



**Investigations of the conditions under  
which the existing natural gas system can  
be used for hydrogen-natural gas mixtures  
(NATURALHY-project)**

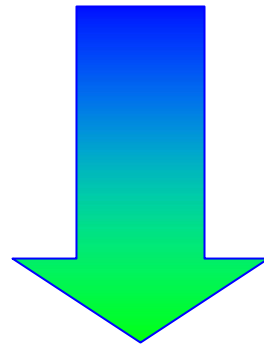
Onno Florisson

Gasunie Research

The Netherlands



The transition to the hydrogen-economy will be lengthy, costly and will require significant R&D



**PRACTICAL STRATEGY**

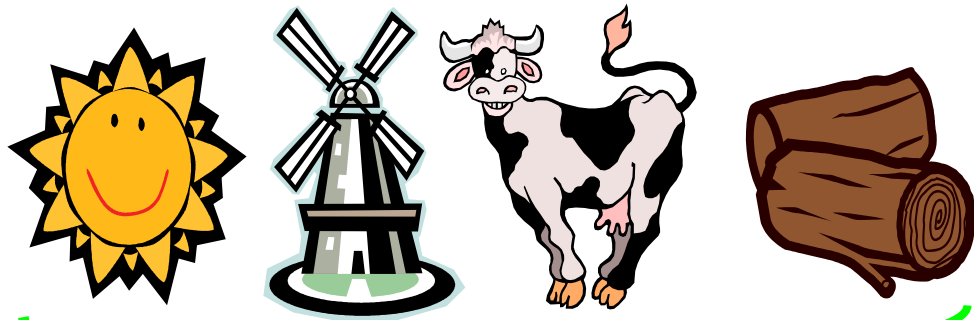


## **Opportunity for natural gas**

**Smooth and short term** introduction of H<sub>2</sub> into the society at **relatively low costs** by using the existing **widespread** natural gas system for mixtures of natural gas and H<sub>2</sub>

**However, .....: NATURALHY-project**

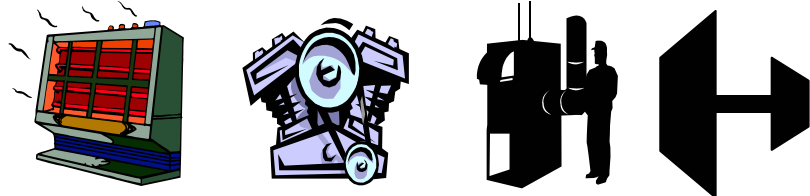
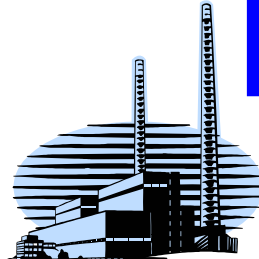
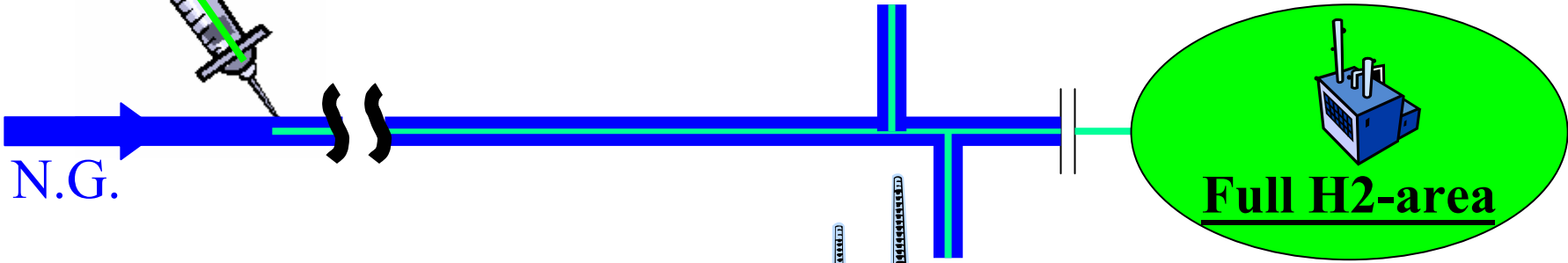
# The NATURALHY approach



H<sub>2</sub>



N.G.





## **Adding H<sub>2</sub> to natural gas effects the physical and chemical properties and might have impact on:**

- Safety aspects of transmission – distribution - end use
- Pipeline durability
- Pipeline integrity
- End user appliances' performance



## **The main objective:**

*Definition of the conditions under which the existing natural gas system (transmission-distribution-end use infrastructure and appliances) can be used for mixtures of hydrogen and natural gas.*



## **Main Deliverables:**

- Assessment tool
- Membranes for H<sub>2</sub> separation
- Socio-Economic and LC Assessments
- Enthusiasm of the stakeholders



