EUROPEAN COMMISSION
Community Research

Overview of European R&D on Hydrogen and Fuel Cells: current activities and future prospects

"2005 DoE Hydrogen Program Annual Review"

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Angel PEREZ SAINZ
DG RTD Unit J-2
Energy Production and distribution Systems

European Commission

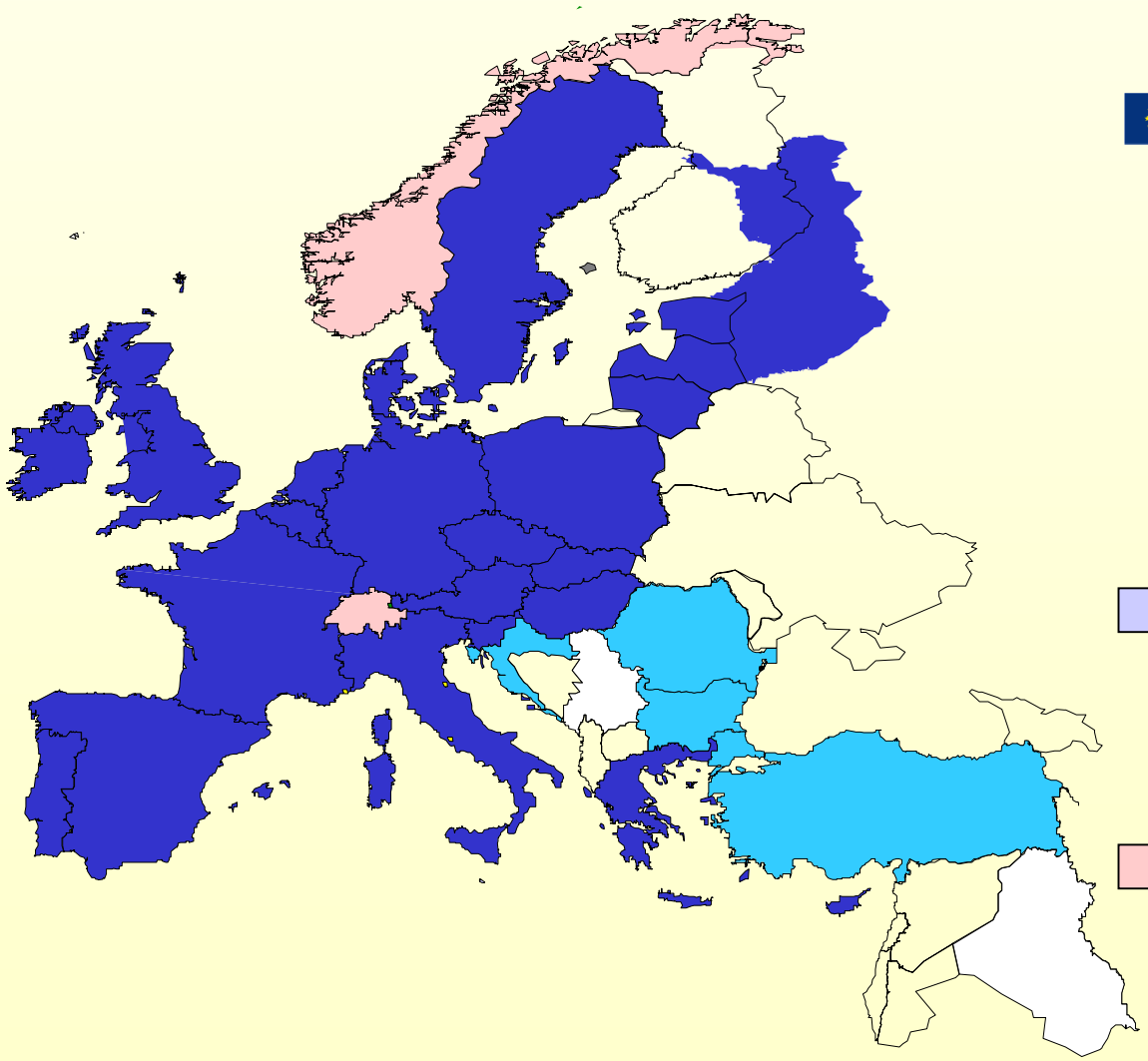
Presentation outline

- Introduction to the European Union (EU) and the EU Energy Policy context
- The 6th EU Framework Programme (FP6)
- A Strategy for Europe: The European Hydrogen and Fuel Cells Technology Platform
- Energy Research in the 7th EU Framework Programme (FP7): Joint Technology Initiatives

The European Commission

- The **European Union** (EU) is a treaty-based political association of European countries that defines and manages economic and political cooperation among its European member countries. From May 1st 2004, the EU includes 25 member countries and **450 million** people.
- The **European Commission** (EC) is the **executive arm** of the EU institutions and embodies the general interests of the EU. It proposes policies and legislation and implements the measures approved by the governments of the member states, which together constitute the European Council, and by the European Parliament.
- Its responsibilities include **policy areas** such as trade, competition, agricultural policy and economic development, but also research, public health and humanitarian aid.

Enlarged European Union



EU until 30 April 2004

- Austria
- Belgium
- Denmark
- Finland
- France
- Germany
- Greece
- Ireland
- Italy
- Luxembourg
- The Netherlands
- Portugal
- Spain
- Sweden
- United Kingdom

Since 1 May 2004:

- Cyprus
- Estonia
- Hungary
- Latvia
- Lithuania
- Malta
- Poland
- Czech Republic
- Slovenia
- Slovakia

Candidate countries:

- Bulgaria
- Croatia
- Romania
- Turkey

European Economic Area:

- Iceland
- Norway
- Switzerland

The EU's «Institutional Triangle»

