Energy Technology Perspectives
Past Trends and Future Outlook

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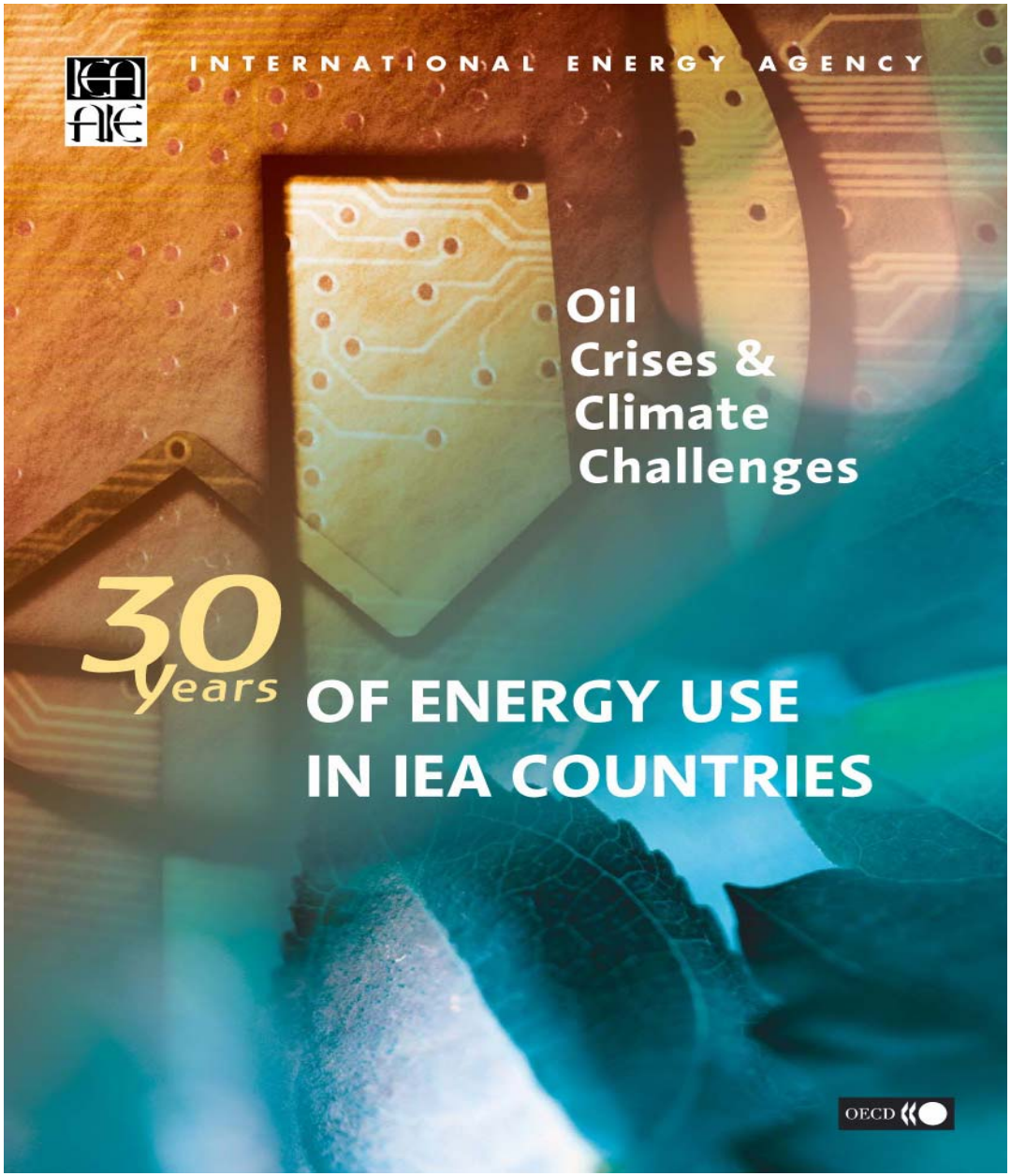
Looking Back

Energy Use and CO_2 Emissions in IEA Countries the Last Three Decades


Oil
Crises &
Climate
Challenges
30 Years
OF ENERGY USE
IN IEA COUNTRIES


INTERNATIONAL ENERGY AGENCY
Oil
Crises &
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30 Years
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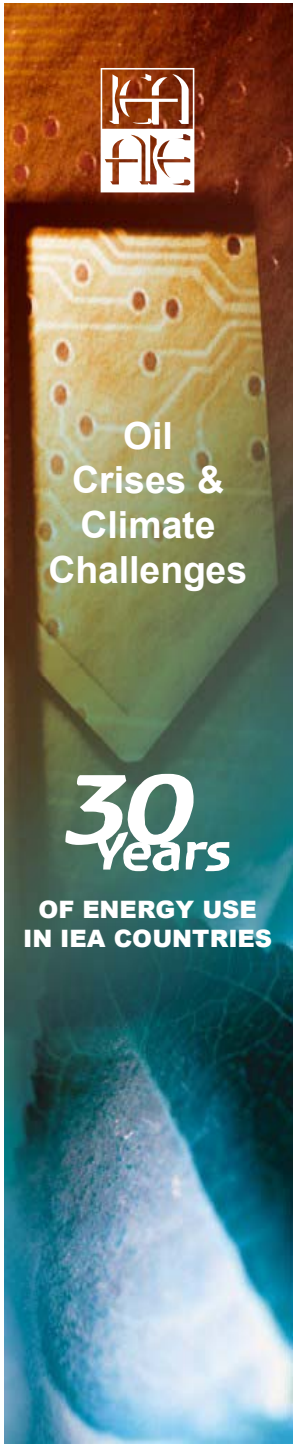
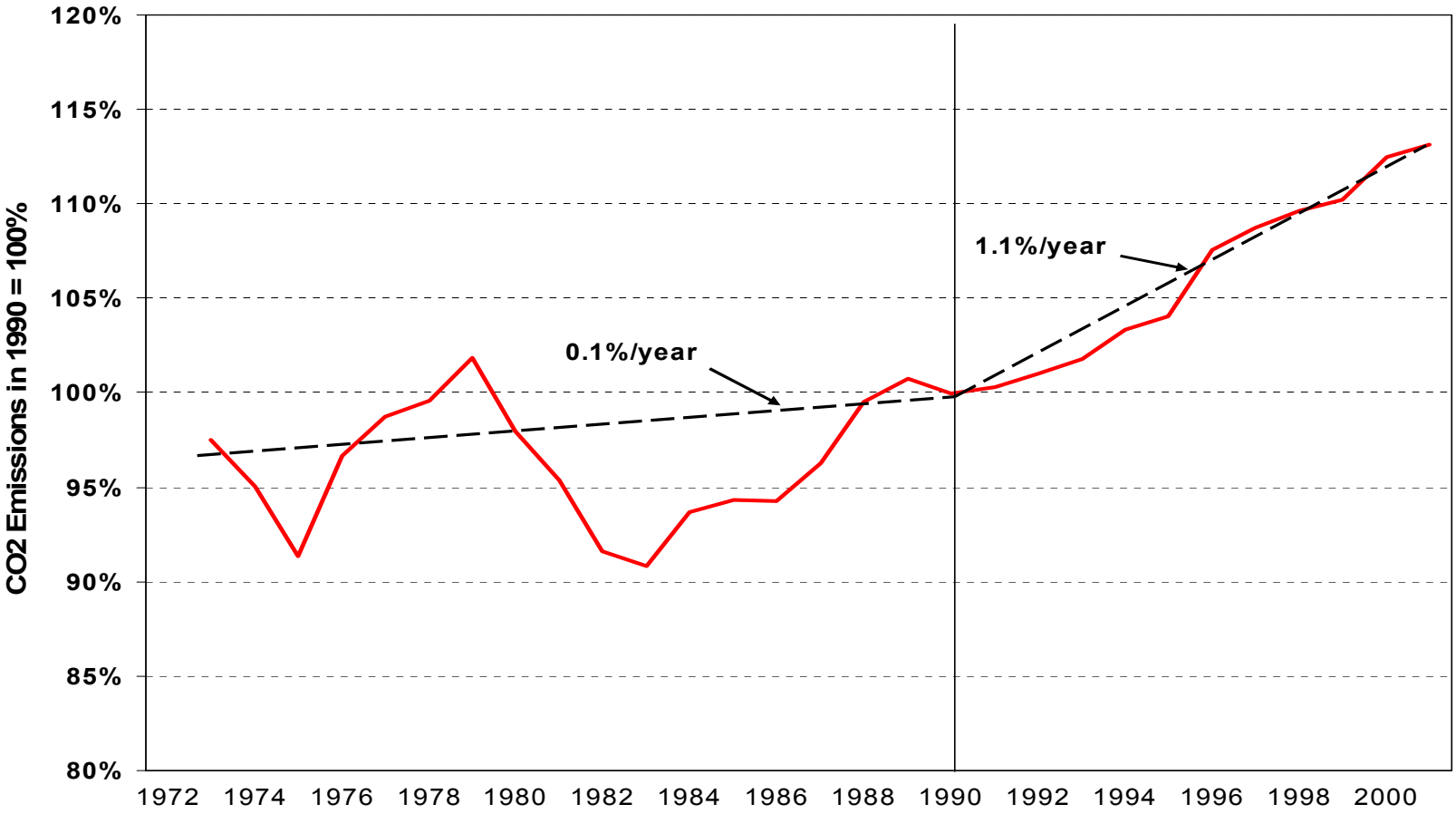
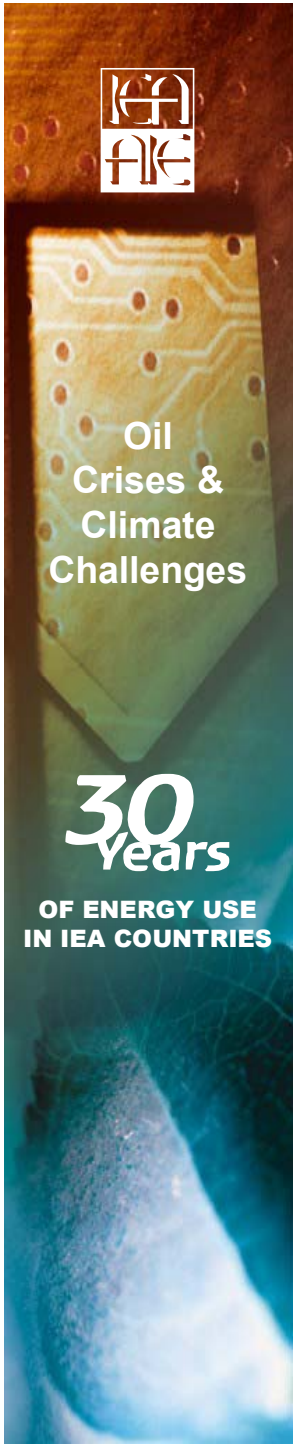
IN IEA COUNTRIES
OECD