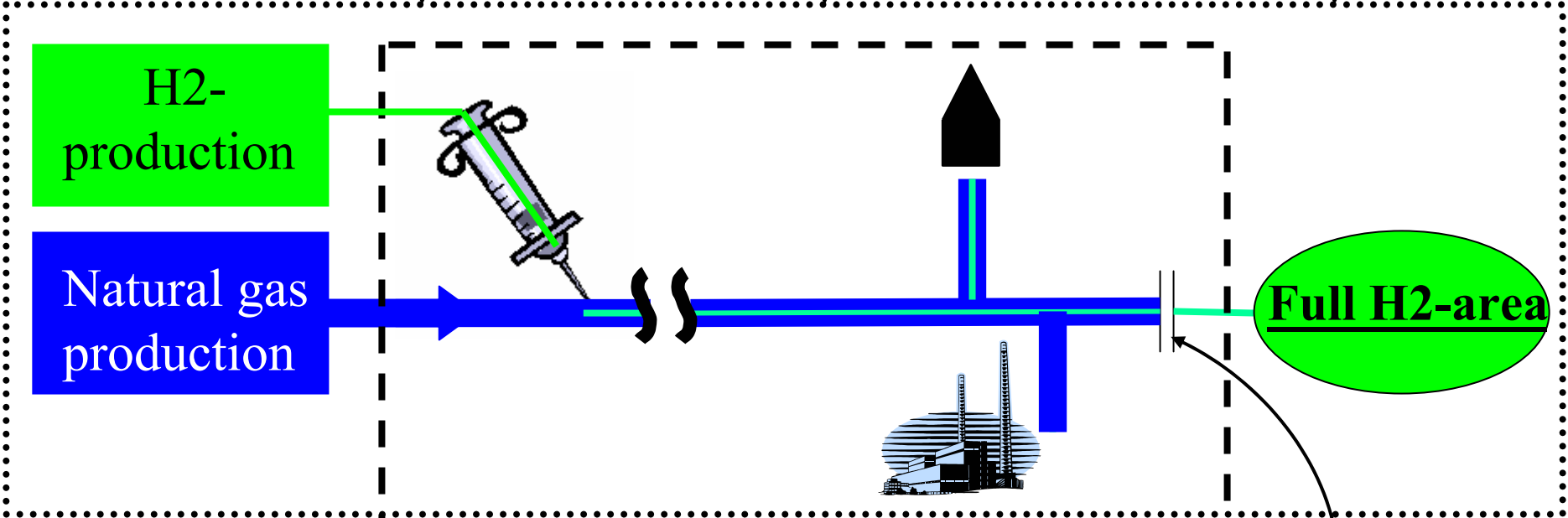
## Characteristics

- 39 European partners, including 15 from the gas-business
- Funded by the European Commission
- Project budget 17.3 M€, EC-grant 11 M€
- Start 01-05-2004, duration 5 years



Socio-economic  
& LCA

Dissemination (in  
cooperation with  
HYSAFE)



Durability

Safety

Performance

H2-Membranes

Integrity

Standards  
and norms



## Parties

**Gas companies and gas research institutes  
financed by gas companies**

GERG

Gasunie

Gaz de France

Statoil

DEPA

Naturgas Midt-Nord

IGDAS

TRANSCO

DBI

Shell Hydrogen

IFP

Total

BP

ISQ

DGC



## Parties (continued)

### **Manufacturers and consultants**

CSM CMI TOG GE CETH SAVIKO Exergia SQS

### **Universities and Institutes**

NEN COGEN ECN HSE TNO CEA PLANET

Technical University Berlin

Nat. Techn. Univ. Athens

Leeds University

Loughborough University

Hogskolan Boras

Marmara Research Center

University of Warwick

UP Metz

NTNU



## **Project organisation:**

3 Committees to manage the execution

Strategic Advisory Committee





# List of members of the Strategic Advisory Group (under development):

**Safety:** UK Health Safety Executive, HYSAFE

**Energy/natural gas:** IGU, IEA, Ruhrgas, ENItecnology, DVGW, IAHE

**Policymaking:** HYWAYS, EU-Commission, NL Min. of Economics and Environment, EU-Platform for hydrogen and fuel cells, Wuppertal Institute, EU-Parliament, DOE of the US (?)

**Regulations:** CEN

**Environment:** WWF, Bellona

**End use:** ENGVA



**THANK YOU FOR YOUR ATTENTION**

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## Comparison of the main risk aspects of hydrogen versus natural gas

<b>Physical aspect</b>	<b>Impact on risk (H<sub>2</sub>-n.g.)</b>
Energy content /m <sup>3</sup>	-
Ignition energy	+
Combustible gas/air ratios	+
Combustion velocity	+
Radiation of flames	-
Density	-
Diffusion	-
<b>Total</b>	<b>?</b>



