

Technological Solutions: Grey Clouds or Silver Linings

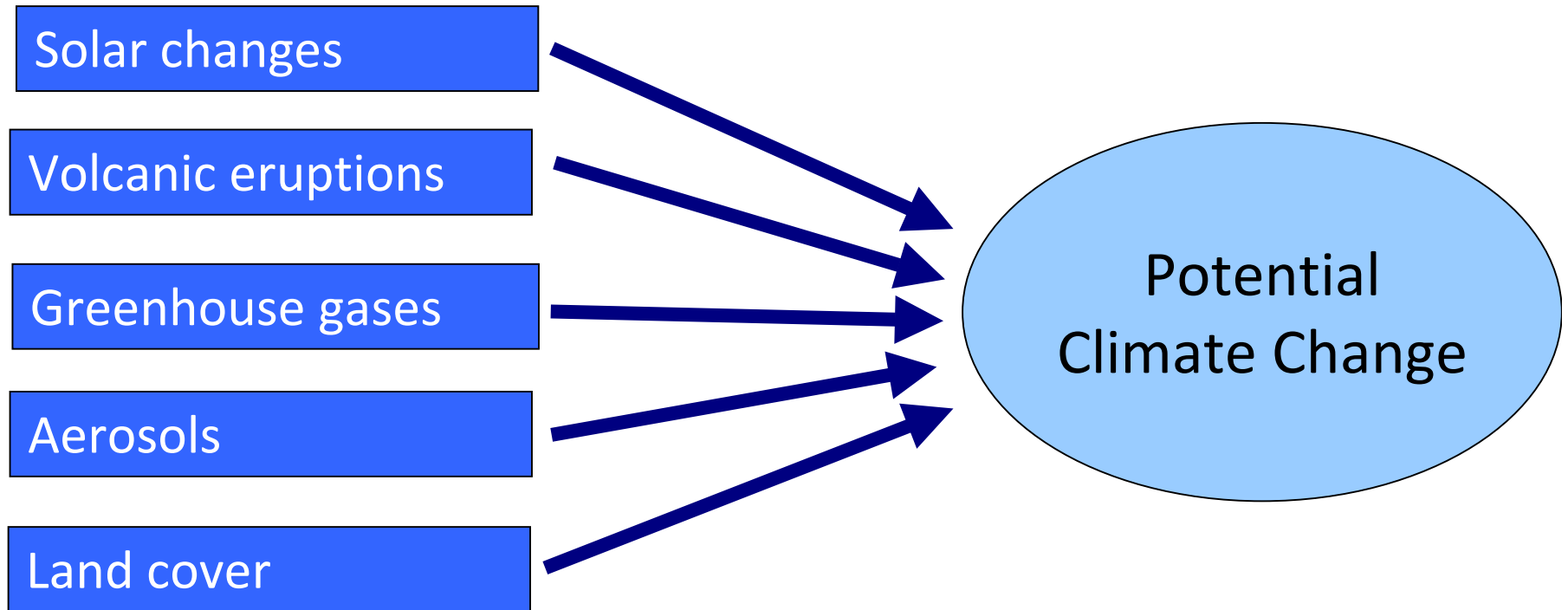
Lenny Bernstein

26 February 2008

Outline of talk

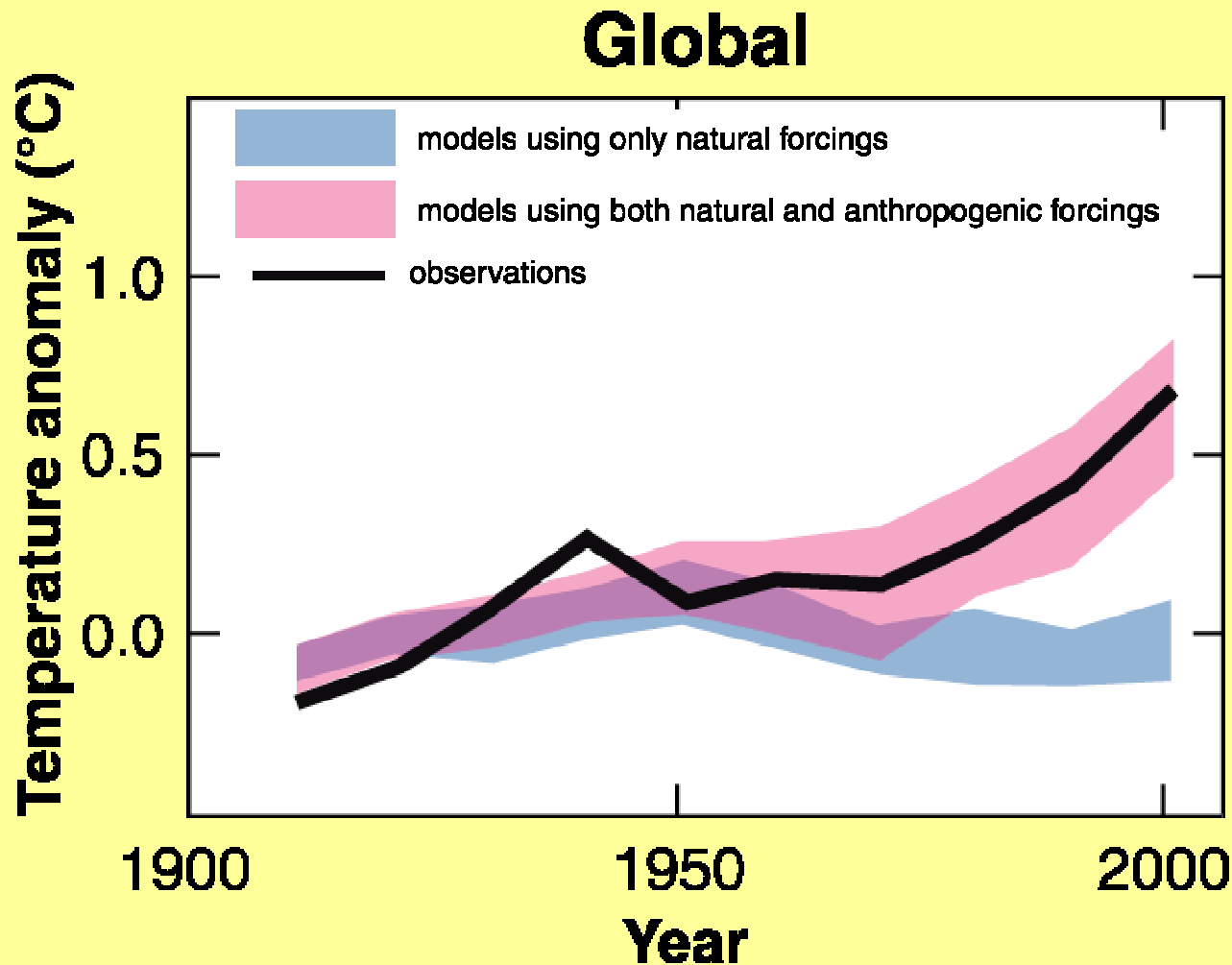
- Human-induced climate change
- The mitigation challenge
- Mitigation potential
- Available technologies
- Barriers and ways of overcoming them