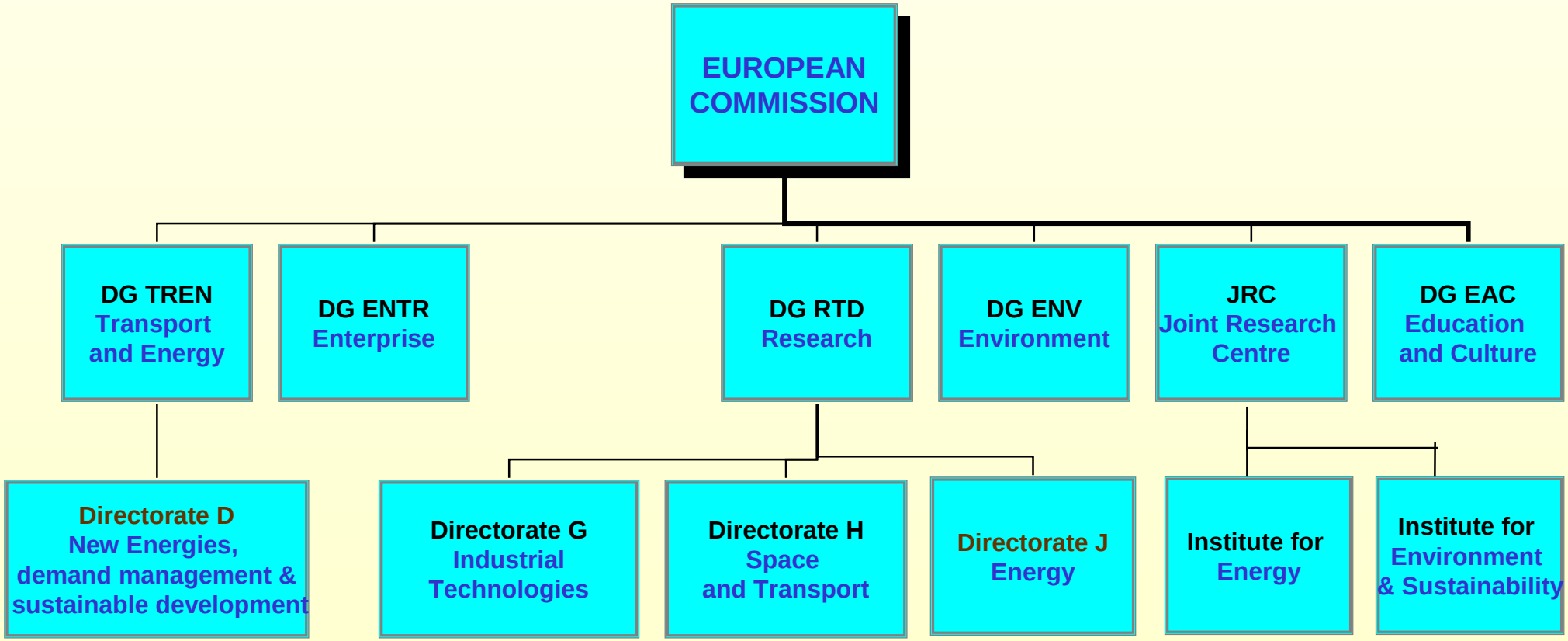
Proposes and implements legislation

Governments of the 25 states

Jointly decide on legislation

Directly elected

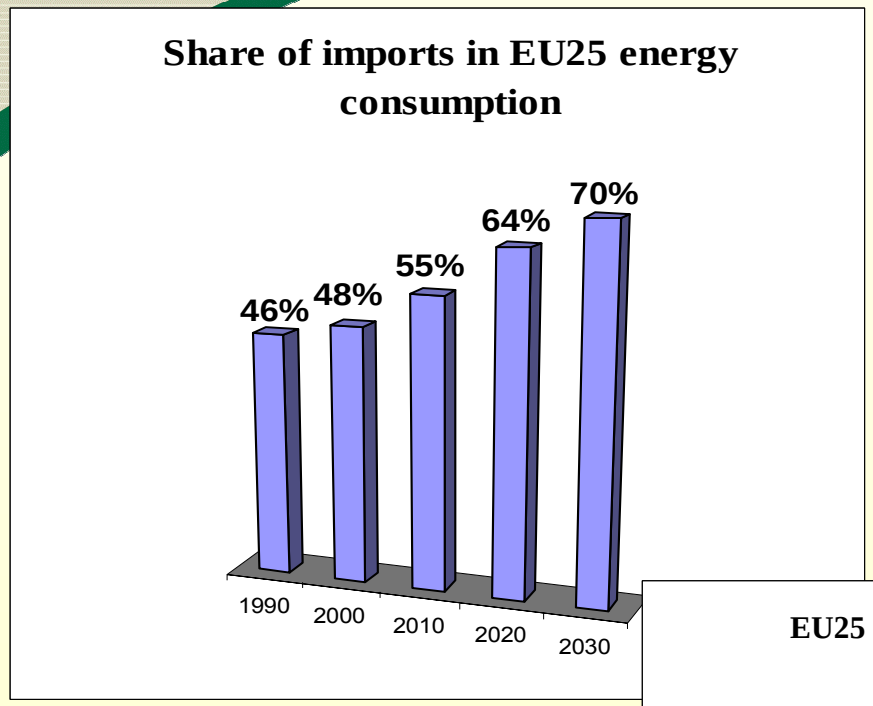
Main EC DGs with responsibilities on Hydrogen and Fuel Cells Projects