**Natural gas, the bridge to a sustainable energy system**

**The NATURALHY-project, the natural approach to prepare for hydrogen as an energy carrier**



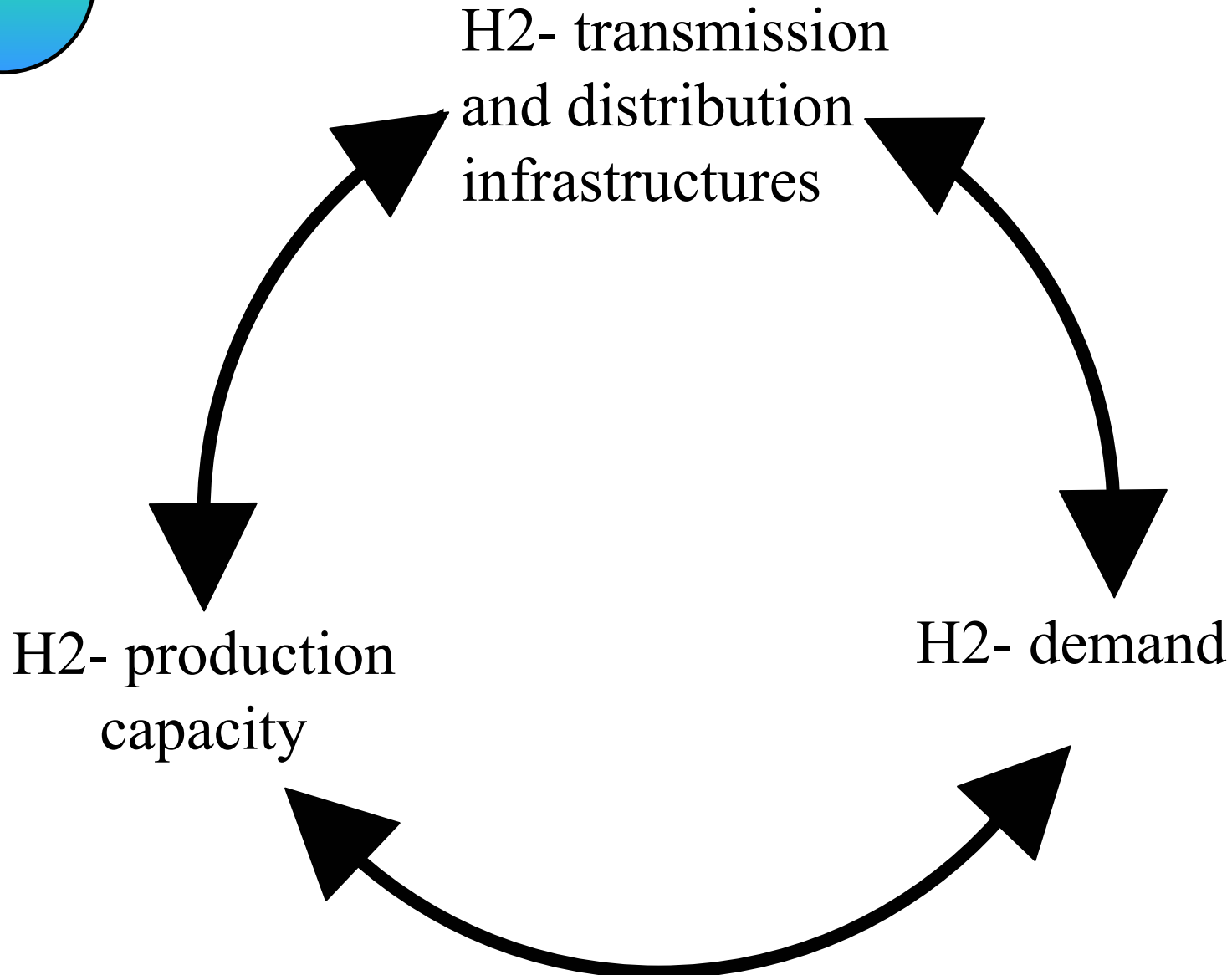
<b><i>WORK PACKAGE</i></b>	<b><i>WORK PACKAGE LEADER</i></b>
Life Cycle and Economic Assessments	University of Warwick
Safety	Univ. of Loughborough
Durability	Gaz de France
Pipeline integrity	TNO
End user aspects	University of Warwick
Assessment tool	ISQ
Dissemination	Exergia
Project Coordination	Gasunie



**Transmission and distribution of gas and more in particular of hydrogen are complex matters!**



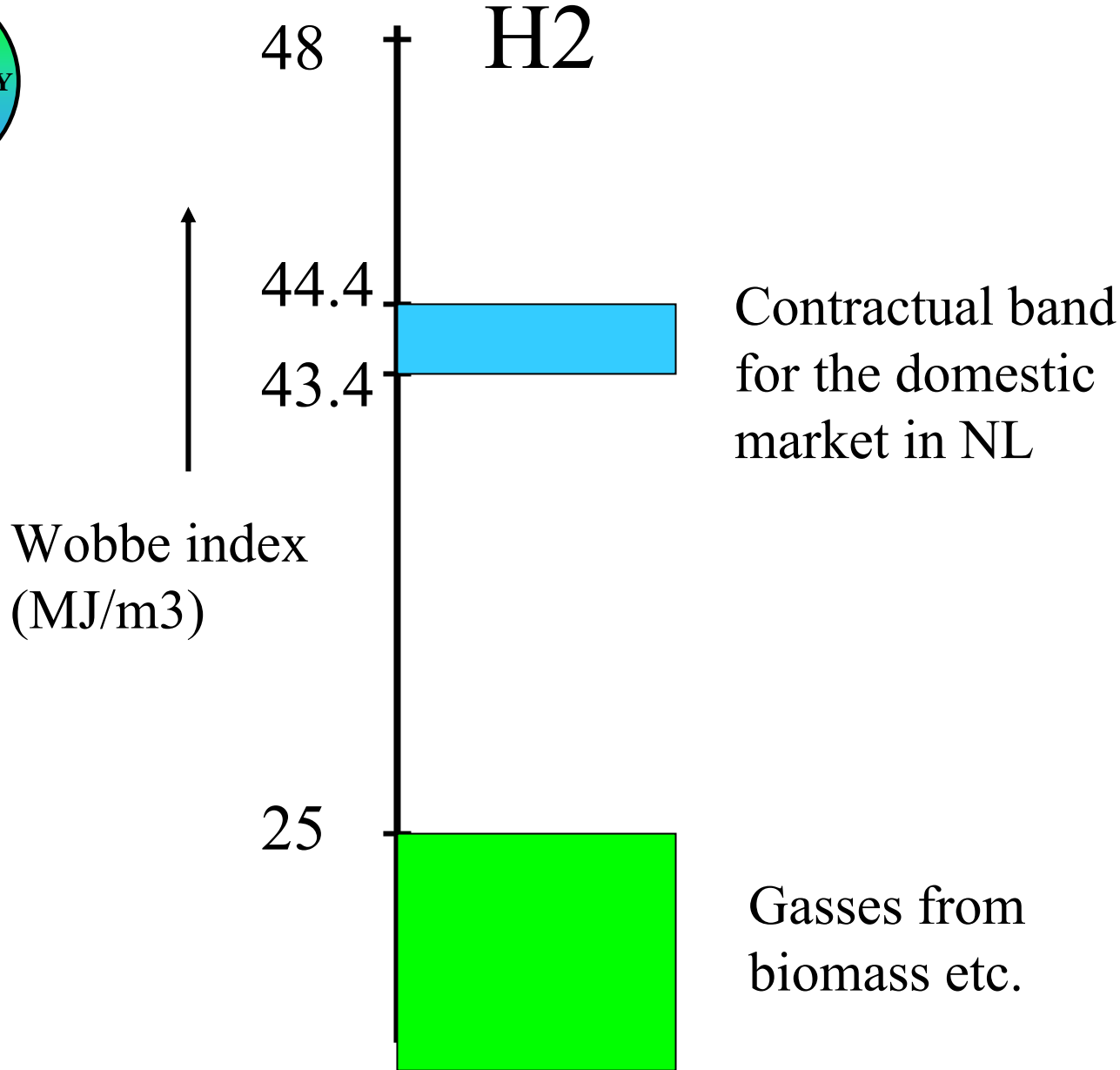
# Chicken and egg dilemma:





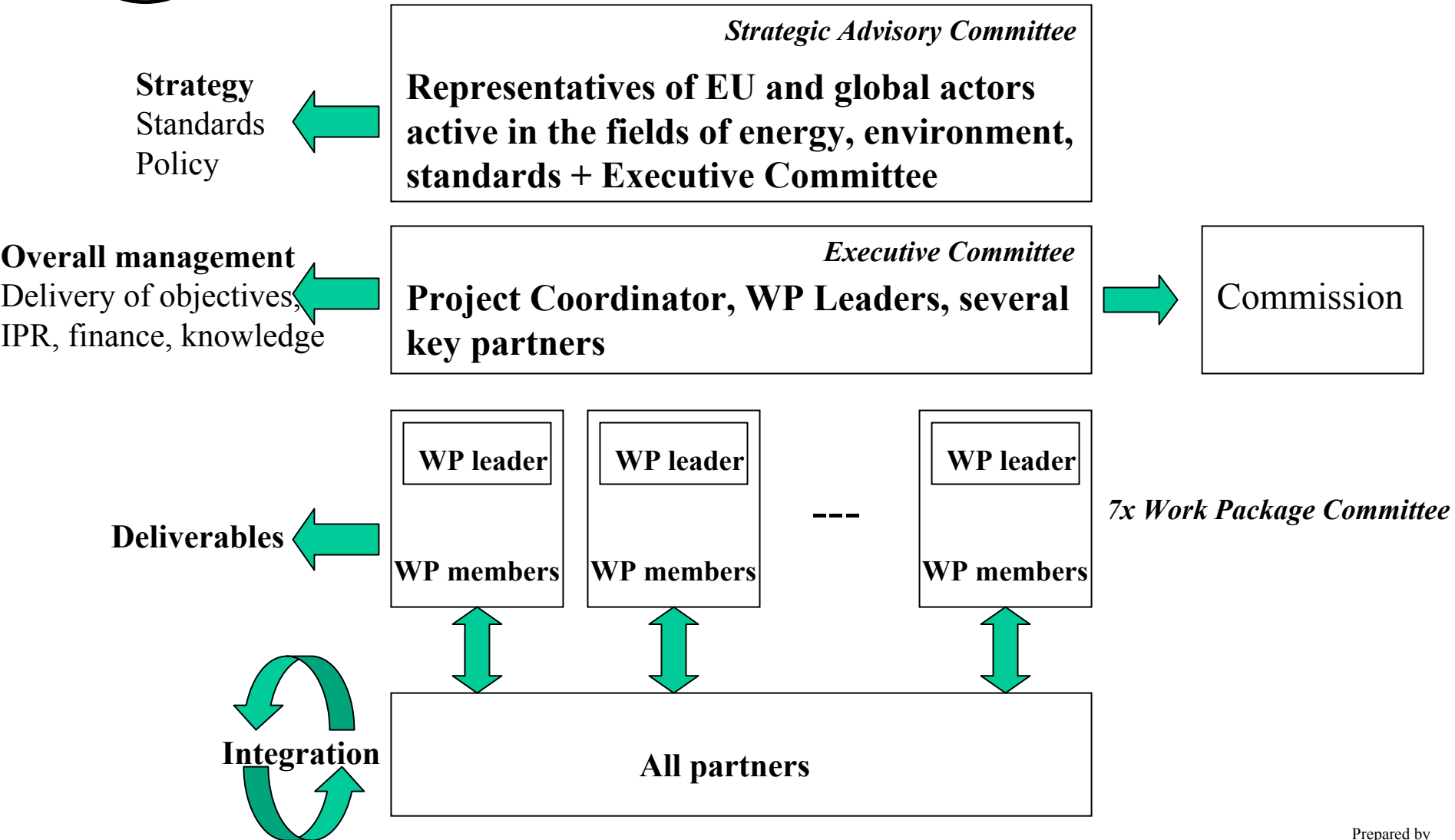
## **Demands regarding:**

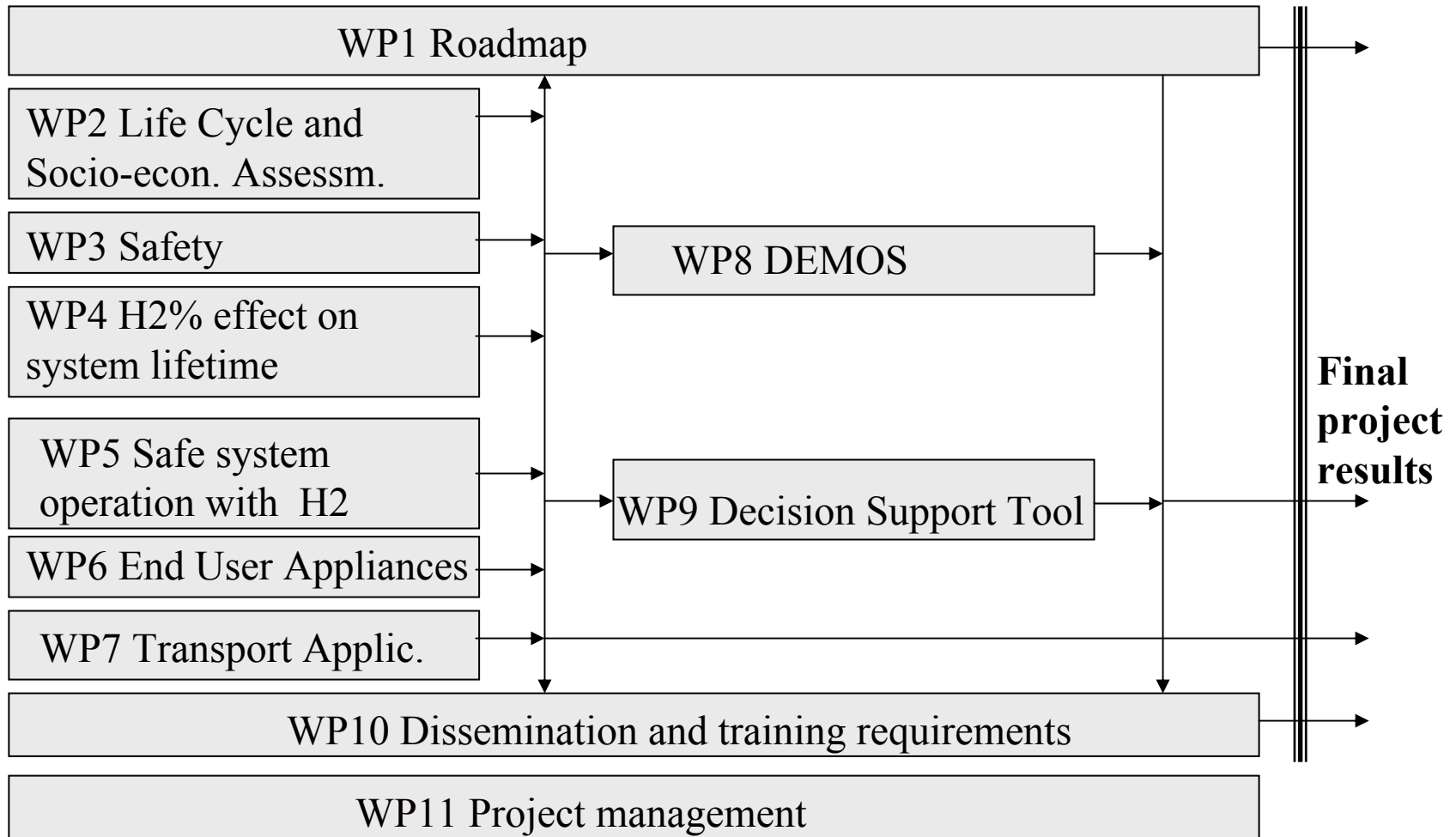
- Safety
- Security of supply (quantity and quality)
- The extent of the grid
- Acceptance by the end user & enthusiasm of the gas company





