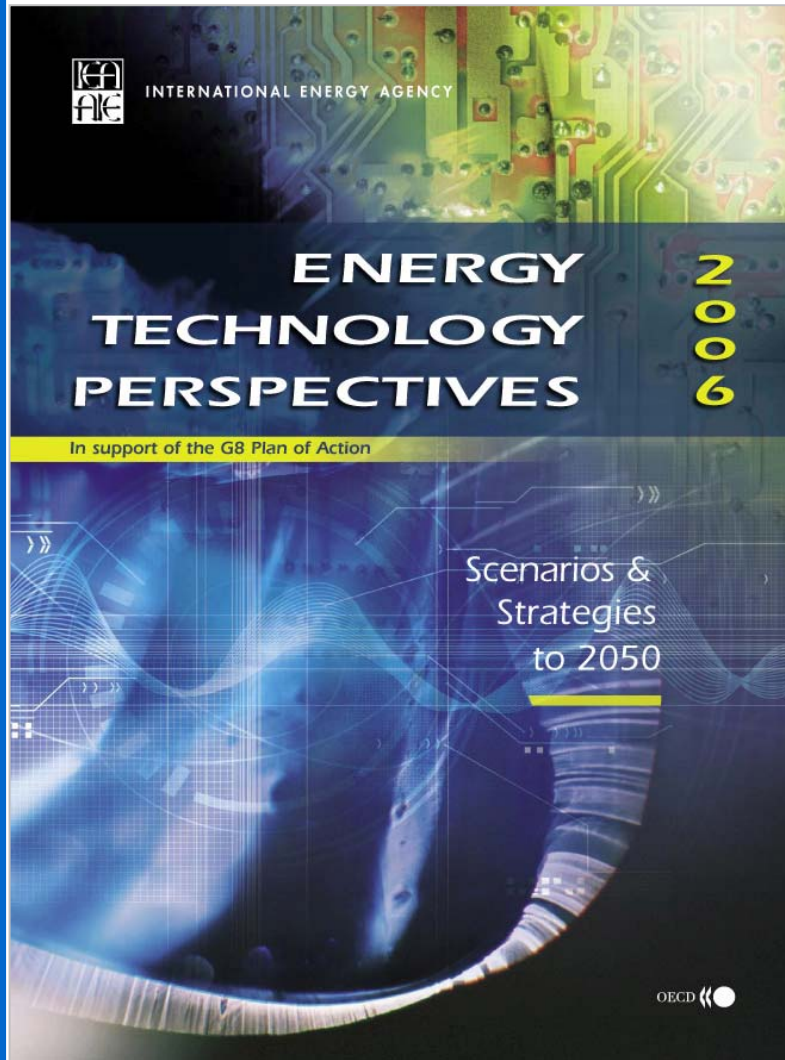




Energy technology perspectives, scenarios and strategies to 2050



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Energy Technology Collaboration
International Energy Agency

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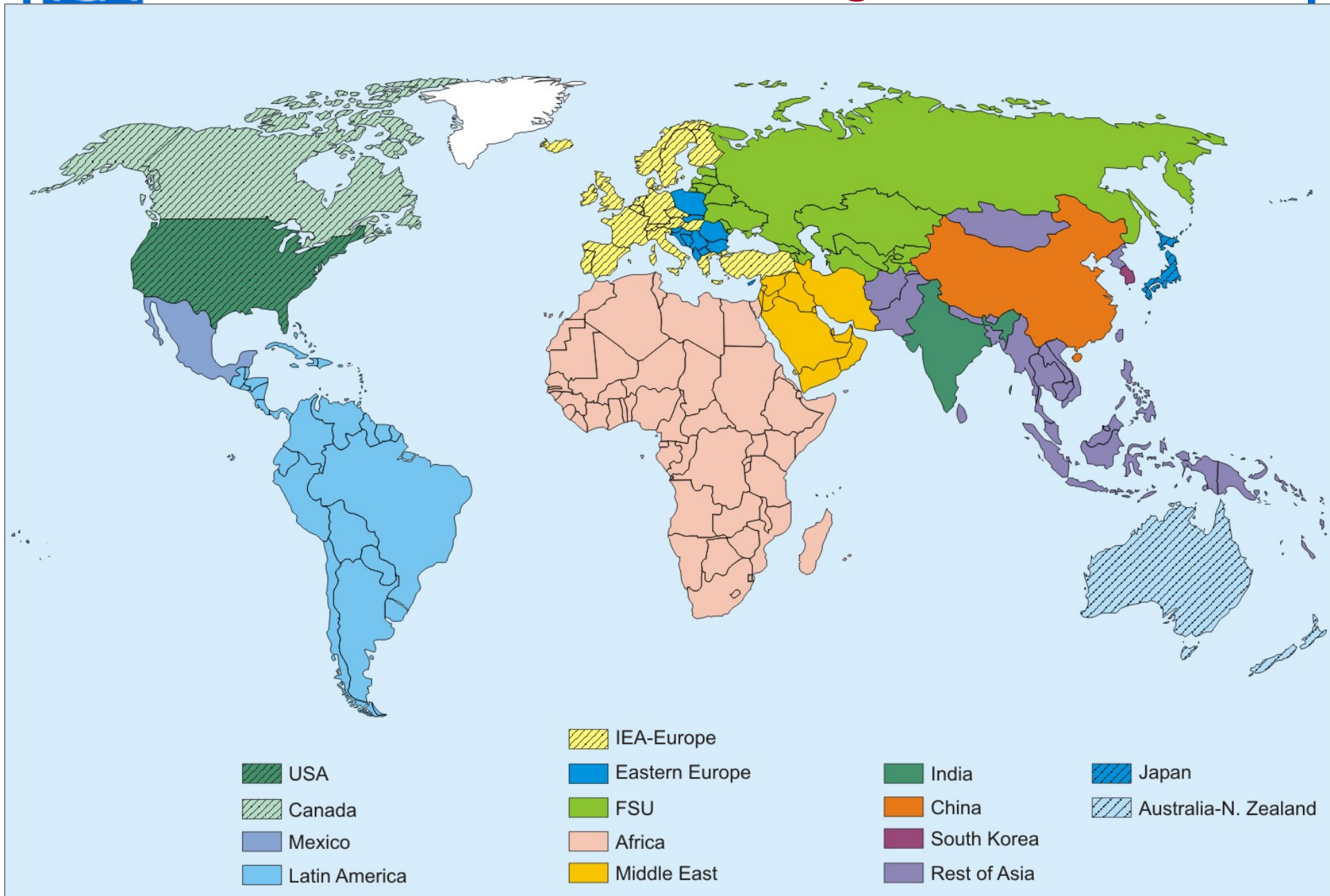