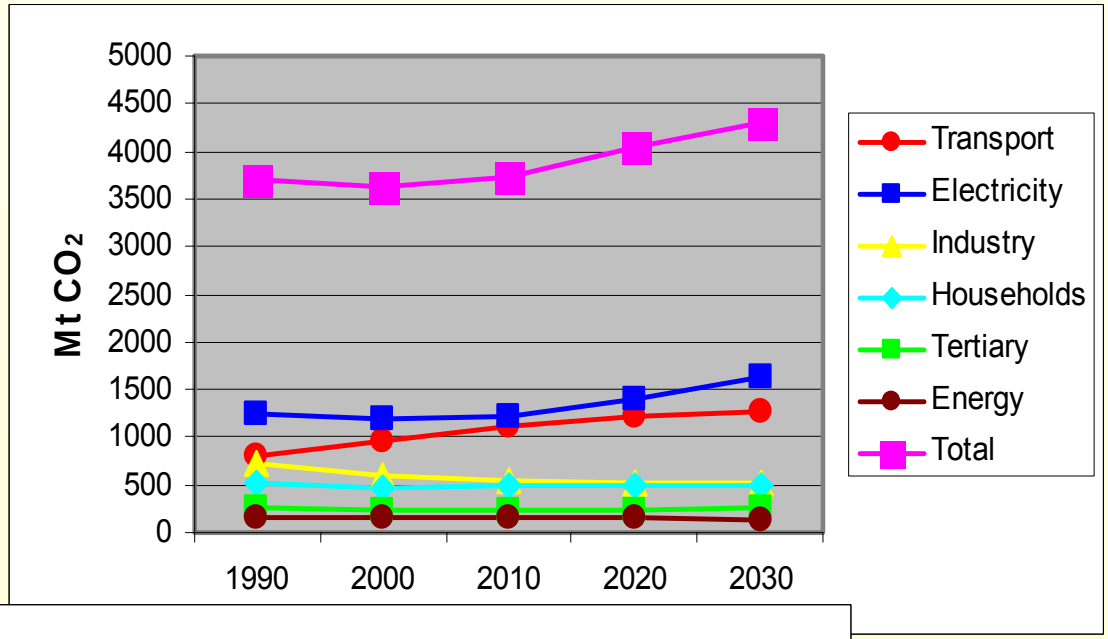


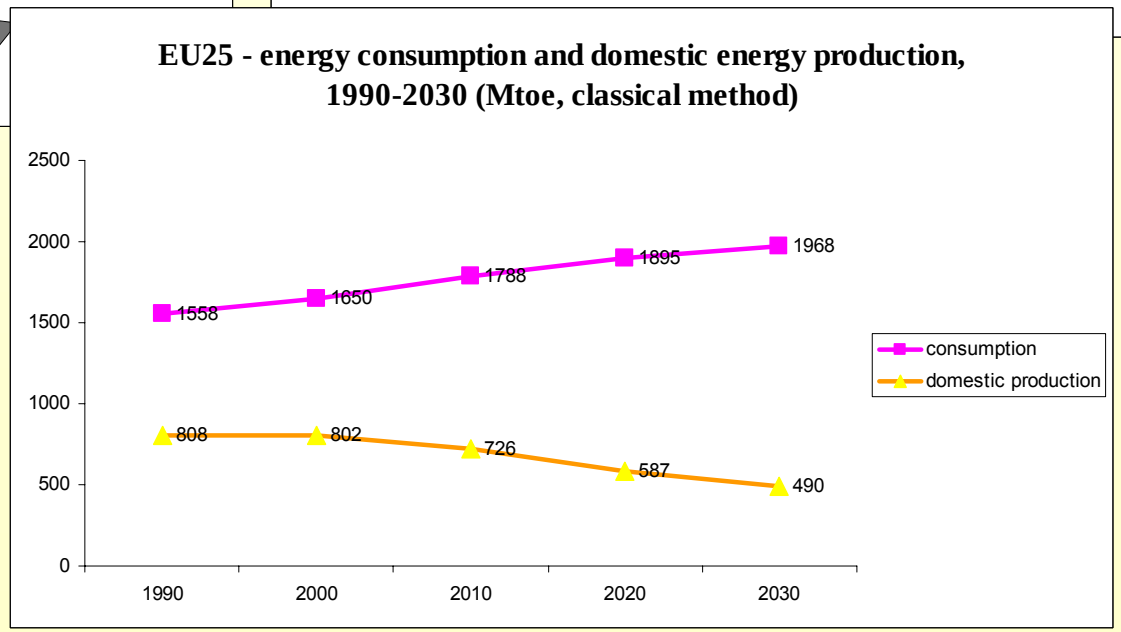
EU Policy Context

- Security of EU energy supply
- Reduction of EU greenhouse gases and pollutant emissions (Kyoto and beyond)
- Improve energy efficiency, reduce energy intensity
- Increase share of renewable energy
- Improve EU industrial competitiveness

EU energy policy context





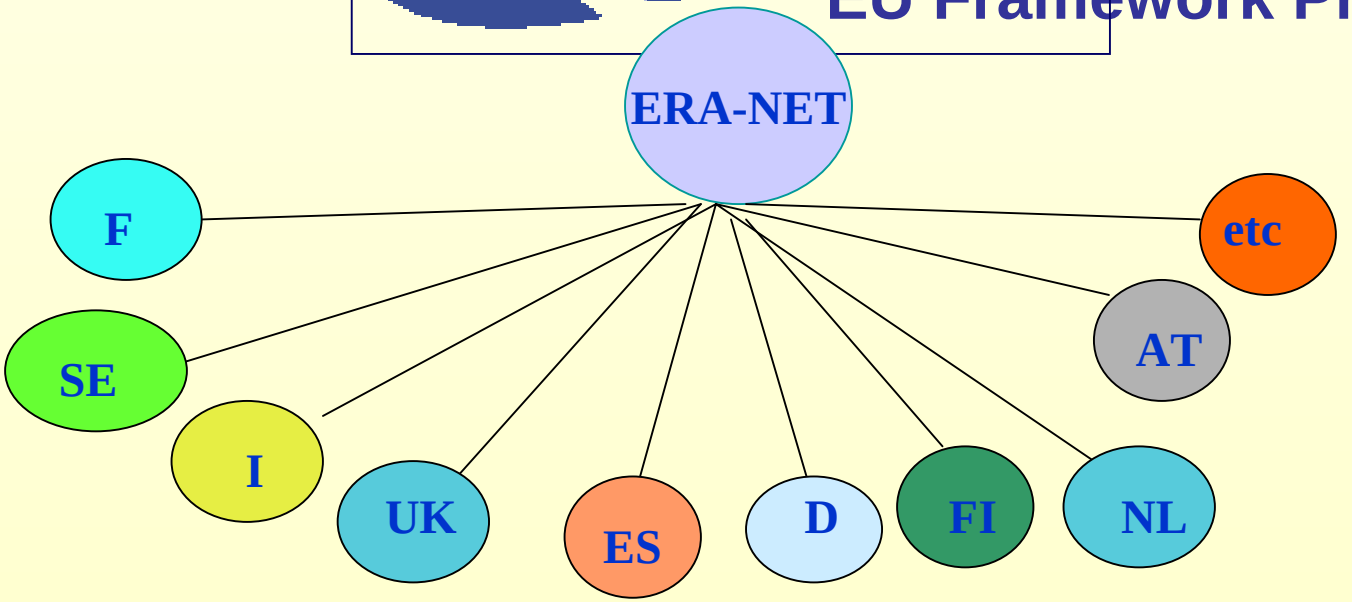


Public funding of RD&D in Europe

- RD&D on H2/FC activities in Europe is funded at different levels: EU, national and regional.
- The main instrument for EU funding is the RD&D Framework Programme (FP).
- The overall public budget of EU national and regional programmes is estimated to be more than 160 Mio € per year; industry budgets are even larger.
- Up to recently the EU R&D efforts were dispersed, fragmented and lacking a clear overall common strategy.

