Carbon, vulnerability and energy systems

Frans Berkhout

Sketch

1. Energy systems and carbon emissions
2. Vulnerabilities to GHG emissions reductions from energy systems
   - Climate stabilisation
   - Costs of emissions reductions
3. Energy system vulnerability to climate change impacts

Vulnerability

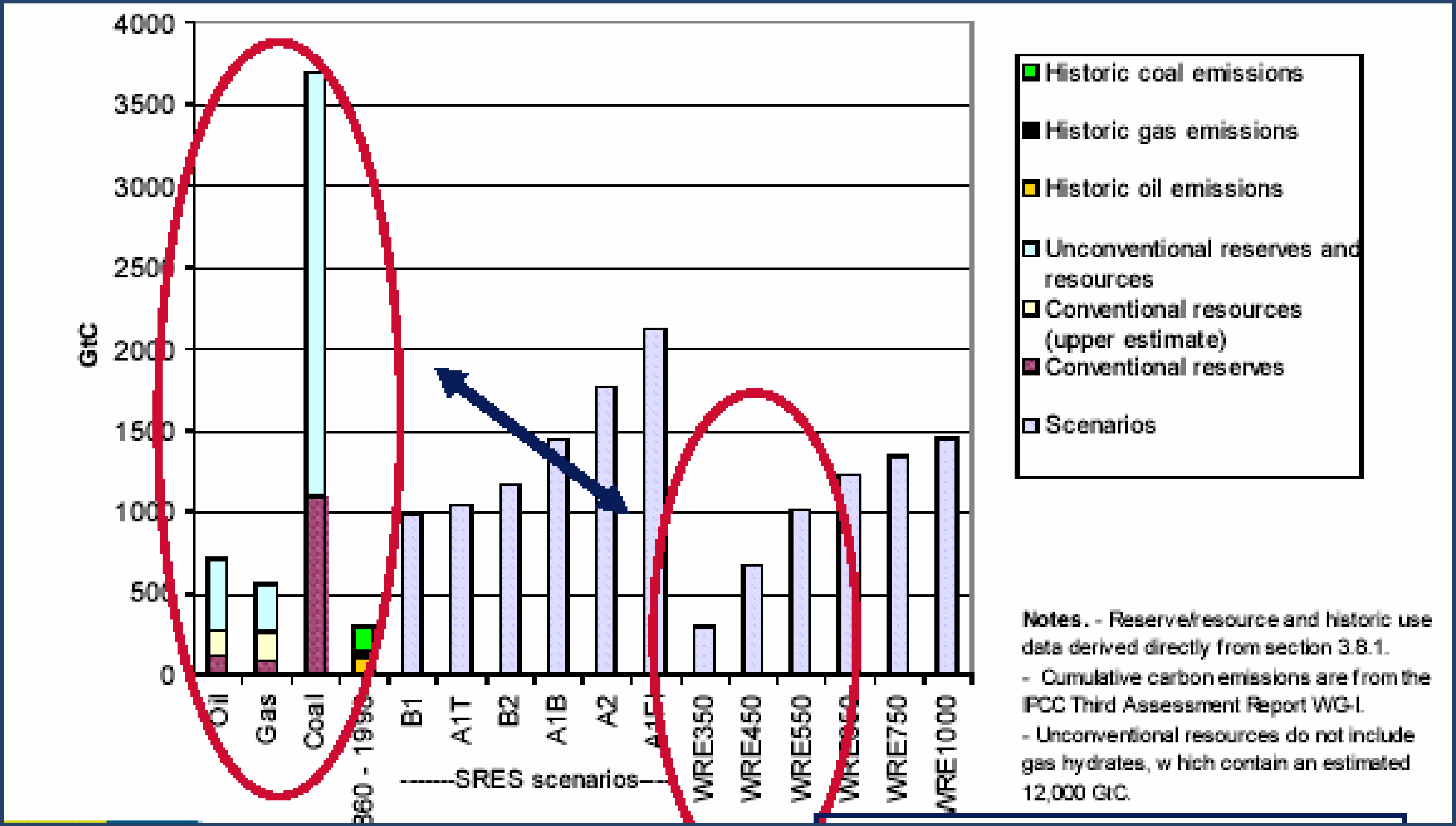
The disposition to suffer harm

- Sensitivity to impacts of change
- Resources to recover from impacts (coping range)
- Capacity to adapt:
  - Capacity to reduce risk of harm (exposure, sensitivity)
  - Capacity to make adjustments to experienced or expected changes
  - Capacity to take advantage of opportunities

