Honda Clarity Fuel Cell
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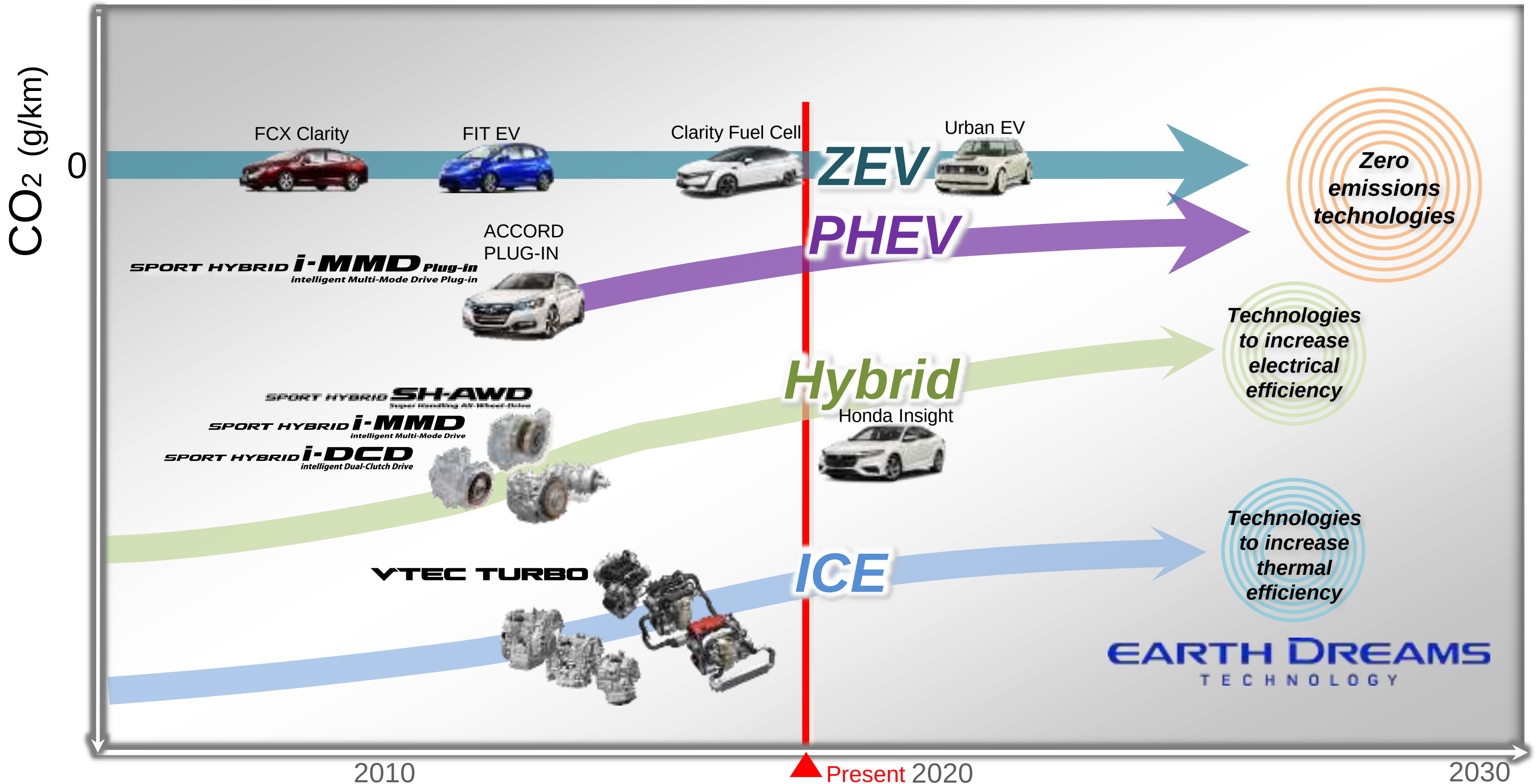
Two Thirds of Global Sales Electrified by 2030