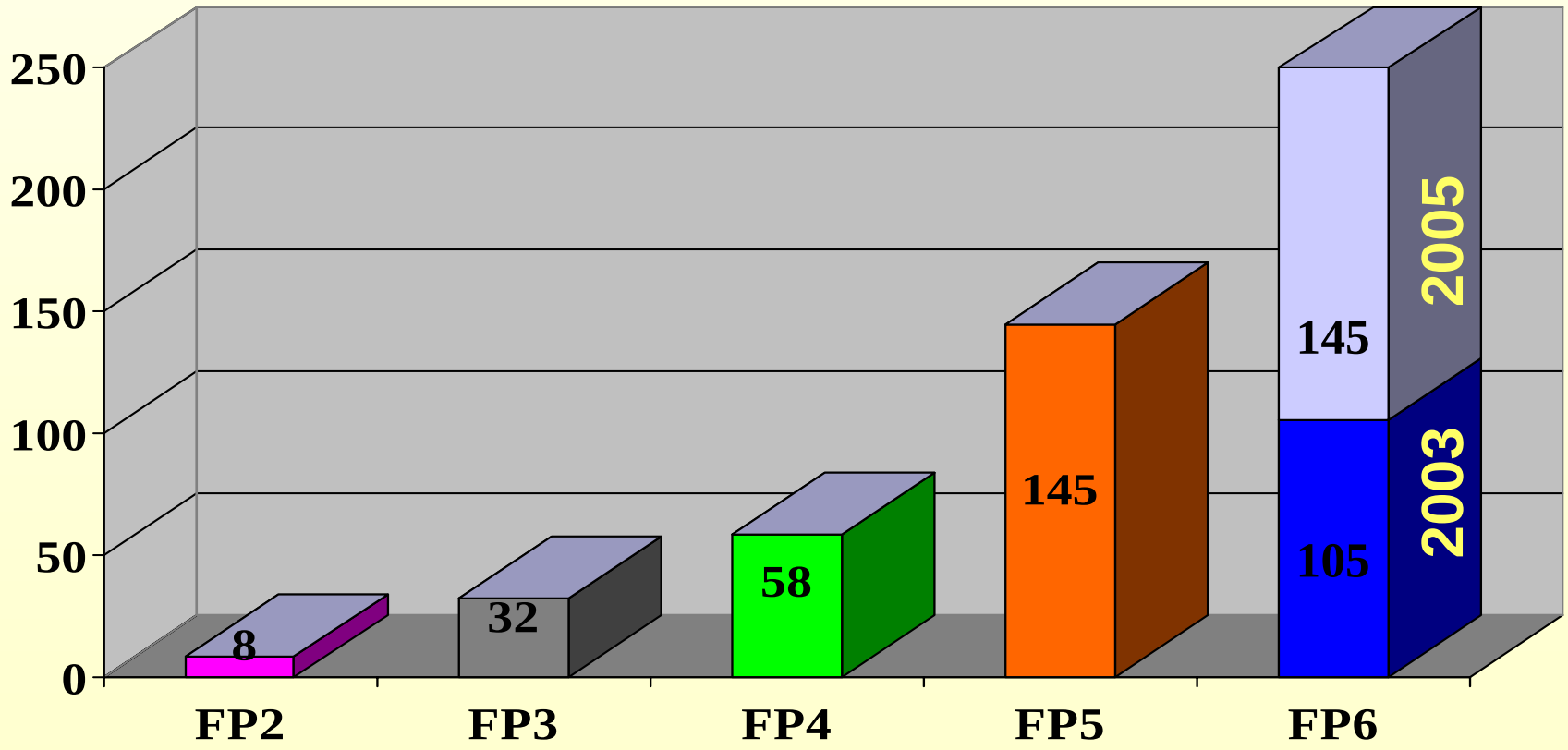
Current RD&D structure in Europe

EU Framework Programme



National Programmes

EC Support to Fuel Cell and Hydrogen R&D in Framework Programmes



EC contribution to FP6 Projects

	AREA	EC funding (M€)
HYDROGEN	Production	41.33
	Storage	20.8
	H2 distribution	11
	H2 end use (ICE)	5
CROSS - CUTTING	Safety, Regulations, Codes & Standards	13.6
	Pathways and roadmaps	16.17
	Socio-economy	7.07
FUEL CELLS & APPLICATIONS	High Temp. FC Long Term R&D	16.1
	Low Temp. FC Long Term R&D	13.3
	FC Portable applications	2.85
	FC Transport applications	19
	FC Stationary Applications	13
	Hybrid vehicle auxiliary components	21.6
VALIDATION & DEMONSTRATION	Technology validation and demonstration for transportation	43.5
	GRAND TOTAL	244.32

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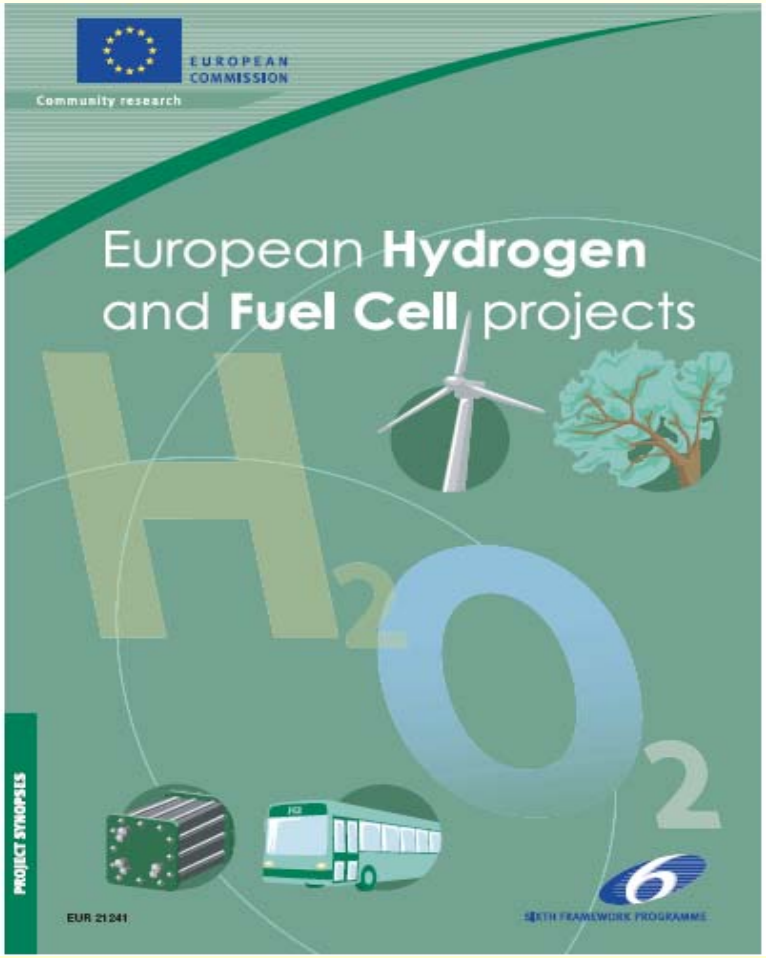
Important FP6 Projects

