

# Medium- to longterm Energy Perspectives: Sustainable Energy Systems and the future role of Hydrogen

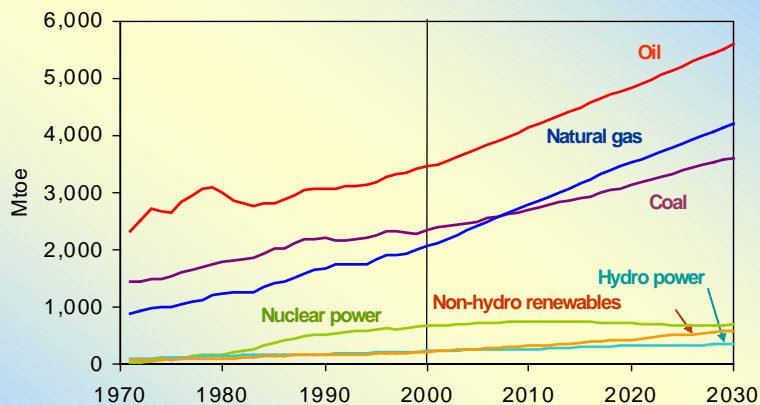
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**Director, IEA**

«Hydrogen- and Fuel Cell Based Energy Systems  
In a Future Sustainable Energy World »

Vienna; March 31 – April 1, 2004



## World Primary Energy Demand 1970-2030

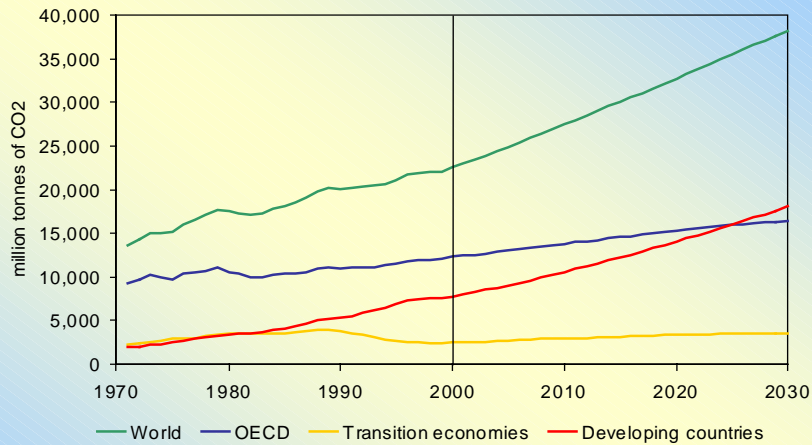


**Gas grows fastest in absolute terms & non-hydro renewables  
fastest in % terms, but oil remains the dominant fuel in 2030**

Source: IEA World Energy Outlook, 2002



## Energy-Related CO<sub>2</sub> Emissions



**World emissions increase by 1.8 % per year to 38 billion tonnes in 2030 – 70% above 2000 levels**

Source: IEA World Energy Outlook, 2002



## Transition to Sustainable Energy System

- **Policies Matter**
  - Global and local
  - Cost effective, predictable, flexible
- **Technologies Matter**
  - Current technologies do not meet energy security and environmental challenges at reasonable cost
  - Need to expand technology frontier
- **Energy Security and Access Matters**
  - Affordable, stable energy prices essential for economic growth



# Which Technologies ...

- Efficient Energy End-Uses;
- CO<sub>2</sub> Capture and Storage for Fossil Fuel Power Generation;
- Renewable Energies;
- Advanced Nuclear Power;
- Hydrogen for Transport, Energy Storage and Distributed Generation; and
- Fusion Energy... in a very long term



## Energy Efficiency Has A Key Role To Play, And Is Available In The Short Term



High performance buildings



Least life-cycle cost appliances



Labelling and certification

### Energy efficiency offers:

- **substantial energy and greenhouse gas savings at low or negative cost**
  - 470 Mt/y CO<sub>2</sub> in IEA region by 2020 in appliances alone
    - ◆ At negative cost: -€169/t CO<sub>2</sub> (IEA)
- **energy security and reliability benefits**
  - Up to 1.5 Gt/y C by 2010; 2.7 Gt/y by 2020
    - ◆ Half of this at negative cost (IPCC)
- **enhanced business competitiveness and social welfare**