Causes of change



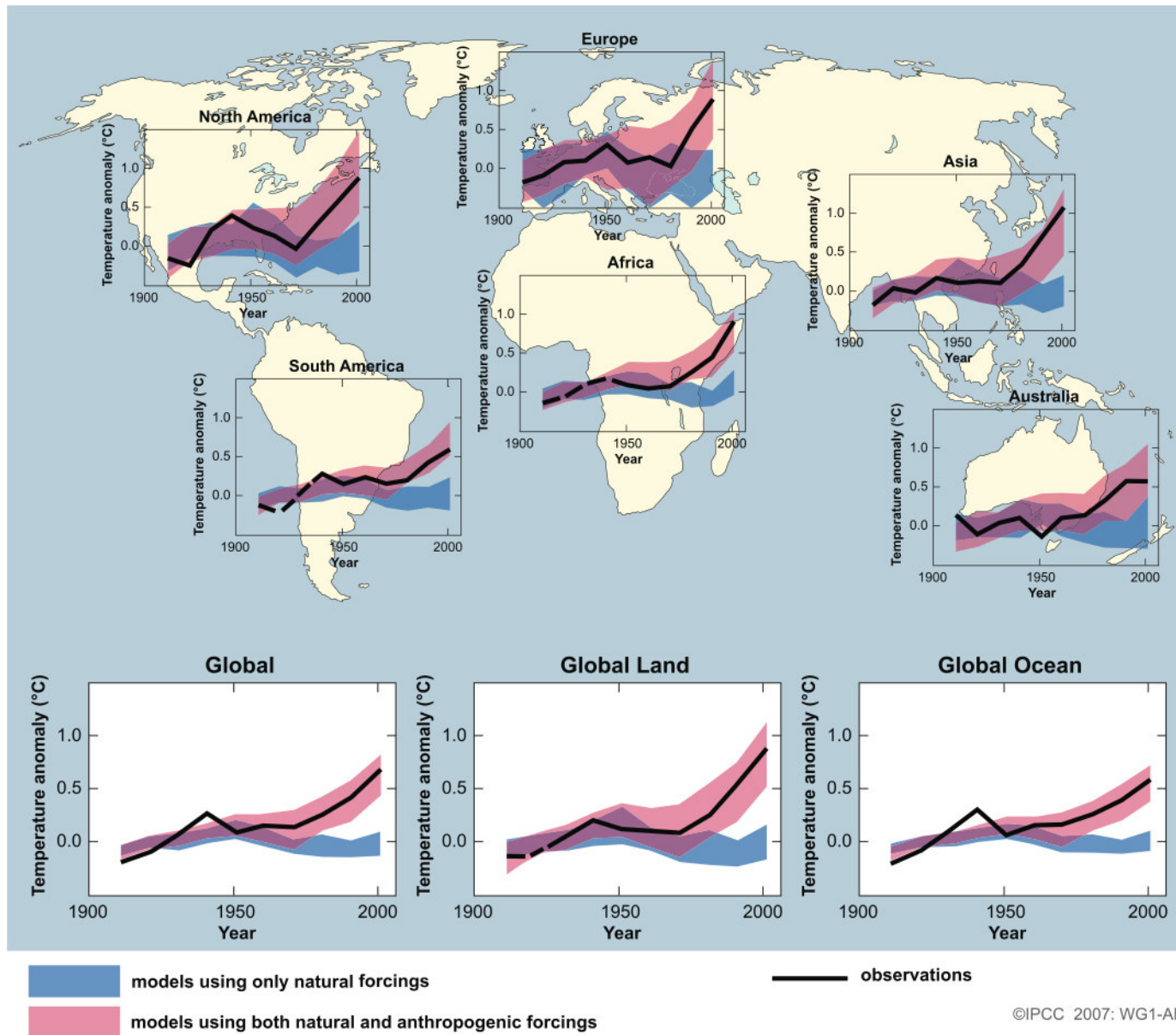
There are both natural and anthropogenic drivers of climate change