CHRISGAS
fuels from biomass

HySafe



Zero Regio

FURIM

NATURALHY

REAL SOFC

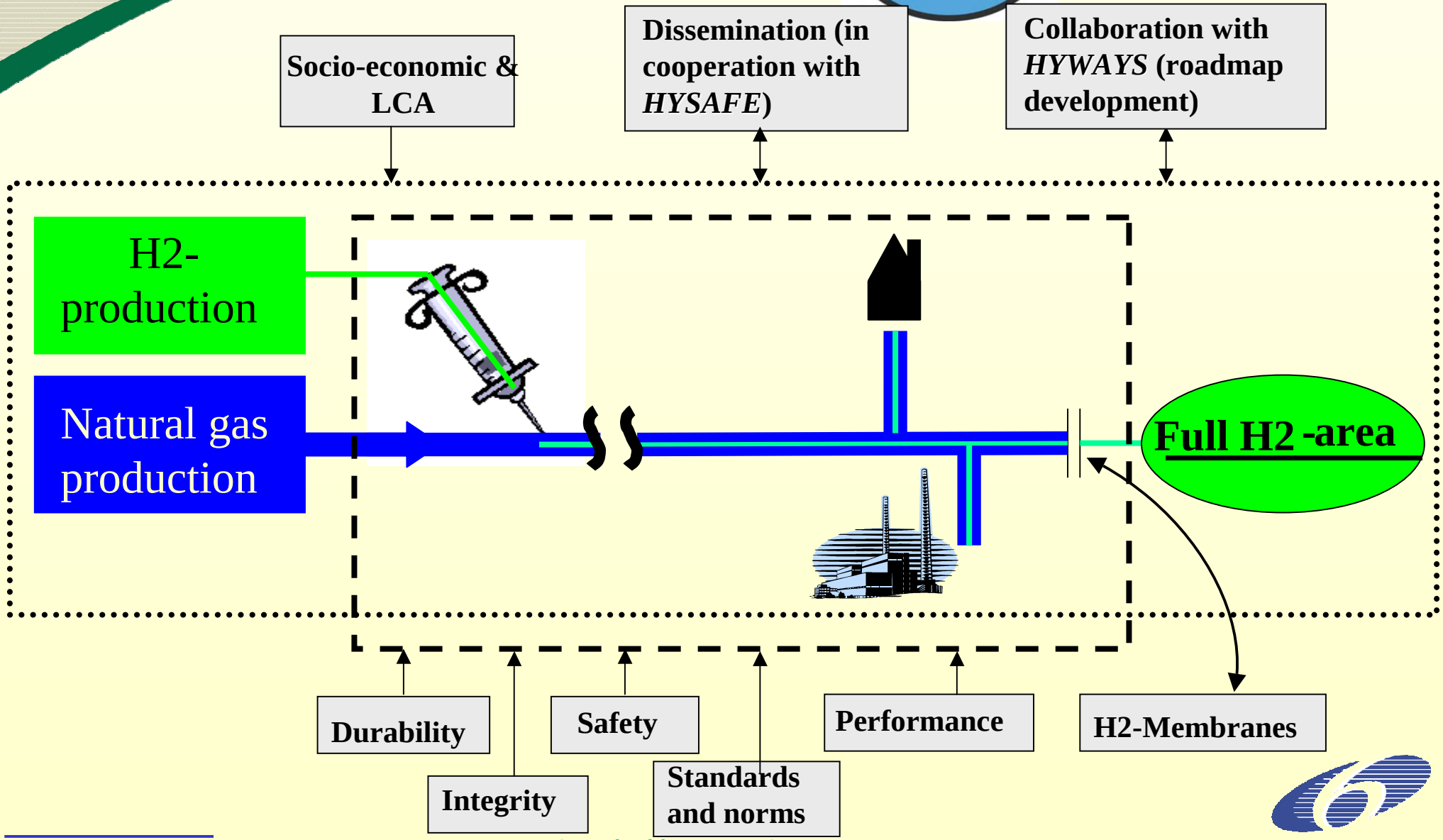
STORHY

HyTRAN

HyICE

HyWays
Hydrogen Energy in Europe

Project


Socio-economic & LCA
Dissemination (in cooperation with *HYSAFE*)
Collaboration with *HYWAYS* (roadmap development)
H2-production
Natural gas production
Full H2 -area
Durability
Integrity
Safety
Standards and norms
Performance
H2-Membranes

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HySafe

General Goal

Contributing to a **safe transition** to a **sustainable development** in Europe by facilitating the **safe introduction of hydrogen** technologies / applications

Objectives

- strengthen and focus, **integrate** fragmented **research** on hydrogen safety -> competitive scientific and industrial community
- Promoting **public awareness and trust** in hydrogen technologies
- Development of an excellent **safety culture**

Consortium

- 24 partners from 12 European countries and 1 Canadian partner
- 12 public research organisations, 7 industrial partners, 5 universities

Budget

Total > 13 M€ with a EC grant of max. 7 M€ for 5 years

Objectives

- develop a harmonised *European Roadmap* for H2 energy,
- provide recommendations for an *Action Plan* (Roadmap implementation)
- develop a *standard procedure* for the roadmap process,

by means of

- describing the *future steps* towards H2's large-scale introduction,
- considering *transport and power sectors* (storage medium for RES),
- using inputs from EU *industry, R&D institutes* and *member state experts,*
- combining known *technology databases* and *socio-economic analysis*,
- evaluating *stakeholder scenarios* for sustainable H2 energy systems and
- reflecting real life member state *opportunities and barriers*.