Energy systems and carbon emissions

- Historic carbon emissions from energy systems of the order 300 GtC
- Resources/reserves of fossil carbon of the order 5000 GtC
- IPCC SRES scenarios (2001) predict a range of emissions scenarios to 2100 between 1000-2100 GtC
- Emissions budgets associated with current EU climate policy objectives in the range 600-1000 GtC

Fossil carbon and emissions scenarios

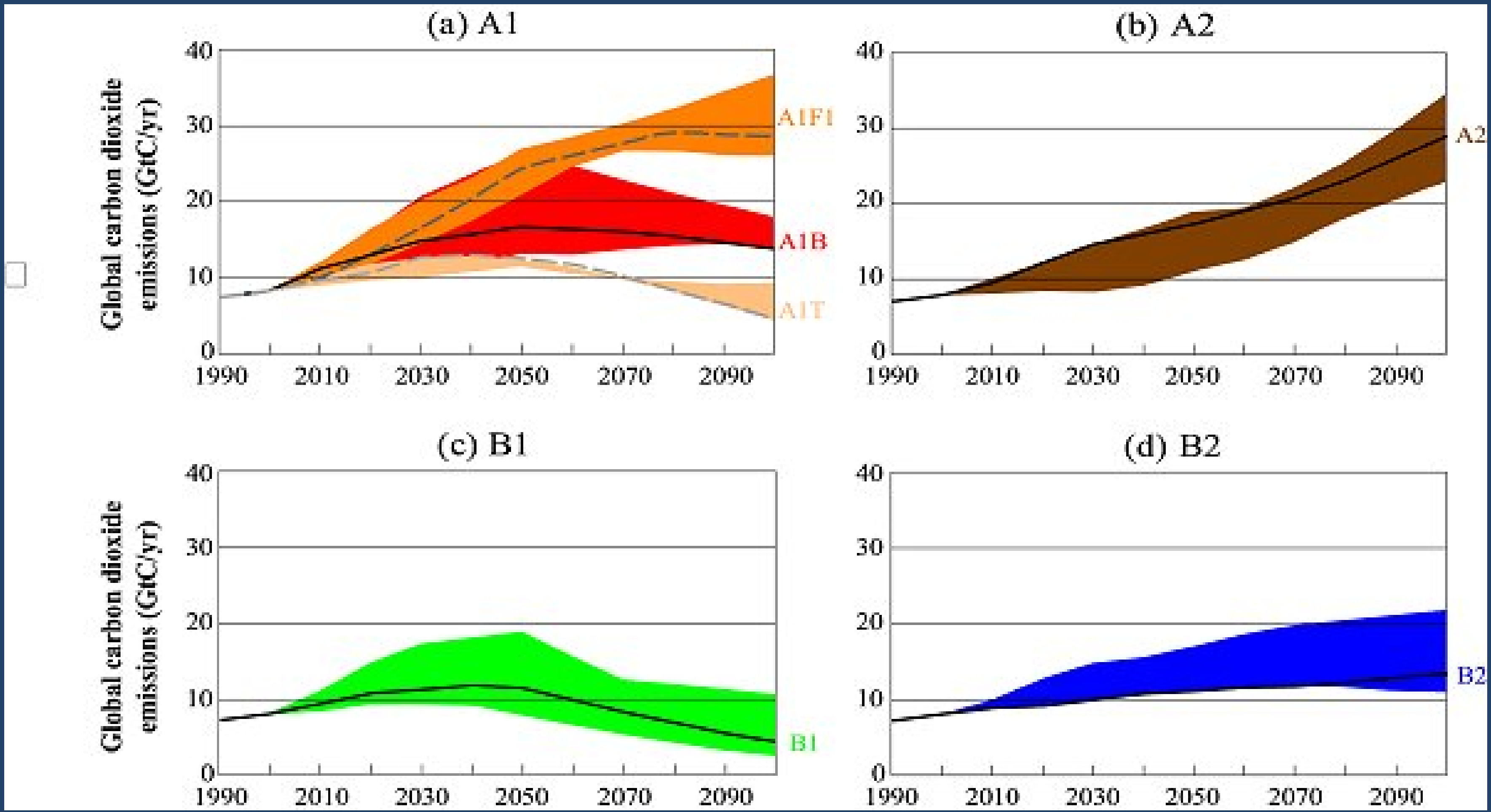


