Climate change 2007, Mitigation of climate change

The IPCC Fourth Assessment Report

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Main conclusion on mitigation of climate change

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…There is substantial economic potential for the mitigation of global GHG emissions over the coming decades, that could offset the projected growth of global emissions or reduce emissions below current levels…

The challenge

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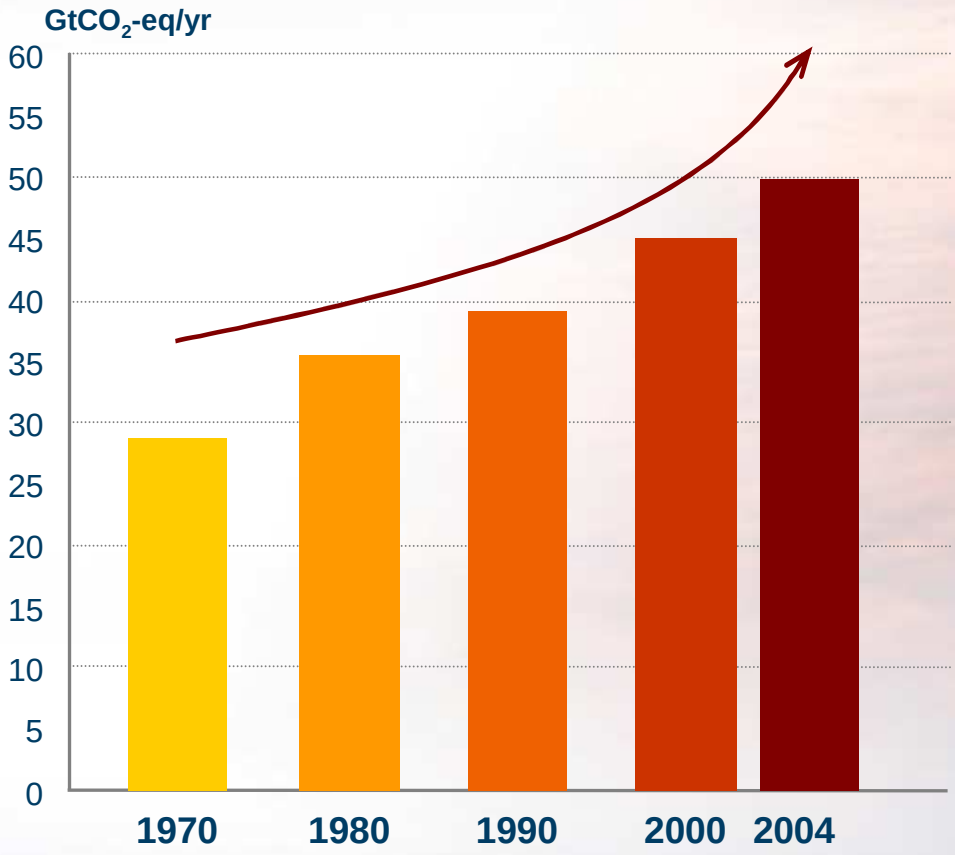
Total Greenhouse Gas emissions



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

Carbon dioxide is the largest contributor

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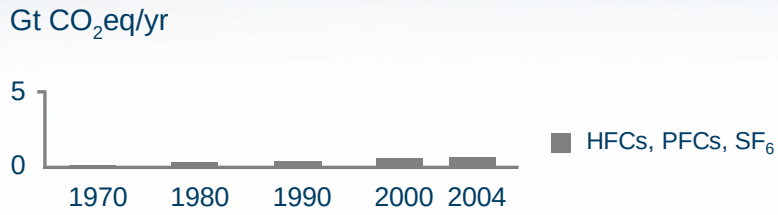
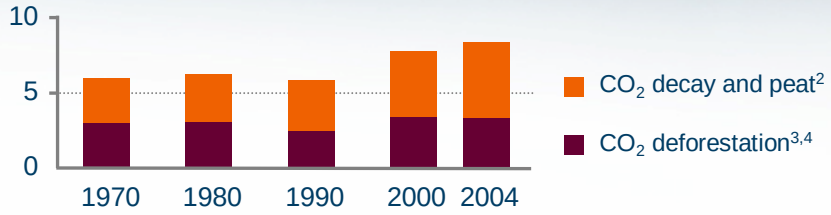
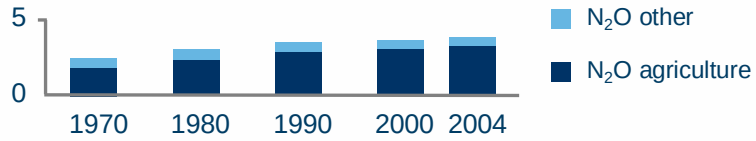
F-gases



