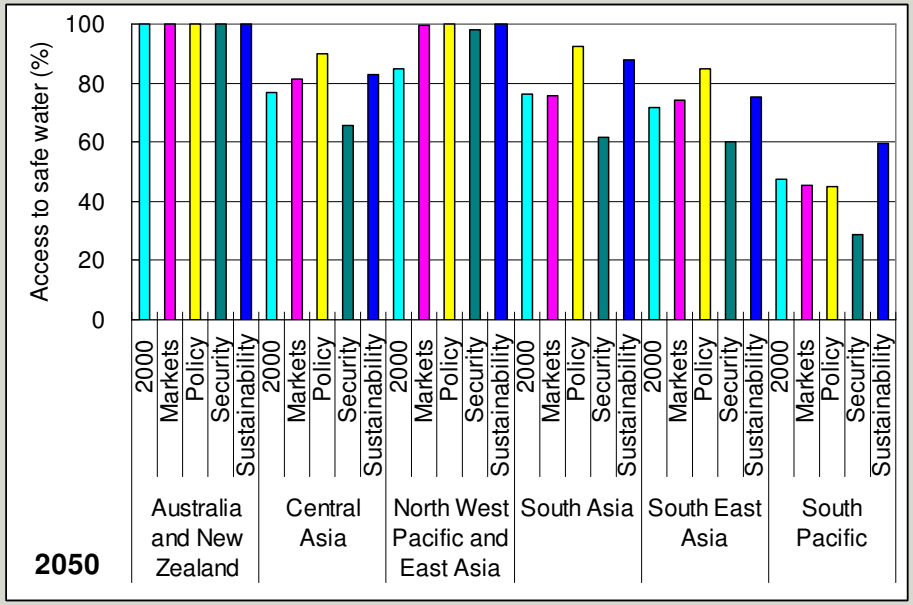
- Request for Storyline
  - ✓ Millennium Development Goals 7, Target 10: Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation
  - ▸▸▸ Timing of MDG achievement
  - ▸▸▸ Quality of safe water/sanitation technologies or investment cost



- Quantification
  - ✓ Consistency check between access to safe water/sanitation by technology, investment costs and MDG achievement
  - ✓ Potential mortality of diarrhea

Access to safe water in 2015 and 2050





- 2015
  - ✓ PF scenario in every sub-region except South Pacific achieves MDG due to fully investment cost and SuF scenario achieves MDG in some sub-regions.
  - ✓ MF only achieves MDG in Northwest Pacific and East Asia and SeF scenario fail to achieve MDG.
  - ✓Austria and New Zealand already have 100% access to safe water.
- 2050
  - ✓In Northwest Pacific and East Asia, four scenario almost achieve 100% access to safe water based on rapid economic growth
  - ✓ In other sub-regions, growth of access to safe water coverage stagnates because of rapid population growth, investment cost limitation and rise of investment cost for household connection

Millennium Development Goal (MDG), Goal 7, Target 10: Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation

How much speed of technological change should be required to achieve Low Carbon Society?