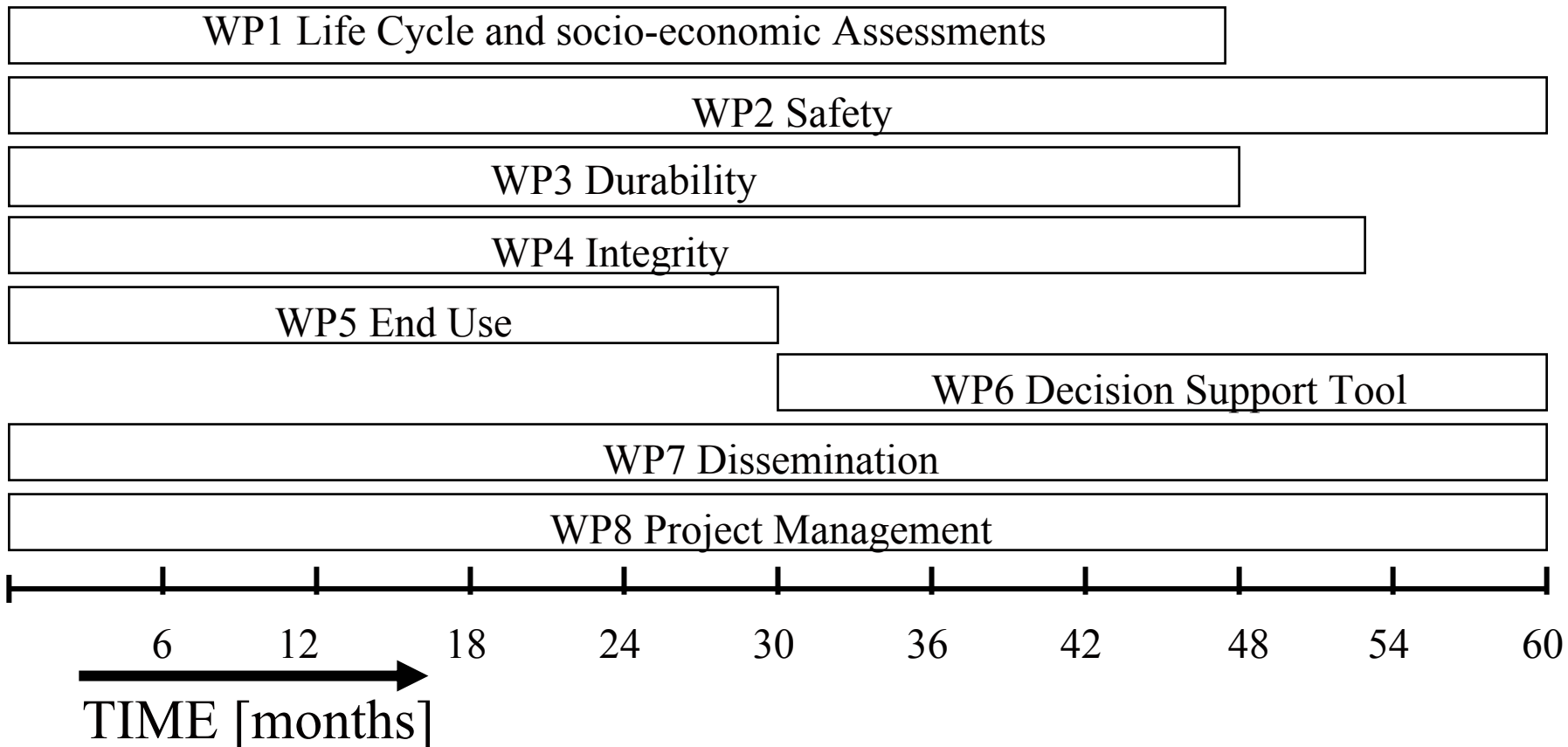
# Project management structure







# Implementation plan broken down in Work Packages





“Natural gas: The bridge to sustainable”