Energy Technology Perspectives Presents

- Status and perspectives for key energy technologies in:
 - Electricity Generation
 - Road Transport Technologies & Fuels
 - Buildings & Appliances
 - Industry
- Global scenarios to illustrate potentials for different technologies under accelerated policies
- Strategies for helping key technologies make a difference



15 ETP model regions



Scenario Analysis

- Scenarios analysed:
 - Baseline Scenario
 - Accelerated Technology Scenarios (ACT)
 - TECH Plus scenario
- ACT and TECH Plus scenarios:
 - Analyse the impact from R&D, Demonstration and Deployment measures
 - Incentives equivalent to 25 \$/tonne CO₂ for low-carbon technologies implemented world-wide from 2030 and on
 - Individual scenarios differ in terms of assumptions for key technology areas

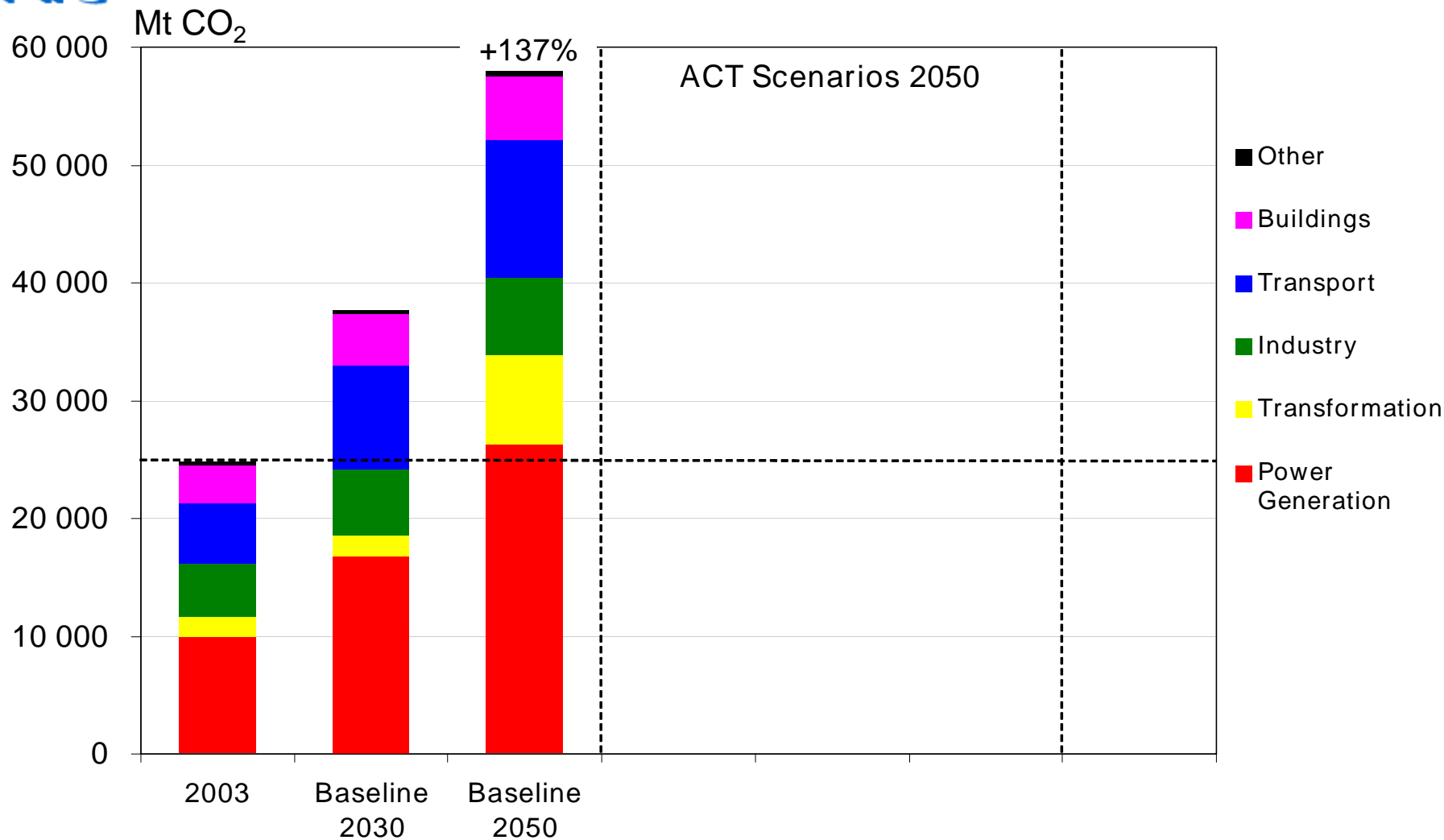


Technology Assumptions

Scenario	Renewables	Nuclear	CCS	H ₂ fuel cells	Advanced biofuels	End-use efficiency
ACT Map	Relatively optimistic across all technology areas					2.0 % p.a. global improvement
ACT Low Renewables	Slower cost reductions					
ACT Low Nuclear		Lower public acceptance				
ACT No CCS			No CCS			
ACT Low Efficiency						1.7 % p.a. global improvement
TECH Plus	Stronger cost reductions	Stronger cost reductions & technology improvements		Break-through for FC	Stronger cost reductions & improved feedstock availability	

