Climate Stabilization Scenarios:
New Integrated Assessment Approaches for IPCC AR5 and Recent IIASA Scenarios

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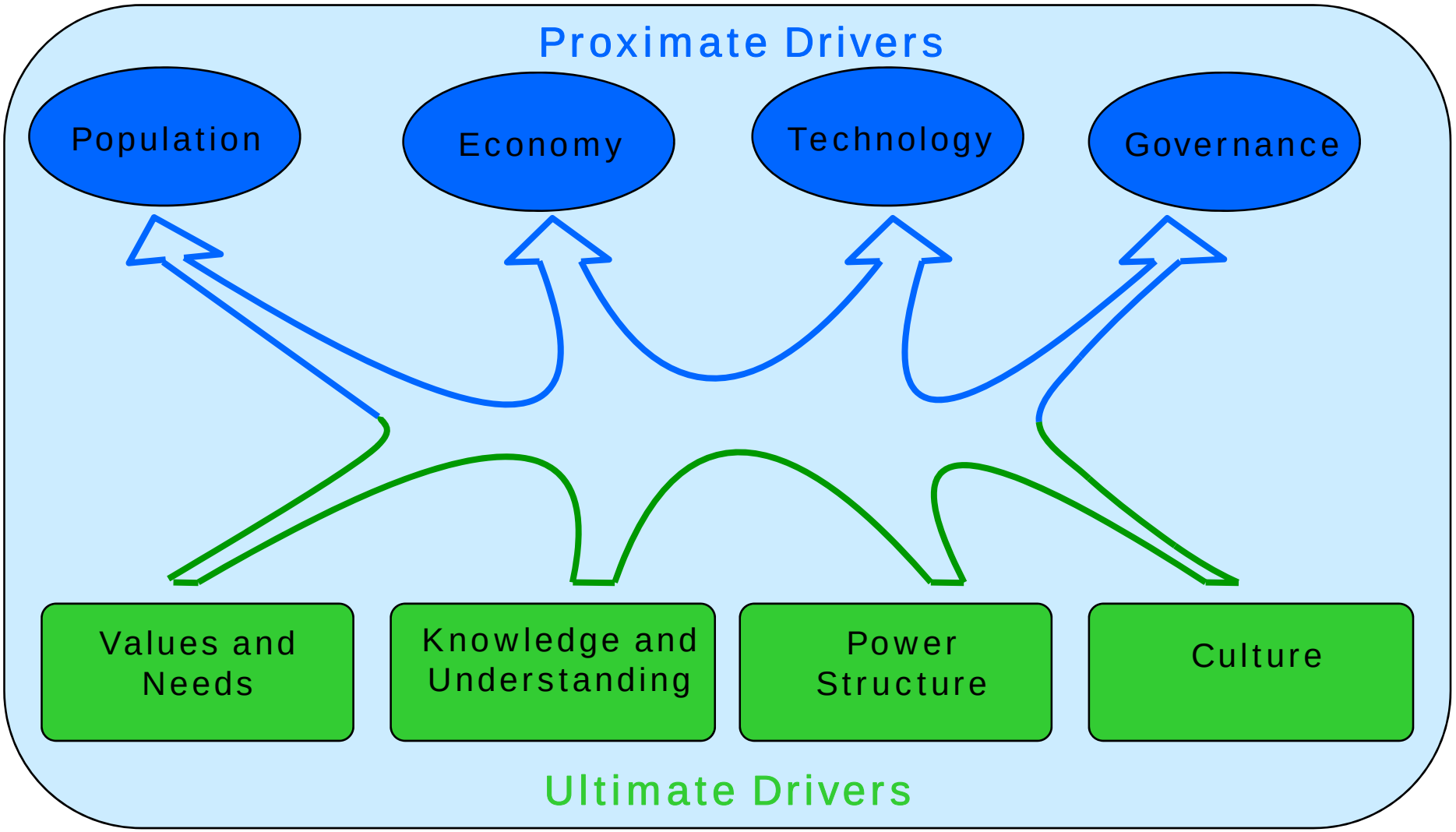
Scenarios:

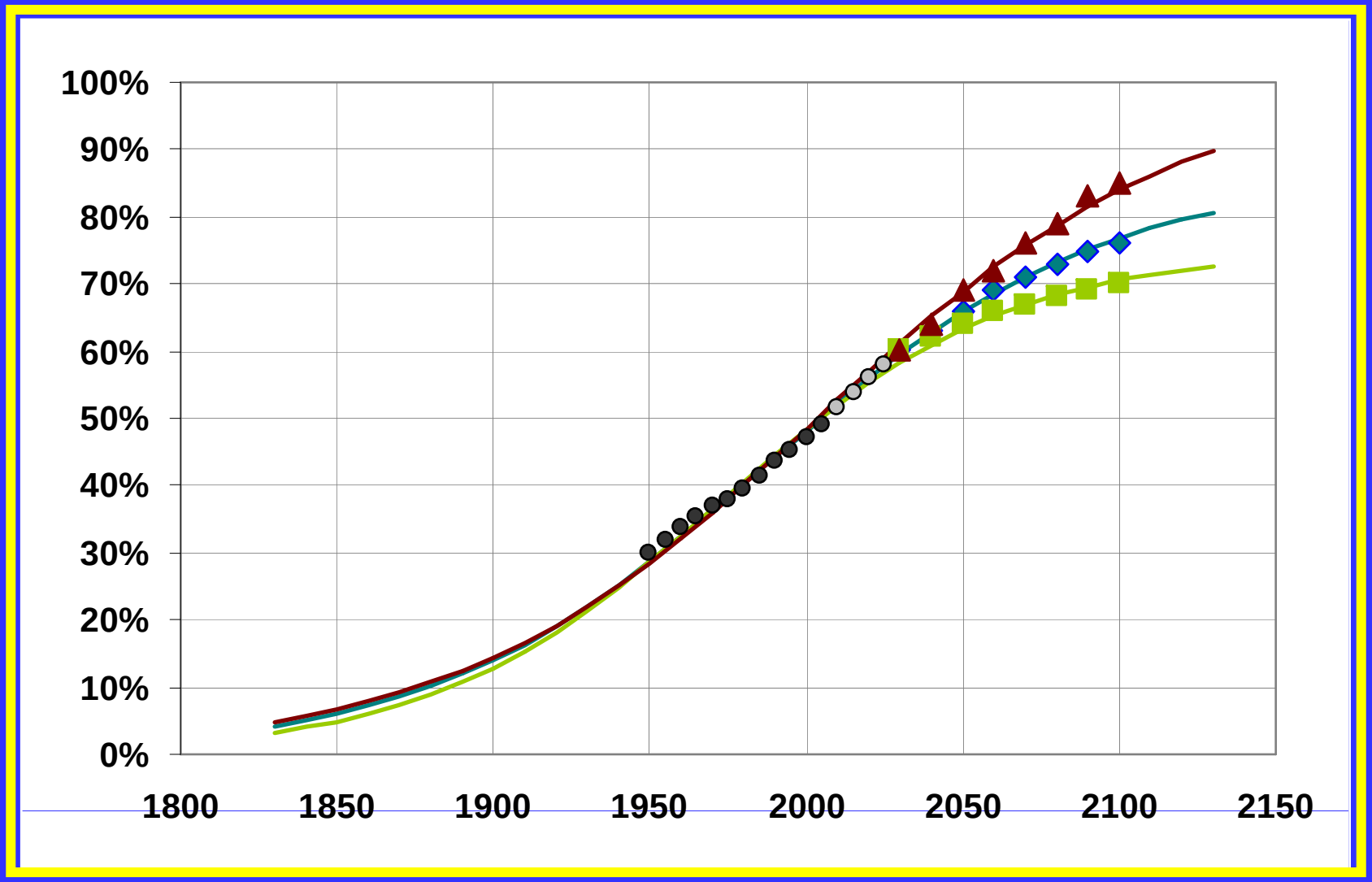
- Provide a framework for decision making which illuminates the impact associated with alternative courses of action
- Facilitate the interpretation of possible future states
- Include elements that cannot be formally modeled
- Aimed at challenging prevailing mind sets

Proximate and Ultimate Drivers

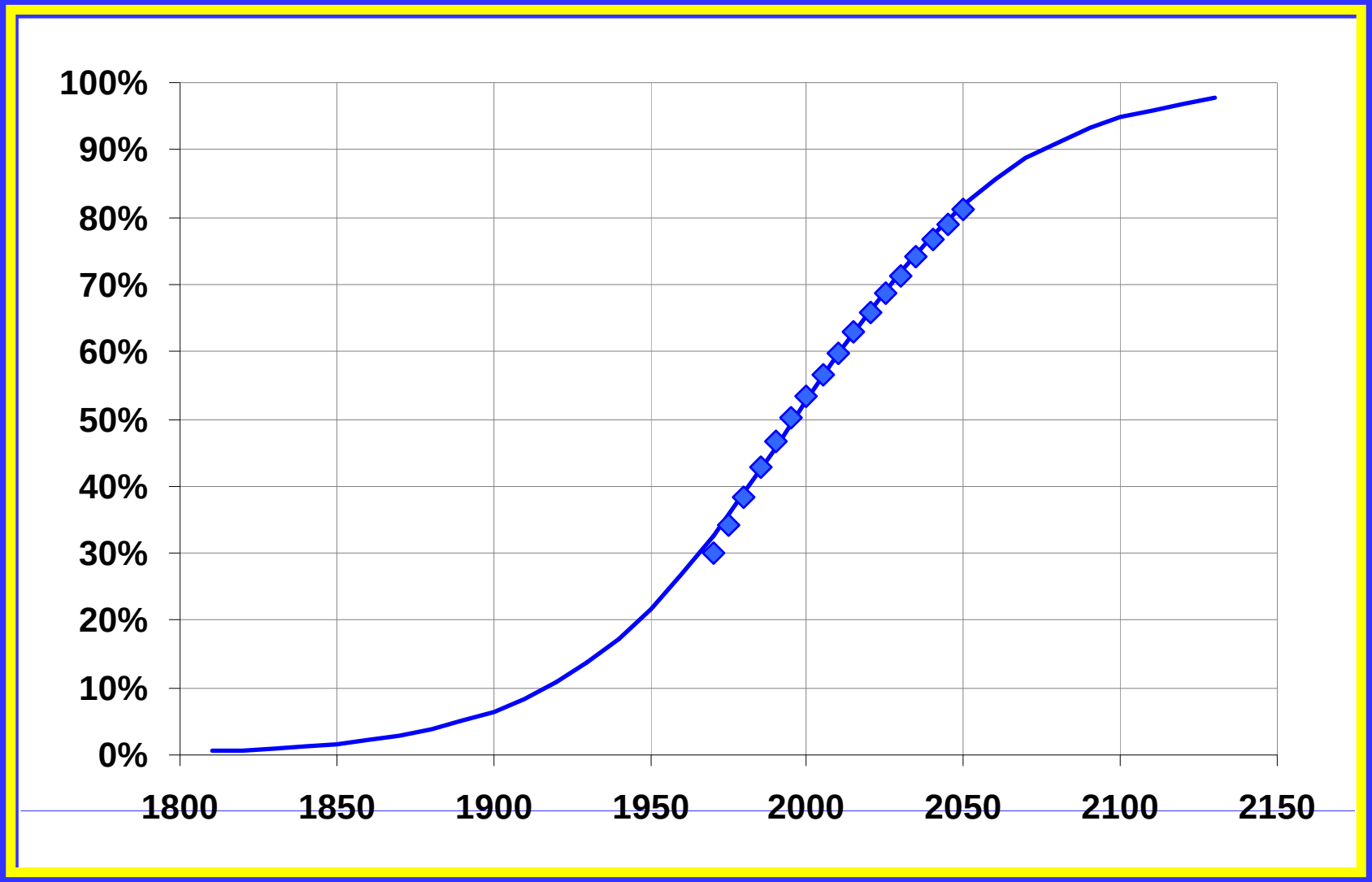


Source: Paul Raskin, 2002

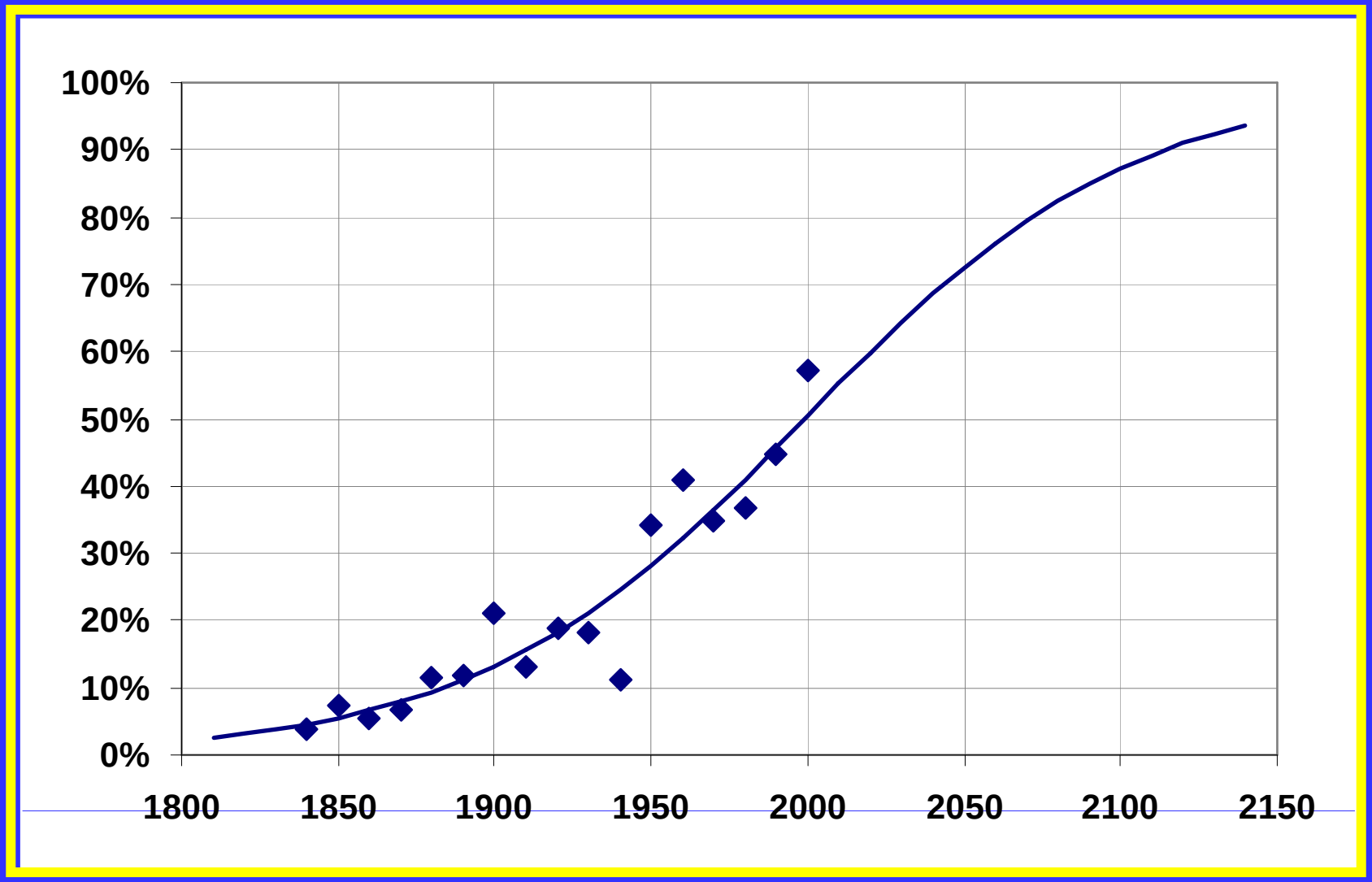
Urbanization



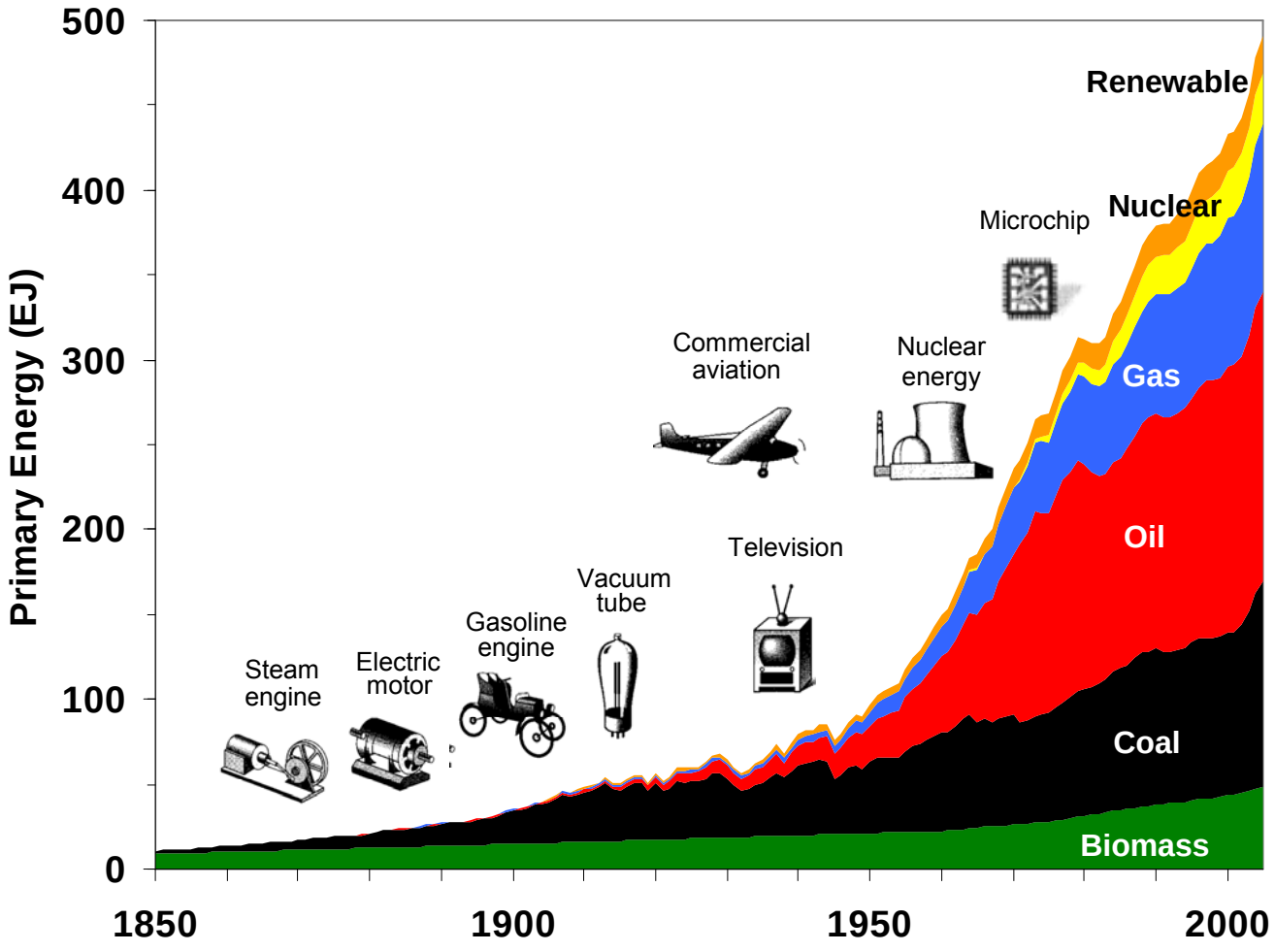
Education


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1800
1850
1900
1950
2000
2050
2100
2150

