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Fuel Cell Vehicle Development and Toward Hydrogen Society Including “CASE” activities

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Contents



- Environment and Energy Issue
 - CASE & Background
 - 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
 - Recent Trends toward Introduction
- Summary

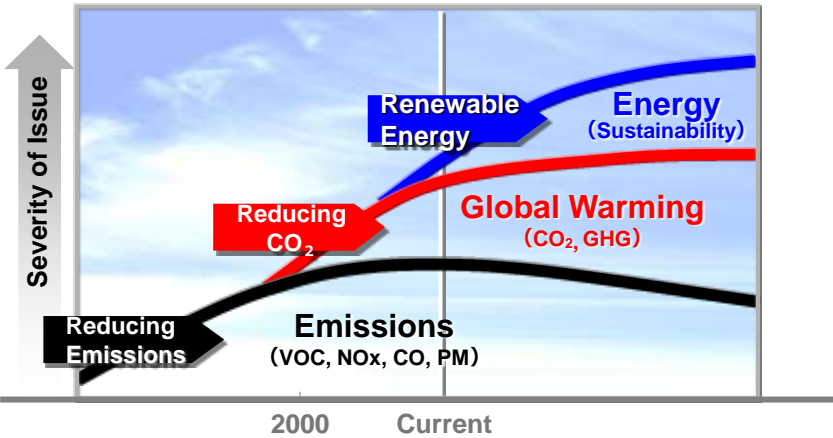
Issues of Environment and Energy

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OEMs must reduce CO2 exhaust emission because of yearly strengthening of Fuel Economy regulation in all countries.



3

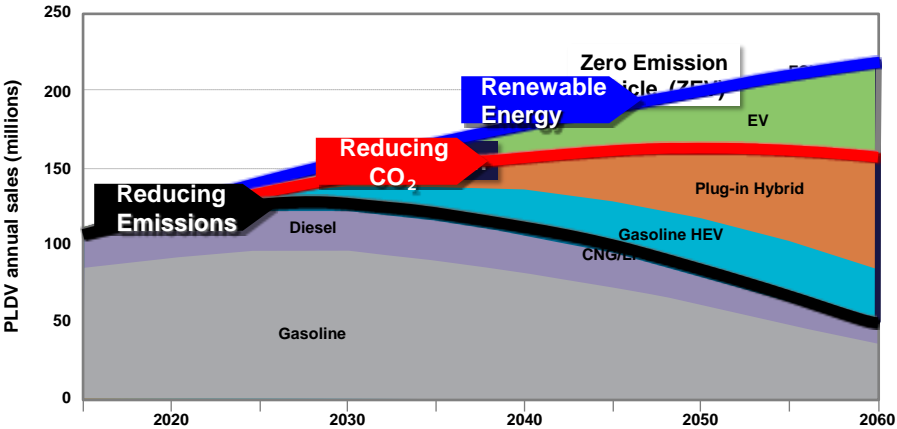
Vehicle sales prediction of IEA

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OEMs must tackle ZERO Emission Vehicle development toward the future.



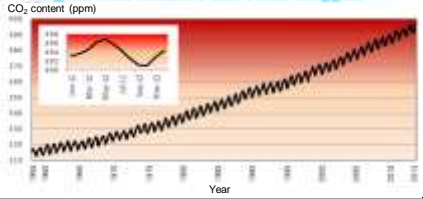
出典：IEA Energy Technology Perspectives 2017 Fig.5-3 2DS LDVs

4

Recent Movement

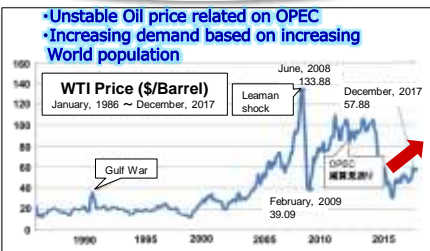
Climate Change

Keeling Curve Measured at Mauna Loa, Hawaii
 •Target : CO2 content holds down 450ppm.