Observed warming simulated only if anthropogenic forcings included

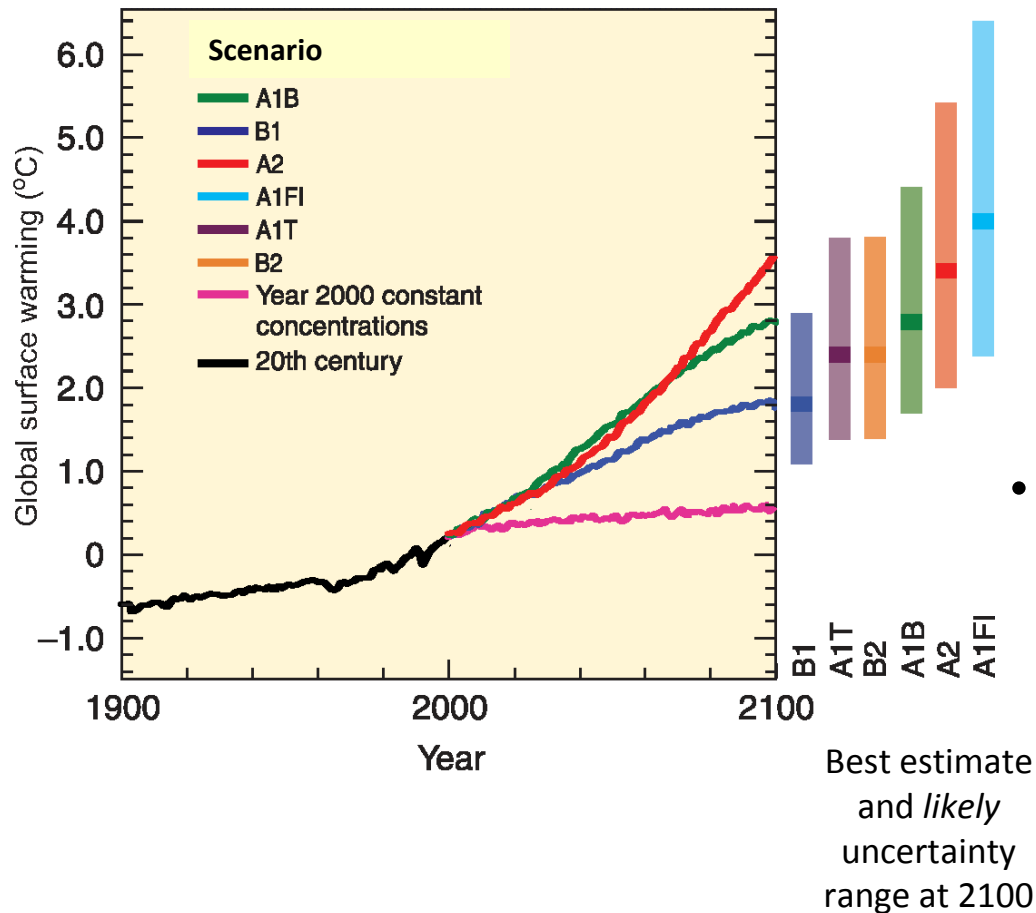


Decadal averages of observed and simulated global average surface temperature.

Shaded band shows 5 – 95% range from climate model simulations

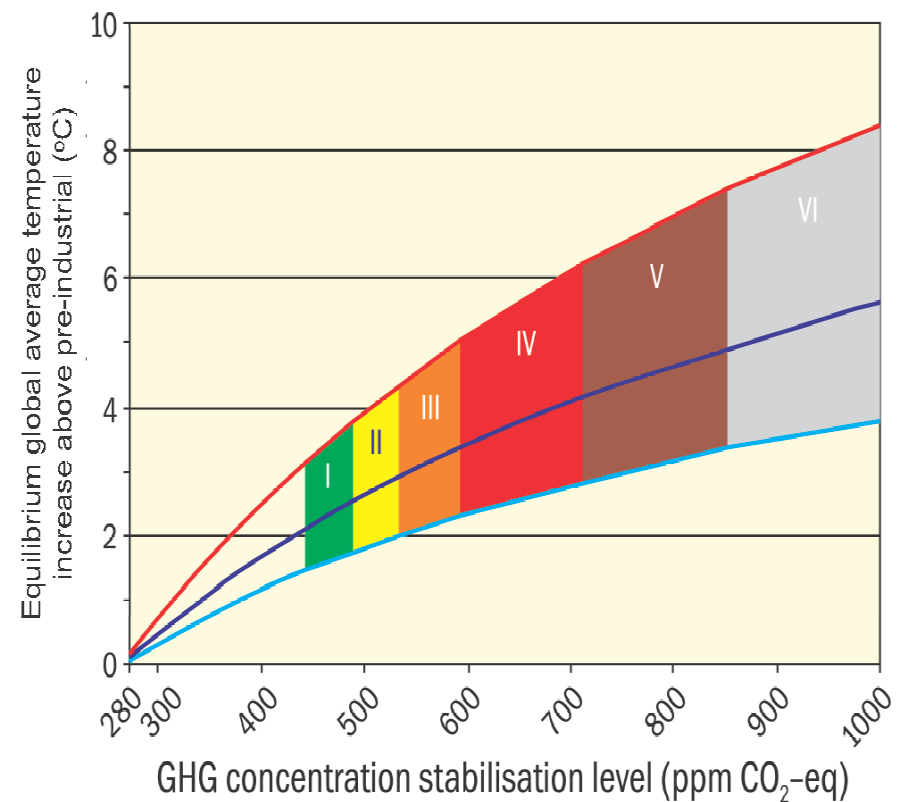
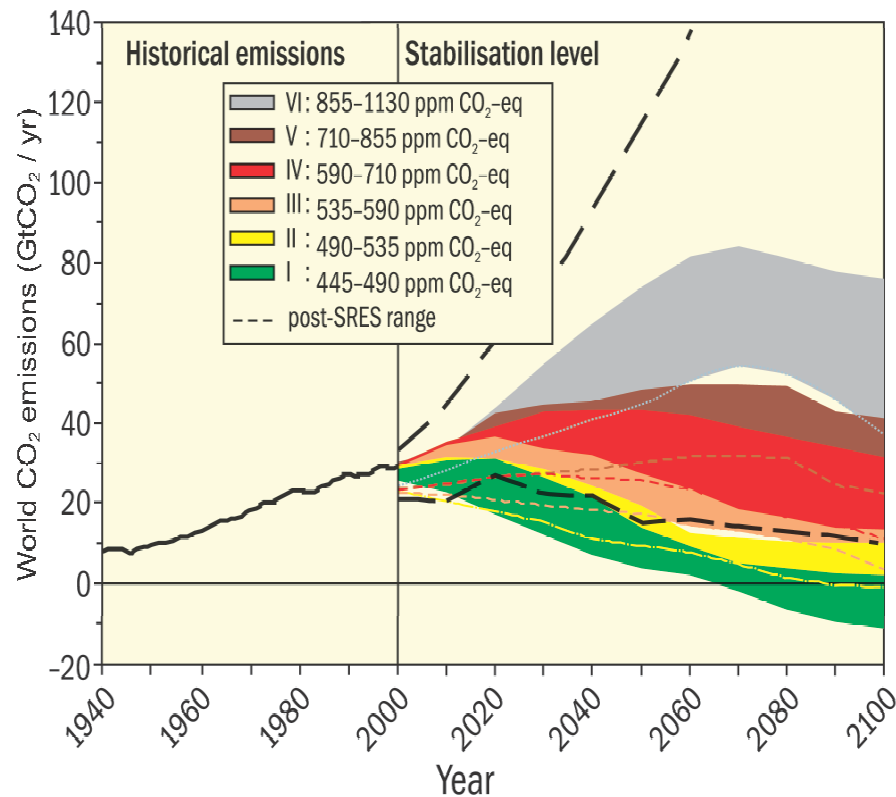