Democratization

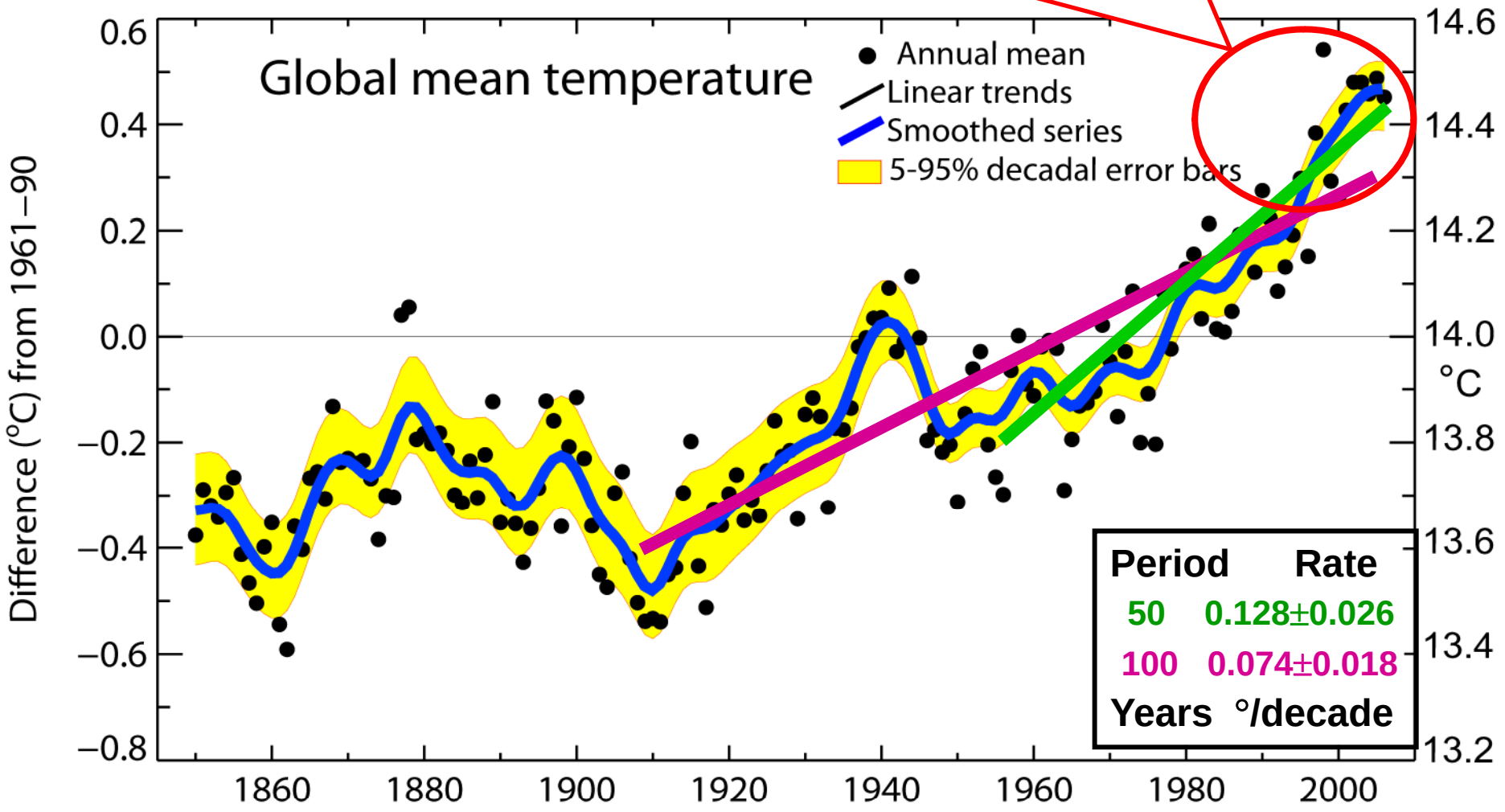


World Primary Energy

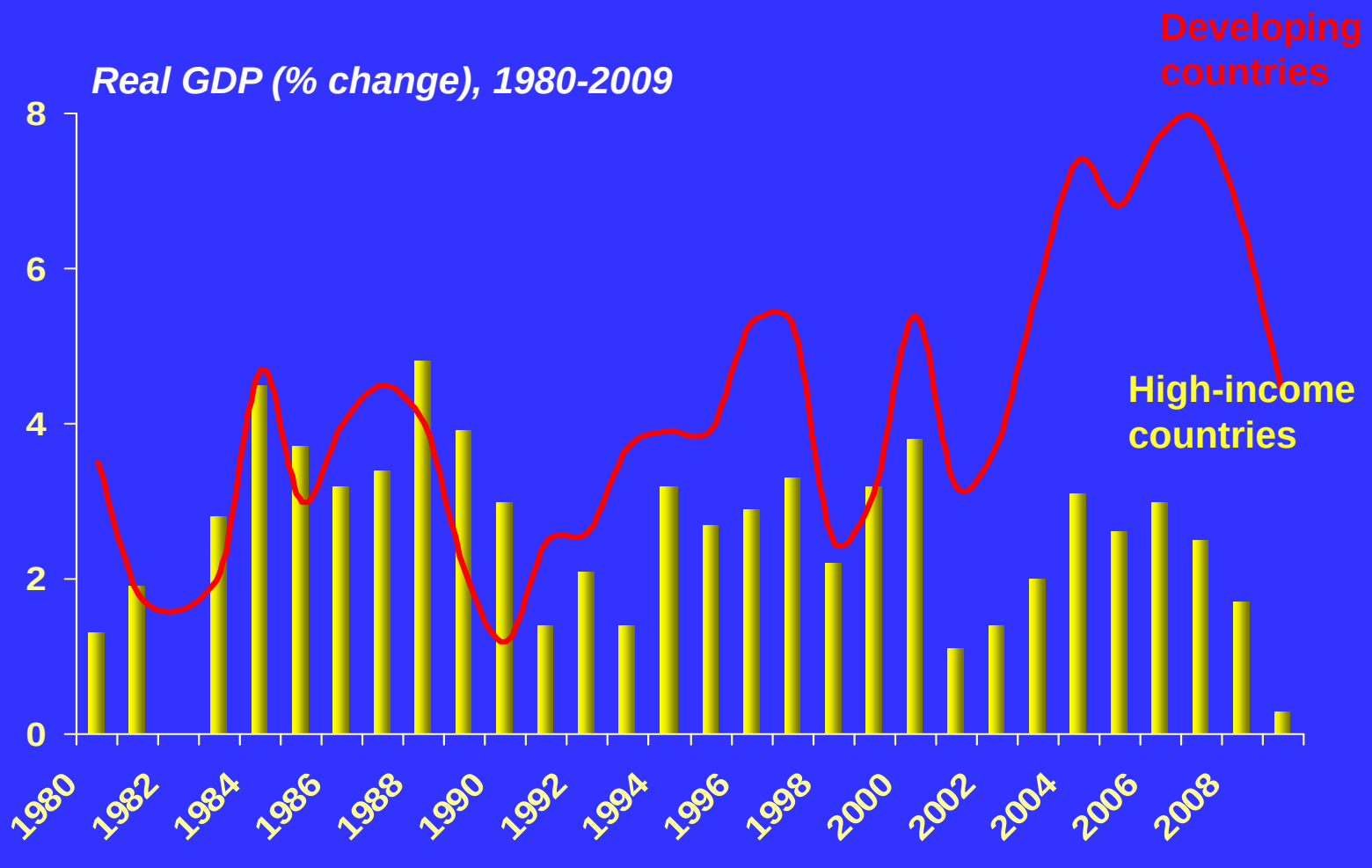


Global Mean T sing

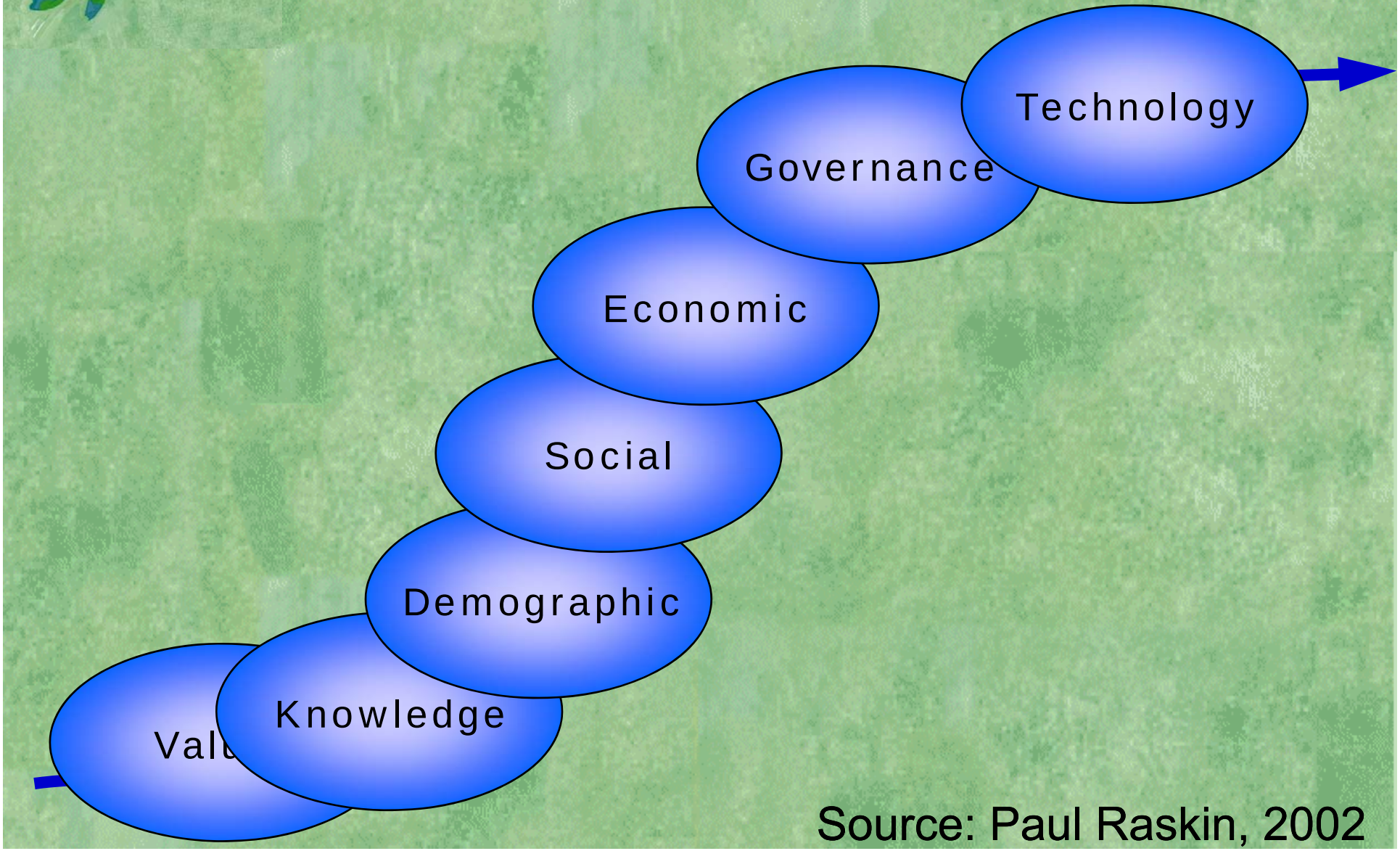
Warmest 12 years:
1998, 2005, 2003, 2002, 2004, 2006,
2001, 1997, 1995, 1999, 1990, 2000



