French strategy on H_2

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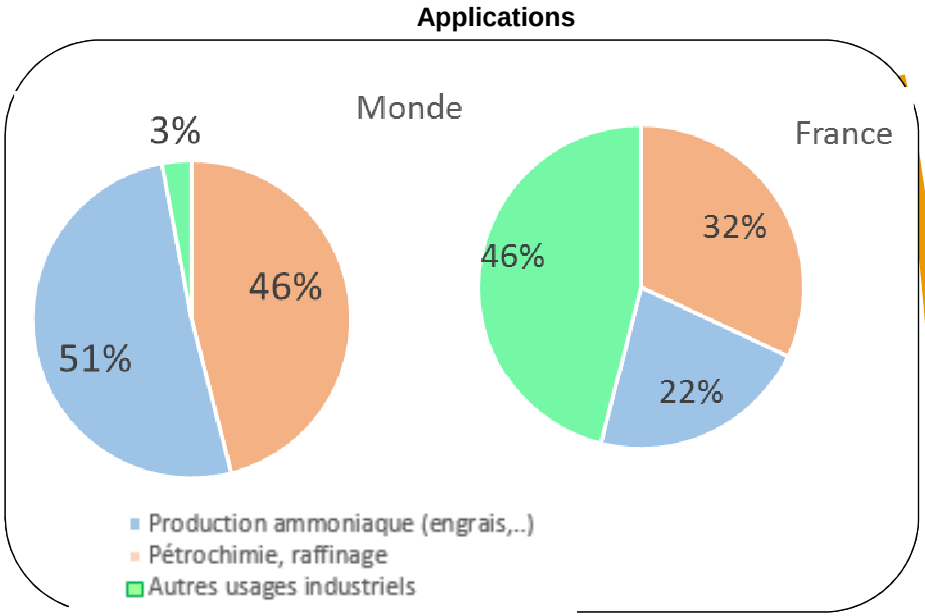
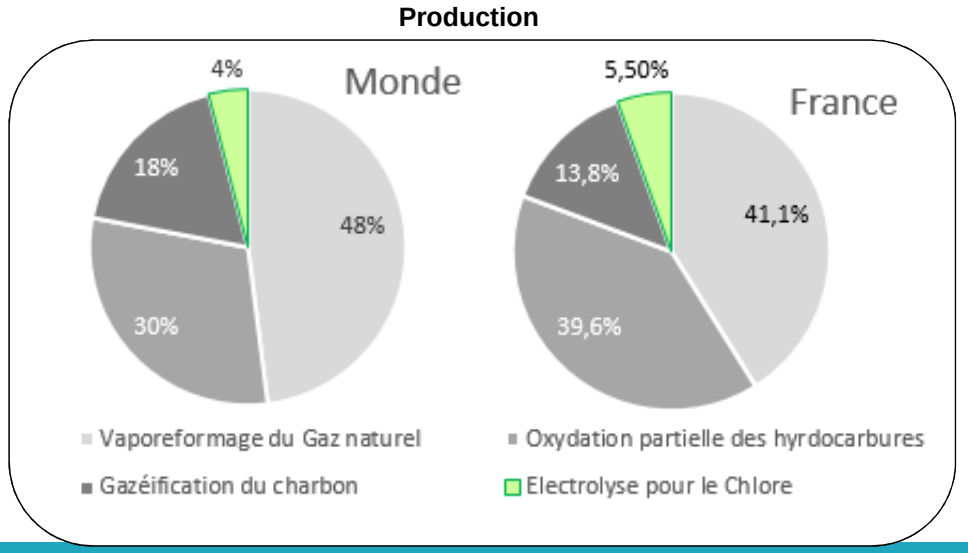
H_2 markets and applications

H_2 market is mainly industrial : Worldwide 61 Mt, France 900kT

- Main uses
  - Ammonia, fertilizers
  - Chemistry
  - Refinery
- Produced from fossil fuels
  - From methane mainly
  - But also coal and other oil products
- CO_2 emissions :
  - 800 $MtCO_2eq$ in the world, around 2% of the emissions
  - 11,5 $MtCO_2eq$ un France, around 3% of the national emissions
- Industrial H_2 production cost in France is between 1,5 et 2,5€/kg





Context – in France

- Call for projects in 2016 : revealed a strong potential in France

39 «H_2 territories » labeled for about 100 projects candidates.
Twelve projects financed in 2017 by the State (+ financing by EU or local communities)

- In November 2017, the Minister launched a mission in order to define the French deployment strategy for low-carbon/green H_2

Around **50 stakeholders were interviewed** in December – January representing all the value chain and the applications of H_2

