Mitigation of Climate Change

IPCC Working Group III contribution to
the
Fourth Assessment Report

Rutu Dave

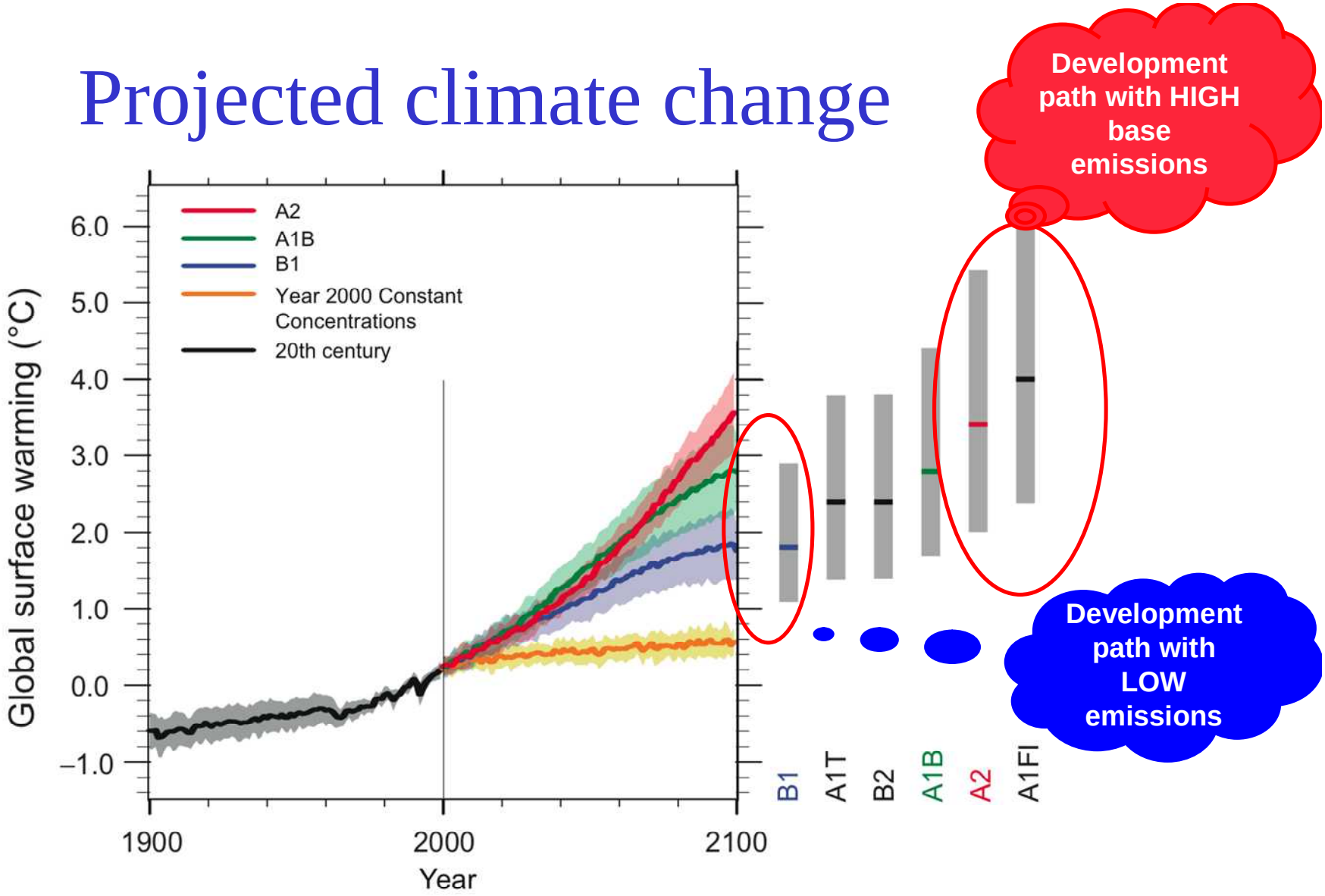
Scientific Officer WG III

Japan Outreach Meeting

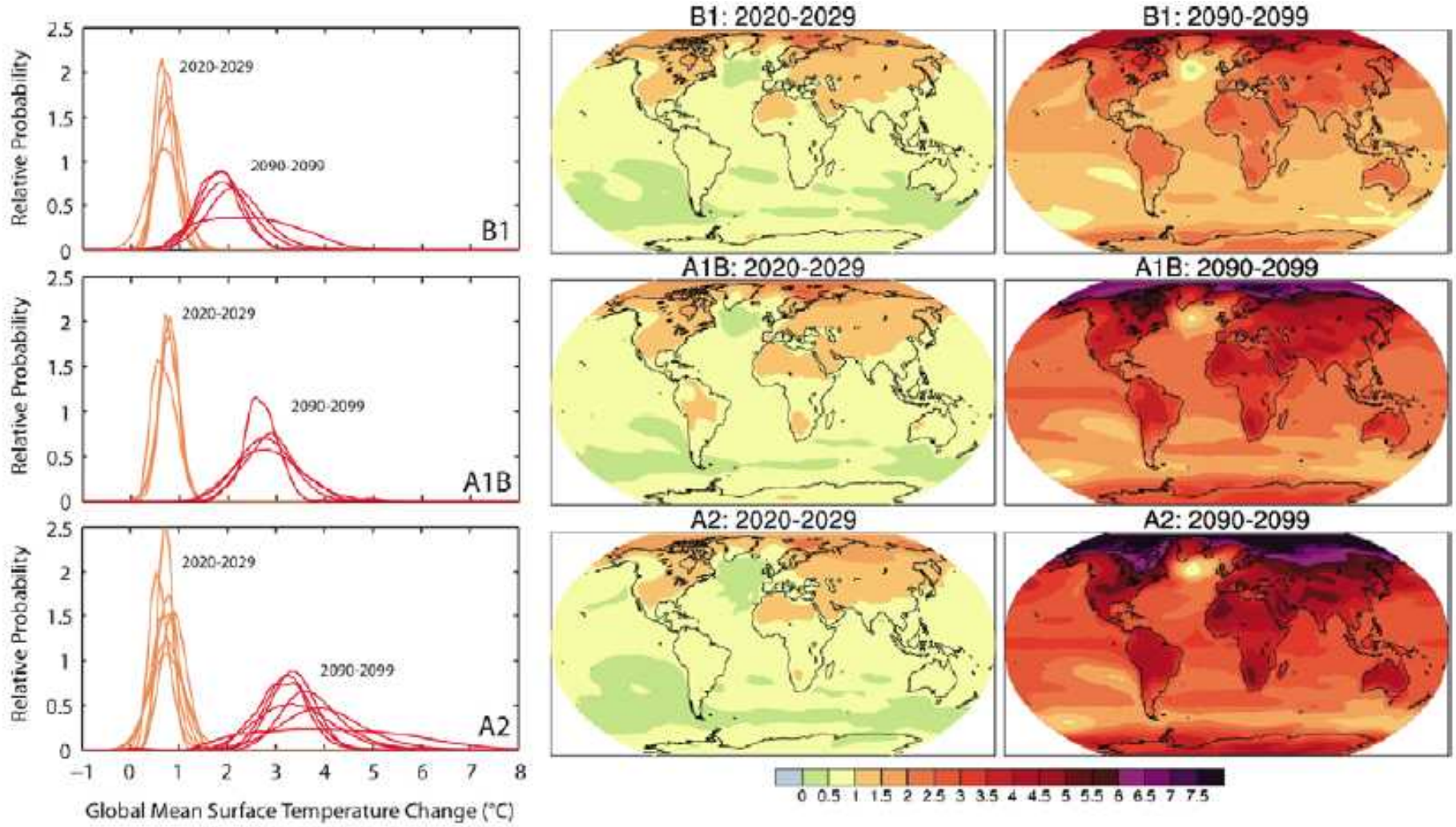
Key message: climate change is a development issue and can be solved

