

# Taking on the Challenge of Creating the Future



**We will pursue even more human-centered technologies and continue to take on every challenge to create valuable technologies that benefit people and society.**

President and Representative Director  
Honda R&D Co., Ltd.  
Managing Executive Officer  
**Keiji Otsu**

## All Technology is for People

Honda's origins lie in a product called the "Batabata," a bicycle equipped with a generator engine. Since our founding, we have continued to sincerely address the question, "What kind of technology is needed to help people?" Honda R&D is not simply a place for pursuing technology; we place importance on deeply understanding and researching people. The significance of technology becomes clear only when we identify what people need. In other words, our essential purpose is to help people, and technology is merely a means to achieve that goal.

"If i02BCt can help people, let's take on the challenge." Based on this spirit, we have expanded our products across land, sea, and air, from motorcycles and automobiles to generators, tillers, outboard motors, and the HondaJet that soars through the skies. In 2024, we delivered approximately 28 million products to customers around the world. With 31,536,000 seconds in a year,

a simple calculation shows that one product was sold every 1.1 seconds. In other words, we believe that every 1.1 seconds, somewhere in the world, our products are supporting people's lives and industries.

No matter how society changes in the future, our philosophy of "technology for people" will remain unchanged. Now, at a time when we are at a major technological turning point, with AI, electrification, and intelligence technologies, we will pursue "human-centered technology" more than ever, aiming to contribute to society.

## Unrelenting Passion for Technological Innovation

Honda is often said to be a company that continues to hone its technology with dreams as its driving force. We believe that a strong desire to serve people and create a better society is what makes a "dream." This desire gives us the strength to face

challenges, becomes the energy that maximizes each associate's capabilities, and leads to the realization of technology. To realize such a society, it is essential to have an unwavering conviction that this technology is absolutely necessary, and to have the attitude to overcome obstacles. We believe that it is through repeated challenges like this that new technology is born.

There are two phrases from our founder, Soichiro Honda, that I particularly remember. One is, "Success is the 1% supported by the 99% of failures." The other is, "Rather than fearing to take on a challenge and fail, be afraid to do nothing." The road to technological development is never smooth, and you will inevitably face challenges. However, fear of failure will not lead to innovative technology. Even if things do not go as expected, investigating the cause and continuing to take on the challenge with faith in success will lead to technological innovation.

## Technological Development That Opens up the Future

As an independent research and development division of Honda Motor Co., Ltd., Honda R&D fosters an environment where researchers can pursue research with free thinking and a spirit of inquiry, unconstrained by short-term business results. Conversely, our role is to constantly prepare forward-looking technologies to ensure Honda is prepared for any situation. Therefore, engineers must constantly consider the future and people's lives, and maintain a perspective of "what kind of technology will help realize the ideal society?" By setting targets and conducting research and development based on this mindset, the resulting technology will naturally be highly competitive. When I joined the company and worked on engine development, even while it was still in the planning stage, I was often asked, "Will that be the best in the world if we can achieve it?" The founder's commitment to becoming the best is still cherished in our everyday work. Respecting each engineer's curiosity, inquisitiveness, and passion for realizing their dreams is the starting point for the creation of new technologies. I believe that creating an environment where people can immerse themselves in technology is my mission as president of Honda R&D. In this environment, we have taken on various challenges and brought new technologies to the world. For example, the CVCC engine, the world's first map-based

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automotive navigation system “Honda Electro-Gyrocarator,” Collision Mitigation Braking System “CMBS,” Level 3 autonomous driving and “Honda SENSING Elite” — all of these technologies were world-firsts and were the result of our engineers’ strong desire to make them a reality, no matter what. Although these are past achievements, that spirit continues to this day.