Compact Fluorescent Lamps



LED traffic lights



Efficient information and communication technologies

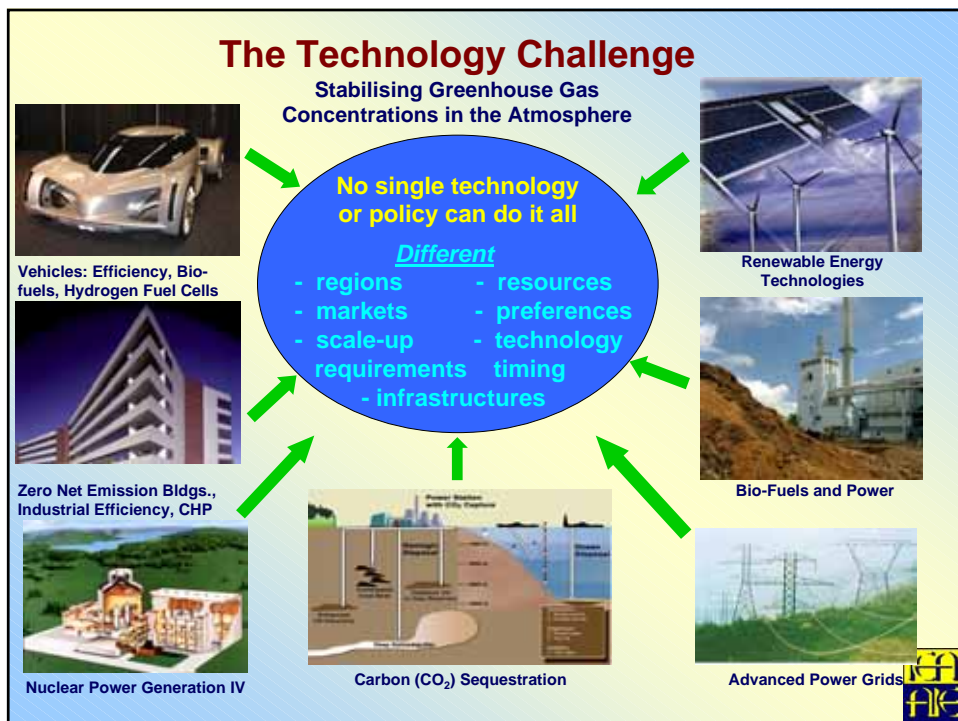


Reducing standby power consumption



Super windows & daylighting





- ## What Actions
- Spur investments in clean energy technology
  - Support underlying basic sciences R&D
  - Harmonize energy technology policies and exploit synergy of the international co-operations
-

## What lessons from the past ...

- Reducing CO<sub>2</sub> emissions will not be free even with the benefits of advanced technologies;
- Learning-by-doing will require societal technology investments to reduce cost;
- Energy policies and real governmental commitment will be needed to achieve uptake of advanced technologies;
- Governments should not “pick winners“ but identify and support technology priorities.



## International H<sub>2</sub> & FC Collaboration

### National Programs Federal & Local

- US: \$1.7 B for a 5 years
- EU: up to €2 B in the 6<sup>th</sup> FP on renewables and H<sub>2</sub>/FCs
- Japan: R&D budget tripled since 1990
- Other committed countries: Australia, Brazil, Canada, China, France, Germany, Iceland, India, Italy, Korea, Russia, UK ...

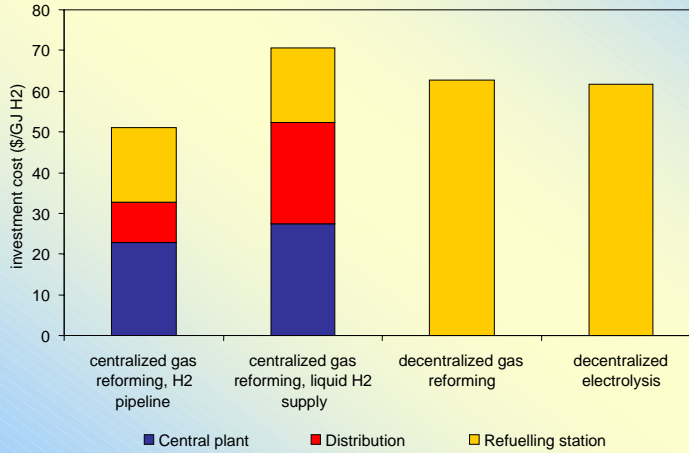
### International Collaborations

- IEA Hydrogen Co-ordination Group
- IEA Implementing Agreements
- US International Partnership on Hydrogen Economy (IPHE)
- EU Hydrogen & Fuel Cells Platform
- APEC Hydrogen Initiative
- Bilateral Agreements