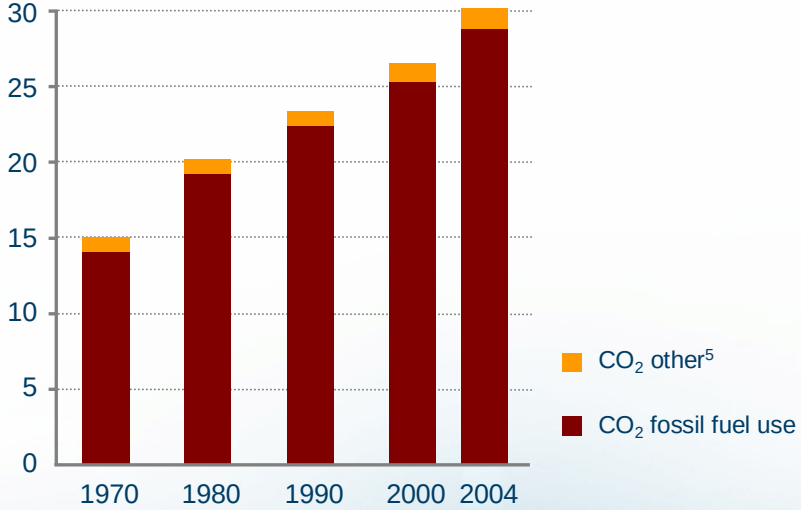
Carbon Dioxide



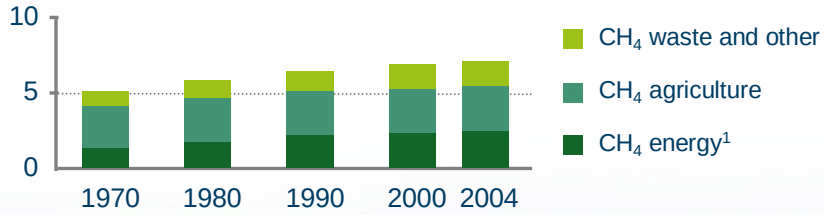
Di-nitrogen-oxide



Carbon Dioxide



Methane



Global greenhouse gas emissions will continue to grow

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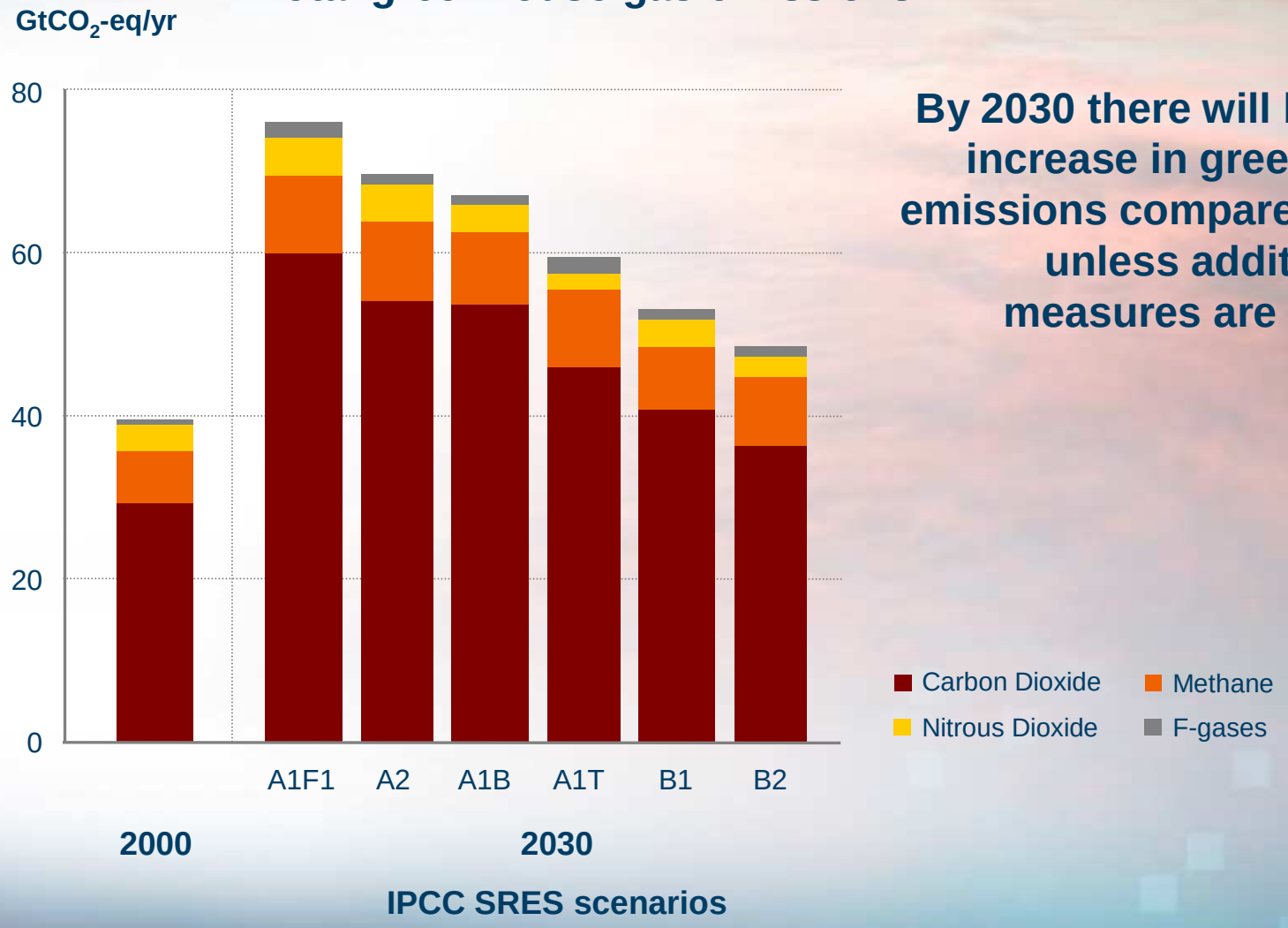
Total greenhouse gas emissions



By 2030 there will be a 25-90% increase in greenhouse gas emissions compared with 2000 unless additional policy measures are put in place