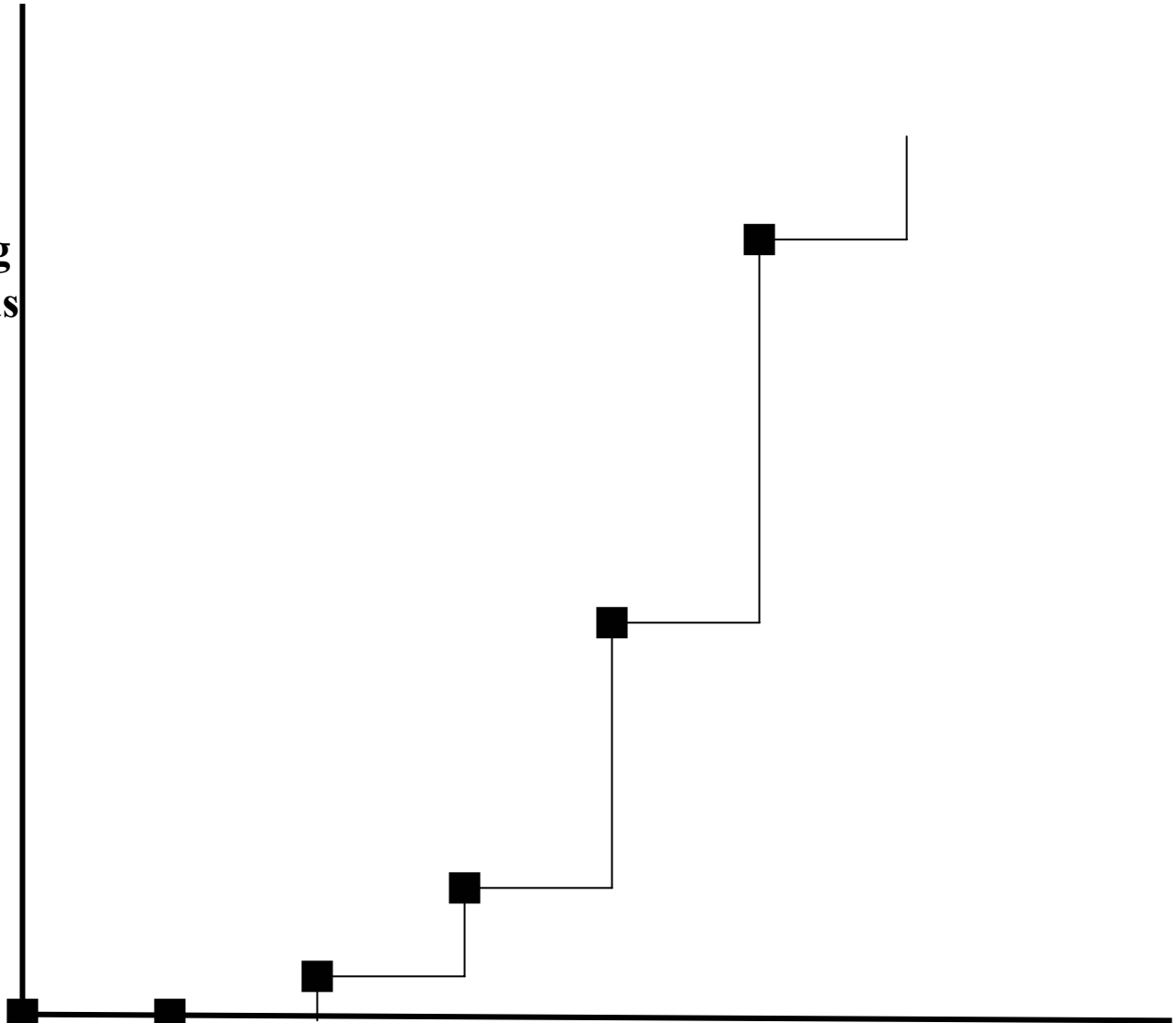
**Opportunity for natural gas:**

**Smooth and cost effective** introduction of H<sub>2</sub> into the society by using the existing **widespread** natural gas system for mixtures of natural gas and H<sub>2</sub>

**However, .....: NATURALHY-project**



**Costs to overcome the  
consequences of adding  
hydrogen to natural gas**



**% of hydrogen added to the natural gas**



# **NATURALHY-project: breaks the chicken and egg dilemma:**

Smooth