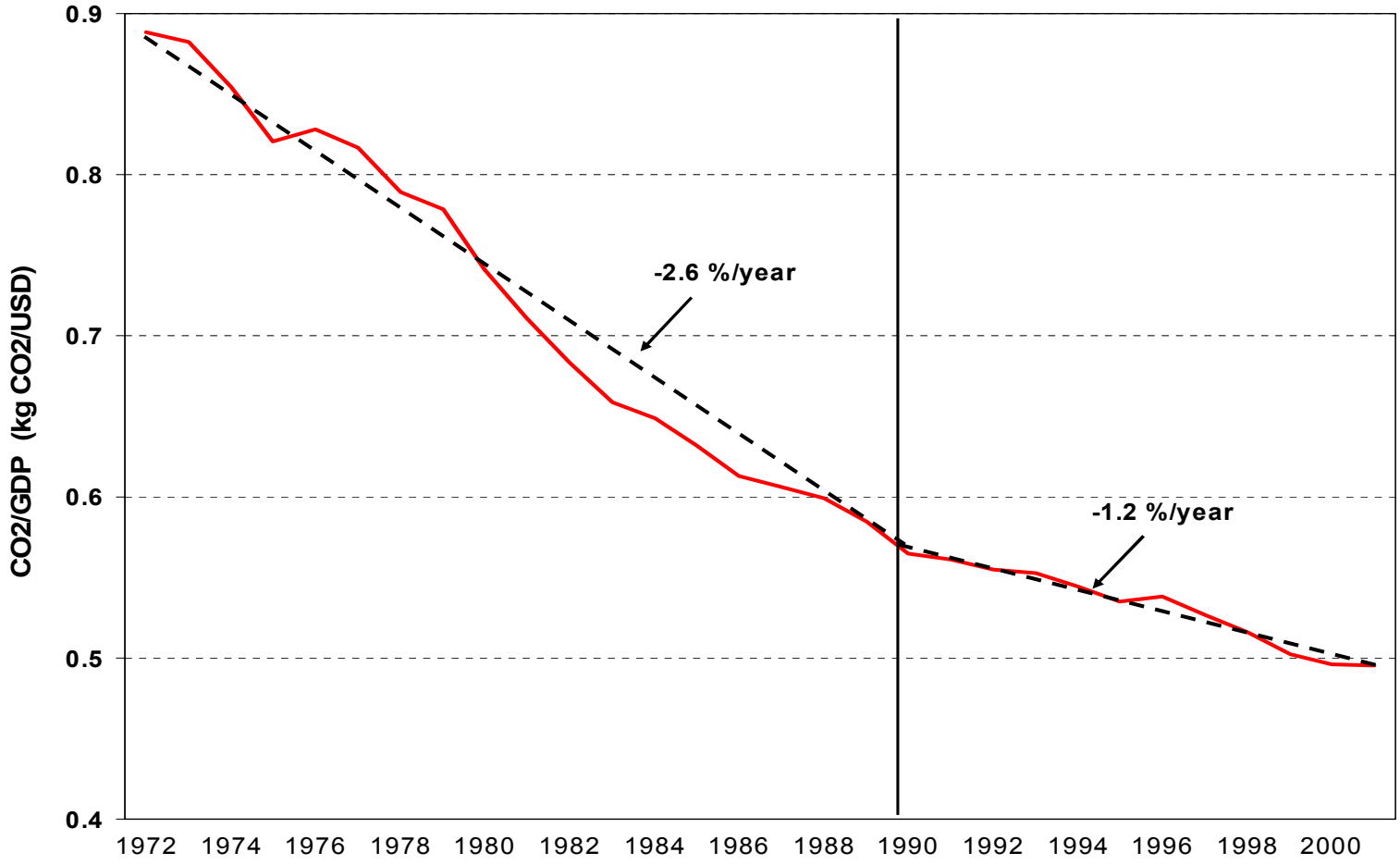
IEA CO_2 Emissions 1973 - 2001



Recent trends show steady increase

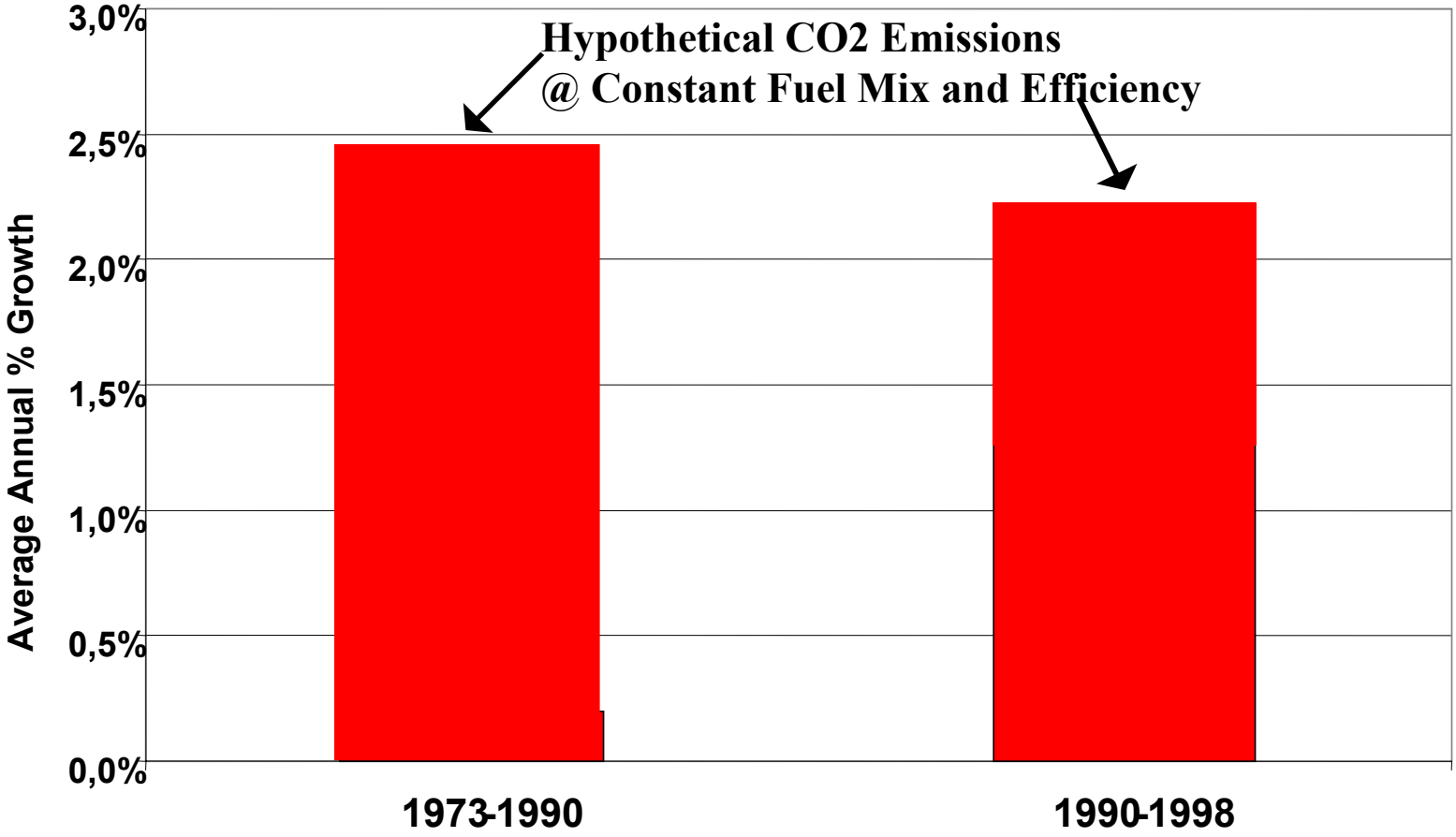


IEA CO_2 Emissions per GDP