Global CO₂ Emissions 2003-2050

Baseline Scenario

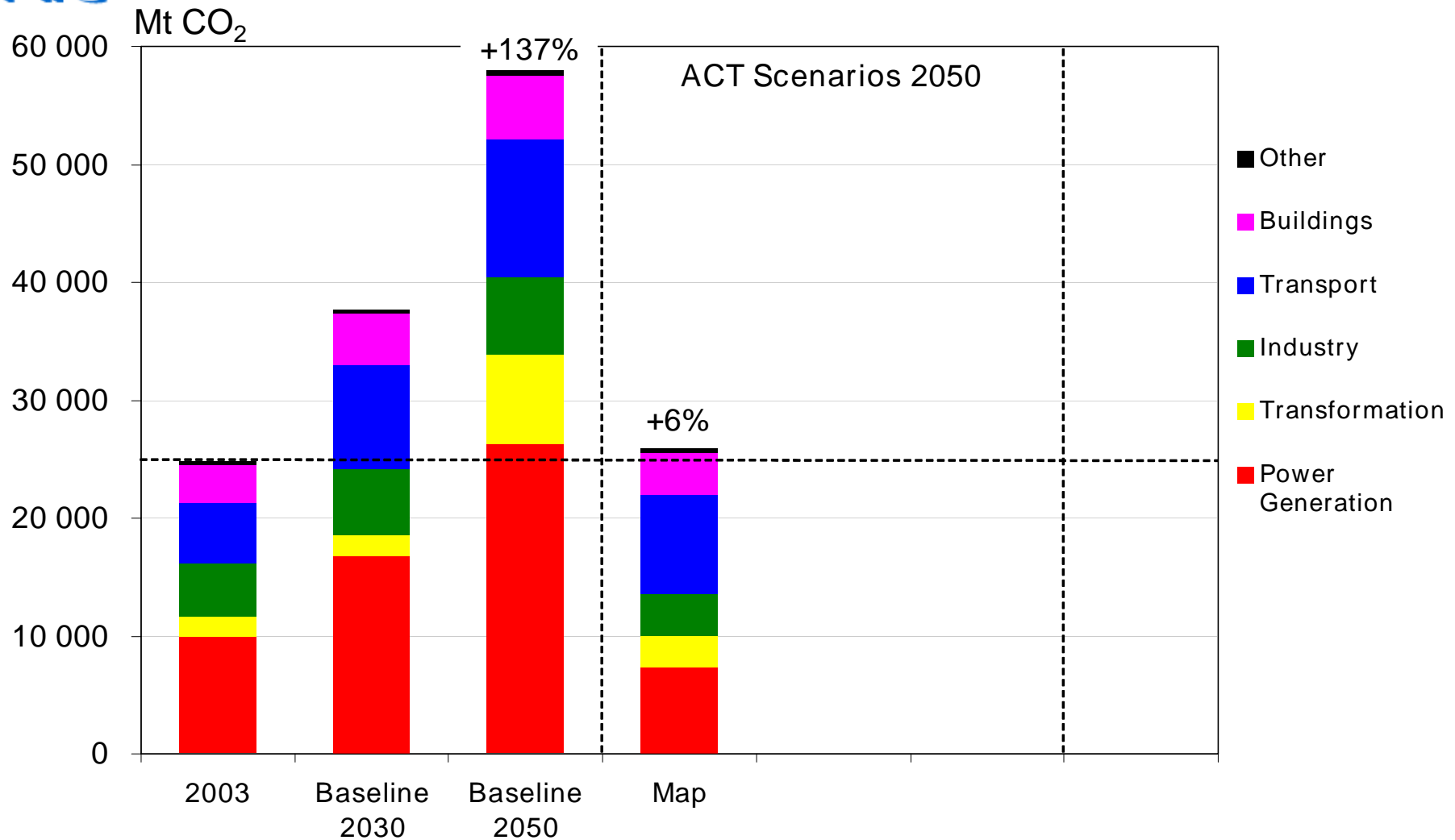


Emissions increase 137% from today's level



Global CO₂ Emissions 2003-2050

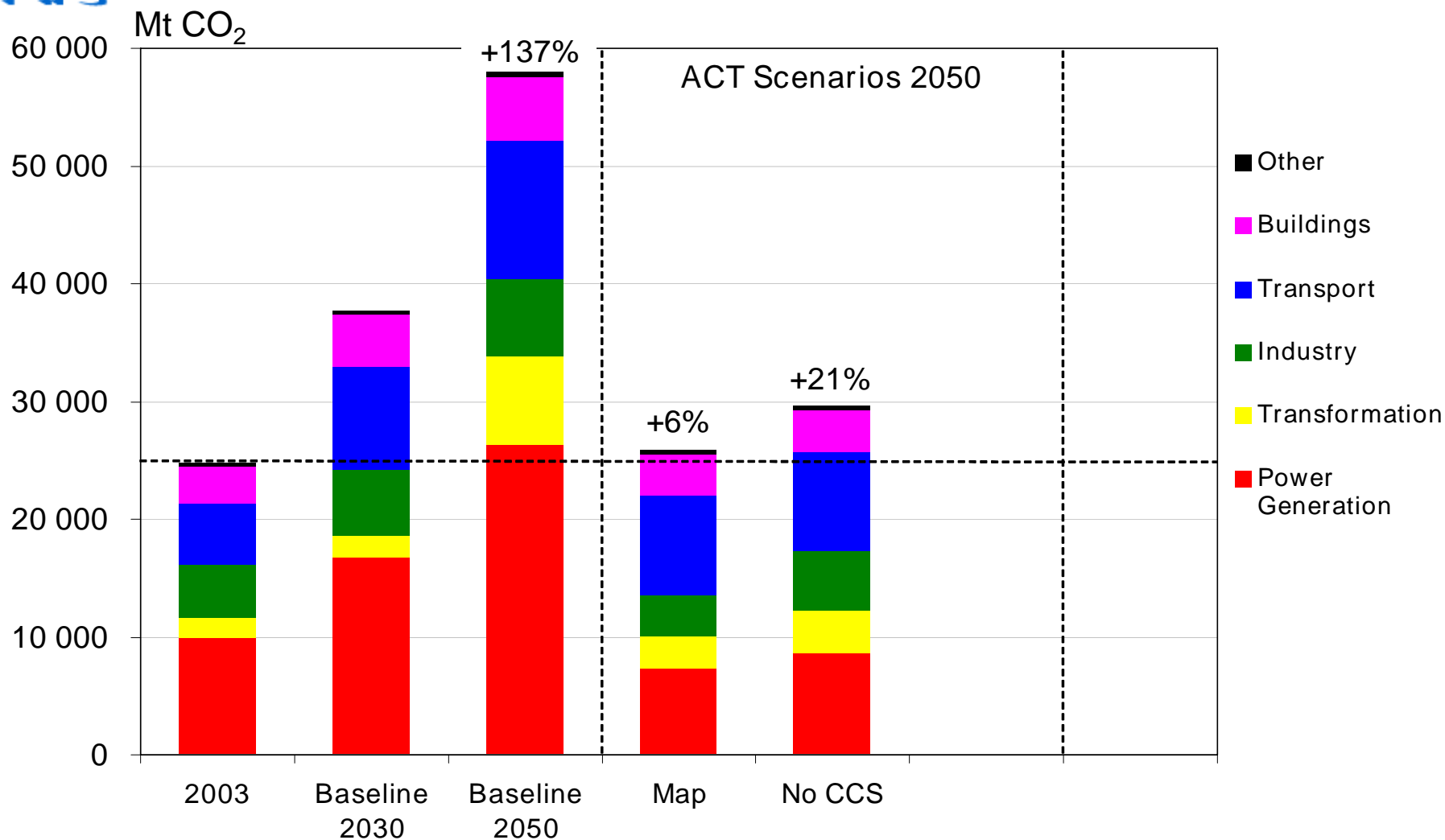
Baseline and Map Scenario



*Map Scenario (Relatively optimistic across all technology areas) :
Emissions returned towards today's level*