Projection of future changes in climate



- Range of projections is broadly consistent with the TAR.
 - High end of range is larger than in TAR.
 - Broader range of available models suggests stronger climate-carbon cycle feedbacks.
- Sea level rise projections for the 21st century are consistent with the TAR.
 - Uncertainty hinders making reliable estimates of the upper bound.

The lower the stabilisation level the earlier emissions must go down



Mitigation potential

- Baselines for mitigation potential assume that new technology will enter the market if:
 - economically attractive or
 - needed to meet other legal requirements (e.g. air pollution control)
- Improved baseline technology results in significant emission reduction compared with a frozen technology case
- WG III used several baselines: SRES A1B and B2, WEO 2004
- Mitigation potential is the additional emission reduction that could occur under a given set of assumptions: carbon price, etc.

IPCC reports

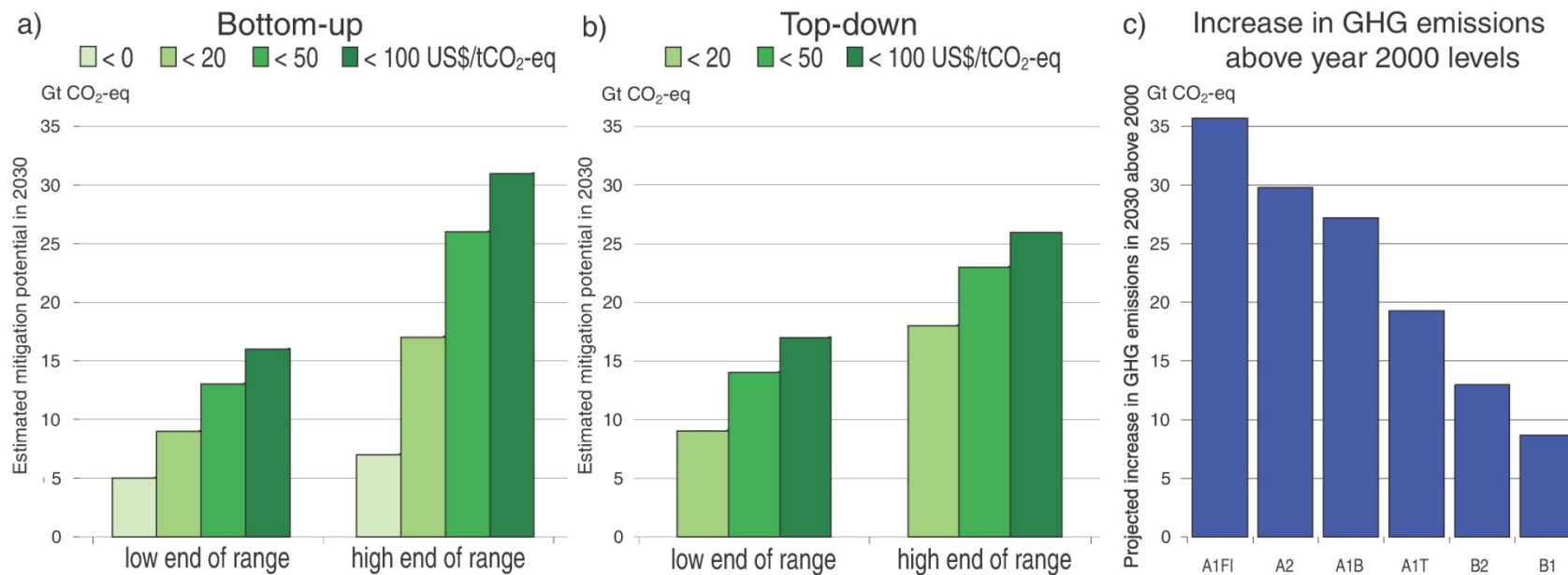
economic mitigation potential

- Economic mitigation potential includes:
 - social benefits, e.g., improved health because of lower air pollution
 - social costs, e.g., unemployment as a result of improved efficiency
 - social discount rates (~5%), lower than private discount rates
- It is the potential that could exist if market efficiency were improved by government policies and measures and barriers removed
- Higher than Market Mitigation Potential, which assume current market conditions and private discount rates (~15%)

