



Energy Technology Perspectives

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UNFCCC Dialogue Workshop
Bonn, 16-17 May 2007

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G8 - Gleneagles Communiqué July 2005



“We will act with resolve and urgency to meet our shared multiple objectives of reducing greenhouse gas emissions, improving the global environment, enhancing energy security and cutting air pollution in conjunction with our vigorous efforts to reduce poverty“

“The IEA will advise on alternative energy scenarios and strategies aimed at a clean, clever and competitive energy future”

IEA

Scenarios & Strategies to 2050

- The ETP scenarios show new pathways to a more sustainable future (< 550 ppm CO₂ eq)
- Emissions can be returned to today's level by 2050, if proper energy policies are implemented
- Technology plays a key role
- Model-based analysis for the world, split into 15 regions
- Cost-based decision making
- Efforts are balanced across sectors and world regions

Scenario Analysis

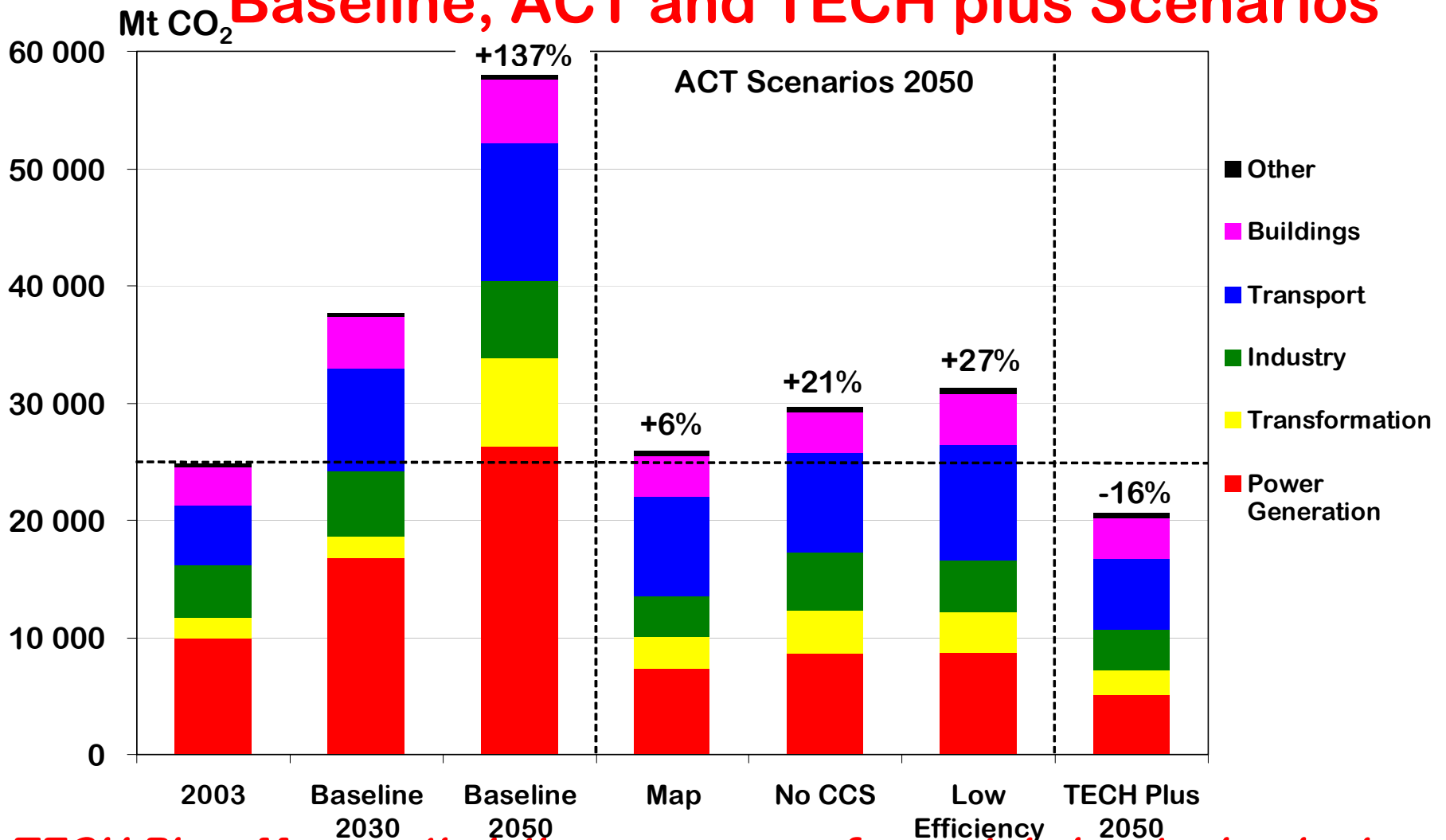
- Scenarios analysed:
 - ◆ Baseline Scenario
 - ◆ Accelerated Technology Scenarios (ACT)
 - ◆ TECH Plus scenario
- ACT and TECH Plus scenarios:
 - ◆ Analyse the impact from R&D, Demonstration and Deployment measures
 - ◆ Incentives equivalent to 25 \$/tonne CO₂ for low-carbon technologies implemented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