Source: IPCC TAR, 2001

Building GHG emissions scenarios

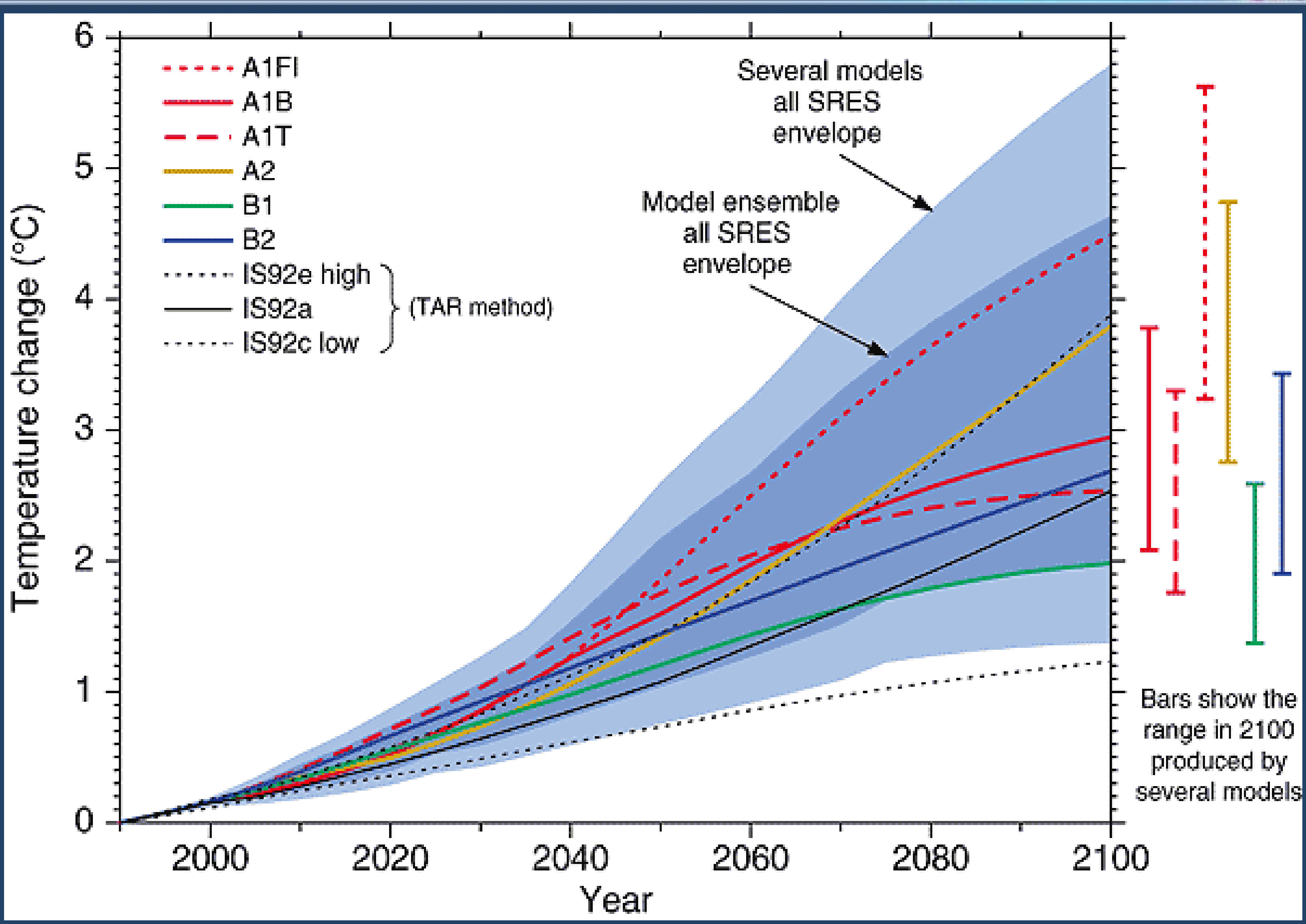
- Emissions scenarios increasingly take account of a range of gases (GHG, ozone precursors, sulphur aerosols)
- Future emissions shaped by socio-economic conditions and assumptions about technological change (in energy producing and using systems)
- Each of the four IPCC SRES scenarios represents a different balance between mitigative and adaptive capacities