...and with financial woes spreading to the "real economy " …

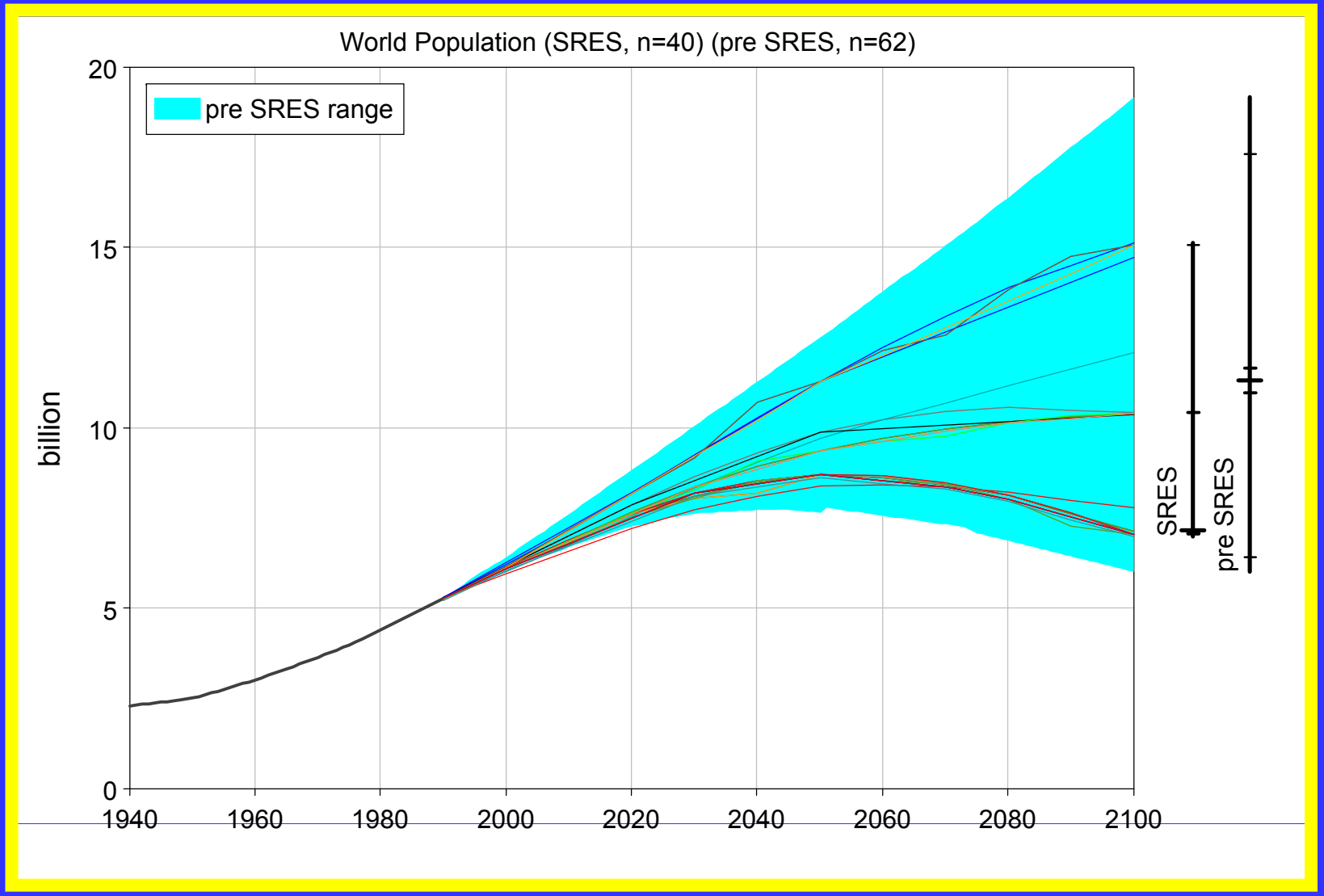


Dimensions of Transition

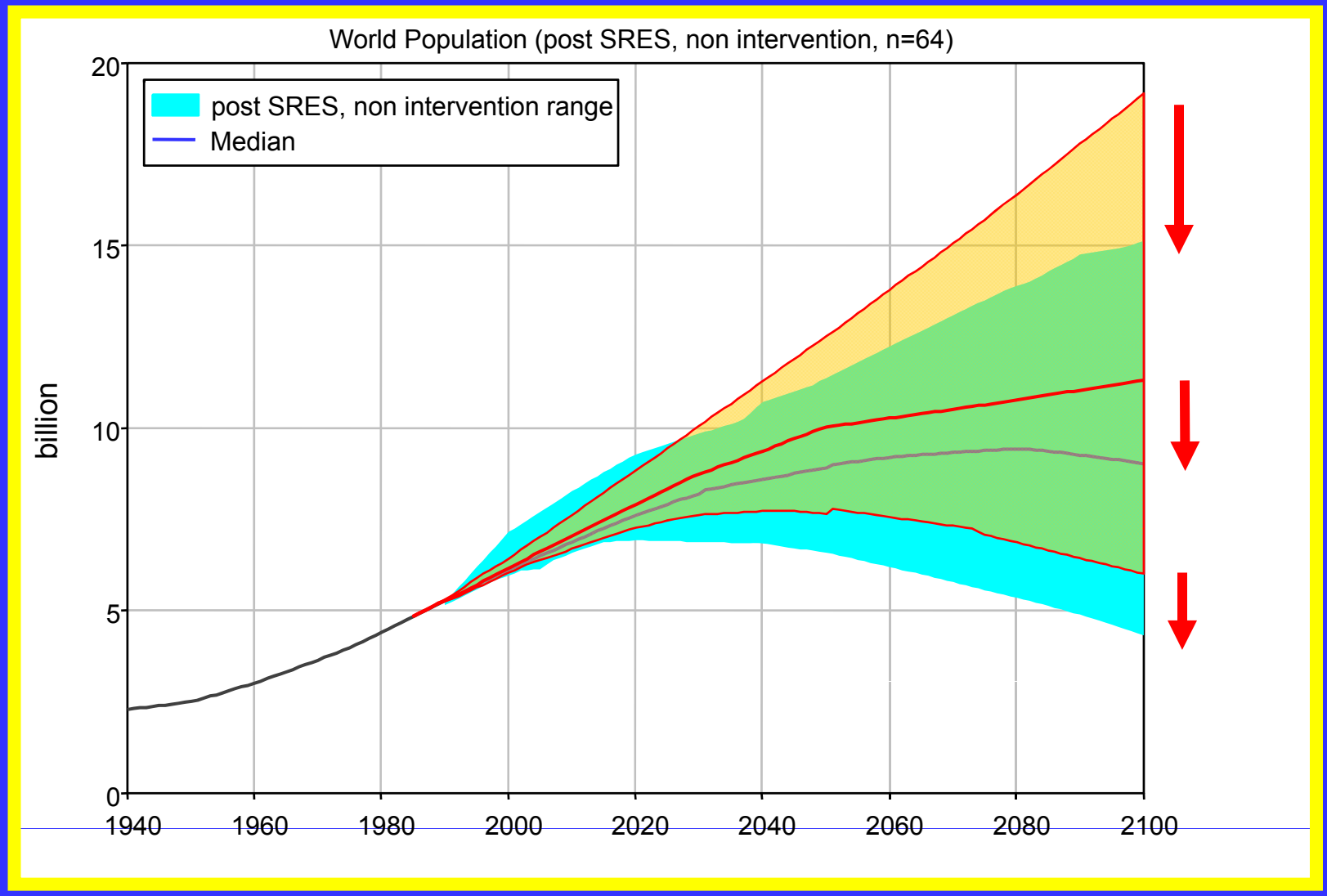


Source: Paul Raskin, 2002

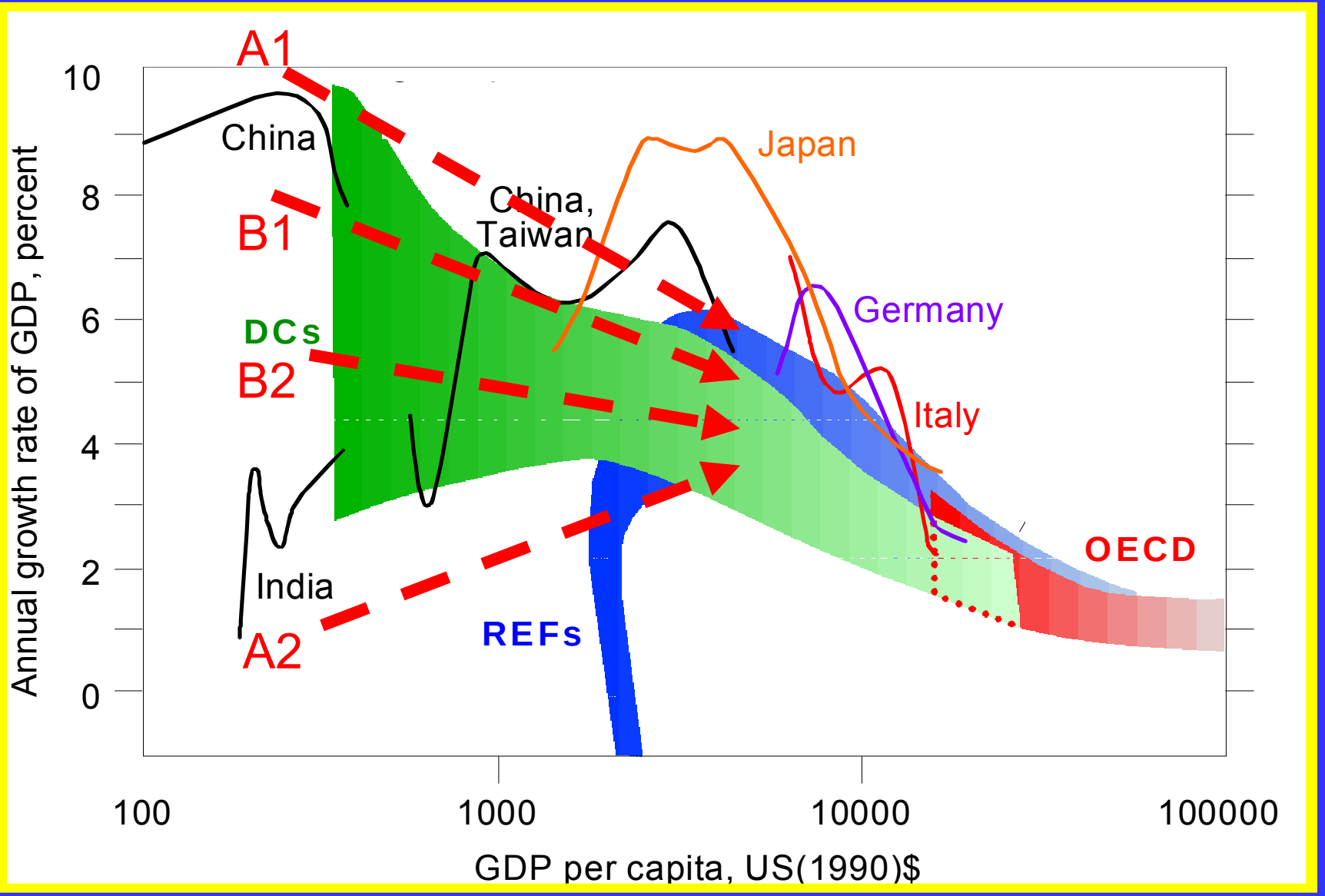
Global Population Projections



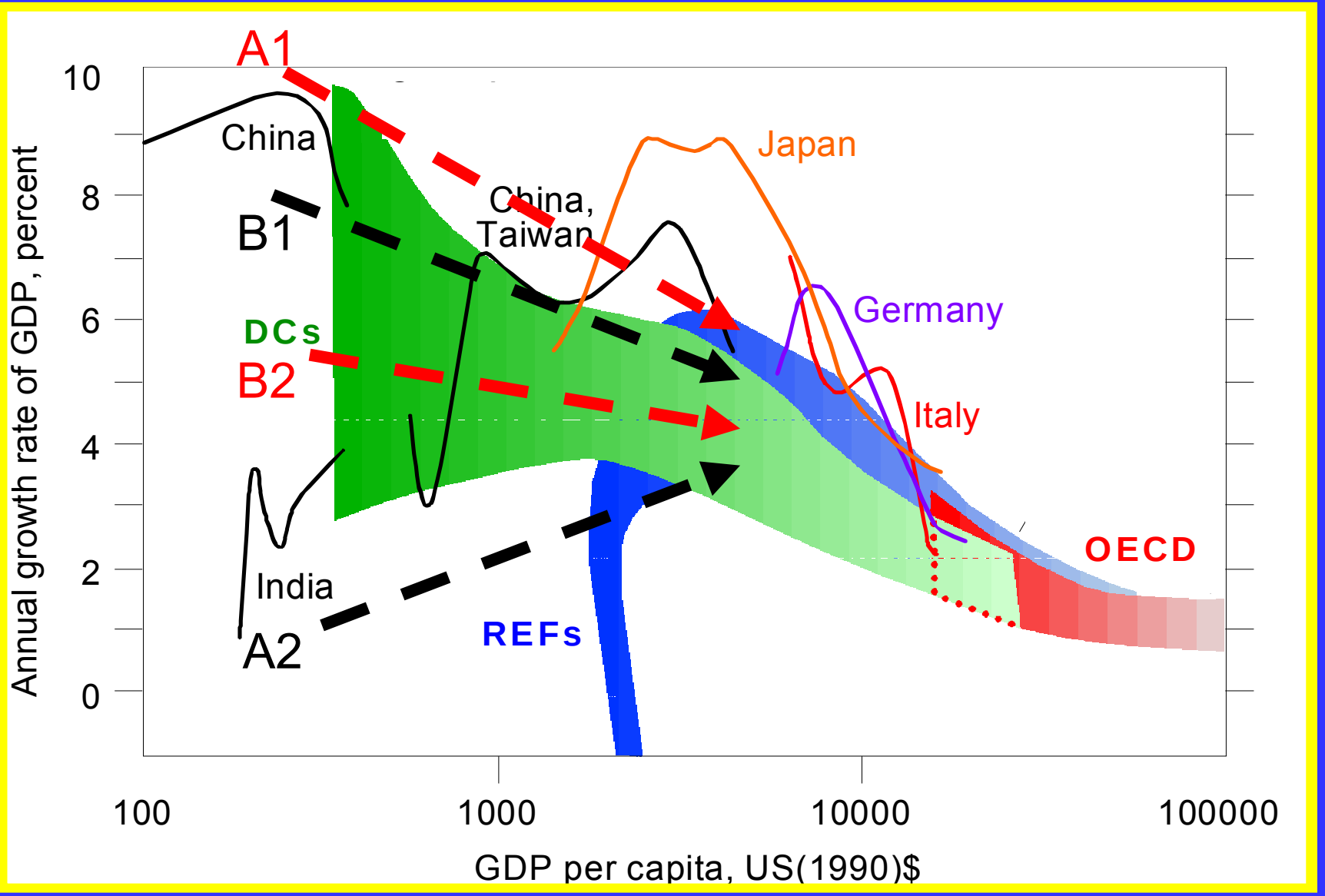
Global Population Projections



GDP Growth Rates and Affluence

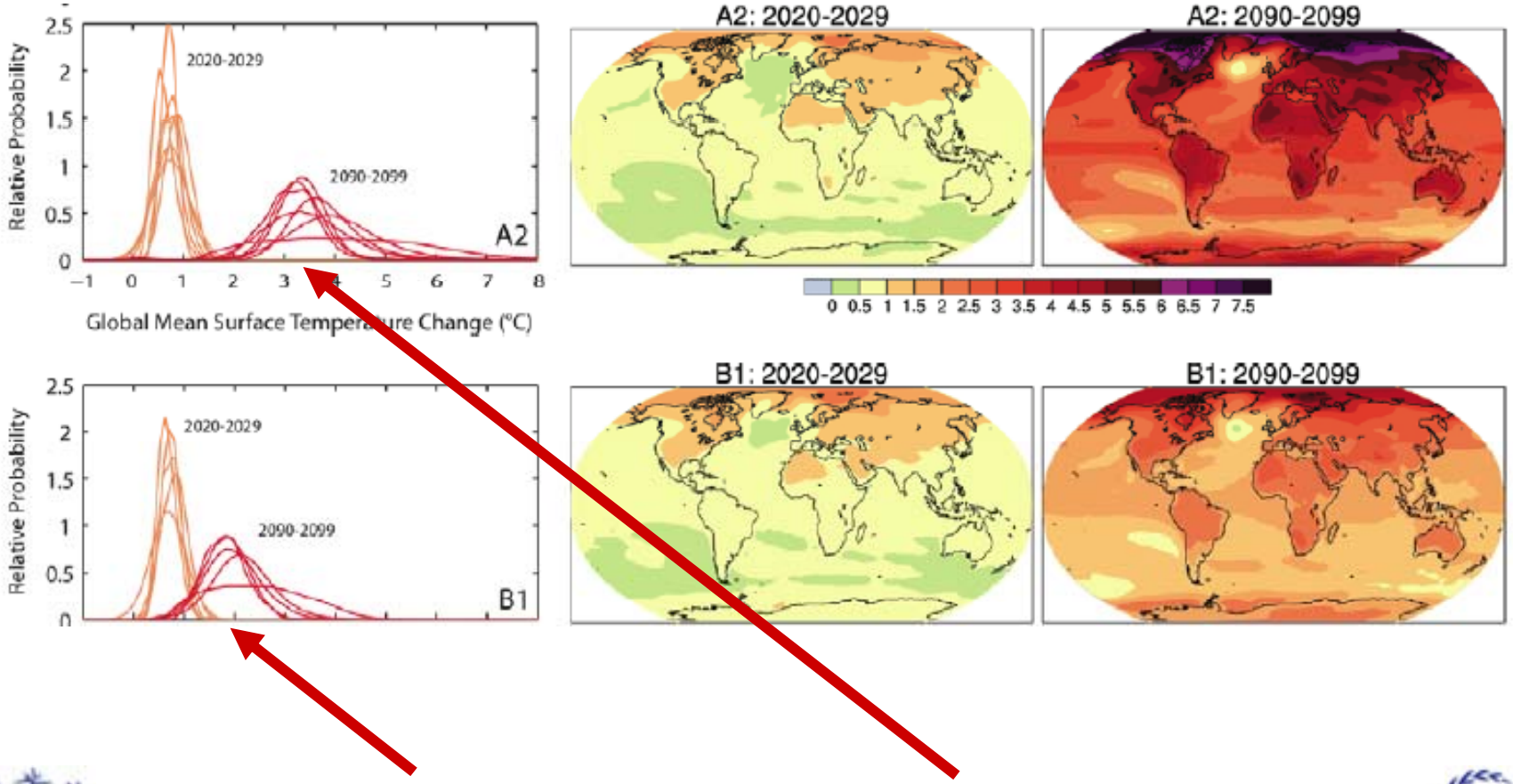


GDP Growth Rates and Affluence

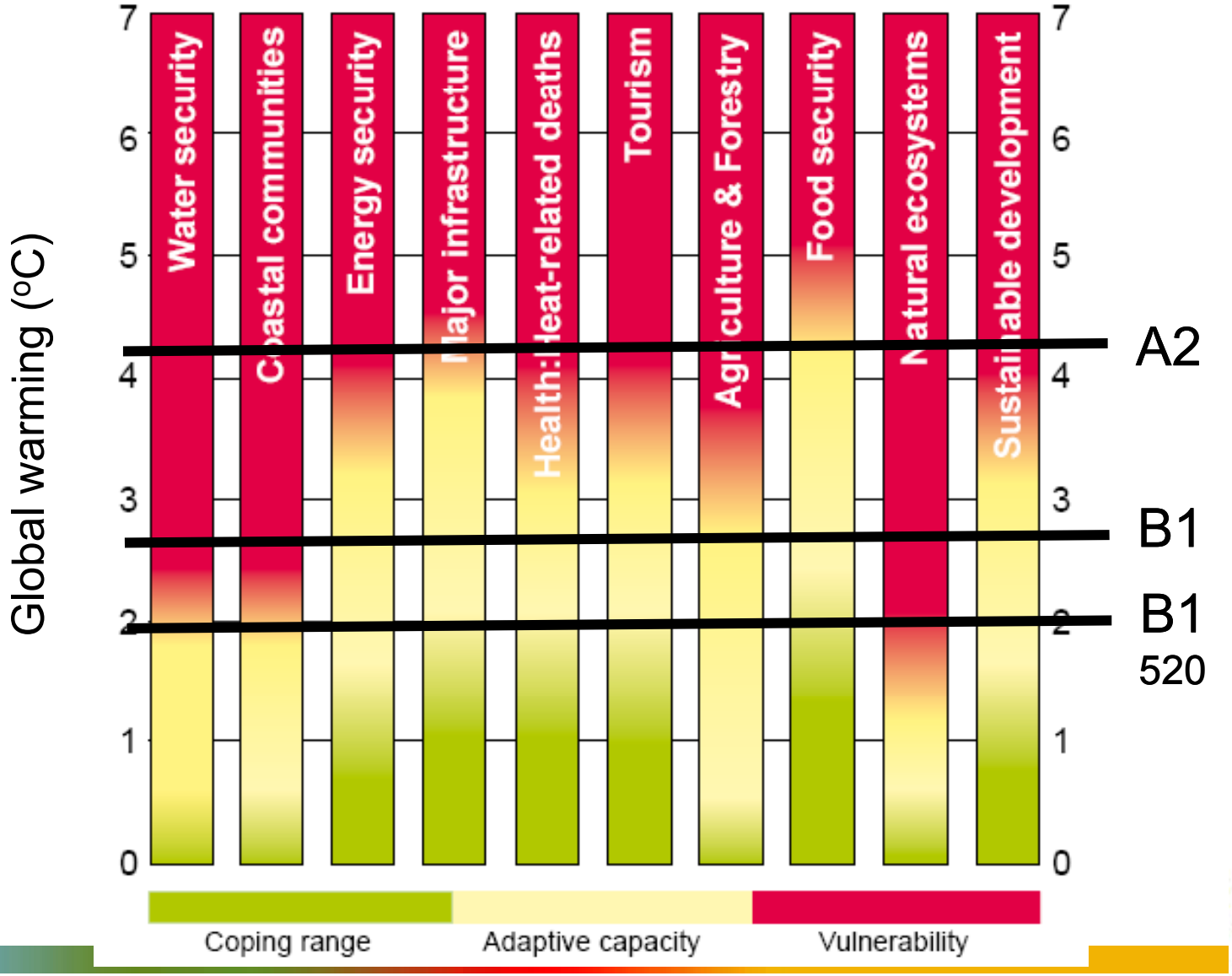


Surface Temperature Change

AOGCM projections for illustrative SRES scenarios



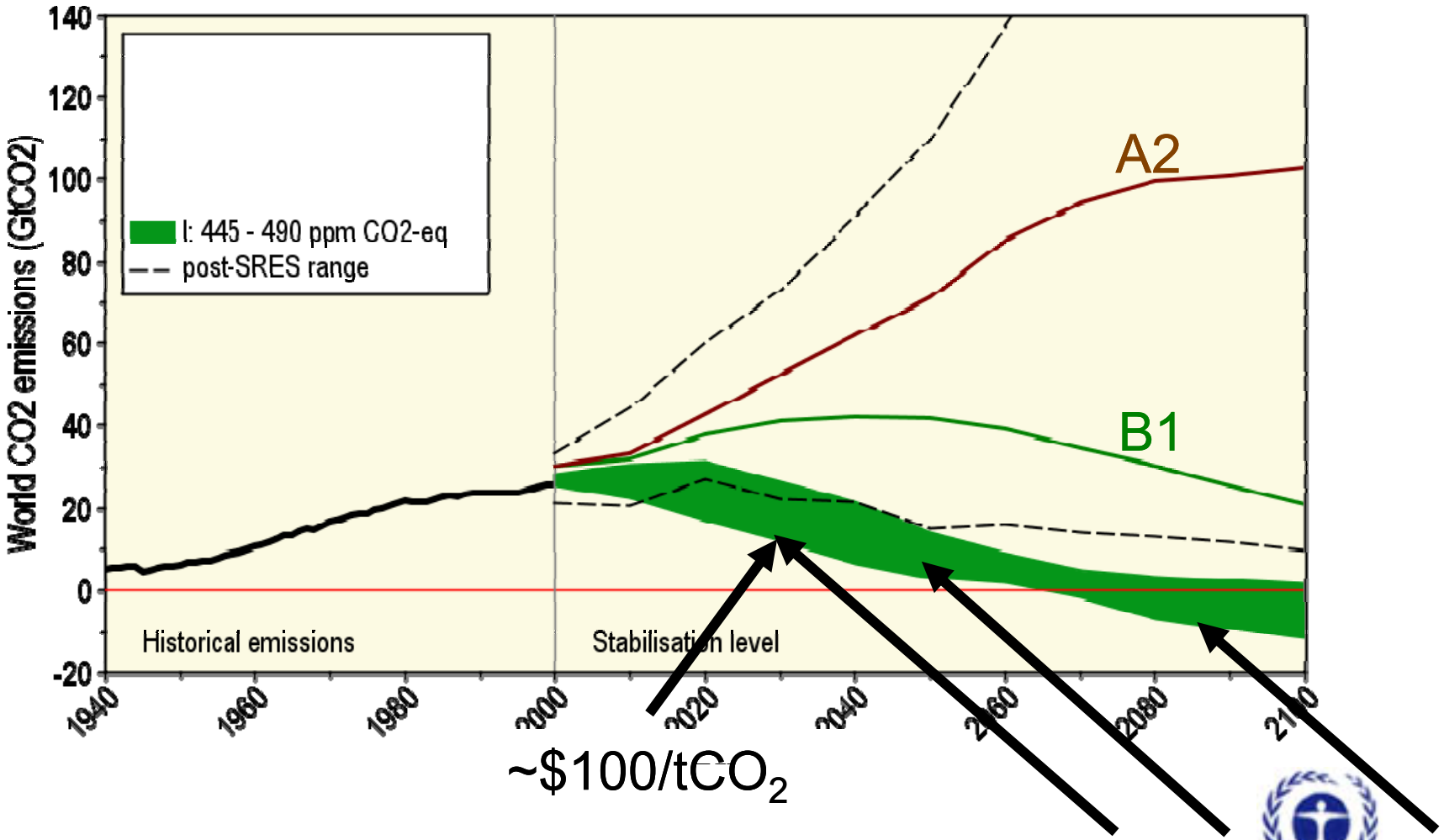
Vulnerability of Key Sectors



WMO

UNEP

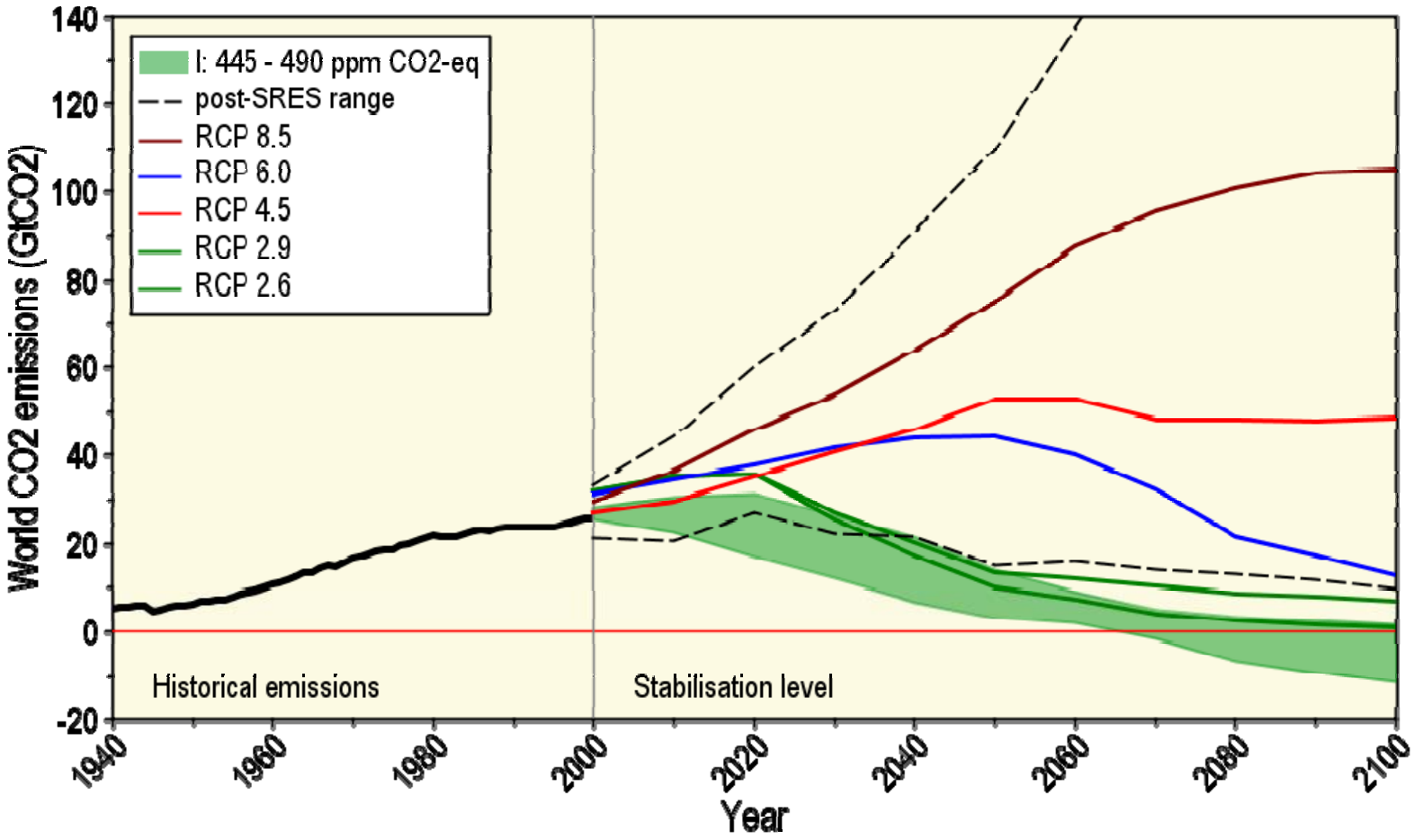
Long-Term Stabilization Profiles



WMO

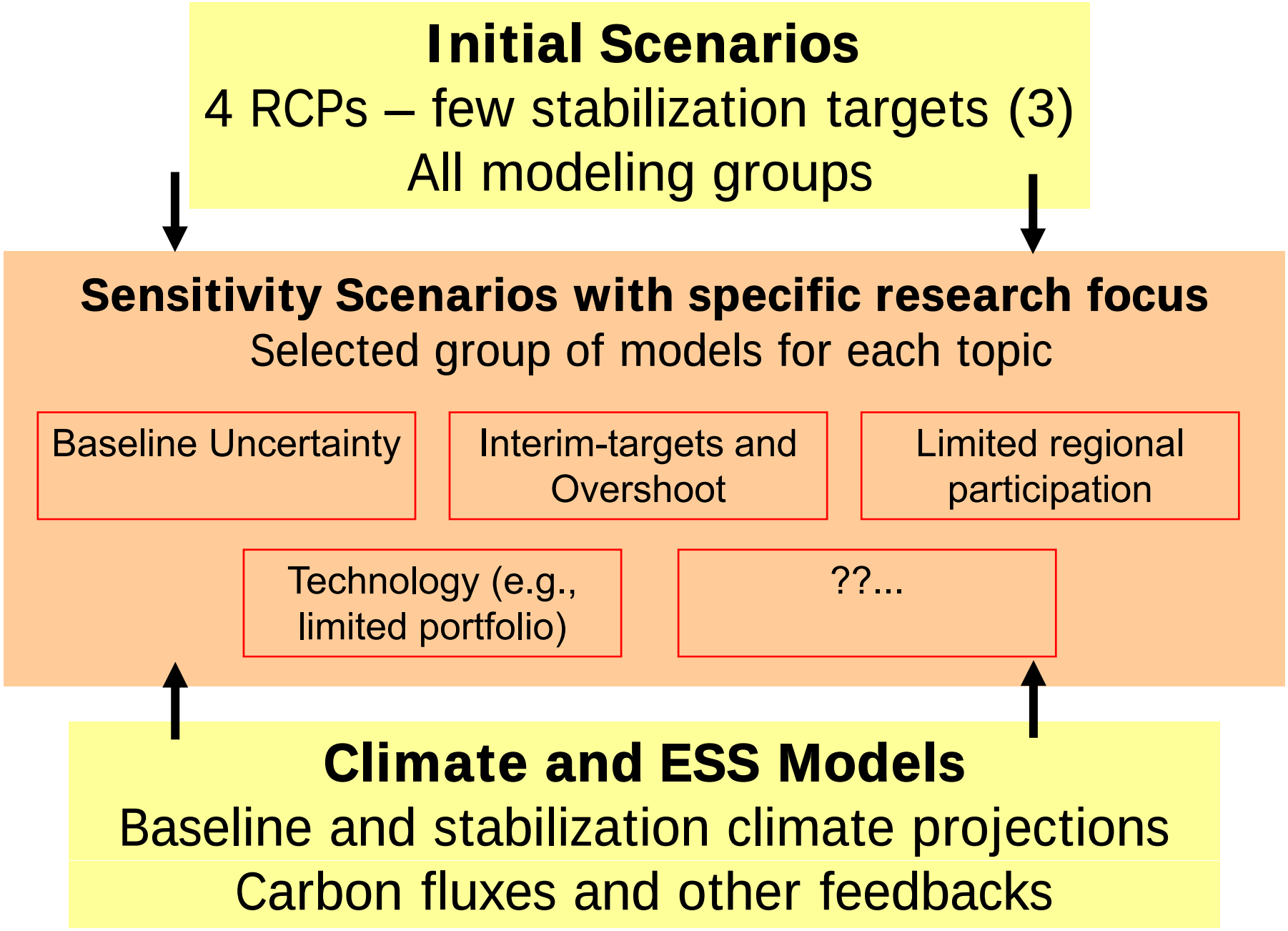
UNEP

RCP Stabilization Profiles



WMO

UNEP



Source: After Keywan Riahi, 2006

Intended uses and limits

- Intended uses
  - Input to CMs