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

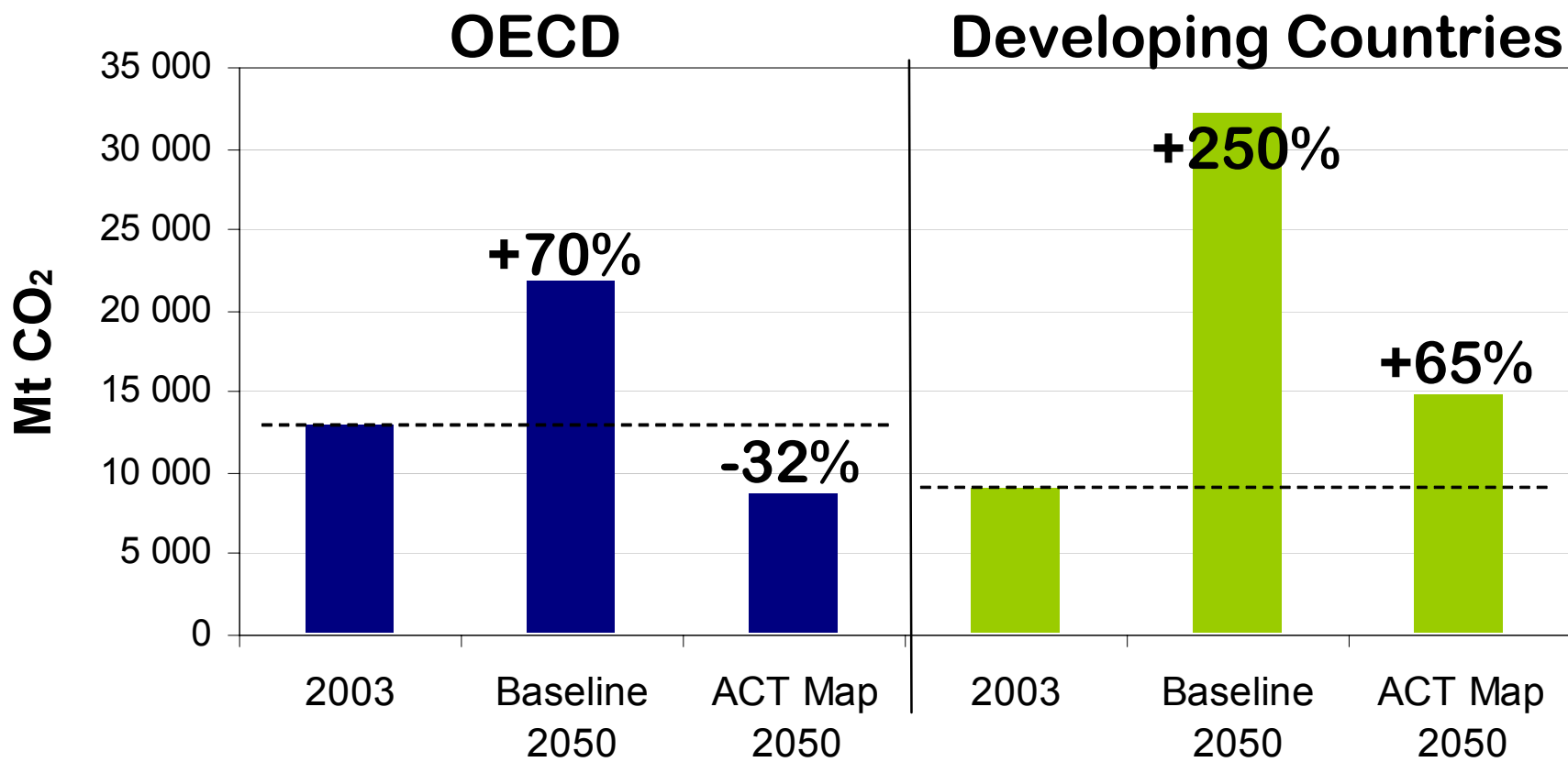
Baseline, ACT and TECH plus Scenarios



TECH Plus: More optimistic on progress for certain key technologies

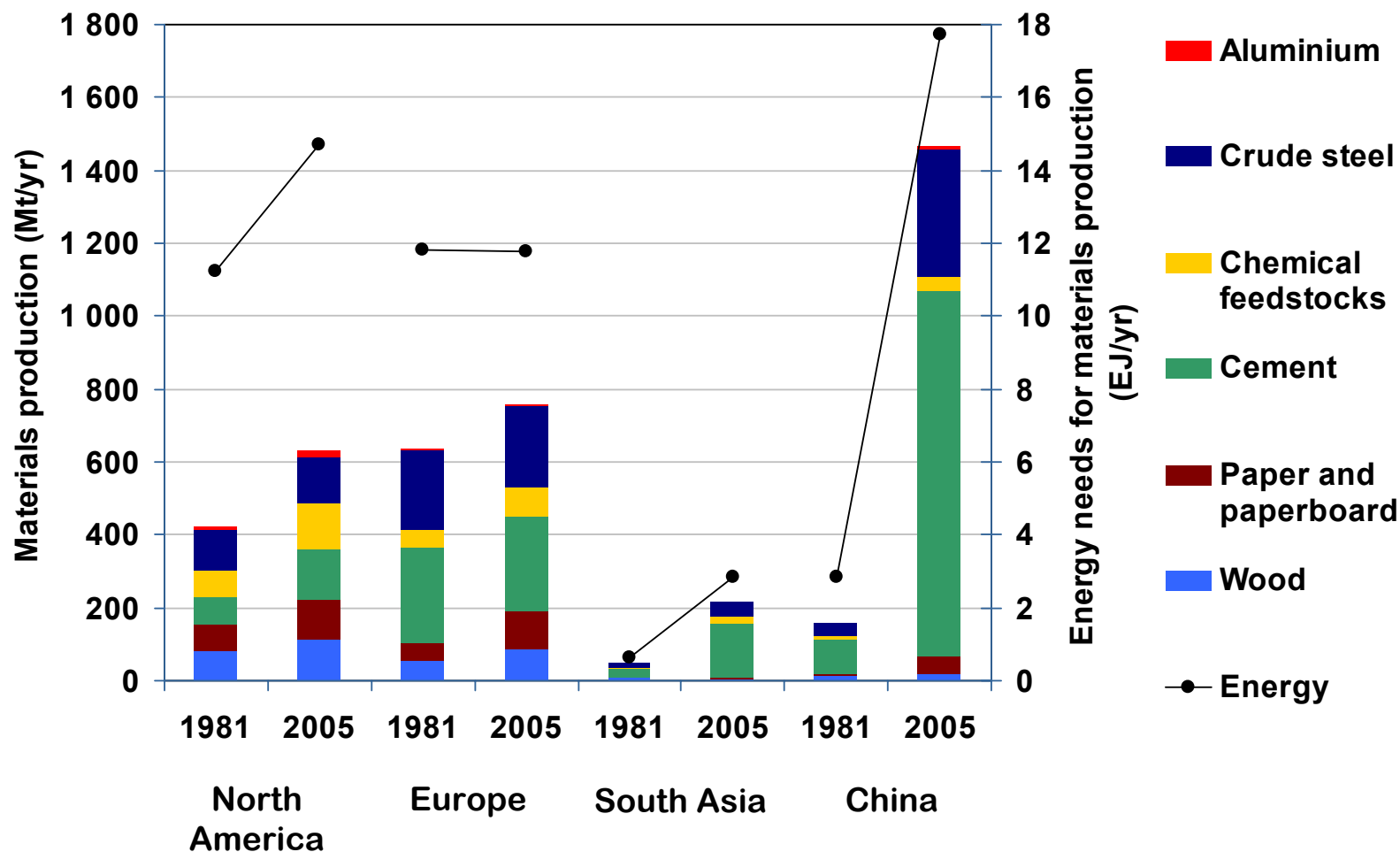
CO₂ Emissions

Baseline and Map Scenarios



