HONDA
The Power of Dreams

Honda's Pursuit of Carbon Neutrality and Electrification Technology

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Global Warming: How Far Have We Come?

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What Are Greenhouse Gases (GHGs) Causing the Global Warming? 3

Greenhouse gases (GHGs) in the atmosphere absorb the heat on the Earth warmed by sunlight, preventing the heat from escaping to space. The adequate amount of GHGs in the air makes the Earth habitable for humans.

Source: Website of Japan Automobile Manufacturers Association

Composition of greenhouse gases (GHGs)

- CO2 (accounting for 76% of total GHGs)
- Methane (25 times as potent as CO2)
- Sulfur hexafluoride (24,000 times as potent as CO2)
- Nitrogen monoxide, CFC, vapor

Average global temperature is 14°C.
If not for GHGs, it would be -19°C.

Since the Industrial Revolution, CO2 emissions from fossil fuels have thrown GHGs off balance and caused global warming

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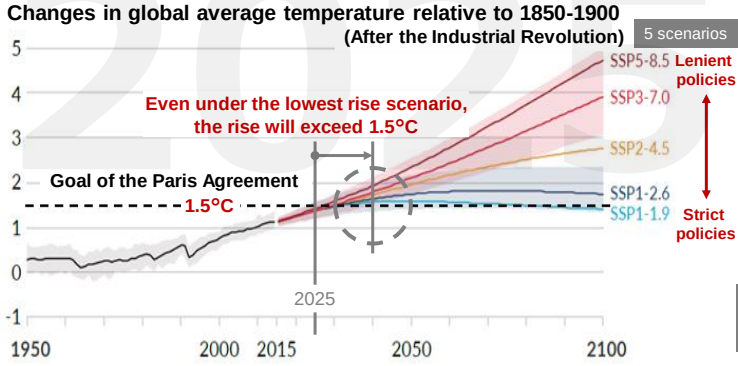
Current State of Global Warming according to IPCC Report 4

Current state of global warming threatening our lives and health

IPCC WG I Contribution to the Sixth Assessment Report
August 2021

"It is unequivocal that human influence has warmed the atmosphere, ocean and land."

Changes in global average temperature relative to 1850-1900 (After the Industrial Revolution)



SSP5-8.5: Fossil fuel-driven development
Highest emissions scenario with no climate policy

SSP1-1.9: Scenario to keep the temperature rise to 1.5°C or less
Introducing policies to keep the temperature rise until the end of the 21st century to less than 1.5°C from pre-industrialization level;
CO2 emissions expected to become net zero in the mid-21st century.

Global warming is approaching 1.5°C, a goal set by the Paris Agreement

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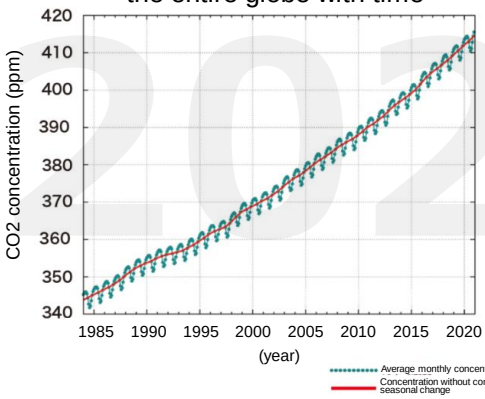
Current State of Global Warming

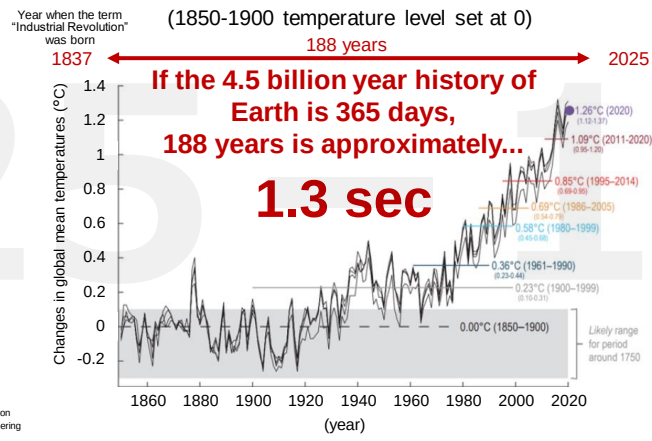
CO2 concentrations and mean temperatures are rising globally

Changes in CO2 concentrations on the entire globe with time



Source: Changes in CO2 concentrations on the entire globe with time (on the website of Japan Meteorological Agency) based on data collected by World Data Centre for Greenhouse Gases (WDCGG)

Observed global mean temperature levels



Source: IPCC WG I Contribution to the Sixth Assessment Report

How to Stop Global Warming: 1.5°C Scenario

1.5°C is a tipping point at which significant changes will start to occur

■ **Risks related to global warming (according to IPCC)**

- **Flood, sea level rise**
- **Inland flood**
- **Infrastructure disruption**
- **Deaths and diseases due to heat wave**
- **Food shortage due to temperature rise and drought**
- **Ecological change**

1°C increase means 7% increase of rainfall.

The increased water vapor in the atmosphere leads to more typhoon disasters.

The areas burned by wildfire around the Mediterranean Sea have increased 41%.