1973 - 2001

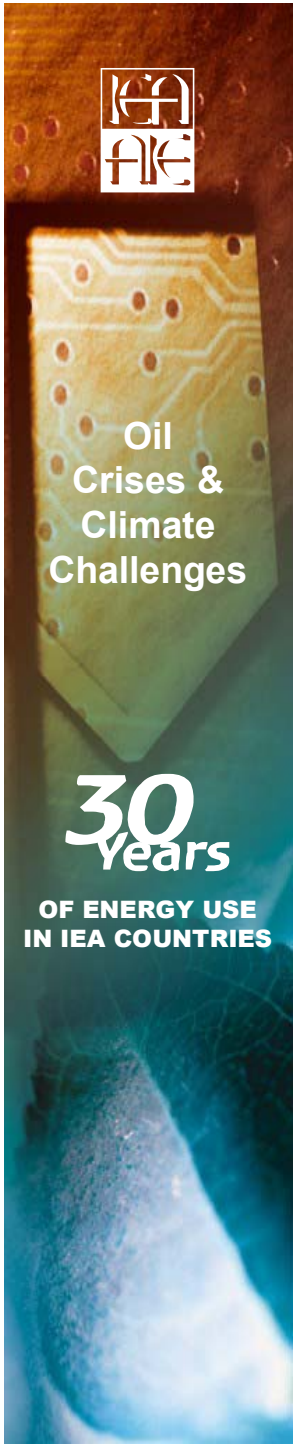


Rate of decline has slowed since 1990

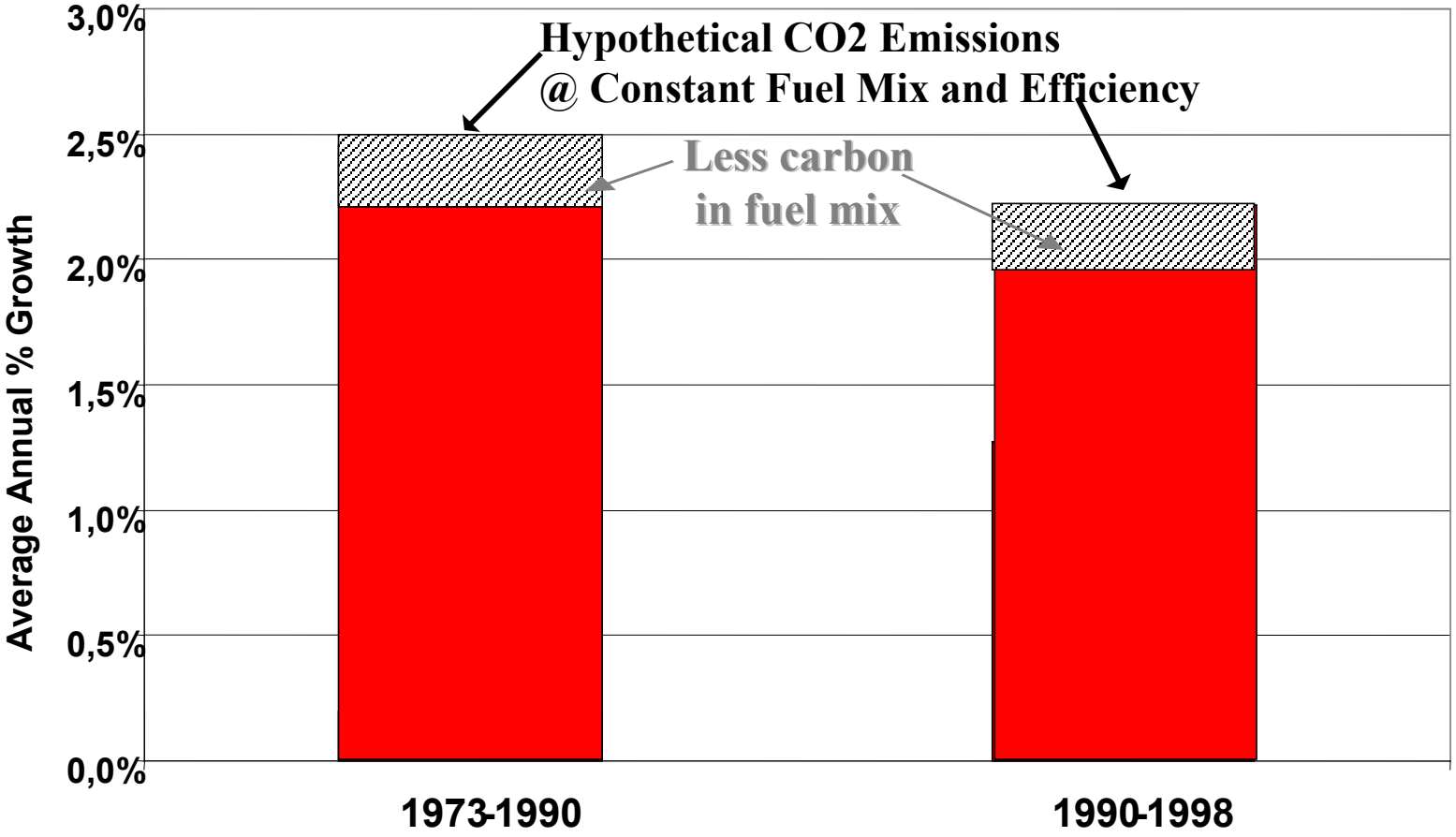
IEA-11 CO_2 Emissions Technology Frozen at 1973-level