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

Materials Production Energy Needs



Emission reduction by sectors

MAP Scenario:
32 Gt CO₂ reduction in 2050

Industry 10%

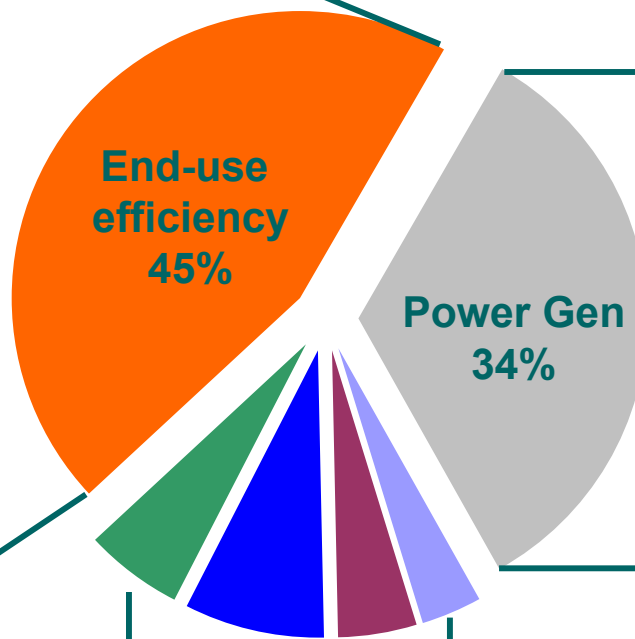
- Energy & feedstock effic. 6%
- Materials & products effic. 1%
- Process innovation 1%
- Cogen. & steam 2%

Buildings 18%