Emissions of greenhouse gases can be avoided

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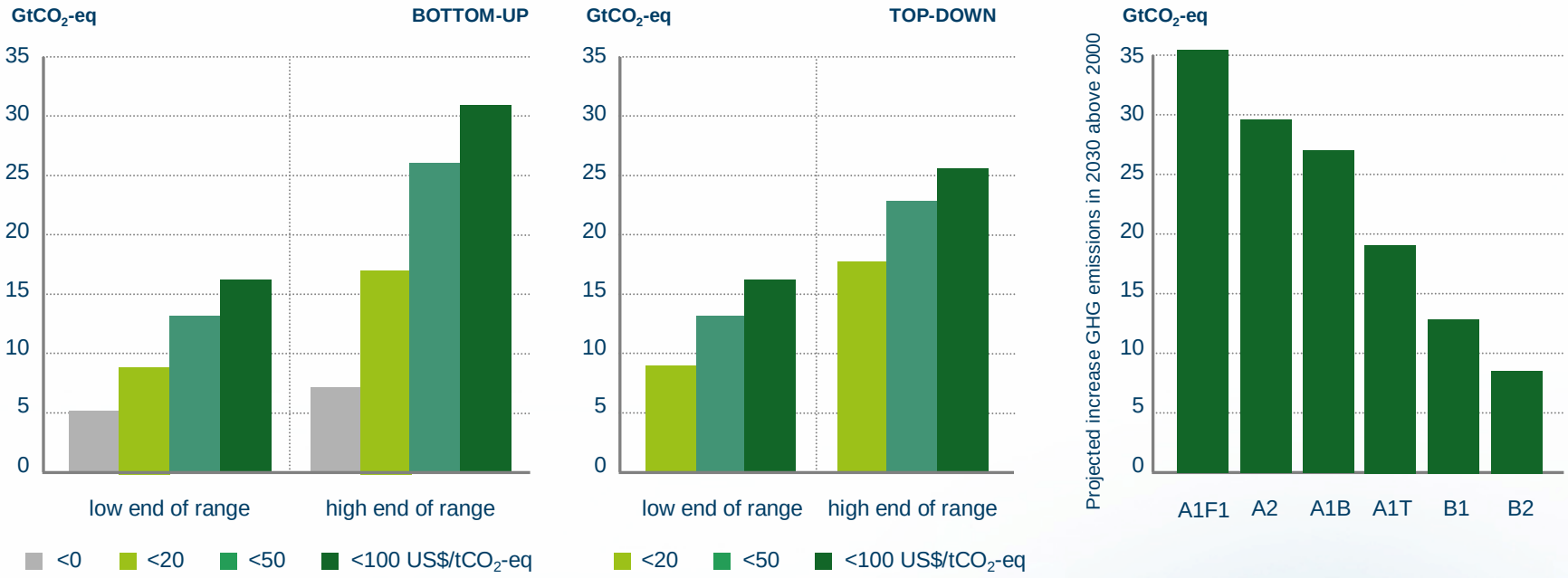
There is substantial capability to prevent emissions of greenhouse gases in 2030. Economic mitigation potential until 2030 could offset the projected growth of global emissions, or reduce emissions below current levels



Global economic potential in 2030

Greenhouse gas emissions

Note: estimates do not include non-technical options such as lifestyle changes

Mitigation measures do not have an unrealistically high price

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What does US$50/tCOeq mean?

Crude oil

~US$25/barrel

Gasoline

~12ct/litre
(50ct/gallon)

