

*IPCC 4<sup>th</sup> Assessment*  
*Main findings Working Group III:*  
**mitigation of climate change**

*Pre-COP IPCC workshop*  
*2nd October 2008, Institute of*  
*Meteorology and Water Management,*  
*Warsaw , Poland*

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Mitigation = reduction of  
greenhouse gas emissions, mainly  
 $\text{CO}_2$



# Key messages

- *Man causes dangerous climate change – man can cure it!*
- *Economics: affordable or even profitable*
- *All major emitting countries have to reduce their greenhouse gas emissions*
- *No time to loose -the longer we wait the larger the damage*



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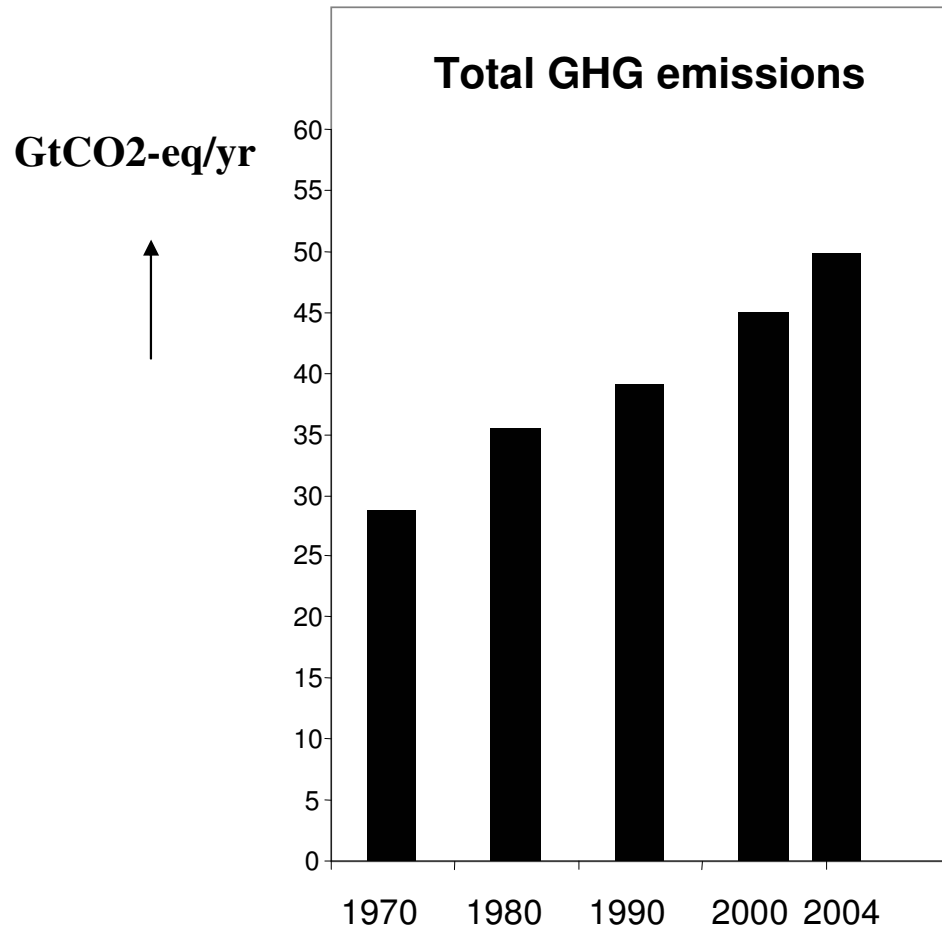
1. Emissions
2. Key mitigation technologies (2030)
3. Combined costs and potentials (2030)
4. Climate policies (now-2030)
5. Long term mitigation (2050-2100)
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# 1. Emissions



