

## Activities of JH2F

- In order to achieve the common goal to US and Japan of carbon neutrality by 2050, the acceleration of social implementation of hydrogen is important.
- The Japanese government, affiliated governmental organizations and Japanese companies work together, share knowledge and information, and heighten the momentum toward hydrogen society in order to accelerate the social implementation.

### ① Hold a monthly meeting

- General Meeting: Invite guests for lecture, share information
- Steering Committee: discussion for improving JH2F
- Sub Committee: exchange opinions, gather information

### ③ Approach Federal, State, local governments and organizations

- We, as JH2F, approach Federal, State, local governments and organizations and encourage collaboration
- If needed, convey requests and make policy recommendations

### ② Support the hosting of delegations from Federal, State and local governments

- Support the hosting of delegations from Federal, State and local governments
- Deal with requests from governments and companies in the US

### ④ Support business matching between US companies and Japanese companies

- Support business matching through J-Bridge provided by JETRO and business matching platforms provided by banks.

# Activities of Each member

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# I. Hydrogen Production

- **Choshu Industry Corporation of America, Inc.**  
 Hydrogen Station Package “SHiPS” provided Water Department of Nagano Japan. It is 100% green hydrogen produced by Electrolyzer and hydroelectricity.
- **INPEX Americas, Inc.**  
 INPEX globally commercialize 3 or more projects by around 2030 and aim to produce and supply 100K tons or more of hydrogen/ammonia per year.
- **Iwatani Corporation of America**  
 As a leading H2 supplier and with the experience more than 80-years on H2 business in Japan, Iwatani is going to start shortly to supply Green Hydrogen including logistic and distribution and subsequently produce Green Hydrogen in US.  
 Iwatani is moving forward to be a vertically integrated Green Hydrogen supplier, ranging from Production to Retail at Hydrogen Refueling Stations.
- **Mitsubishi Corporation (Americas)**  
 Signed MOU with Shell Canada regarding hydrogen production using CCS in Alberta, Canada.
- **Mitsubishi Heavy Industries America**  
 MHIA Invests in C-Zero, innovative catalytic base Methane Pyrolysis technology  
 C-Zero’s technology converts natural gas into hydrogen and solid carbon. The hydrogen provides clean, low-cost energy on demand, while the carbon can be permanently sequestered.



- **Mitsui & Co.(USA) Inc.**

Mitsui empower the innovative H2 production solution, as in the investment in EKONA Power, who develops a methane pyrolysis process, which enables the production of hydrogen and solid carbon from methane. This technology will achieve lower CO2 emissions in the production process, while curbing the production cost to the same level as other conventional hydrogen production technologies, such as a steam methane reforming.

Press release: [https://www.mitsui.com/jp/en/topics/2022/1242779\\_13410.html](https://www.mitsui.com/jp/en/topics/2022/1242779_13410.html)

- **Sumitomo Corporation of Americas**

- ✓ Studying the feasibility of blue hydrogen production by utilizing the associated gas from oil field in Oman
- ✓ Green hydrogen production utilizing renewable power from hydro generation in Malaysia and export to the other countries.
- ✓ Green hydrogen production for the fuel conversion from natural gas to hydrogen at alumina refinery in Australia
- ✓ Concluded MOU with the authorities in Gladstone, Australia to create hydrogen ecosystem
- ✓ Concluded MOU with the Namie-town in Fukushima, to create hydrogen ecosystem

- **Toshiba America Energy Systems Corporation**

Toshiba hydrogen technologies ranging from hydrogen production to utilization. The company is a key project member in the national project of development and construction of the Fukushima Hydrogen Energy Research Field (FH2R), a 20 MW solar-powered generation facility with a 10 MW-class electrolyzer with capacity to produce, store, and supply 900 tons of green hydrogen per year. Toshiba also has a long history in the development, commercialization and good track record in the installation of fuel cell.

## ▪ **Mitsubishi Power Americas Inc.- Hydrogen Hub Projects and Partnerships**

Mitsubishi Power's current partnerships for large-scale hydrogen production, energy storage and transportation include;

- North America's largest green energy storage project: Advanced Clean Energy Storage, a partnership with Magnum Development in Delta, Utah, to create a green hydrogen hub that will eventually provide pipeline connectivity throughout the Western Interconnect of North America. The project will produce renewable hydrogen, store it in vast underground salt dome caverns, and dispatch it as a clean fuel for power generation, transportation and industrial applications.
- North America's largest blue hydrogen project: A joint development agreement with Bakken Energy to create a hydrogen hub in North Dakota comprising facilities that produce, store, transport and consume blue hydrogen. The hub will be connected by pipeline to other hydrogen hubs being developed throughout North America.
- A strategic partnership agreement with Texas Brine that provides salt dome rights that position Mitsubishi Power to develop green or blue hydrogen hubs in New York, Virginia, Louisiana and Texas.
- DT Midstream and Mitsubishi Power have entered into a strategic agreement to identify, develop and deploy projects that integrate Mitsubishi Power's power generation and hydrogen technologies with DT Midstream's energy infrastructure development and operational expertise.

## II. Transportation

- **Iwatani Corporation of America**

Iwatani started the operation of 4 Hydrogen Refueling Stations in CA in 2019 and additional 6 stations start the operation in 2022.

Iwatani is planning to expand up to 23 +.

Over 100 stations will be operated by Iwatani in US and Japan in total in a couple of years.

Iwatani is also providing H2 Station O&M services.

- **Mitsui & Co.(USA) Inc.**

Mitsui leads the adoption of hydrogen in mobility sector both from creating demand with Hexagon Composites, the leading H2 storage solution provider, as well as supply side with FirstElement Fuel, leading H2 station developer/hydrogen supplier for the FCEVs. Hexagon provide hydrogen supply system for cars, buses/trucks, rails, ships as well as any needs to store compresses gaseous hydrogen in light weight container system. It also provides hydrogen delivery solutions to move hydrogen in efficient way. FirstElement has been creating public fueling market in California, and expanding its capability into buses/trucks with its design and operation know-how, and on its way to establish hydrogen fueling network in US.

Hexagon Composites/Purus: <https://hexagonpurus.com/>

FirstElement Fuel: <https://www.truezero.com/>

- **Sumitomo Corporation of Americas**

- ✓ Studying the feasibility of hydrogen import to Central Japan from other countries for industry-arching demand
- ✓ Strategic partnership with one of electrolyzer companies for the development of multi-megawatt projects in Japan
- ✓ Studying the feasibility of ammonia supply business to marine vessels in Singapore
- ✓ Participating blue hydrogen supply chain from Australia to Japan

- **Toyota Motor North America**

Toyota introduced its Mirai, a light-duty hydrogen-powered fuel cell electric vehicle in 2015. As of December 2021, more than 9,000 Mirai have been sold to date in the US. In 2017, Toyota started real-world testing of its heavy duty fuel cell powertrain truck as a proof of concept.