Mosquitoes are now rarely seen even in summer, as they are not active at above 35°C

Torrential rain in Noto
https://www.asahi.com/articles/photo/

Torrential rain and flood in East Africa
https://a-goal.org/flood-emergency-support/

Wildfire around the Mediterranean Sea
https://www.arabnews.jp/article/middle-east/

Heat wave in Europe
https://www.cnn.co.jp/photo/l/

Challenges Facing the Society to Achieve Carbon Neutrality

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What Is Carbon Neutral?

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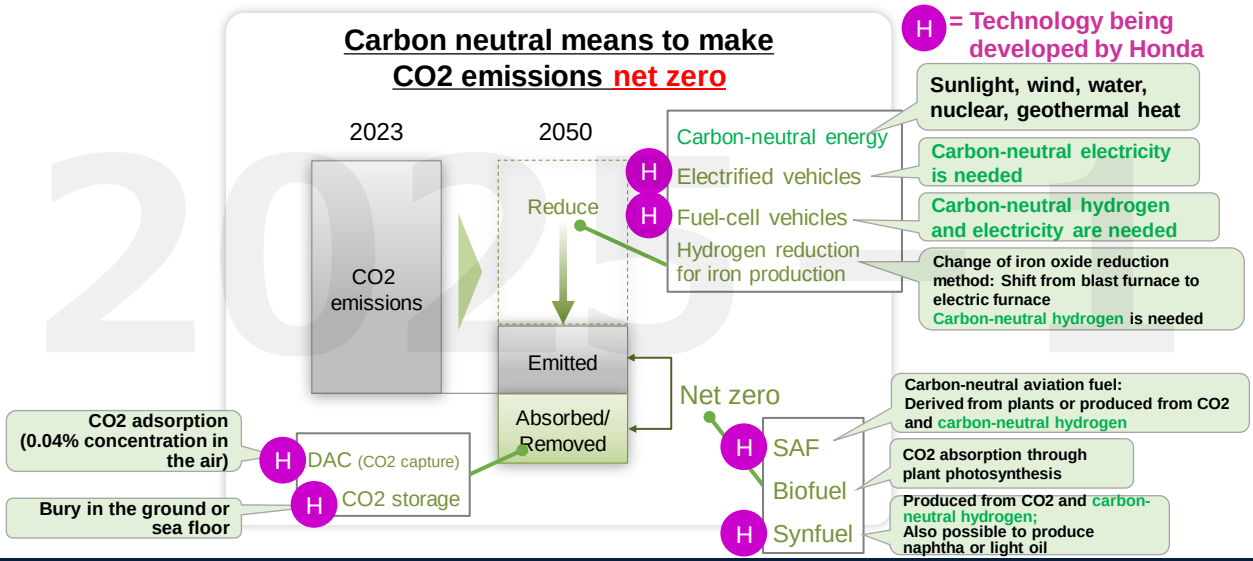
To achieve carbon neutrality, it's important that the energy at source be "clean"



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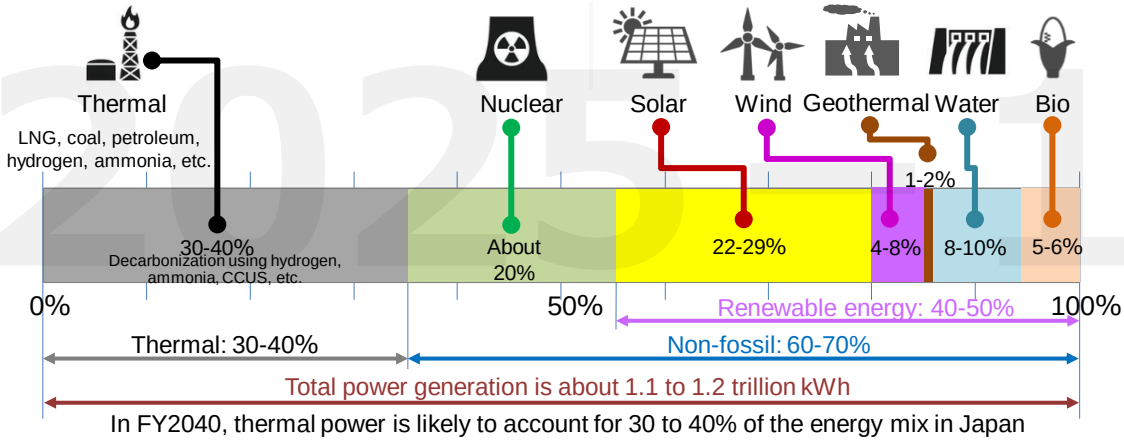
Challenges of Carbon-Neutral Energy

Source: Overview of the Strategic Energy Plan (Draft) by Agency for Natural Resources and Energy

Essentially, the energy strategy of a country is all about shifting to carbon-neutral energy

Japan's Seventh Strategic Energy Plan (draft as of December 2024)



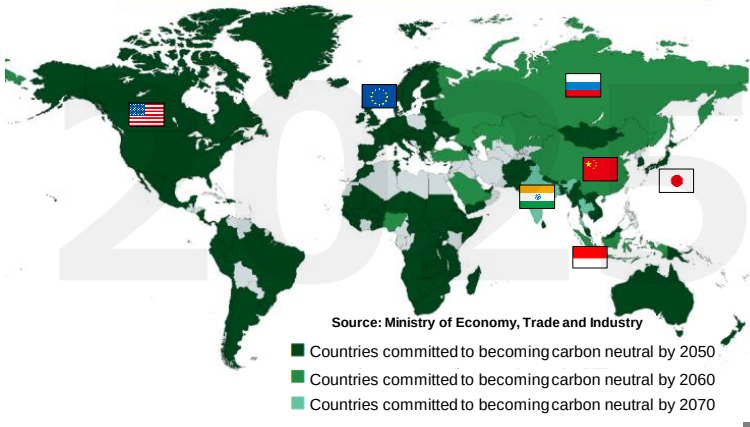
In FY2040, thermal power is likely to account for 30 to 40% of the energy mix in Japan

Carbon-free solutions are essential, e.g. hydrogen, ammonia, CCUS.