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



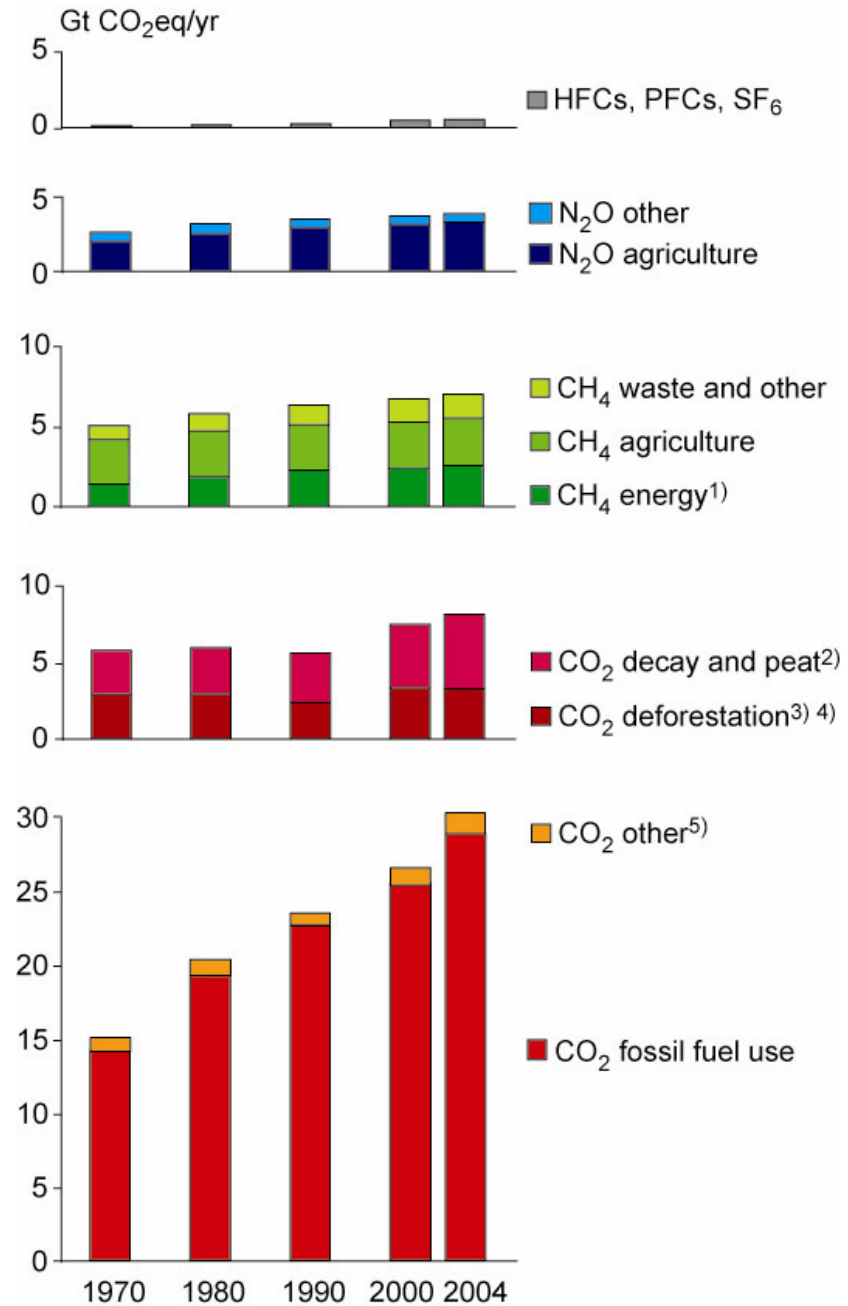
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# Carbon dioxide is the largest contributor



