An Overview of the CEA Road-map for Hydrogen Production

F. Le Naour
P. Anzieu
is involved in International and National Initiatives on H2

International Agreements and Working Groups

An European mobilization

A recent French National Plan

The 1st European platform
270 M€ for H2 & Fuel Cells
FP6 (last 5 years)

A five years Plan
300-360 M€ for H2 & FC
50-80 M€ for H2 production
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must take into account National Specificities

Need to reduce the greenhouse gas emission

Pick oil estimation – reduction of the hydrocarbon reserves

Distribution of oil consumption in France
Transport is the main source of CO2 emission

Develop Hydrogen Economy for transport is one priority in France
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' CEAs strategy guided by criteria of Sustainable Development

**Favorite the processes**

- Free of greenhouse gas emissions
- Competitive
  - High efficiency processes (high temperature)
  - Low costs technologies
- Allowing to meet the needs for transport (massive production)
- Ensuring energy independency

<table>
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**Strategy for sustainable H2 production**

- H2 Production starting from hydrocarbons
- H2 massive production by solar furnaces
- H2 massive production by nuclear plants (Gén IV)
- H2 prod. by renewable energy (solar, geoth, ...)
- H2 massive production by fusion & fission nuclear

- R&D
- Demonstration

- H₂ Production starting from hydrocarbons
- Delocalized production by renewable energies
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The Long Term Routes for Massive Hydrogen Production

Water splitting with clean and low cost energy

- Geothermic
- Nuclear
- Clean and Low cost electricity
- HT solar
- Clean and Low cost Thermal source
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ELYOHT 1
Basic researches / Design parametric studies – thermic, fluidic, thermomechanic modeling & experiments / Material parametric studies – elaboration, process (shaping & welding), corrosion, reliability

ELYOHT 2
Intermediate power electrolyser (5 kW)
System approach in coupling with a geothermal source
Comparative evaluation with alkaline electrolysis

ELYOHT 3
1 MW power electrolyser
System approach in coupling with nuclear or HT solar source

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Why and How compare these different processes?

These processes are long term and not well known processes!
So, today we have to compare the different technologies to decide on which we have to concentrate our R&D efforts!

In the first steps, More we work....Worse it is!
So we have to compare at the same knowledge step level.
A convergent point for all processes – the 1 MW<sub>th</sub> test

- IS Cycle
- Westinghouse
- UT3
- Redox cycles
- alternatives
- HTE

Conceptual Approach
Physical basis

1st Technical & Socio-technico-ecp Analysis

Technological development
Laboratory scale…
…bigger scales

Flow sheets

Large scale Tests & demonstrations

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SusHyPro

SUStainable HYdrogen PROduction

High Temperature Processes for CO2 free massive Hydrogen Production Processes
**Schematic Road Map**

2008

1st Milestone
Evaluation of TC cycles
(flowsheet analysis)

2012

2nd Milestone
1 MWth evaluation

**Schematic Road Map**

- IS flowsheet & exp loops
- Hybrid sulfur flowsheet & analys.
- Alternative cycles flow.
- EHT develop & flowsheet
- Other processes

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Thank you for your attention

Materials

Hydrogen

Production processes

Applications

Safety & social acceptance

Materials

Production processes

Applications

Safety & social acceptance