Global CO₂ Emissions 2003-2050

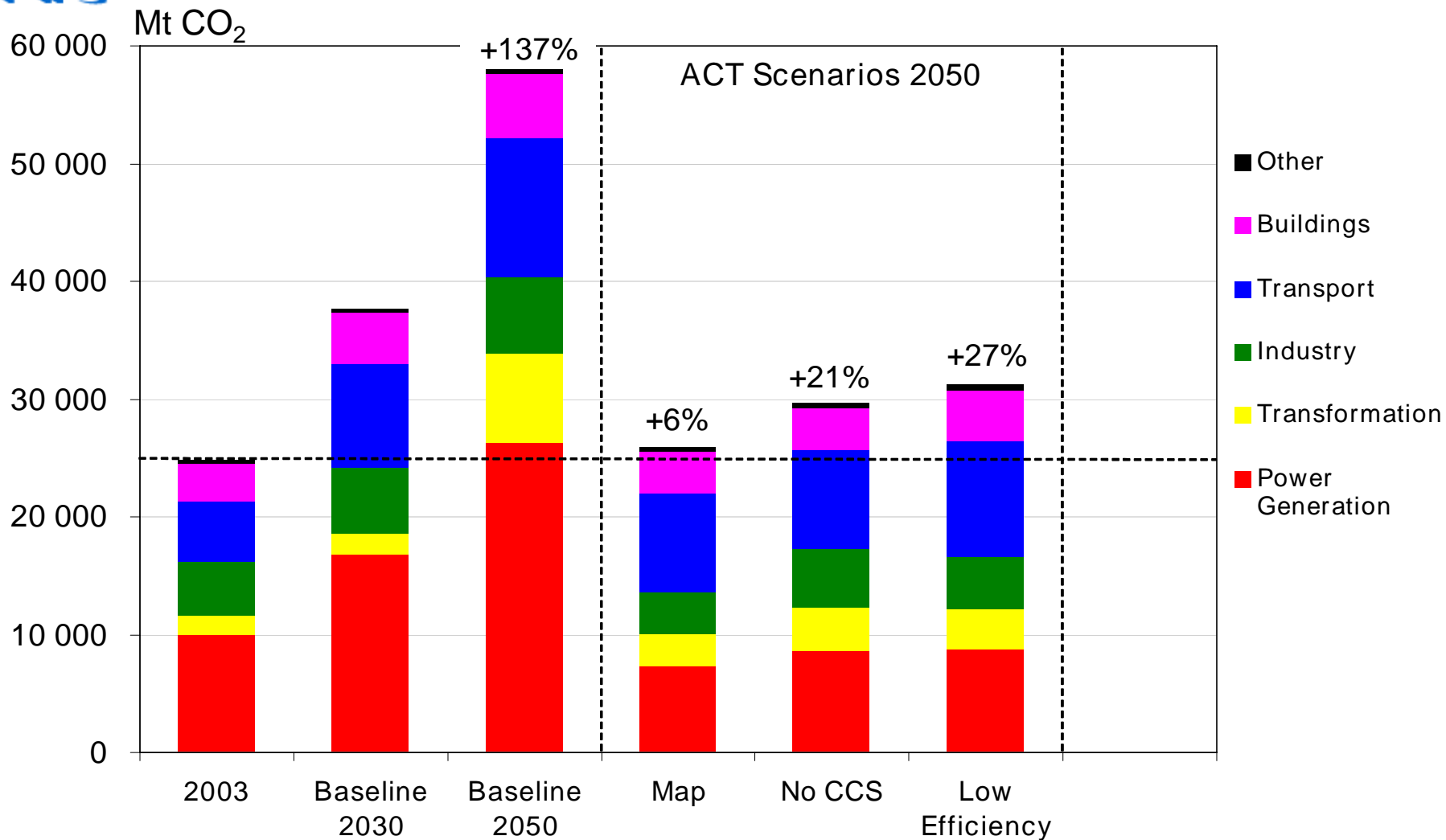
Baseline and ACT Scenarios



Impact of not having CCS available

Global CO₂ Emissions 2003-2050

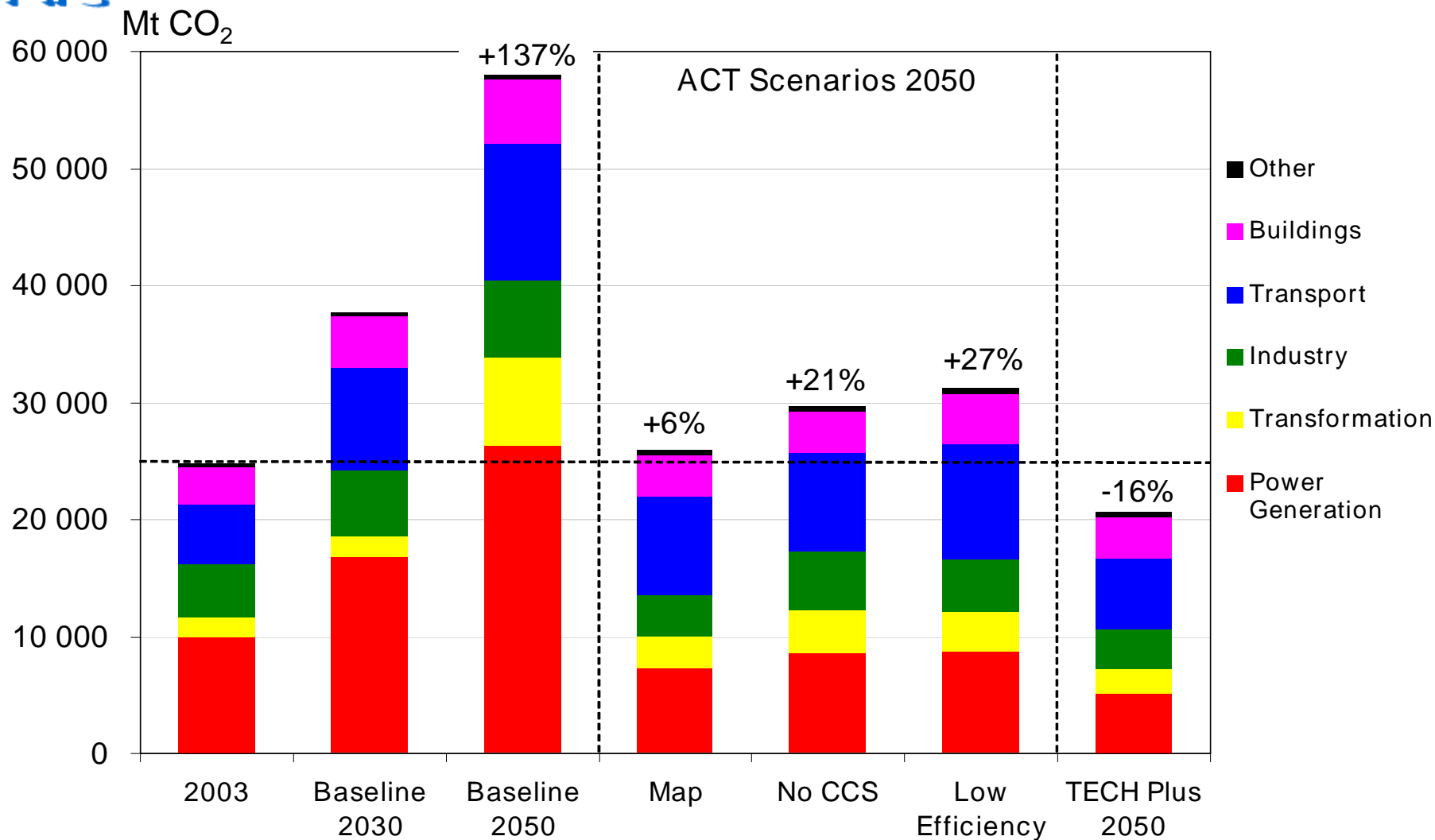
Baseline and ACT Scenarios



Impact of less efficiency progress

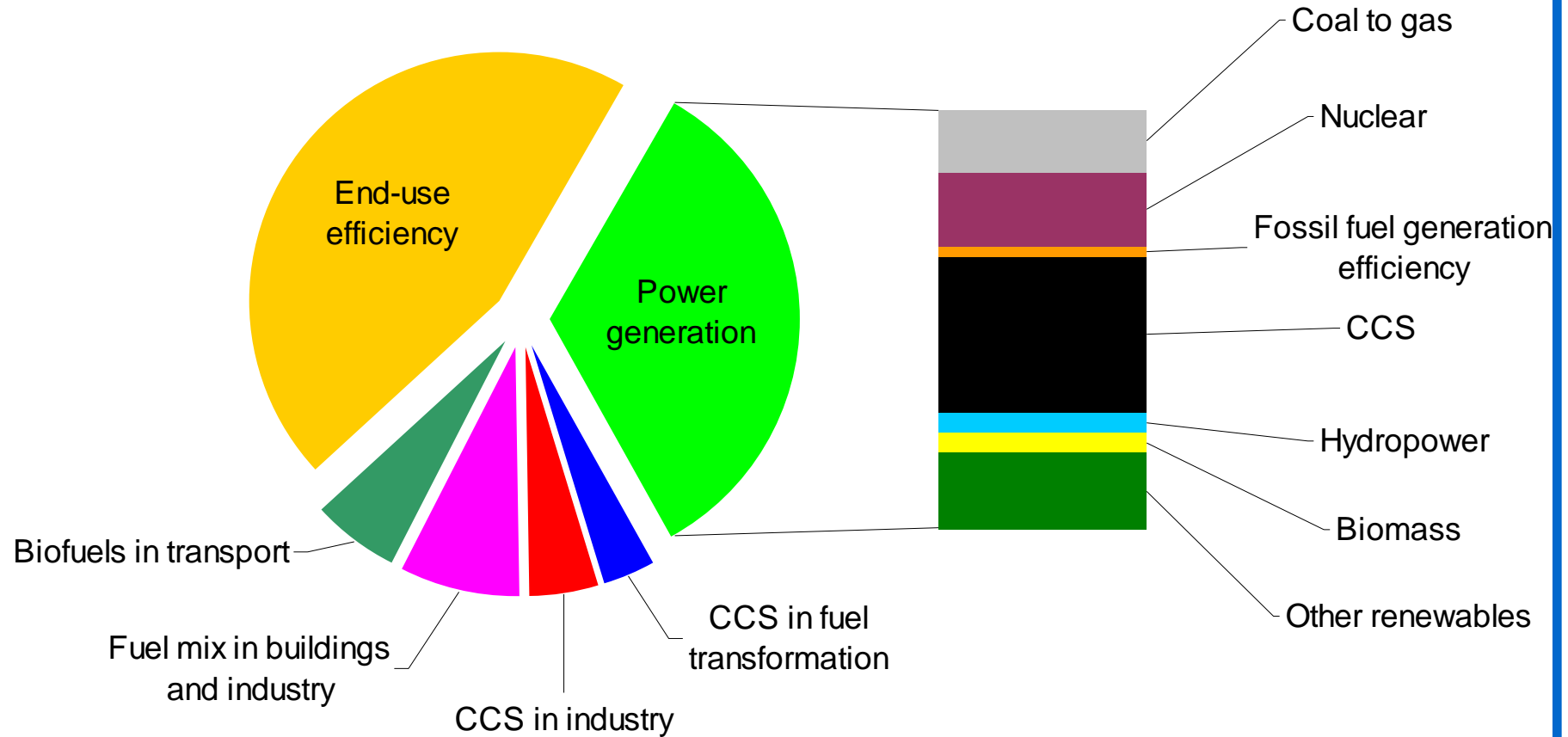
Global CO₂ Emissions 2003-2050

Baseline, ACT and TECH plus Scenarios