- Socio-economic and technological development strong driver for GHG emissions
- Climate change can undermine development and lead to serious disruption of society with international security implications
- Technologies available for limiting climate change to 2 degrees above pre-industrial at relatively low costs
- Strong policies are needed to realise rapid global emission reductions by implementation and further development of necessary technologies
- Aligning these policies with policies aiming at energy security, employment, energy for development, air quality improvement, mobility improvements, etc. will make it much easier to achieve the goals

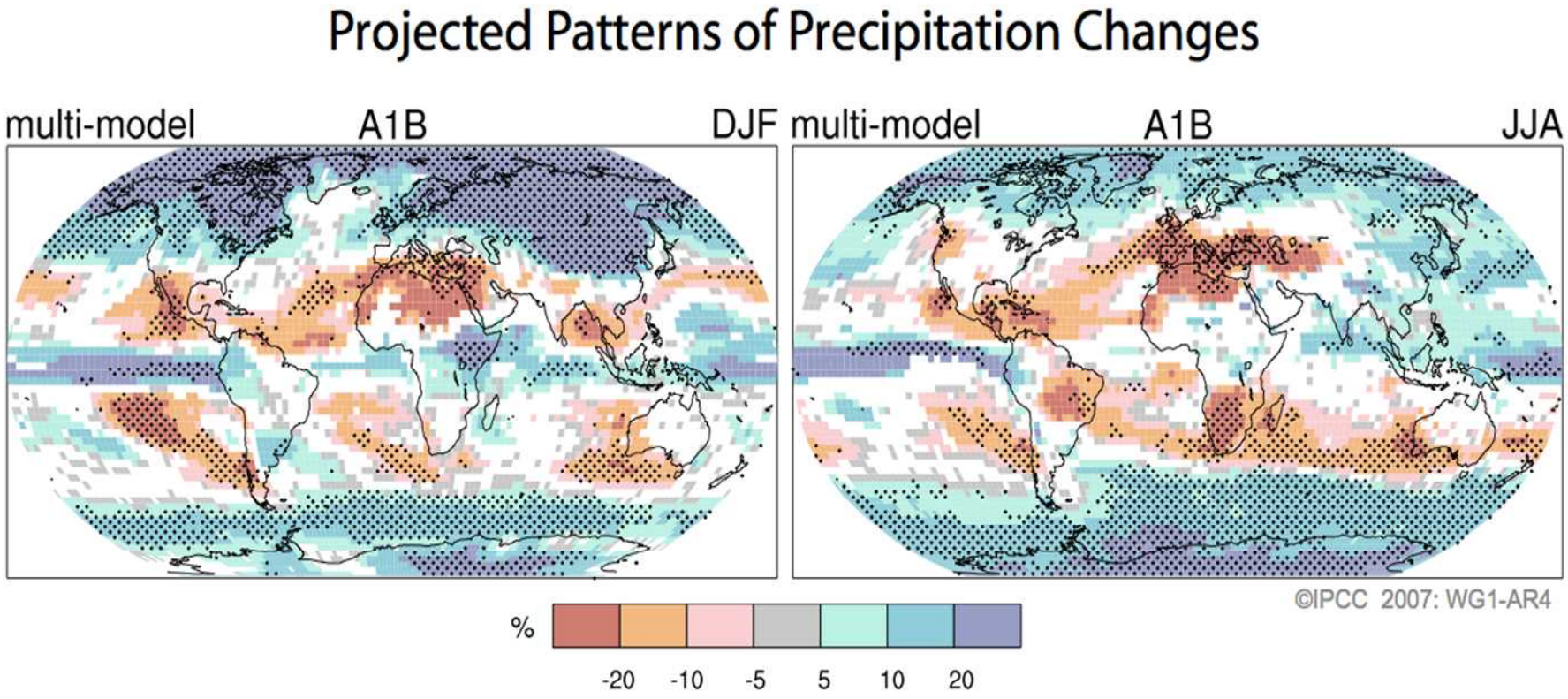
Projected climate change



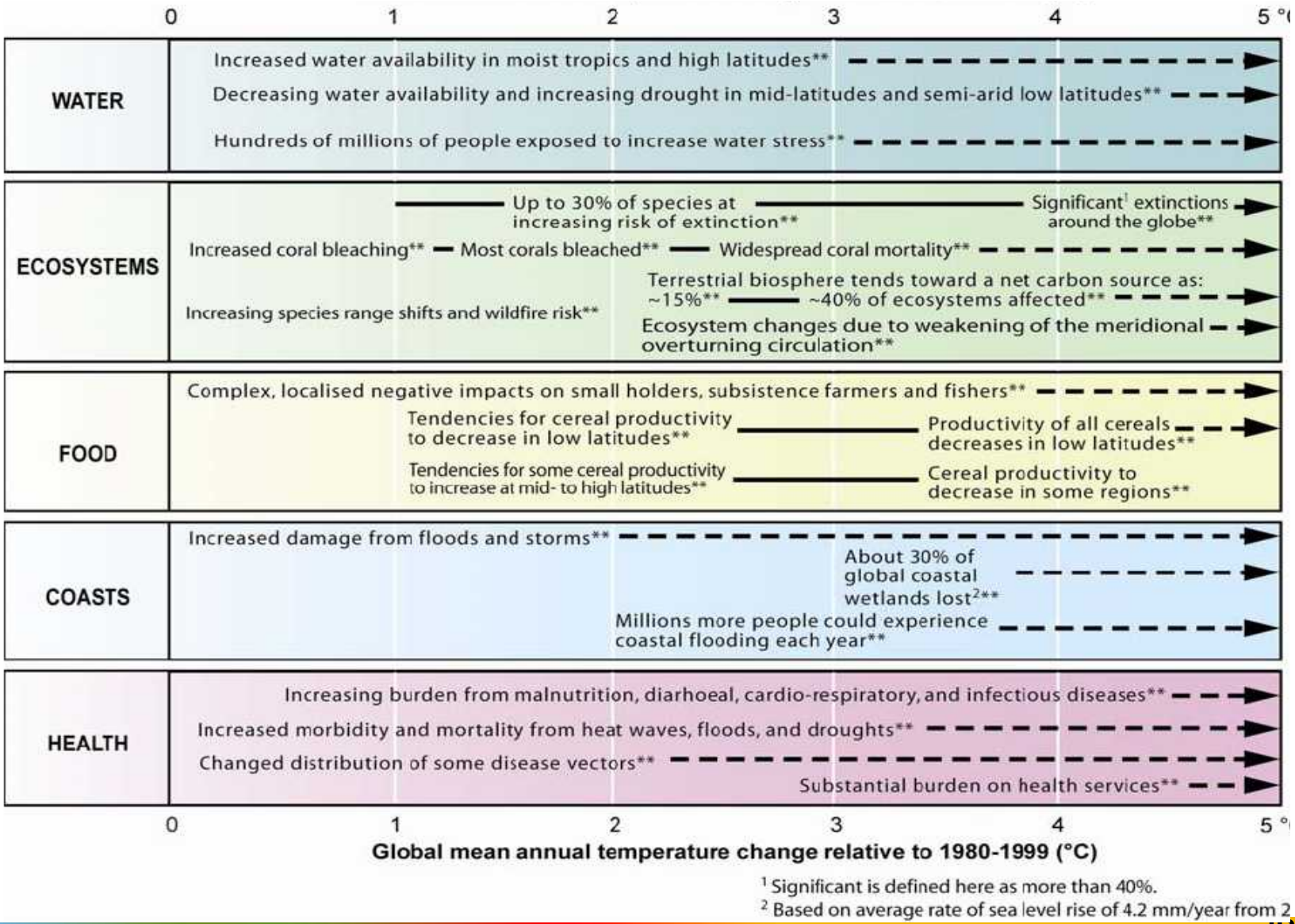
Projections of Future Climate



