How to deploy hydrogen-based mobility

Dr. Florent Petit – March 27, 2014
Hydrogen cars are already on the road

Honda FCX Clarity
weight: 1600 kg
Power: 100 kW (136 ch)
Vmax: 160 km/h
-30°C
Compressed hydrogen (350 bars): 171l
Driving range ~ 300-500 km
Hydrogen cars are already on the road

**Toyota in-house research since 1992 - First prototype FCHV in 1996**

<table>
<thead>
<tr>
<th>Toyota FC stack</th>
<th>FCHV-adv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Max speed</td>
<td>155 km/h</td>
</tr>
<tr>
<td>Range</td>
<td>790 km</td>
</tr>
<tr>
<td>Temperature</td>
<td>Down to -30°C</td>
</tr>
</tbody>
</table>
Hydrogen cars ready for market?
• Technology road map  cost - reliability management

So what exactly is the problem?
So what exactly is the problem?

- Technology road map
- Chicken & egg syndrom

cost - reliability management
So what exactly is the problem?

- Technology road map
- cost - reliability management
- Chicken & egg syndrom
- Soci(et)al acceptance?
So what exactly is the problem?

- Technology road map  
  cost - reliability management

- Chicken & egg syndrome

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So what exactly is the problem?

- Soci(et)al acceptance?
  Value for customer
  Value for industry
  Value for society
Among key findings -

✓ VE: competitive from 2025 on
✓ Long driving-range: FCEV are a good alternative to PHEV
✓ Infrastructure: 1 M vehicles 2020 → 3 Md€

(*) 27 companies + 3 NGO/gvts + Mc Kinsey
Downloadable report
Delivered at pump, w/o taxes/excises

Hydrogen cost
EUR per kg

- Small retail stations operating at low utilization drive high initial cost, but is required to allow vehicle adoption.
- High initial price is only necessary for relatively small volume of H₂.
- Production costs decrease significantly after 2020 due to IGCC and CG.
- Minimal price decrease after 2025 is a result of relatively low learning rates and increase in natural gas price.

IGCC & CG plants start to be built

1 Coverage requirement sets area and retail station density requirements for vehicle adoption.

SOURCE: Study analysis
California H2 highway - Japan national program
German consortium – UK consortium

... and in France now

• Stratégic approach  H2 Mobilité France
• Operational level  MobyPost, MOBILHyTEst
Introduction, context and aims of the NIP

- H₂ Mobilité France, a consortium comprising representatives from industry and French Government, was formed in 2013 to develop a strategy for the rollout of hydrogen vehicles and stations in France.
- Developing hydrogen mobility will contribute to decarbonising surface transport, creating new economic opportunities for France, diversifying energy supply and reducing local environmental impacts of road transport.
- This National Implementation Plan sets out the rollout strategy, and defines the potential roles of consortium members and external stakeholders (such as regulatory bodies or Government).
- This document is the 2nd draft NIP and reflects the status of the H₂ Mobilité analysis as of March 2014. The final report will be delivered in April 2014.

Overview of H₂ Mobilité France participants

- French and European public entities

- Vehicle OEMs

- Hydrogen providers/producers and utilities

- Technology & equipment providers

- Regional representatives

Source: H₂ Mobilité France
Which vehicles, for which usages

0-emission logistics and delivery ➔ Batteries + H$_2$ Range Extender

Today: First EVs

Passenger vehicles ➔ PHEV (Electric + Fossil)

2 introduction pathways

2020-2025? H$_2$ infrastructure roll-out

Automobile mass-market

Courtesy of Symbio FCell
Hydrogen infrastructure and FCEV fleet developments: there are numerous H₂ activities underway and planned across France

**Nord Pas de Calais**
On-going study for short-term captive fleet & HRS deployment (2015)

**Ile de France**
Bus and boat projects in discussion

**Basse Normandie**
‘Energy hydro data 2020’ consortium. 1 HRS planned in 2014 with up to 10 FCEV, 40 FCEV within 2 years

**Pays de la Loire**
H₂ boat demo from 2015. Project of adding RE-FCEV with same HRS, budget in negotiation

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**Work in progress**

**Franche-Comté – Alsace – Lorraine**
Joint commitment under discussion for deployment of HRS, with link with Germany & Luxembourg. Lorraine Plan to deploy 2 HRS in short term
Cluster “Alpeha” in Lorraine and cluster “pôle Vehicule du Futur” in Franche Comté
MOBILHyTEst and MOBYpost : La Poste trialling 3 FC RE-EV and 10 FC quadricycles in 2014

**Rhône-Alpes**
Cluster “Tenerrdis”
3 existing stations and first FC cars. IKEA using FC forklifts
HYWAY: 50 FC-REEVs and 2 HRS to be deployed by 2014-15

**Mid-Pyrénées**
Cluster “Phyrénées”, first public HRS opened in 2014Q1 in Albi, local production of green H₂

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FCEV in use  FCEV on order  ● Main cities  △ HRS – existing  △ HRS – planned

- Budget committed, road mobility activities underway or starting by 2015
- Consortia formed, mobility initiatives starting in medium term
- Interest from local governments / industry – projects being formulated
- H₂M initiatives outside France (UK, NL, DE, CH)
- H₂ production (green: from PV or wind energy, or from waste biogas)
- H₂ production (by-product)
- H₂ production (Steam Methane Reforming)

Note: this map describes only some of the current H₂ activities
A bird’s eye view on H2 Mobility France

Phases of the HRS network rollout

- **Phase 0 Clusters**
  - Customer initiated growth, supported in local clusters
  - Buyers: Fleets, buyers

- **Phase 1 National**
  - HRS of clusters and growth of network to provide nationwide coverage
  - Buyers: Early adopters

- **Phase 2 Self-contained**
  - Profitable HRS
  - HRS network expands to less populated areas and in response to demand

**TRIGGERS**
- Supply of series FCEV
- Policy support

**MILESTONES**
- Evidence consumers will buy
- Gen II FCEV and cost decrease
- Regulation barriers addressed

**MILESTONE**
- Demand established (e.g. FCEV sales > 40,000 p.a.)
A bird’s eye view on H2 Mobility France
8 partners - 2011

Coupling between « solar » H2 with electric vehicles for mail
• Lead-user = La Poste
• Measure operational value of 0-emission longe-range vehicles for mail delivery
• Vehicles = 3 range-extended Kangoo ZE (Symbio Fcell) + 1 truck
  – 1-year experiment
  – 2 locations Luxeuil et Dole
  – Specific constraints: range, climate
MOBILHyTEst phase 1 - master planning

Preparation

Experiment

Data analysis
Phase 2

April 2013 – 1st sem 2014

June 2013

June 2014
(temporary) conclusion - where is the disruption?

• H2 in the energy transition?

• Electric vehicles vs. electrified vehicles?

• Electromobility + Connected / smart mobility + ... = ?

Source: www.bmw-i.fr
Thank you ...  

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