- Space heating 3%
- Air conditioning 3%
- Lighting, misc. 3.5%
- Water heat., cooking 1%
- Appliances 7.5%

Transport 17%

- Fuel economy in transport 17%



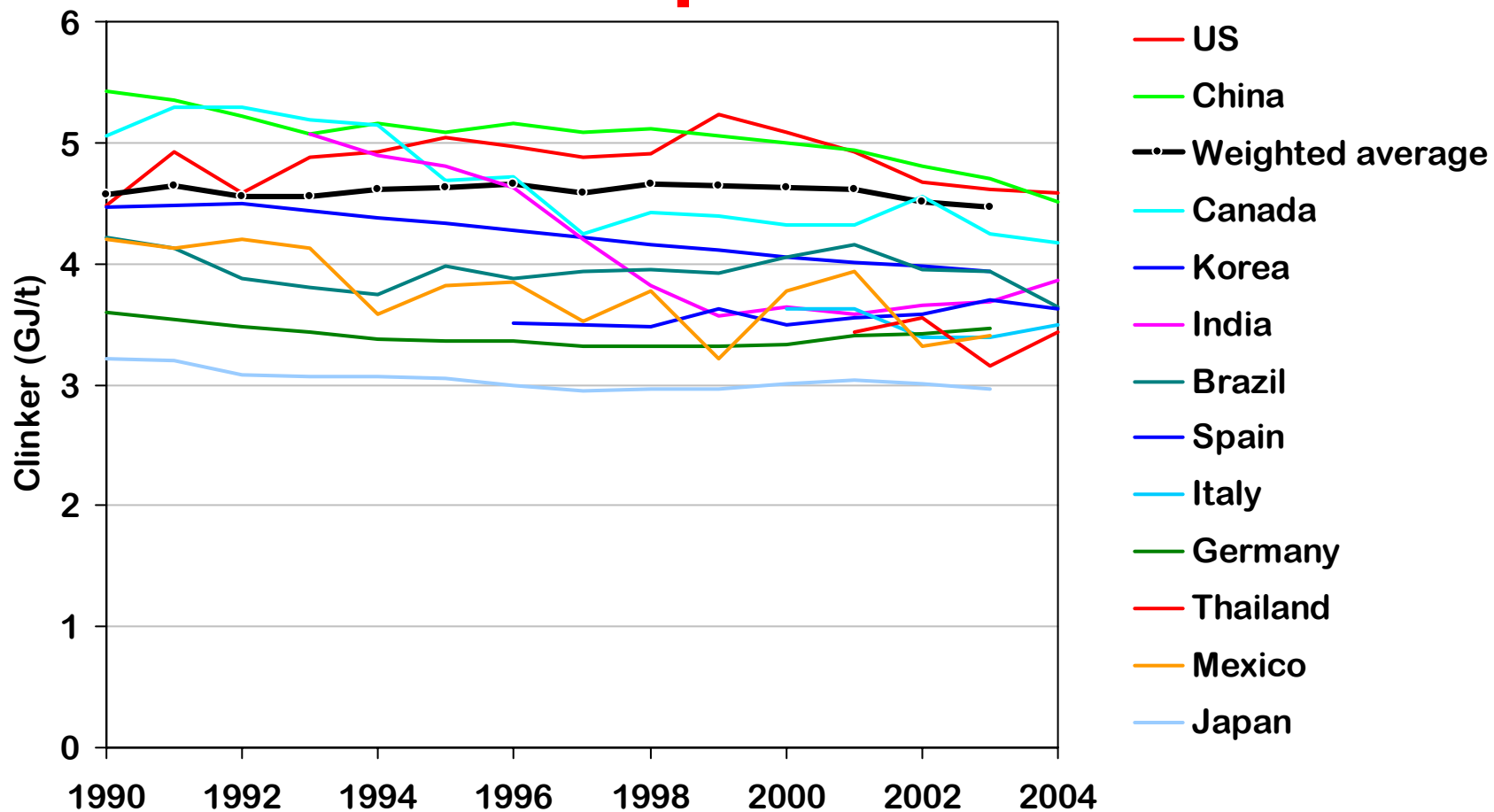
- Coal to gas 5%
- Nuclear 6%
- Fossil fuel gen. eff 1%
- CCS 12%
- Hydro 2%
- Biomass 2%
- Other renew. 6%