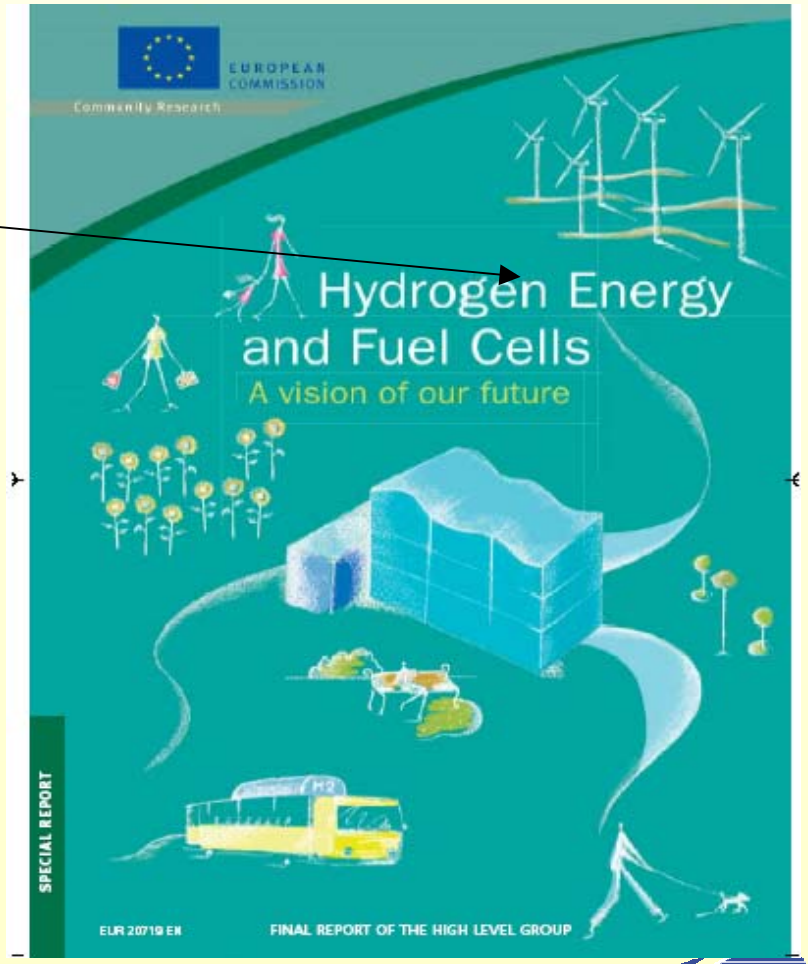
Large consortium (> 30 partners)
Duration: 3 years (in 2 phases of 18 months)
Total Budget: 7.9 M€ (EC Funding: 4.0 M€)

A Strategy for Europe:

The European Hydrogen and Fuel Cells Technology Platform

Elements of a European Strategy for Hydrogen and Fuel Cells

- **High Level Group H2 and FCs (2002-2003) - Vision report : "*Hydrogen energy and Fuel Cells – A vision of our future*"**
- **European Hydrogen and Fuel Cell Technology Platform** (January 2004) **involving main stakeholders**
- **Elaboration of two foundation documents: "*Strategic Research Agenda*" and "*Deployment Strategy*" – *Endorsed in March 2005 at Platform General Assembly***
- ***Strategic Overview* of the above 2 documents – March 2005**
- **FP7 (2006 - 2013) –Hydrogen *Joint Technology Initiative***



Key Objective of *Technology Platforms*

To unit stakeholders around a common vision and approach for the development of key technologies with high societal relevance, with specific focus on the definition of a Strategic Research Agenda (i.e. RTD priorities, timeframes and budgets) and the mobilisation of the necessary critical mass of research and innovation effort.

The H2/FC Technology Platform: Structure and Participants

- **Participants:**
  - Research Community, Industry, Public Authorities, Financial Community, Users and Consumers, Civil Society
- **Platform Operations: General Assembly**
  - On-going and future projects, networks and initiatives, supported by EC, national and regional programmes
- **Steering and support structures:**
  - Advisory Council (and Executive Group),
  - Steering Panels and Initiative Groups,
  - Member States' Mirror Group,
  - Commission Inter-service Hydrogen Project Team
  - Secretariat