Carbon Neutrality Target Years by Country and Region

The world needs to speed up efforts to carbon neutrality by leveraging technology advancement

Countries/regions committed to becoming carbon neutral



Country/ Region	Carbon Neutrality Target Year	Population
EU	2050	0.45 billion
US	2050	0.33 billion
Japan	2050	0.12 billion
China	2060	1.41 billion
Russia	2060	0.15 billion
Indonesia	2060	0.28 billion
India	2070	1.42 billion

Countries unable to achieve CN by 2050

(These 4 countries are not the only ones)

These 4 countries make up 40% of the world population of 8 billion

Honda's Origin: Human-Centric Thinking

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Honda's Origin: Human-Centric Technology

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No matter how technology and car making change, Honda's human-centric approach will never change

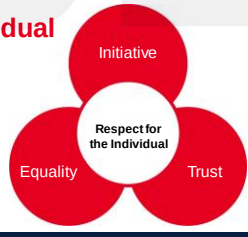
Human-Centric Thinking

Since its founding, Honda has continually strived to make products that delight as many people as possible, in keeping with its desire to be useful to people and society and expand the possibilities of people's lives.
Always central to this thinking is people. Honda believes in the potential of people.

Honda Philosophy

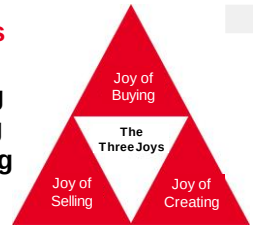
Respect for the Individual

Initiative
Equality
Trust



The Three Joys

Joy of Buying
Joy of Selling
Joy of Creating



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Honda's DNA

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What I research at Honda is, "What do people like?"

(Founder Soichiro Honda)

In other words,

we research "people"

We take on challenges to be of service
to each person, and realize their dreams

Honda's History

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What can we do for people and society?

To be of service
to people

1948

1949: 'Dream' D-type built

1952: General-purpose 'H' engine released

1963: Automobile production starts; T360 and S500 released.

1967: Kei car N360 released

1972: CVCC engine passes the 1975 numerical requirements under the Clean Air (Muskie) Act

1970

1981: World's first car navigation system developed

1987: Japan's first driver-side SRS airbag system

1990

1995: First-ever gasoline engine developed meeting ULEV standard under exhaust gas regulation

2000: SULEV-compliant Accord released

2003: World's first automatic braking system CMBS unveiled

2010

2015: Honda Jet receives U.S. FAA certification

2020: Legend becomes the world's first automobile to qualify for Level 3 self-driving status

2020

1959: First entry into the Isle of Man TT races; won the Constructors Prize

1961: In the Isle of Man TT races, won 1st through 5th places in 125cc and 250cc categories

1964: First entry into F1 (won the Mexico GP the following year)

1986: Research started on the fundamental workings of bipedal locomotion

1988: Won 15 out of 16 races for the first time in F1 history

2000: Humanoid robot ASIMO makes a world debut

2015: 700th victory in World Grand Prix motorcycle racing

2021: Verstappen wins drivers championship in F1

2022, 2023: In F1, won drivers and constructors championships, most wins for drivers in a season (21 wins out of 22 races)

MM (Man-Maximum Mecha-Minimum) Concept for the N360 in 1967

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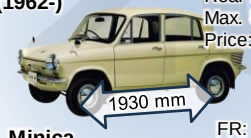
Our Founder's Vision:
“I want to create cars that many people will love.”

Kei cars in the 1960s

SUBARU 360 (1958-)

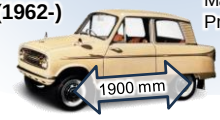
Best-selling kei car
Rear Engine: 16 ps
Max. Speed: 83 km/h
Price: ¥365,000

Carol (1962-)



Rear Engine: 18 ps
Max. Speed: 90 km/h
Price: ¥370,000

Minica (1962-)



FR: 17 ps
Max. Speed: 86 km/h
Price: ¥390,000

Human-centric approach of designing the cabin first: “Utility Minimum”

The origin of the MM Concept

■Requirements

1. Affordable price
2. Easy to drive
3. Sufficient speed and power
4. High-security structure and features
5. Tight and yet comfortable space
6. Modern exterior design

N360 debuted in 1967

Comfortable cabin
Distinctive, sophisticated design

FF: 31 ps
Max. Speed: 115 km/h
Price: ¥313,000

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HondaJet (2017)

