FCEV: Growing momentum and challenges of mass market deployment

March, 2nd 2018  |  Alena FARGERE, Hydrogen Energy World Business Unit
Innovative Financial Schemes for Low Carbon Mobility Infrastructure
Hydrogen has seven roles in the energy transition

1. Enable large-scale, efficient renewable energy integration
2. Distribute energy across sectors and regions
3. Act as a buffer to increase system resilience
4. Decarbonize transport
5. Decarbonize industry energy use
6. Serve as feedstock using captured carbon
7. Help decarbonize building heating
Hydrogen provides 18% of energy demand in a 2° world

18% of final energy demand

This document is PUBLIC
$280bn invested until 2030 build $140bn+ annual market

$ billion

Enable the renewable energy system → Storage, transport, and distribution → Decarbonize end uses

Hydrogen production

End-uses in transportation, industry energy, buildings and feedstock

<table>
<thead>
<tr>
<th>Investment potential 2018-30</th>
<th>Annual revenues 2030¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>$40 billion</td>
<td>$80 billion</td>
</tr>
<tr>
<td>$110 billion</td>
<td>$30 billion</td>
</tr>
<tr>
<td>$70 billion</td>
<td>$90 billion</td>
</tr>
<tr>
<td>$280 billion</td>
<td>$140 billion</td>
</tr>
</tbody>
</table>

¹ Excluding existing feedstock uses, considering only hydrogen value-added

This document is PUBLIC
Finding solutions to the infrastructure challenges

Main issues

- Under-utilization of Hydrogen Stations and “Valley of Death” periods
- Alignment of stakeholders (industry players, financial sector, policy makers)

Main opportunities

- Profitable business cases
- International scale up creates a virtuous circle

Open questions

- Use of virtuous policy/financial tools to derisk and accelerate scale up
- Use of dedicated shared investment vehicles

Advantages

- Attract private capital into H₂ infrastructure development (banks, funds)
- Limited impact on budget/public debt → Strong leverage effect

Source: IEA, H2 roadmap 2015

H₂ Station – cash flow curve

Cumulative annual cash flow of hydrogen refueling station network

Measure for optimising the business case:

- Reduction of investment costs
- Reduction of operational expenses
- Improvement of utilisation
- Public support

Valley of Death
2015 → 2017
The confirmation of a growing momentum
2015 → 2017: Building up scale all over the world!
US / California – the ZEV effect

Anaheim H2 station

FCEV’s:

- 2015: 100
- 2016: 1,200
- 2017: 5,000
- 2020: 18,000

H2 stations:

- 2015: 13
- 2017: 49
**US - Conquering the Northeast**

**Network of 12 Stations**

**Start-up over Q3-Q4 2017**

**Dedicated H₂ supply chain by**

**Project in collaboration with**

- **New York**
  - Bronx, NY
  - Hempstead, NY
  - Brooklyn, NY

- **Connecticut**
  - Hartford, CT

- **Massachusetts**
  - Braintree, MA
  - Mansfield, MA

- **New Jersey**
  - Site location TBA

- **Rhode Island**
  - Site location TBA

This document is **PUBLIC**
Germany – H2 Mobility: Deploying at full speed!

Air Liquide, Daimler, Linde, OMV, Shell and Total have agreed an action plan for the construction of a Hydrogen station network in Germany

- 400 Hydrogen Stations by 2023 (100 by 2017)
- 350m € investment
- Max. 90 km distance between each station on motorways
- 10 Hydrogen Stations in each metropolitan area

This document is PUBLIC
Germany infrastructure: Joint Venture H2 Mobility

Industrial gas Co.
Oil & Gas Co.
Equity ~50%

OEM
Small contribution

State
HRS CAPEX and OPEX
subsidy ~25%

H2 MOBILITY
FUELLING HYDROGEN

Banks
expected loan ~25%

● Network Planning
● HRS Procurement, Ownership & Operation
● H2 Procurement & Sales to end customer
● Customer value proposition & Branding
Japan: Largest H2 station infrastructure in the world

FCEV’s:

- 2015: 200
- 2016: 1,500
- 2017: 3,000
- 2020: 40,000

H2 stations:

- 2015: 40
- 2017: 92

Nagoya Atsuta
Japan infrastructure: Joint Venture under construction

- Network Planning
- HRS Procurement, Ownership; Operation outsourced
- Search for external stakeholders to secure financial support

Industrial gas Co. Oil & Gas Co.
Equity

OEM
Equity depending on cars ramp up

State
HRS and cars CAPEX and OPEX subsidy ~40%

National Infrastructure Consortium

Investors
Equity

Equity depending on cars ramp up
France: Innovative business models for clean mobility

HYPE Taxi Fleet Project - Paris

Launched in Dec. 2015, during COP 21

Air Liquide
Key Enabler of the project

FCEV taxi fleet

2016  2017  2020

10  70  600

An emission-free Paris
France infrastructure: Captive fleet within taxi business

- Cars ownership & operation
- Fast and significant HRS charge from D1
- Aligned deployment of cars and infrastructure
- External stakeholders secure financial support
Investments towards hydrogen on market development

Investments planned by Hydrogen Council members, in EUR billions per year

- Hydrogen Council members **plan to invest at least EUR 1.9 billion per year** in hydrogen technology for the coming 5 years.

- Investments in market introduction and deployment are growing and are showing the **beginning of commercialization**.
The case for acting now: Large-scale deployment initiatives underpinned by long-term policy frameworks to attract investors

Urgency to initiate scale-up to meet climate change targets

Hydrogen technology proven in a wide range of applications

Momentum in the industry – Hydrogen Council is established

Industry
Accelerate development and commercialization of products and build-out infrastructure to support large-scale deployment

Investors
Finance infrastructure and value chain development for large-scale deployment

Policymakers
Collaborate with industry to build national strategies and roadmaps and put in place long-term policy frameworks
2015 → 2017: Building up scale all over the world!

From 1,000 to 10,000 FCEVs!

From 100 to 300 H2 Stations!