

Contributing to Decarbonization with Technologies Accumulated in Automotive Systems Development Aiming to Realize a Hydrogen Society: The Key to Carbon Neutrality

The world is moving toward a carbon-neutral society, and the utilization of hydrogen is key to achieving this goal. Leveraging the technologies honed through its automotive systems development, DENSO is actively engaged in the development of technologies in the areas of hydrogen production and utilization. In this section, we describe how DENSO is taking on the challenge of creating new value by contributing to decarbonization through hydrogen-related businesses.

Addressing climate change is an urgent issue for humanity, and carbon neutrality is gaining momentum in the international community. To protect the environment of our planet while ensuring a comfortable and sustainable lifestyle, the world is undergoing an energy transition from fossil fuels, such as oil and coal, to cleaner energy sources. Hydrogen has been gaining attention as one of these clean energy sources.

Hydrogen is a clean source of energy that does not emit CO₂ when used as energy. Moreover, it can be extracted from various substances, including water, which is found everywhere. If the utilization of hydrogen increases, it will open pathways to decarbonization for facilities that cannot easily be electrified, such as thermal power plants reliant on fossil fuels, and large commercial vehicles such as trucks and buses, which are harder to electrify than passenger cars.

Additionally, hydrogen can be stored, a notable advantage. By converting excess electricity from renewable energy sources like solar power into hydrogen, long-term energy storage becomes feasible. In countries with low energy self-sufficiency, such as Japan, the use of hydrogen is expected to contribute not only to decarbonization but also to energy security.

However, there are still numerous challenges that must be overcome before hydrogen can be widely utilized. Various technical issues must be solved within the supply chain, such as the production, storage, transportation, and utilization of hydrogen. Efficiently producing green hydrogen* from renewable energy, ensuring its proper transport, and expanding the scope of hydrogen utilization to increase demand are crucial steps for promoting the widespread use of hydrogen.

* Green hydrogen: Hydrogen produced using renewable energy, which does not emit CO₂ during the production process, making it the most effective for decarbonizatior



Leveraging Our Technologies Accumulated in Automotive Development to Tackle Challenges in Hydrogen Production and Utilization

To promote the widespread use of hydrogen, it is crucial to address technical challenges related to its utilization, particularly in fuel cells and furnaces, as well as in its production, such as the water electrolysis systems needed to produce hydrogen. The key challenges that have emerged in these areas are improving the efficiency and durability of these systems.

Interestingly, these technical challenges share points in common with requirements in automotive systems. DENSO is applying the automotive technologies it has developed over the years to tackle these challenges in hydrogen.

The first challenge, efficiency, is crucial because it helps lower the cost of hydrogen utilization by ensuring that valuable renewable energy is used efficiently to produce hydrogen and also ensuring that this hydrogen is utilized without any waste.

Through its development of automotive products and technologies, DENSO has accumulated expertise in technologies for efficiently using energy in order to improve fuel economy. This includes thermal management technologies that eliminate energy waste, electrical control technologies derived from electrically powered products, and materials technologies that maximize performance. These technologies can be applied to improve the electrolysis efficiency of water electrolysis systems used in hydrogen production and to enhance the power generation efficiency of fuel cells used in hydrogen utilization.

The second challenge, durability, is essential because, regardless of how efficient or high-performing a hydrogen production or utilization system may be, it cannot be widely used if it frequently breaks down or has poor maintainability, leading to reduced operational uptime. Durability ensures that such systems can be used safely over long periods of time.

In the automotive field, vehicles must be driven safely in various environments, necessitating high durability. Through its development of automotive products refined over many years, DENSO has achieved robust levels of safety and quality that enable vehicles to operate reliably under extreme temperatures weather conditions and road surfaces. Additionally the Company has established the manufacturing technologies needed to deliver these products to customers around the world. DENSO applies sensing technologies, originally developed for advanced driver assistance systems (ADAS), to constantly monitor the operations of hydrogen production and utilization systems, with the aim of ensuring that they can be safely and reliably used over long periods of time.

Providing Diverse Solutions for Hydrogen Production and Utilization to Realize a Hydrogen Society

The utilization of hydrogen remains an area filled with uncertainties, requiring various experiments to determine what solutions are the best. In collaboration with Toyota Motor Corporation, DENSO FUKUSHIMA CORPORATION is conducting demonstrations at one of its plants aimed at achieving carbon neutrality in manufacturing. In March 2024, hydrogen produced at the plant began being used in the manufacturing process for radiators delivered to customers, advancing our efforts to utilize hydrogen. In addition, DENSO is developing solid oxide electrolysis cell (SOEC) systems for producing hydrogen from electricity and solid oxide fuel cell (SOFC) systems for generating electricity from hydrogen. DENSO's manufacturing sites are conducting proof-of-concept testing of these systems.

The hydrogen supply chain has varying technical requirements at each stage. Some stages demand flexibility while others require stability. In some scenarios, small-scale decentralized systems are necessary, while in others, large-scale centralized systems are more appropriate.

DENSO is expanding its lineup of systems to meet these diverse needs. For example, the Company is developing an SOEC water electrolysis system that features a modular structure, allowing it to scale from small to large applications. These systems can be combined and configured to provide optimal solutions for specific use requirements.





* Proton exchange membrane electrolysis cell/Proton exchange membrane fuel cell. Joint development by the Toyota Group





DENSO FUKUSHIMA CORPORATION'S DENSO CORPORATION'S SOEC water electrolysis system demonstration facility

demonstration facility. Hirose Plant

Envisioning a Carbon-Neutral Circular Society

DENSO is expanding the scope of the challenges it undertakes, which started in the mobility domain, to manufacturing plants and other industrial domains, with an eye on creating a society where hydrogen is widely utilized. Through these demonstrations, we aim to enhance the efficiency and durability of hydrogen production and utilization systems. By applying the manufacturing techniques we honed in the automotive industry to realize high quality while lowering costs, we are beginning to see the pathway to overcoming the primary obstacle to widespread hydrogen utilization—reducing the cost of green hydrogen.

For instance, if we can synthesize methane using affordable green hydrogen, it could be supplied as a replacement for currently used city gas on a broad scale. Similarly, if we can synthesize substances like methanol, ethanol, and propane, we can decarbonize various plastic products and fuels used in our daily lives. Moreover, by combining this with carbon recycling technologies, which capture and reuse the CO₂ emitted during the combustion of these products and fuels, it is possible to realize a circular society that does not rely on fossil fuels.

The utilization of hydrogen is indispensable for achieving a circular society that efficiently uses renewable energy without waste. DENSO shares this vision with various partners across different domains, working closely together in co-creation initiatives to ensure that hydrogen is properly utilized and to guide society toward a future of decarbonization without undue burden.