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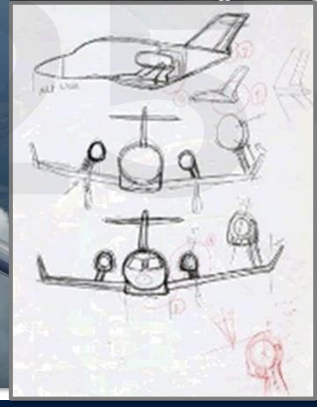
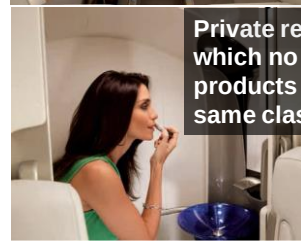
The unconventional design of placing the engines over the wings has not only enhanced the range and speed, but achieved the best-in-class cabin comfort

Engines mounted over the wings



Best-in-class cabin



Private restroom, which no other products in the same class offer

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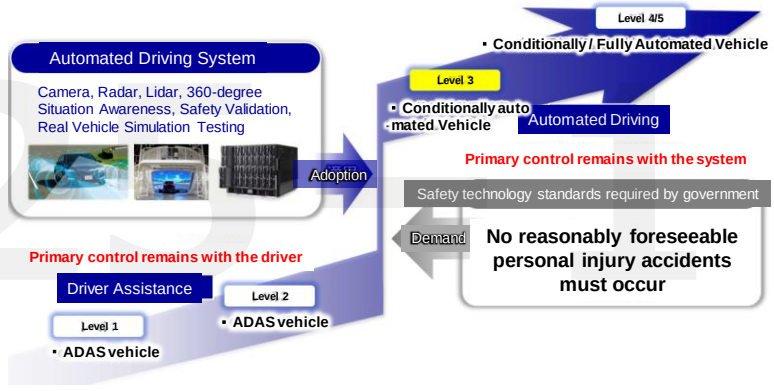
Honda Legend Featuring Level 3 Automated Driving Technology (2020)

17

“Collision-free society,” and “freedom of mobility” beyond that



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Honda’s Initiatives toward Carbon Neutrality

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Carbon Neutrality that Honda Aims to Achieve

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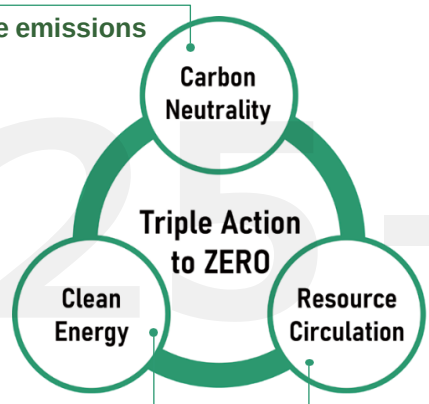
Triple Action to ZERO

Net zero carbon dioxide emissions



100% utilization of carbon-free energy

100% use of sustainable materials

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Multifaceted Approach to Realize Carbon Neutral Society

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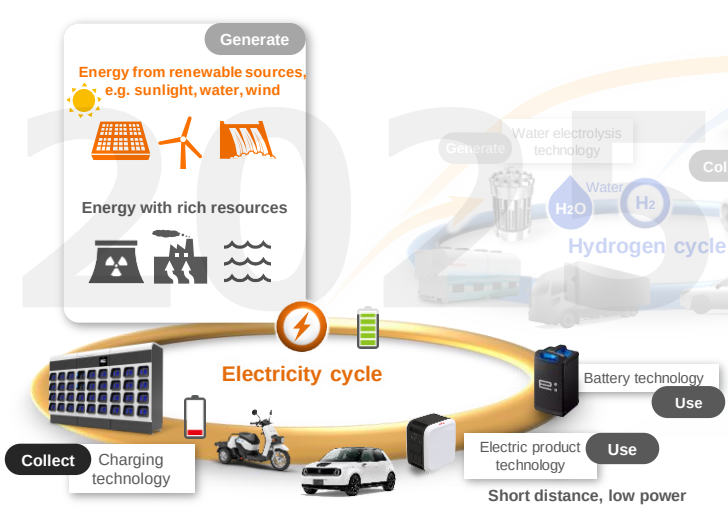
Along with renewable electricity,
establish the circular use of hydrogen and carbon as energy carriers



Utilize appropriate energy depending on regions and applications

Provide the right energy and power unit technologies at the right place

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Honda 0 Concept

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Honda 0 “Thin, Light and Wise”

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Thin

Augmenting design potential, including styling with a low vehicle height, and realizing excellent aerodynamic performance by utilizing a “thin” dedicated EV platform to create a low floor height.

Light

Realizing sporty driving and electricity efficiency performance that defy the established beliefs people have about EVs through Honda original technologies created by going back to the starting point of Honda as an automaker.

Wise

Realizing Honda original software-defined mobility products by leveraging the AD/ADAS, IoT, and connected technologies that fully utilize the knowledge Honda has amassed over the last 75 years of its monozukuri.