Future CO2 emissions scenarios



Source: IPCC/SRES

Future climate change scenarios

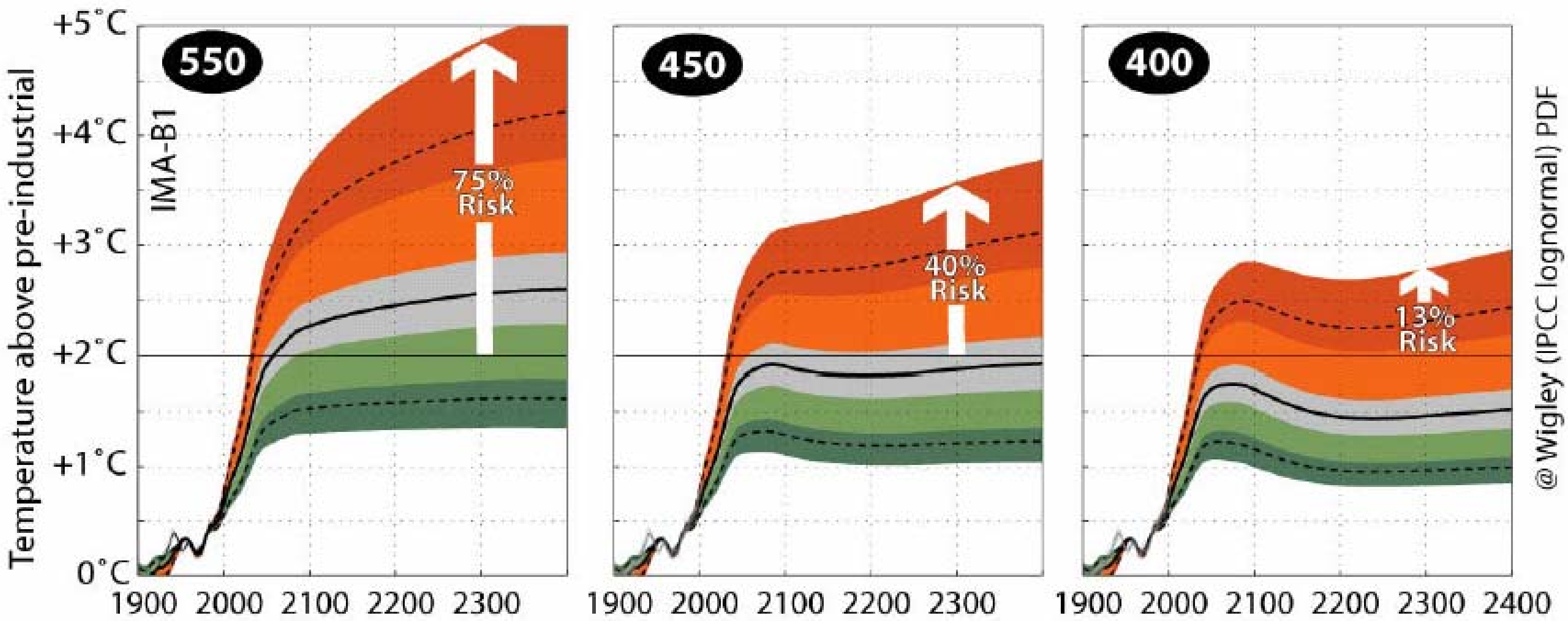


Source: IPCC TAR, 2001

Vulnerabilities to climate change mitigation

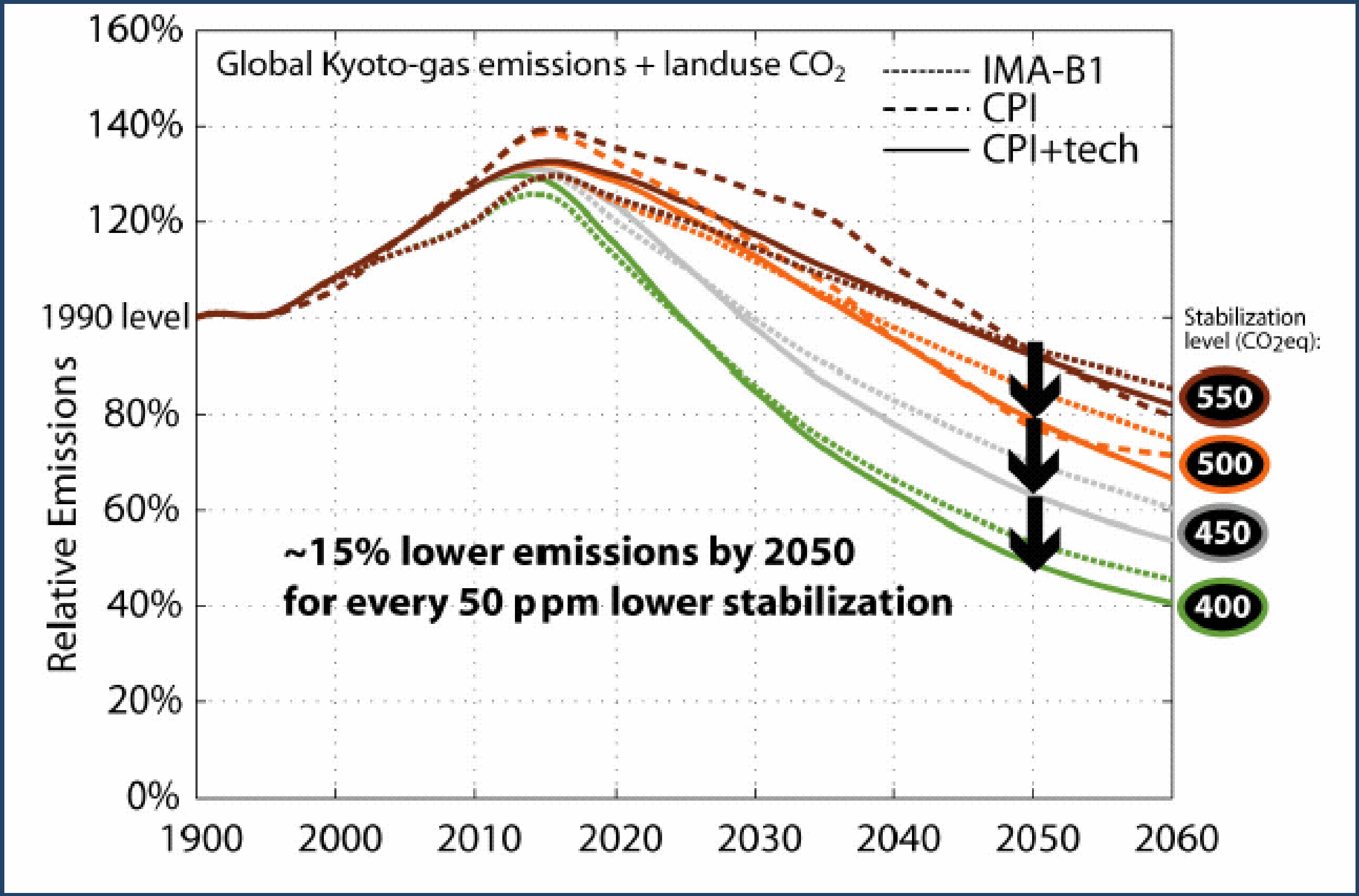
- Concept of ‘dangerous’ climate change embedded in FCCC
- Many interpretations possible – one benchmark is the 1996 commitment by the European Council to limit global average temperature increase to no more than 2degC above pre-industrial levels
- Achieving this will require significant global GHG emissions reductions in the period to 2050 (30-40% below 1990 levels by 2050)
- Making assumptions about landuse CO2 decreases significantly alters reductions of Kyoto gas emissions required (by about 15%)