TECH Plus: More optimistic on progress for certain key technologies

Emission Reduction by Technology Area ACT Map Scenario



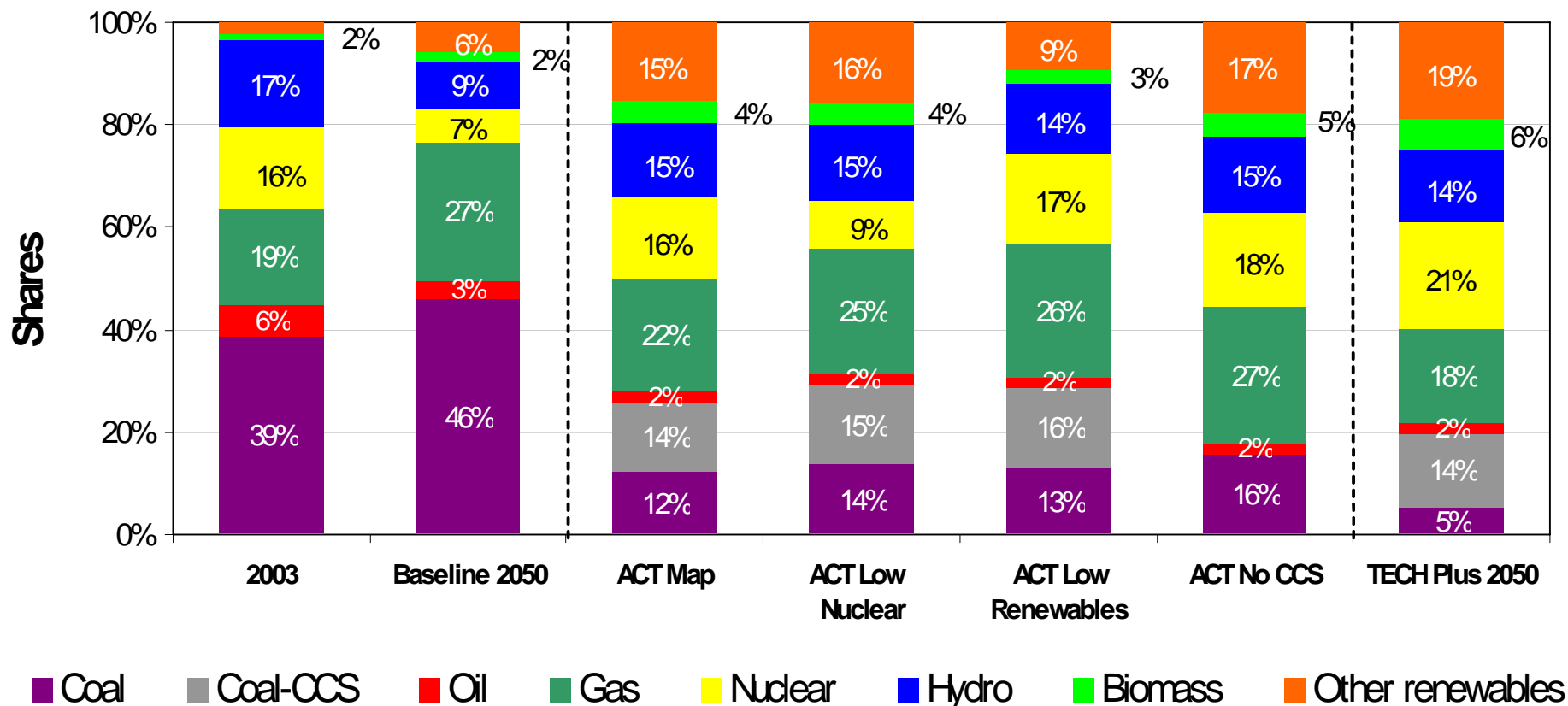
*Improved energy efficiency
is the most important contributor to reduced emissions!*



Energy Efficiency - A top Priority

- Improved energy efficiency saves about 15 000 Mt CO₂ by 2050 - equivalent to 60% of current emissions
- Improved efficiency halves expected growth in electricity demand and reduces the need for generation capacity by a third
- In a scenario with less progress in efficiency, CO₂ emissions increase more than 20%
- Lower efficiency progress increases supply-side investments and costs of reducing CO₂ emissions

Global Electricity Generation by Fuel



ACT Scenarios: Important role for CCS and strong growth in the shares for renewables and nuclear.