Honda: 2/3rds of our vehicles will be plug-in or hydrogen by 2030

Two-Thirds Of 2030 Hondas Will Be Electrified Or Zero Emission: CEO

Honda CEO Shifts Focus to Electric Vehicles

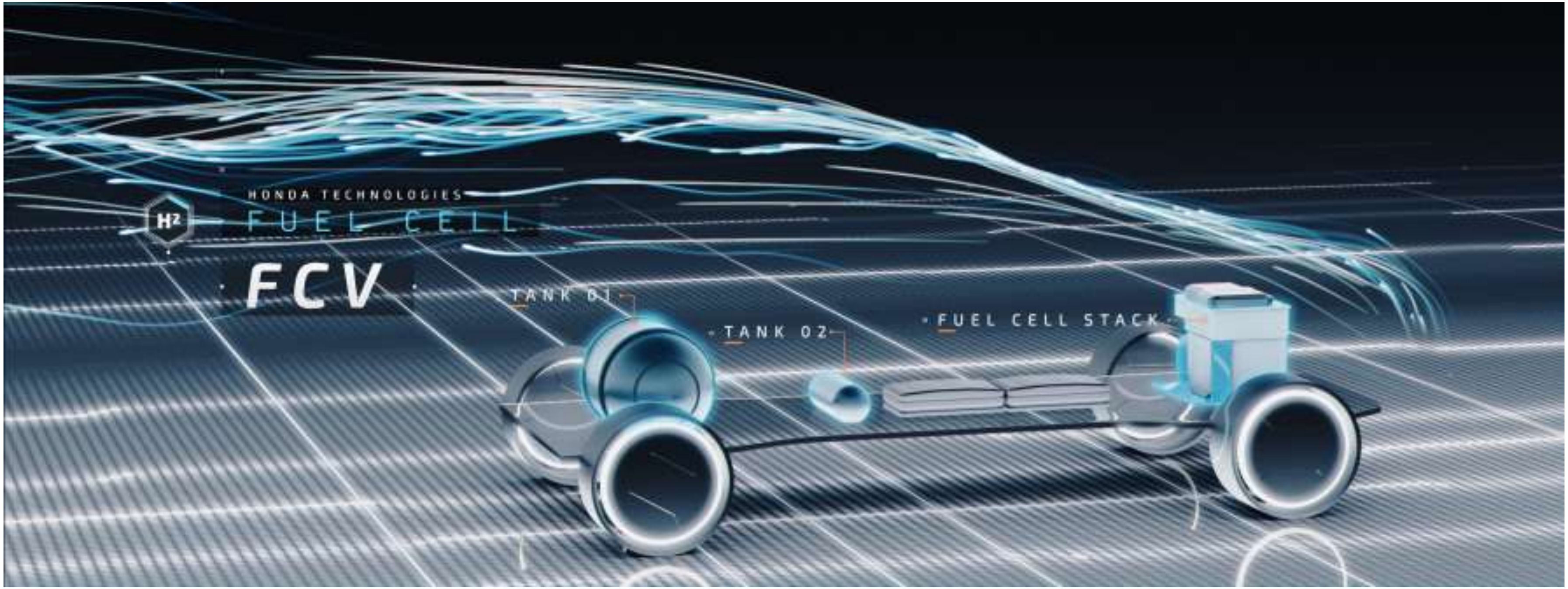
Powertrain Roadmap towards 2030



Two Thirds of European Sales Electrified by 2025

Two Thirds of European Sales Electrified by 2025

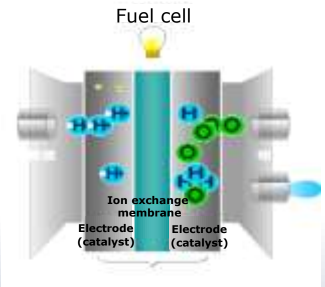
Fuel Cell – a core Honda Technology



Honda Fuel Cell Vehicle History

Late 1980s

- **Basic research**



1998

- **First experimental car** **named V0 in 1998.**

Could have been described as a

mobile chemical plant

First Odyssey-based experimental car accommodating one and a half people

1999

- **Next-gen experimental cars:**

(H2-absorbing alloy)

(On-board methanol reformation)

2000

- **Accelerated development of FCV with a high-pressure hydrogen tank to launch as world's first FCV for commercial use**

Honda Fuel Cell Vehicle History

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2002

- **World's first FCV for commercial use (U.S.-certified)**

2003 FCX

- **Operation (starts) in sub-zero temperatures**
- **World's first FCV leased to individual customers**

2005 FCX

2008

- **Leased to individual customers** (U.S. and Japan)

FCX Clarity


Scott Niedermayer


Jamie Lee Curtis

2016

CLARITY FUEL CELL

Deployment of H_2 infrastructure

Powertrain

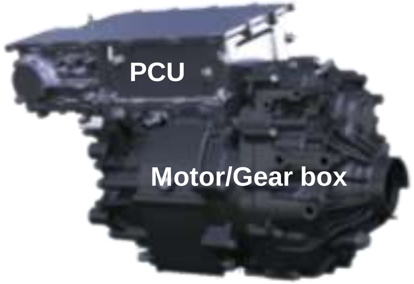
“Having everything expected of a saloon”