- **Mitsubishi Heavy Industries America**

MHIRJ and ZeroAviato collaborate on the design & development of Zero Emission propulsion technology for Regional Jets  
MHIRJ will be supporting ZeroAviaby providing engineering services in support of the certification of the engines to PART 33 for aircraft, as well as assisting ZeroAviaby providing advisory services evaluating the feasibility of a green retrofit program for regional aircraft.

# III. Port

- **PACECO Corp.**

In September 2021 MES-M initiated a hydrogen fuel cell powered zero emission (ZE) Transtainer RTG development project (**H2-ZE Transtainer RTG**), which will be delivered to a terminal in the Port of Los Angeles for feasibility testing.

- **Toshiba America Energy Systems Corporation**

Toshiba hydrogen technologies ranging from hydrogen production to utilization. The company is a key project member in the national project of development and construction of the Fukushima Hydrogen Energy Research Field (FH2R), a 20 MW solar-powered generation facility with a 10 MW-class electrolyzer with capacity to produce, store, and supply 900 tons of green hydrogen per year. Toshiba also has a long history in the development, commercialization and good track record in the installation of fuel cell.

- **Toyota Motor North America**

Additionally, Toyota has demonstrated a different proof of concept truck, its FC Yard truck, showing its ability to perform real-world operations at one of the terminals in the Port of Los Angeles in 2019.

- **Toyota Tsusho America, Inc.**

Toyota Tsusho America, Inc. (TAI) develops “Decentralized Hydrogen Value Chain” focusing on “local production for local consumption” using invested biogas resources for hydrogen production. TAI attempts to create hydrogen demand and supply by suitable supply methods by customer application with necessary scaled hydrogen production near the customer locations.

As an activity example, TAI will carry out a FC port equipment and hydrogen supply demonstration collaborating with Port of Los Angeles (below diagram) that verifies technical and economic viability for user confidence as well as preparation of equipment commercialization.



## IV. Power Generation

- **Choshu Industry Corporation of America, Inc.**

Choshu Industry Corp. of America, Inc (CICA) signed partnership contract with city of Lancaster, and CICA will provide hydrogen station package "SHiPS" with electrolyzer and stationary power generator using Fuel Cell called "MizTomo".

The event was commemorated by the agreement signing at the official residence of Japan Consul General Akira Muto on May 7th. This is first case supported from JH2F, and under MOC between California and Japanese government.



▪ **Mitsubishi Power - Joint Development Projects and Hydrogen Off-takers**

Mitsubishi Power has already secured several joint development agreements (JDAs), gas turbine orders for power projects with hydrogen capabilities, and off-taker agreements. Current projects and partnerships include;

- JDAs with Entergy in the Gulf Coast and with Puget Sound Energy in the Pacific Northwest to develop strategies and projects to assist the utilities in meeting their carbon reduction goals
- Hydrogen gas turbine orders, now secured and released for manufacturing, with the Intermountain Power Authority in Utah and Capital Power in Alberta, Canada
- Mitsubishi Power and El Paso Electric (EPE) have signed a JDA creating a collaboration framework to jointly develop projects that will enable EPE to achieve its clean energy goals.
- Off-taker agreements in unregulated U.S. power markets with independent power producers Agate Power's Danskammer project in New York, Balico's Chickahominy project in Virginia, and Advanced Power / Emberclear's Harrison project in Ohio.

# V. Finance

- **Japan Bank for International Cooperation**

To respond to energy transformation toward the realization of a decarbonized society, JBIC promotes Green Finance and Transition Finance. Moreover, through continued engagement with the relevant national governments and authorities, as well as multilateral cooperation, JBIC will support and accelerate the energy transition towards a decarbonized society.

As examples of Green Finance, JBIC is enhancing its support toward projects in the field of hydrogen, including investment in FirstElement Fuel, the largest hydrogen station developer and operator in California, and loan for hydrogen station construction and operation project undertaken by Iwatani Corporation of America.

- **MUFG Bank, Ltd.**

MUFG supports FirstElement Fuel, Inc. (FEF), California's largest developer and distributor of hydrogen fuel stations, with debt financing and equity financing.

By supporting FEF's expansion of its hydrogen distribution infrastructure, MUFG hopes to gain knowledge on California's innovative hydrogen business, and benefit its stakeholders and society in the United States and Japan with a shared value to realize a low carbon emission society.

- **Mitsubishi Heavy Industries America**

MHIA Invests in Infinium, for electrofuelsolution by innovative catalyst technology. Hydrogen & carbon dioxide are converted to syngas in the Infinium reactor using the proprietary CO2Cat™ catalyst. Syngas is fed through a proprietary synthesis step that directly produces high value fuels. Result is net zero carbon fuels

- **Sojitz**

Sojitz has “Sustainability Challenge”, its long-term sustainability vision leading up to 2050 based on the U.N.’s Sustainable Development Goals and the Paris Agreement.

Sojitz is an initial investor of Universal Hydrogen (Los Angeles, CA) which makes hydrogen-powered commercial flight a near-term reality.

Through this partnership, Sojitz contributes to realize a decarbonized society by reducing carbon emissions while keeping flights affordable.

- **Sumitomo Corporation of Americas**

Investment in start-up companies, which develop the technology to contribute to energy transition. (Syzygy Plasmonic, OneH2 Inc, H2Pro)

- **Sumitomo Mitsui Banking Corporation**

SMBC has been supporting an effort to achieve a “hydrogen society” through its financial capabilities and solutions. With a specialized team set up to focus on business alliances in the U.S., SMBC is connecting hydrogen startup companies in the U.S. and its Japanese clients, thus enhancing the value of the U.S./Japan collaboration on hydrogen business initiatives.

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# I. American Honda Motor Co., Inc



# Introduction of Honda's approach to Hydrogen Energy

American Honda Motor Co., Inc.

