Honda FCV Development and Toward Hydrogen Society

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  • Recognition of Issue
  • Toward Next Generation technology
  • Introduce SHS and Power Exporter

■ Fuel Cell Electric Vehicles as a Viable Alternative
  • FCV Development history
  • Honda FCV Development Status
  • FCV Expansion Barriers

■ Summary
Energy and Environmental Issues

Running on naturally generated hydrogen

Fuel cell technology

Energy (Sustainability)

Renewable fuels

Global warming (CO₂, GHG)

Emissions (VOC, NOₓ, CO)

Reducing CO₂

Reducing emissions

Severity of Issue

2000

Present

FCV (Zero CO₂ emissions)
Environmental Vehicle Initiatives at Honda

Focus our efforts on further enhancing HEV performance as well as on PHEV and zero emission vehicles.
Concept toward the Hydrogen Society

- 風力 (Wind)
- 水力 (Water)
- 太陽光 (Solar)
- バイオマス (Biomass)

Generate Hydrogen

Use Hydrogen

Get Connected with Hydrogen

Power Exporter

Power Manager

H2 (Hydrogen)

CLARITY FUEL CELL

HONDA
The Power of Dreams

Prototype FCX FCX CLARITY CLARITY FUEL CELL

Use

Fundamental Research Generate


EX500 Inverter Mobile Inverter

Get connected

V2H (2013~ V2L (2014~)
**Smart Hydrogen Station (SHS)**

- **Simple**
  - 1 day installation connected water and electricity (without groundwork)

- **Small**
  - Small package type (10ft Container 3m×2.5m)

- **Sustainable**
  - Hydrogen production from Renewable energy and the other low carbon power

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**Main Specifications**

<table>
<thead>
<tr>
<th>items</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Flow rate</td>
<td>1.5 kg/Day (0.7Nm³/h)</td>
</tr>
<tr>
<td>Pressure</td>
<td>35 MPa (40 MPa)</td>
</tr>
<tr>
<td>Storage</td>
<td>19 kg @15℃</td>
</tr>
<tr>
<td>Purity</td>
<td>&gt;99.99%</td>
</tr>
<tr>
<td>System Size</td>
<td>W3280 X D2140 X H2100 (m³) Foot-print App. 7 m²</td>
</tr>
<tr>
<td>Electrolysis Unit</td>
<td>High differential pressure electrolyzer</td>
</tr>
<tr>
<td>Refueling</td>
<td>Rapid refueling (2Banks•Cathode)</td>
</tr>
<tr>
<td>Utility</td>
<td>200VAC/Tap Water</td>
</tr>
</tbody>
</table>
Power Exporter 9000

“Get connect to Vehicle, Expansion to Living”

- Maximum power supply 9kW connecting to FCV
- High reliability accumulated Honda inverter business
- High quality AC power output
- High general-purpose properties based on V2L guideline
- Usable in outdoor and emergency

<table>
<thead>
<tr>
<th>AC100V 3kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply to standard home</td>
</tr>
<tr>
<td>Single phase 3 lines</td>
</tr>
<tr>
<td>100/200V 6kVA</td>
</tr>
<tr>
<td>Large capacity heater, Air conditioner Electromagnetic cooker</td>
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</tbody>
</table>

| Home | Emergency case | Storage Battery |

Demonstration

Vehicle to Home

Vehicle to Load (Disaster case)

※ Collaboration with DMAT (Disaster Medical support Team)

<table>
<thead>
<tr>
<th>Year</th>
<th>Model</th>
<th>Door</th>
<th>Passenger</th>
<th>Cold Temp. Performance</th>
<th>FC L/O</th>
<th>Separator</th>
<th>Body</th>
<th>Body Type</th>
<th>Range ※</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002.12</td>
<td>FCX</td>
<td>2</td>
<td>4</td>
<td>&gt; 0 °C</td>
<td>Under floor</td>
<td>Carbon</td>
<td>EV-Plus</td>
<td>Small 2 Box</td>
<td>360km</td>
</tr>
<tr>
<td>2004.11</td>
<td>FCX</td>
<td>2</td>
<td>4</td>
<td>-20 °C</td>
<td>Center tunnel</td>
<td>Stamped Metal</td>
<td></td>
<td></td>
<td>470km</td>
</tr>
<tr>
<td>2008.6</td>
<td>FCX Clarity</td>
<td>4</td>
<td>4</td>
<td>-30 °C</td>
<td>Under hood</td>
<td>Carbon</td>
<td>New body</td>
<td></td>
<td>620km</td>
</tr>
<tr>
<td>2016.3</td>
<td>CLARITY FUEL CELL</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
<td>Carbon</td>
<td>New body</td>
<td></td>
<td>750km</td>
</tr>
</tbody>
</table>