“more compact machine for people”
Man maximum **M**achine minimum

Powertrain

- Downsizing drive unit: reduction in height

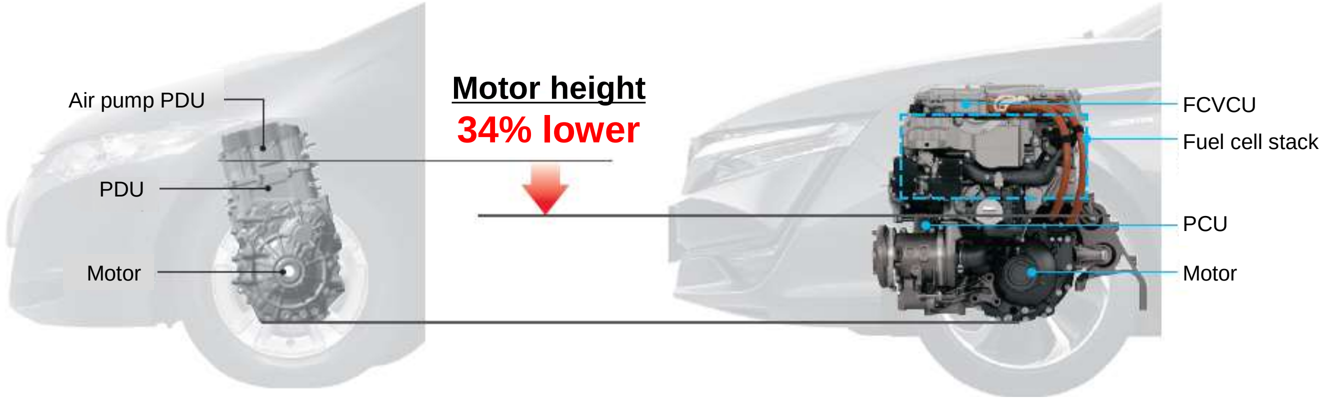
Previous model



New model

Create space above the drive unit

Rotate forward 90 degrees



Fuel Cell System

- Downsizing drive unit: reduction in height

Previous model

Downsizing the stack

Clarity Fuel Cell

Fuel Cell Stack System

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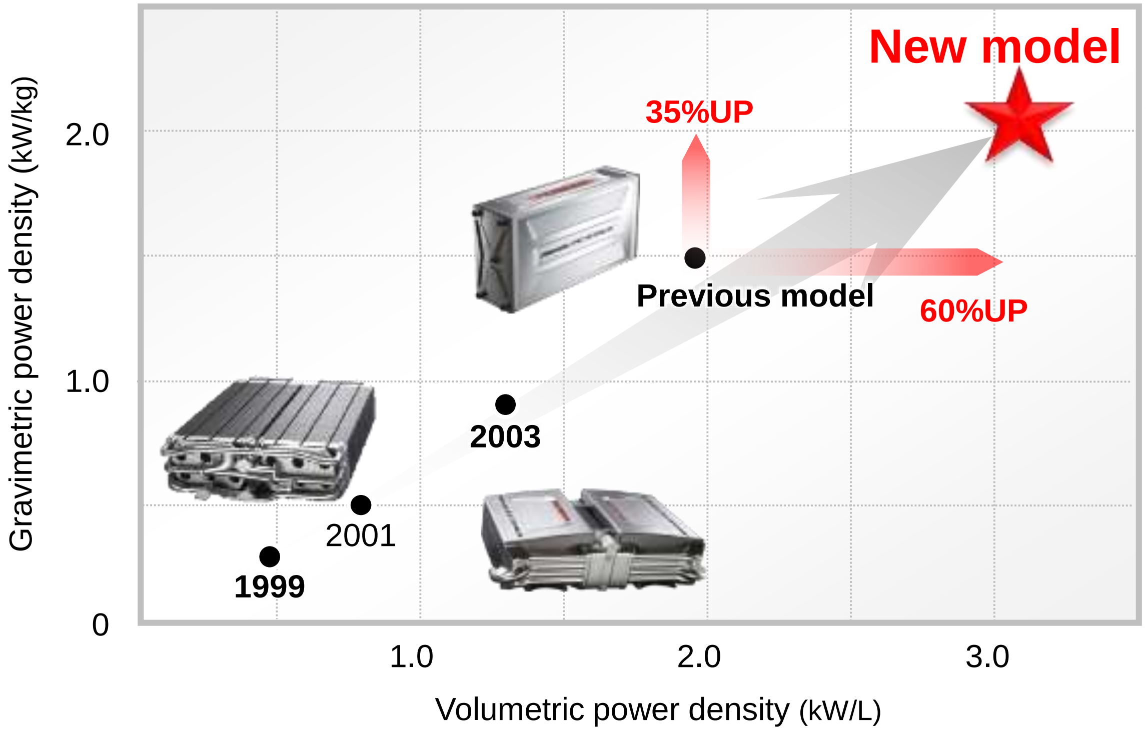
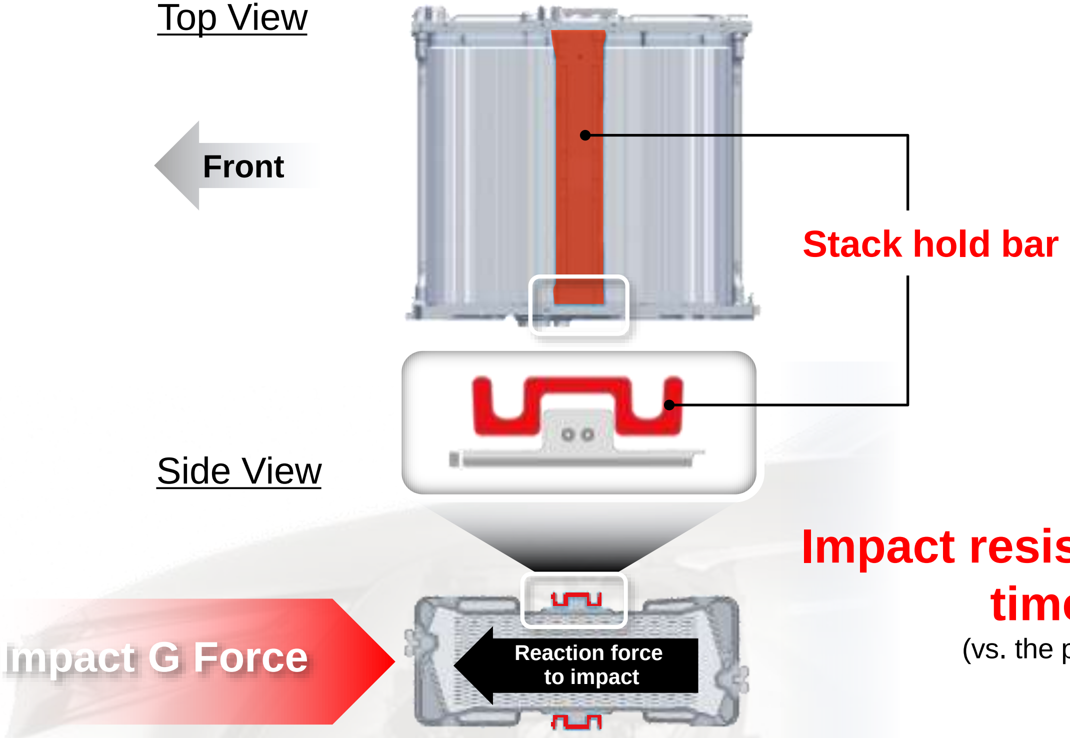
- Downsizing fuel-cell stack: evolution of the fuel cell stack

33% smaller (vs. Previous Model)



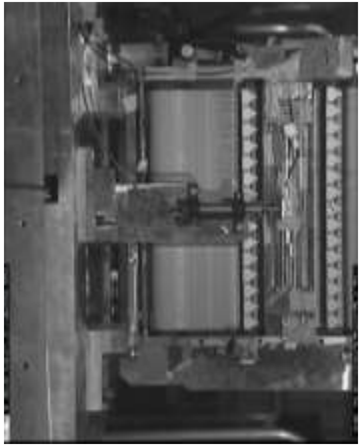
Fuel Cell Stack System Design

- Impact resistance of fuel-cell stack: impact-resistant structure to protect cells



Cross-section of the stack

- Conducted an impact resistance test on a single fuel cell stack



Impact resistance: 4 times better

(vs. the previous model)

World's first FC powertrain installed under sedan hood

- System configuration

Newly-developed FC boost converter (FCVCU)

Steps up the voltage of the stack. Drives the motor with high voltage. Small but high output because of a SiC power module.