**HONDA**  
The Power of Dreams

# Honda Initiatives on Environment

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2050



## Carbon Neutral

Net zero CO<sub>2</sub> emissions  
(All products and corporate activities)



## Clean Energy

100% utilization of  
Renewable Energy



## Resource Circulation

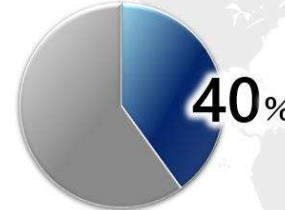
100% use of  
sustainable materials

## Electrification of automobiles

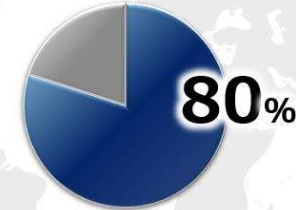
All major markets combined

Global

2030

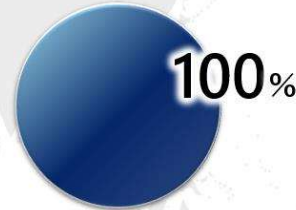


2035



EV & FCEV

2040

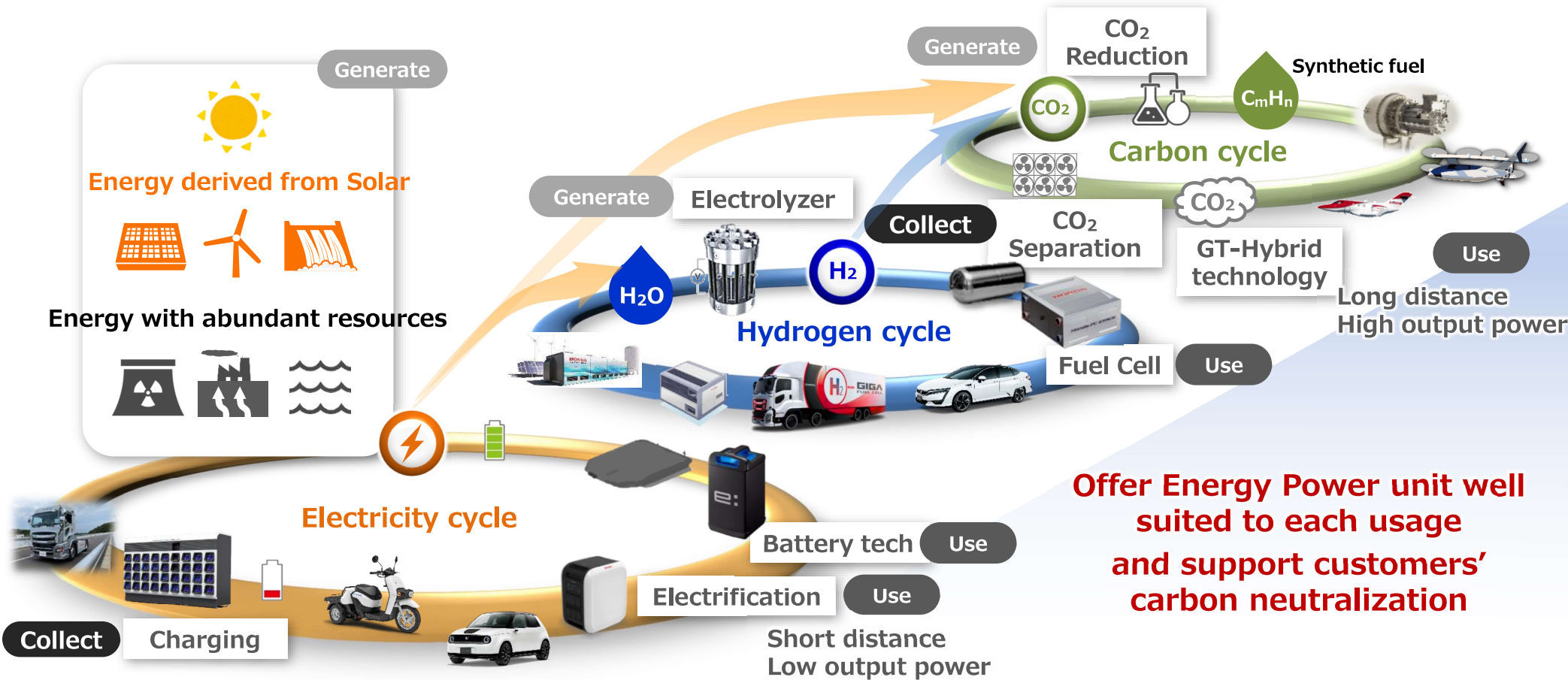


**“Strive for a circular/resource-recycling society that aims for “zero environmental impact”**

**Honda set the target of electrification of automobiles to achieve carbon neutral target including new/already sold products and all corporate activities.**

# Multi-pathway towards Carbon Neutral

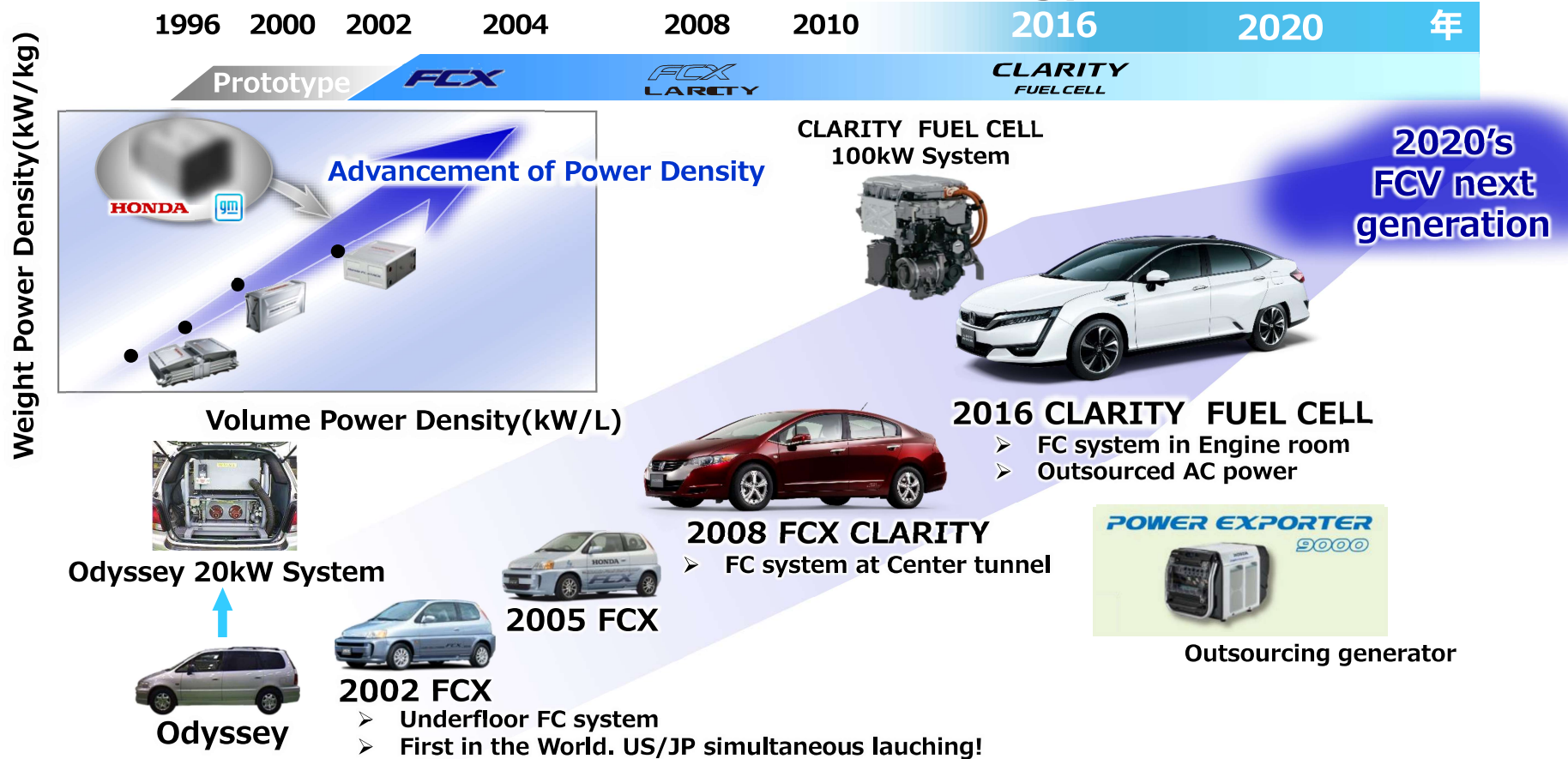
In addition to renewable electricity, **Utilize H2 & Carbon as energy carrier**