Projections of Future Changes in Climate

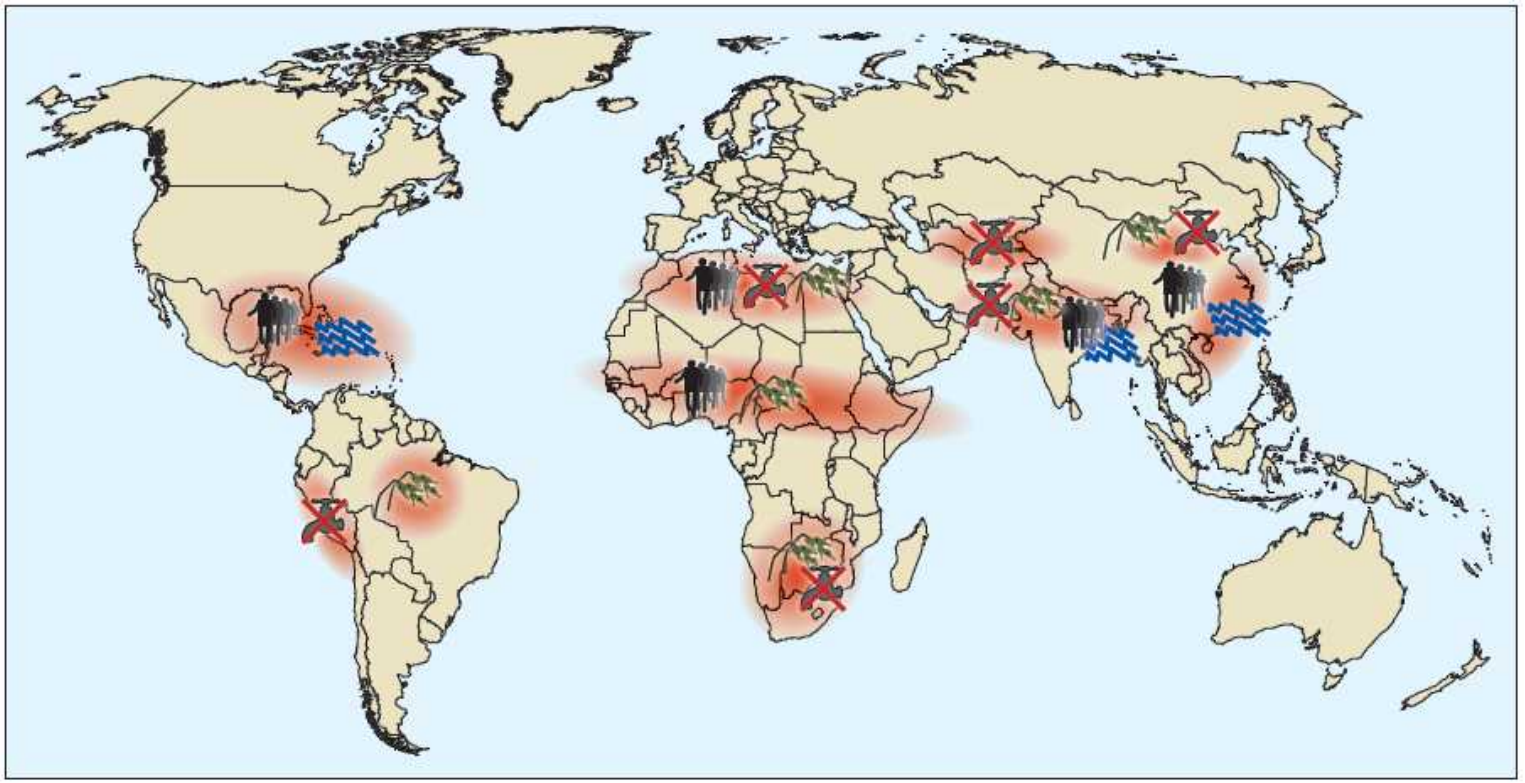


Impacts of climate change



[1] Significant is defined here as more than 40%.
[2] Based on average rate of sea level rise of 4.2 mm/year from 2

Security risks associated with climate change

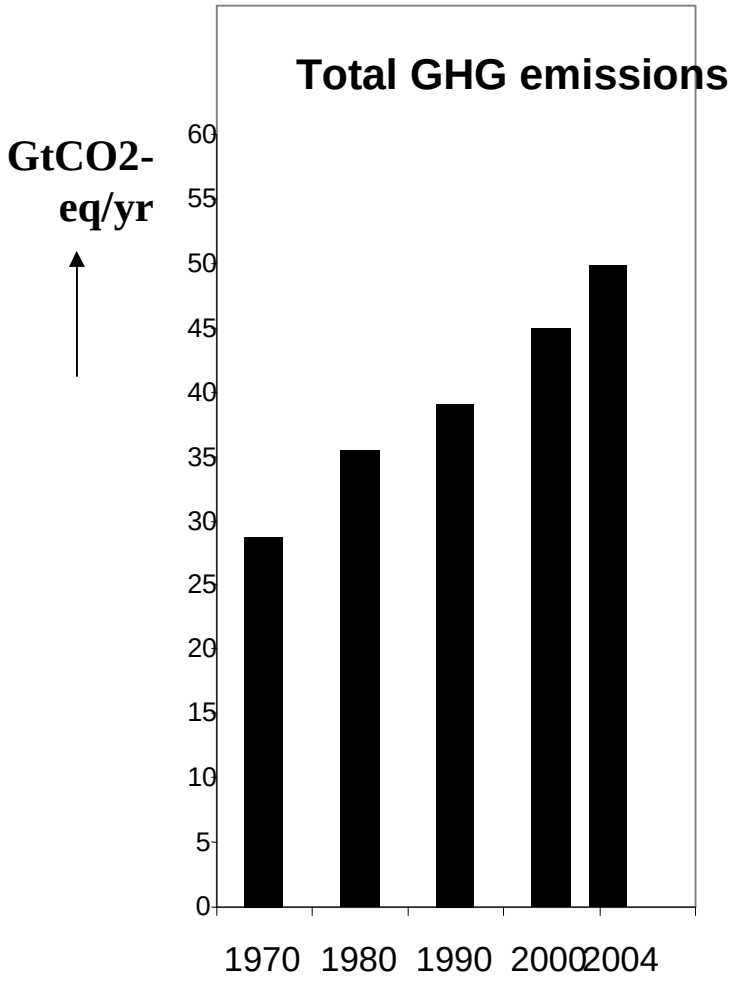


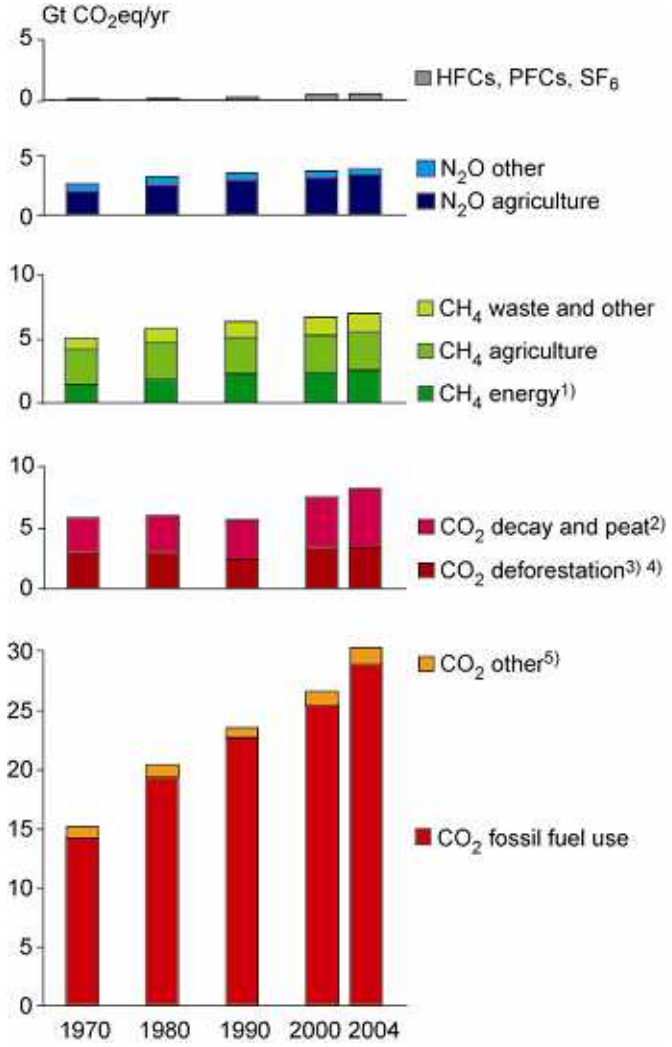
Source:German Advisory Council on Global Change, 2007