Hydrogen supply system

Air supply system

Electric turbocharger-type air compressor

Air supply pressure: 1.7 times compared to previous model

Fuel cell stack

33% more compact

Drive unit

Drive motor, gear box, power control unit-integrated system

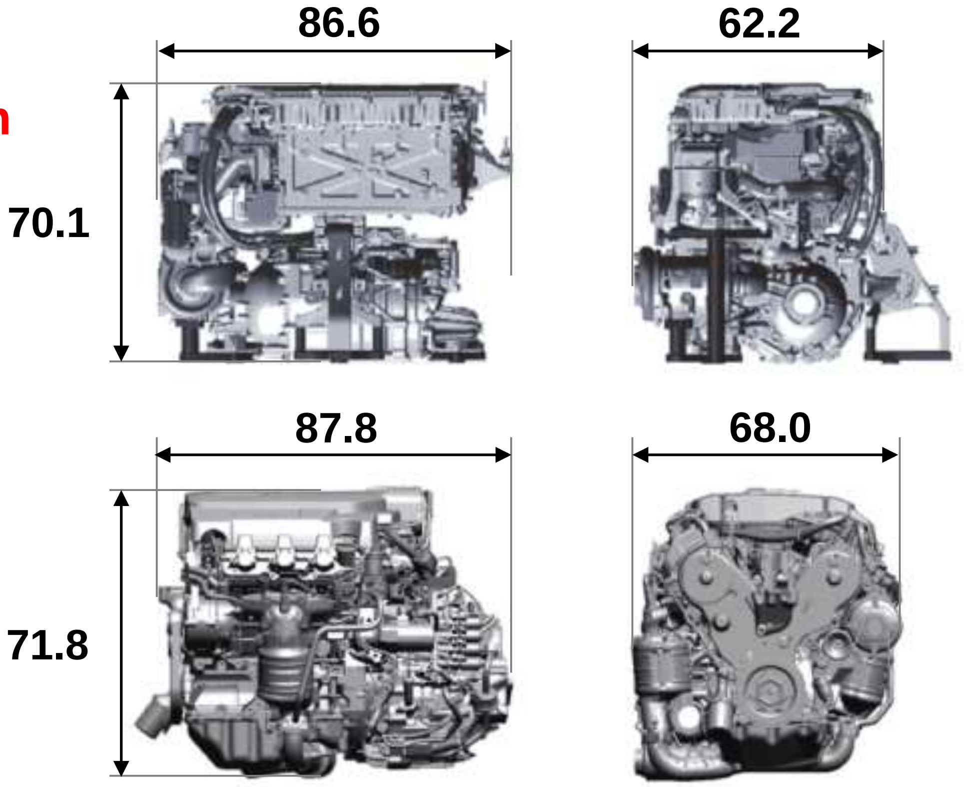
Compact powertrain ➔ equivalent to V6 powertrain

- Size comparison

Fuel cell powertrain

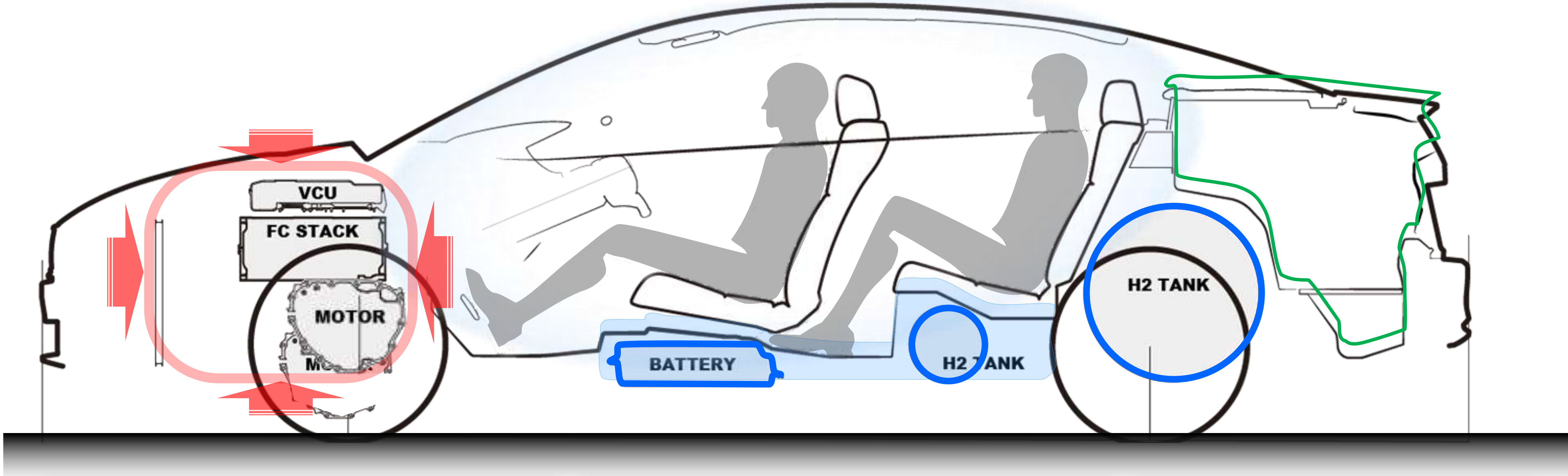
V6 powertrain

***Honda 3.5-litre petrol engine**



(in cm)