# Greenhouse gas emission trends

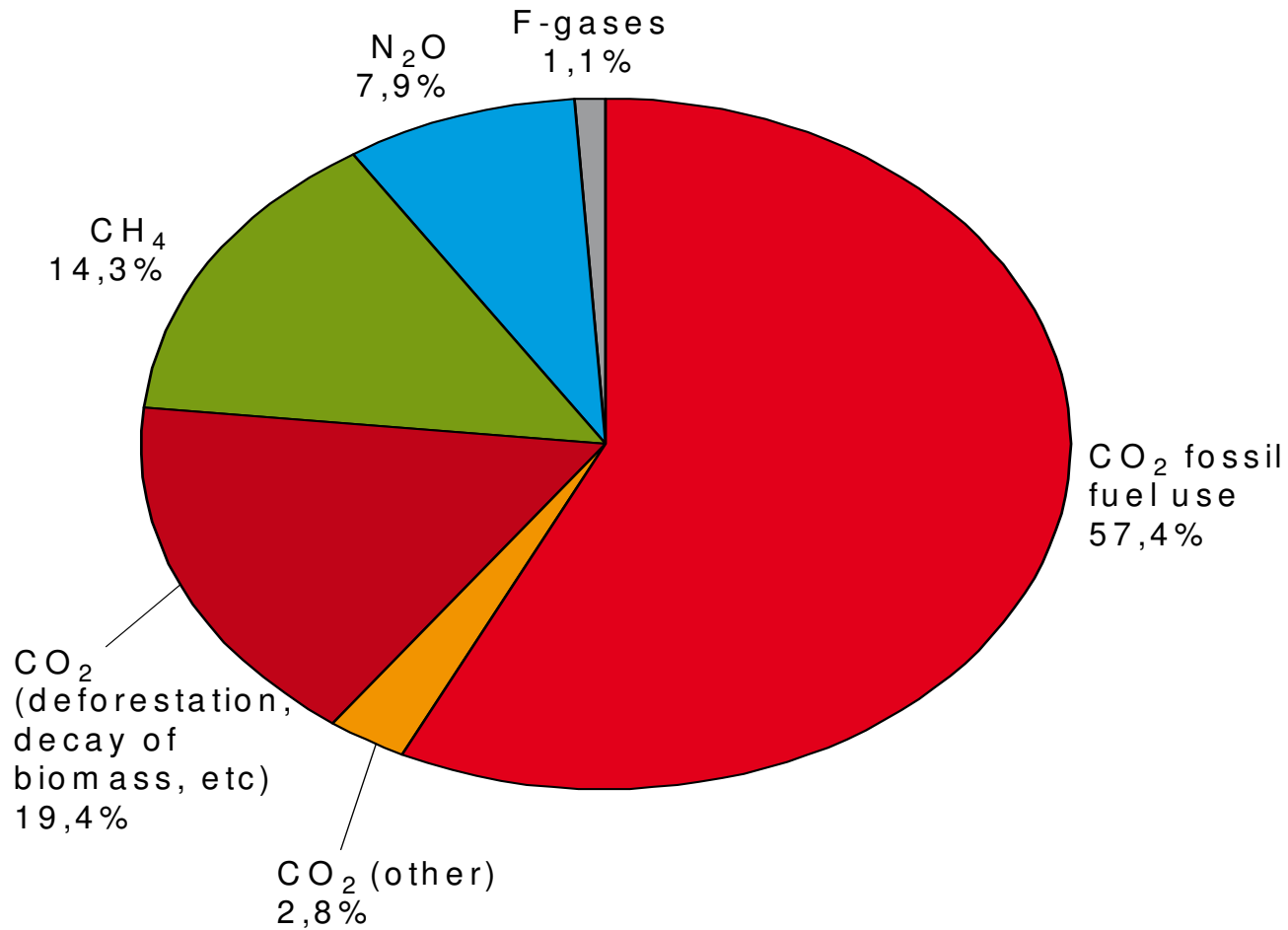
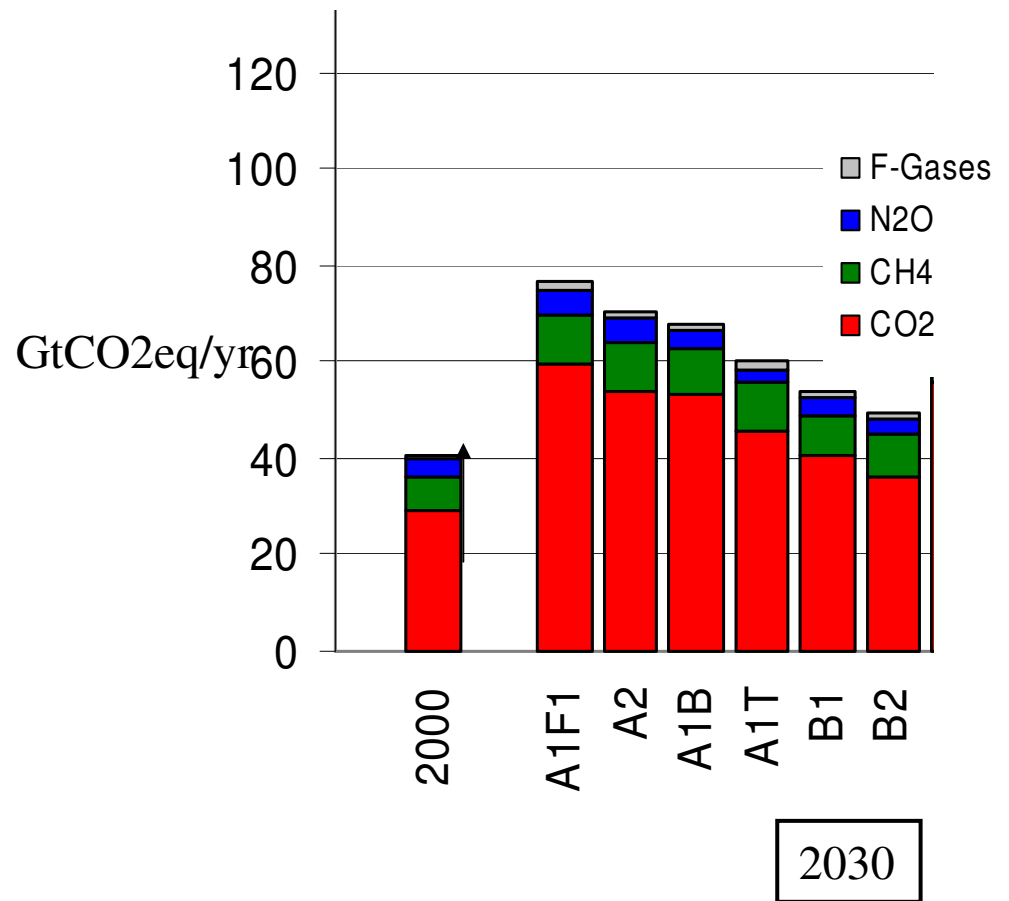