- Comparison of scenarios -

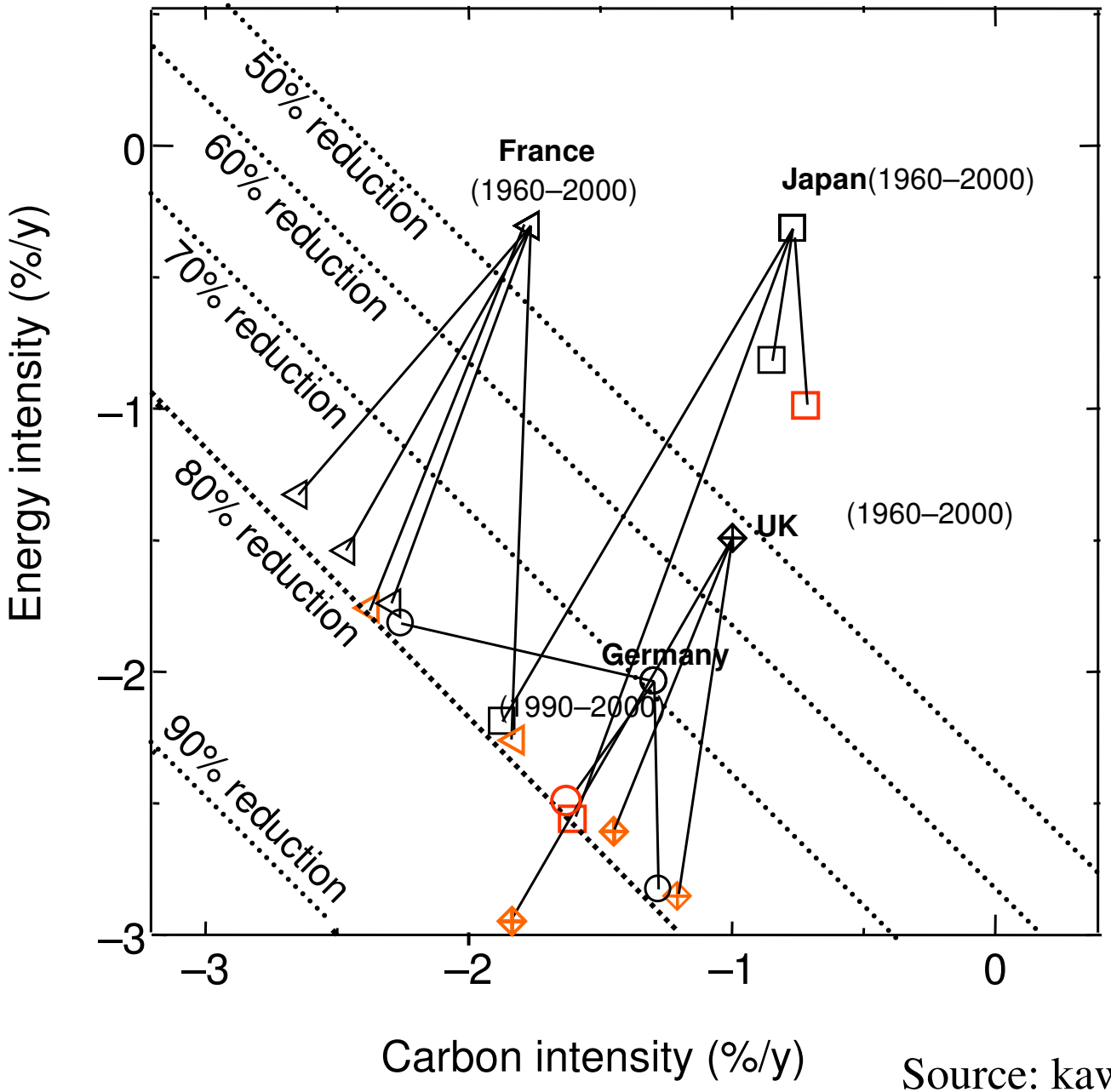
CO2 emission disaggregation by Kaya identity