### Industry



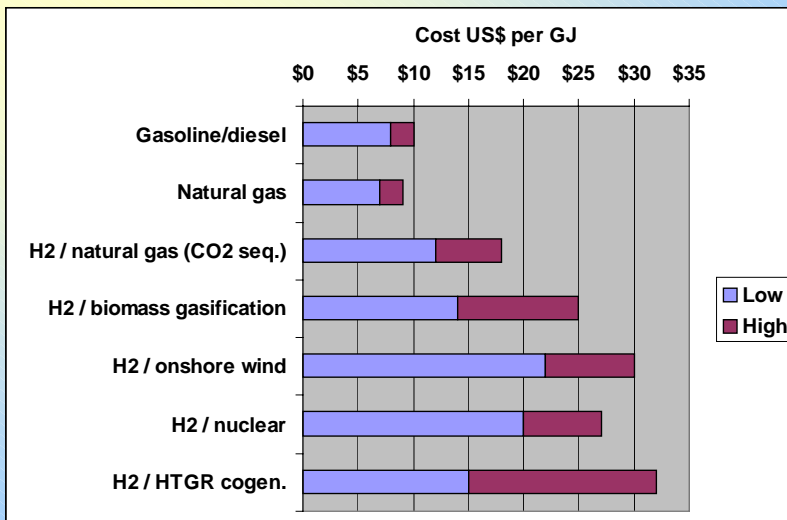
# Long-term Investment Costs of Alternative Hydrogen Production and Supply Systems



Source: IEA World Energy Investment Outlook, 2003



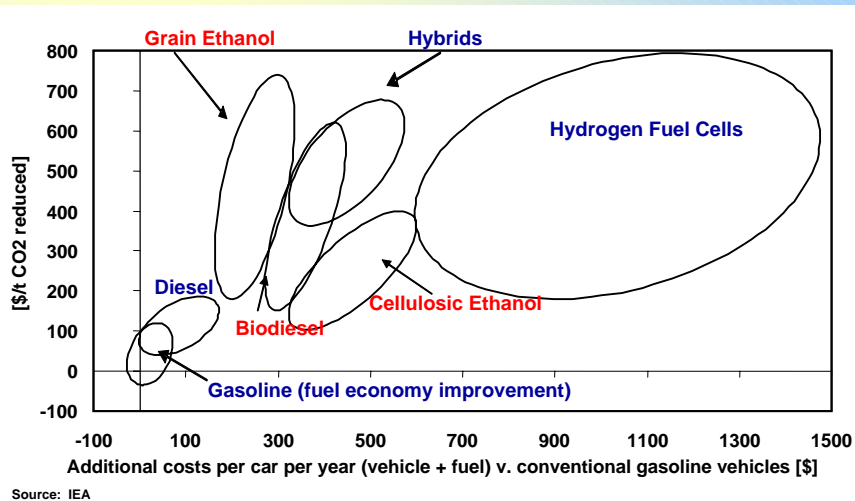
# Hydrogen Supply Costs



Source: World Energy Investment Outlook, IEA, 2003.



## CO2 Reductions and Cost: How do H2/FCs compare?



## The Challenge Ahead

- **Market competition** with other, cost effective technology options and measures to reduce emissions and enhance security;
- **Stationary Use:** **Cost and availability of CO<sub>2</sub>-neutral Hydrogen** (fossil fuels with CO<sub>2</sub> sequestration, renewables, nuclear?);
- **Mobile Use:** **Cost and availability of H<sub>2</sub> Infrastructure and FCV market** (chicken & egg);
- **Fuel Cell cost and lifetime.**