For example, the electric vertical take-off and landing (eVTOL) aircraft we are currently developing combines our gas turbine engine expertise, cultivated over many years, the electrification technologies cultivated through our hybrid vehicles, and the aerodynamics expertise we’ve built up through motorsports and the HondaJet. Furthermore, in line with the trend toward electrification, we are also developing all-solid-state batteries as next-generation battery technology. Compared to conventional liquid lithium-ion batteries, these batteries offer the same range while being approximately 50% more compact, 35% lighter, and potentially costing more than 25% less. This is the core technology that enables us to deliver more affordable EVs with longer driving ranges to our customers. As we steadily prepare these highly competitive technologies, we aim to create valuable technologies and deliver them to society as useful products, even in the coming era of increasing intelligence and electrification.

## Taking on Challenges in New Domains

We are currently taking on a new challenge: the space domain. Space is considered a field with great business potential in the future. We are working on three main initiatives within this field, the first of which is the construction of a circular renewable energy system. Water is said to exist on the moon, and it is possible to produce oxygen and hydrogen by electrolyzing water using electricity obtained from sunlight. The oxygen can be supplied to human habitation, while the hydrogen can be used as an energy source. Furthermore, by combining hydrogen and oxygen and feeding it into a fuel cell system for which we possess technology, electricity can be generated. In this way, we envision using our technology to supply the resources necessary for life in space.

Our second initiative is the development of a reusable rocket, which successfully completed a takeoff and landing test of an experimental vehicle in June 2025. This initiative began with an engineer’s attempt to see if rocket development could be achieved by leveraging the core technologies we have cultivated. Rocket development brings together multiple advanced technologies, including combustion technology, fluid technology, and thermal management technology. Furthermore, because it is reusable, the vehicle must return to Earth after launch, and autonomous driving technology is applied for guidance and control. Additionally, we are considering applying cost-reduction technologies that utilize our manufacturing know-how, with the aim of realizing future mass production and more convenient transport technology. In this way, we are taking on the challenge of developing an affordable, reusable rocket, something that only



Launch of the Reusable Rocket Demonstrator, June 2025

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an automobile manufacturer can achieve.

Our third initiative is avatar robots. If avatar robots become a reality, it may not be impossible to work in space while remaining on Earth. We call this technology “4D (fourth-dimensional) mobility,” and we see it as a technology that will realize a new concept of movement that transcends time and space.

In the field of robotics, we are particularly focused on developing multi-joint, multi-fingered hand technology, aiming to engineer the movements of the human hand. If robots can perform tasks autonomously through integration with AI technology, it will be possible to replace human work with robots. In fact, there are processes in current factories that cannot be handled by industrial robots, but we believe that by using these technologies, we can achieve a higher level of automation.

### Looking Ahead

Even as we work on developing technologies for the future, society is undergoing rapid change. For example, as we move toward an electrified society, the lineup of our competitors has changed dramatically. Amid these changes, it is becoming increasingly important not only to advance and combine existing technologies, but also to create new technologies. We need to think more flexibly than ever before, foresee the future, understand our competitors, and surpass them.

Honda R&D is celebrating its 65th anniversary this year. We will continue to strive for greater competitiveness and take on all challenges, while cherishing the perspectives of “for people” and “for society.” We take on challenges again and again, and even if things don’t go well, we keep thinking deeply about why they didn’t work out, and never give up, but instead get to the root cause and resolve it. This is how technology is developed, and each and every person involved grows. Honda R&D has such an environment, and I believe it is the driving force behind Honda.





# New Efforts to Connect Carbon Neutrality to Economic Value

## Vision

To realize zero environmental impact involving Honda motorcycles and automobiles globally by 2050, Honda is advancing the Triple Action to ZERO concept, which integrates three pillars of “carbon neutrality,” “clean energy,” and “resource circulation”. We view the reduction of environmental impact not only as a corporate social responsibility but also as an opportunity to create new economic value for building a sustainable future.