Comfortable sedan package designed with a focus on creating space for 5 people



Fuel Cell powertrain installed underneath the bonnet

Comfortable 5-passenger sedan packaging

Top-class cargo space among FCV sedans

Space Design: No Compromise

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Comfortable sedan package designed with a focus on creating space for 5 people

metres
(vs. previous model)

High-pressure Hydrogen Tank

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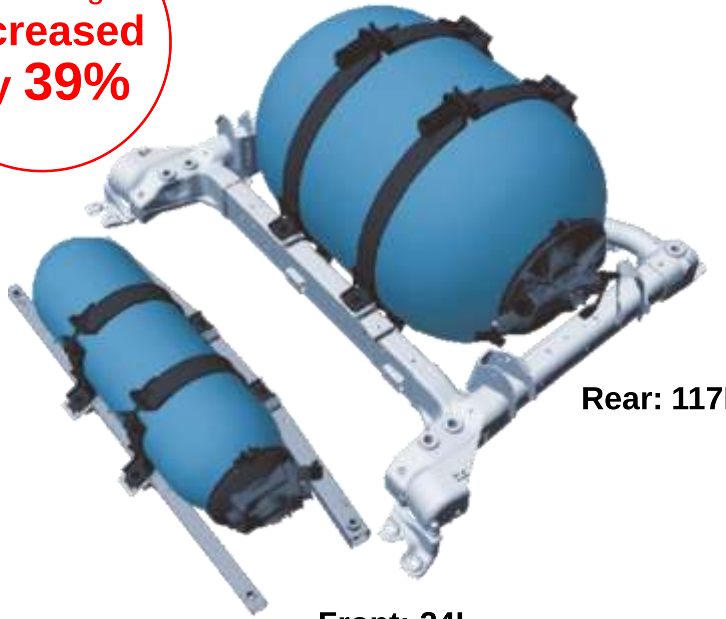
Increased hydrogen storage while increasing packaging efficiency & range

	Previous model	Clarity Fuel Cell
Nominal pressure	35MPa	70MPa
Tank volume	171L	141L Front: 24, Rear: 117
Hydrogen storage	3.6kg	5.0kg

H_2 storage Increased by 39%



Range

- Driving range per charge

Approx.
650km*

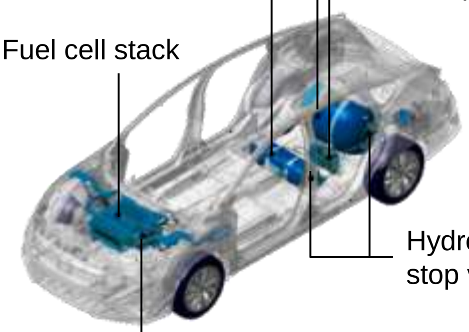
Which equals the distance from Munich to Budapest

*** Honda internal data based on NEDC consumption and 95% SOC**

Design for Hydrogen Safety

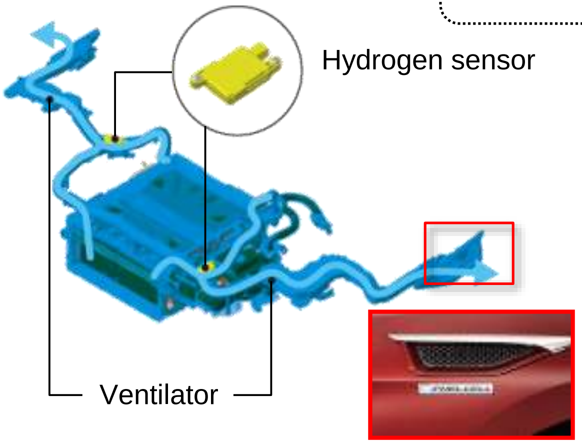
Basic Honda approach for hydrogen safety

- **Design a system that prevents leakage**
- **Detect and stop leakage if it occurs**
- **Ventilate hydrogen leaks in a safe manner**

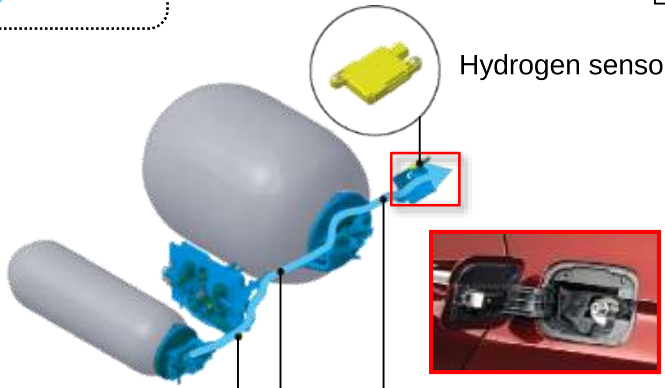


Flow of leaking hydrogen

Fuel cell stack



Hydrogen tanks



Performance

Output Performance

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Drive motor: High output, high torque, high rpm