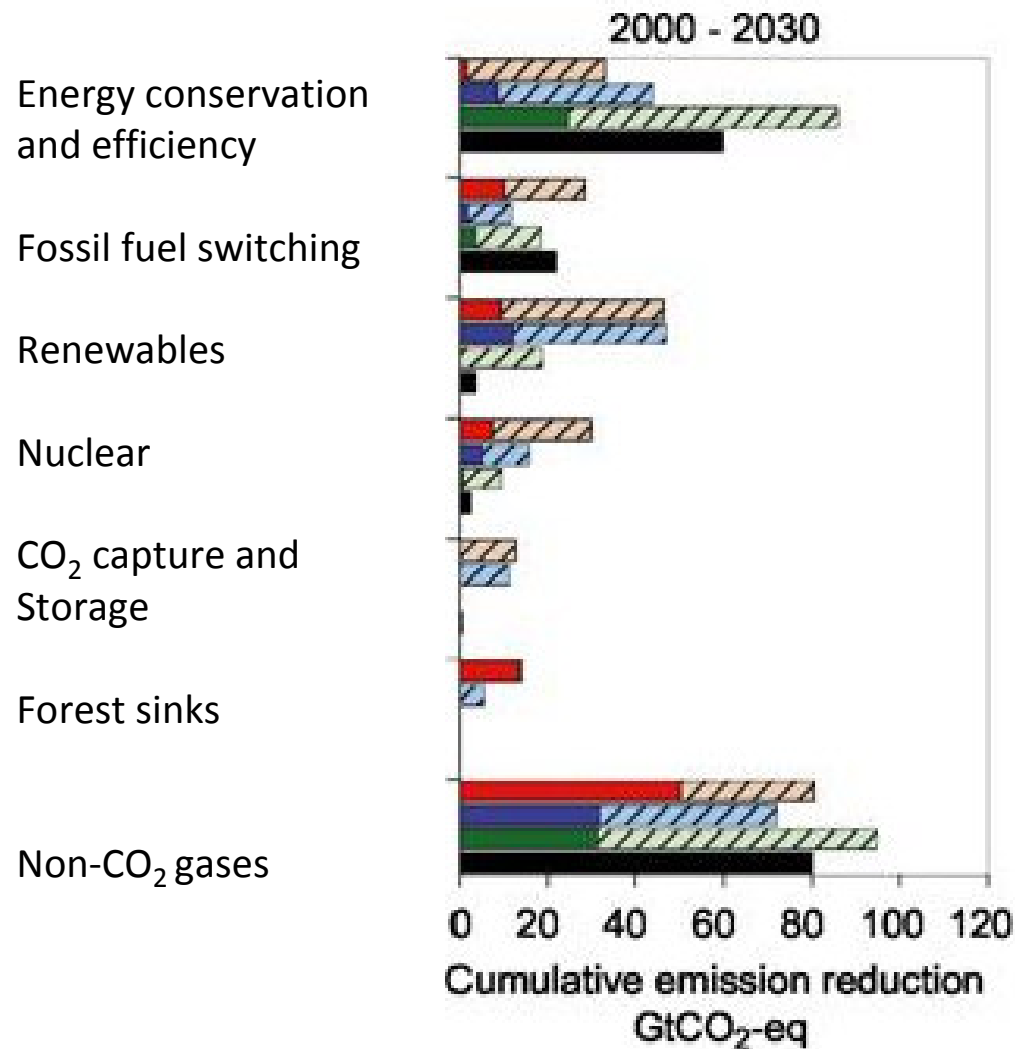
Top-down and bottom-up approaches

- Top-down approaches estimate mitigation potential using macroeconomic models that calculate least-cost solutions assuming perfect market conditions
 - Lowest cost technology used first, independent of other considerations
 - Costs will be raised if any technology, region, or greenhouse gas is excluded
 - Costs can be lowered by including co-benefits and induced technological learning, or by recycling revenues
- Bottom-up approaches consider the cost and potential of individual technologies and determine mitigation potential by added them up
- Economic mitigation potential can be determined using either approach