Energy Demand and Supply

•Unstable Oil price related on OPEC
 •Increasing demand based on increasing World population



Global Environmental Issue

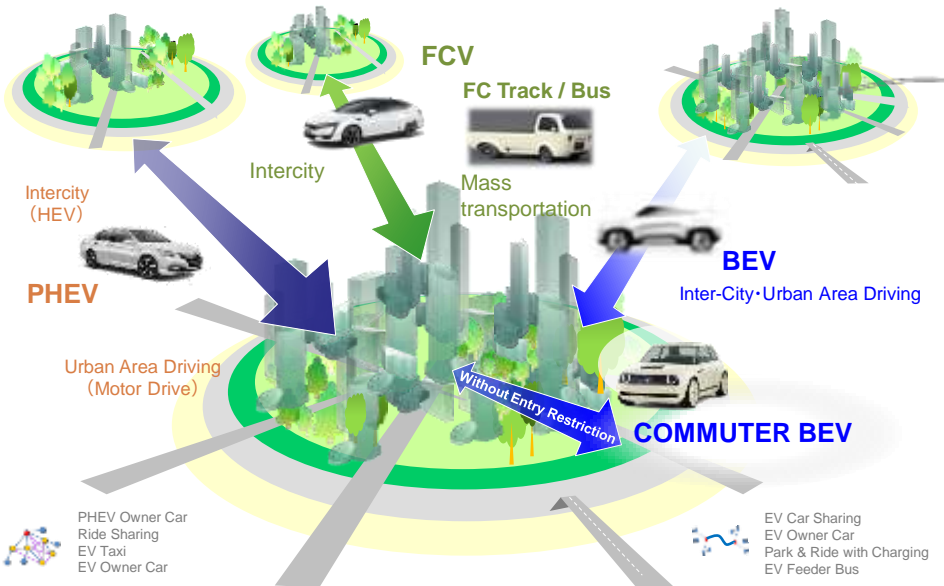


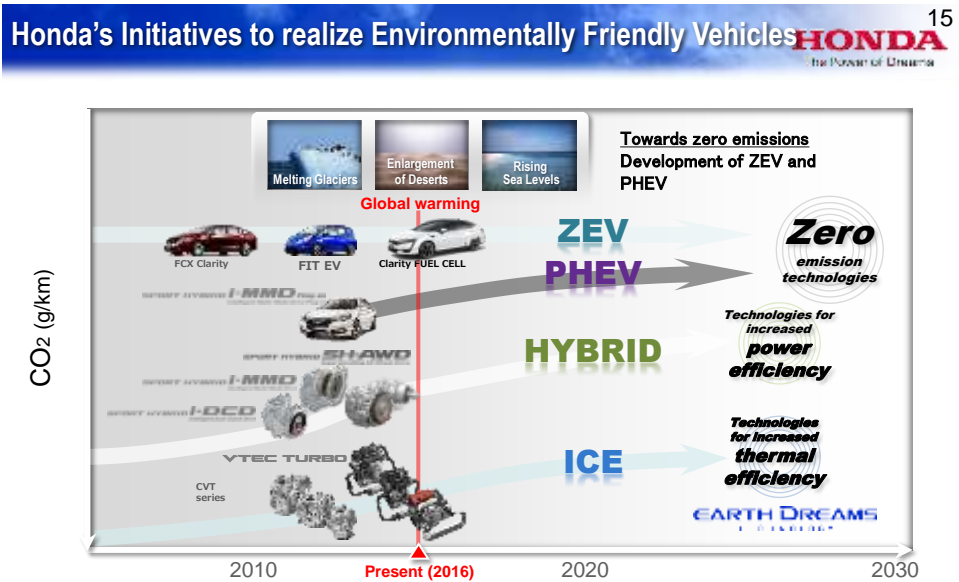
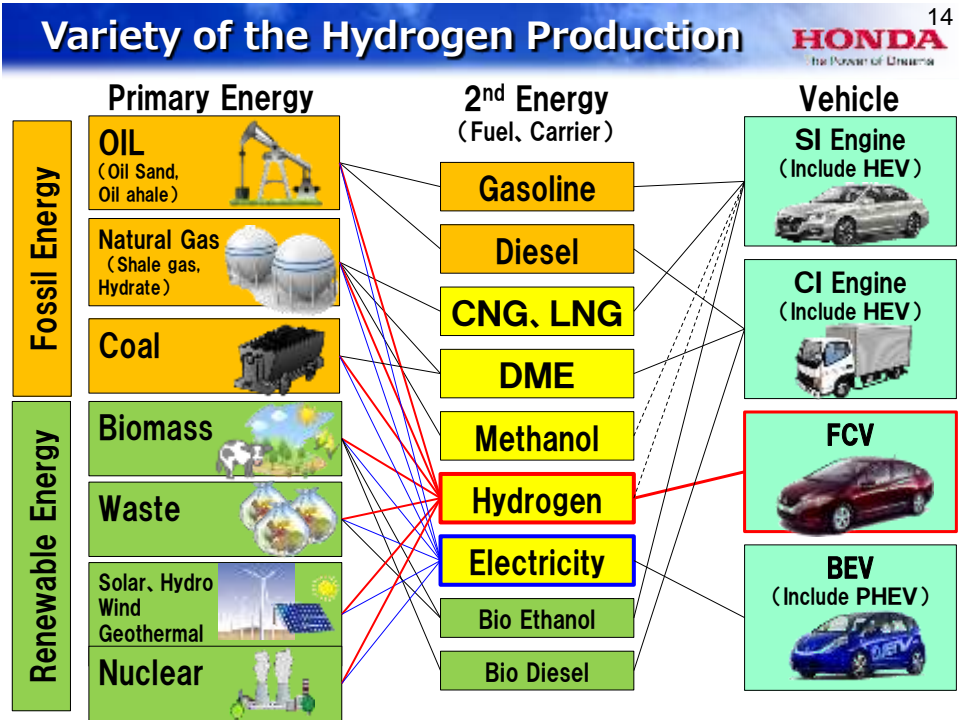
To reduce the exhaust GHG in the upper level in the range from 40% to 70% compare to 2010 GHG until 2050.