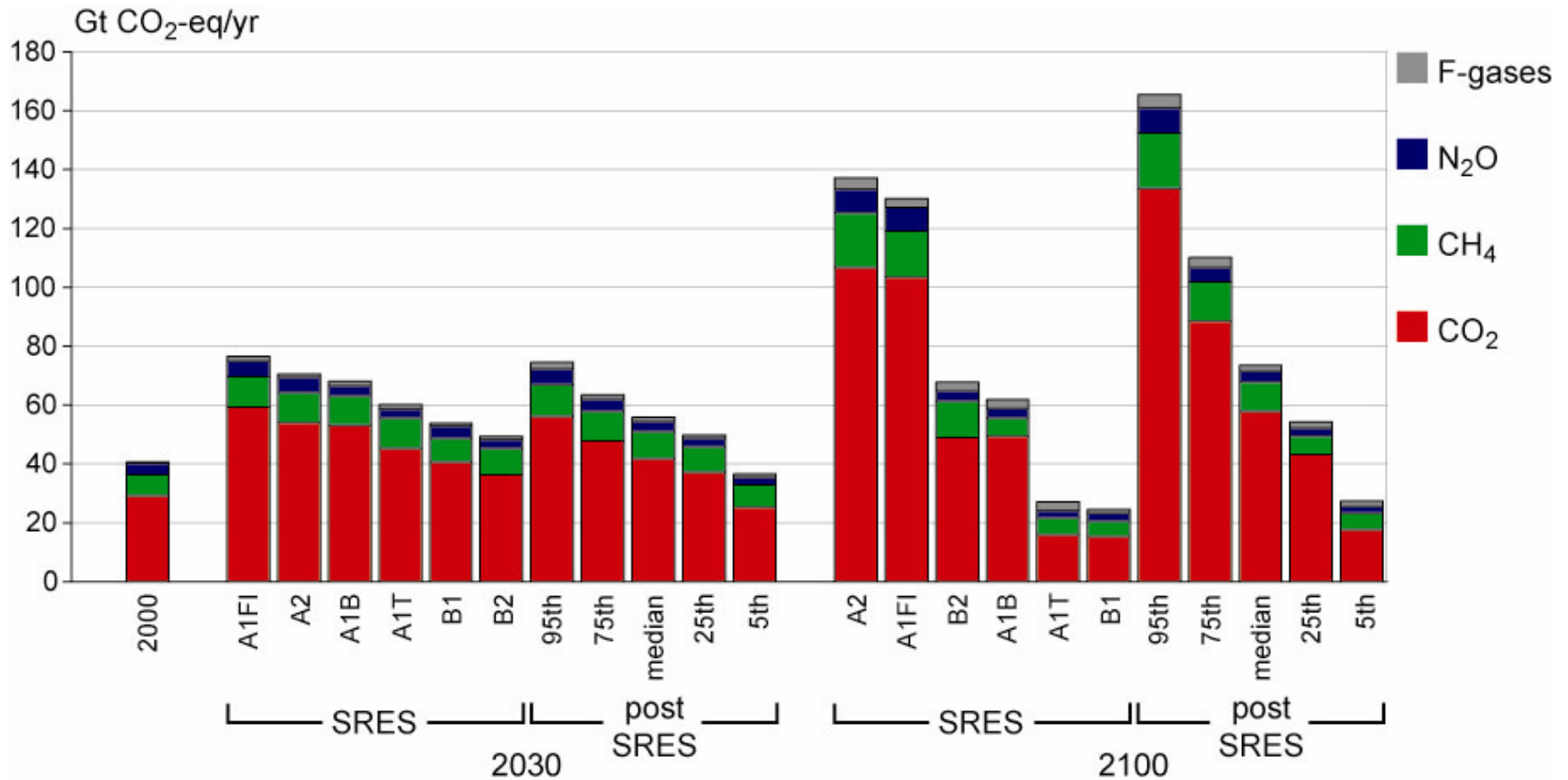
Figure 1.1b: Global anthropogenic greenhouse emissions in 2004. Source: Adapted from Olivier et. al, 2005; 2006).