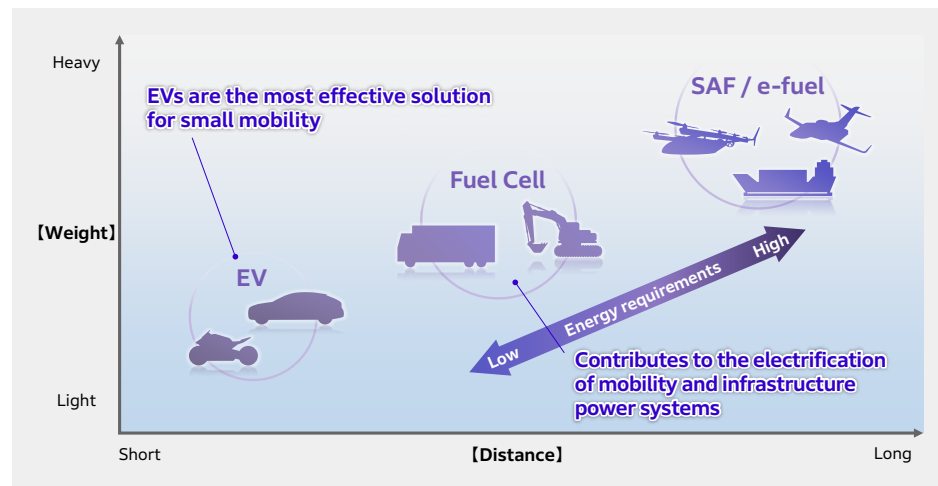
To achieve this, Honda is advancing the carbon neutrality of mobility. Utilizing diverse energy solutions, including electricity, clean hydrogen, e-fuel, and Biofuel\*<sup>1</sup>, we aim to optimally utilize renewable energy. For small mobility such as passenger vehicles, battery EVs directly using electricity are considered optimal. For large mobility such as trucks, fuel-cell EVs using clean hydrogen are considered optimal. For ultra-high-load areas such as aircraft, clean gas turbines\*<sup>2</sup> using sustainable aviation fuel (SAF)\*<sup>3</sup> derived from e-fuel or Biofuel are considered optimal. Honda is actively advancing the in-house development of powertrains\*<sup>4</sup> for these applications.

\*<sup>1</sup> Biofuel: Renewable fuel produced from biomass such as corn, waste oil, or algae.

\*<sup>2</sup> Clean gas turbine (Clean Gas Turbine Hybrid System): A next-generation hybrid drive system combining gas turbine power generation, batteries, and motors for Honda's electric vertical take-off and landing aircraft (eVTOL) under development.

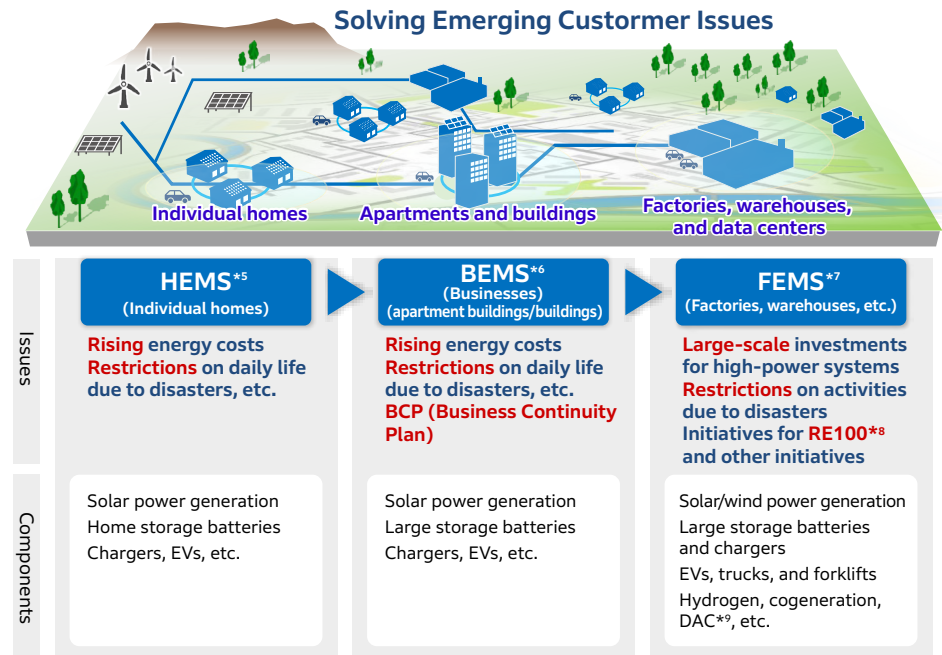
\*<sup>3</sup> SAF: Aviation liquid fuel manufactured from renewable resources or waste-derived materials.