  - To facilitate pattern scaling
  - To explore ranges of socioeconomic conditions
  - To explore climate implications of spatial forcing patterns
- Limits
  - Not forecasts or absolute bounds
  - Not policy prescriptive
  - Socioeconomics underlying each RCP are not unique; and, across RCPs, are not a set

REPRESENTATIVE CONCENTRATITON PATHWAYS *FORCING AGENTS*

GHG Emissions and Concentrations from IAMs

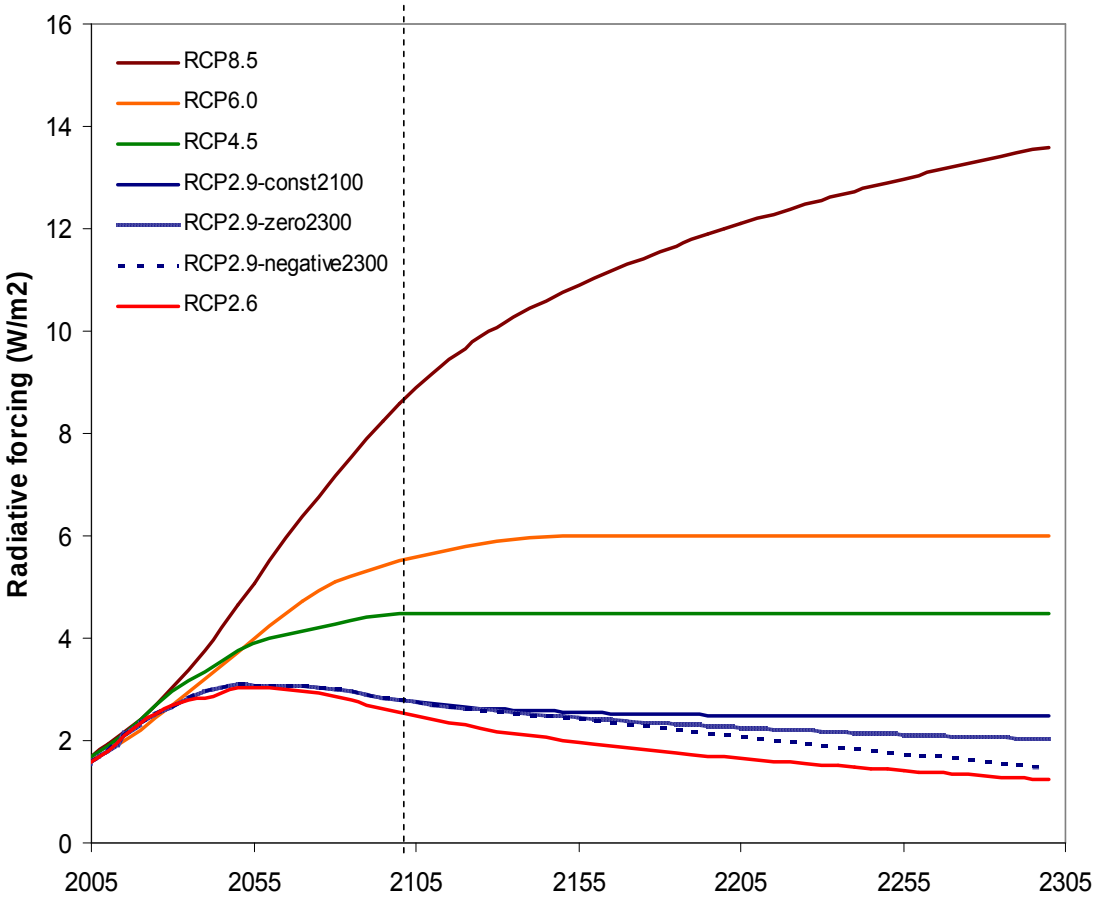
- Greenhouse gases: CO_2, CH_4, N_2O, CFCs, HFC's, PFC's, SF_6
- Emissions of chemically active gases: CO, NO_x, NH_4, VOCs
- Derived GHG's: tropospheric O_3
- Emissions of aerosols: SO_2, BC, OC
- Land use and land cover

2.6 W/m^2 or 2.9 W/m^2?

- Which scenario for the low (<3W/m^2) RCP?
- Noordwijkerhout debate over what it means to be
  - "compatible with the full range of stabilization, mitigation, and baseline emissions scenarios available in the current literature"

Proposed Extensions to 2300!