Electricity

from coal fired plant:
~5ct/kWh

from gas fired plant:
~1.5ct/kWh

All sectors and regions have the potential to contribute

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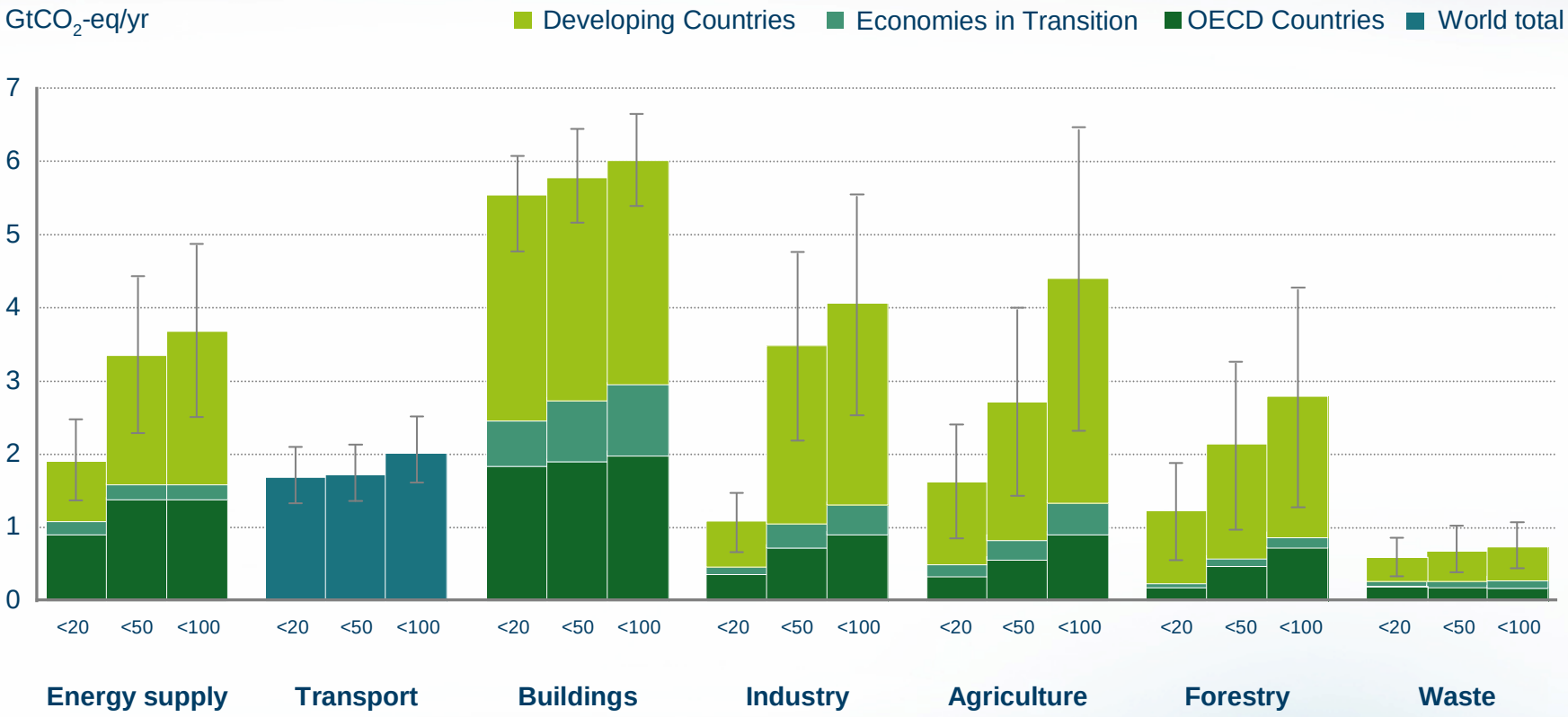

Emission reductions based on the end-use of energy

How can emissions be reduced?
Energy Supply

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Key mitigation technologies and practices currently commercially available

- Efficiency
- Fuel switching
- Nuclear power
- Renewable (hydropower, solar, wind, geothermal and bioenergy)
- Combined heat and power
- Early applications of CO_2 capture and storage (CCS)

Key mitigation technologies and practices projected to be commercialised before 2030

- CCS for gas
- Biomass and coal-fired electricity generating facilities
- Advanced renewables (tidal and wave energy, concentrating solar, solar PV)

How can emissions be reduced?
Transport

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Key mitigation technologies and practices currently commercially available

- More fuel efficient vehicles
- Hybrid vehicles
- Biofuels
- Rail and public transport systems
- Cycling, walking
- Land-use planning

Key mitigation technologies and practices projected to be commercialized before 2030

- Second generation biofuels
- Higher efficiency aircraft
- Advanced electric and hybrid vehicles with more powerful and reliable batteries

How can emissions be reduced?
Industry

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Key mitigation technologies and practices currently commercially available

- More efficient electrical equipment
- Heat and power recovery
- Material recycling
- Control of non-CO_2 gas emissions