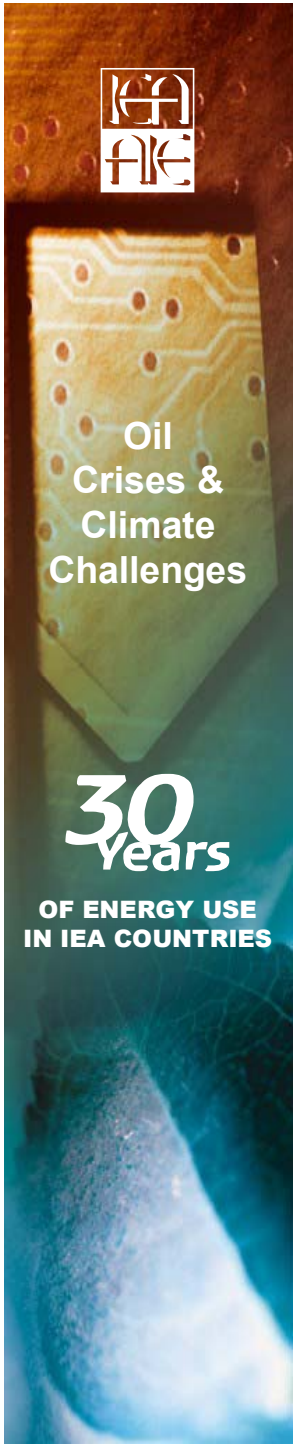
Without changes in fuel mix and energy efficiency emissions would have increased 2.2-2.5%/year



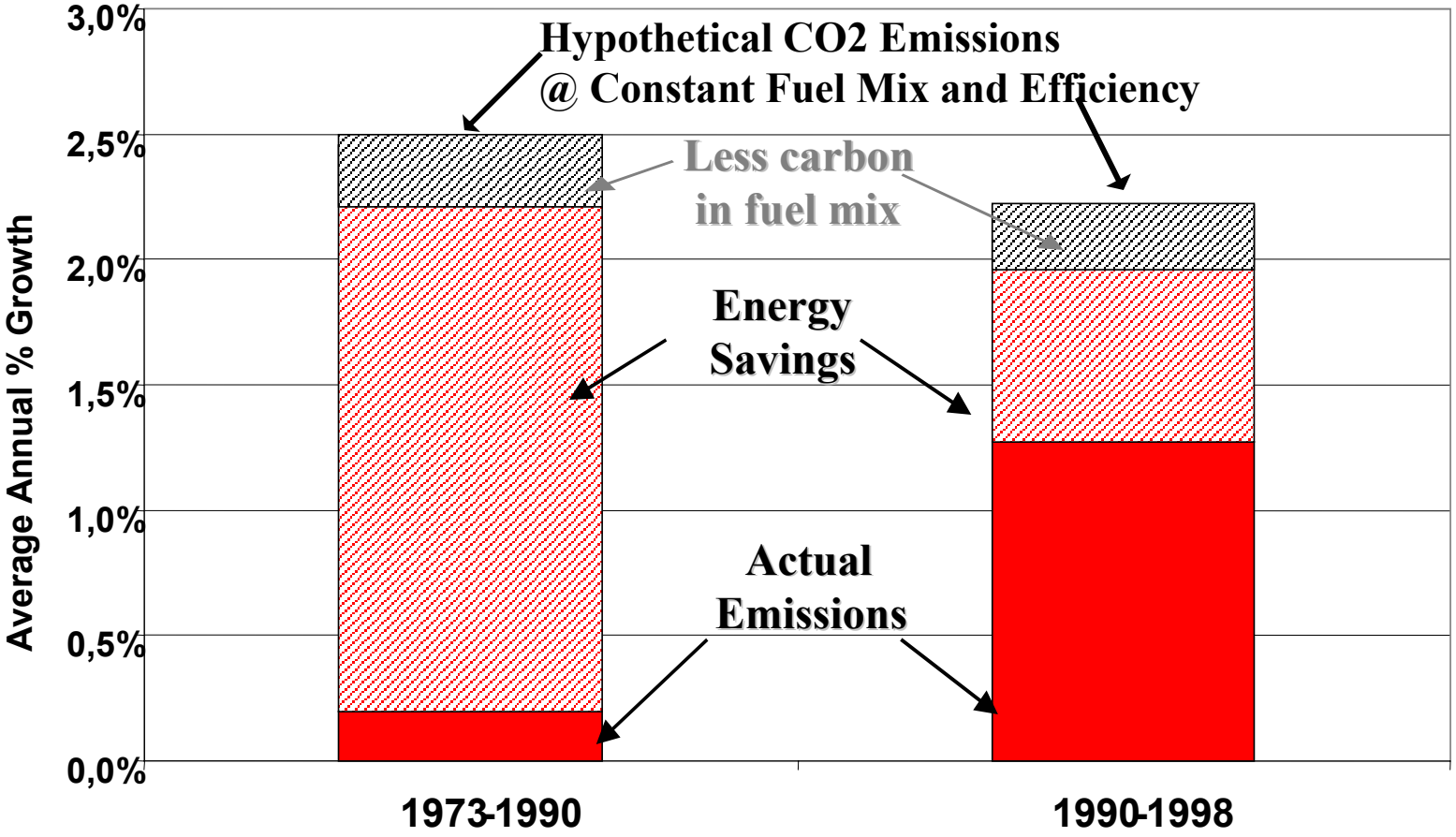
IEA-11 CO_2 Emissions
Impact of Changes in Fuel Mix



Changes in supply and end-use fuel mix moderated growth in emissions by 0.5%/year



IEA-11 CO_2 Emissions
Impact of Fuel Mix & Energy Savings



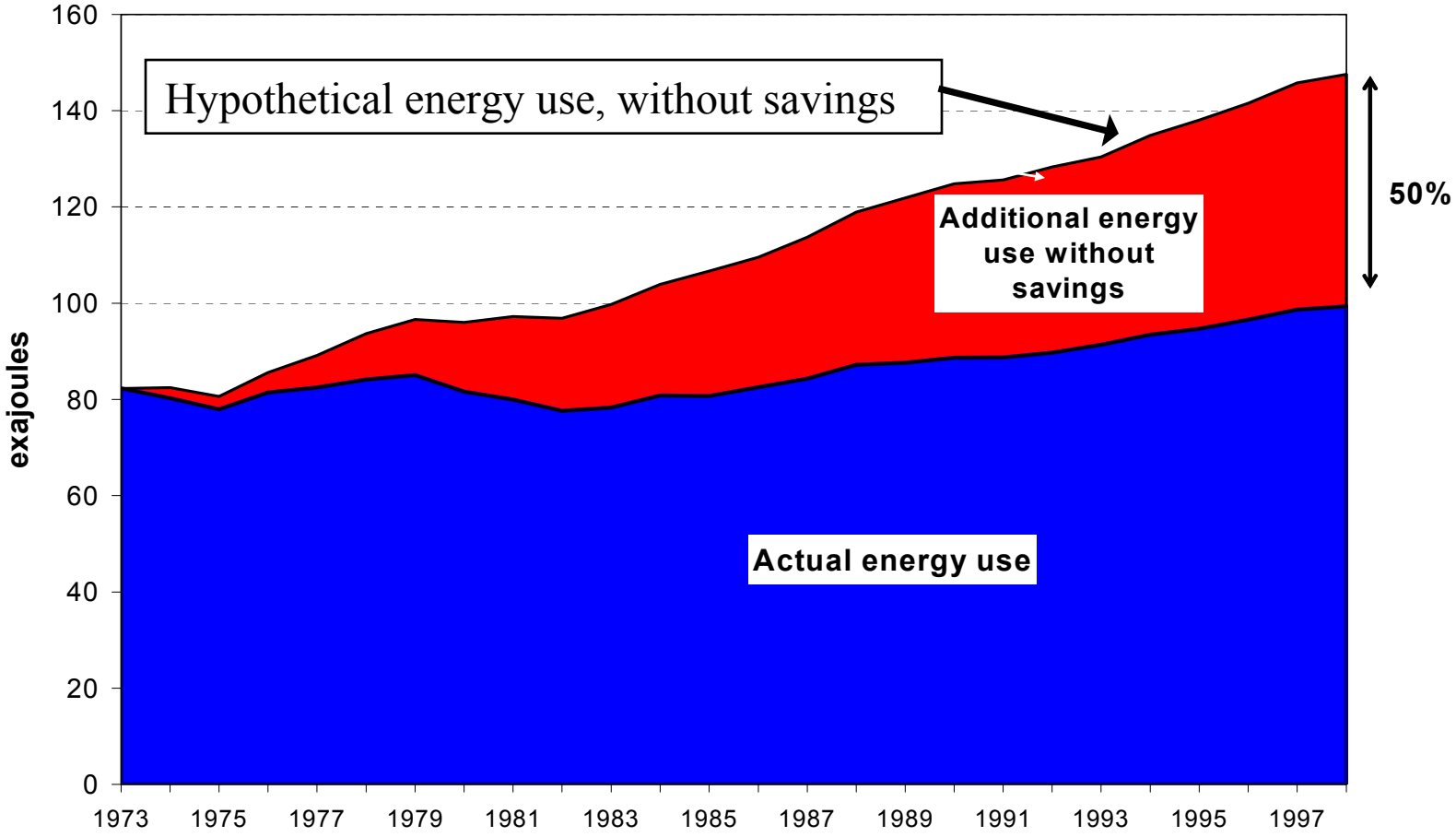
Slowing energy savings rates primary reason for accelerated growth in emissions after 1990