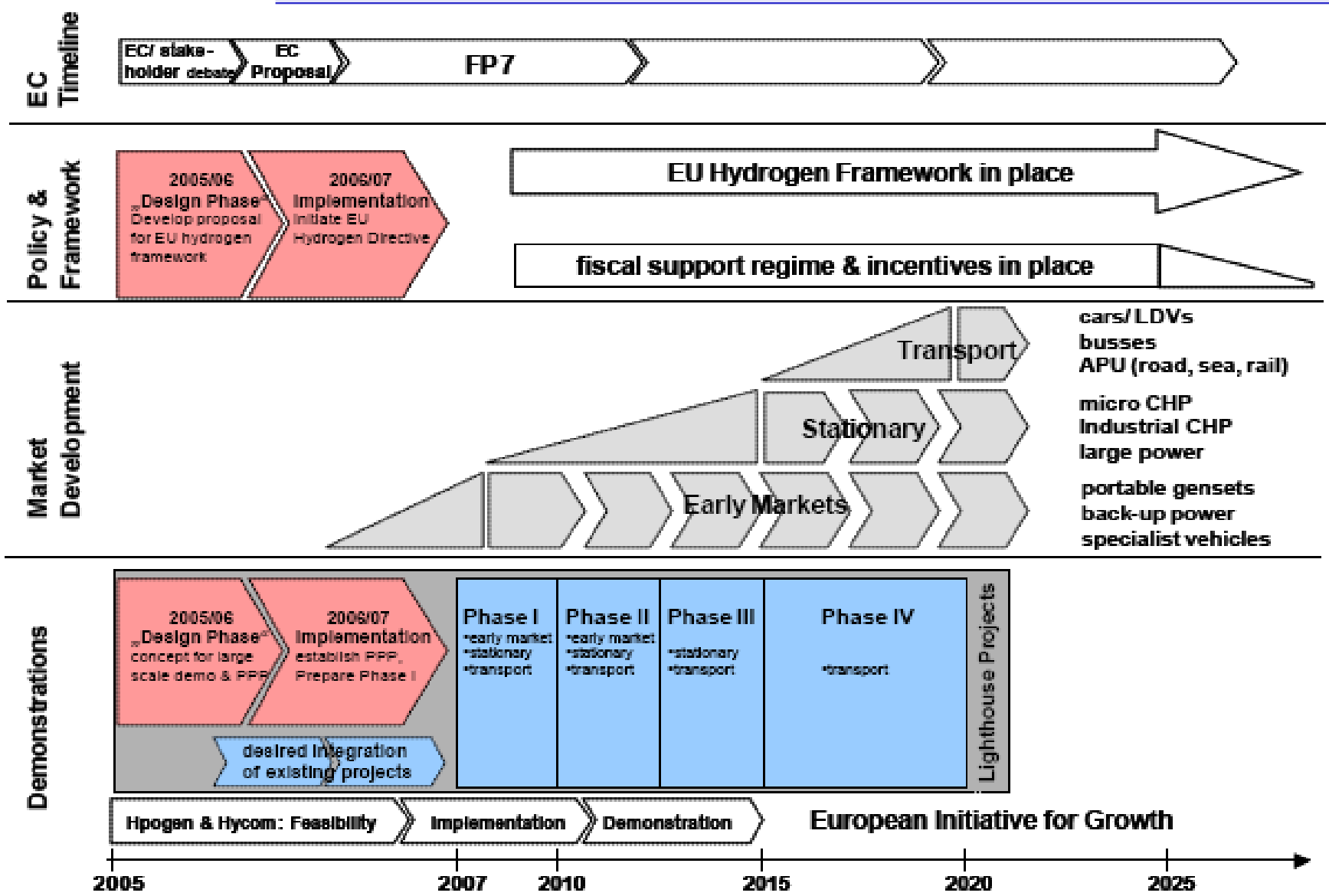
Key points of the strategic overview

1. **Hydrogen fuel and FC applications can contribute significantly to EU public policy objectives - Transport applications will be particularly critical.**
2. **A highly focused, 10 year RD&D programme is needed to :**
   - ✓ **reduce FC system costs by a factor 10 (100 for transport applications);**
   - ✓ **enhance performance and durability of FC systems by a factor ≥ 2**
   - ✓ **reduce costs of hydrogen delivered by a factor ≥ 3**
   - ✓ **achieve competitive hydrogen storage densities**
3. **Private and public investment – including EU, member states and regions – to double present effort and to match R&D funding levels of major global competitors. Policy frameworks and financial planning are essential.**
4. **Large-scale, demonstrations ('Lighthouse Projects') are needed to bridge the gap between R&D and commercialisation.**
5. **Early markets - including specialist vehicles and portable applications – could be established by 2010, with stationary applications achieving commercialisation by 2015 and mass transport applications by around 2020**

Key Assumptions on Hydrogen and Fuel Cell Applications for a 2020 Scenario

	Portable FCs for handheld electronic devices	**Portable Generators & Early Markets**	**Stationary FCs** Combined Heat and Power (CHP)	**Road Transport**
EU H2/ FC units sold per year projection 2020	~ 250 million	~ 100,000 per year (~ 1 GW_e)	100,000 to 200,000 per year (2-4 GW_e)	0.4 million to 1,8 million per year
EU cumulative sales projections until 2020	n.a.	~ 600,000 (~ 6 GW_e)	400,000 to 800,000 (8-16 GW_e)	n.a.
EU Expected 2020 Market Status	**Established**	**Established**	**Growth**	**Mass market roll-out**
Average power FC system	15 W	10 kW	3 kW (Micro CHP) 350 kW (ind. CHP)	
FC system cost target	1-2 €/ W	500 €/kW	2.000 €/kW (Micro) 1.000-1.500 €/kW	< 100 €/kW (@ 150.000

Schedule for a deployment strategy



7th FRAMEWORK PROGRAMME

Building the ERA of Knowledge for Growth

Energy Research in FP7

RTD policy drivers

LISBON
(March 2000)
Most competitive and dynamic knowledge-based economy by 2010

BARCELONA
(March 2002)
Need to boost RTD
Aim: 3% of EU GDP by 2010 (2/3 private)

BUILDING THE EUROPE OF KNOWLEDGE
European Research Area

7th Framework Programme

- **For the period 2006-2013**
- **At least doubling the research budget of FP6**
- **Orientations presented in Commission Communication**
  (COM/2004/353 of 16 June 2004)
- **Proposes a new concept of European Joint Technology Initiatives (JTI), in particular for Hydrogen and Fuel Cells**
- **Tentative timetable:**
  - ✓ **FP7 proposal of the Commission –** April 2005
  - ✓ **FP7 adopted by Council and Parliament –** summer 2006
  - ✓ **First calls –** late 2006

Specific Programmes

Cooperation **– Collaborative research**

Ideas **– Frontier Research**

People **– Human Potential**

Capacities **– Research Capacity**

+

JRC (non-nuclear)

JRC (nuclear)

Euratom

Cooperation – Collaborative Research

9 themes :

1. Health
2. Food, Agriculture and Biotechnology
3. Information and Communication Technologies
4. Nanosciences, Nanotechnologies, Materials and new Production Technologies
5. Energy
6. Environment (including Climate Change)
7. Transport (including Aeronautics)
8. Socio-Economic Sciences and the Humanities
9. Security and Space

Energy Context in FP7

KEY CHALLENGES

- Global energy demand predicted to increase by 60% over the next 30 years
- EU energy dependency could rise from 50% to 70% by 2030; damaging volatility of oil prices and geopolitical instability
- Over 90% of EU CO2 emissions, causing climate change, are attributable to energy
- Global energy investments of €12 trillion required up to 2030 – huge opportunity for EU industry

Energy Research in FP7

OBJECTIVE

Transforming the current fossil-fuel based energy system into a more sustainable one based on a diverse portfolio of energy sources and carriers combined with enhanced energy efficiency, to address the pressing challenges of security of supply and climate change, whilst increasing the competitiveness of Europe's energy industries.