and low cost introduction of hydrogen into the society by using the existing natural gas infrastructure



Many persons have contributed to the definition of the NATURALHY-project, including

Dave Pinchbeck (GERG)

Nigel Mortimer (Sheffield Hallam University)

Geoff Hankinson (Loughborough University)

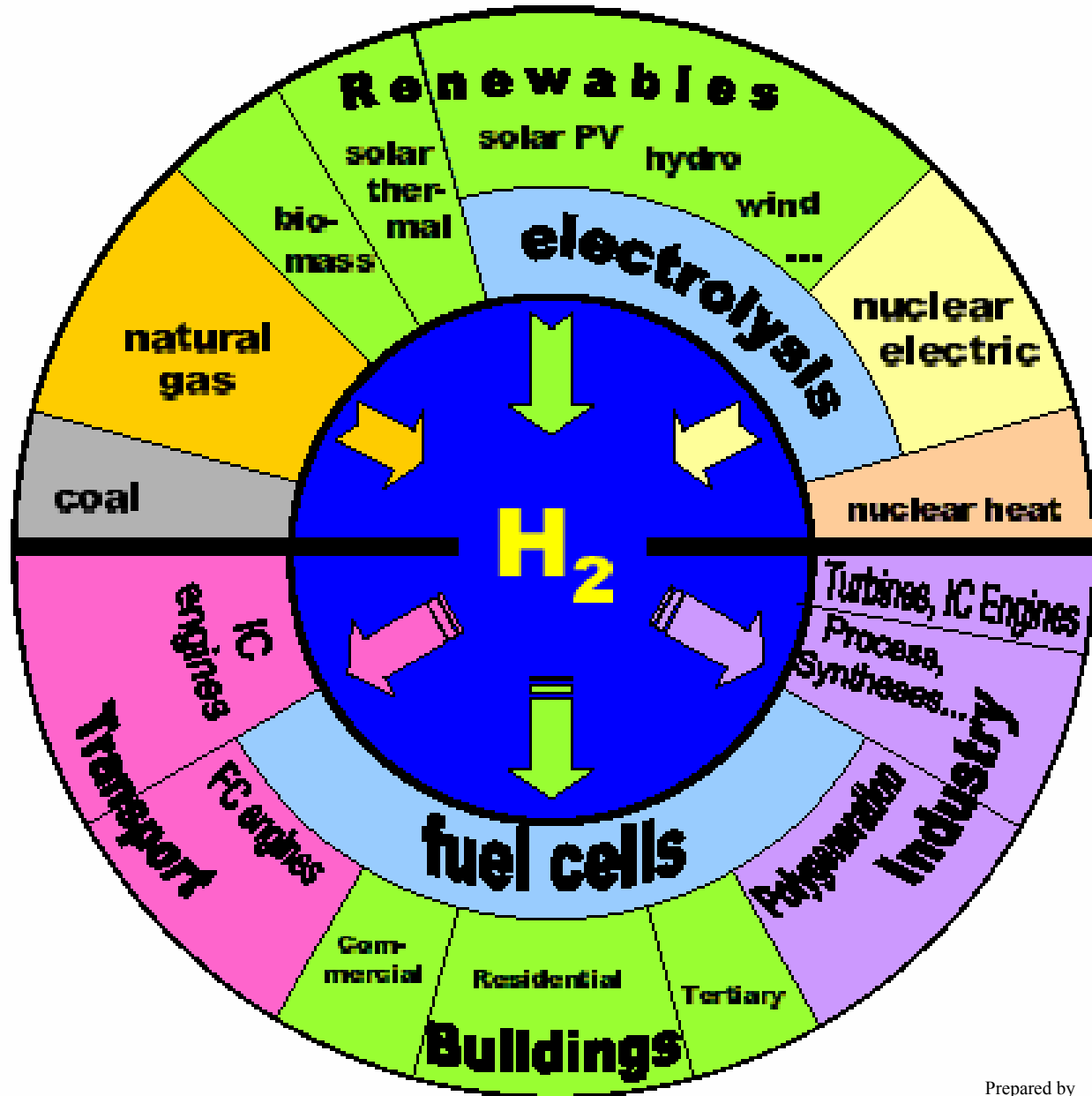
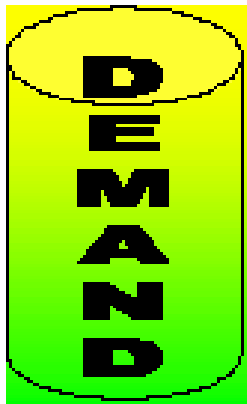
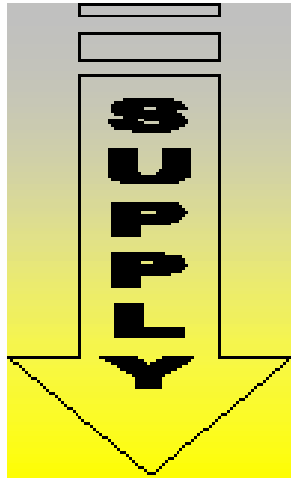
Isabelle Alliat, Mures Zarea and Remi Batisse (Gaz de France)