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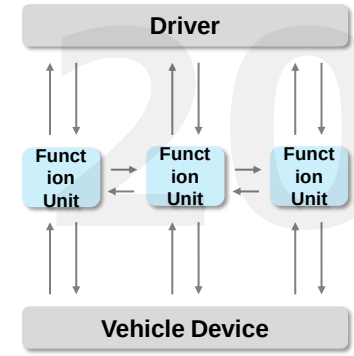
Wise: The World that SDVs Can Create

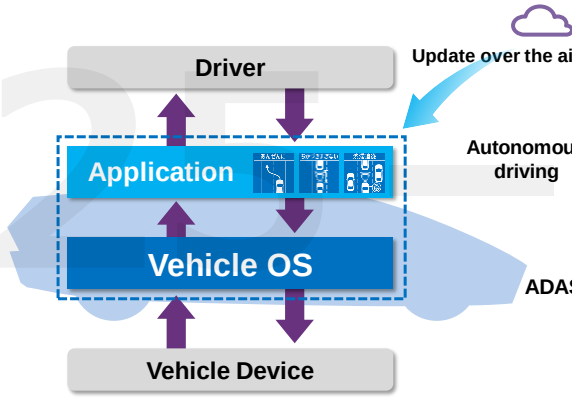
SDVs allow valuable functions to be added one after another using software to make the vehicles wiser

Conventional unit configuration



Value of a car is basically fixed at the time it goes on sale (i.e. value of hardware)

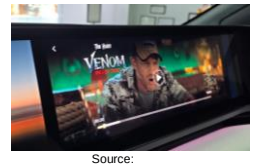
Configuration with a vehicle OS



Through software updates, value of cars keeps increasing with technology advancement

Autonomous driving

ADAS



Entertainment

Source:

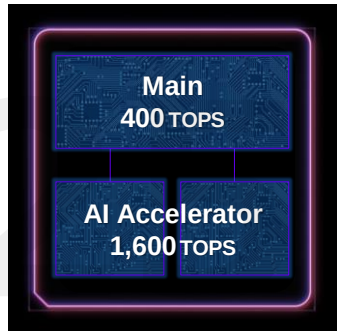
Wise: Customized SoC

Honda's unique AI-based SoC aimed to offer new value continuously

AI Accelerator (NPU)

2,000 TOPS
*Sparse

AI algorithm optimization



Power saving

3 nm process node applied

20 TOPS/W

RENESAS

Packaging technology

Integrated packaging enabled by chiplets / Accelerated processing using UCIe

Wise: Advancement of Self-Driving Technologies

Reliable recognition performance even in complicated situations, without relying on high-accuracy maps

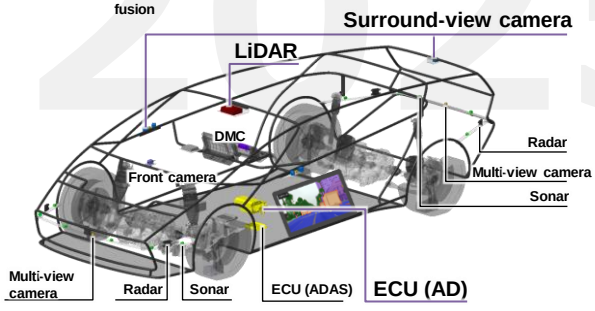
High-accuracy detection sensors

Combination of dissimilar sensors covers larger areas than humans, ensuring all risks will be recognized

Characteristics

- Not affected by changes in weather
- High-accuracy and highly-reliable long distance detection
- High performance even at night
- Driving our unique AI, sensor fusion

- Combination of LiDAR, radar, and camera
- LiDAR
- Surround-view camera (high dynamic range)
- High-performance ECU



Honda's unique AI technology

Concept learning with higher levels of abstraction, unsupervised learning

- Expand the area of service in a short period of time
- Real-time recognition of structures with infinite patterns
  Eyes-off driving possible even in variable environments or on a road the driver has never experienced

+

Driving behavior model of experienced drivers

Predicts the behavior of agents like an experienced driver to navigate around obstacles smoothly

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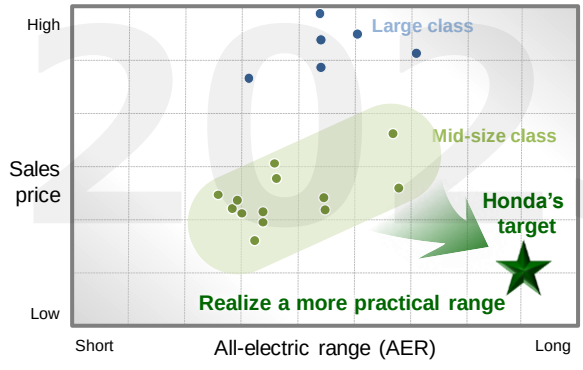
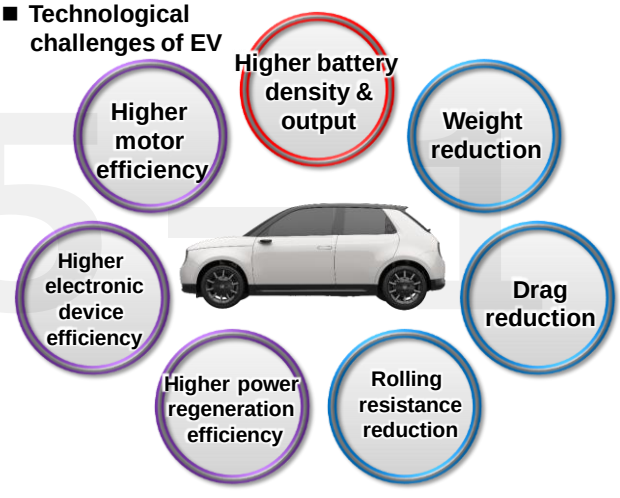
Battery EV that Honda Aims for