$$CO_2 = (CO2/E) \times (E/GDP) \times GDP$$

E : Primary energy use, E/GDP: Energy intensity

CO2/E : Carbon intensity

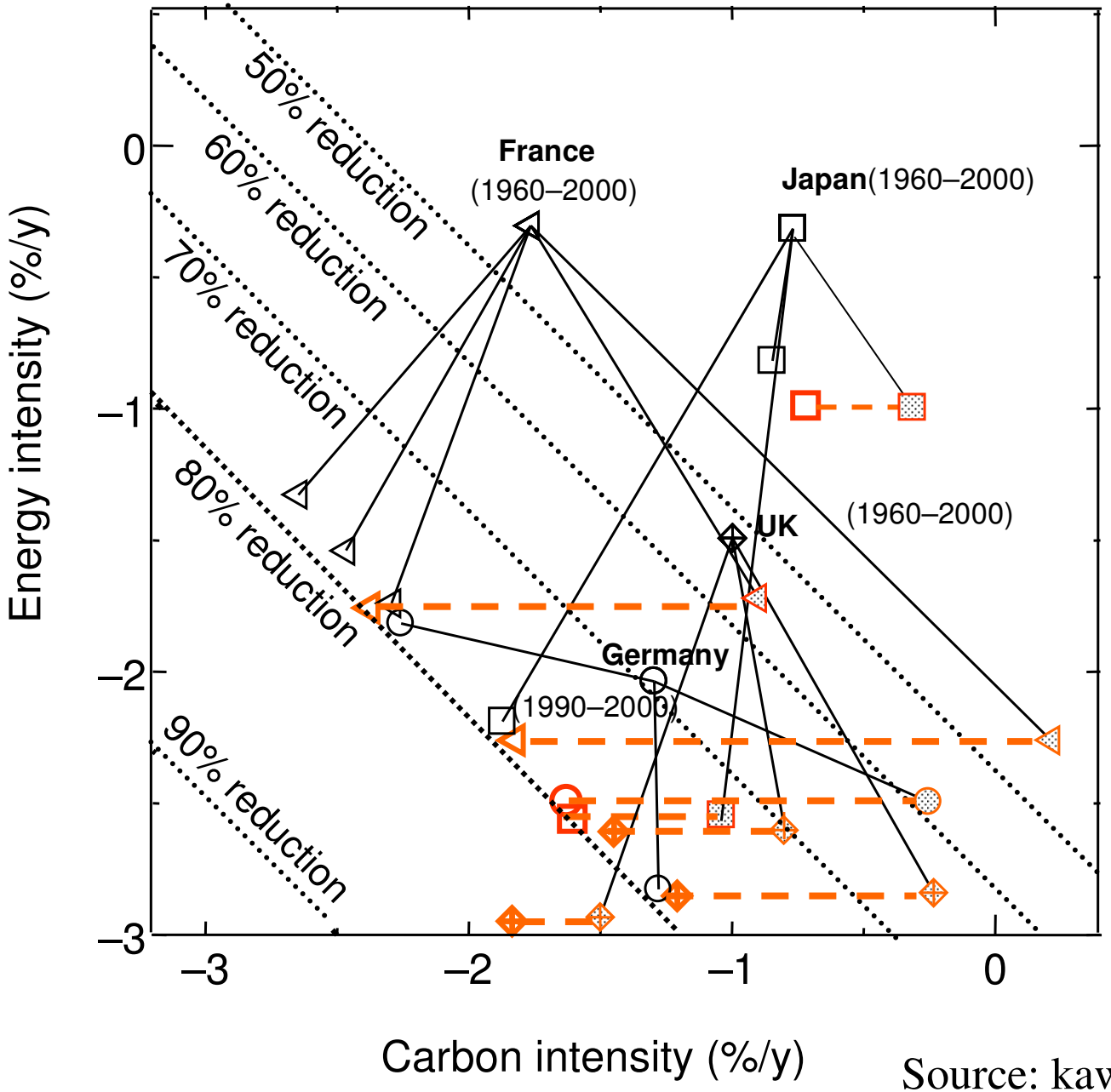
Rates of change of aggregated energy intensity and carbon intensity



Dotted isoquant lines show the estimated CO2 reduction over 50years assuming annual GDP growth rate of 1% for each country; It must be noted that reduction levels shown here are not the same as those reported by each country's scenarios because they assume different GDP growth rate

Source: kawase et al., 2006

Rates of change of aggregated energy intensity and carbon intensity



Change in carbon intensity excluding carbon capture and storage (CCS)

Change in carbon intensity with CCS

Dotted isoquant lines show the estimated CO2 reduction over 50yrs assuming annual GDP growth rate of 1% for each country; It must be noted that reduction levels shown here are not the same as those reported by each country's scenarios because they assume different GDP growth rate