GHG reduction Targets at 2030

Country	Reduction Target
Japan	26% compared to 2013 (25.4% compared to 2005)
EU	40% compared to 1990
China	60~65% based on GDP compared to 2005
Russia	20~25% compared to 1990
USA	26~28% compared to 2005 until 2025

Role of PHEV BEV FCV



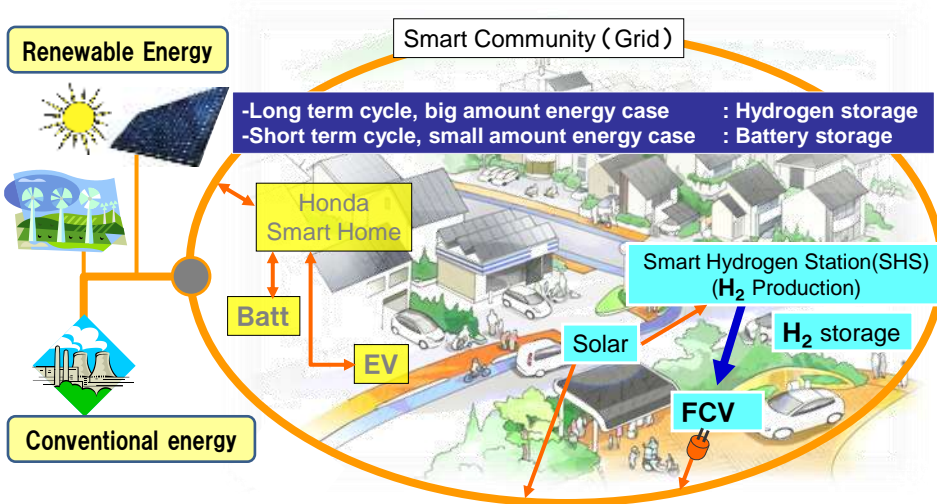


Honda will strive to make two-thirds of our overall unit sales by plug-in hybrid/hybrid vehicles and zero-emissions vehicles such as, FCVs and battery EVs by around 2030.

Smart Community using Hydrogen (Image)

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Renewable energy is usually not stable. Peak power storage is very useful for levelization of energy management in community. Hydrogen production, storage, transportation and usage are very important to achieve future smart community.