To popularize EVs without burden on customers, we aim to realize EVs far superior to ICE from AER and sales price perspectives

■ **Honda's desired EV**



■ **Technological challenges of EV**



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Honda's All-Solid-State Battery Development

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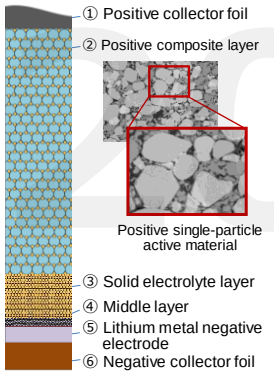
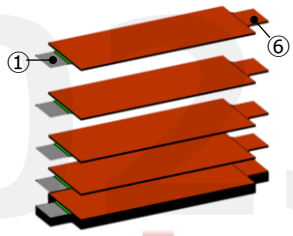
Development of innovative battery with high energy density

Cell specification development

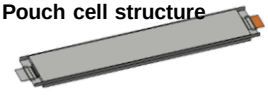
■ Electrode structure



■ Electrode laminated structure



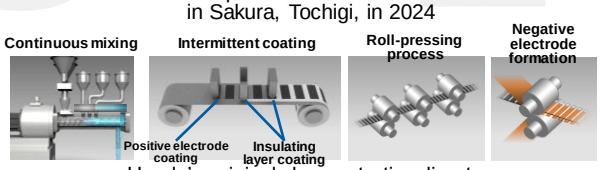
■ Pouch cell structure



We can achieve higher energy density than that of conventional liquid LiB

Production process development

We've completed the demonstration line in Sakura, Tochigi, in 2024



Honda's original demonstration line to establish the cell production technology

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Honda's All-Solid-State Battery Development

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Characteristics of All-Solid-State Batteries

"Solid" electrolyte	High energy density
More stable, thus safer, than liquid electrolytes	High-capacity materials can be used

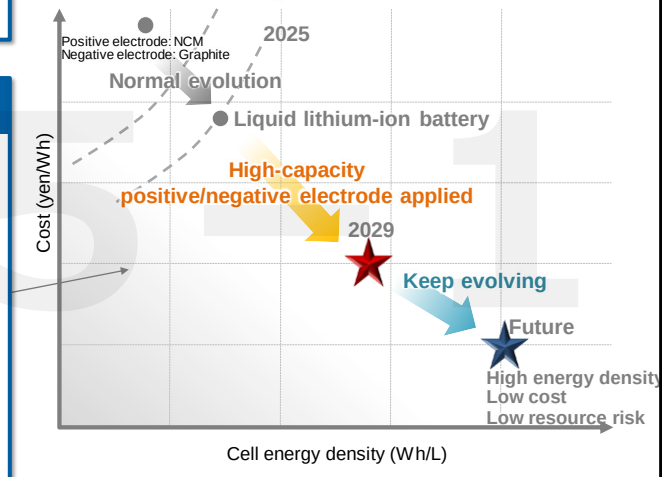
Aim and Potential

(Compared to conventional liquid LiB)

	Late 2020s	By 2040s
Range	2 x (e.g. 500 km → 1000 km)	More than 2.5 x (500 km → 1250 km or more)
To achieve same level of range as liquid LiB		
Battery size	-50%	-60%
Battery weight	-35%	-45%
Battery cost	-25%	-40% *Based on principle cost

By leveraging solid electrolytes, we will enhance the flexibility in positive/negative electrode selections with an aim to avoid resource risks and continue to improve energy density and cost.

Roadmap of all-solid-state battery evolution taking advantage of the flexibility of solid electrolytes in positive/negative electrode selections



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Multifaceted Approach to Realize Carbon Neutral Society

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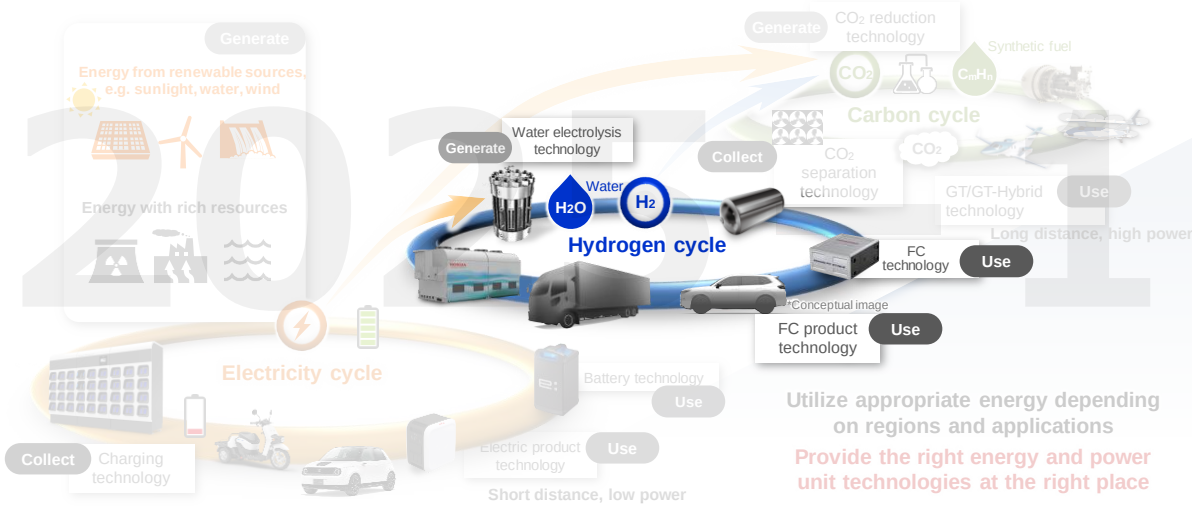
Along with renewable electricity,
establish the circular use of hydrogen and carbon as energy carriers