- Biofuels in transport 6%
- CCS in fuel transformation 3%
- CCS in industry 5%
- Fuel mix in building 5% and industry 2%

Energy Efficiency - A top Priority

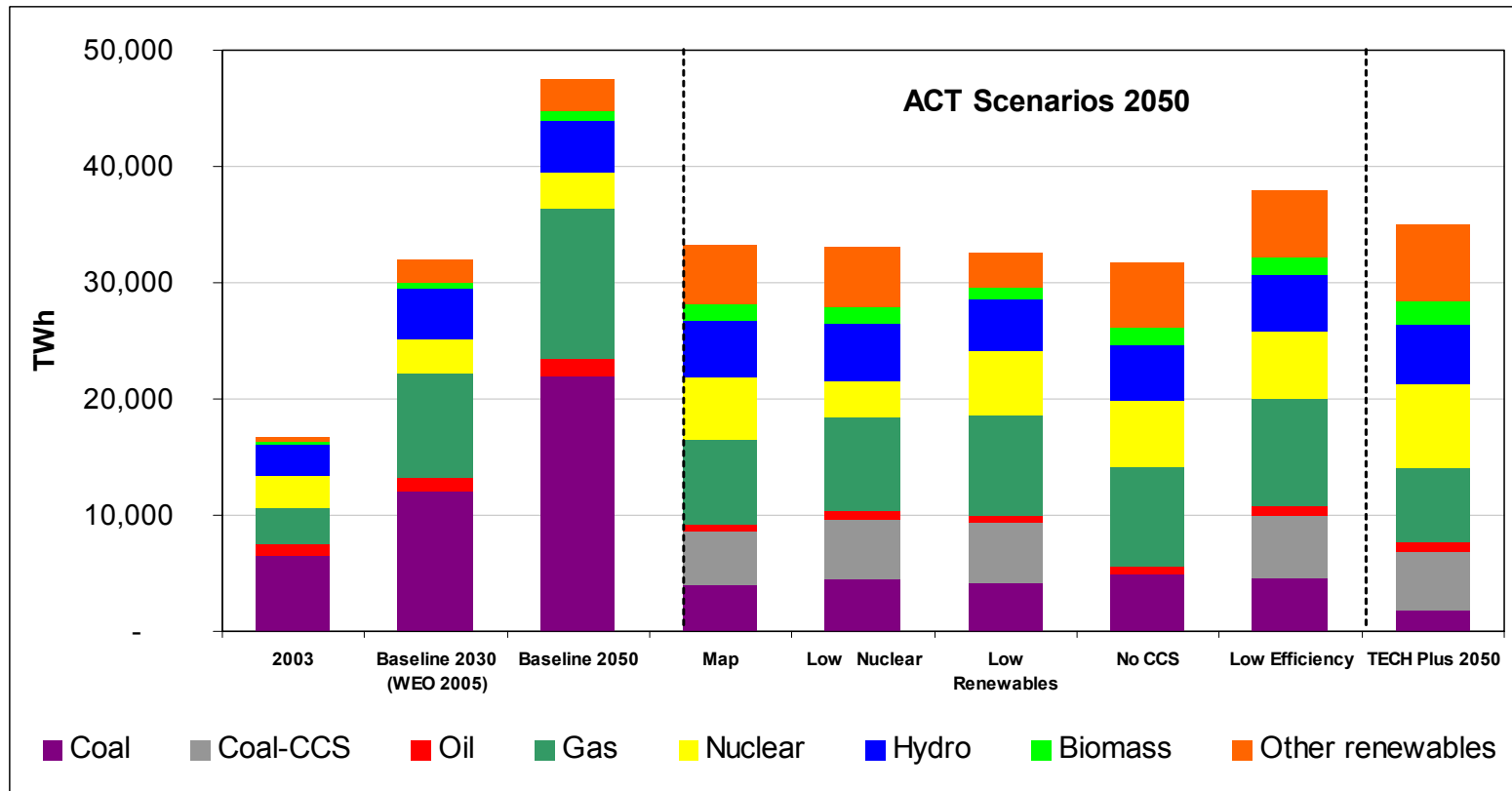
- Improved energy efficiency saves about 15 000 Mt CO₂ by 2050 - equivalent to 60% of current emissions
- Improved efficiency halves expected growth in electricity demand and reduces the need for generation capacity by a third
- In a scenario with less progress in efficiency, CO₂ emissions increase more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