Oil Crises & Climate Challenges

30 Years

OF ENERGY USE IN IEA COUNTRIES

Energy Savings: The Most Important Fuel



Without energy savings achieved since 1973 energy demand in 1998 would have been 50% higher

Future Outlook:

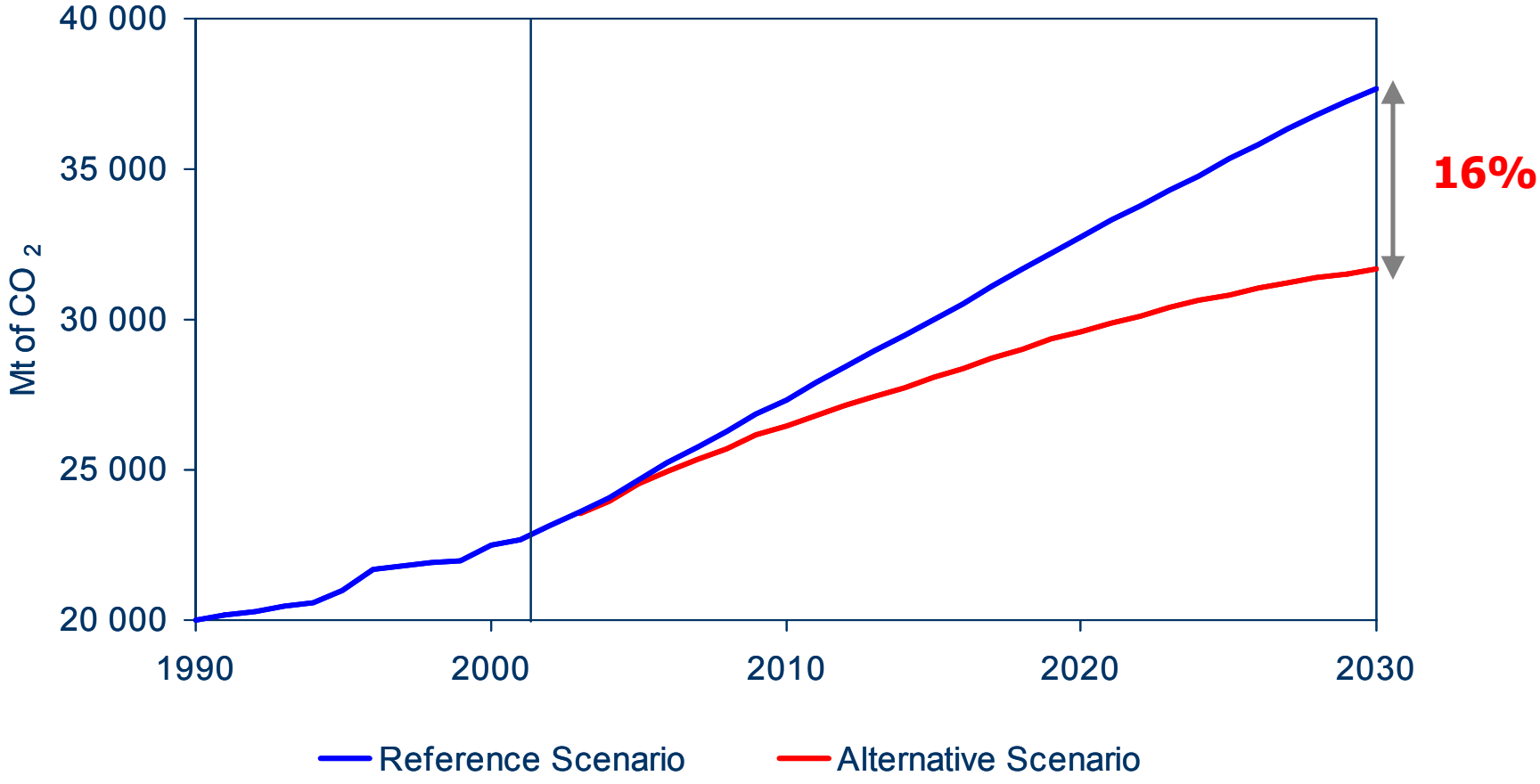
Energy Technology Perspectives

Scenarios and Strategies to 2050

Energy Technology Perspectives (ETP)

- Investigating the role energy technologies can play in long-term energy markets
- Contributes to the IEA response to the G8 Plan of Action *("Advising on scenario strategies aimed at a clean, clever and competitive energy future")*

Global CO_2 Emissions in the WEO 2005 Reference & Alternative Scenarios



CO2 emissions are 16% less in the AS in 2030 but still up more than 50% from 1990-levels

More is Needed....

- *Global Energy Technology Perspectives* will look further and investigate how technologies can help changing the energy future
- *Covers both demand side;*
  - *transport*
  - *buildings*
  - *industry*
- *and supply side;*
  - *renewables*
  - *Carbon Capture and Storage*
  - *nuclear*
  - *hydrogen*

ETP 2006 Focus

- Status and perspectives for key energy technologies in different sectors
- Global scenario analysis to illustrate how technologies can make a difference out to 2050
- Technology Strategies:
  - How much can different technologies deliver?
  - By when can they deliver?
  - What barriers have to be overcome to make them deliver both in the short term and over the next 3-5 decades?
  - Pathways to overcome barriers

Outline of Book

Part I Potential for Energy Technology to Impact the Global Energy Economy to 2050

1. Overview
2. Scenarios to 2050: Energy Demand, Supply and CO_2 Emissions
3. Technology Strategies for a Clean, Clever and Competitive Energy Future

Part II Energy Technology Status and Outlook

4. Electricity Generation Technologies
5. Building and Appliance Technologies
6. Industry Technologies
7. Road Transport Technologies and Fuels

Scenario Analysis

- Scenarios analysed:
  - Baseline, building on WEO Reference Scenario
  - Accelerated Technology Scenarios (ACT)
- Analytical framework
  - ETO's ETP model (global multi-region energy technology model based on cost optimization)
  - Supplemented with new improved versions of demand side models developed in collaboration with EAD/LTO for WEO
  - Technology data collected and assessed in previous IEA projects on CCS, hydrogen and fuel cells, renewables and efficiency