**With current mitigation policies *and related sustainable development practices*, global GHG emissions will continue to grow next decades...**

- IPCC SRES scenarios: **25-90 % increase** of GHG emissions in 2030 relative to 2000



... and may rise to 4 times 2000 level by 2100



## 2. Key mitigation technologies (2030)



# But: mitigation in next decades can offset or even reduce emission growth in emissions below current levels

- Ch. 4 Energy supply
- Ch. 5 Transportation
- Ch. 6 Residential/commercial buildings
- Ch. 7 Industry
- Ch. 8 Agriculture
- Ch. 9 Forestry
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## 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 CO <sub>2</sub> 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, and solar PV)

Potential share of global electricity supply in 2030 for carbon prices < US\$50/tCO<sub>2</sub>eq:

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



# How can transport emissions 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, biodiversity

# How can industry emissions be reduced?

<b>Sector</b>	<b>(Selected) Key mitigation technologies and practices currently commercially available.</b>	<b>Key mitigation technologies and practices projected to be commercialized before 2030. (Selected)</b>
Industry	More efficient electrical equipment; heat and power recovery; material recycling; control of non-CO <sub>2</sub> 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 countries
- Barriers include slow stock turnover and (for SMEs) lack of financial resources, inability to absorb technical information



## How can emissions from buildings be reduced?

<b>Sector</b>	<b>(Selected) Key mitigation technologies and practices currently commercially available.</b>	<b>Key mitigation technologies and practices projected to be commercialized before 2030. (Selected)</b>
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%

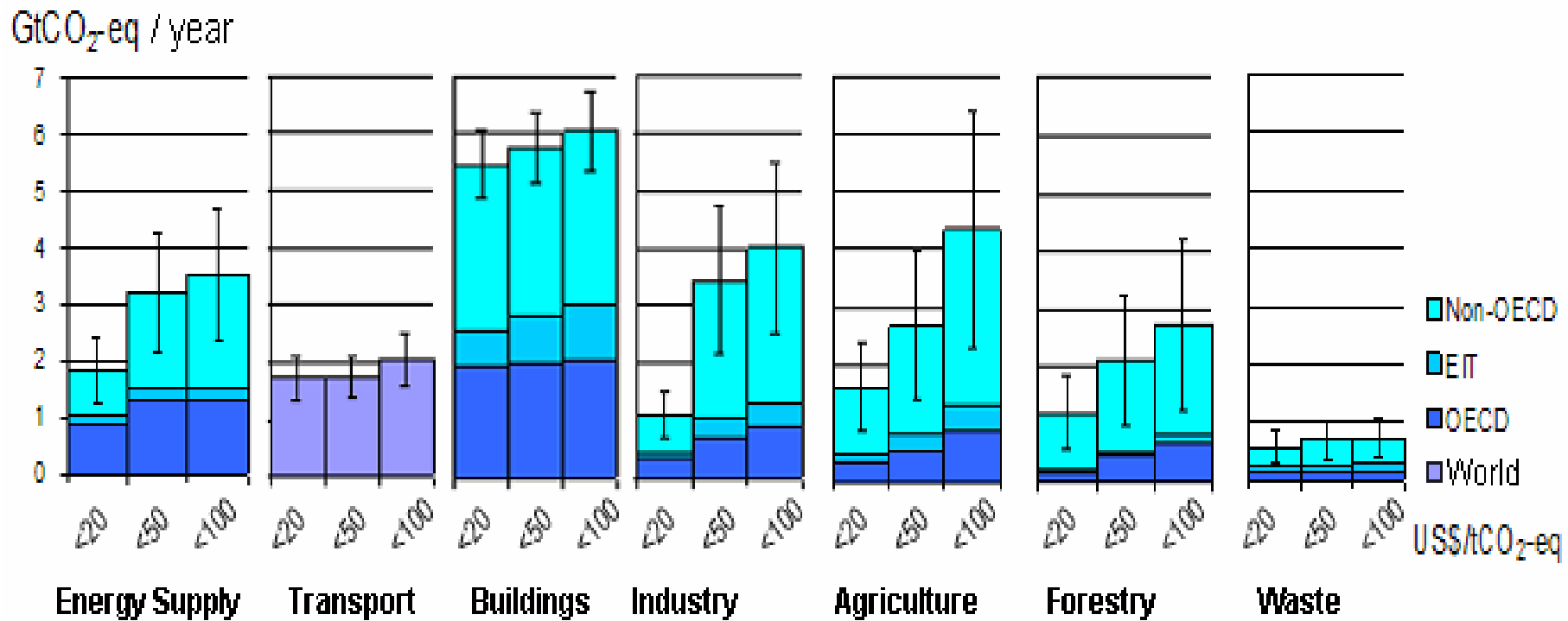
Forests: avoided deforestation ~50%

Effect of climate change < 2030: uncertain

# **3. Combined costs and potentials and GDP effects in 2030**



# All sectors and regions have the potential to contribute – enough to offset business-as usual growth up to 2030



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

- **Mitigation can be profitable**
- **Even with stringent mitigation ( towards 2<sup>0</sup>C goal), costs are below 3 % of GDP in 2030**

Trajectories towards stabilization levels (ppm CO <sub>2</sub> -eq)	Median GDP reduction (%)	Range of GDP reduction (%)	Reduction of average annual GDP growth rates (percentage points)
590-710	0.2	-0.6 – 1.2	< 0.06
535-590	0.6	0.2 – 2.5	<0.1
445-535	-	< 3	< 0.12