Source: kawase et al., 2006

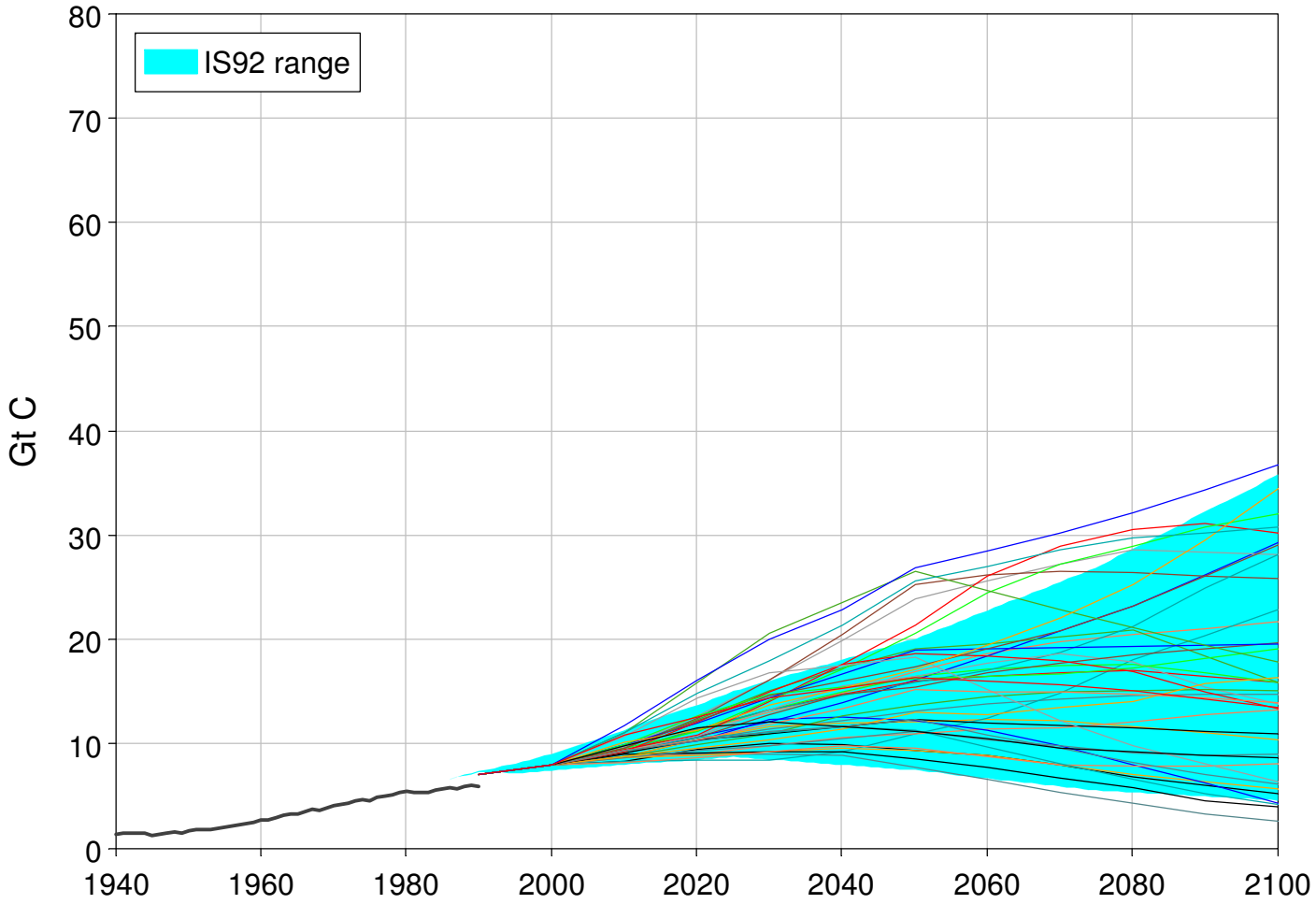
Summary

- To achieve ambitious target of a 50-90% CO2 emission reduction, the pace of aggregated energy intensity improvement and carbon intensity decrease must be 2-3 times greater than the 40-year historical change, while the change rates should be maintained for 50 years.
- We need ‘trend-braking’ intervention. What and How?
- Scenarios can help to foresee the future world and provide lessons from the future.

Thank you for your attention!