Energy Efficiency of Cement Clinker production



A Mixed Picture of Country Level Efficiencies

Global Electricity Generation by Fuel



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

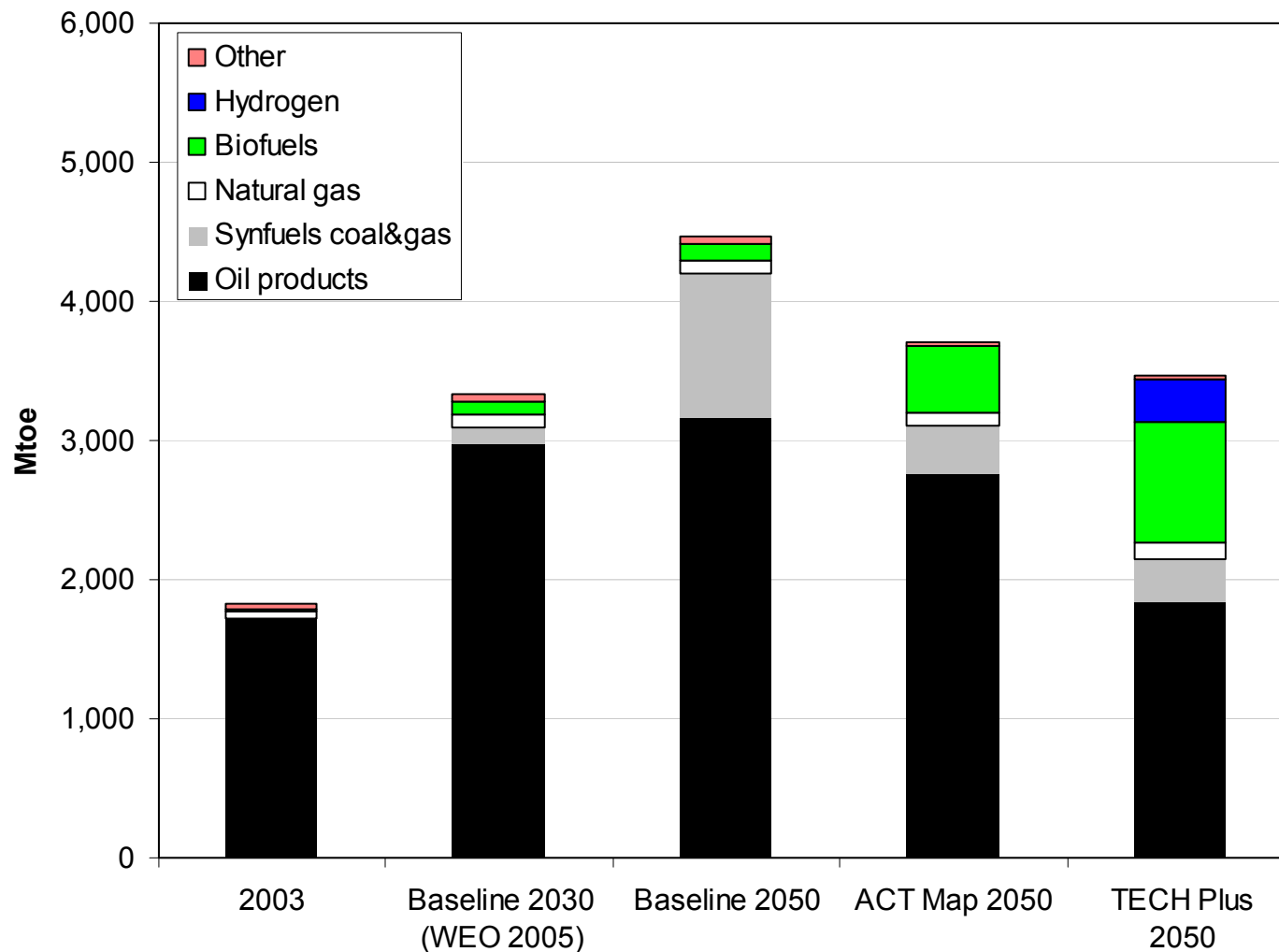
Electricity Generation

- 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

Transportation Sector

- **Total transport fuel demand in Baseline scenario grows 140% (2050)**
- **LDV vehicle travel grows 140%**
- **Average Baseline LDV stock efficiency gain 18% (annual gain half that of the past 25 years)**
- **Average LDV stock efficiency gain Act Map +40%, TechPlus +50%**