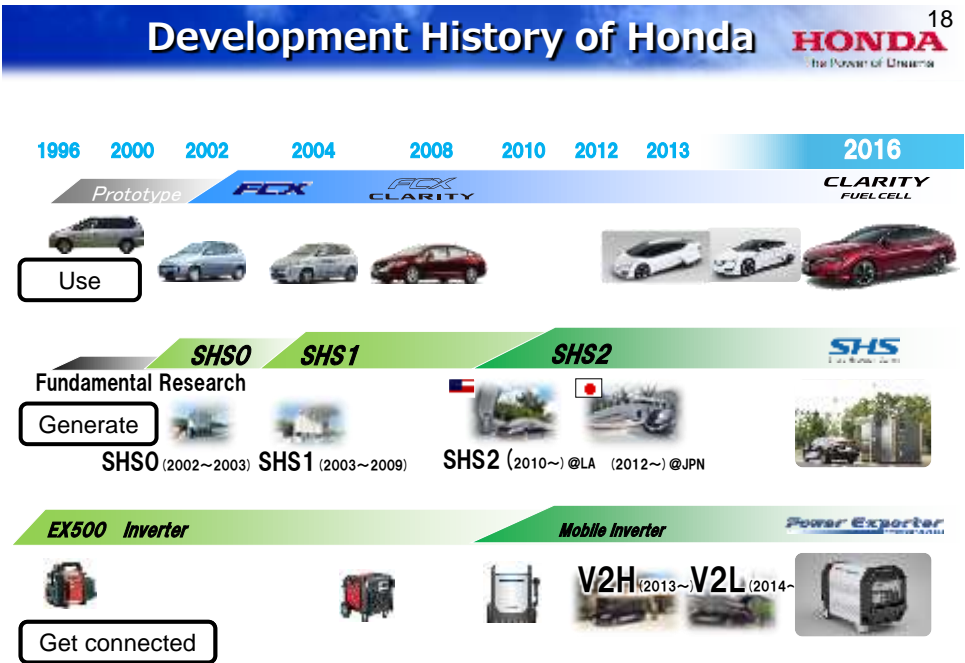
Concept toward the Hydrogen Society

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Producing hydrogen with renewable energy will realize a recycling-based society. Concept toward hydrogen society is consisted of "Generate", "Use", "Get connected".



SHS Deployment

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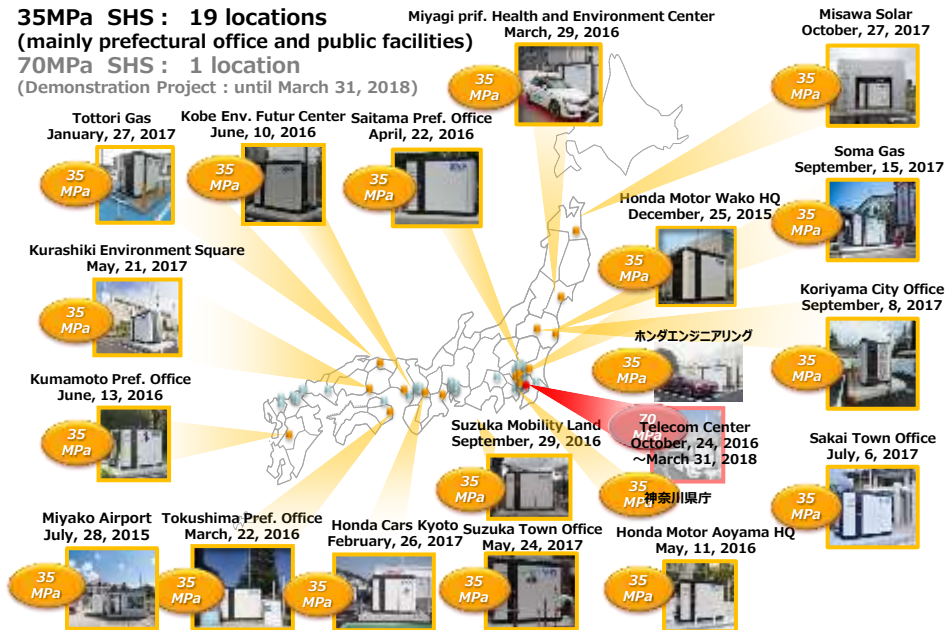
20

35MPa SHS : 19 locations

(mainly prefectural office and public facilities)

70MPa SHS : 1 location

(Demonstration Project : until March 31, 2018)



Power Exporter 9000

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“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

9kVA
Maximum Power Output



AC100V 3kVA

Power supply to standard home

Single phase 3 lines

100/200V 6kVA

Large capacity heater,
Air conditioner
Electromagnetic cooker



Home





Emergency case

Storage Battery

Honda FCV Development

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22

	2002.12 FCX  World First limited Sales In US and Japan	2004.11 FCX  First Japanese FCV Type certification	2008.6 FCX Clarity 	2016.3 CLARITY FUEL CELL 
Door	2	←	4	←
Passenger	4	←	←	5
Cold Temp. Performance	> 0 °C	-20 °C	-30 °C	←
FC L/O	Under floor	←	Center tunnel	Under hood
Separator	Carbon	Stamped Metal	←	←
Body	EV-Plus	←	New body	←
Body Type	Small 2 Box	←	Sedan	←
Range ※	360km	470km	620km	750km

※ Driving in JC08 mode, figure measured by Honda

Honda introduced FCV in 2002, and installed the first Honda-built fuel cell stack in 2004. Following that, lease marketing of the sedan-type FCX CLARITY began in 2008, and of the CLARITY FUEL CELL in March 2016.