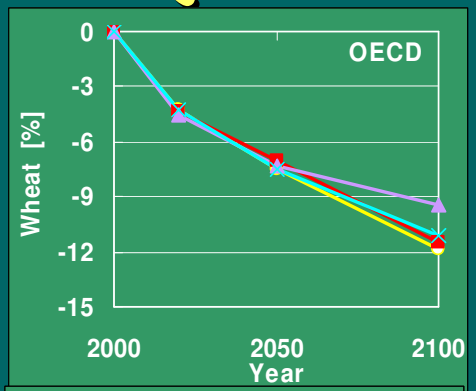
Carbon Emissions

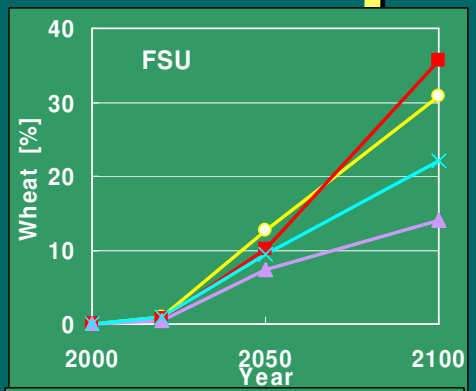
SRES Range of Scenarios

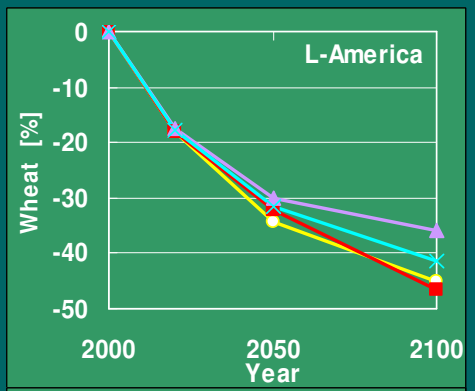


Source: Nakicenovic et al., 2006

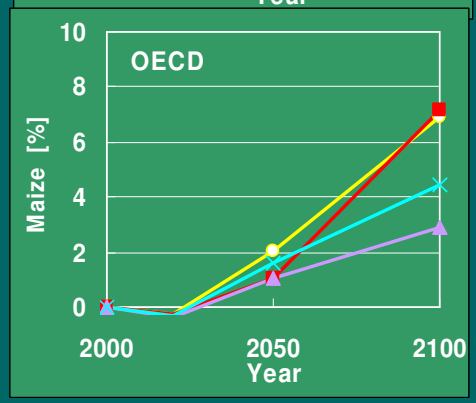
Simulation Results (Potential crop productivity)

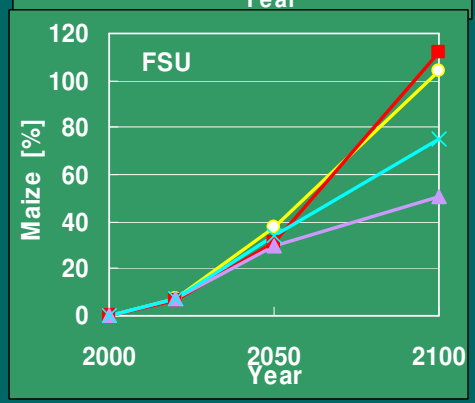


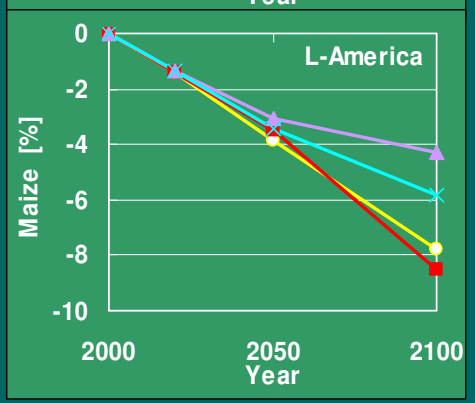




Wheat







Maize

-Generally, the degree of potential productivity change coincides with the speed of temperature increase; FW > EO > LL >TG. Potential productivity will increase in high-latitude regions, and decrease in low-latitude regions. In mid-latitude regions, effect of climate change depends on the variety of crops.

-FSU: productivities of wheat and maize increase very rapidly by global warming under any scenarios.

-Latin America: As global warming progresses, the potential productivity will decrease.

-OECD: the potential productivity of wheat will decrease, while that of maize will increase because of global warming. Generally, the most suitable temperature for maize growth is higher than that for wheat growth.

Proposed Plan for the Outlook Component of GEO-4

Starting point

- The GEO-3 scenarios will act as the first draft scenarios for GEO-4.
- The focus of the work will be on the global and regional levels with some differentiation, as appropriate, on a sub-regional level.