**Offer Energy Power unit well suited to each usage and support customers' carbon neutralization**

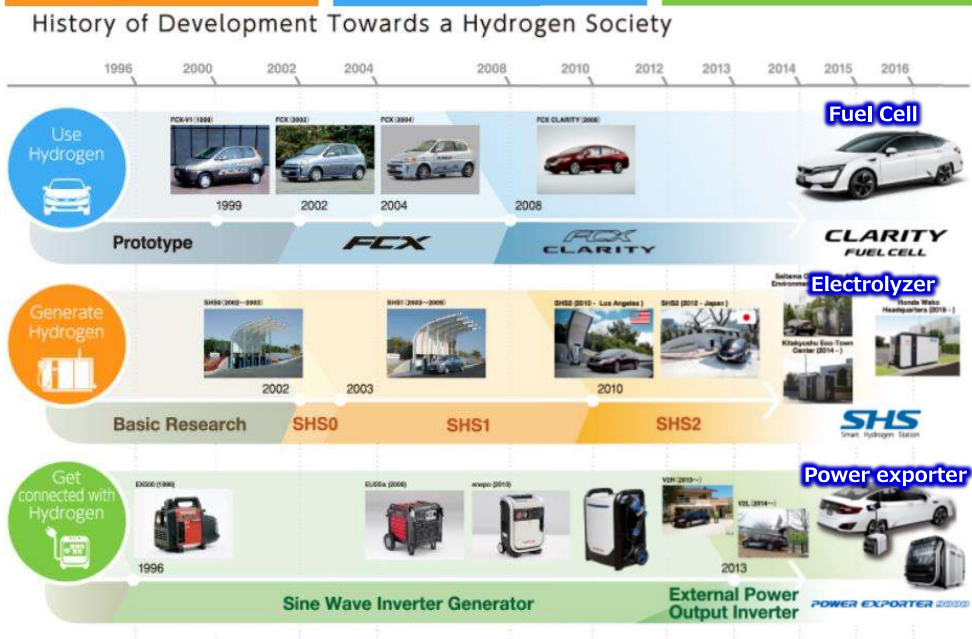
# History of Honda Hydrogen Fuel Cell Vehicle

More than 20 years of Research, Development and Application in terms of FC technology

