6th International Workshop on Hydrogen Infrastructure and Transportation
11-12 Sep 2018
Country update: Japan

Katsumi YOKO-moto

Fuel Cell & Hydrogen Group
Advanced Battery and Hydrogen Technology Dept.
New Energy and Industrial Technology Development Organization (NEDO)
Today’s topics

1. Strategy for $\text{H}_2$ & FC in Japan
2. Current Status: FCV & HRS
3. Budget for Hydrogen and Fuel Cells
4. Current Topics of NEDO’s Program
1. Strategy for H₂ & FC in Japan

CABINET

Basic Hydrogen Strategy

Scenario for Strategy

METI

Strategic Roadmap

NEDO

R&D
“Basic Hydrogen Strategy”

- **2050 Vision:**
  - Position $\text{H}_2$ as a new energy option (following Renewables)

- **Target:**
  - **$\text{H}_2$ Volume:** 300k t/y by 2030 $\Rightarrow$ 5~10m t/y
  - **$\text{H}_2$ Cost:** $3$/kg by 2030 $\Rightarrow$ $2$/kg

1. Strategy for H₂ & FC in Japan

"Scenario for Basic Hydrogen Strategy"

Present picture

- Fossil fuel-based hydrogen (by-product hydrogen, natural gas reformation)
- Supply chain development and demonstration, scale-up
- (Present) 200 (commercial supply chain capacity)
- (2020) 4k
- 5~10m + α (depending heavily on consumption for power generation)
- (R&D stage)
- ~10 (hydrogen station price)

2030

- Developing international hydrogen supply chains
- Developing domestic Power-to-Gas for renewable hydrogen supply
- CO₂-free hydrogen (Brown coal combined with CCS, utilizing renewable energy)
- 300k (commercial supply chain capacity)
- 2 (1/5 or less)
- ¥17/kWh (Commercial stage)

Target future picture

- Scale-up Substantial cost cuts
- 5~10m + α (depending heavily on consumption for power generation)

Use

- Hydrogen stations
  - (Present) 100
  - (2020) 160
  - Halving hydrogen station costs
- FCV/Hydrogen stations becoming independent
  - (Present) 25k
  - (2020) 40k
  - (2030) some 900
- Strategic hydrogen station development, regulatory reform, technological development
  - FC buses
    - 100
  - Forklifts (ton)
    - 40
  - 500
- Relevant government organizations cooperating in developing hydrogen supply networks
  - Ene-Farms becoming independent
    - 230k
  - 5.3m

Mobility

- Replacing gas stations
  - 1.2k
  - 10k
- Replacing conventional gasoline mobility
  - Introducing large FCVs
- Replacing traditional residential energy systems
  - Number of gas station: 31,500

Cost ($/kg)

- Natural gas imports: 85 million t/y
- Natural gas import price: $1.6/kg
- Unit LNG power generation cost: ¥12/kWh
- Fossil power generation capacity: 12GW
- Number of gas stations: 31,500
- Number of passenger cars: 62 million
- Number of households: 53 million
1. Strategy for H₂ & FC in Japan

“Strategic Roadmap for Hydrogen & Fuel Cell by METI”

**Phase: 1**
A dramatic increase of Fuel Cells Installation
- 2009: Residential FC
- 2014: FCV

**Phase: 2**
Hydrogen Power Plant/ Mass Supply Chain
- Accelerate RD&D
- Introduction support and R&D
- 2nd half of 2020’s: Enhance Supply Chain in Japan
- Around 2030: Hydrogen Power Plant

**Phase: 3**
CO₂-free Hydrogen
- Around 2040: Full Scale CO₂-free Hydrogen

- FCV: Fuel Cell Vehicle
- HRS: Hydrogen Refueling Station
### Residential Fuel Cells

**Targets**
- 1.4 million units by FY2020
- PEFC: 800,000 yen (approx. $7,000) by FY2019
- SOFC: 1,000,000 yen (approx. $8,800) by FY2021

Marketed in 2009

- Around 250,000 units

### FCV & HRS

**Targets**
- **FCV**
  - 40,000 by FY2020
  - 200,000 by FY2025
  - 800,000 by FY2030
- **HRS**
  - 160 by FY2020
  - 320 by FY2025