※ Driving in JC08 mode, figure measured by Honda
Clarity Fuel Cell Packaging

**MM Concept: Fuel Cell Sedan Package**

Man maximum Machine minimum

- High-efficiency package with fuel cell powertrain fitted under hood
- Optimal positioning of battery and hydrogen tank realizes comfortable sedan passenger space
- Luggage space large enough for 3 golf bags
New Honda FC Stack achieved 33% compactness compared to previous model. Volume power density achieved over 3.1kW/L.
Compact fuel cell system and drive unit

Voltage Control Unit
- Increases stack voltage to drive motor at high voltage
- Use of SiC power module enables size reduction with increased power output

Hydrogen supply system

Air supply system

Electric turbo compressor
- Air supply pressure: 1.7X previous model

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Vehicle dimensions: 4,915 x 1,875 x 1,480 mm
Number of passengers: 5
Driving range (Reference figure): App. 750km (Driving in JC08 mode; figure measured by Honda)
Fuel cell power: More than 100kW
Fuel cell stack power density: 3.1kW/L (Figure measured by Honda)
Hydrogen filling time: Around 3 minutes
Hydrogen tank filling pressure: 70MPa (700 atmospheres)

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*1 Figure measured by Honda after filling at a 70MPa hydrogen station employing standard conditions as specified by SAE standards (J2601). Because the volume of hydrogen in the tank may differ when filling at hydrogen stations with differing specifications, driving distance may also differ.

Driving distance also varies significantly as a result of the use environment (temperature, traffic congestion, etc.) and the mode of use (sudden takeoffs, air conditioner use, etc.).

*2 Differences in filling pressure and external air temperature may result in differences in filling time.
Fuel Cell electric Vehicle: Issues Lying Ahead

- Performance
  - Size/weight reduction

- Durability
  - Reliability
  - Thousands of hours

- Environment
  - Adaptability
    - Sub-zero startup
    - Heat dissipation at high temperatures

- Driving Range
  - Hydrogen storage

- Quality control
  - Cell uniformity

- Cost
  - Reduce platinum use
  - Mass production technology

• Hydrogen infrastructure
• Fuel cost

• Related regulations still in preparation
• Need for common international standard

Range, Environment adaptability and Performance are received vision from past developments. Durability, Reliability, Quality control and Cost reduction have a characteristics affected one other.
Building a new ecosystem together and delivering joy to customers throughout the world

“Contributing to the electrification of mobility modalities for which the use of batteries is challenging”

Production of fuel cell systems
Establishment of JV

Honda Fuel Cell Power

Zone of hydrogen/FC advantage

Zone of battery advantage

Vehicle weight
Travel distance

Sea
Rail
Sky

Road

hydrogen $H_2$
For low CO2 emission community, Hydrogen is very promising energy buffer of easily converting to electricity.

Vehicle electrification is the main pathway toward reduced greenhouse gases and a shift to alternative, renewable sources of energy.

Honda work positively to develop the various technologies to realize the future hydrogen society, based on concept of “Generate”, “Use” and “Get Connected”.

Honda delivered Fuel Cell Vehicle named “CLARITY FUEL CELL” and must continuously tackle to reduce cost and to establish quality control toward the future commercialization.

Fuel Cell has high potential for applying various applications.

A concerted effort among related industries/companies, the establishment of global standards and the creation of a hydrogen refueling infrastructure are also required if FCVs are to be marketed as scheduled starting.
BLUE SKIES FOR OUR CHILDREN