FP7 – Proposed Priority Topics in Energy

- Hydrogen and fuel cells
- Energy savings and energy efficiency
- Renewable electricity generation
- CO2 capture and storage technologies for zero emission power generation
- Renewable fuel production
- Clean coal technologies
- Renewables for heating and cooling
- Smart energy networks
- Knowledge for energy policy making

JTI concept and values

- Implements in an effective and efficient manner the Integrated Strategy for research and deployment developed in the Technology Platforms
- It is a Public-Private-Partnership with an appropriate governance and management structure (avoiding conflicts of interest)
- Envisages strong industrial participation
- Supporting a European Research Area (ERA)
- Developing outreach at international level
- Capitalising on FP5 and FP6

Key criteria for JTIs

- **High strategic importance for Europe**
- **A new, pan-European approach is needed – existing instruments not sufficient**
- **Clear objectives and outcomes - measurable**
- **Demonstrated commitment from industry**
  - ✓ leading to an increase in private R&D spending
  - ✓ and enhanced leverage effect – other funding
- **Appropriate technical, legal, financial and managerial frameworks identified**

Possible content of a JTI on H2/FCs

Broad themes:

- **European FC development programme** – focussed R&D programme with key milestones/ quality gates (feeding into demonstration actions)
- **Sustainable hydrogen supply programme** – accelerated development of the critical technologies of hydrogen production, storage and distribution, including infrastructure (feeding into demonstration actions)
- **Lighthouse demonstration programme** – phased approach, with stepwise improvements in technologies (QGs) and increasing number of sites and demonstrators (feeding into research and cross-cutting framework activities)
- **Market framework preparatory activities** (cross-cutting, e.g. pre-normative and socio-economic research, education and training, public outreach, ...) – proactively fostering business opportunities and early market applications in Europe and removing non-technical barriers (feeding into demonstration actions)

Staying Informed

Energy Research at Europa

http://europa.eu.int/comm/research/energy/index_en.html

General information on the Sixth Framework Programme:

http://europa.eu.int/comm/research/fp6/index_en.html

CORDIS FP6 Service:

http://www.cordis.lu/fp6/

Energy helpdesk:

rtd-energy@cec.eu.int

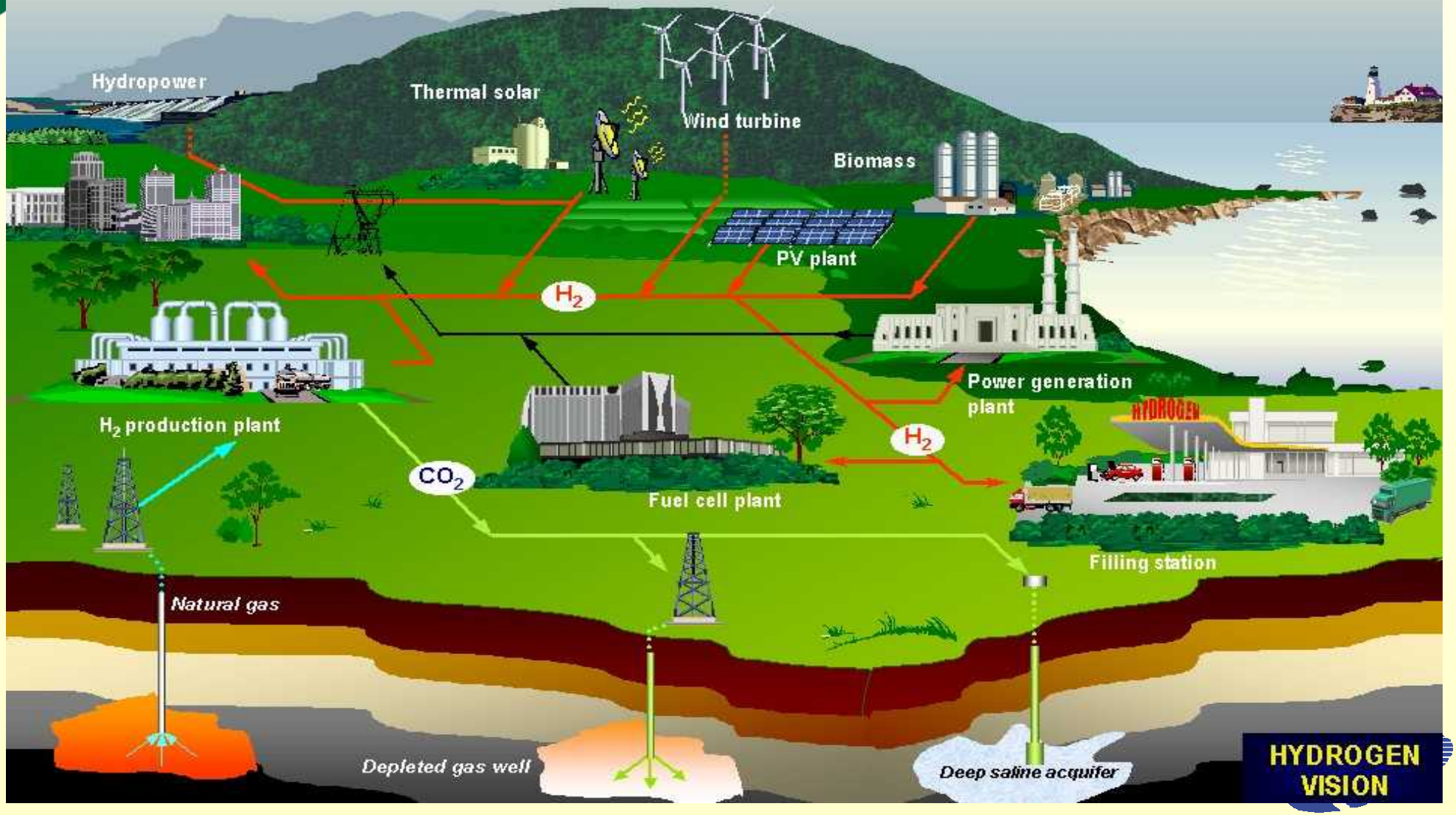
HFP technology Platform:

www.HFPeurope.org

Towards FP7:

http://europa.eu.int/comm/research/future/index_en.html

THANK YOU !!!


Hydropower
Thermal solar
Wind turbine
Biomass
PV plant
H_2
Power generation plant
H_2 production plant
CO_2
Fuel cell plant
H_2
Filling station
Natural gas
Depleted gas well
Deep saline acquifer
HYDROGEN VISION