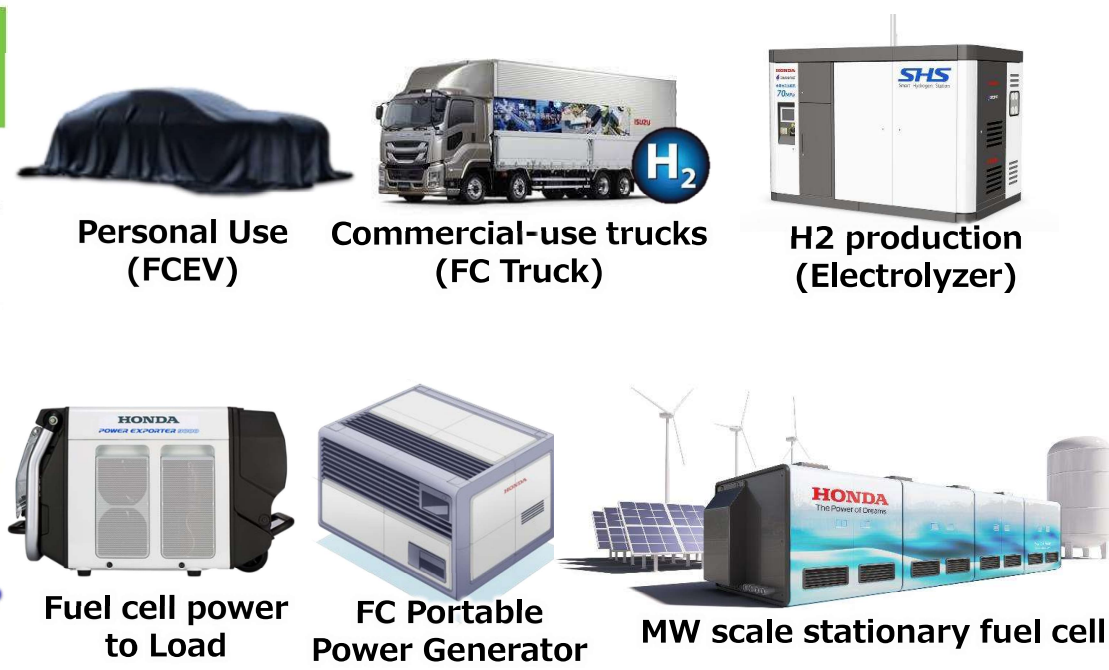




# Honda's approach to hydrogen & Fuel cells



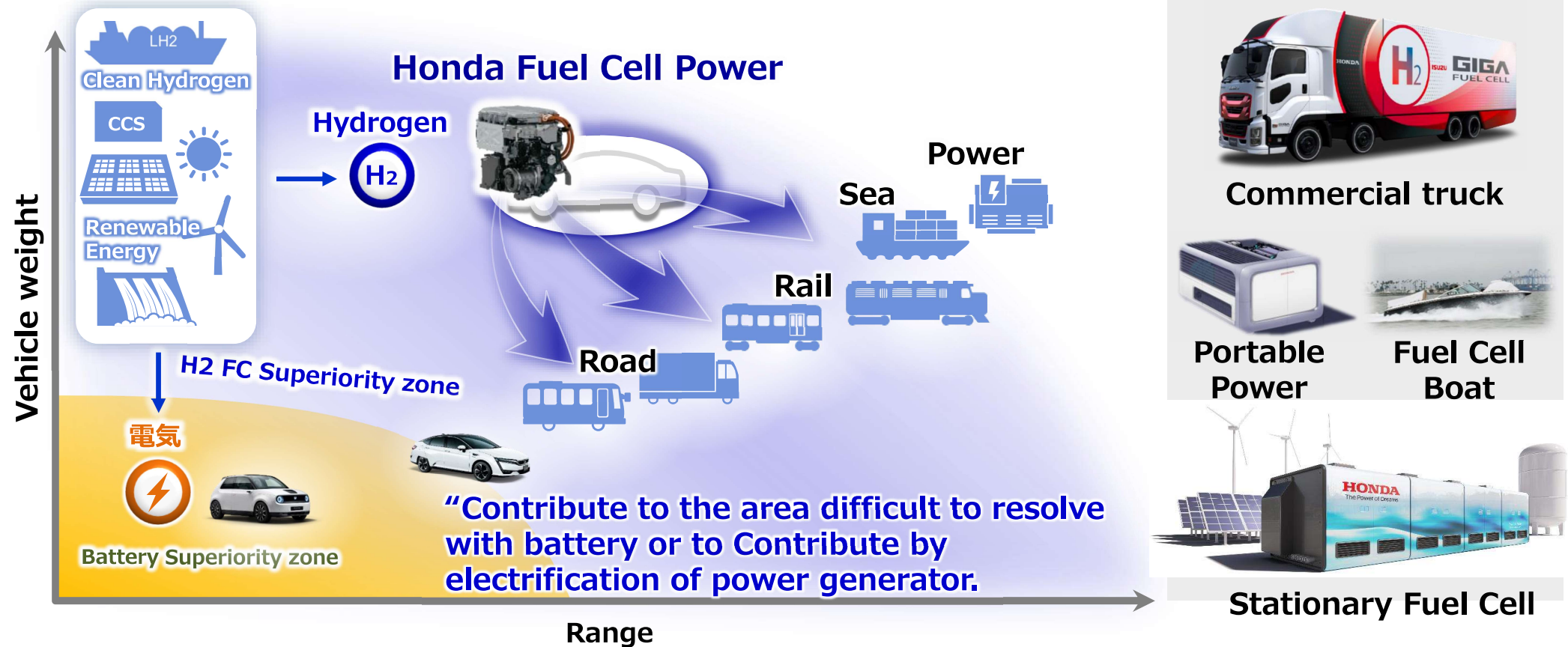
## Next Gen Products Towards Making H2 Common



Honda expands hydrogen fuel cells to the commercial vehicle and power sources towards making H2 Common.

# Fuel Cell Application Expansion

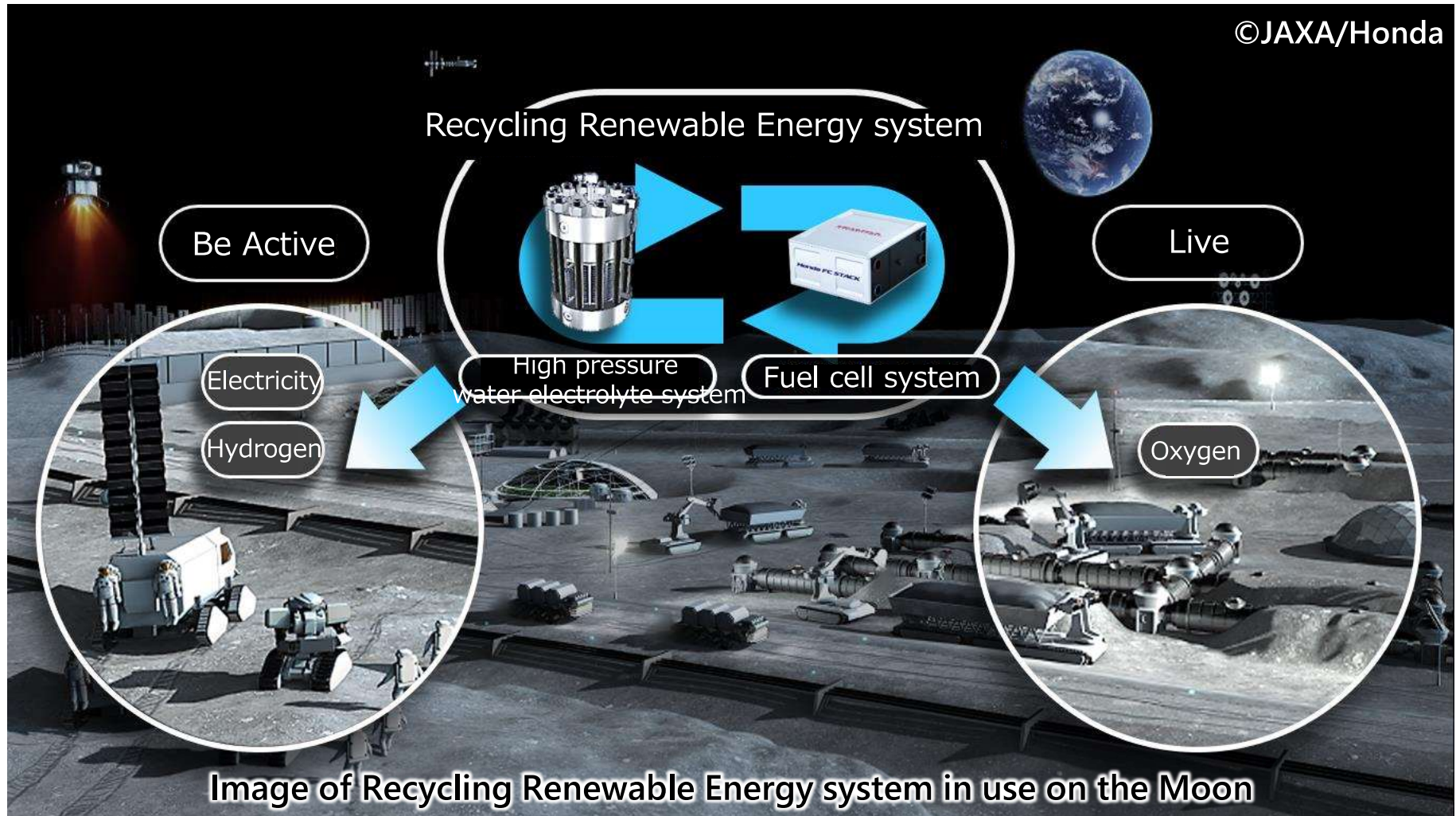
Clean transport and Safe energy is now possible by **versatile usage** of FC core technology and **expansion of H2 use**.