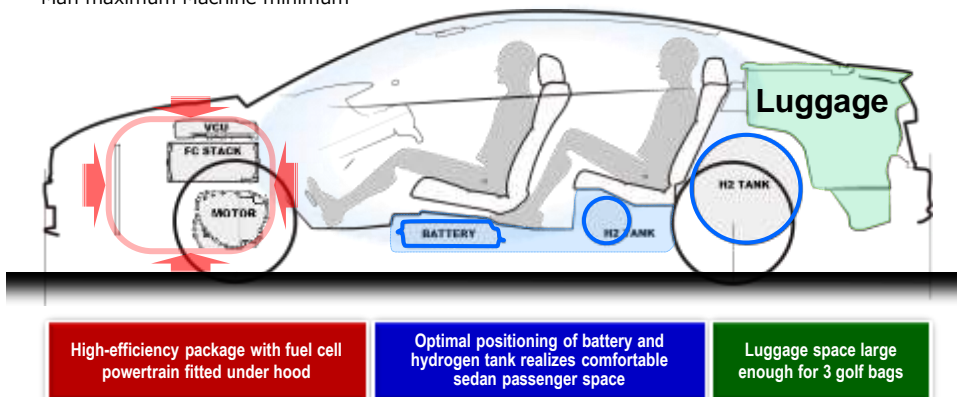
Clarity Fuel Cell Packaging

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MM Concept: Fuel Cell Sedan Package

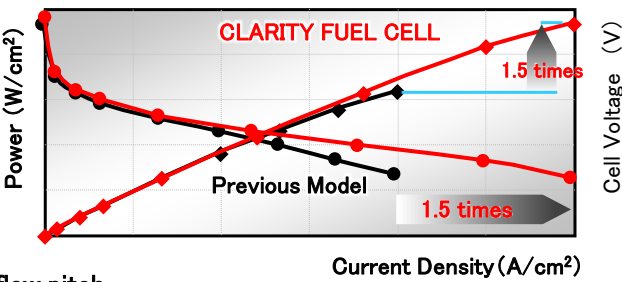
Man maximum Machine minimum



Improvement of generating performance 24



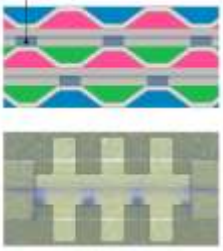
● Comparison of IV characteristics



● Narrow gas flow pitch

Gas diffusion is blocked by condense water.

Previous Model



Narrow gas flow pitch

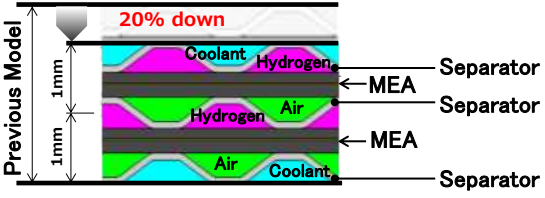
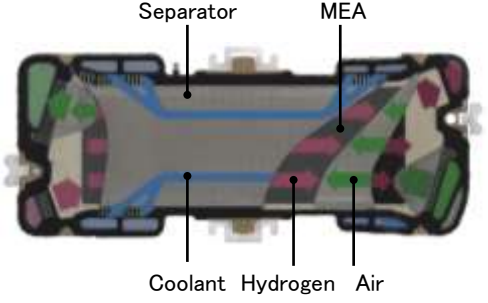
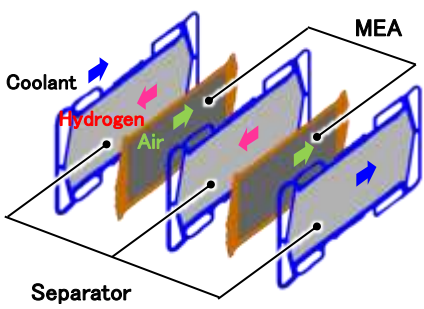
CLARITY FUEL CELL

Condense water exhaust performance was improved by narrow pitch.