Key mitigation technologies and practices projected to be commercialized before 2030

- Advanced energy efficiency
- CCS for cement, ammonia, and iron manufacture
- Inert electrodes for aluminum manufacture

How can emissions be reduced?
Buildings

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Key mitigation technologies and practices currently commercially available

- Efficient lighting
- Efficient appliances and air-conditioners
- Improved insulation
- Solar heating and cooling
- Alternatives for fluorinated gases in insulation and appliances

Key mitigation technologies and practices projected to be commercialized before 2030

- Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control
- Solar PV integrated in buildings

How can emissions be reduced?
Agriculture

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Key mitigation technologies and practices currently commercially available

- Improved land management
- Restoration of cultivated peat soils and degraded land
- Improved rice cultivation
- Improved livestock and manure management
- Improved N-fertiliser application
  (+ bioenergy crops)

Key mitigation technologies and practices projected to be commercialised before 2030

- Improvement of crop yields

How can emissions be reduced?
Forestry

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Key mitigation technologies and practices currently commercially available

- Afforestation, reforestation
- Forest management
- Reduced deforestation
- Harvested wood product management
  (+ bioenergy crops)

Key mitigation technologies and practices projected to be commercialised before 2030

- Tree species improvement
- Improved remote sensing technologies for mapping, land use change and carbon sequestration potential

How can emissions be reduced?