Transport Sector Fuel Demand



Key Findings

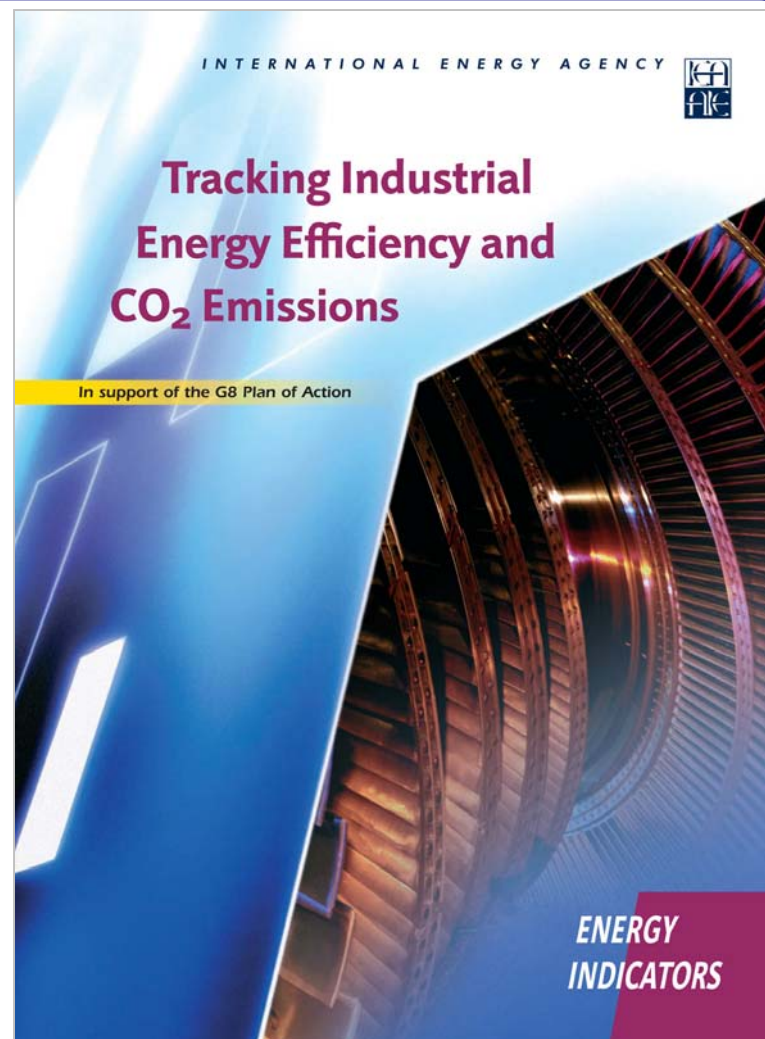
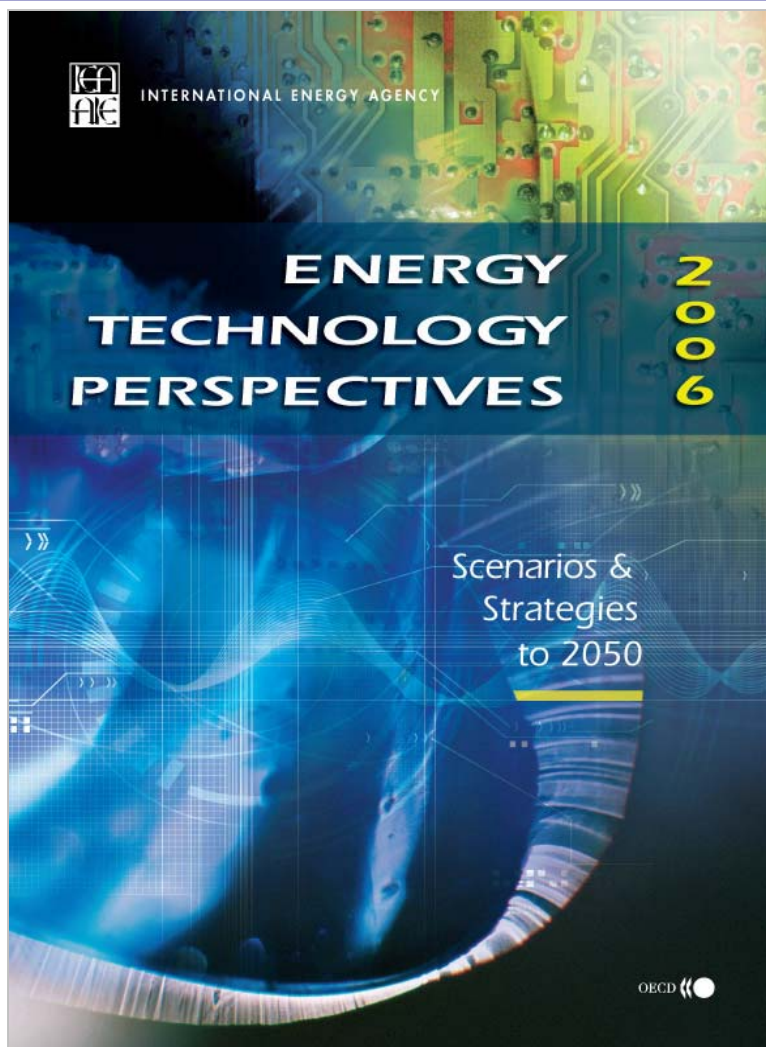
- Current policies will not bring us on a path towards a sustainable energy future
- A more sustainable energy future is possible with a portfolio of clean and efficient technologies
- Using technologies that have an additional cost of less than 25 \$/tonne CO₂ avoided:
 - ◆ Global CO₂ emissions can be returned to today's level by 2050
 - ◆ Expected growth in both oil and electricity demand can be halved
- Requires urgent action to promote, develop and deploy a full mix of energy technologies
- Collaboration between developing and developed nations will be essential

RDD&D and Investment Actions

- **Provide credible long-term CO₂ price indications**
- **Increase RD&D funds substantially**
- **Deployment funding needs exceed RD&D funding**
- **Start with more stringent efficiency standards and regulations**
- **Limit investments in coal w/o CCS possibility**

Technology Access for Developing Countries

- Most key technologies are available today, but too expensive
- Capital availability/scale issue
- Solve IP issues
- Develop a level playing field
- CDM can only be a transitional solution
- Leapfrogging ?



Thank You

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