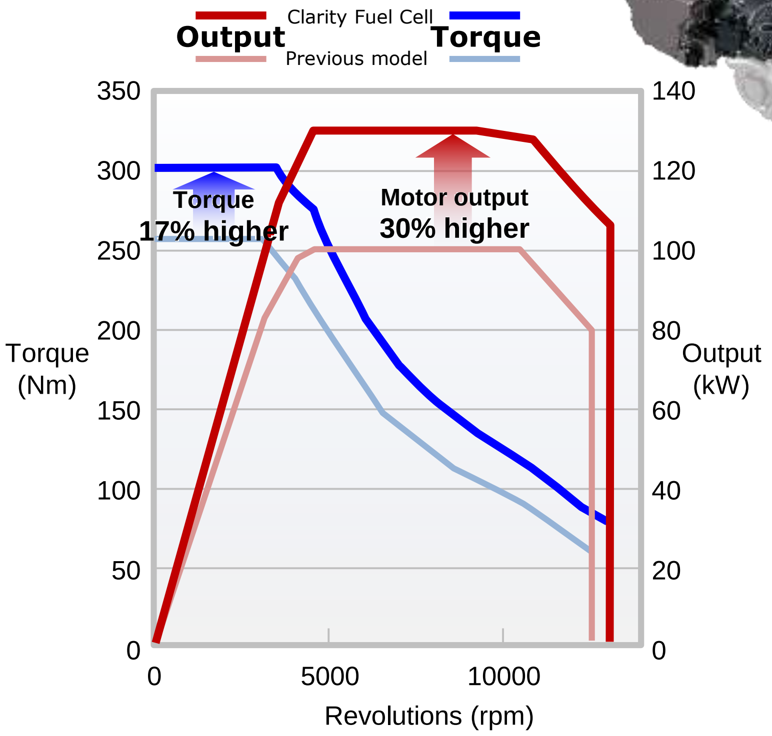
Maximum drive voltage: 330V ⇒ 500V

Max. output	**130kW (176PS)**	**+30%**
Max. torque	**300Nm**	**+17%**
Max. motor speed	**13,000rpm**	**+500rpm**

Maximum speed

165 km/h

■ **Performance curves**



Clarity Fuel Cell in Europe

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10 Clarity Fuel Cell in Demonstration Projects in Europe

FCV & H2 station deployment

Identification of customers

Data Gathering

hyFIVE

Hydrogen Mobility Europe

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

This activity has received funding from the European Union's FP7 through the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) under grant agreement number 62129.

These activities have received funding from the European Union's Horizon 2020 Programme through the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) under grant agreement number 671438 and 700350.

HyLAW relevant issues

FCV certification and regulation - Experiences in the UK

For the HyFIVe vehicles, although 1 by 1 certification was done together with VCA, a Vehicle Special Order (VSO) was issued and Honda had to contact each and every Fire Rescue Service individually informing about FCV operation in specific areas.

As long as the VSO has not been repealed, every single fire authority (45 in England) where the FCV is likely to be driven need to be contacted.

A dialogue initiated with the Fire Rescue Services identified that there is no single central fire authority that oversees the 45 - they are all fragmented and individually:

Status today:

Road Vehicles (Authorised Weight) and (Construction and Use) (Amendment) Regulations 2017 came in to force on 1st October 2017, eliminating the need for vehicle special orders (VSO) for new hydrogen and liquefied natural gas (LNG) vehicles:

New vehicles intended by the manufacturer to operate on:

- Hydrogen
- liquefied natural gas

will no longer require vehicle special orders to operate legally, provided manufacturers have obtained type approval prior to registration.

This includes testing:

- hydrogen-fuelled
- natural gas-fuelled vehicles

to relevant EU or UN-ECE Regulations (as set out in the Road Vehicles (Approval) Regulations 2009 (SI 2009/717)).

Further relevant issues

“Outer factors” enabling a speedy market introduction

- Advanced FC Stack production facilities
- Economies of scale for cost reduction of single components
  Honda and GM entered into a Joint Venture producing Fuel Cell Systems
- Supply Chain improvement: establishment of more TIER 1 suppliers
- Collaboration on EU level on commissioning HRSs
- High level recognition of renewable hydrogen as most important energy vector next to direct electricity use
- AFID/DAFI ➔ a fostered positioning of H2 in MS AF infrastructure strategies is required
- Engagement of more Car OEMs in FCV business

Fuel Cell System Manufacturing, LLC will operate within GM’s existing battery pack manufacturing facility site in Brownstown, Michigan, south of Detroit. Mass production of fuel cell systems is expected to begin around 2020 and create nearly 100 new jobs. The companies are making equal investments totalling $85 million in the joint venture.

HyLAW

H2 / vehicles / 2025	0	75	<0.01	0	0	5	0		(OK)	X

Hungary, in its NPF, has established targets for the deployment of a hydrogen refuelling infrastructure, accessible to the public ➔ but 5 HRS only