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Roles of Electricity and Hydrogen

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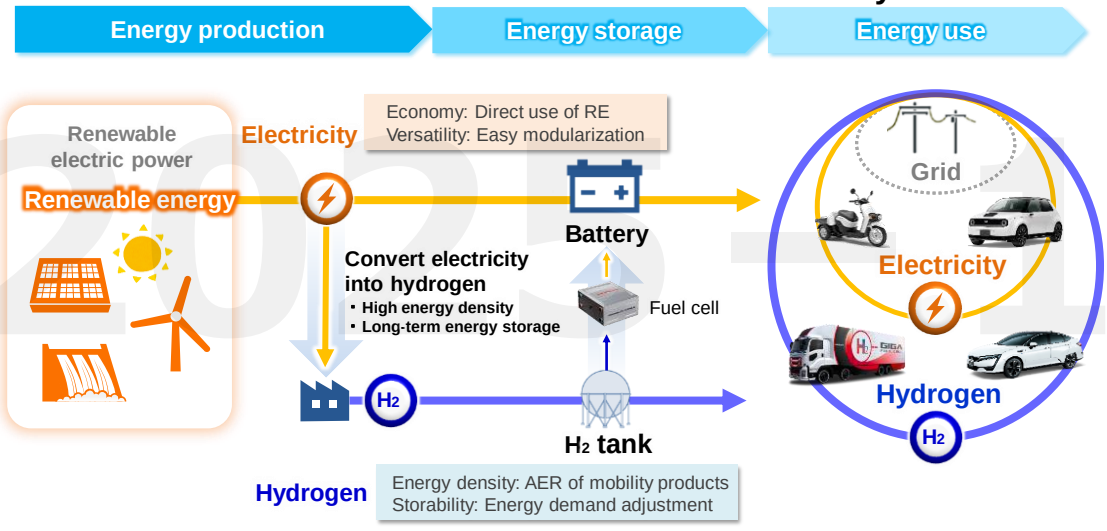
Wisely utilize hydrogen energy as well as electricity to accelerate electrification of the whole society



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3rd-Generation Fuel Cell System

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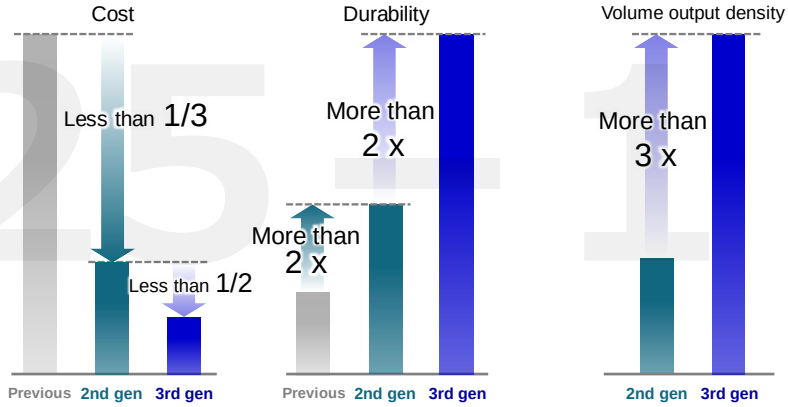
Mass production to start at our new domestic plant in 2027

Developed by Honda

3rd-gen fuel cell system

Rated output: 150 kW

■ **Generational evolution of our fuel cell system**



Wider Applications of FC Technology and Widespread Use of Hydrogen

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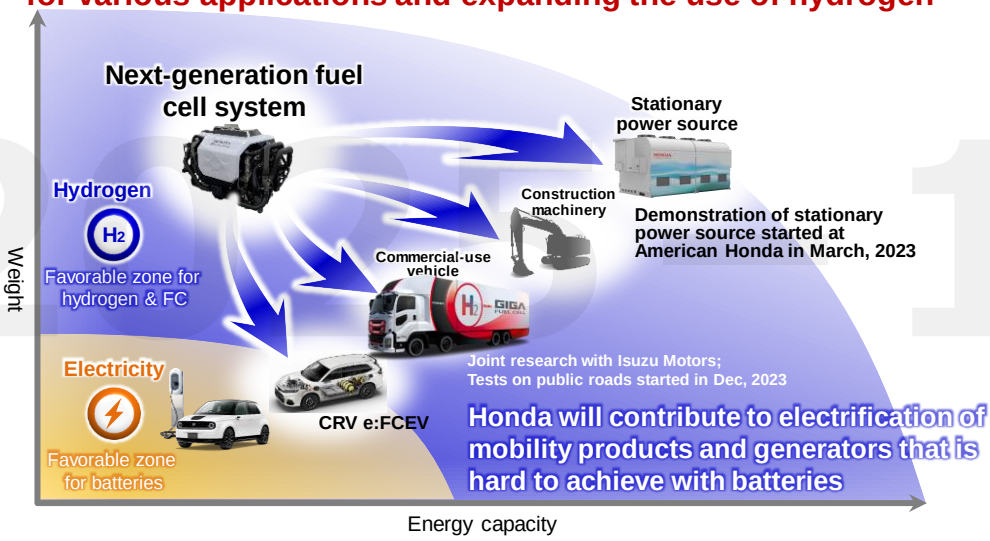
We'll provide clean mobility and reliable energy by using our core FC technology for various applications and expanding the use of hydrogen