Changes in lifestyle & behaviour

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Key mitigation technologies and practices currently commercially available

- Consumers change their behaviour through their choice of lifestyle options
- Staff incentives encourage a change in practices in the workplace
- Car owners employ a more fuel-efficient way of driving; ‘eco-driving’, by accelerating and braking less strongly.
- Reduce car use by shifting to other modes of transport.

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

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- Policies such as regulation, restricting the quantity of emissions produced and economic instruments such as a carbon tax or allocating tradable emission permits make it costly to emit greenhouse gases
- The resulting extra costs for industries and consumers could encourage investment in non-carbon based technologies
- To obtain stabilisation at around 550ppm (parts per million), CO_2 equivalent carbon prices should reach US$20-80 per tCO_2 eq by 2030
- At these prices, large shifts of investments into low carbon technologies can be expected

What are the macro-economic costs in 2030?

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Macro-economic costs are global averages for least cost approaches from top-down models
Costs do not include co-benefits and avoided climate change damages

- The financial impact - even if tough measures are put in place to reduce emissions.
- For the most severe path to reach stabilisation of greenhouse gases in the atmosphere and thus to stablise global temperature, the effect on the world economy would be less than 3% in 2030. A loss of 3% of GDP means a country would be equally well off one year later.

Trajectories towards stabilisation 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.

There are also co-benefits of mitigation

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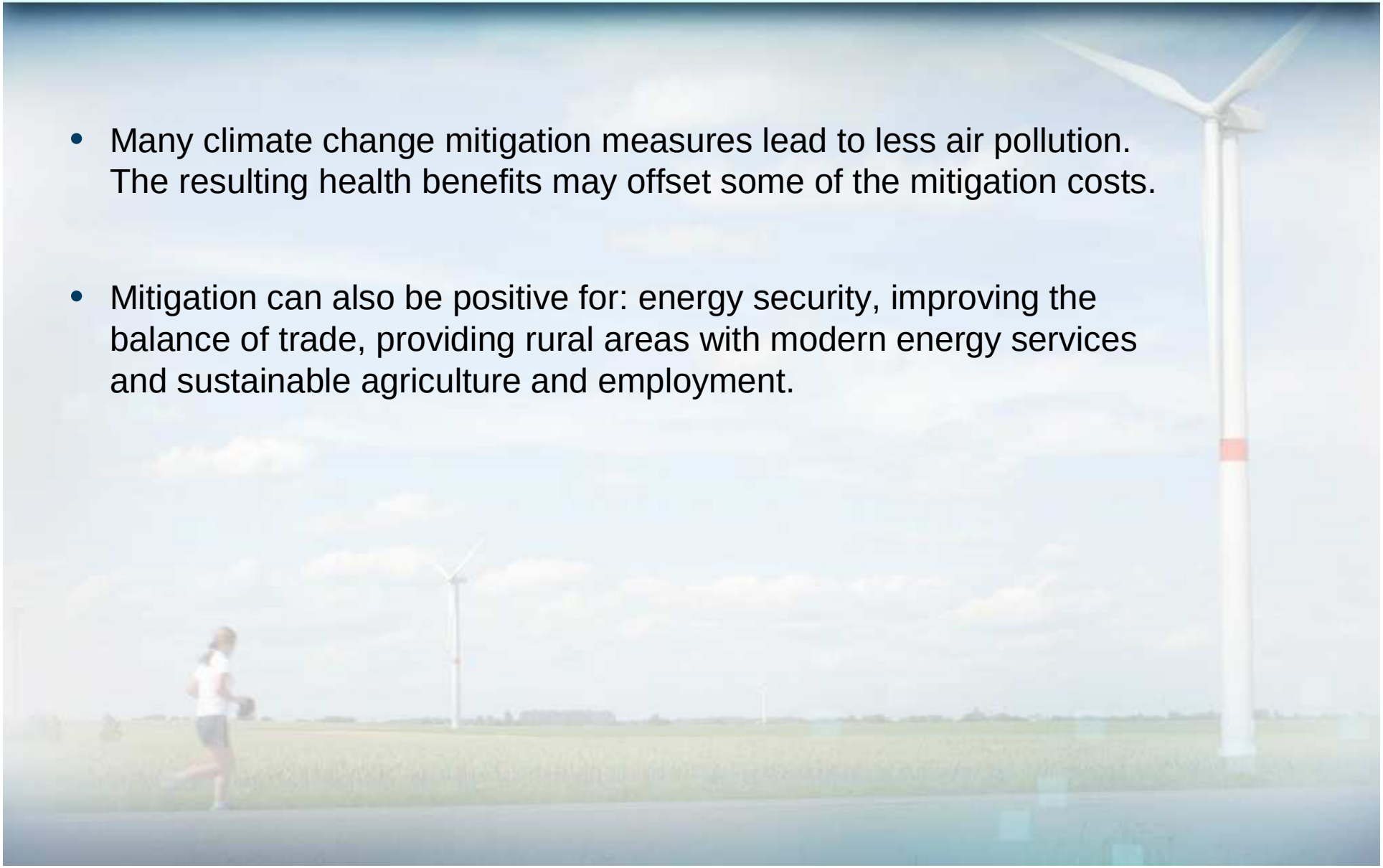
- Many climate change mitigation measures lead to less air pollution. The resulting health benefits may offset some of the mitigation costs.