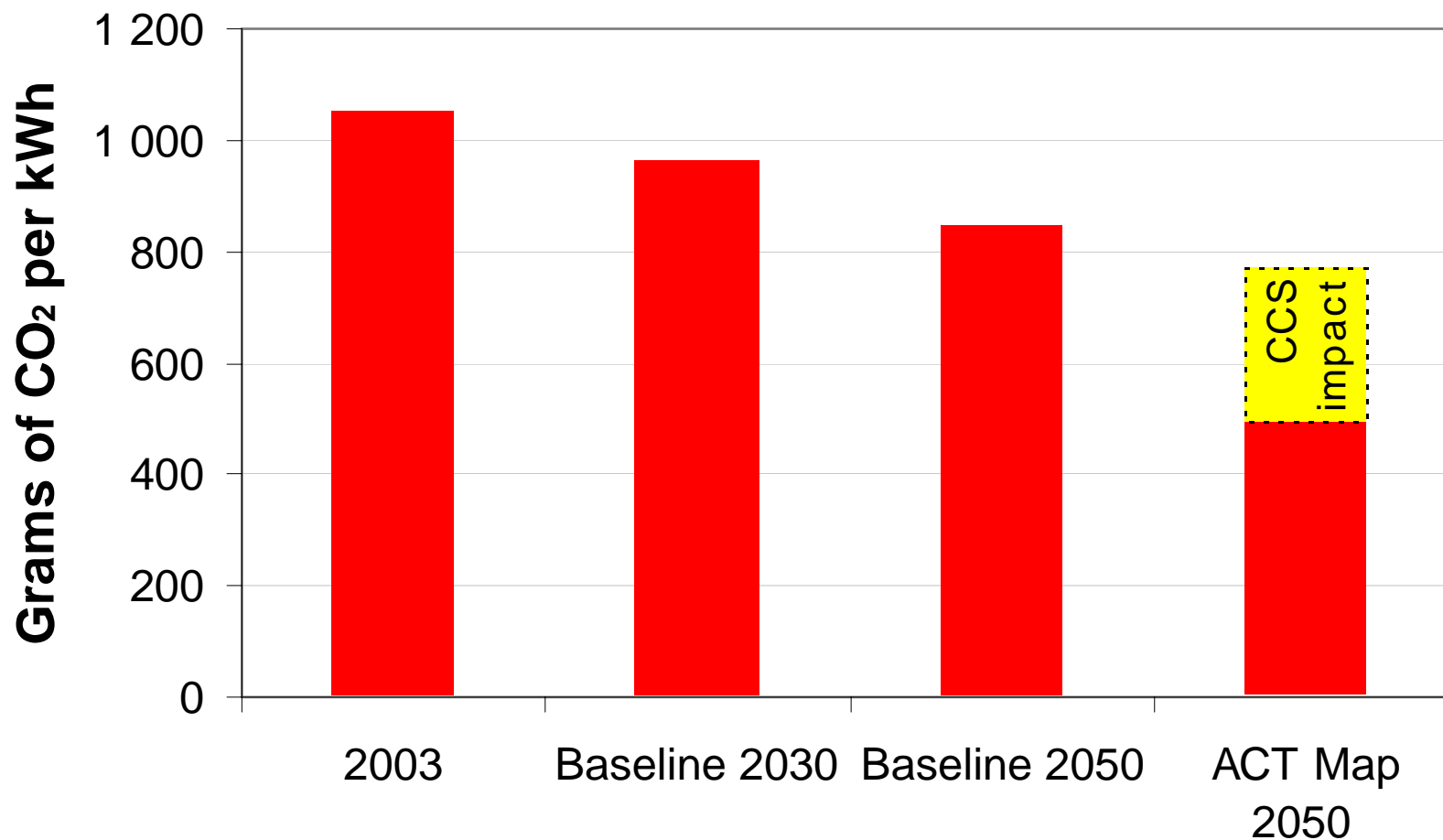
Electricity Generation

CO₂ Capture and Storage a Key Option

- CCS is crucial for the role coal can play in a CO₂ constrained world – without CCS coal-fired generation in 2050 drops below today's level
- By 2050 more than 5 000 TWh electricity globally can be produced by coal-plants equipped with CCS
- There is an urgent need for more R&D and for full-scale CCS demonstration plants
- Generation from renewables can quadruple by 2050
- Nuclear can gain a much more important role in countries where it is acceptable

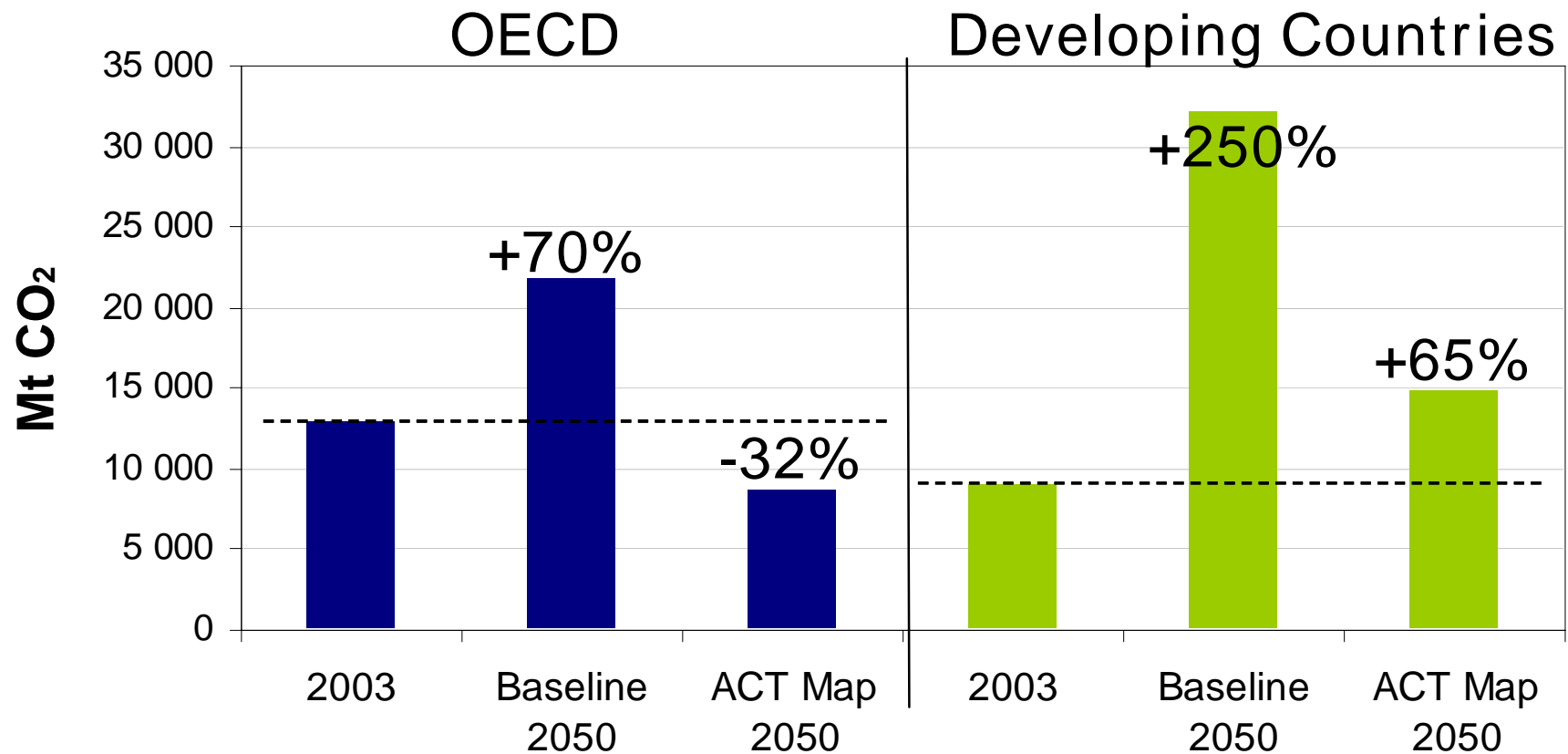


CO₂ Intensity Coal Fired Power Generation China 2003 - 2050



More than 50% reduction in CO₂ intensity due to improved generation efficiency and CCS .