# Challenges to the ultimate close recycling society (Space)

©JAXA/Honda



**HONDA**  
The Power of Dreams

Thank you !



# Recent Honda Fuel Cell Applications

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## Mobile Power Generator



## Stationary Fuel Cell



## Commercial Fuel Cell Truck



Power supply	AC	Max 9kVA 100V 1.5kVA×6□ / 200V 6.0kVA×1
	DC	Max 50kW (in study)
Power generation efficiency	62% (Peal value)	
H2 supply	Internal High pressure tank + H2 supply from outsource	
Output power	115kWh+ outsource	
Weight	990kg	
Exterior Size	1851×1488×1402	

Output	1152kW-DC
Foot Print	1100 cm X 230cm x250 cm
Mass	10625kg Est.
Hydrogen	ISO14687-2 10 bar ~
Cooling	1750kW (500ton), > 2Bar, >3785lpm, 480V, 260A
Function	Wireless 4G, Onboard SSD
Code/Standards	NFPA 853, IEC62282, NFPA 55,UL1741 (grid inverter)

Base type model	ISUZU GIGA (Fr 2 axis 8x4 GVW25t)
Length/Width/Height	11,985/2,495/3,790
Total weight	25t
FC stack	Honda FC stack
Motor	AC synchronous motor
High Pressure H2 tank	High Pressure(70MPa)H2 tank
Drive Battery	Lithium Ion Battery
Cruising range (target)	600km approx.※

## II. Mitsubishi Power Americas Inc.

# Mitsubishi Power – Decarbonization Support by Hydrogen

## Green Hydrogen project in Utah



### U.S. Green Hydrogen Project (Fig. 20-1 and Fig. 20-2)

The Advanced Clean Energy Storage project in Utah is a green hydrogen hub to decarbonize western area of the US. The project will change curtailed renewable energy into hydrogen as a long term storage media by electrolyzers and store it in the salt caverns contributed by Magnum Development. Our customer can use hydrogen as a fuel for power generation for



stable and decarbonized power supply into the grid. We partnered with Magnum Development in 2019 and are aiming to create one of the world's largest energy storage facilities fed by 100% renewable sources, with a capacity of more than 1,000MW.

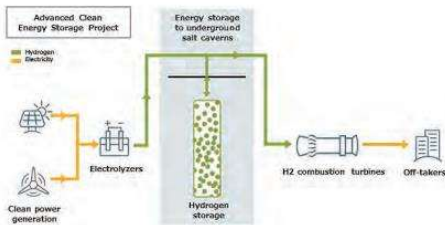


Fig. 20-1 Advanced Clean Energy Storage project



Fig. 20-2 Illustration of a Hydrogen Power Generation and Storage Plant

The Intermountain Power Agency (IPA) awarded Mitsubishi Power a contract for two M501JAC power trains for the Intermountain Power Plant (IPP) in Delta, Utah in March 2020. This award marks the first Advanced Class Gas Turbines in the industry specifically designed and purchased as part of a comprehensive plan to sequentially transition from coal, to natural gas and finally to renewable hydrogen fuel, and creates a roadmap for the global industry to follow.

This transition will start in 2025, when the turbines will be commercially guaranteed capable of using a mix of 30% hydrogen and 70% natural gas fuel. This fuel mixture will reduce carbon emissions by more than 75% compared to the retiring coal-fired technology. Between 2025 and 2045, the hydrogen capability will be systematically increased to 100% renewable hydrogen, enabling carbon-free utility-scale power generation.

## Decarbonization collaboration with Entergy



### U.S. Collaboration with Entergy (Fig. 21)

In September 2020, we signed a MOU with Entergy, agreeing to collaborate in the decarbonization of the company's utility fleet in four southern U.S. states (Arkansas, Louisiana, Mississippi, and Texas). We are working with Entergy on a comprehensive range of projects, including the development of hydrogen-capable gas turbine combined cycle facilities, the production, storage and transportation of green hydrogen and the development of utility-scale battery storage systems.

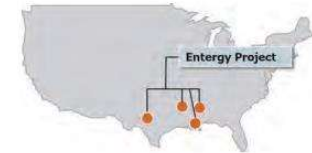


Fig. 21 Signing of Mitsubishi Power's Agreement with Entergy

### III. Paceco Corp.



** PACECO® GROUP**

ZERO EMISSION SOLUTIONS  
H<sub>2</sub>-ZE TRANSTAINER RTG



## History

As PACECO Group, we have been pioneers in the container handling equipment industry since the first ship-to-shore crane was designed and manufactured in 1958 for Matson.