■ **0.6% gain to 3% decrease of GDP**



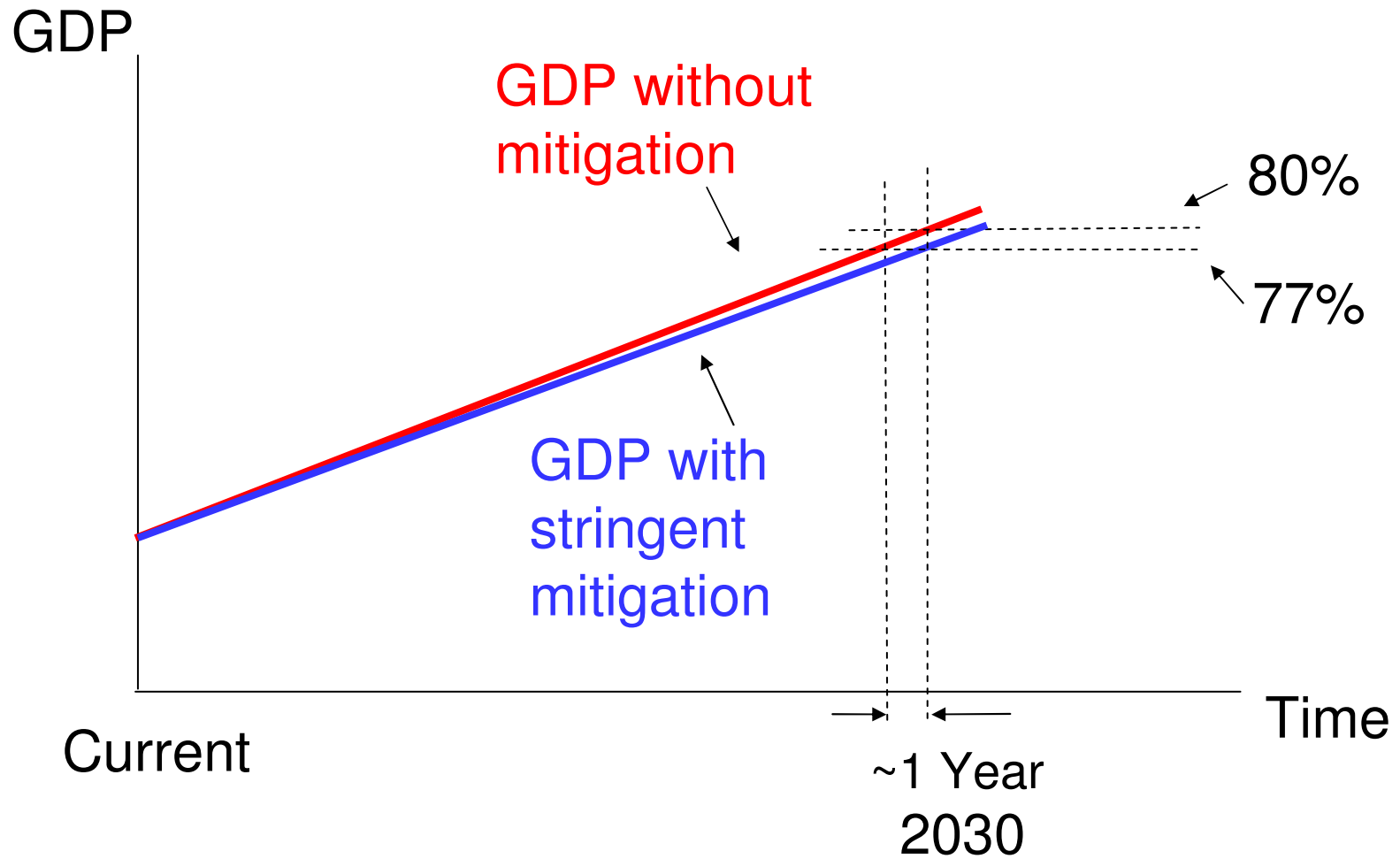
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# Illustration of cost numbers



# 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, in relation to urban planning and availability of public transport
- Behaviour of staff in industrial organizations in light of reward systems






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# Examples of side-effects of climate mitigation