CO₂ Emissions Baseline and Map Scenarios



Map: OECD Emissions 32% below 2003 level, while emissions in Developing Countries are 65% higher.

Scenario Analysis

Key Findings

- Most energy still comes from fossil fuels in 2050
- CO₂ emissions can be returned towards today's level by 2050
- Growth in oil and electricity demand can be halved
- Power generation can be substantially de-carbonised by 2050
- De-carbonising transport will take longer but must be achieved in the second half of the century

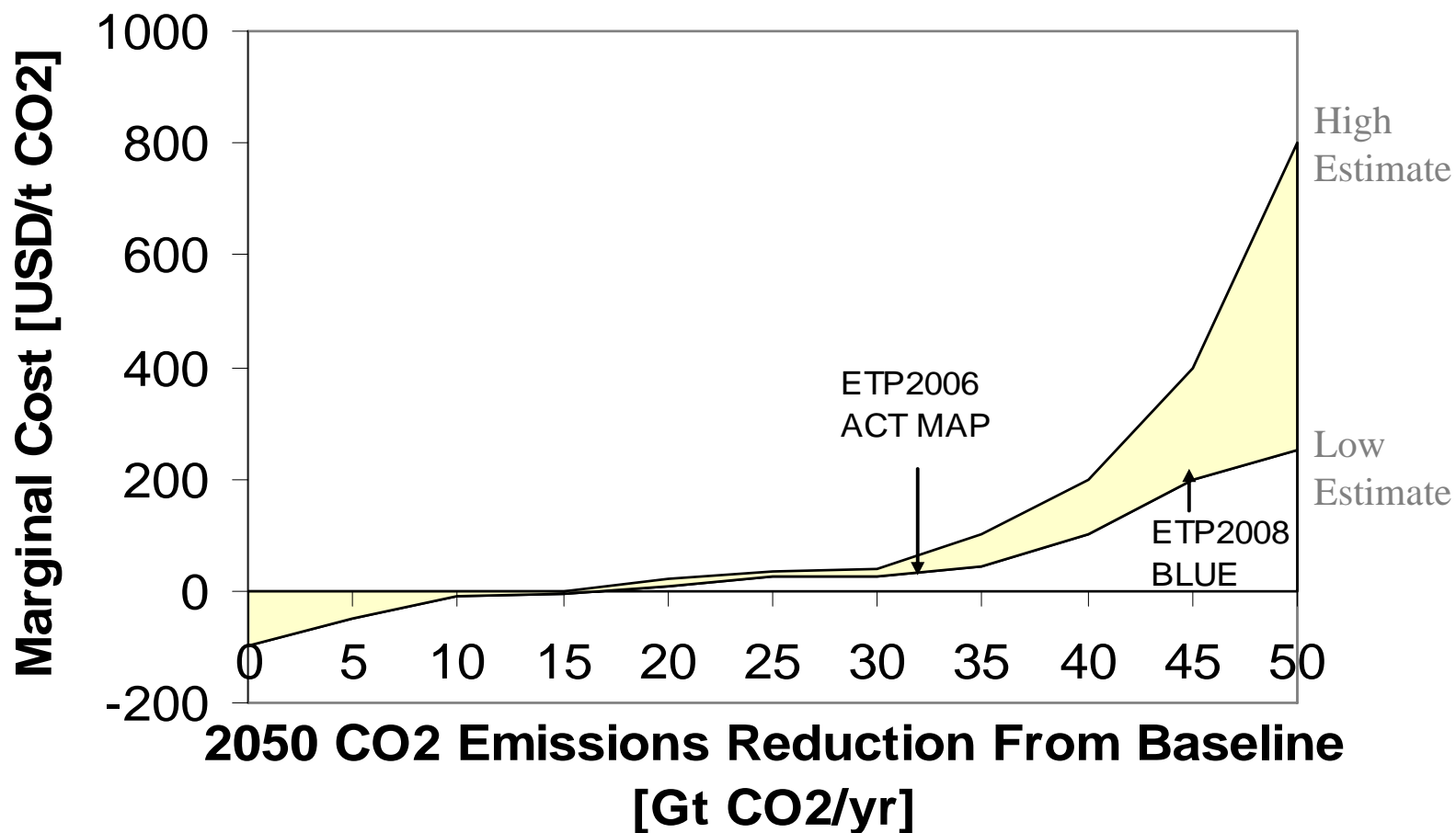
Technology Implications

- A technology portfolio will be needed
- Improving energy efficiency is top priority
- CCS is key for a sustainable energy future
- Other important technologies:
 - Renewables, including biofuels
 - Nuclear
 - Efficient use of natural gas
 - In time and with effort, hydrogen and fuel cells

IPCC 4th Assessment Report and ETP

Temp. increase	All GHG	CO2	CO2 emissions 2050 (% of 2000 emissions)
(°C)	(ppm CO2 eq.)	(ppm CO2)	(%)
2.0-2.4	445-490	350-400	-85 to -50
2.4-2.8	490-535	400-440	-60 to -30
2.8-3.2	535-590	440-485	-30 to +5 (ACT scenarios)
3.2-4.0	590-710	485-570	+10 to +60
~6			+135 (ETP baseline)

A Very Preliminary Estimate: USD 200/t CO₂ Incentive Needed



What Can Be Done ?

- More of the same, such as:
 - ◆ More efficiency/structural change (BAT everywhere)
 - ◆ More nuclear
 - ◆ More biofuels
- More expensive options, such as:
 - ◆ Gas fired power plants + CCS
 - ◆ Retrofit + early replacement of buildings, power plants, factories
 - ◆ Better public transportation in cities
- New technologies, such as:
 - ◆ Transport sector options (plug-ins, freight & air options)
 - ◆ New heat pump technology



Thank you!

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