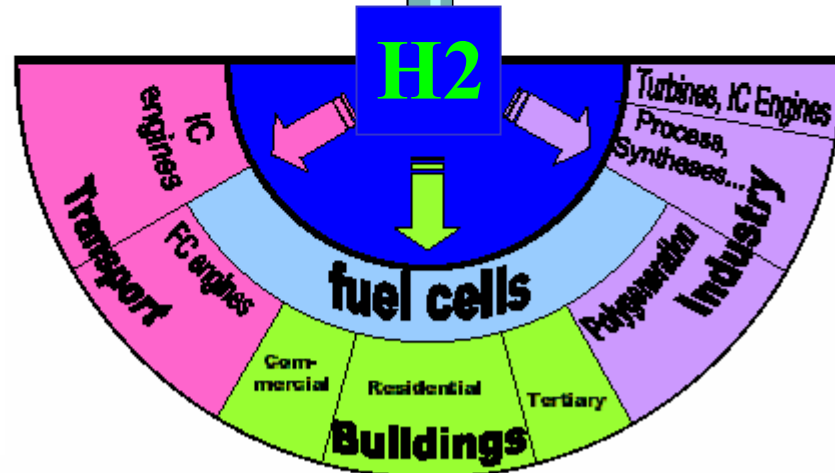
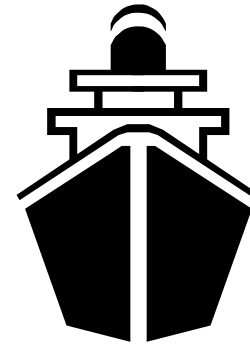
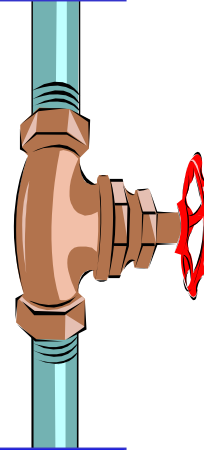
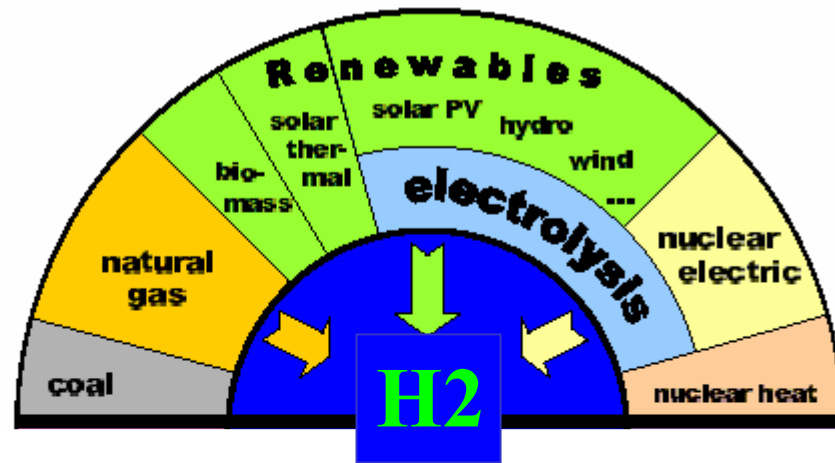
Peter Bartlam (ISQ)

Rolinda Huizing (Gasunie)

Arend de Groot (ECN) and Martin Seifert (SVGW)

.....







## **Regarding the safety work:**

**Approach: adaptation of existing safety models for natural gas**

**Limitation to 0-50% H<sub>2</sub> in natural gas**

**Planned large scale experiments :**

*Gas Build-up and Explosions in Confined/Vented Enclosures*

*Gas Build-up and Explosions in Congested Regions*

*High Pressure Jet Fires*

*Pipeline Fires*