- 100 Stations Opened (11 planned)
- 2,500 FCVs deployed

**Current Status:** Fuel Cell application
2. Current Status: FCV & HRS

**FCV: 2,500 on road**

**HRS: 100 in operation + 11 planned**

150t-H$_2$ in 2017

Initial installation in 4-major-populated areas
3. Budget for Hydrogen and Fuel Cells in FY 2018

METI’s Total: 28.4 billion JPY (260 million US$)

Not including subsidy for FCV
4. Current Topics of NEDO’s Program

- Development of Technologies for Realizing a Hydrogen Society (2014~2020)
- Advancement of Hydrogen Technologies and Utilization Project (2014~2022)
- Development of Technologies to Promote Practical Application of SOFCs (2013~2019)
- Development of Technologies for Hydrogen Refueling Stations (2018-2022)

- Hydrogen
- Fuel Cell

New !!!
4. Current Topics of NEDO’s Program

New Project of “Development of Technologies for HRS”

To make HRS independent by the 2nd half of 2020s, R&Ds are as follow:

① To address Regulatory reform on HRS/FCV
   - To operate unmanned HRS (self-HRS) with remote monitoring
   - To perform Risk Assessment on HRS
   - To expand the scope of steel types, such as Stainless Steel

② Cost Reduction for both Operating and Installation Cost

③ International Collaboration
   - To promote technological development for International Standardization etc. (ISO, HFCV-GTR・・・)
   - To cooperate with relevant organizations
4. Current Topics of NEDO’s Program

② Cost reduction of HRS

Aim to reduce

① Installation cost to 230 million yen by around 2020.
② Annual operating cost to closer to 20 million yen level.
(except for depreciation expense)  
(as of the end of 2015)

**Breakdown of costs for installation**

- **Compressor**: 1.1
- **Construction cost**: 1.2
- **Pressure accumulator**: 0.4
- **Dispenser**: 0.3
- **Pre-cooler**: 0.2
- **Other equipment**: 0.4

Total cost for establishment: About **360 million yen**

**Breakdown of operating cost**

- **Employment cost**: 11
- **Electricity expense**: 2
- **Repair expense**: 23
- **Other costs**: 4

Total cost for management: About **40 million yen**

* Average amount of grant money applied (as of FY 2015) (fixed off site 300 Nm³/h)
* Meanwhile, please note various facility expenses that are not covered by the support will be needed in addition to the above.

[Source] Created by the Agency for Natural Resources and Energy based on amount of grant money applied for projects for installation of hydrogen supply facility and reported amount of actual benefit.
4. Current Topics of NEDO’s Program

② Cost Reduction for both Operating and Installation Cost (continued)

To achieve the target,

- Development of Polymer materials for Gas seals and Dispensing Hoses

- Development of life-extension method of Ground storage pressure vessels

- Development of refueling method for reducing cost (Possibility of higher temperature etc)

- Development of new type compressor, such as Electro-chemical compressor

etc
4. Current Topics of NEDO’s Program - Others

◆ Hydrogen Supply Chain / Gas Turbine:
  - Developing combustor for Hydrogen Gas Turbine (continued)
    Dual fuel (NG & H2), 100% H2 fuel
    Several hundred MW, Several MW
  - Developing hydrogen supply chain (continued)
    Liquefied Hydrogen, MCH

◆ Power to Gas:
  - PtG with 10MW class electrolysis (continued)
    @ Fukushima Prefecture: Distribute H2 to Tokyo 2020 Games
  - Basic research for electrolysis (NEW project)
    Analyzing reaction mechanism, develop lifetime evaluation,
    (Alkaline, PEM, SOEC)
Hydrogen gas turbine demonstration project

1MW dual fuel Gas Turbine (LNG & H2)
Provide Heat and Power
Current Topics (Demonstration)

New “Power to Gas” : start construction in July 2018 @ Fukushima Pref.
With 10MW electrolysis / provide H₂ to Tokyo 2020
Thank you for your kind attention!