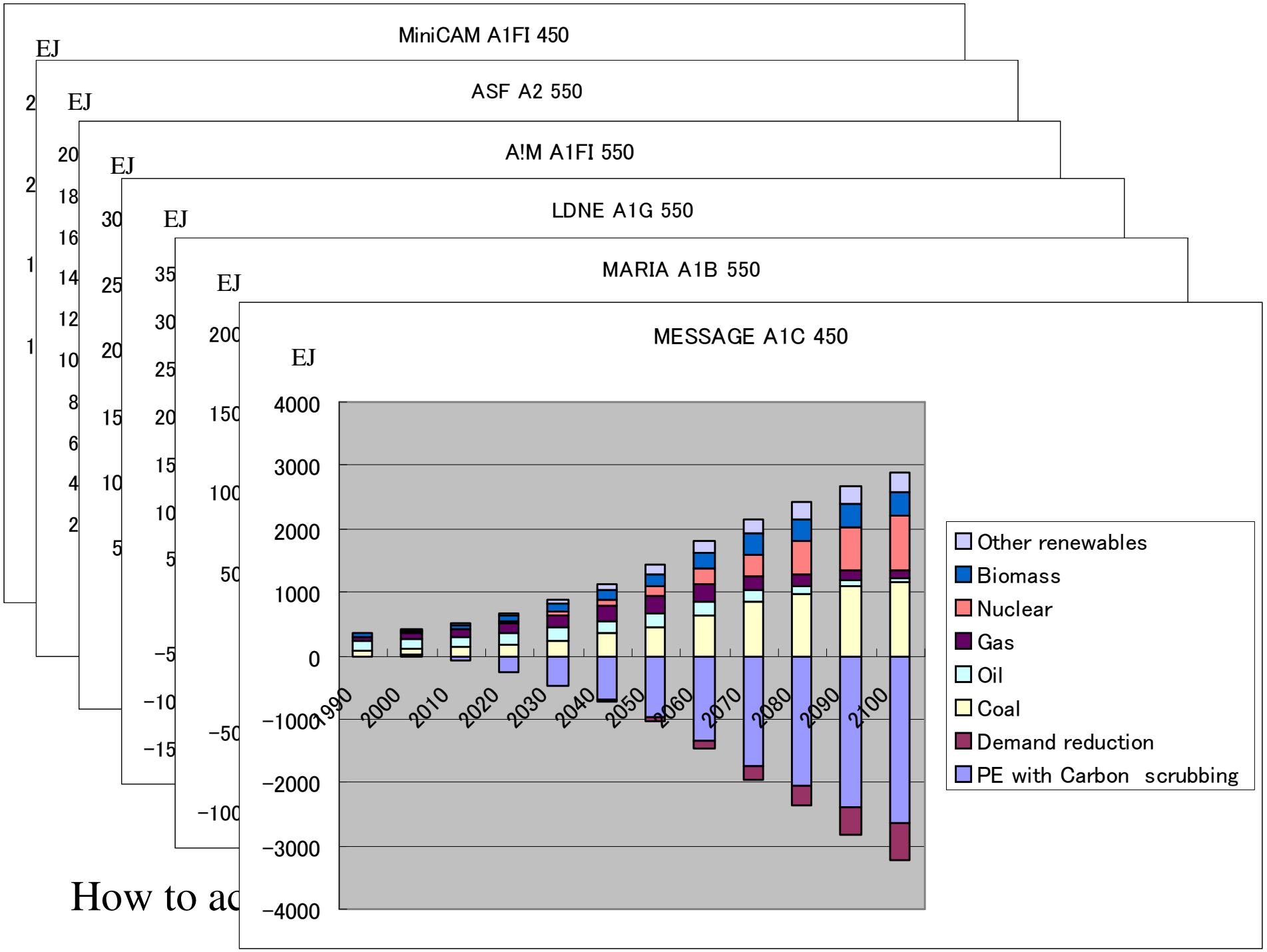
Temporal Specification

- Time horizon for narratives and quantification will be 2050
- Reporting of indicators in 2015 (short-term)
- Certain environmental indicators to 2100 (long-term)