\*<sup>4</sup> Powertrain: A series of systems that transmit power generated by an engine, a motor, or other power sources to the wheels or other outputs through the transmission, clutch, driveshaft, and other components, converting it into driving force.



Honda is also focusing on the development of energy management systems. In the current situation where the stable supply of renewable energy is challenging, systems for energy management, such as energy storage and regulation, are essential. In advancing the carbon neutrality of mobility, Honda deeply recognizes the importance of effective energy management. Leveraging our long-standing experience in energy-related products, we believe that we can harness Honda's unique strengths. By developing energy management systems that connect mobility with homes, buildings, factories, and communities, and through the efficient utilization of renewable energy, we are also taking on the challenge of creating new economic value.

Starting with the carbon neutrality of mobility, Honda is advancing the utilization of diverse energy solutions and the development of energy management systems. By realizing a balance between the environment and the economy, we will contribute to building a sustainable society and passing a hopeful future on to the next generation.



\*<sup>5</sup> HEMS (Home Energy Management System): A system for monitoring and optimizing household electricity consumption, in coordination with solar power generation, storage batteries, home appliances, and other devices, supporting energy savings and comfort throughout the living environment.

\*<sup>6</sup> BEMS (Building Energy Management System): A system that visualizes and controls the energy usage of systems such as air conditioning, lighting, and elevators in office buildings, commercial facilities, and other establishments.

\*<sup>7</sup> FEMS (Factory Energy Management System): A management system for factories that monitors the use of energy such as electricity, heat, and air at manufacturing sites in real time, balancing productivity and energy savings.

\*<sup>8</sup> RE100 (Renewable Energy 100): A global corporate initiative aiming to source 100% of electricity used in business activities from renewable energy.

\*<sup>9</sup> DAC (Direct Air Capture): Innovative carbon removal technology that directly captures CO<sub>2</sub> from the air.

## New Efforts to Connect Carbon Neutrality to Economic Value

### Transformation into a Circular Business Utilizing Battery EVs

As the first step toward realizing Honda's vision for a carbon-neutral world, we are advancing a transformation into a circular business utilizing battery EVs. This endeavor was initiated in earnest in Japan through ALTNA, a joint venture established with Mitsubishi Corporation. At ALTNA, a new business model is being developed that aims for the carbon neutrality of mobility and the maximum utilization of energy and resources.

Through its power service business utilizing battery EVs, ALTNA realizes the affordable and stable supply of electricity derived from renewable energy and promotes the reliable collection of batteries through its EV leasing business. During the lease period, battery usage is continuously monitored to assess its state of degradation, leading to optimal reuse after collection. Collected batteries are deployed in the repurposed energy storage system (ESS) business\*10 for reuse as ESS, contributing to the stable supply of renewable energy. In addition, pricing is designed based on the assumption that batteries will transition from in-vehicle use to ESS use, helping reduce the financial burden on EV users. Furthermore, a scheme will be established whereby batteries that have completed their role as a repurposed ESS and end-of-life vehicles are taken back by Honda and, after undergoing dismantling and recycling processes, are utilized in the production of next-generation mobility.

These initiatives enhance the maximum utilization of energy and resources throughout the EV lifecycle, provide flexibility to the power network through power service and energy storage businesses, and contribute to the wider adoption of renewable energy. Honda is advancing the realization of a sustainable society that can stand proudly for future generations through technological innovation and the promotion of a circular business.