Participation in Writing the Report

- Lead Authors: 168
  - from developing countries: 55
  - From EITs: 5
  - from OECD countries: 108
- Contributing authors: 85
- Expert Reviewers: 485

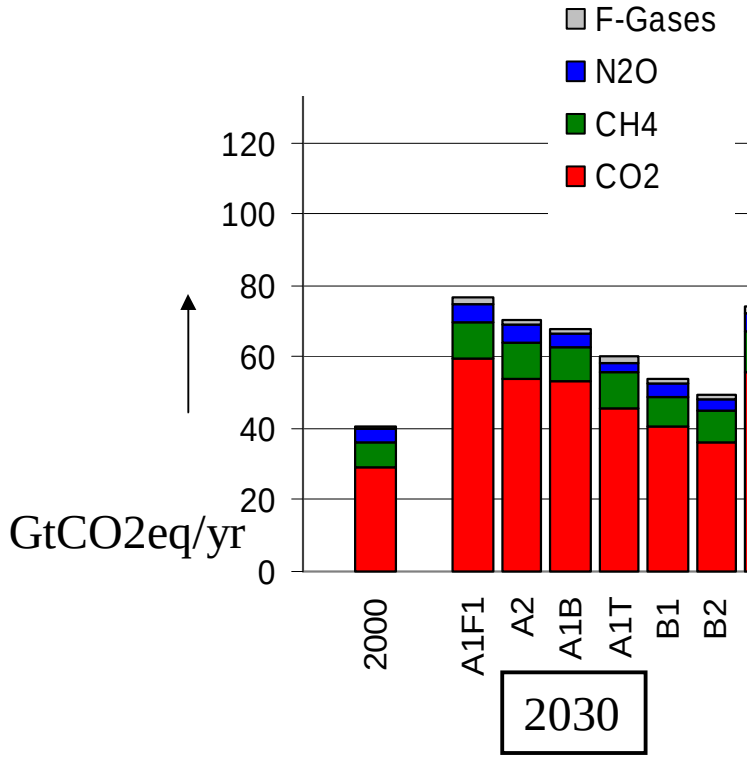
Between 1970 and 2004 global greenhouse gas emissions have increased by 70 %





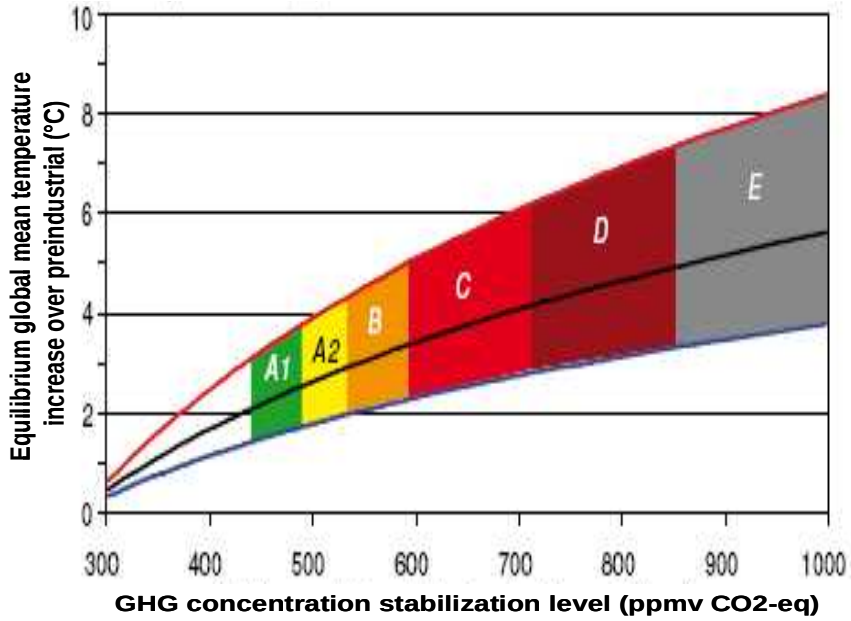
With current climate change mitigation policies *and related sustainable development practices*, global GHG emissions will continue to grow over the next few decades

- IPCC SRES scenarios: 25-90 % increase of GHG emissions in 2030 relative to that of 2000
- Two thirds to three quarters of the increase of CO2 emissions are projected to come from developing countries
- Average per capita CO2 emissions in developing country regions will remain substantially lower (2.8– 5.1 tCO2/cap) than in developed country regions (9.6-15.1 tCO2/cap).



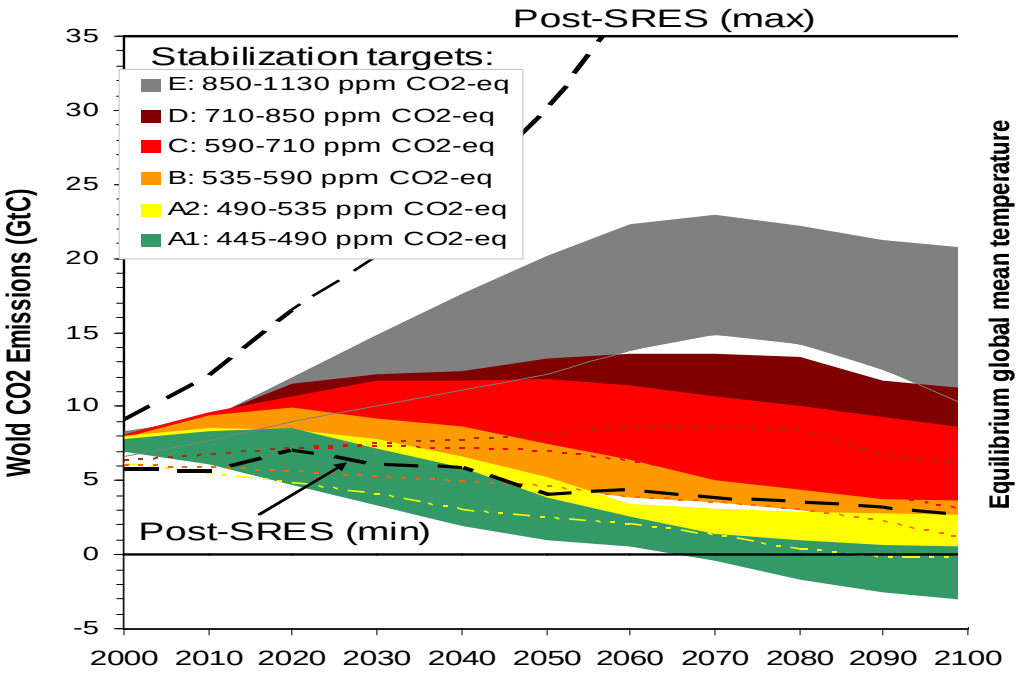
The key question: can “dangerous anthropogenic climate change” be avoided?