<i><b>OPTIONS</b></i>	<i><b>SYNERGIES</b></i>	<i><b>TRADEOFFS</b></i>
<p><i><b>Energy:</b></i> efficiency, renewables, fuel-switching</p> 	<ul style="list-style-type: none"> <li>• air quality</li> <li>• supply security</li> <li>• employment</li> <li>• costs (efficiency)</li> </ul>	<ul style="list-style-type: none"> <li>• particulate emissions (diesel)</li> <li>• biodiversity (biofuels)</li> <li>• costs (renewables)</li> </ul>
<p><i><b>Forestry:</b></i> reduce deforestation, plant trees</p> 	<ul style="list-style-type: none"> <li>• soil protection</li> <li>• water management</li> <li>• employment</li> <li>• biodiversity (deforest.)</li> </ul>	<ul style="list-style-type: none"> <li>• biodiversity (plantations)</li> <li>• competition food production</li> </ul>
<p><i><b>waste:</b></i> landfill gas capture, incineration</p> 	<ul style="list-style-type: none"> <li>• health &amp; safety</li> <li>• employment</li> <li>• energy advantages</li> </ul>	<ul style="list-style-type: none"> <li>• ground water pollution</li> <li>• costs</li> </ul>

## Conclusions on emission mitigation potentials

- Despite substantial uncertainties, emission reduction potentials are very substantial
- Costs seem affordable
- But how to get there?



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# 4. Climate policies



# 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 CO<sub>2</sub> emissions to 2005 levels by 2030 would require a large shift in the pattern of investment
- It is often more cost-effective to invest in end-use energy efficiency improvement than in increasing energy supply



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# 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



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

- A price of carbon ( like in the EU Emission Trading System) creates incentives to invest in low-carbon products, technologies and processes.
- For stabilisation at around 550 ppm CO<sub>2</sub>eq carbon prices should reach 20-80 US\$/tCO<sub>2</sub>eq by 2030
- But... do not forget the co-benefits



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# 5. Long term mitigation



# What is 'stabilisation'

- UNFCCC goal = stabilisation of GHG concentrations
- At a level that prevents 'dangerous anthropogenic climate change'
- EU target 2 °C = approx. 450 ppm
- For stabilisation of **concentrations**, **emissions** must go down