\*10 Repurposed energy storage system (ESS) business: An initiative that reutilizes end-of-life batteries removed from electric vehicles as storage batteries within energy storage systems after re-inspection and condition evaluation.

### Expansion and Deployment of a Next-Generation Fuel Cell Module

To accelerate the carbon neutrality of mobility, Honda is advancing the development of a next-generation fuel cell module that uses hydrogen as an energy carrier, as part of diverse energy solutions. In February 2025, we released the specifications of a compact, high-performance module with more than three times the volumetric power density of the current model. This next-generation fuel cell module aims to more than double the durability while halving manufacturing costs.

Medium and large commercial mobility require highly efficient operation, such as long-distance driving, continuous operation, high output, and rapid refueling, making complete battery replacement challenging. As part of carbon-neutral solutions in the logistics area, Honda is exploring the introduction of fuel cells. Since December 2023, we have launched a public road demonstration of heavy-duty fuel-cell trucks in collaboration with Isuzu Motors Limited, and we will conduct public road demonstrations in collaboration with multiple transportation operators going forward. Honda will also address challenges in hydrogen supply infrastructure to accelerate the initiatives toward the practical deployment of fuel-cell trucks.

Furthermore, Honda started a demonstration project jointly with Tokuyama Corporation (Tokuyama) and Mitsubishi Corporation (MC), to operate a data center using by-product hydrogen and a stationary fuel cell (FC) power station designed to reuse FC systems from fuel cell electric vehicles (FCEVs). In this demonstration project, by-product hydrogen produced by Tokuyama's salt water electrolysis business will be utilized to generate electricity with a stationary FC power station that Honda is developing designed to reuse fuel cells recovered from FCEVs, and the electricity will be supplied to a distributed data center operated by MC, at the demonstration site. Through this demonstration project, the three companies will explore the potential of reusing automotive FC systems for stationary FC power station applications, and verify the possibility of contributing to 1) a reduction in the economic burden on customers who will install and operate stationary FC power stations and 2) the decarbonization of electric power, through effective use of FC systems, which are expected to see broader adoption in the future.

Through these demonstration projects, in addition to providing power units for medium- and large-sized commercial mobility applications that are difficult to electrify, Honda will also consider supplying stationary FC power stations utilizing both new and reused fuel cells to data centers, logistics warehouses, factories, and other facilities. By widely delivering hydrogen-derived clean energy to society, Honda aims to help achieve carbon neutrality.



Opening ceremony of the demonstration project for stationary FC power stations for data centers

## New Efforts to Connect Carbon Neutrality to Economic Value

### Demonstrations for Carbon Neutrality at European Research Sites

Starting with the carbon neutrality of mobility, Honda is utilizing diverse energy solutions and developing energy management systems to take on the challenges of realizing a sustainable society and creating new businesses. We are combining various energy and mobility technologies, including electricity and hydrogen, as well as battery EVs and fuel-cell EVs, and are also working on developing advanced energy management systems that integrate electricity and hydrogen.

This advanced initiative is implemented through demonstration tests at our research site in Germany, which is at the forefront of the energy transition. Since 2016, Honda has been working on creating new value from EVs and renewable energy at this site. We have developed a BEMS that integrates multiple bidirectional chargers coordinated with EVs; solar power generation; repurposed ESSs; hydrogen production equipment using water electrolysis; and other equipment, realizing comfortable EV charging and the achievement of carbon neutrality and energy cost optimization for buildings. Furthermore, we received the world's first prequalification for participation in balancing markets with multiple aggregated bidirectional chargers and aggregated EVs. Through an advanced vehicle-to-grid (V2G) demonstration, we have proven that EVs can go beyond being mere means of transportation and create new value as distributed energy assets that contribute to stabilizing power grids.

