FCEV Market Creation: H2 Economic Studies at NISSAN MOTOR

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June 26, 2014
Today’s Topic

Energy Supply Responsibility to future FCEV customers
H2 Business Creation

H2 is ... Stable? Vehicle price?
Affordable? Secured? Available?
Safe?

IS H2 PROFITABLE?

OEMs

CUSTOMERS

INVESTORS

NISSAN MOTOR CORPORATION

IEA H2 Workshop 140626
H2 Profitability in the far Future

Energy Cost Reduction by <CH2/ICEV→H2/FCEV>

- Crude Oil: €33B/y for 75M ICEVs
- Natural Gas: €10B/y for 75M FCEVs
- Energy Purchase Reduction: €23B/y (from 2010 Japan’s Statistics)

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<th>Japan</th>
<th>USA</th>
<th>Germany</th>
<th>UK</th>
<th>France</th>
<th>Norway</th>
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<tbody>
<tr>
<td>Crude Oil for Gasoline</td>
<td>€33B</td>
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H2 Profitability in the near Future

The ICEV in Japan from 1945

- It took over 60 years, even for Liquid Fuel (gasoline)
  - Technology Demonstration → Enough or Moderately needed
  - Economics Demonstration → Highly needed
Energy Cost Structures and the Risk

- Hydrogen Fixed Cost is twice as volatile as Gasoline Fixed Cost

**Gasoline**
- 100km $\rightarrow$ about €10(price) w/o tax

**Hydrogen**
- 100km $\rightarrow$ about €10(price) w/o tax

*JHFC 2nd report (2010)

\[ 1\text{€} = 100\text{JPY} \]

**Only if this equation holds**

**SUPPLY** = **DEMAND**
Business Sustainability: GRS

- Statistically, the ICEV price range starts from €10k in Japan
- The number of ICEVs per GRS PMA is 2,176 (about 2,000)

**SUPPLY**

Large GRS

2,000

**DEMAND**

2,000 (€10k over)

holds

*Primary Market Area: an area of neighborhood ICEVs (1-10km2/ST in Japan)*
Accumulated Sales Ratio

Source: Nissan

Price [JPY]

Accumulated Sales Ratio [%]

€10K

€50K

€10k or higher

€50k or higher

35.1% Copenhagen

26.8% Denmark

10.5% TOKYO

2.3% JAPAN

1€=100JPY
Business Sustainability: HRS

- “€50k or higher” is only 10.5% even in Tokyo (about 200)
- ICEV will be still attractive, FCEV may be 10% or less (about 20)
- “New car” is 8.6% of registered vehicles (about 2 per year)
Supply (HRS) and Demand (FCEV)

- Smaller HRSs (2,000 → 200) are needed to secure “Energy Supply Responsibility” in early business years.
- In parallel, the FCEV value needs to be enhanced (20 → 200) without increasing the FCEV price.

![Small HRS Diagram](image)

200 = holds

![FCEV Diagram](image)

from 2 to 200 (€50k over)

1€ = 100 JPY
Supply (HRS) and Demand (FCEV)

**H2 SUPPLY CAPACITY**

Station Downsizing

| FCEVs per HRS PMA | 2 | 20 | 200 | 2000 |

Value Enhancement

**FCEV CUSTOMERS**
FCEV Demand Creation by HRSs

A) Large HRS

@Price
Stations €5M x20

@Demand
Stations 200 x20
Demand Creation 4,000

B) Small HRS

@Price
Stations €0.5M x200

@Demand
Stations 200 x200
Demand Creation 40,000

Total Budget €100M

2,000 > 200

200 = 200
## H2 Price & Investment “Ceiling”

### H2
- FCEV running cost target
  - FCEV fuel consumption
  - $\€0.06/\text{km} \times 100 \text{km/kg}$
- Variable Costs
- Fixed Costs + Profit
  - *Depreciation*

### Small HRS
- FCEV Annual Driving Range
- Annual H2 consumption
  - $100 \text{kg/year} \times \€2.5/\text{kg}$
- $\€250/\text{y} \times 10 \text{y} \times 200 \text{ FCEVs}$

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**EXAMPLE**

- Price Ceiling
  - $\€6.0/\text{kg}$
- Invest. Ceiling
  - $\€500k$
Price Projection: Small HRSs

- How far can HRS ‘Price per Customer’ keep constant?
  - Scaling Effect(+) vs. Mass-production Effect(-)

HRS Price per Customer

HRS Supply Capacity = Number of FCEVs Needed

Scaling Effect

Mass-production Effect

@€0.5M x 10

€5M x 1

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Portable: Rapid Expansion Capability

201X

Small and Portable

202X
Portable: A Historical Fact in Japan

Number of ICEVs supported by a 600L Portable GRS (1951)

SUPPLY side
- ex. 500L x 40 weeks
- 20,000 L/y

DEMAND side
- 988 L/y-ICEV(1951)
- 20 ICEVs
- 19,760 L/y

Source:
「トミナガ100年のあゆみ」
22 rows x 5 columns
= 110 Portable GRSs
Supporting 110 x 20
= 2,200 ICEVs
Usability: Driving Time to Stations

- ‘Adjacent Household Coverage’ in 10 min is easy to achieve 90%
- ‘Average Statistical Driving Time’ is, however, much shorter than 10 min*
  - Tokyo $\rightarrow (1.3x\frac{\pi}{2})$ min, Hokkaido $\rightarrow (2.8x\frac{\pi}{2})$ min

*to be submitted to elsewhere

Gasoline Station: 2159

Hydrogen Station: 75

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Energy Supply Responsibility

- 1st scenario can be **Subsidy-Sustained**
- Next scenario must be **Self-Sustained** (>X5 subsidy leverage*)
- Full deployment of a business package, consisting of small and portable HRSs and a relevant number of FCEVs, **has a strong impact** to OEM’s business decision in early business years

* P. Devlin, IEA Hydrogen Technology Roadmap North America Workshop, Jan 28th, 2014
Energy Supply Responsibility
to future FCEV customers
Thank you for your attention