Economic mitigation potential in 2030

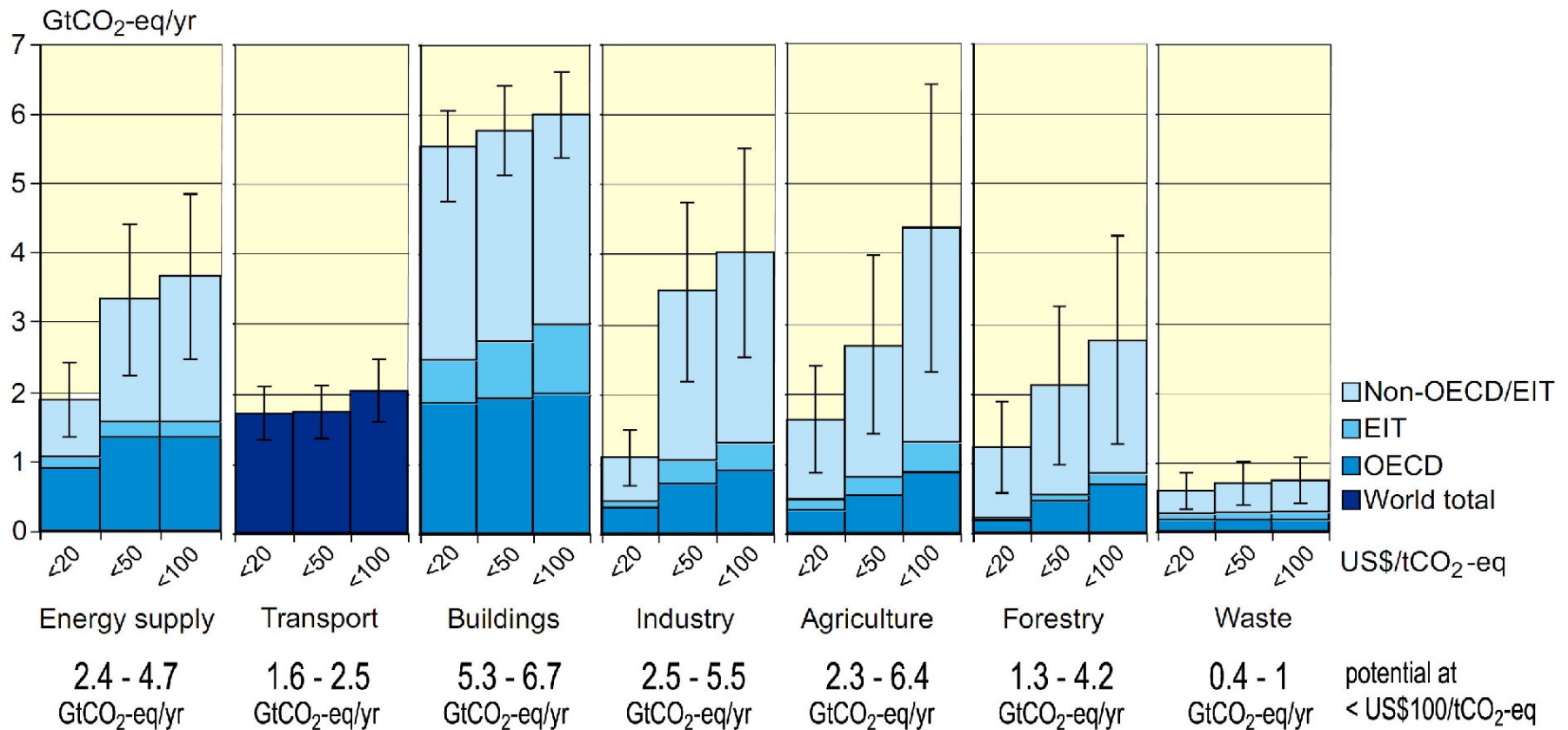


Cumulative global emission reductions, 2000-2030 for stabilization pathways



Bars indicate different top-down economic models. Solid bars indicate mitigation needed to be on a 650 ppm stabilization pathway; dashed bars indicate additional mitigation for a 450 ppm pathway.

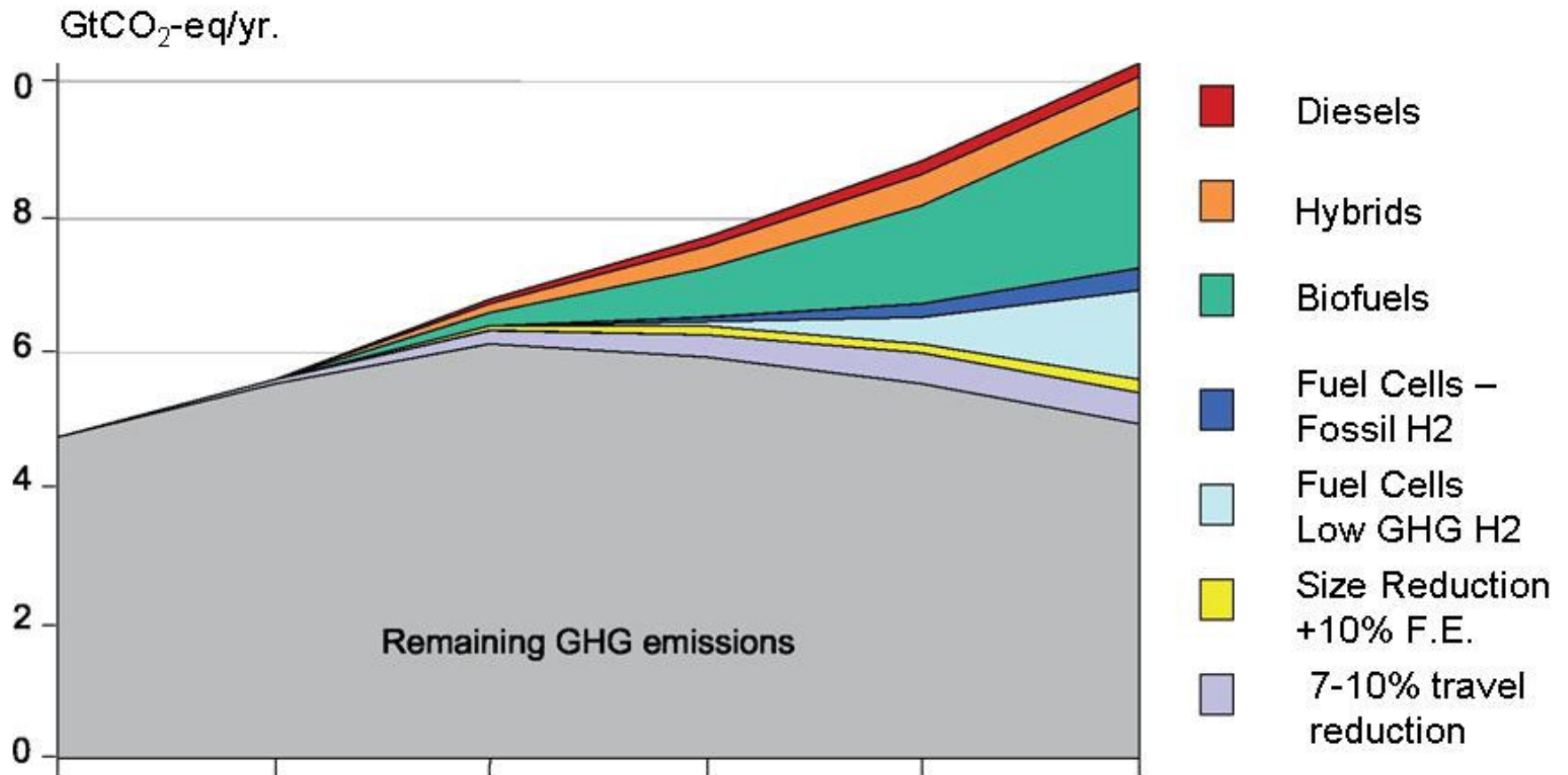
Economic mitigation potential in 2030 is spread across all sectors and regions