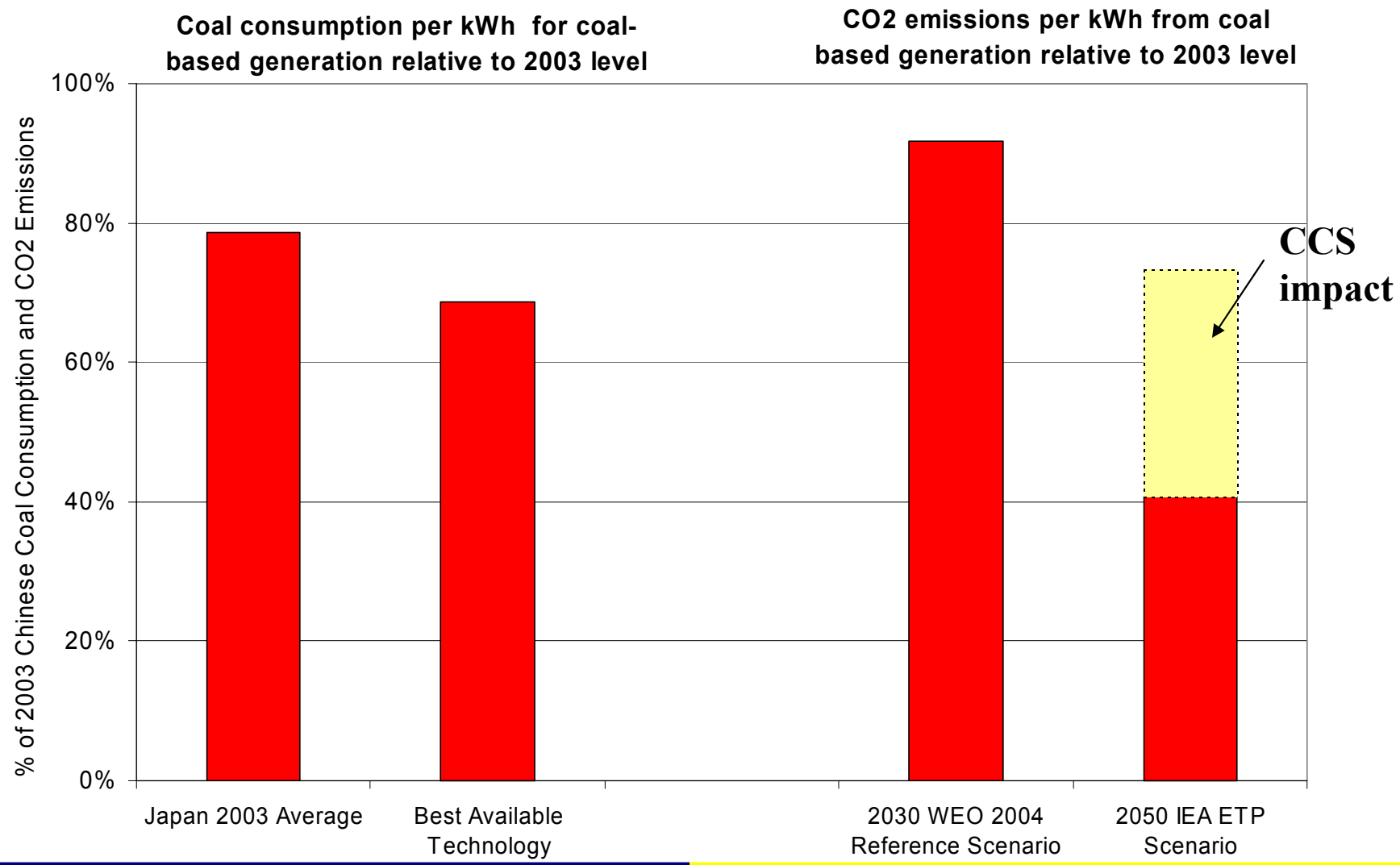
Accelerated Technology Scenarios (ACT)

- A family of scenarios to demonstrate how technologies that are already commercial or under development can help towards a sustainable energy future
- All scenarios analyse the impact from measures to accelerated R&D, demonstration and deployment efforts as well as measures aimed at giving incentives for low-carbon technologies
- The scenarios differ in terms of assumptions for nuclear, CCS, renewables, advanced biofuels, hydrogen fuel cells and energy efficiency progress

Draft Key Messages

- We can depart from our current unsustainable energy path
- By using a portfolio of current and emerging technologies the world can enhance energy security, stimulate economic growth and avert the trend of increasing CO_2 emissions
- The most important technologies and practices are;
  - Improved energy efficiency;
  - Clean coal with CCS;
  - Renewables, including biofuels
  - Nuclear
  - Efficient use of natural gas
  - Hydrogen and fuel cells
- A lot can be done even if certain key technologies would not deliver and more can be achieved if R&D efforts succeed with technologies such as hydrogen-fuel cells and advanced biofuels
- Urgent action is needed to unlock the potential of existing technologies and ensure that new are developed

Example of the Analysis:
Opportunities for Energy Efficiency and CO2 Emissions:
Coal Fired Electricity Generation in China

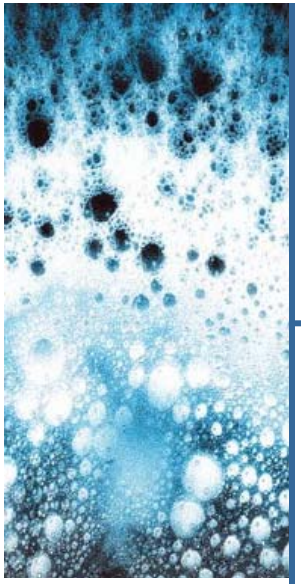


Energy Technology Perspectives
Scenarios and Strategies to 2050

NEW IEA PUBLICATION
May 2006

Extra slides:

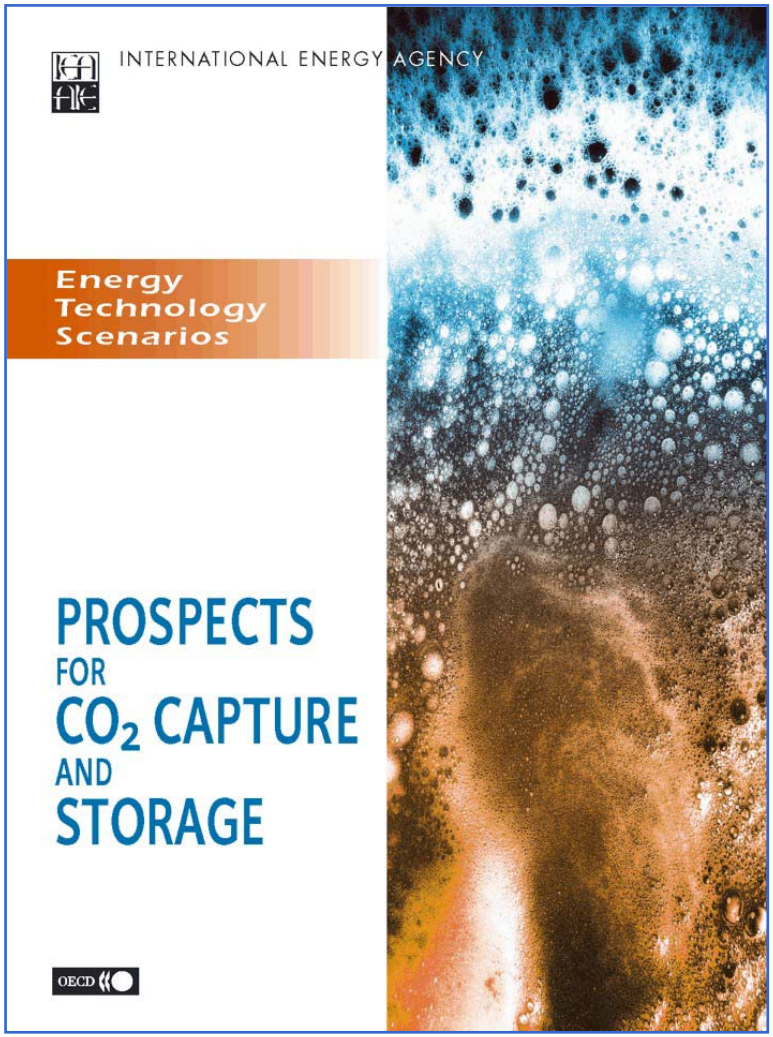
Examples of past IEA Technology Scenario Work