A report was submitted to the Minister in April 2018

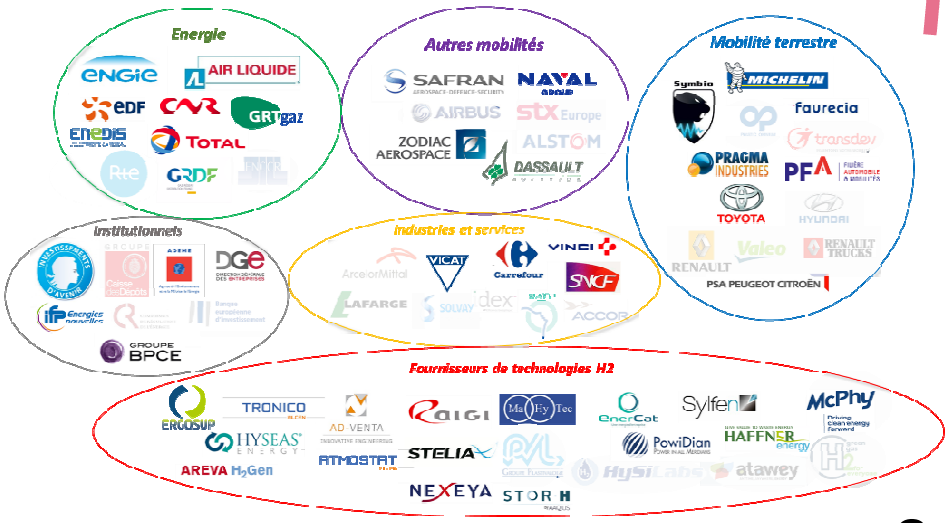
- In June 2018, the Minister presented the French strategy on H_2

Based on the report and containing several recommendation in order to start deploying H2

Objectives :

Define the role of H_2 for the energy transition

Define the French strategy for the Multiannual energy Plan (2018-2028)



Main findings of the report

- **H_2 is an opportunity to accelerate the energy transition**
- From a economic perspective, costs of electrolysis system have been rapidly decreasing over the last 5 years but scaling-up electrolysis production is needed in order to make it competitive
- H_2 is now the only storage technologies that can **provide inter-seasonal storage**
- Nevertheless, France has currently enough flexibility to integrate variable RES:

→ Studies suggest that the needs for inter-seasonal storage will arise when variable RES will reach 40-60% of the electric mix.

→ This will probably occur around 2035-2040 in France (mainland)

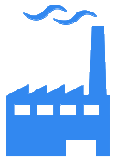
- H_2 also allows to decarbonize the gas sector **through direct feed-in of H_2 in the grid or through methanation (Power-to-gas)** and is one solution among others for **clean mobility**
- In the meantime and in order to allow for cost reductions, **other markets must be developed :**
  - Industrial H_2 (captive applications)
  - Mobility in the territories (intensive uses, heavy vehicles)
  - Grid services in French overseas (non-interconnected territories)

A plan for hydrogen

The hydrogen plan focuses on the 3 markets :

1

Industrial low-carbon H_2



Aim : Substitution of fossil H_2 by H_2 produced through electrolysis

➔ **Main opportunity to create the volume effect needed for scaling up**

Challenges: price, logistics

Quantitative (indicative) objectives:

- **2023 : 10% of low-carbon H_2 in the industry**
- **2028 : 20 to 40%**

2

Clean mobility

Advantages : zero emissions, autonomy, short charging time complementarity with EVs and NGVs, …

➔ **Captive fleets and heavy vehicles are key for the business models of charging stations**

Challenges: distribution infrastructure, broadening of the range of heavy vehicles (trucks, buses, trains…)

Quantitative (indicative) objectives :

- **2023** : 5 000 light commercial vehicles and 200 heavy vehicles (buses, trucks, train, boats) and 100 charging stations
- **2028** : 20 000 to 50 000 light commercial vehicles, 800 to 2000 heavy vehicles and 400 to 1000 charging stations

3

Flexibility for the power grids and decarbonation of the gas grids (i.e. inter seasonal storage, electricity/gas interactions) :
Main challenges: long term needs, technical and economic conditions, security

Example of actions:

- Determine the conditions for H_2 fed in the gas grids
- Scaling-up power-to-gas demonstrators
- Pilot projects in French Overseas regions providing flexibility to the power grid

Call for projects are being launched in order to help financing the first H_2 deployment projects on the 3 main areas : industry, transport and energy

Proposals for H_2 deployment in France

- **Decarbonize industrial H_2 with electrolysis**

  For some applications, H_2 can reach 10 to 20 €/kg → there could be already profitable applications for electrolysis

  Issues : reduce the cost for electrolysis systems (technology improvement, scale effects through mass production), electricity prices (value grid services ?)

  ➔ **Need for investment aid allocated through a call for projects**

  ➔ **Creation of a traceability system for H_2 by 2020 (guarantees of origin)**

  ➔ **Taking into account the production source of hydrogen in Greenhouse gas emissions regulation (GHG audit)**

- **Development of H_2 mobility**

Need for a regulatory framework for H_2 stations (security issues) → published during the summer

Focus on intensive uses : develop captive professionals fleets (this model allows for the station to be profitable thanks to high utilization rates) with an investment aid

Broaden the range of vehicles : support through research programs in order to develop heavy vehicles (heavy trucks, boats, trains, …), where hydrogen makes more sense

Proposals for H_2 deployment in France

- **Support projects and local communities**

  The French energy agency (ADEME) has a recognized expertise in this respect

  The ADEME will be in charge of :

  - Coordinating and assisting the communities and stakeholders with their H_2 projects
  - Redirecting stakeholders to the relevant institutional partners (regulation, financing)

- **Additional studies to prepare for the long term :**
  - Prepare for power to grid : study to be managed by the gas TSO and DSOs for determining the injection conditions for H_2 (maximal %, security of installations)
- **Ensuring the stakeholders involvement**
  - “Green deals” will be elaborated with the stakeholders during 2018/2019

Thank you