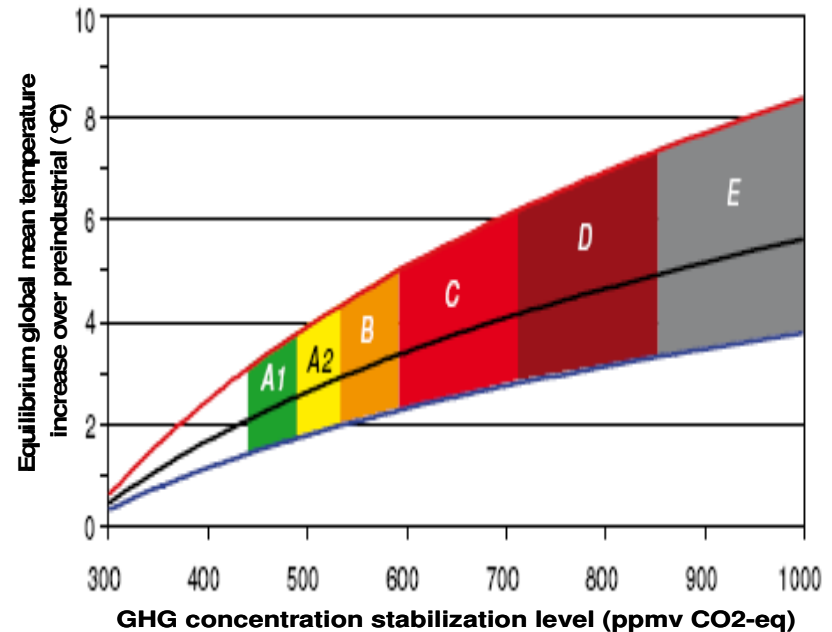


# The key question: can “dangerous anthropogenic climate change” be avoided?

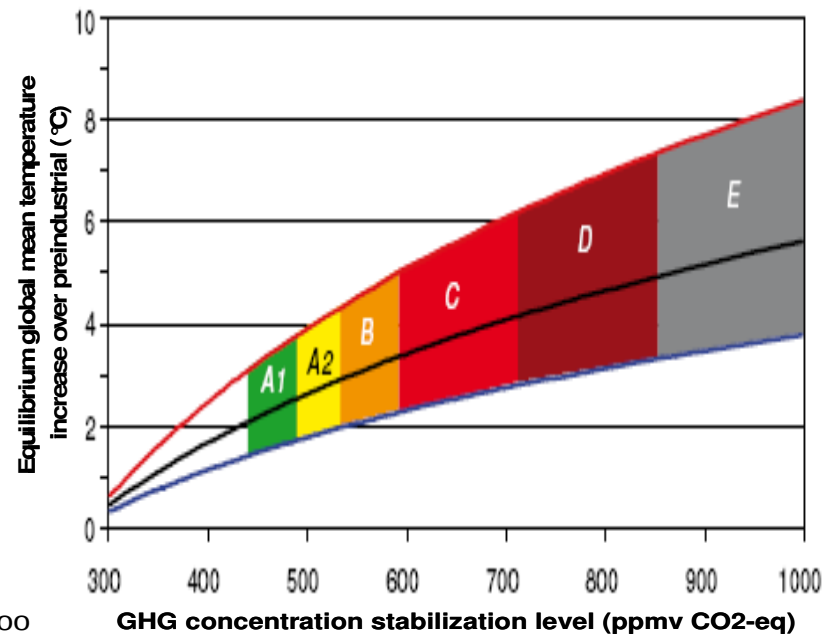
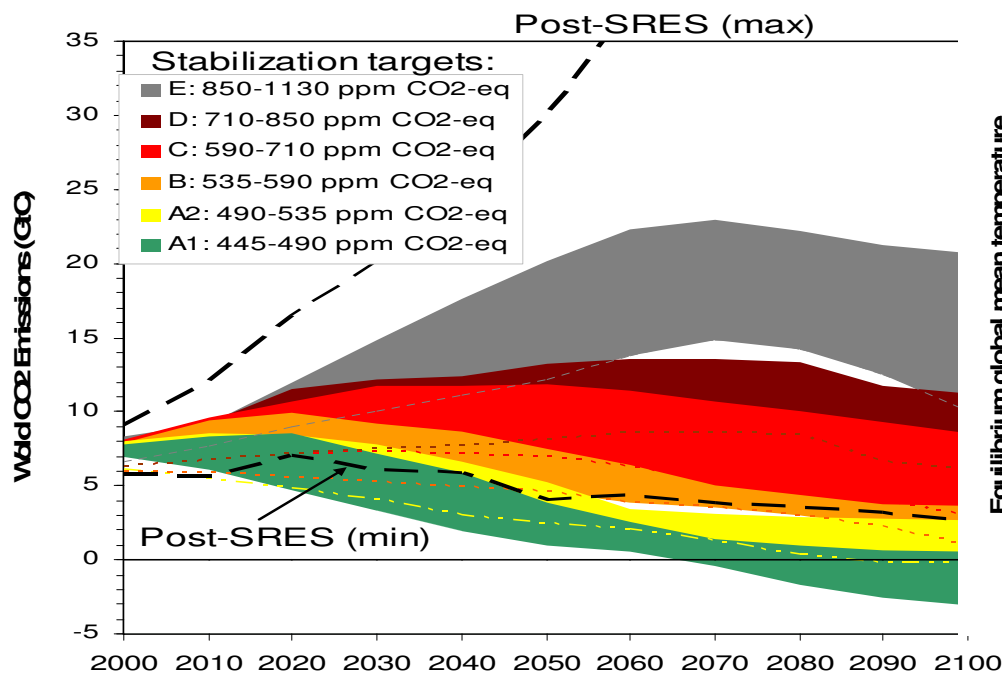
EU,  
Norway



Even 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 CO<sub>2</sub> only studies combined

## Pathways towards stabilization

Stabilization level (ppm CO <sub>2</sub> -eq)	Global mean temp. increase at equilibrium (°C)	Year CO <sub>2</sub> needs to peak	Year CO <sub>2</sub> emissions back at 2000 level	Reduction in 2050 CO <sub>2</sub> 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

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



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## 6. Relevance to UNFCCC, further work IPCC



# Emission allowances in 2020/2050 levels for Annex I and non-Annex I countries

Scenario category	Region	2020	2050
A-450 ppm CO <sub>2</sub> - eq <sup>b</sup>	Annex I	-25% to -40%	-80% to -95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm CO <sub>2</sub> - 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 <sub>2</sub> - eq	Annex I	0% to -25%	-30% to -80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

## Decision UNFCCC AWG Bali

The AWG (...) noted the usefulness of the ranges referred to in the contribution of Working Group III to the AR4 of the IPCC and that this report indicates that global **emissions of greenhouse gases (GHGs) need to peak in the next 10–15 years** and be reduced to very low levels, well below half of levels in 2000 by the middle of the twenty-first century in order to stabilize their concentrations in the atmosphere at the lowest levels assessed by the IPCC to date in its scenarios (...)(this) **would require Annex I Parties to reduce emissions in a range of 25–40 % below 1990 levels by 2020,(..)**

## IPCC WG3 further actions

- IPCC Special Report Renewable energy in 2010
- Start AR5 in 2009
- New WG III Bureau: Ottmar Edenhofer, Youba Sokona, Ramon Pichs cochairs
- WG III AR5 assessment: opportunities to participate!



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- *Man causes dangerous climate change – man can cure it!*
- *Economics: affordable or even profitable*
- *All major emitting countries have to reduce their greenhouse gas emissions*
- *No time to loose -the longer we wait the larger the damage*

**Dziękuję bardzo za Państwa uwagę!**



## What does US\$ 50/ tCO<sub>2</sub>eq 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



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