- Mitigation can also be positive for: energy security, improving the balance of trade, providing rural areas with modern energy services and sustainable agriculture and employment.



Stabilising global mean temperature requires a stabilisation of greenhouse gas concentrations in the atmosphere.

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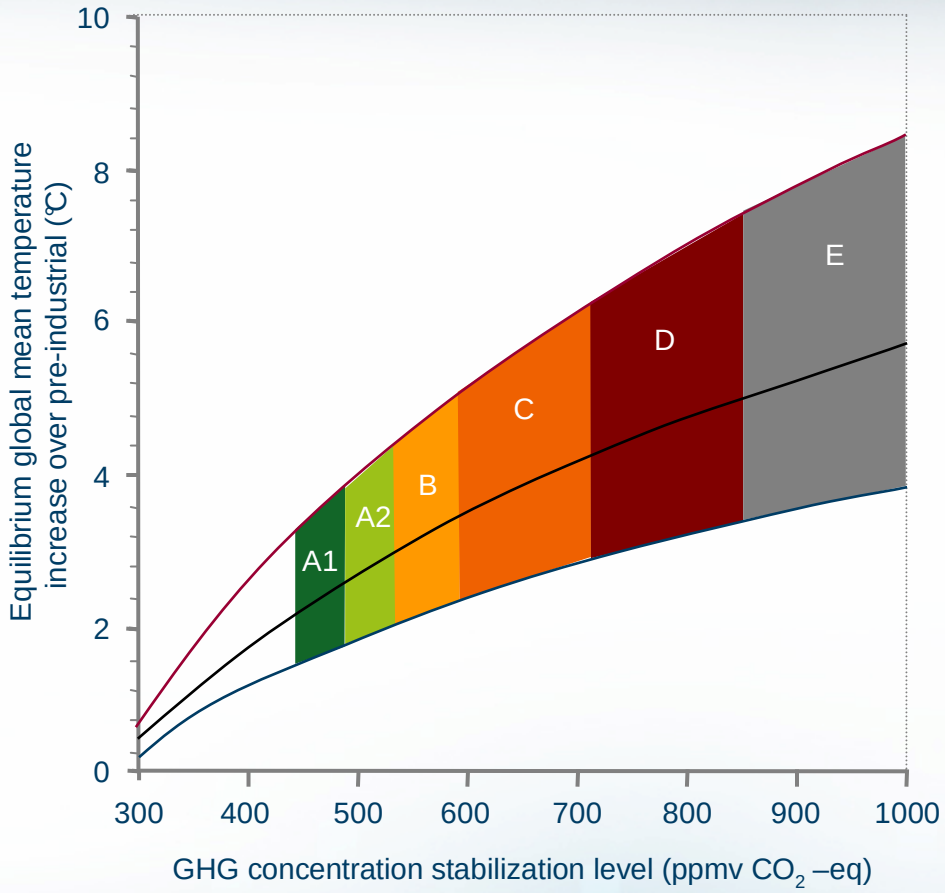
The lower the aspired temperature increase, the lower the concentration stabilisation level