- RCP8.5: fix emissions at 2100 levels, derive concentrations
- RCP 4.5 / 6.0: fix concentrations, derive consistent emissions
- RCP2.6/2.9:
  - Fix emissions at 2100 levels, derive consistent concentrations
  - Other 2.9 option: allow emissions to fall to zero or negative, and fix
- Land-use: scale cropland and pasture land with population (current proposal); or hold constant (alternative)
- For ESM data, harmonize the unique IAM extended emissions and concentration data with a single climate model (e.g. MAGICC)

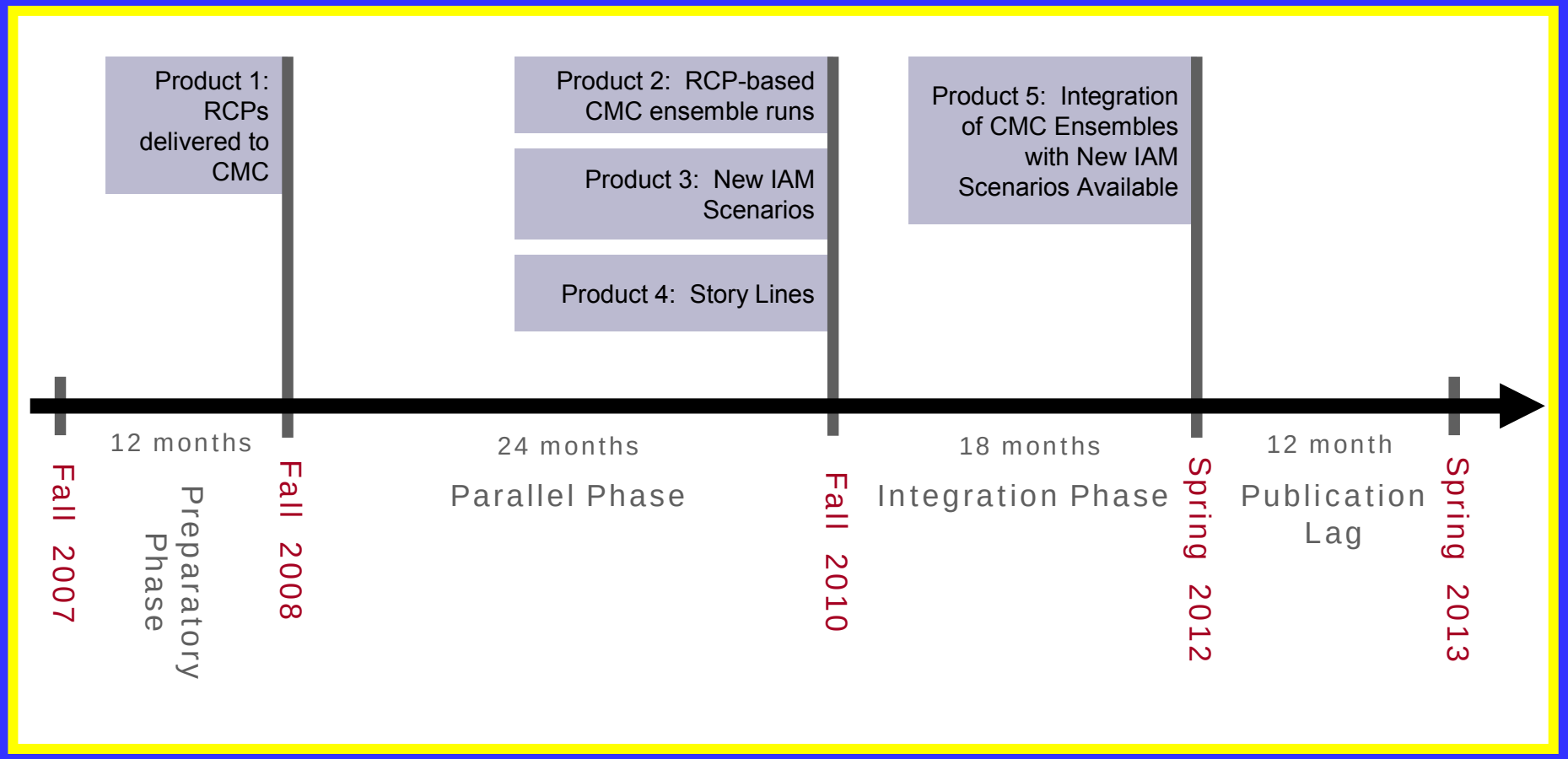


International IAM Consortium

Facilitate the coordination of scenario development efforts

International Institute for Applied Systems Analysis (IIASA)	Energy Modeling Forum (EMF) Stanford University	National Institute for Environmental Studies (NIES)
➢**Australian Bureau of Agricultural and Resource Economics (ABARE)** - *Hom Pant* ➢**Bundeswehr University, Munich** - *Stefan Pickl* ➢**Business Council for Sustainable Development – Argentina** - *Virginia Vilariño* ➢**CEA-LERNA, University of Social Sciences** - *Marc Vielle* ➢**Centre for International Climate and Energy Research (CICERO), University of Oslo** - *H.Asbjorn Aaheim* ➢**Argonne National Laboratory** - *Donald Hanson* ➢**Centre International de Recherche sur l'Environnement et le Developpement, EHESS - U.A. CNRS 940 (CIRED)** - *Jean-Charles Hourcade* ➢**CRA International** - *Brian Fischer* ➢**Department of Energy, Transport, Environment, DIW Berlin** - *Claudia Kemfert* ➢**Electric Power Research Institute (EPRI)** - *Richard Richels, Francisco de la Chesnaye* ➢**Energy Research Institute, National Development and Reform Commission (NDRC)** - *Kejun Jiang* ➢**ETH Zurich** - *Thomas Rutherford*	➢**Hamburg University and Economic and Social Research Institute (ESRI)** - *Richard Tol* ➢**Indian Institute of Management** - *Priyadarshi Shukla* ➢**Institut d'Economie et de Politique de l'Energie, IEPE-CNRS** - *Patrick Criqui* ➢**International Institute for Applied Systems Analysis (IIASA)** - *Nebojsa Nakicenovic, Keywan Riahi* ➢**San Marcos University** - *Eduardo Calvo* ➢**National Institute for Environment Studies (NIES)** - *Mikiko Kainuma* ➢**National Center for Atmospheric Research (NCAR)** - *Brian O'Neill* ➢**Ohio State University** - *Brent Sohngen* ➢**Pacific Northwest National Laboratory, Joint Global Change Research Institute at the University of Maryland** - *Jae Edmonds, Hugh Pitcher, Ronald Sands, Steve Smith* ➢**Potsdam Institute for Climate Impact Research (PIK)** - Ottmar Edenhofer, Elmar Kriegler, Brigitte Knopf ➢**Programa de Planejamento Energético - PPE/COPPE/UFRJ** - *Emilio Lèbre La Rovere* ➢**Purdue University** - *Thomas Hertel* ➢**RAND** - *Rob Lempert*	➢**Research Institute of Innovative Technology for the Earth (RITE)** - *Keigo Akimoto* ➢**Stanford University** - *John Weyant* ➢**Tellus Institute** - *Richard Rosen* ➢**Texas A&M University** - *Bruce McCarl* ➢**The Institute of Applied Energy** - *Atsushi Kurosawa* ➢**The Netherlands Environmental Assessment Agency (MNP)** - *Detlef van Vuuren* ➢**Tyndall Centre for Climate Change Research, The University of East Anglia** - *Andrew Watkinson, Robert T. Watson* ➢**Universidad de Los Andes / Universidad Nacional de Colombia** - *Jose Eddy Torres* ➢**Universidad Iberoamericana Puebla** - *Maria Eugenia Ibarraran Viniegra* ➢**University of Cambridge** - *Andreas Schafer* ➢**University of Oldenburg** - *Christoph Boehringer* ➢**US Environmental Protection Agency** - *Allen Fawcett, Steven Rose* ➢**VTT** - *Sanna Syri* ➢**World Bank** - *Dominique van der Mensbrugghe*

Timeline for New Scenarios

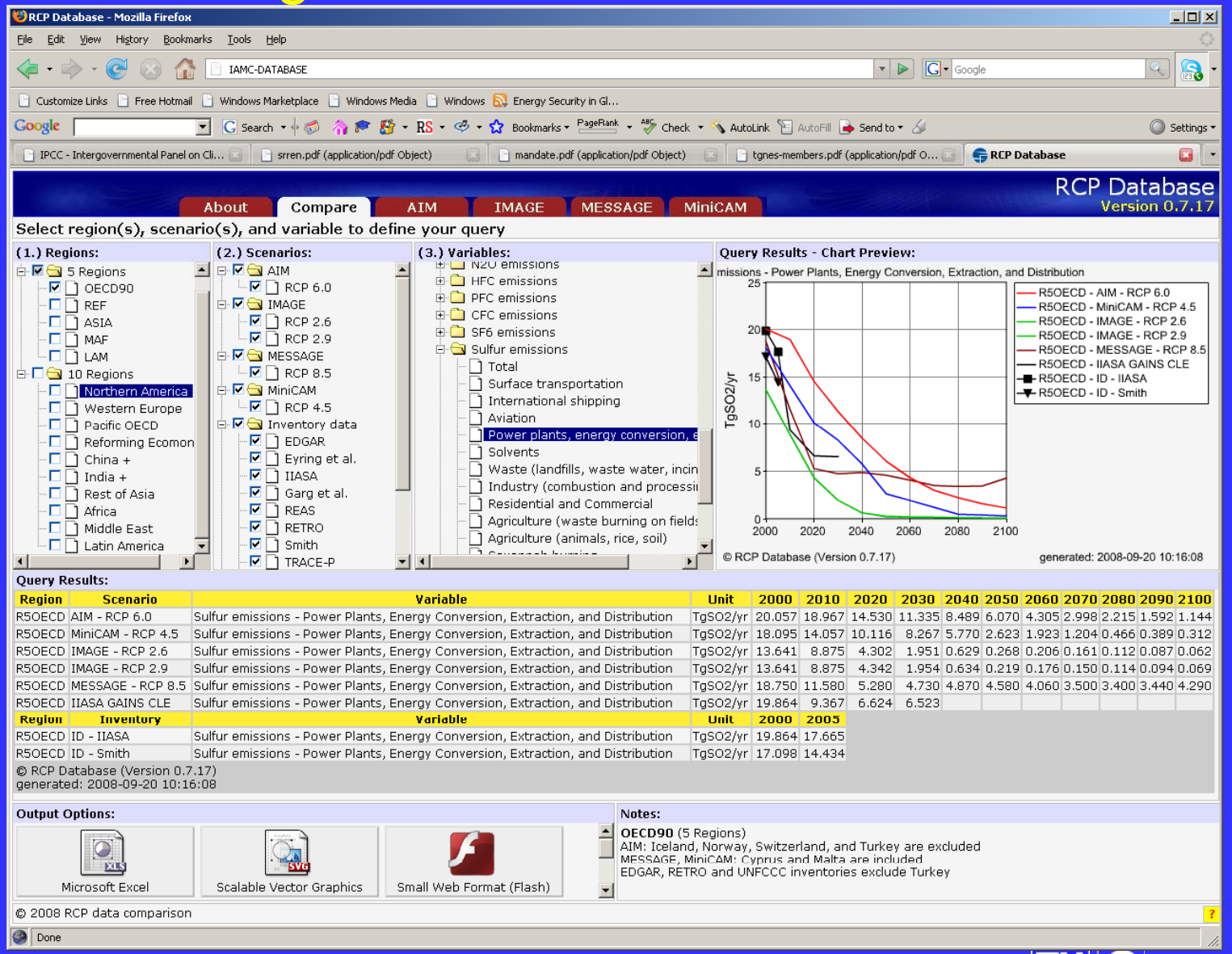


RCP Database

- Central data repository to share information and to provide easy access to the data
- Interactive & web-based “working environment”
  - detailed comparisons between RCPs and base year inventory data
  - quick data visualization
  - help to understand major data differences (eg. identify definitional issues across RCPs)
- At the moment limited access, since all data is preliminary
- Plan to make the database publicly accessible for data dissemination once the data is final

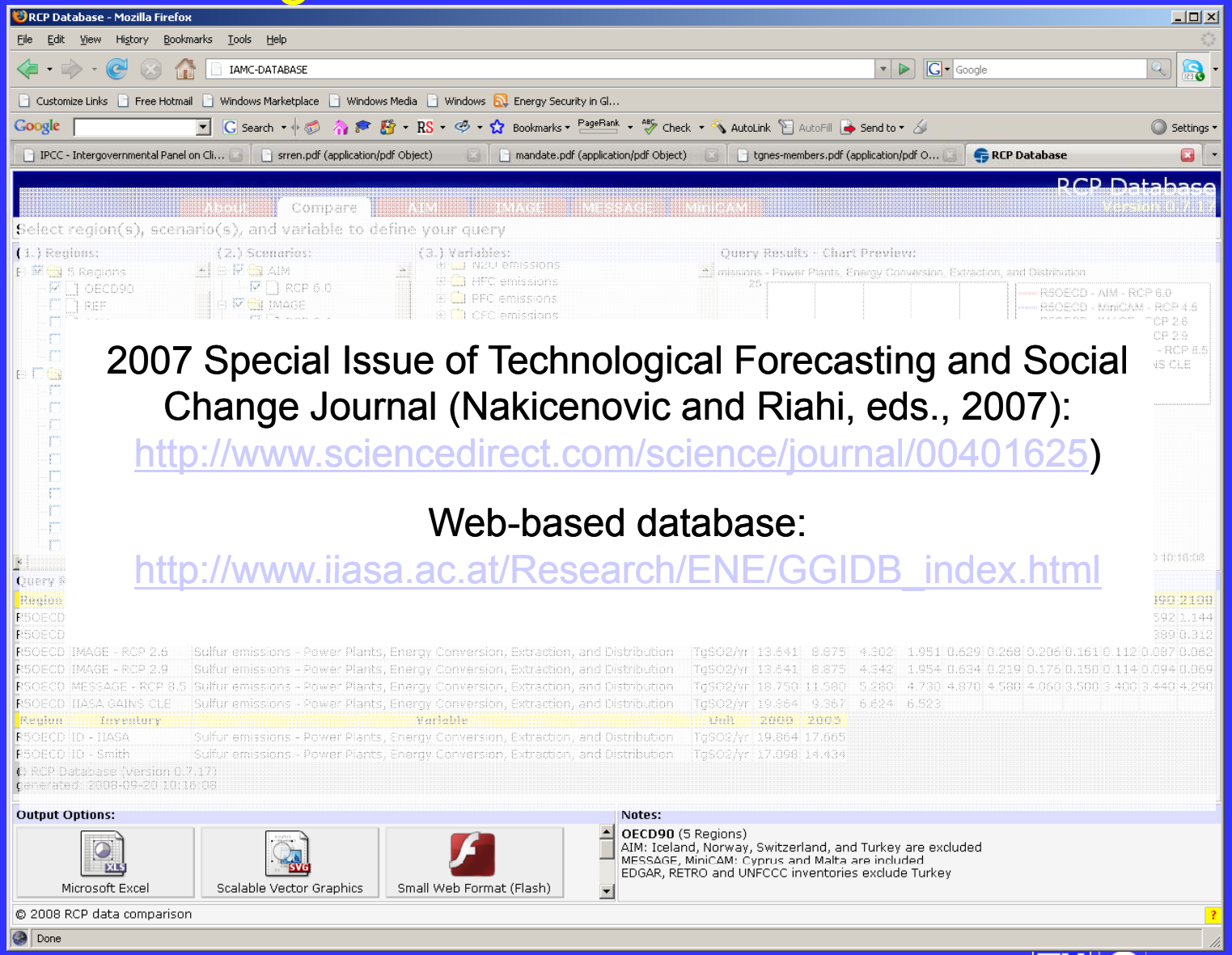
Central IAM Data Repository

IAM working environment & data dissemination



IIASA IAM Data Repository

IAM working environment & data dissemination

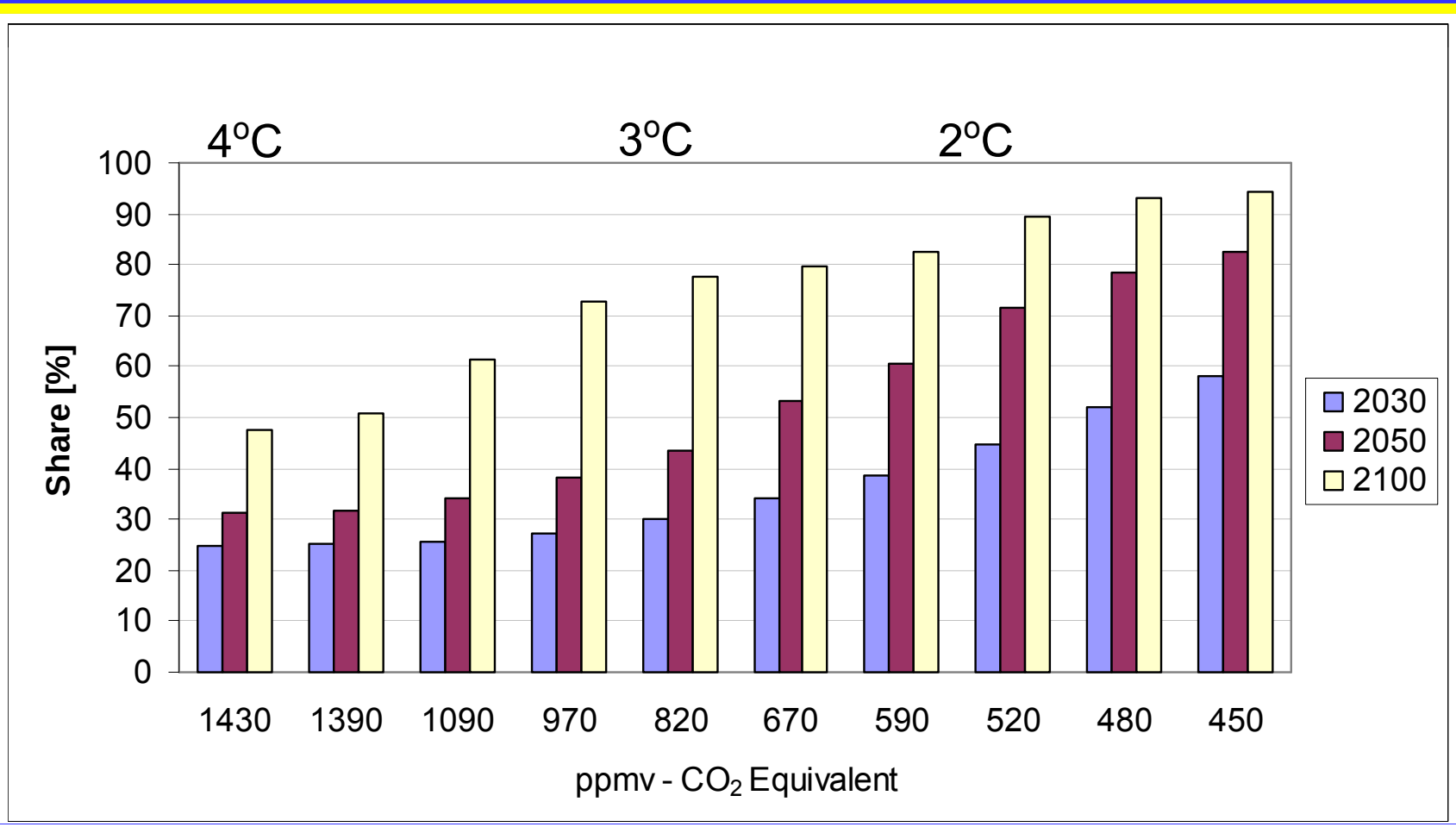


2007 Special Issue of Technological Forecasting and Social Change Journal (Nakicenovic and Riahi, eds., 2007): http://www.sciencedirect.com/science/journal/00401625)