These endeavors are not limited to technological development alone; they also have the potential to create new business models and achieve global rollout, forming a key pillar of Honda's carbon-neutral strategy. These initiatives constitute the core of Honda's Triple Action to ZERO, symbolizing technological innovation and business model evolution toward a zero environmental impact society involving Honda motorcycles and automobiles globally. Our strategy to address the challenge of the instability of renewable energy by maximizing the utilization of energy and resources throughout the lifecycle is positioned as a solid opportunity for growth toward a carbon-neutral society. Starting with the carbon neutrality of mobility, we will serve people worldwide with the "joy of expanding their life's potential."

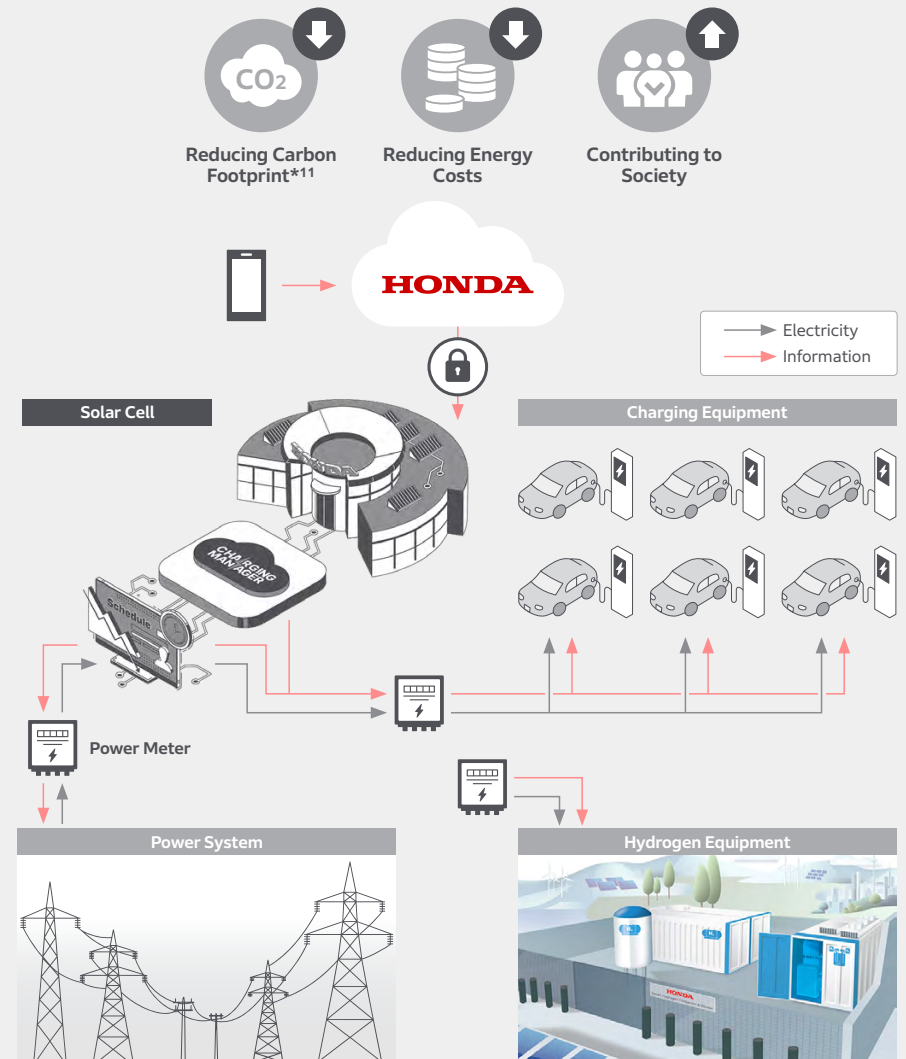


Research Facility in Europe (Germany)



Hydrogen Facility

### Aims of Carbon Neutral Demonstration



\*11 Refers to the total amount of greenhouse gases emitted directly or indirectly from product manufacturing and corporate activities, generally expressed in carbon dioxide (CO<sub>2</sub>) equivalents. It is an important indicator for assessing a company's progress toward carbon neutrality.