Technologies: Electricity supply

Technology	Economic mitigation potential in 2030, Mt CO ₂ -eq. at \leq \$100/tCO ₂ -eq.
Renewables (biomass, wind, solar, etc.)	3700
Nuclear	1880
Fuel switching and generation efficiency	1070
Carbon capture and storage	710

Technologies: Transport



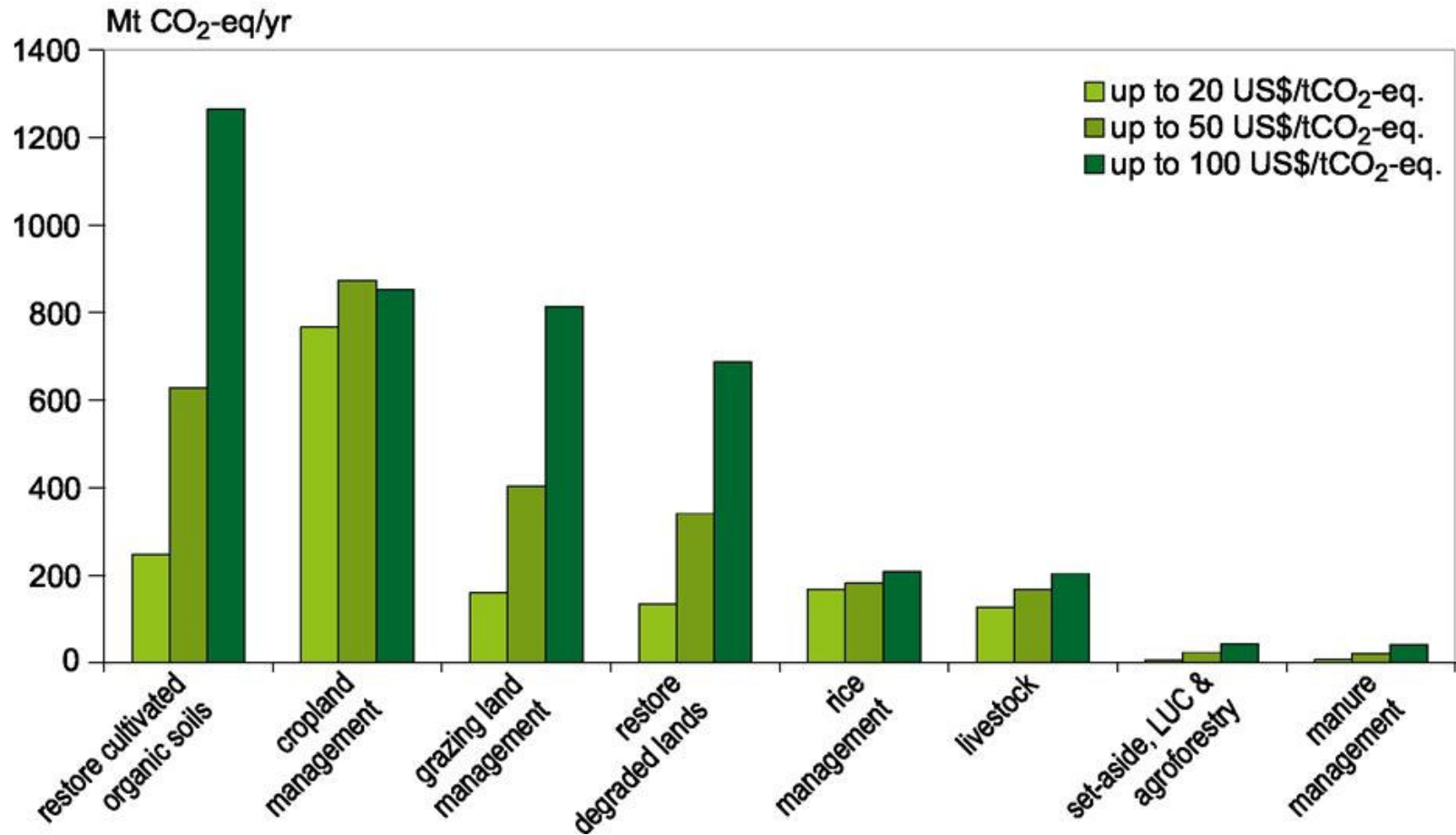
Technologies: Buildings

- Reduce energy consumption
 - Efficient lighting and day-lighting
 - Improved insulation
 - More efficient heating, cooling, and electrical appliances
 - Improved cook stoves
- Switch to low- and non-carbon energy sources
 - Passive and active solar design
- Control emissions of non-CO₂ emissions
 - Alternative refrigeration fluids
 - Recovery/recycle of fluorinated gases