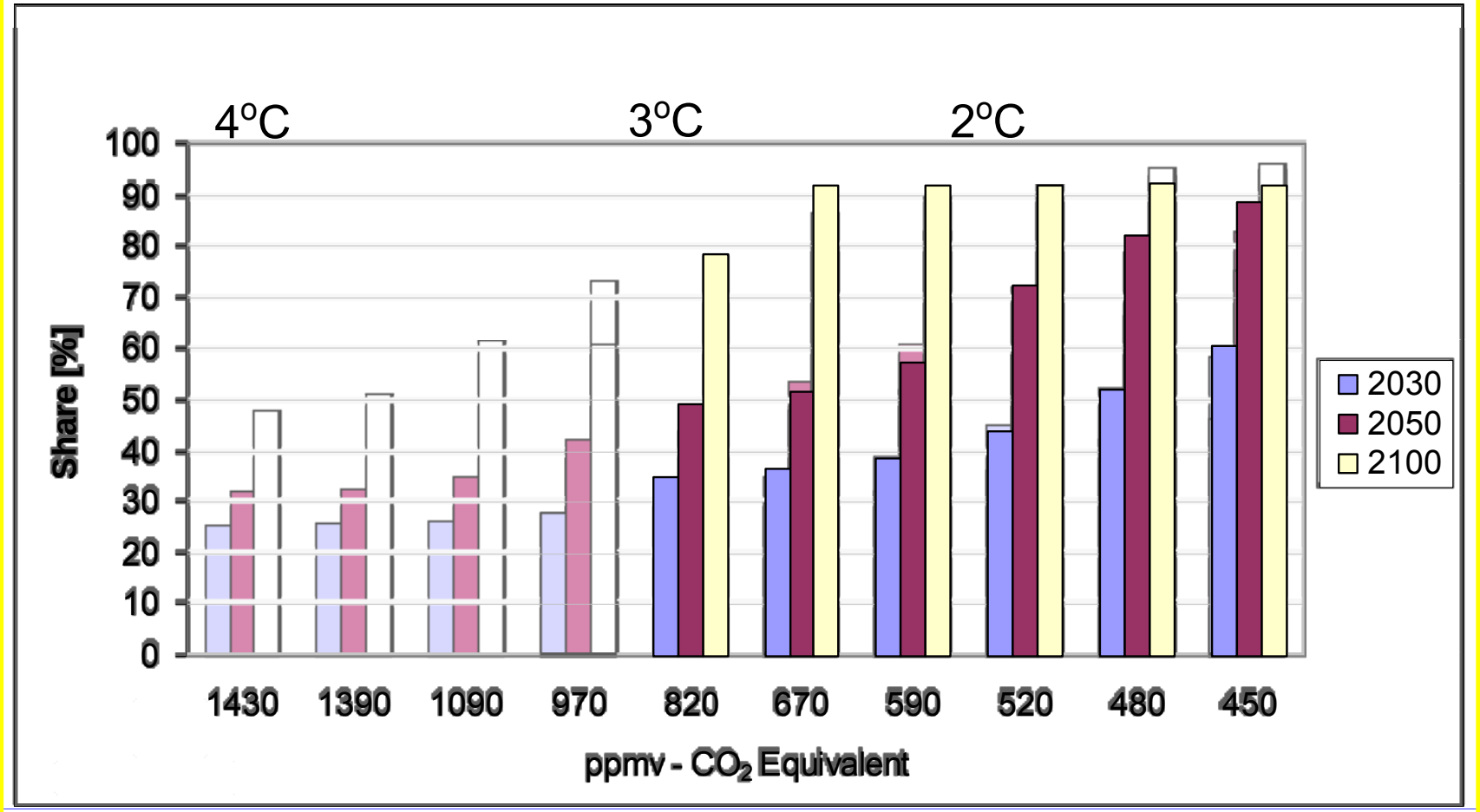
Web-based database:

http://www.iiasa.ac.at/Research/ENE/GGIDB_index.html

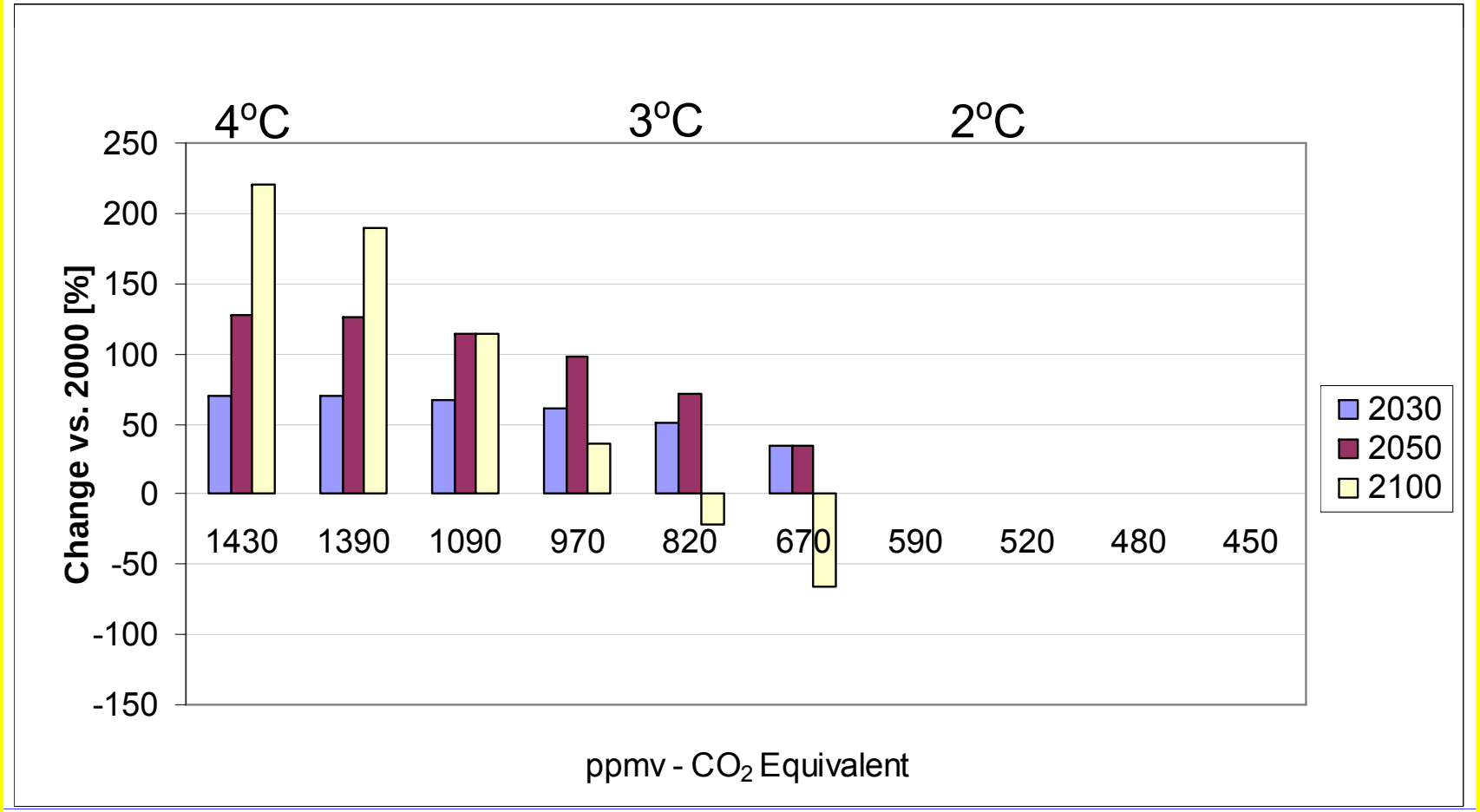
Carbon-Free Energy in A2r



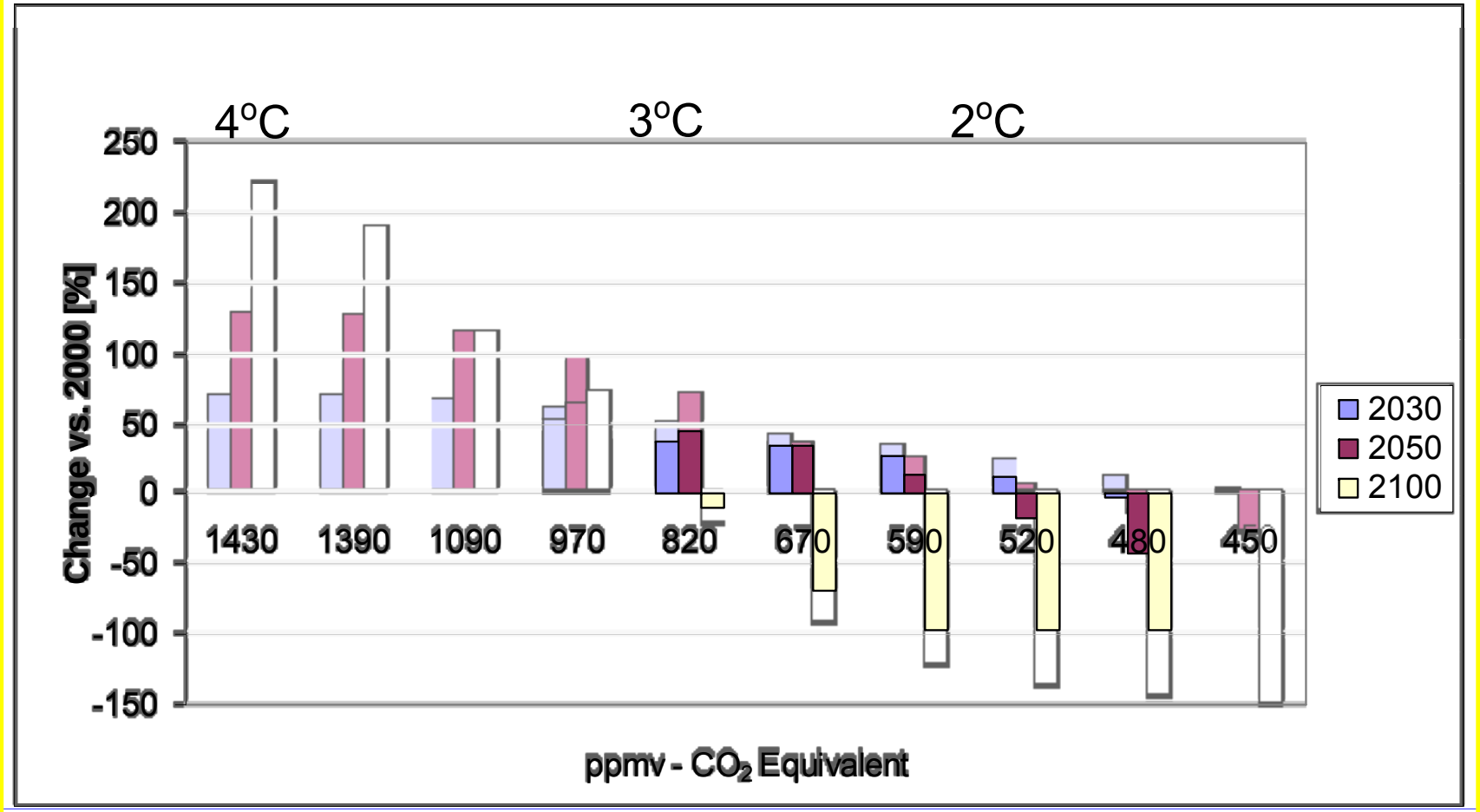
Carbon-Free Energy in B1



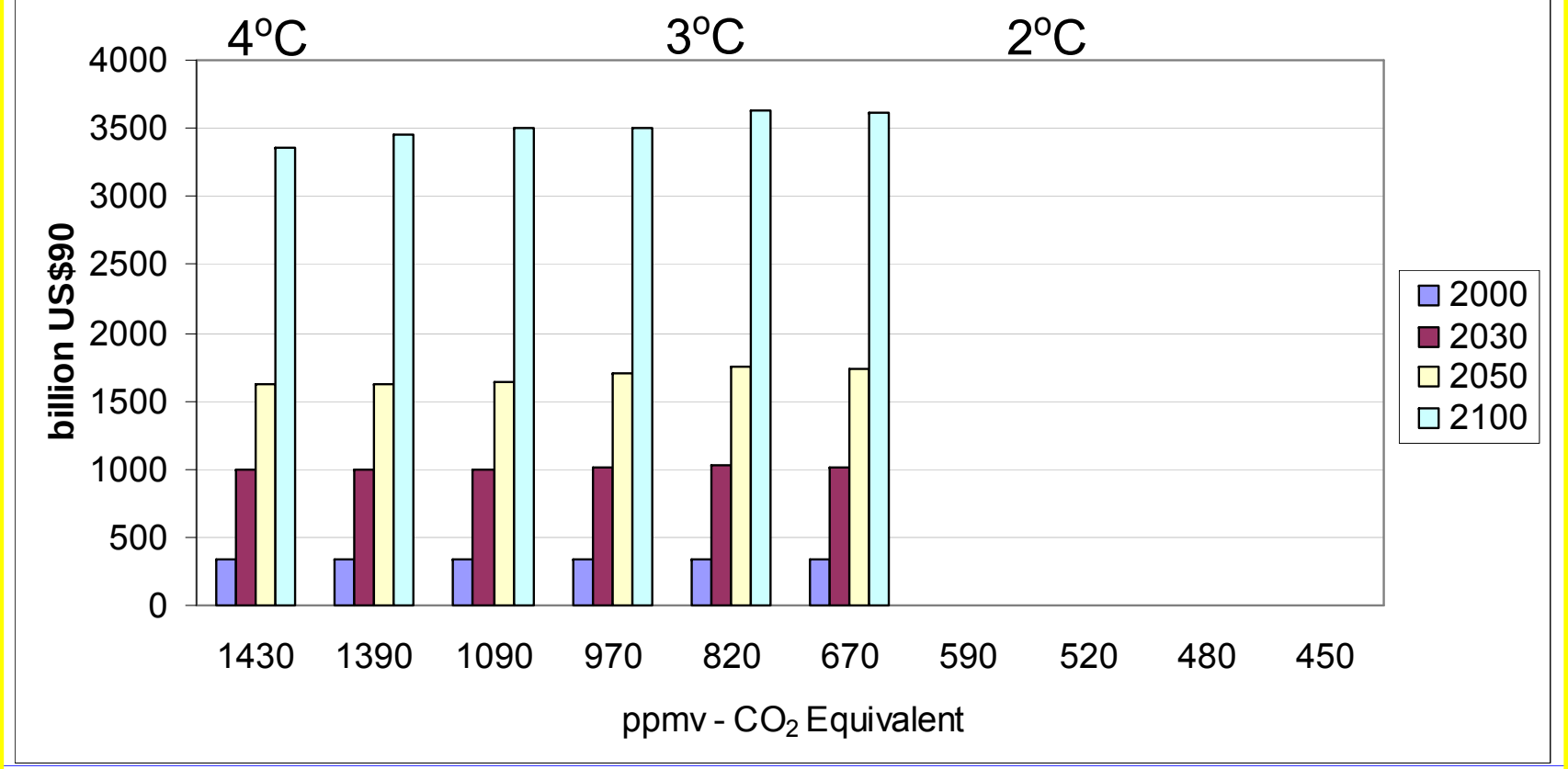
GHG emissions in A2r



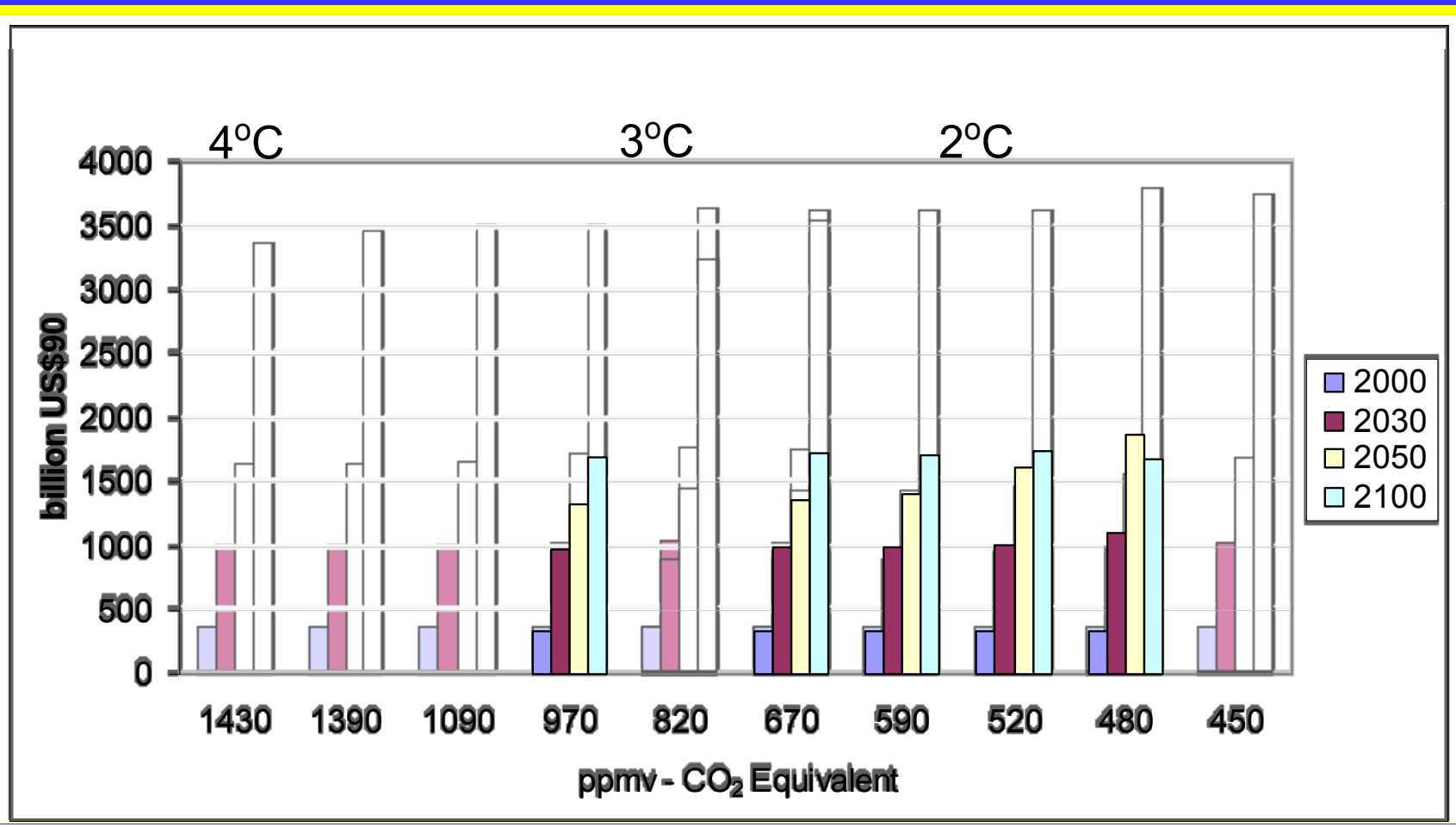
GHG emissions in B1



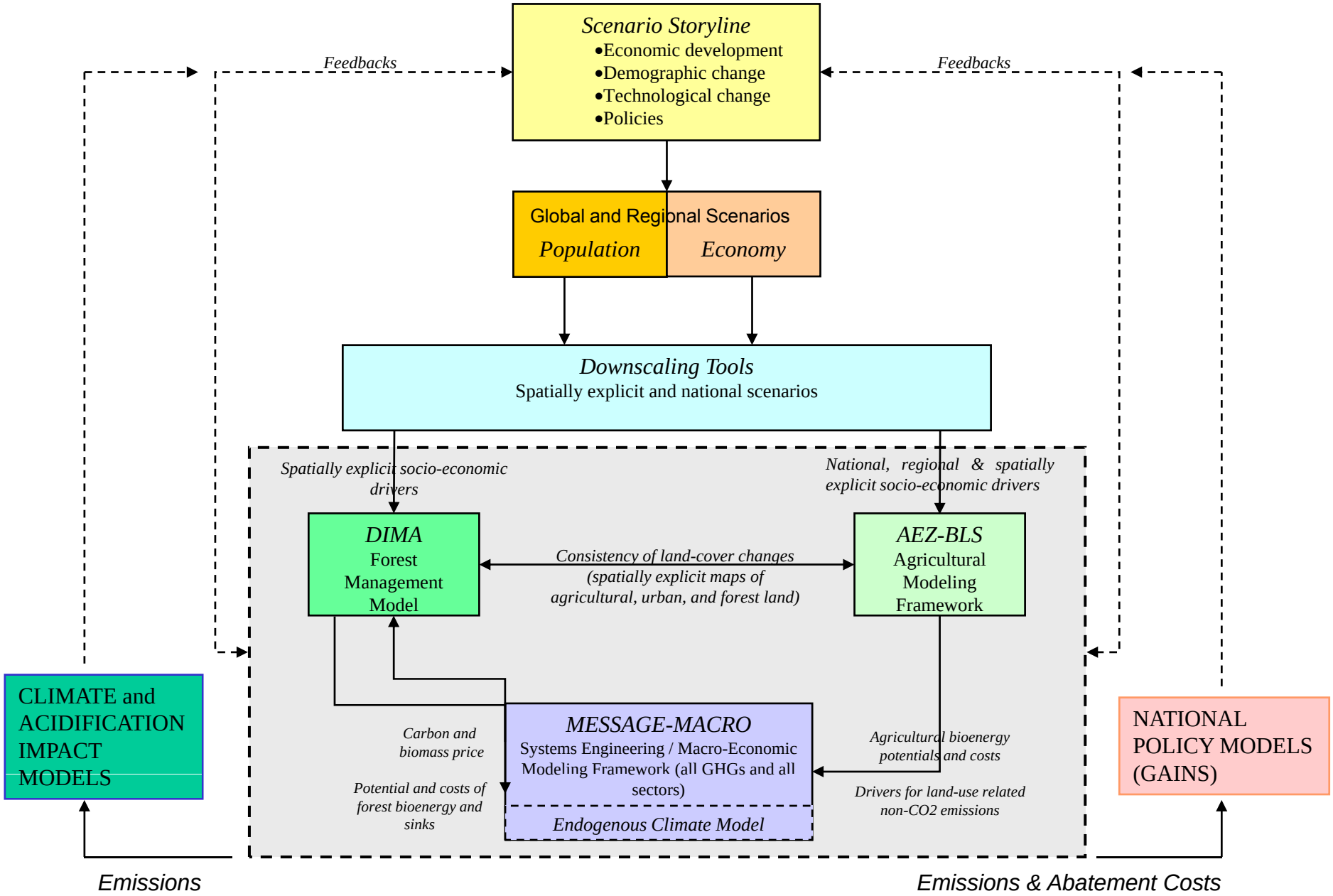
Energy Investments in A2r



Energy Investments in B1



Integrated Assessment Framework



Determinants of Demand

Scenario Drivers

Demographic-Energy Linkages

Scenarios

Scenario Overview

Downscaling

Linkages Energy – Agriculture - Forestry

Forests

Agriculture

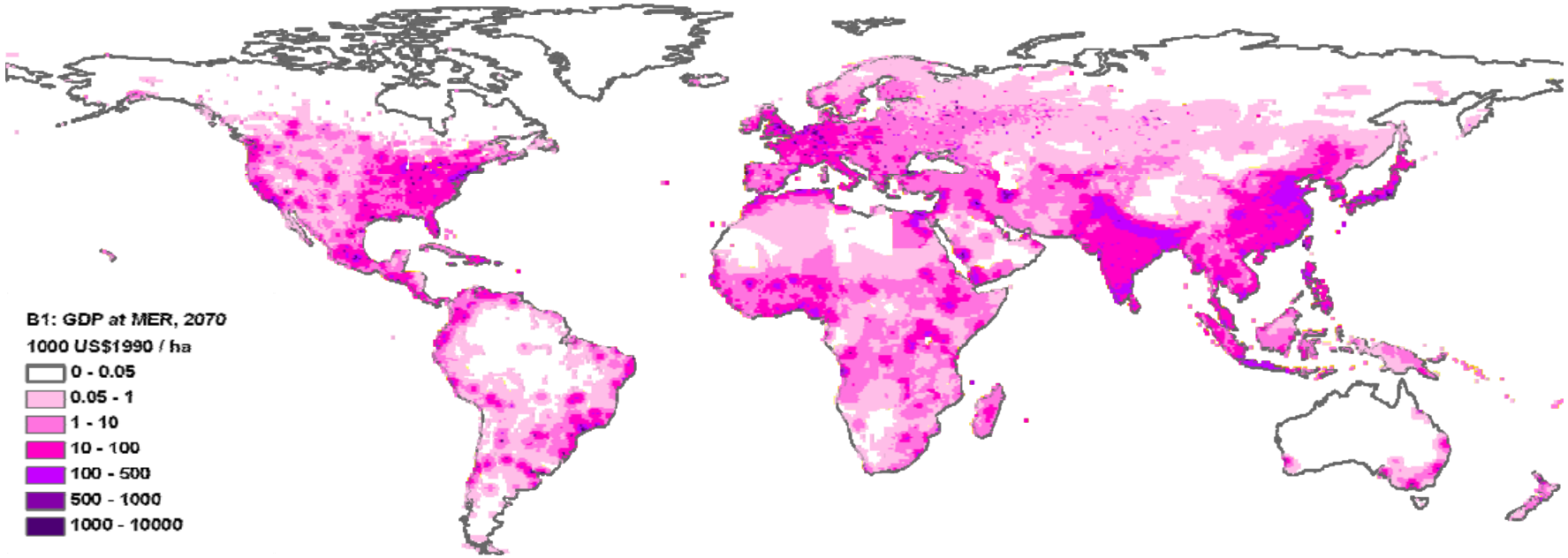
Policy Synergies & Co-benefits

NATIONAL POLICIES

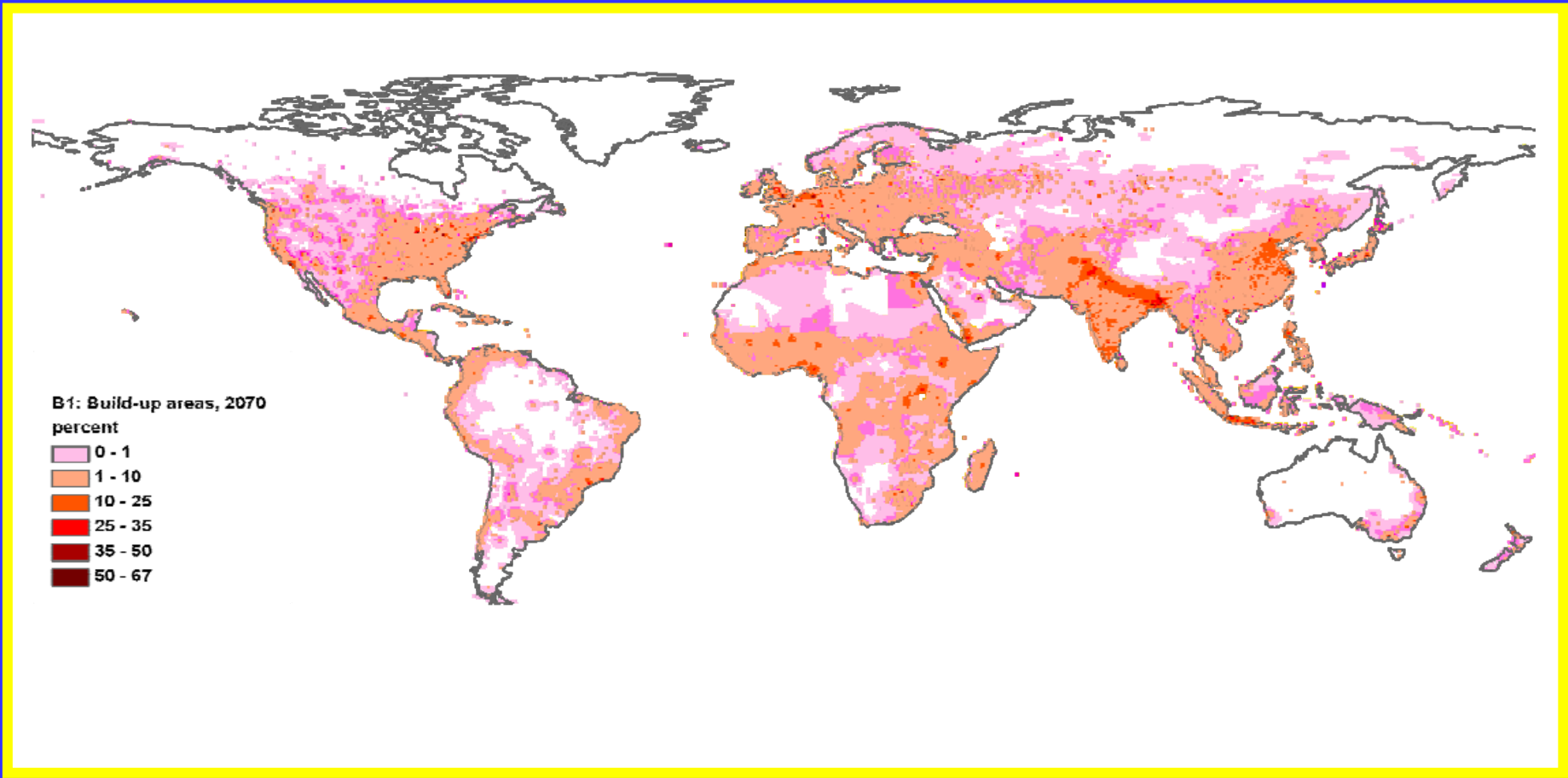
Energy Scenarios and Technology Portfolios