Cell Structure 25



● 2 Cells cooling Structure

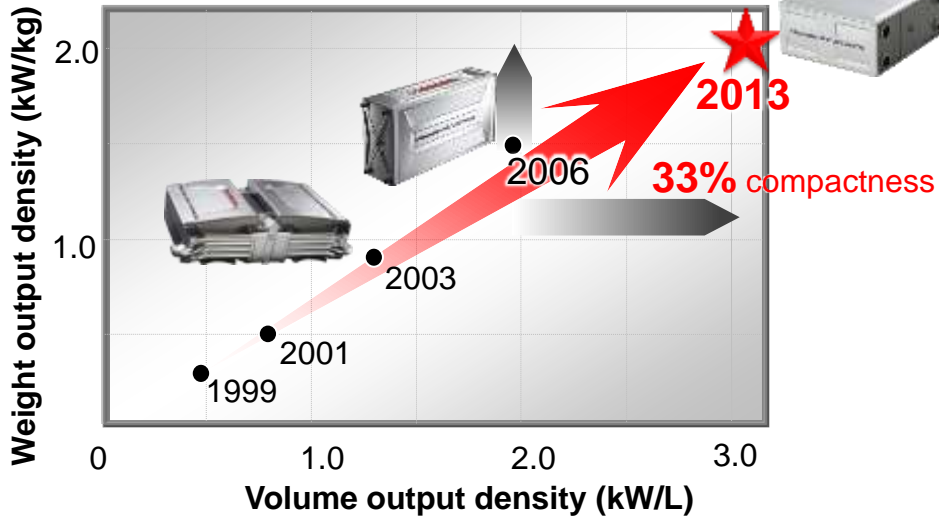


1 Unit (2 cells) is constructed by 2 MEAs and 3 separators.
1mm cell thickness is achieved by reduction of condense water.

New Honda FC Stack

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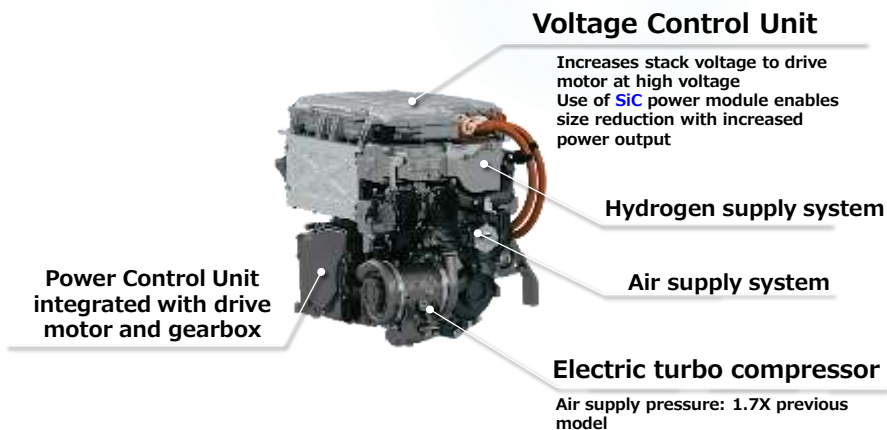
New Honda FC Stack achieved 33% compactness compared to previous model. Volume power density achieved over 3.1kW/L.

Fuel Cell Power Train

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Compact fuel cell system and drive unit



Fuel Cell Power Train is integrated compact fuel cell system and low height traction motor redesigned in order to install under engine hood.

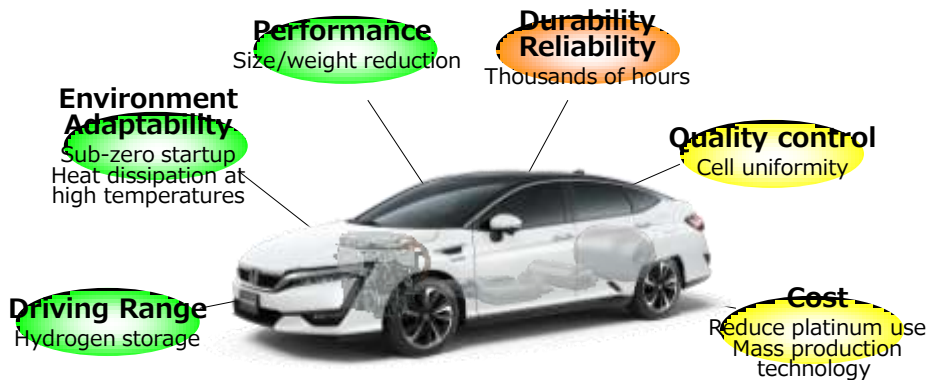


Vehicle dimensions	4,915 x 1,875 x 1,480 mm	
Number of passengers:	5	
Driving range (Reference figure)	App. 750km (Driving in JC08 mode; figure measured by Honda)	*1
Fuel cell power	More than 100kW	
Fuel cell stack power density	3.1kW/L (Figure measured by Honda)	
Hydrogen filling time	Around 3 minutes	*2
Hydrogen tank filling pressure	70MPa (700 atmospheres)	