Achieving the 2degC target



Source: Wigley and Raper, 2001

Stabilisation levels related to emission reductions

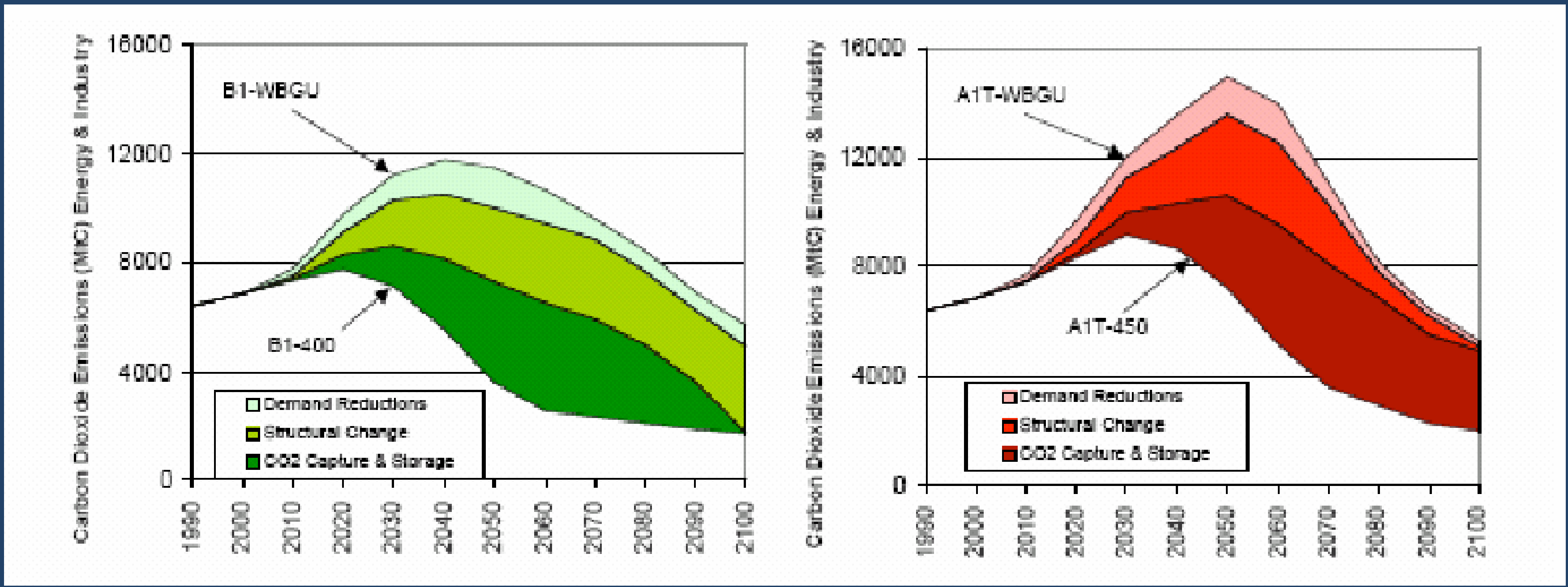


Source: Den Elzen and Meinshausen, 2005

Achieving emissions reductions

- Emissions reductions will need to be achieved through a combination of measures
  - Demand reduction (absolute reduction)
  - Technological and structural change (decarbonisation)
  - Carbon capture and storage
- A shorthand way of expressing vulnerability to mitigation is to define it in terms of aggregate costs and learning rates (capacity to innovate and absorb new technologies into the economy)
- Since the last oil crisis, energy intensity improvements of 1-2% per year have been achieved in industrialised countries (but with a corresponding growth of demand)