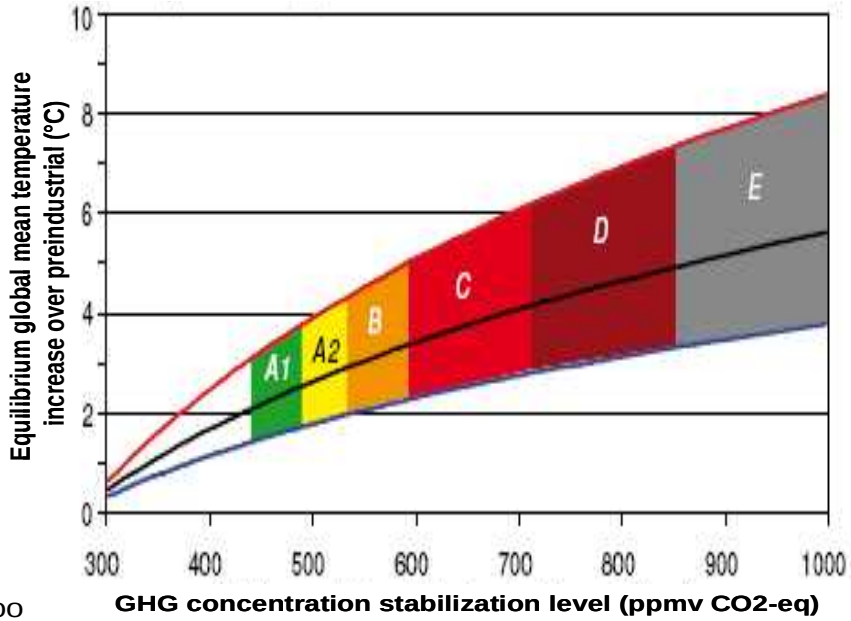
EU,
Norway



At 2 degrees global mean warming serious adaptation is required!

The lower the stabilisation level the earlier global emissions have to go down





Multigas and CO2 only studies combined

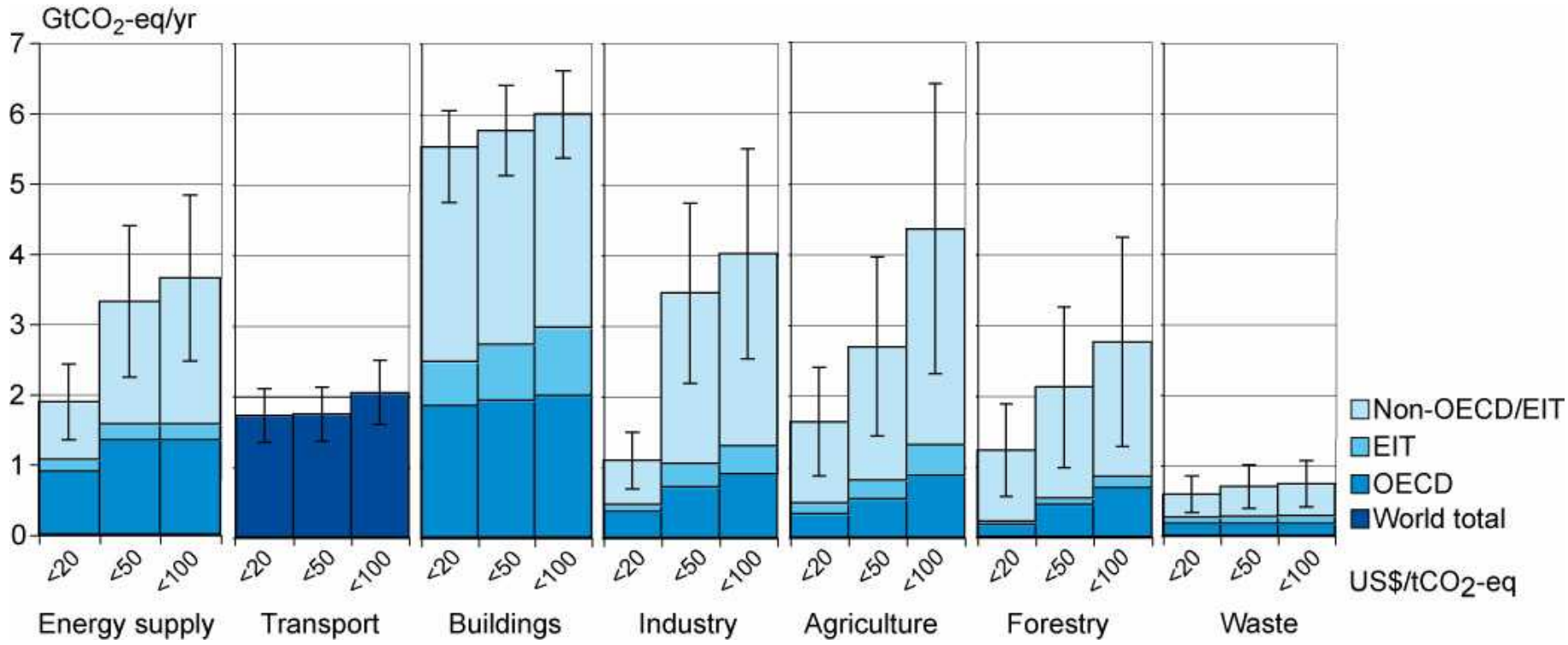
Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels

Stabilization level (ppm CO_2-eq)	**Global Mean temperature increase at equilibrium (°C)**	**Year global CO_2 needs to peak**	**Year global CO_2 emissions back at 2000 level**	**Reduction in 2050 global CO_2 emissions compared to 2000**
445 – 490	2.0 – 2.4	2000 - 2015	2000- 2030	-85 to -50
490 – 535	2.4 – 2.8	2000 - 2020	2000- 2040	-60 to -30
535 – 590	2.8 – 3.2	2010 - 2030	2020- 2060	-30 to +5
590 – 710	3.2 – 4.0	2020 - 2060	2050- 2100	+10 to +60
710 – 855	4.0 – 4.9	2050 - 2080		+25 to +85
855 – 1130	4.9 – 6.1	2060 - 2090		+90 to +140

Implications for international agreements

Scenario category	Region	2020	2050
A-450 ppm CO_2 –eq[2)]	Annex I	-25% to -40%	-80% to -95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia	Substantial deviation from baseline in all regions
B-550 ppm CO_2 -eq	Annex I	-10% to -30%	-40% to -90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, especially in Latin America and Middle East
C-650 ppm CO_2 -eq	Annex I	0% to -25%	-30% to -80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

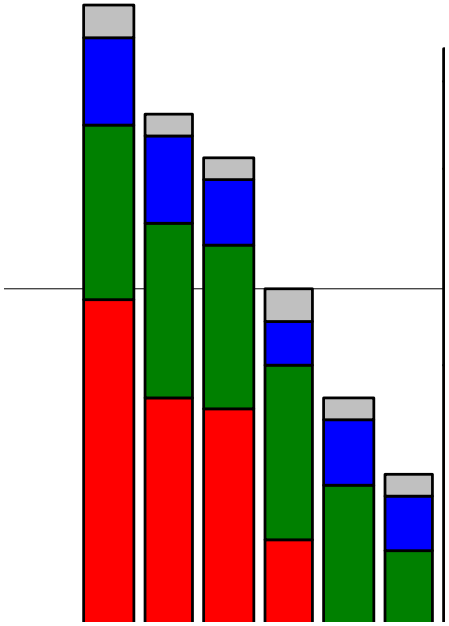
All Sectors and Regions have potential to contribute to CC mitigation



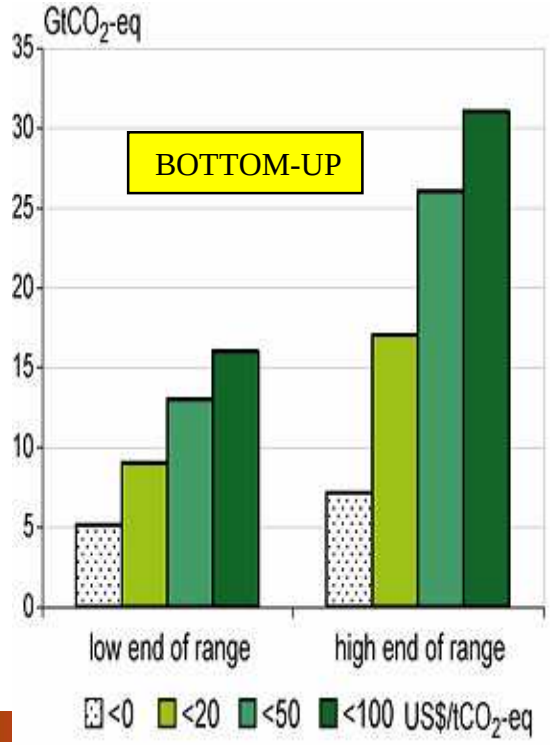
Note: estimates are for 2030 and do not include non-technical options, such as lifestyle changes.

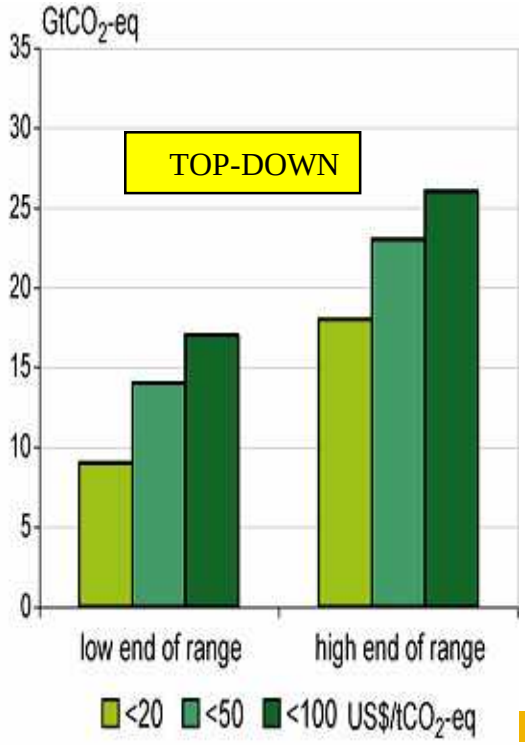
Economic mitigation potential could offset the projected growth of global emissions, or reduce emissions below current levels

Projected increase



Potential decrease





How can emissions be reduced from the energy supply sector?

Sector	Key selected mitigation technologies and practices currently commercially available.	Key selected mitigation technologies and practices projected to be commercialized before 2030.
Energy Supply	efficiency; fuel switching; nuclear power; renewable energy (hydropower, solar, wind, geothermal and bio-energy); combined heat and power; early applications of CO2 capture and storage (CCS)	CCS for gas, biomass and coal-fired electricity generating facilities; advanced nuclear power; advanced renewable energy (tidal and waves energy, concentrating solar, solar and solar PV)

Potential share of global electricity supply in 2030 for carbon prices < US$50/tCO2eq:

- Renewable energy: 30-35% (now 18%)
- Nuclear energy: 18% (now 16%)

How can emissions from transport be reduced?

Sector	**(Selected) Key mitigation technologies and practices currently commercially available.**	**Key mitigation technologies and practices projected to be commercialized before 2030. (Selected)**
Transport	More fuel efficient vehicles; hybrid vehicles; biofuels; modal shifts from road transport to rail and public transport systems; cycling, walking; land-use planning	Second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries

Biofuel potential 2030:

- Depends on production pathway, vehicle efficiency, oil and carbon prices
- 3% of global transport energy in 2030
- 5-10% , if cellulose biomass is commercialised
- Caution: land and water availability, competition with food

How can emissions from industry be reduced?