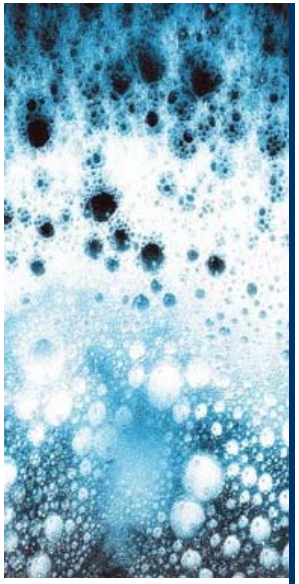


PROSPECTS
FOR
CO_2 CAPTURE
AND
STORAGE

Prospects for CO_2 Capture and Storage

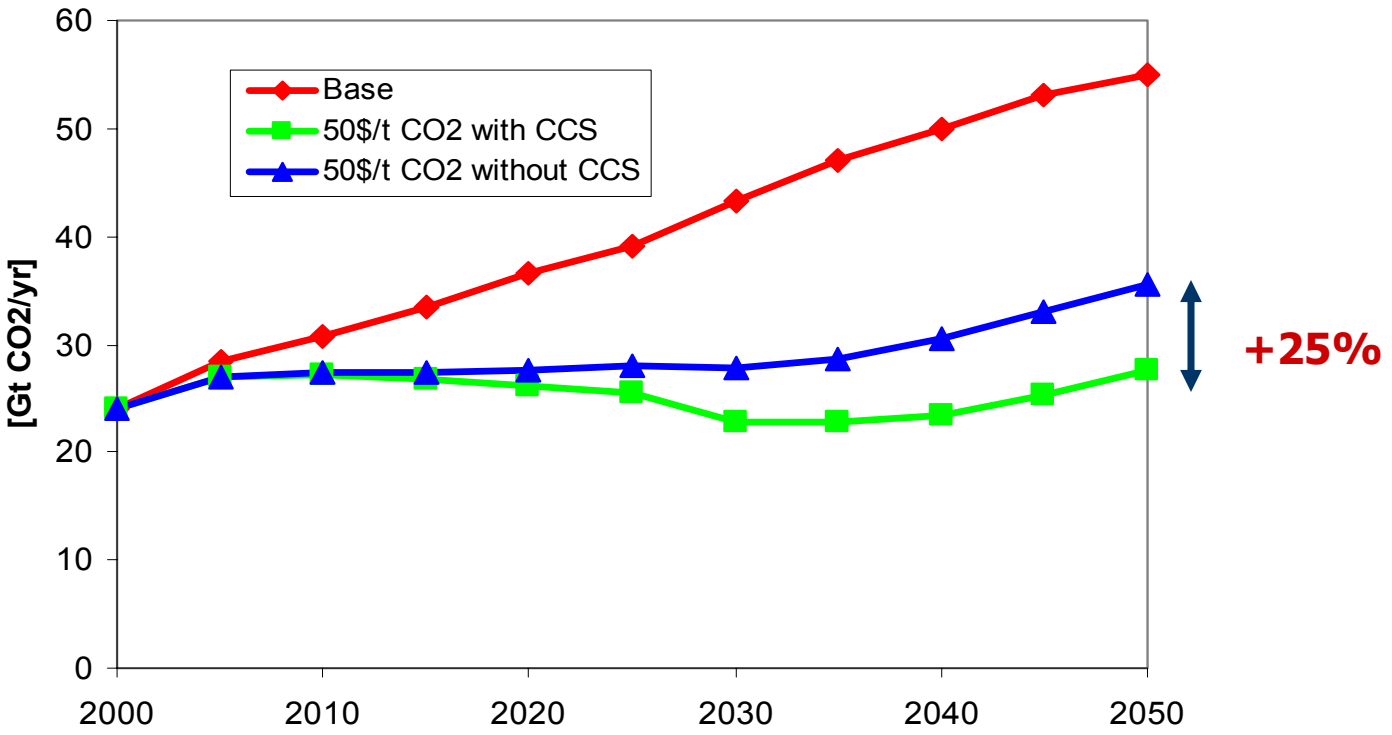
- Technology status report
- CCS prospects – scenario analysis
- RD&D and policy challenges





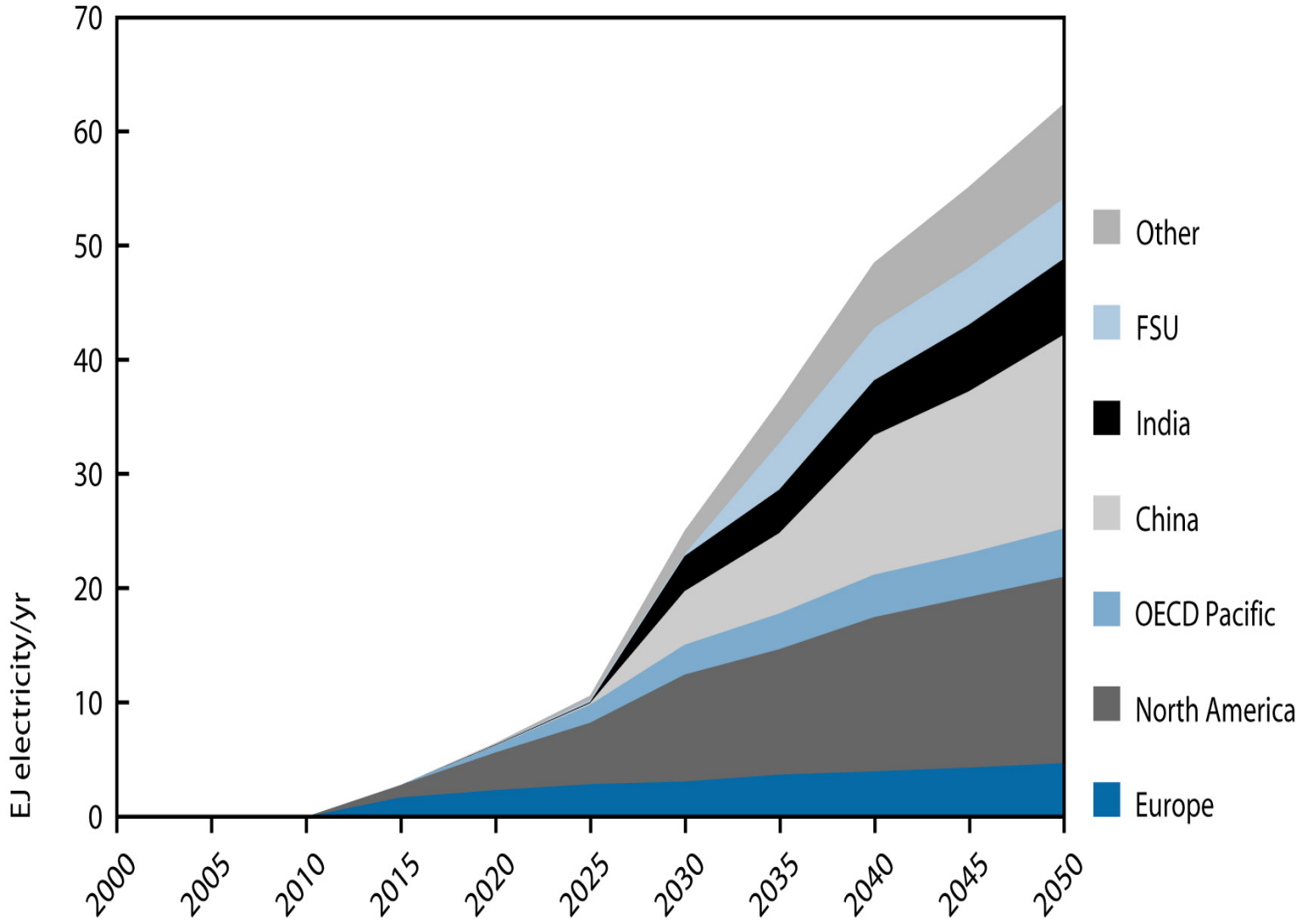
PROSPECTS
FOR
CO_2 CAPTURE
AND
STORAGE

Results of model analysis: Annual emissions with 50 $/t CO_2 penalty with and without CCS