Proposed Plan for the Outlook Component of GEO-4

Content Elements

- Specific priority, cross-cutting, and emerging issues
- Trends in key drivers, e.g. population, consumption, production, and technology
- Trends in key environmental indicators, e.g. pollutant levels, land cover, and biodiversity
- Progress toward specific goals and targets, e.g. MDGs
- Global story with regional elements, separate regional stories for each of the scenarios, (sub-)regions free to elaborate on issues that are important to them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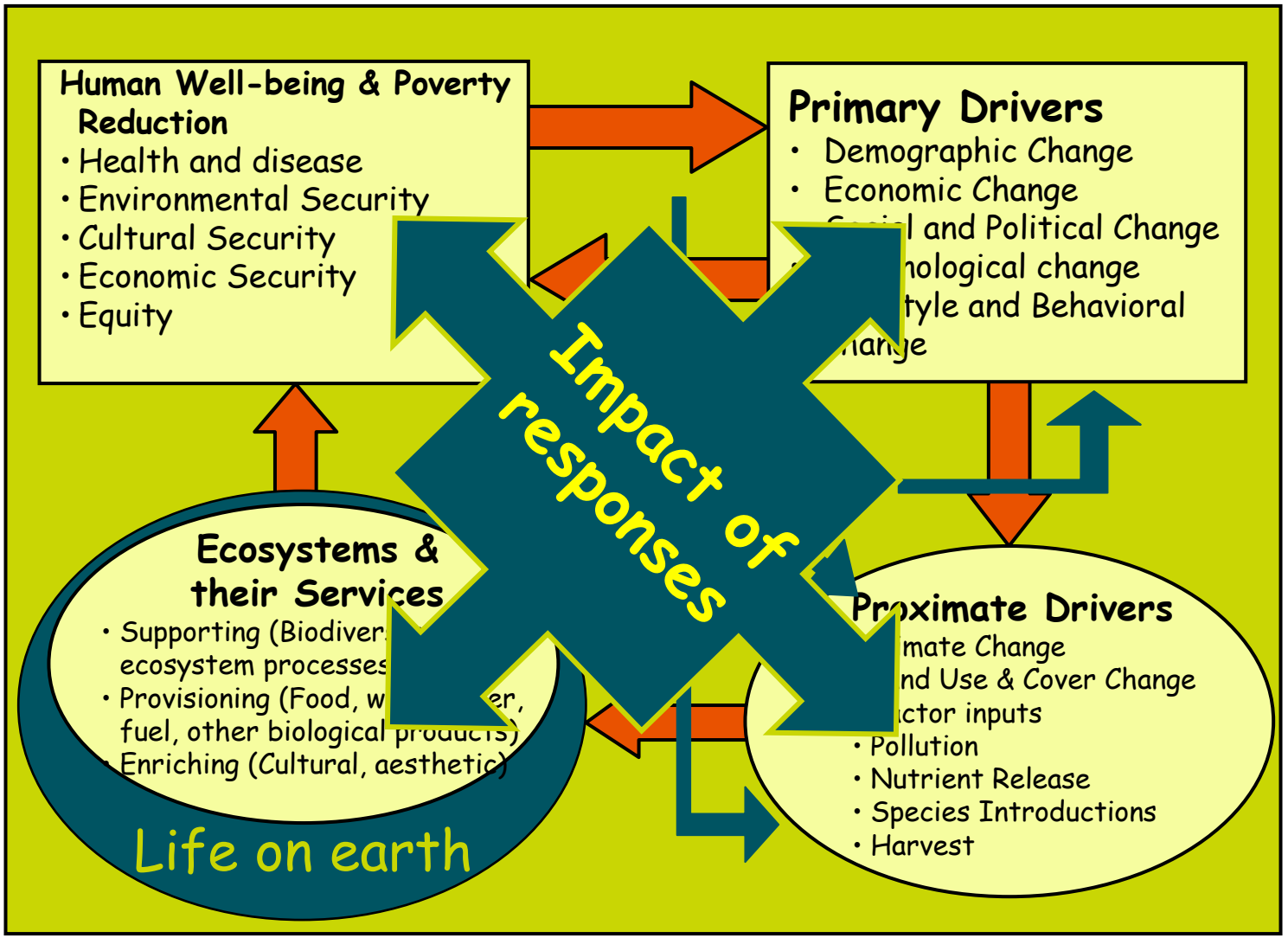
Oil
Coal
Demand reduction
PE with Carbon scrubbing

How to ac

Framework of MA
(Millennium ecosystem assessment)



= Strategies and Interventions

Ecosystem Services

Provisioning Services

Products obtained from Ecosystems

- Food
- Fresh water
- Fuelwood
- Fiber
- Biochemicals
- Genetic resources

Regulating Services

Benefits obtained from regulation of ecosystem Processes

- Climate regulation
- Disease regulation
- Water regulation
- Water purification
- Pollination

Cultural Services

Nonmaterial benefits obtained from Ecosystem

- Spiritual religious
- Recreation and ecotourism
- Aesthetic
- Inspirational
- Educational
- Sense of place
- Cultural heritage

Supporting Services

Services necessary for the production of all other ecosystem services

- Soil formation
- Nutrient cycling
- Primary production