Sector	**(Selected) Key mitigation technologies and practices currently commercially available.**	**Key mitigation technologies and practices projected to be commercialized before 2030. (Selected)**
Industry	More efficient electrical equipment; heat and power recovery; material recycling; control of non-CO_2 gas emissions	Advanced energy efficiency; CCS for cement, ammonia, and iron manufacture; inert electrodes for aluminium manufacture

- Potential predominantly in energy intensive industries.
- Many efficient installations in developing countires
- Barriers include slow stock turnover and (for SMEs) lack of financial resources, inability to absorb technical information

How can emissions from buildings be reduced?

Sector	**(Selected) Key mitigation technologies and practices currently commercially available.**	**Key mitigation technologies and practices projected to be commercialized before 2030. (Selected)**
Buildings	Efficient lighting; efficient appliances and airconditioners; improved insulation ; solar heating and cooling; alternatives for fluorinated gases in insulation and appliances	Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control; solar PV integrated in buildings

- About 30% of projected GHG emissions by 2030 can be avoided with net economic benefit.
- New buildings: >75% savings compared to current (at low to zero additional cost)
- Barriers include availability of technologies, financing, cost of reliable information and limitations in building designs

How can emissions from agriculture and forestry be reduced?

Sector	**(Selected) Key mitigation technologies and practices currently commercially available.**	**Key mitigation technologies and practices projected to be commercialized before 2030. (Selected)**
Agriculture	Land management to increase soil carbon storage; restoration of degraded lands; improved rice cultivation techniques; improved nitrogen fertilizer application; dedicated energy crops	Crop yield improvement
Forests	Afforestation; reforestation; forest management; reduced deforestation; use of forestry products for bioenergy	Improved species and productivity; remote sensing systems

Agriculture: soil carbon sequestration ~90%

Forests: avoided deforestation ~50%

Effect of climate change < 2030: uncertain

Changes in lifestyle and behaviour patterns can contribute to climate change mitigation

- Changes in occupant behaviour, cultural patterns and consumer choice in buildings.
- Reduction of car usage and efficient driving style, availability of public transport and improved urban planning
- Behaviour of staff in industrial organizations in light of reward systems

What are the macro-economic costs in 2030?

- Costs are global average for least cost appoaches from top-down models
- Costs do not include co-benefits and avoided climate change damages

Trajectories towards stabilization levels (ppm CO_2-eq)	Median GDP reduction[1] (%)	Range of GDP reduction [2] (%)	Reduction of average annual GDP growth rates [3] (percentage points)
590-710	0.2	-0.6 – 1.2	< 0.06
535-590	0.6	0.2 – 2.5	<0.1
445-535[4]	Not available	< 3	< 0.12

[1] This is global GDP based market exchange rates.
[2] The median and the 10th and 90th percentile range of the analyzed data are given.
[3] The calculation of the reduction of the annual growth rate is based on the average reduction during the period till 2030 that would result in the indicated GDP decrease in 2030.
[4] The number of studies that report GDP results is relatively small and they generally use low baselines.

Policy action is needed to realise potential

1. Climate change policies

- **Can have positive or negative (side) effects**

2. Non-climate change (sustainable development) policies

- **Start from development needs**
- **Requires mainstreaming climate change in development decision-making**
- **Can influence GHG emissions as much as specific climate policies**

Climate change policies

- Effectiveness of policies depends on national circumstances, their design, interaction, stringency and implementation
  - Regulations and standards
  - Taxes and charges
  - Tradable permits
  - Financial incentives
  - Voluntary agreements
  - Information instruments
  - Research and development

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**
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.

An effective carbon-price signal could realise significant mitigation potential in all sectors

- Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to significantly invest in low-GHG products, technologies and processes.
- Such policies could include economic instruments, government funding and regulation
- For stabilisation at around 550 ppm CO2eq carbon prices should reach 20-80 US$/tCO2eq by 2030 (5-65 if “induced technological change” happens)
- At these carbon prices, major shifts in investments is expected to low carbon technologies

Investments

- Energy infrastructure investment decisions, (20 trillion US$ till 2030) will have long term impacts on GHG emissions.
- The widespread diffusion of low-carbon technologies may take many decades, even if early investments in these technologies are made attractive.
- Returning global energy-related CO2 emissions to 2005 levels by 2030 would require a large shift in the pattern of investment, although the net additional investment required ranges from negligible to 5-10%
- It is often more cost-effective to invest in end-use energy efficiency improvement than in increasing energy supply

Non-climate policies can significantly influence GHG emissions

- *Macro-economic policy*: taxes, subsidies, other fiscal policies, structural adjustment
- *Trade policy:* "embodied carbon", removing barriers for low-carbon products, domestic energy sources
- *Energy security policy :* efficient energy use, domestic energy sources (low-high carbon)
- *Access to modern energy:* bioenergy, poverty tariffs
- *Air quality policy:* clean fuel
- *Bank lending policies*: lending for efficiency/ renewables, avoid lock-in into old technologies in developing countries
- *Insurance policy:* Differentiated premiums, liability insurance exclusion, improved conditions for green products

Co-benefits of mitigation and relation with adaptation

- Near–term *health benefits* from reduced air pollution may offset a substantial fraction of mitigation costs
- Mitigation can also be positive for: *energy security*, *balance of trade improvement*, *provision of modern energy services to rural areas*, *sustainable agriculture* and *employment*
- Land-use measures positive for improving resilience to climate change
- Low carbon energy important for energy requiring adaptation options (air conditioning, water pumping)

The Summaries for Policy Makers , the Technical Summaries and the full WG Reports can be downloaded from

www.ipcc.ch

Further information:

IPCC Working Group III Technical Support Unit
at the Netherlands Environmental Assessment Agency:
ipcc3tsu@mnp.nl

What does US$ 50/ tCO2eq mean?

- Crude oil: ~US$ 25/ barrel
- Gasoline: ~12 ct/ litre (50 ct/gallon)
- Electricity:
  - from coal fired plant: ~5 ct/kWh
  - from gas fired plant: ~1.5 ct/kWh