The lower the stabilisation level, the earlier global CO_2 emissions have to peak

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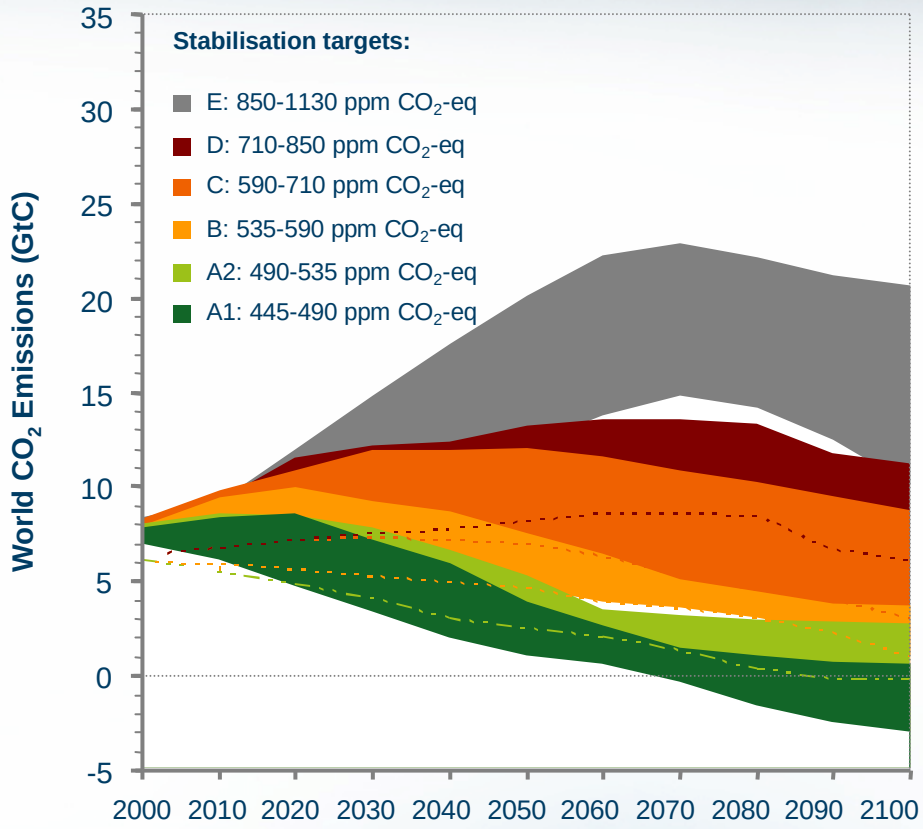
- The lower the target stabilisation level limit, the earlier global emissions have to peak.
- Limiting increase to 3.2 – 4℃ requires emissions to peak within the next 55 years.
- Limiting increase to 2.8 – 3.2℃ requires global emissions to peak within 25 years.
- Limiting global mean temperature increases to 2 – 2.4℃ above pre-industrial levels requires global emissions to peak within 15 years and then fall to about 50 to 85% of current levels by 2050.



Multigas and CO_2 only studies combined

Investments

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- 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

The importance of technology policies

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- The lower the stabilisation levels, the earlier global CO_2 emissions have to peak

- Government support is important for effective technology development, innovation and deployment

- BUT, government funding for most energy research programmes has been declining for nearly two decades; now about half of 1980 level

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The report of IPCC Working Group III is available at www.mnp.nl/ipcc