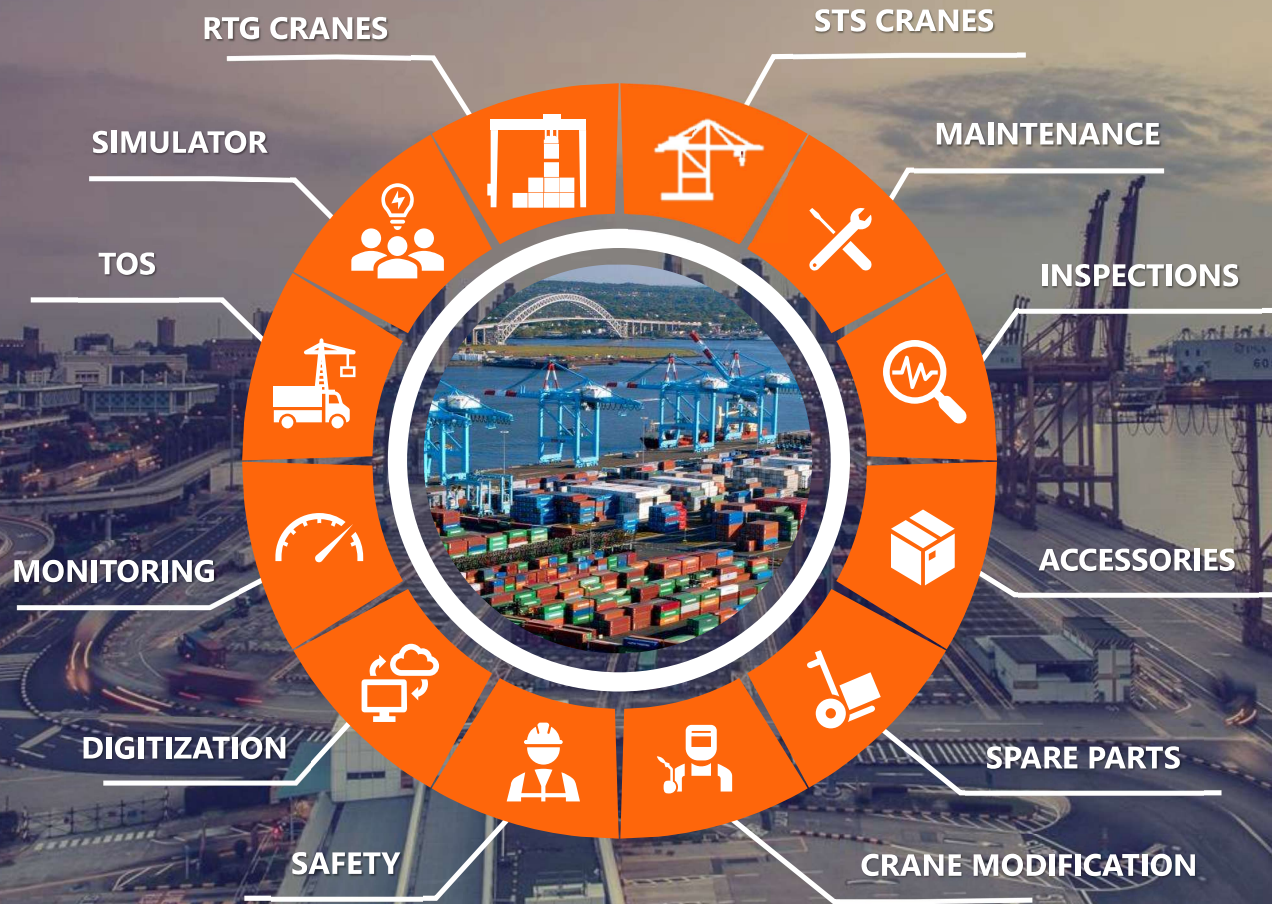
Today, we continue to be leaders in container handling equipment and in addition, new technology for Port Systems.



PACECO Group:

- PACECO Corp. (Hayward, CA, USA)
- Mitsui E&S Machinery Co., Ltd. (Tokyo/Oita Japan)
- PACECO Momentum (Madrid Spain)

# // All in one Solution for Maritime Terminals



# // PACECO Group Global Deliveries



STS Portainer: 500+  
RTG Transtainer: 2000+



# // PACECO Group Roadmap to Sustainability



2004 PACECO tested 1<sup>st</sup> Hybrid RTG in Long Beach, California

First in world  
270+ hybrid in operation

**RTG**  
1961

Hybrid RTG w/Capacitor  
2006

Electrified RTG w/ Onboard Cable Reel  
2009

Hybrid RTG w/Li-ion Battery  
2009

**MESecoTT**

Near Zero Emissions RTG  
2021

**NE**

Zero Emissions RTG w/ Fuel-cell  
2023

**H<sub>2</sub>-ZE**

Hybrid Technology greatly expanded in market

1997 - Kyoto Protocols

2009 – Hakata Port – Japan’s most environmentally friendly port

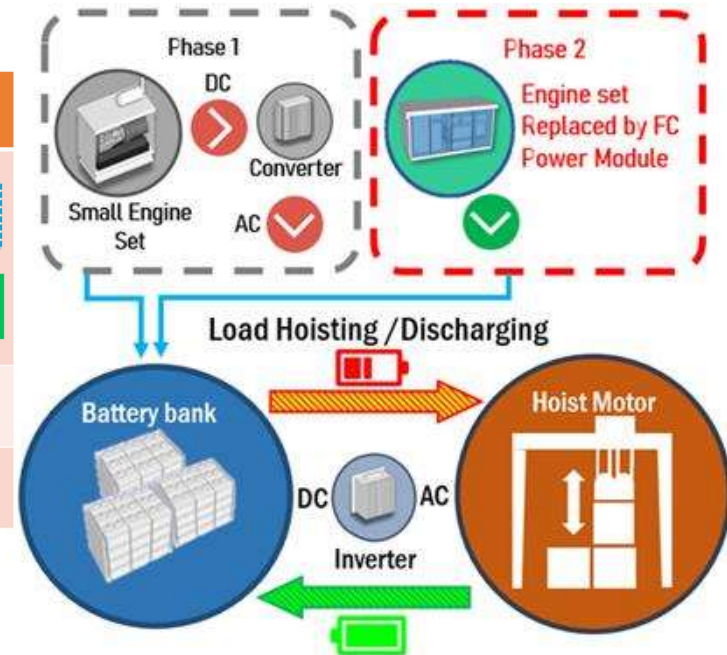
US and EU port goal emission reduction by 2030/2050

# // PACECO Group Two Step Approach to Zero Emission

RTG engine size comparison (reference)

Model	Conventional	Standard Hybrid	Near Zero Emission	Zero Emission
Principal Configuration	Full Size Engine	Small Size Engine Lithium-ion Battery	Smaller Size Engine Larger Lithium-ion Battery	Fuel Cell Power Pack Larger Lithium-ion Battery
Engine Size	~400-500kW	~200kW	~50-100kW	N/A (Fuel Cell Power Pack)
CO2 Emission (Compared with PACECO-Mitsui conventional RTG)	100%	~60% less	~70-80% less	Zero Emission

[Note]  
 •The date above described is for reference.  
 •CO2 Emission results could be different depending on handling frequency and other condition of crane operation.