*⁴ 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

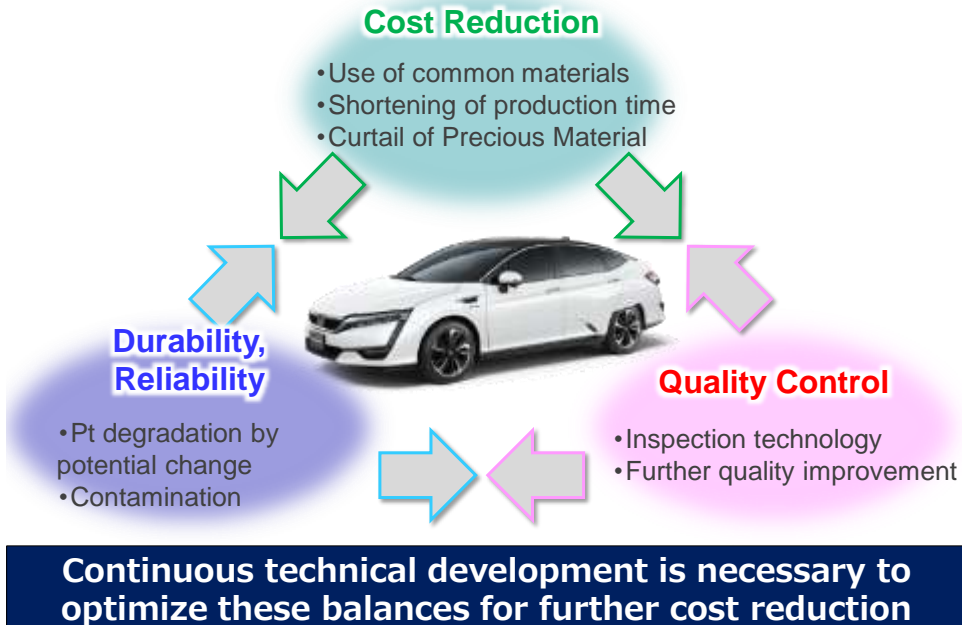


- Hydrogen infrastructure
- Fuel cost

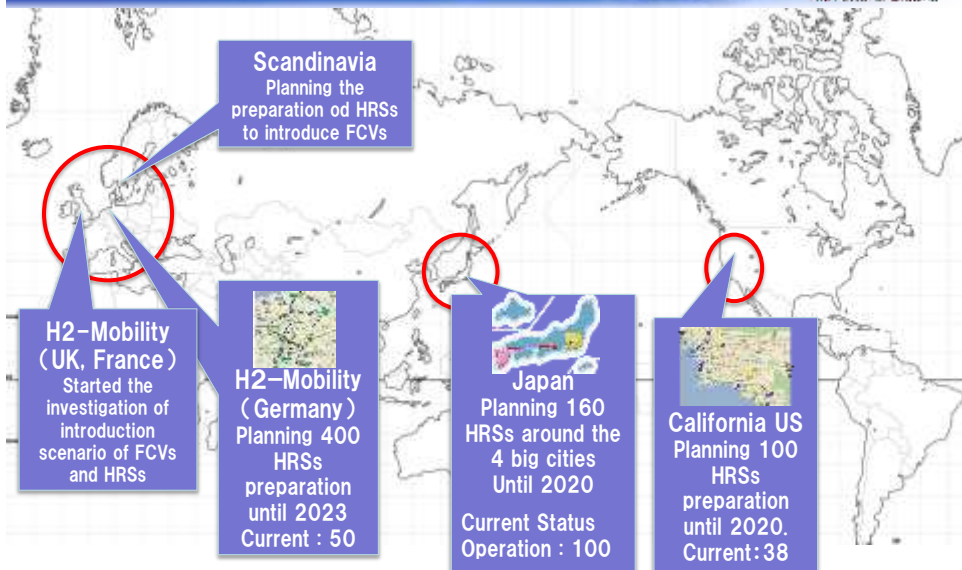
- Related regulations still in preparation
- Need for common international standard

Range, Environment adaptability and Performance are received vision from past developments. Durability, Reliability, Quality control and Cost reduction have a characteristics affected one other.