IMPACTS

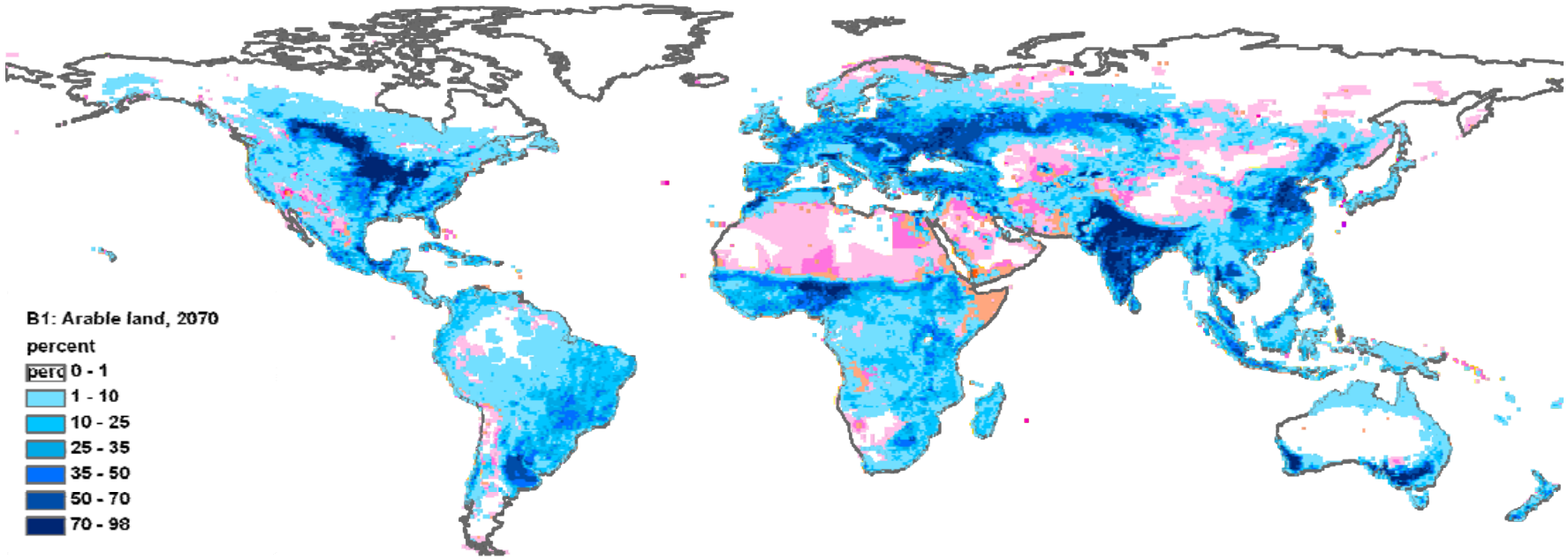
Global GDP Density



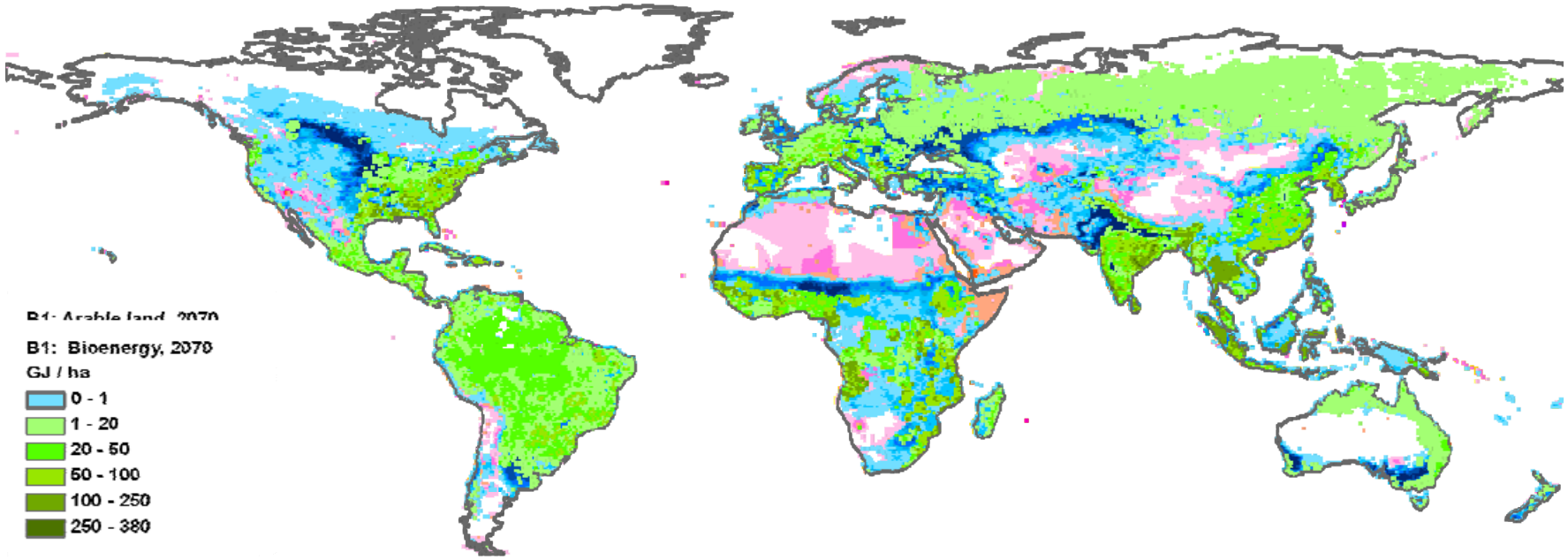
Global Build-Up Area



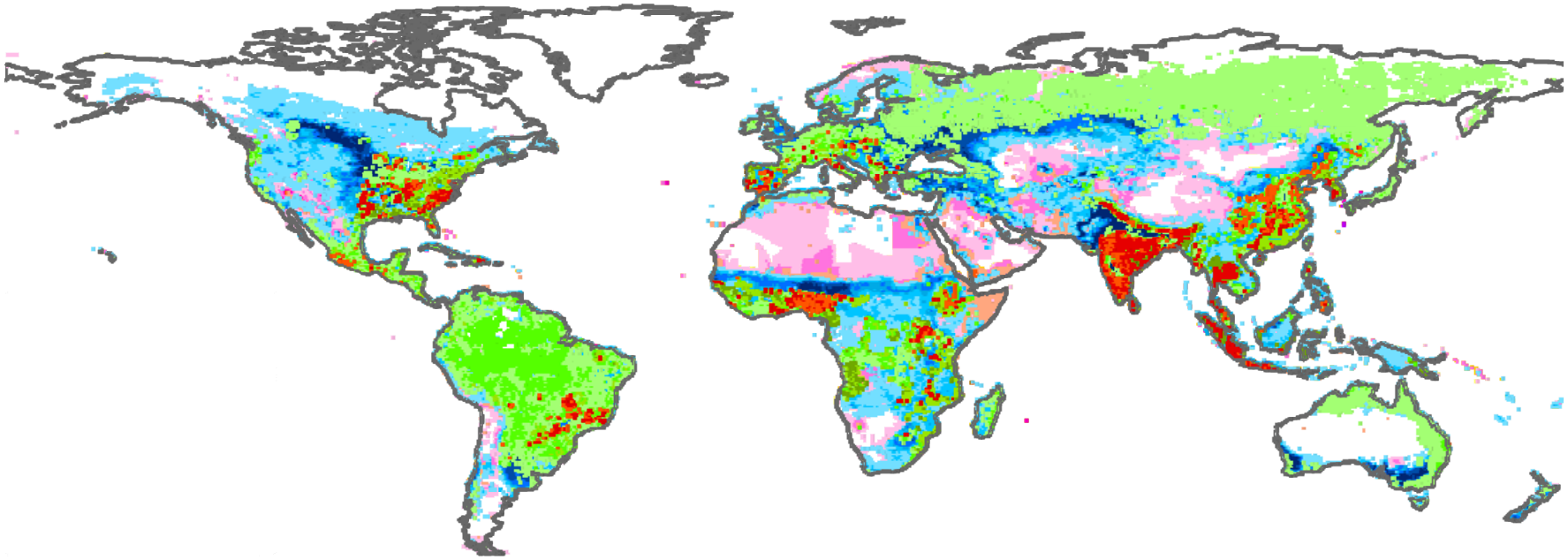
Global Arable Land



Global Bioenergy Land

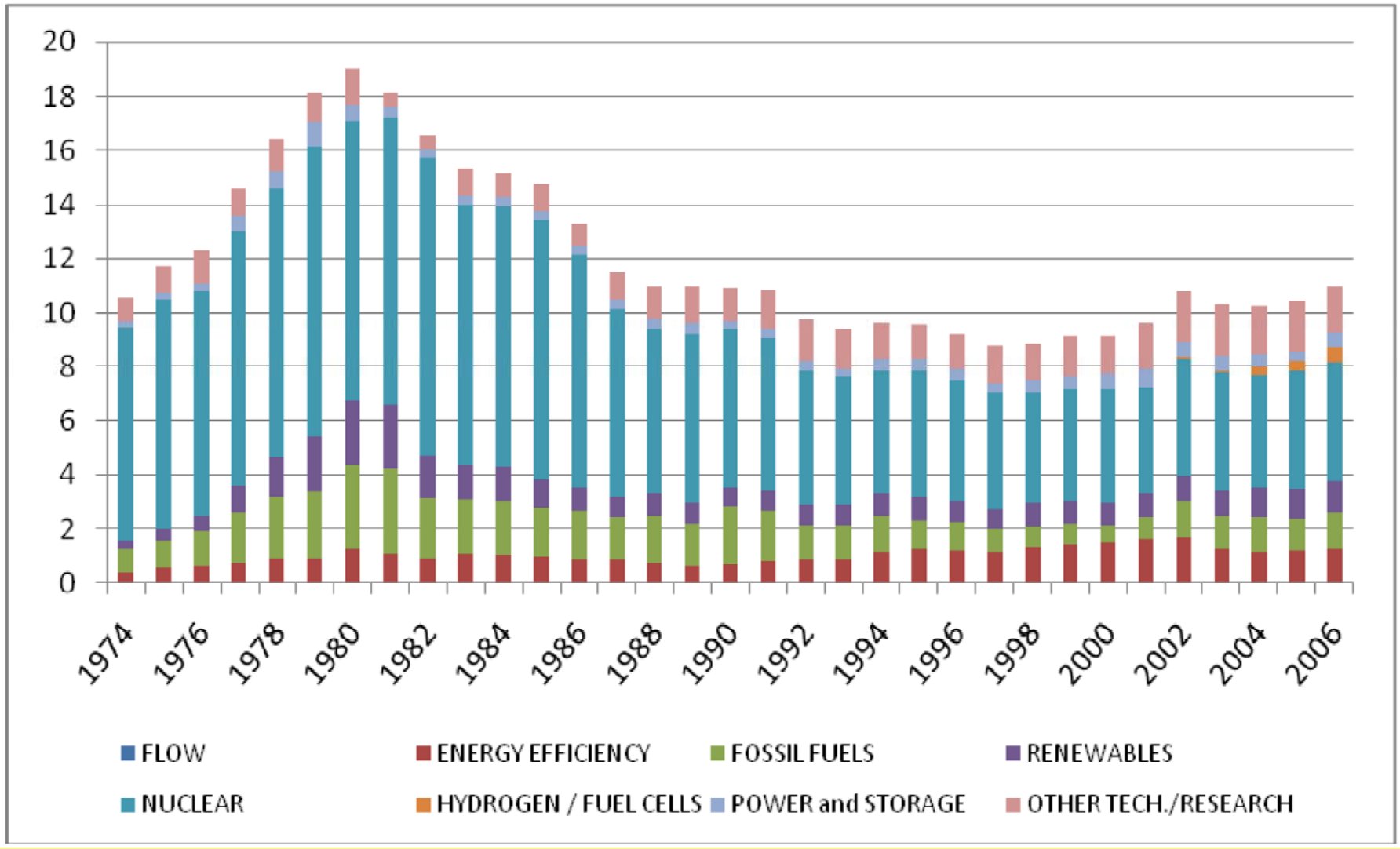


Energy and Food Land Conflicts

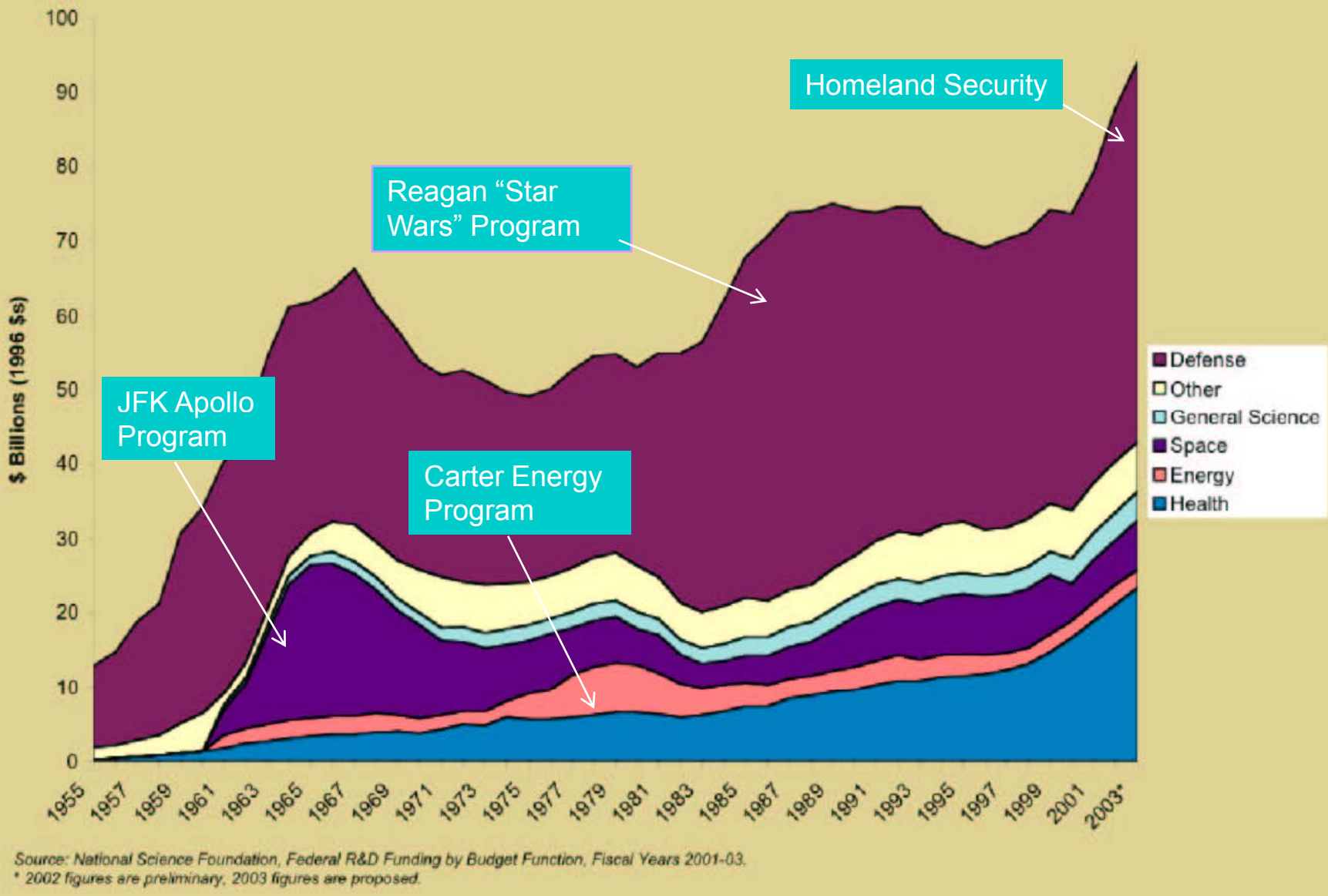


Government R&D in IEA countries

in billion US$ (2006)

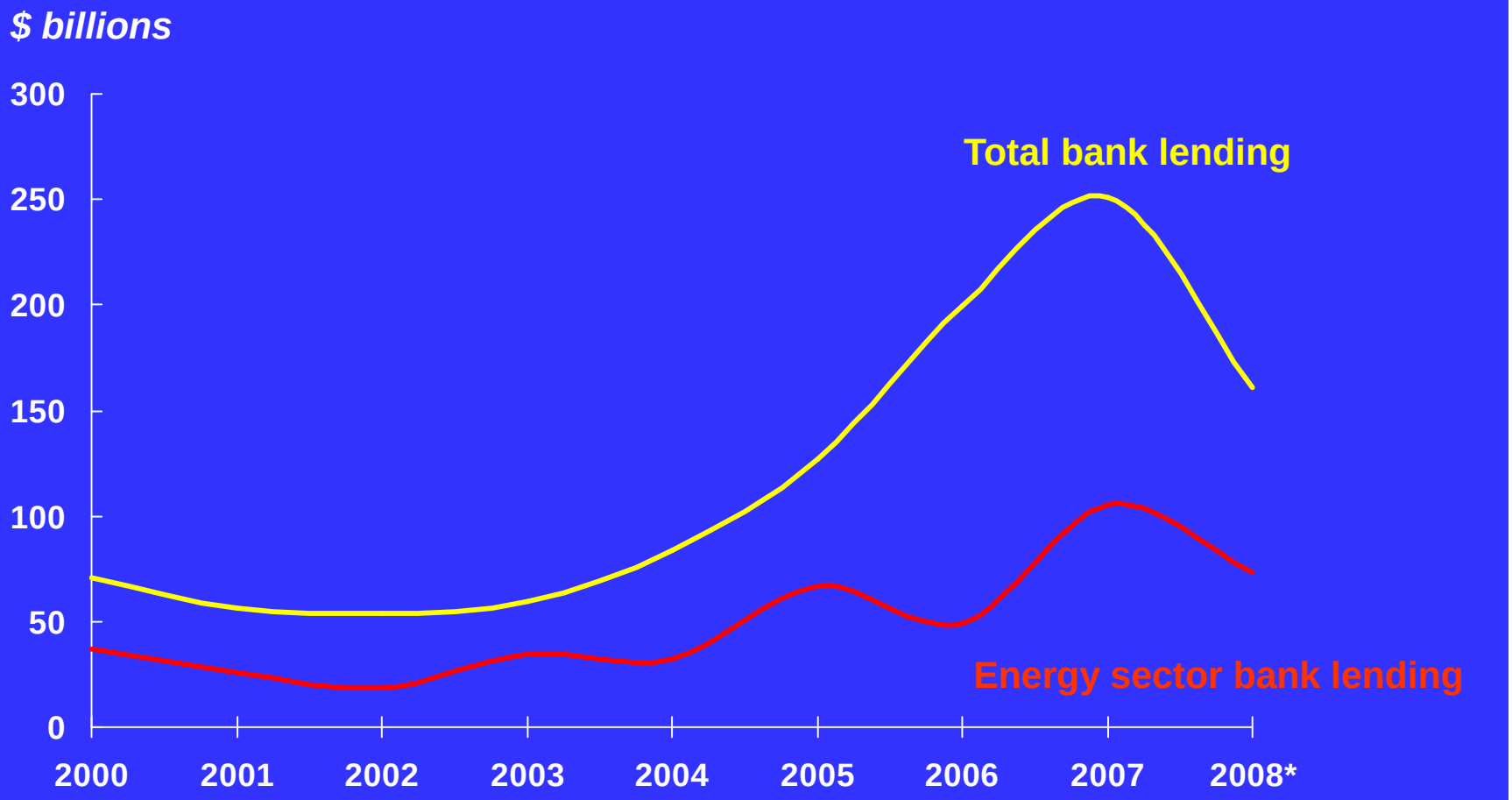


History of US Federal Government R&D



...accounting for one-third of total international bank financing

Bank lending to energy-sector and total bank lending to emerging markets



Towards a more Sustainable Future

- The *magnitude of the change* required in the global energy system will be huge
- The challenge is to find a way forward that addresses *simultaneously* climate change, security and equity issues.
- *Paradigm change is needed*: radical improvements in energy end-use efficiency, new renewables, advanced nuclear and carbon capture and storage.
- Needs to be *globally integrated* but with maximum support of countries and local levels.
- In the best spirit of science: *fact-based and peer-reviewed*

Confronting the Challenges of Energy for Sustainable Development: The Role of Scientific and Technical Analysis

IIASA

International Institute for Applied Systems Analysis
and its international partners present

www.GlobalEnergyAssessment.org

www.GlobalEnergyAssessment.org

Towards a more Sustainable Future

- The *magnitude* of the change required is *huge.*
- The challenge is to find a way forward that addresses all the issues *simultaneously.*
- A paradigm shift is needed: energy end-use efficiency, new renewables, and, if concerns can be resolved, carbon capture and storage and nuclear.