50$/t CO2 : 2050 emissions would be 25% higher in absence of CCS

Electricity production from power plants fitted with CCS, by region 50$/t CO2

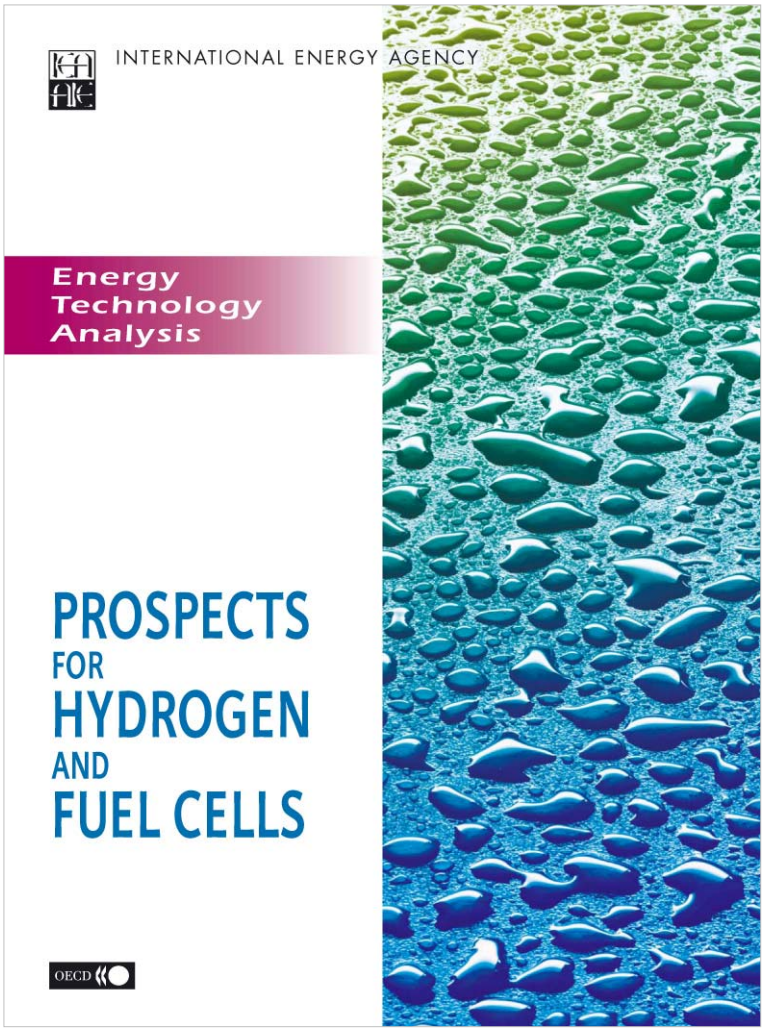


PROSPECTS FOR CO_2 CAPTURE AND STORAGE

Prospects for H_2 and Fuel Cells

An analysis of H_2/FC potential using the IEA ETP model (scenarios to 2050)

Published December 2005



H_2/FC vehicles in transport if ...

- Decisive policies for reducing emissions and oil use
- Substantial advances in fuel cells, H_2 on-board storage, H_2 distribution systems, CO_2 capture & storage
- Hydrogen cost can be reduced 3-10 time and fuel cell cost can be reduced 10-50 time

Under these conditions …

- H_2/FC would enter the market in 2020-2025 and power up to 30% of vehicles by 2050 (700 mill cars), using less than 3% global energy, saving 13% oil import
- Along with other emerging technologies, H_2/FC could help halve global CO_2 emissions by 2050

With less favorable conditions …

(if no decisive policy to curb emissions, or insufficient cost reduction and technology advance …)

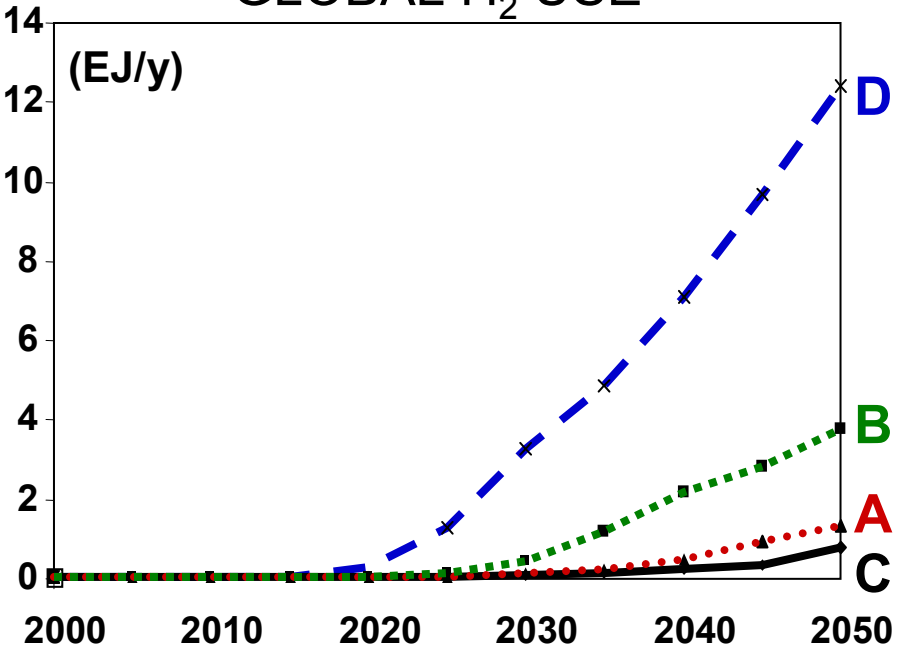
H_2/FC vehicles are unlikely to reach the critical mass needed for market uptake

and

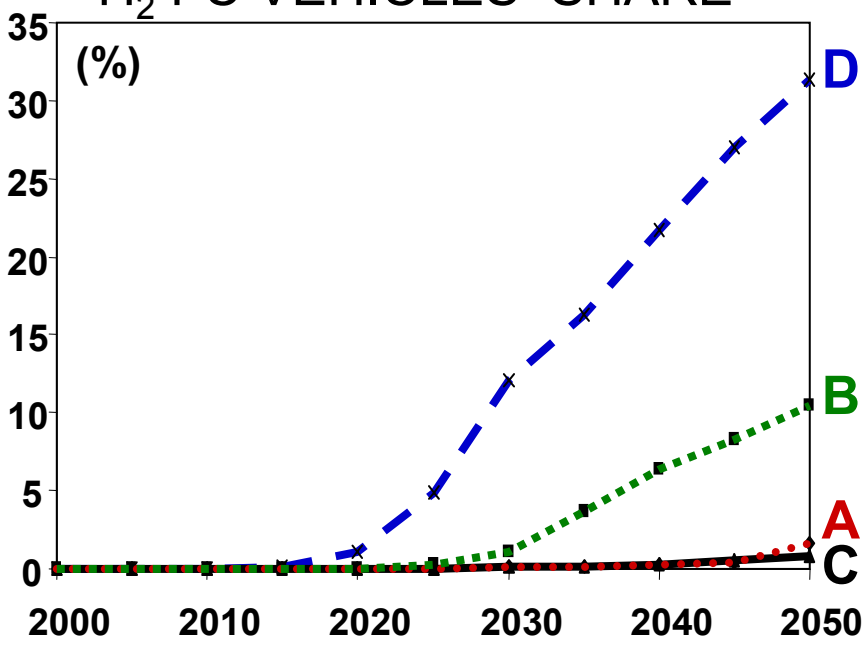
other technologies (synfuels, biofuels) may gain market share.

Market Scenarios

GLOBAL H_2 USE



H_2 FC VEHICLES SHARE



A - Weak CO_2 policy and tech. development

B - Strong CO_2 policy in Kyoto countries and tech. development

C - Strong CO_2 policy in Kyoto countries and tech. lag

D - Strong CO_2 policy world wide and tech. development

Up to 30% H_2 fuel cell vehicles by 2050