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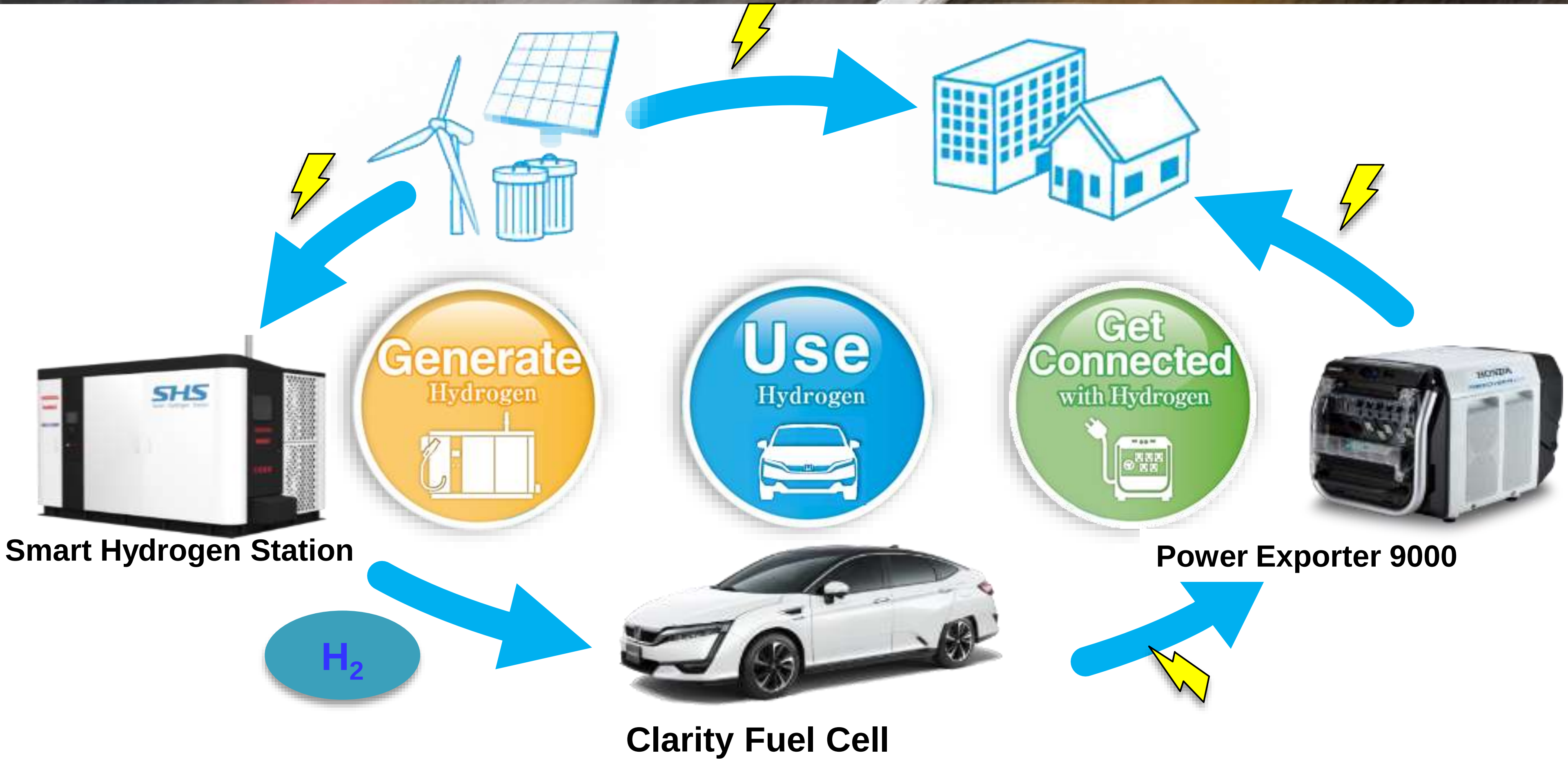
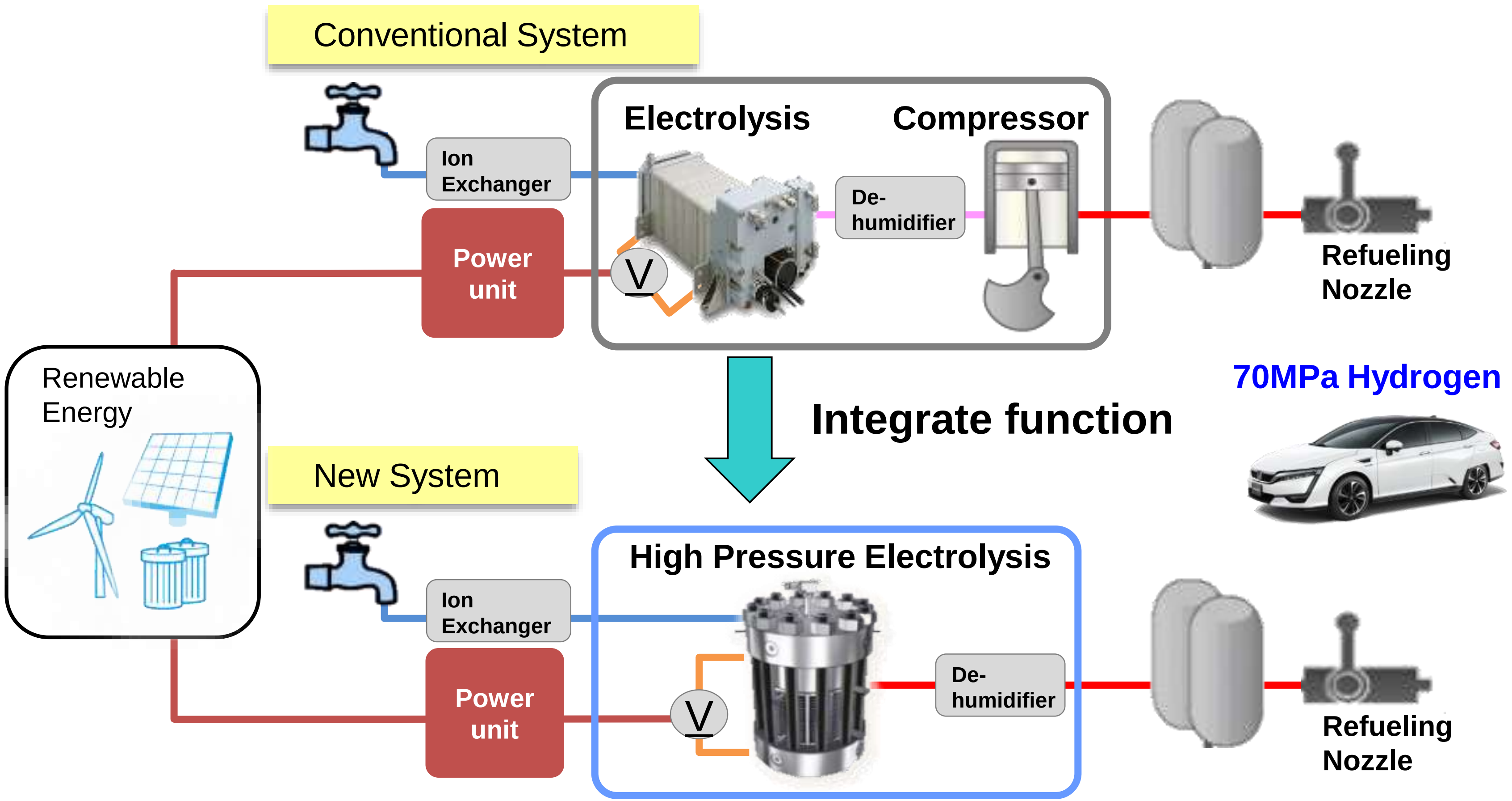
Linking Technology