Multifaceted Approach to Realize Carbon Neutral Society

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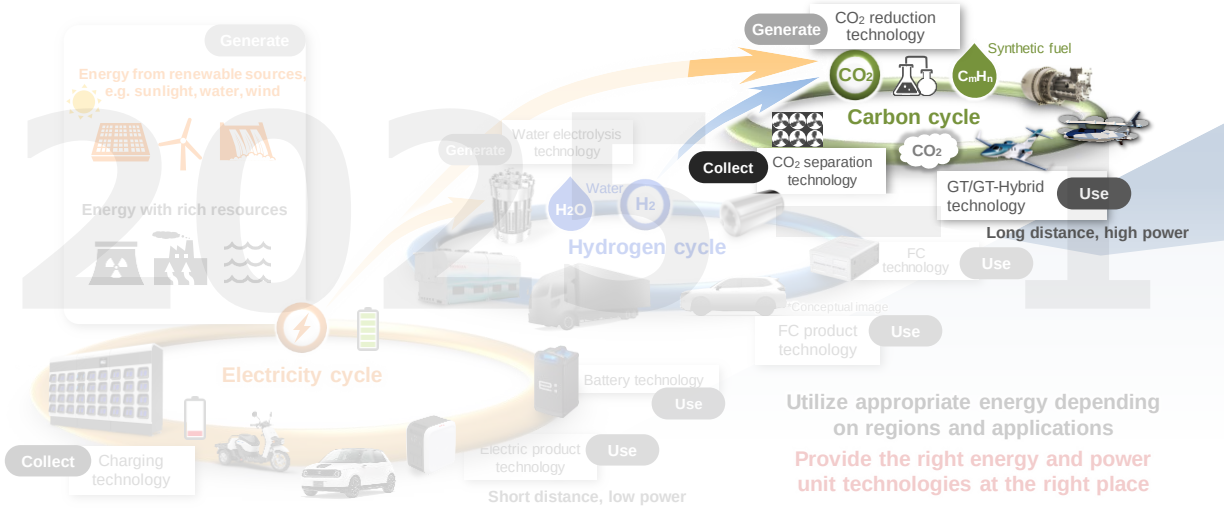

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Carbon Capture Utilization and Storage (CCUS) Technology

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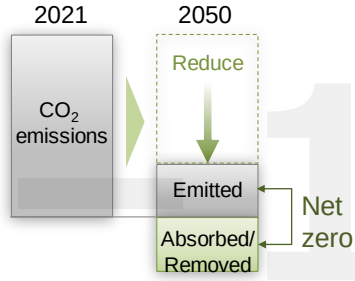
Hard-to-electrify domains

Utilizing carbon-neutral fuel
e-fuel, biofuel

Unavoidable CO_2 emissions



Technology to make CO_2 emissions net zero
CCS, DACCS

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Direct Air Capture (DAC) + e-fuel Technology

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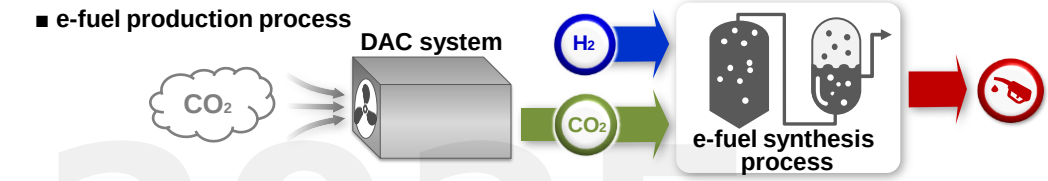
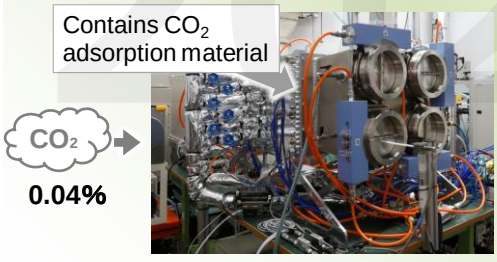
We're working on the technology for capturing CO_2 from the air and synthesizing carbon-neutral fuel

■ e-fuel production process

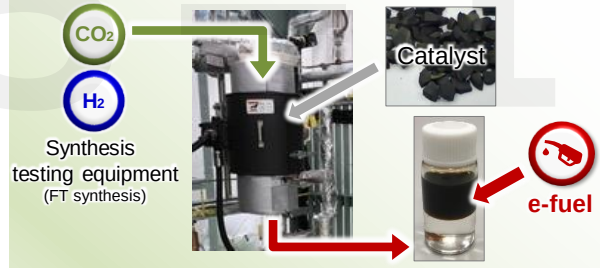


DAC test module



Enrich CO_2 by specifically absorbing/desorbing it

e-fuel synthesis testing equipment



Use catalysts to produce e-fuel out of hydrogen and CO_2

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Conclusion

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