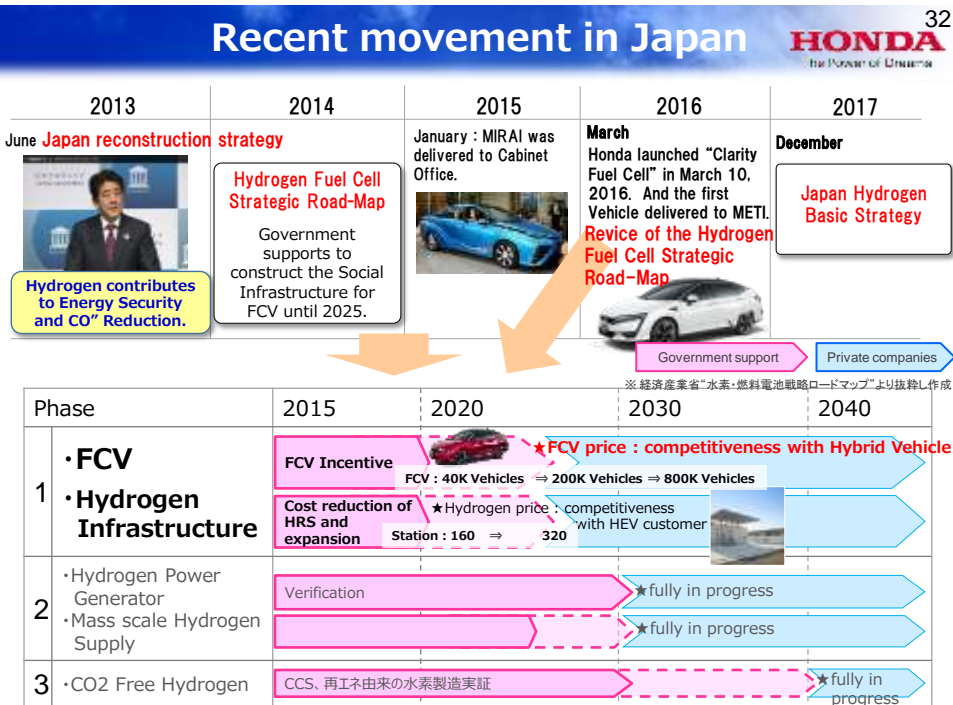
Future Works



Hydrogen Refueling Station (HRS) preparation




Several countries start to prepare the HRSs for introduction of FCVs. Japan has most aggressive activities cooperating between government and industry.



Establishment : January 18, 2017@Davos
 13 Companies ⇒ Current Members 53 Companies

Collaboration and Joint production with GM


Collaboration Contract (July 2, 2013)



34

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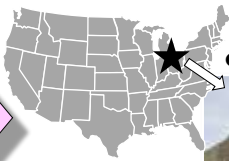
Announcement of Joint Venture establishment (January 30, 2017)




- Key1 One team
- Key2 Equal & fair relation
- Key3 Joint learning

➔

Fuel Cell System



● Browns Town (MI)



Fuel Cell System Manufacturing, LLC

Honda and GM collaborate on developing fuel cell systems for the next Generation FCVs around 2020, and produce in one factory.
 Also established Joint Venture (Fuel Cell System Manufacturing, LLC) in Brownstown, MI, US, and the fuel cell system that the company produces will be installed in FCVs that both companies release.


Roadmap to FCV Commercialization

35

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Technology Demonstration	Technology and Market Demonstration	Commercialization
2002~	2008~	2015 2020 2025~
<p>Honda launched "Clarity Fuel Cell" in March 10, 2016. And the first Vehicle delivered to METI in March 17.</p>	<p>Collaboration with GM toward 2020 (July 2, 2013)</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: left;"> <p>■ Sales expansion</p> <ul style="list-style-type: none"> • Affordable price <p>■ Expansion</p> <ul style="list-style-type: none"> • Cost down </div> <div style="text-align: left;"> <p>■ Sales to general public</p> <ul style="list-style-type: none"> • Cost • Production quality • More driving range </div> </div> <p>Announce the establishment of JV company with GM in US (January 30, 2017)</p>

'03M FCX



■ World's first FCEV


'05M FCX



■ Technology improved

- Cold start up

FCX Clarity



■ Expanding of a Lease

- Performance
- Durability
- Driving range

The image of hydrogen infrastructure deployment

Launch the CLARITY FUEL CELL in March 10, 2016.
 Expand the FCV collaborated with GM (technology and scale merit) in 2020
 Necessary for cooperation of Hydrogen Refueling Station toward the FCV expansion

- Automaker faces the “Reform term in once per 100 year” as represented by “CASE”. Honda has developed all “CASE” technologies and will keep hard development efforts in the future.

Hydrogen & Fuel Cell Development

- For low CO₂ emission community, Hydrogen is very promising energy buffer for easy conversion to electricity.
- Vehicle electrification is the main pathway toward reduced greenhouse gases and a shift to alternative, renewable sources of energy.
- Honda works positively to develop the various technologies realize the future hydrogen society, based on concept of “Generate”, “Use” and “Get Connected”.
- Honda delivered New Fuel Cell Vehicle named “CLARITY FUEL CELL” from the March of 2016 and must continuously tackle to reduce cost and to establish quality control toward the future commercialization.
- 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 date.



BLUE SKIES FOR
OUR CHILDREN