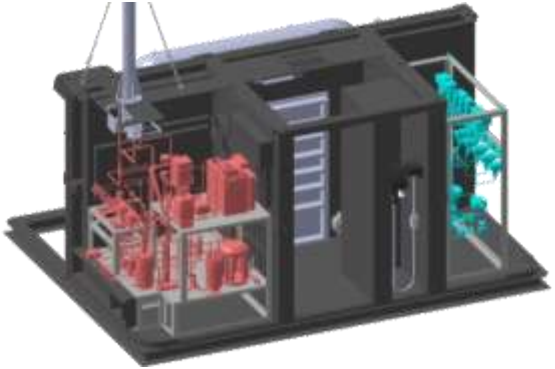
Concept towards the Hydrogen Society



Electrolysis Hydrogen Station



SHS Smart Hydrogen Station 70MPa



New Mobile Inverter POWER EXPORTER 9000

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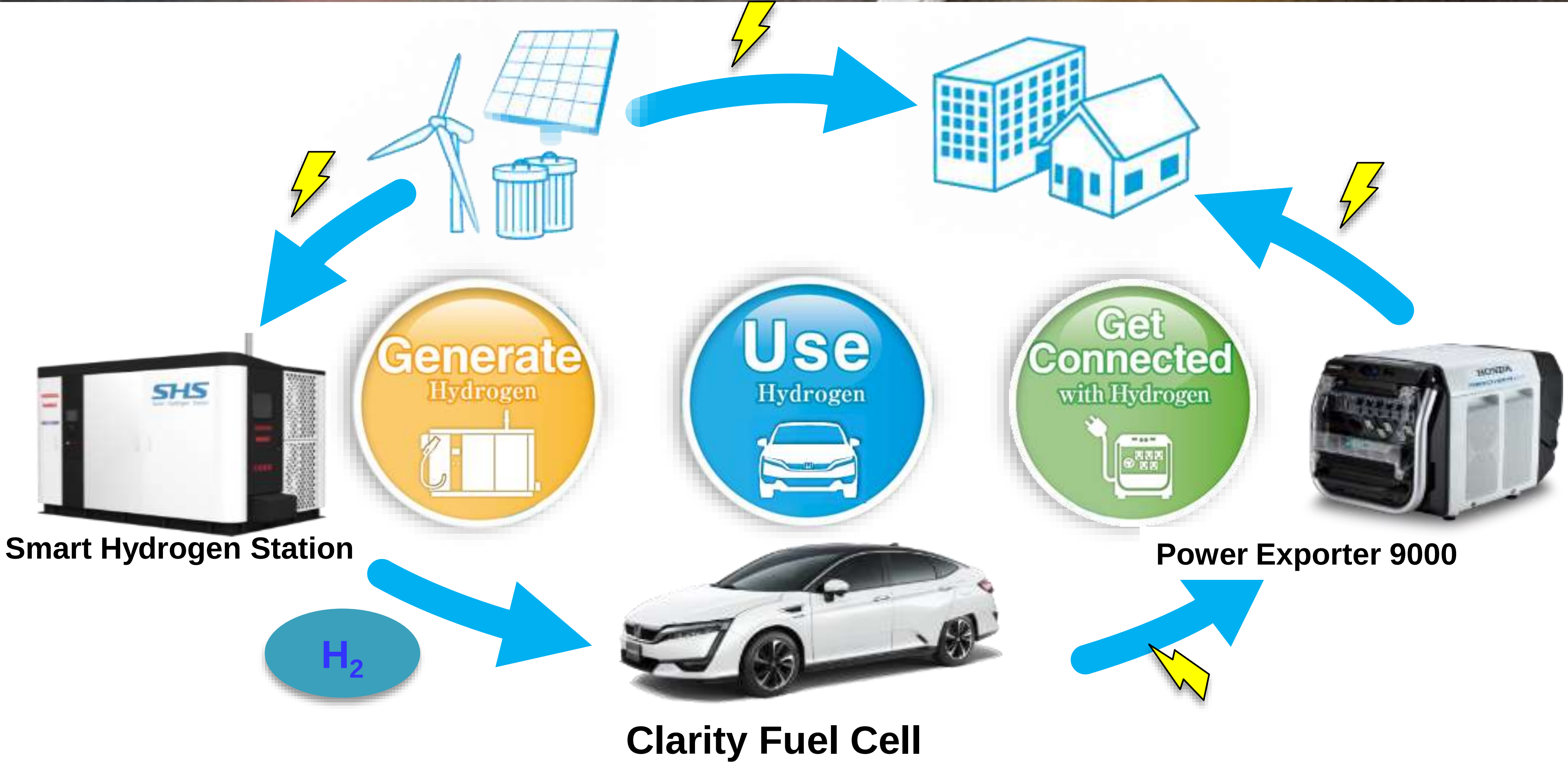
AC100V 3kVA
Power supply to standard home

Single phase 3 lines
100/200V 6kVA
Large capacity heater,
Air conditioner,
Electromagnetic cooker, ...

Concept towards the Hydrogen Society

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