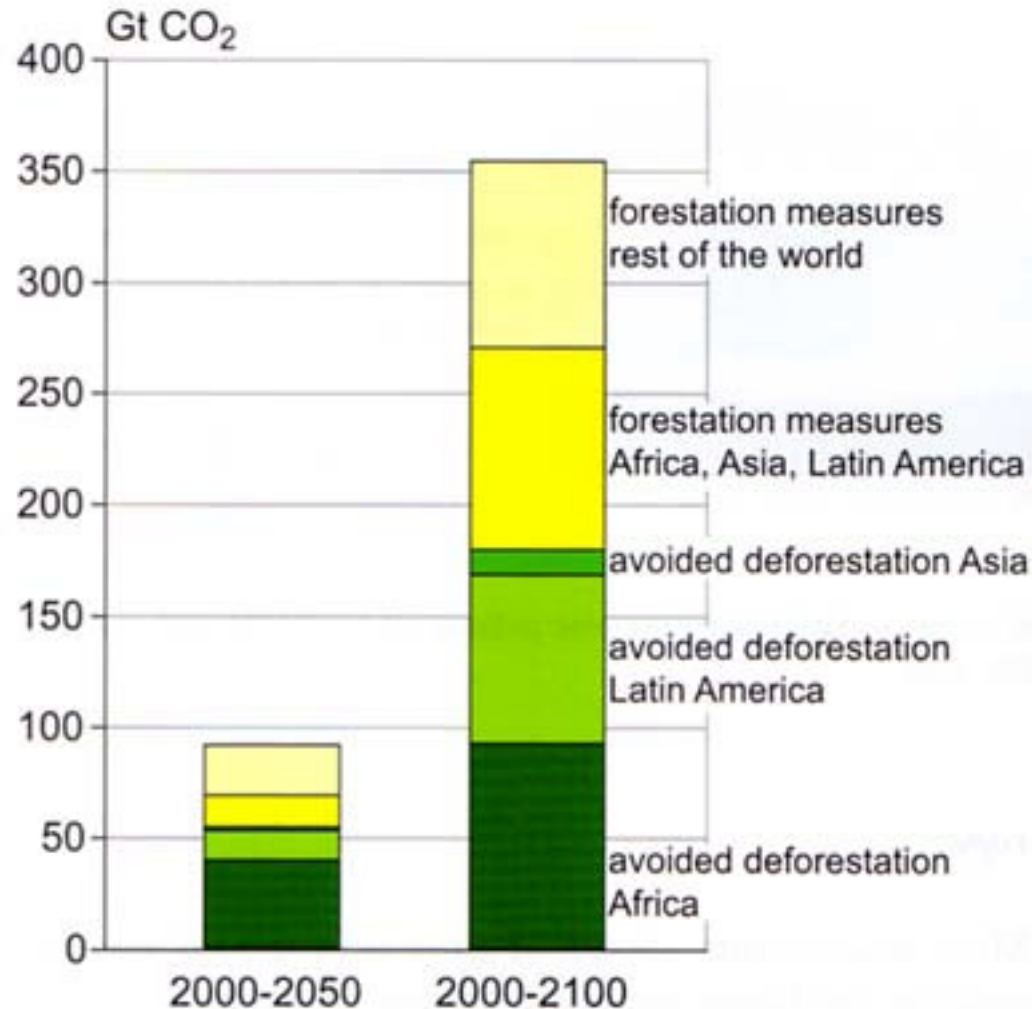
Technologies: Industry

Industry or option	Economic mitigation potential in 2030, Mt CO ₂ -eq. at ≤ \$100/tCO ₂ -eq.
Steel <ul style="list-style-type: none"> - Heat/energy recovery from byproducts - Coke dry quenching - Blast furnace top gas energy recovery 	420 - 1500
Cement <ul style="list-style-type: none"> - Fuel/material substitution 	480 - 2100
Paper and pulp <ul style="list-style-type: none"> - Additional use of biomass energy - Recycling 	40 - 420
Control of non-CO₂ gases	380

Technologies: Agriculture



Technologies: Forestry



Technologies: Waste management

Technology	Economic mitigation potential in 2030, Mt CO ₂ -eq. at ≤ \$100/tCO ₂ -eq.
Greater landfill gas recovery	400 - 800
Control of N ₂ O from waste water, other technologies	0 - 200

Barriers to mitigation

- Lack of requirement in much of the world
- Slow capital stock turnover
- Highly fragmented sectors, esp. buildings and agriculture
- Lack of financial and human capital
- Impact of life style on emissions

Overcoming barriers to mitigation

- IPCC cannot be policy prescriptive; it can only assess the literature, which indicates that the following policy approaches may be effective
 - Integrating climate policies into broader development policies
 - Regulations and standards
 - Taxes and charges
 - Tradable permits
 - Financial incentives
 - Voluntary agreements
 - Information instruments
 - Development and use of advanced technology
- The optimum choice of policy mix will depend on national circumstances

Can we stabilize atmospheric concentrations of GHGs?

- Current technology, and the technology expected over the next few decades, is sufficient to start on a path towards stabilization at the low levels being considered in the Bali Action Plan
 - Additional technology would be needed post-2030
- Achieving stabilization will require:
 - Major shifts in energy supply and end-use technology
 - + IEA projects that by 2030 an investment of >\$20 *trillion* will be required to meet the world's energy needs
 - + The incremental cost of meeting those needs with clean energy is 0-10%
 - + Top-down models indicate that starting on a path towards stabilization would reduce global GDP by <0.12%/yr – costs for individual countries or regions could be larger
 - Controlling emissions from land-use change
 - + Currently 20% of global CO₂ emissions
 - Changes in life-style
 - + Societal change is possible, but takes time

For more information, see Working
Group III's Contribution to the IPCC
Fourth Assessment Report

Available on the IPCC website:
www.ipcc.ch