Achieving emissions reductions, 2



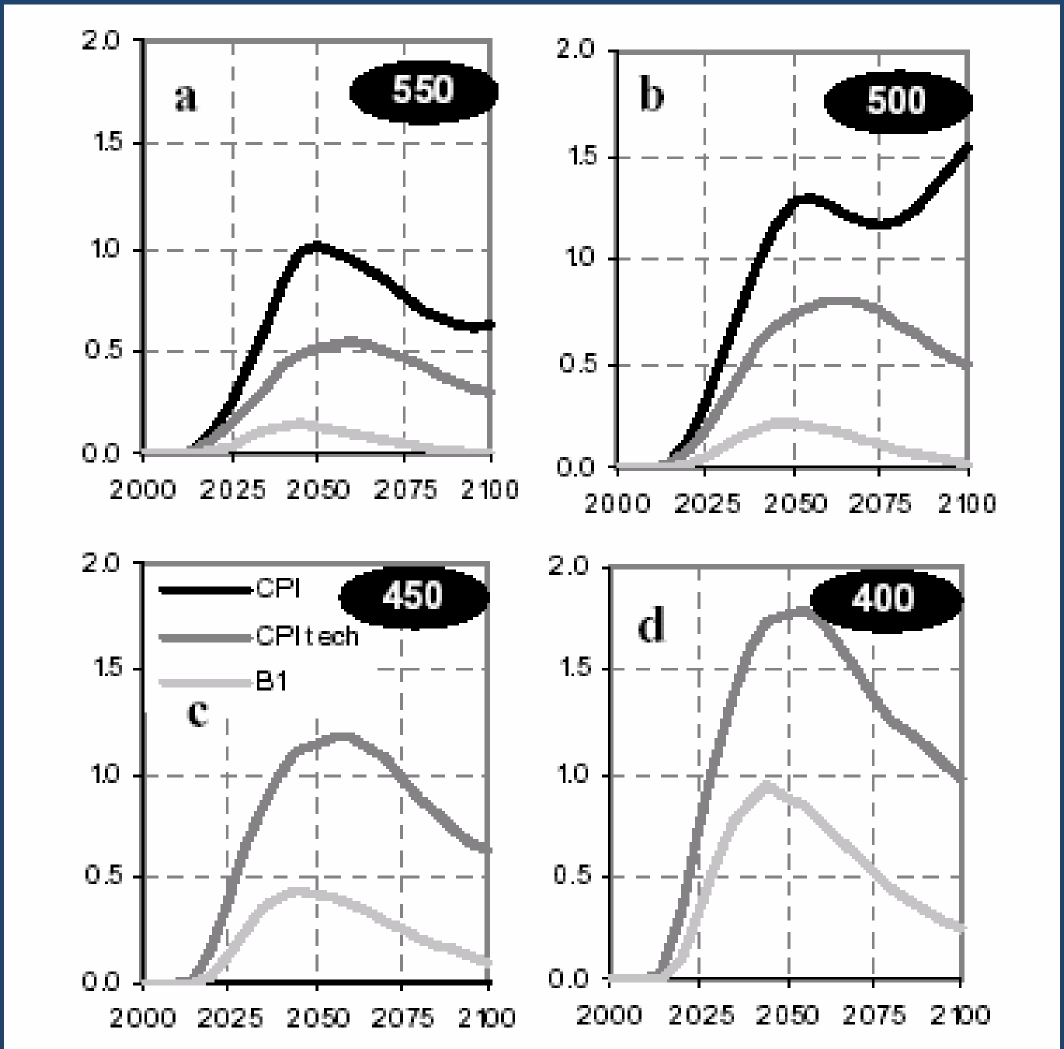
Source: Nakicenovic and Raihi, 2003

Achieving emissions reductions, 3

- Many commentators now argue that deep GHG emissions reductions can be achieved with commercialised (or near-market) technologies – the key is widespread diffusion
- However, the costs of transition to ‘low-carbon economy’ are significant and primarily determined by assumptions about technological learning
- Early reductions reduce longer-term costs of meeting stabilisation targets
- Very rapid emissions reductions would have a more marked effect on economic growth rates and therefore on overall social welfare