## NZE (Near Zero Emission) to ZE; two-step concept

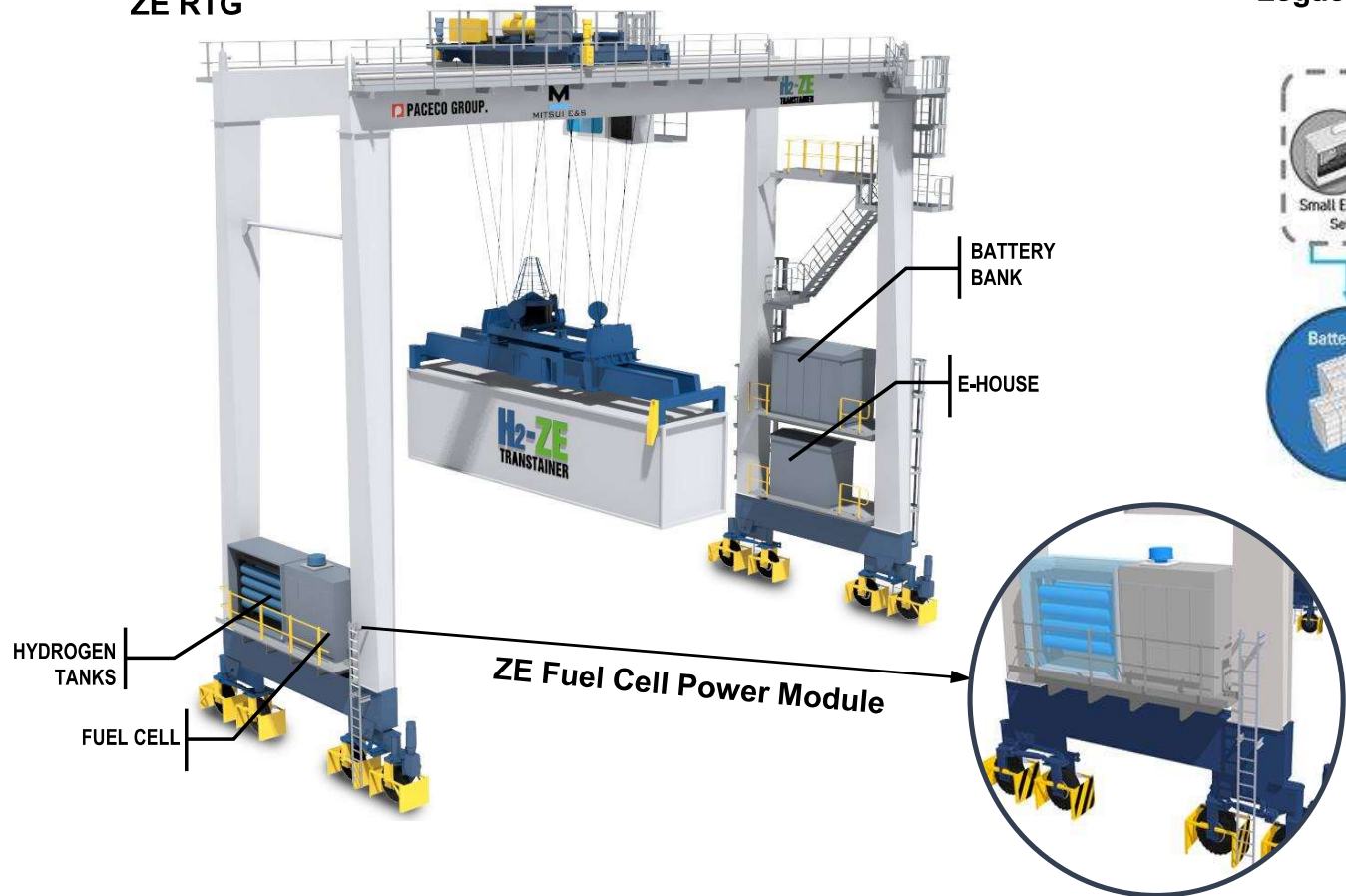
Step 1 – NZE model TRANSTAINER® with larger battery and smaller Tier 4f D-G set used in operation (available today).

Step 2 – Convert to Fuel Cell (FC) power pack when FC and H<sub>2</sub> supply infrastructure is ready. Upgrade requires replacement of diesel genset to H<sub>2</sub> fuel cell power pack and H<sub>2</sub> tanks.\*<sup>1</sup>

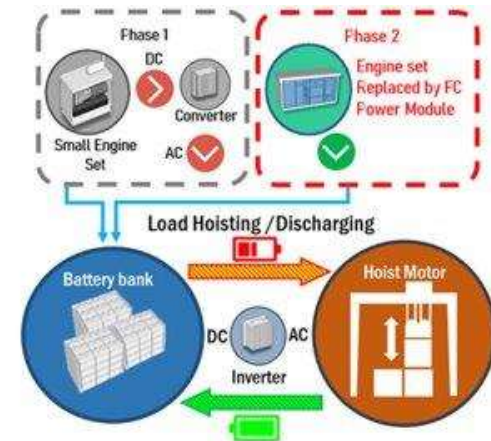
\*1: Depending on the using condition during Step 1, worn parts including battery may be replaced.

# PACECO Group H<sub>2</sub>-ZE (Zero Emission) Transtainer RTG

ZE RTG



Legacy diesel RTG upgrade to ZE  
Easy 2 step process



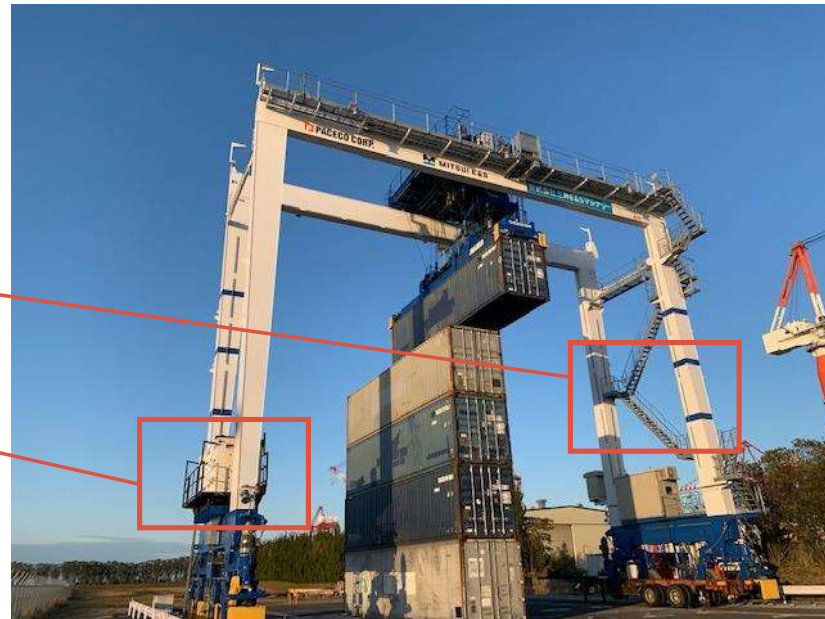
Note: Final ZE design not entirely determined and subject to change

## // PACECO Group Development of Fuel Cell RTG

- 2018: PACECO/Mitsui E&S Machinery (MES-M) launched its in-house development/demonstration facility for new technologies of NZE (Near Zero Emission) model hybrid TRANSTAINER® RTGs at Oita works.
- 2021: Received the first order of NZE TRANSTAINER® cranes to be delivered at Port of Kobe in May 2022.
- 2021: MES-M is developing the H2-ZE (Zero Emission) model hybrid TRANSTAINER® crane with FC power unit and plan to complete factory test in 2022.

Add battery pack above the electrical house

Change from diesel genset to hydrogen fuel cell power module with hydrogen tanks



Development TRANSTAINER® crane and test site in MES-M Oita works