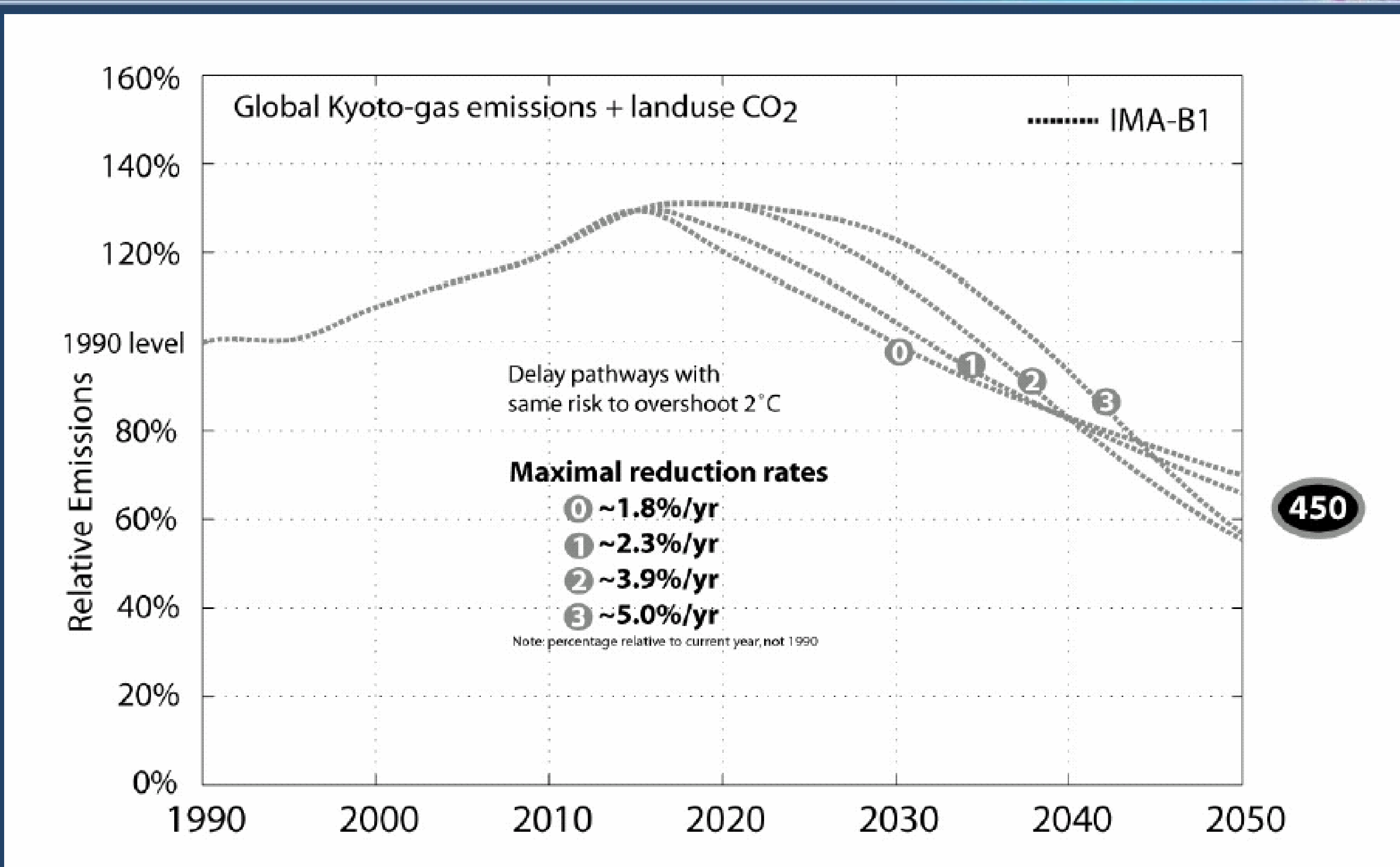
Costs of stabilisation scenarios

% Global GDP



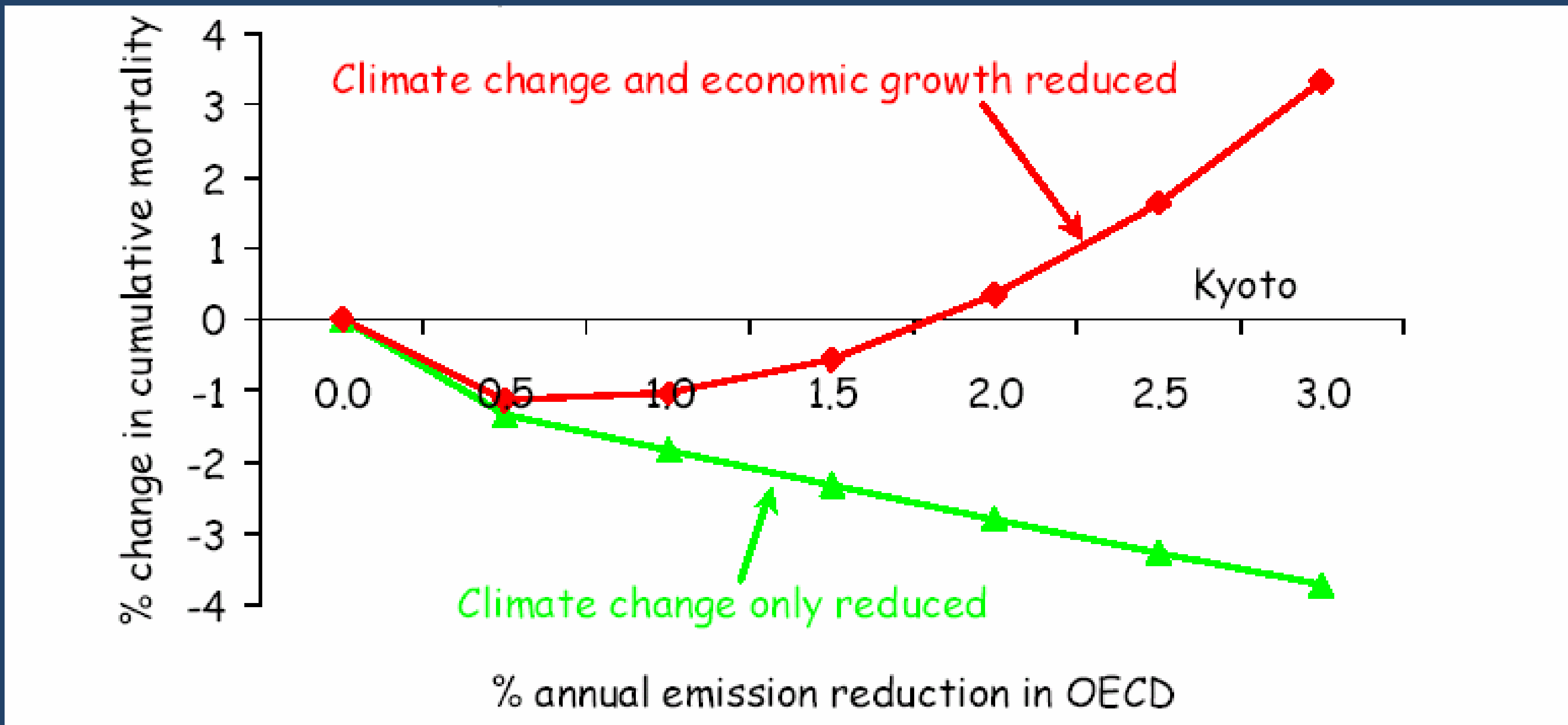
Source: Den Elzen and Meinshausen, 2005

Effects of delayed emissions reduction



Source: Den Elzen and Meinshausen, 2005

Costs of policies to mitigate GHG emissions



Source: Tol, 2005

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Energy system vulnerability to climate impacts

- Impacts on production and distribution infrastructures – extreme events (droughts and storms) and sea-level rise
- Impacts on energy demand (peak management)

- Possible adaptations: more resilient networks, re-siting of facilities