

News Release

Hyundai Motor Exhibition at CES 2024 Envisions Transition to Hydrogen Energy and Software-Defined Mobility Solutions

- Exhibition at the Las Vegas Convention Center, West Hall displays its vision for a hydrogen-powered, software-driven transformation and Group-wide technologies
- Hyundai Motor Group announces fuel cell system brand HTWO's expansion into hydrogen value chain business brand
- Presents each stage of the entire clean hydrogen value chain (Production, Storage, Transportation and Utilization) through the HTWO solution package 'HTWO Grid'
- Reveals 'software-defined vehicle' (SDV) technologies under development to lead to a 'Software-defined Everything' (SDx) ecosystem beyond mobility
- Display of 'SDV E/E Architecture' and self-driving/safety feature technologies and High-Performance Vehicle Computer (HPVC) for SDVs
- Video installations show core software and AI technologies of SDVs and various practical software-defined mobility services in motion, being operated today
- Presents future mobilities (e.g., DICE, SPACE, CITY POD) based on human-centered vision, implemented through hydrogen energy and software technologies
- Displays 'Stretch', a logistics loading and unloading robot by Boston Dynamics

LAS VEGAS, January 9, 2024 – Hyundai Motor Company is showcasing future technologies from across Hyundai Motor Group (the Group) at CES 2024 in Las Vegas from January 9–12. Under the theme 'Ease every way,' the company presents a redefinition of its role in creating a more comfortable everyday life, focusing beyond mobility to innovate a human-centered life through the completion of a hydrogen energy ecosystem and a shift toward software-driven approaches.

Hyundai Motor's exhibition at this year's CES, in the West Hall of the Las Vegas Convention Center (LVCC), is three times larger than its display at CES 2022, spanning an area of around 21,600 sq. ft. It showcases exhibits demonstrating hydrogen and 'software-defined vehicle' (SDV) and artificial intelligence (AI)-related technologies that aim to realize a safe and free future for society.

Through this exhibition, Hyundai Motor aims to offer customers an experiential journey into the human-centered future vision through the introduction of key demonstrative technologies in hydrogen and software, alongside future mobility concepts.

Transition to a hydrogen society: 'Hydrogen can be used by anyone, anywhere'

In 2021, Hyundai Motor committed to achieving carbon neutrality by 2045 and continues to make efforts to reduce carbon in all areas of the value chain.

At the CES 2024, Hyundai Motor announced that it would expand HTWO, its existing fuel cell brand, into the Group's hydrogen value chain business brand, and announced a 'HTWO Grid' solution that will accelerate the transition to a hydrogen society.

HTWO harnesses the capabilities of each affiliate within the Group to offer an optimized, customized package that integrates unit solutions ('Grid') to meet the diverse environmental characteristics and needs of customers at every stage of hydrogen production, storage, transportation and utilization.

At CES, Hyundai Motor is displaying a media table that can examine the technologies that will be applied at each stage of the value chain and showcase the company's future direction that will speed up the transition to a hydrogen society.

First, in the production stage table, visitors can look at the resource-circulating hydrogen production technology, including two approaches: Plastic-to-Hydrogen (P2H) and Waste-to-Hydrogen (W2H), and a green hydrogen process.

P2H involves melting waste plastics that cannot be recycled, such as contaminated plastic and vinyl waste, which can be transformed into clean hydrogen energy. It can be achieved by combining liquefaction technology developed by Hyundai Engineering and the gasification technology of the global oil and gas company, Shell.

W2H is a process that converts biogas from organic waste, such as livestock manure and food waste, into hydrogen. Group entities Hyundai Engineering & Construction (E&C) and Hyundai Rotem are collaborating to enhance the technological development of this process. The W2H Process Diorama displayed next to the HTWO Grid media table demonstrates the process from biogas collection to hydrogen production, carbon capture and hydrogen-refueling station.

Visitors can also learn about green hydrogen that is produced by electrolyzing water. Electrolysis plants operate on renewable energy sources, such as wind, solar and hydropower. As green hydrogen is produced by a carbon-free energy source, it neither emits polluting gases during combustion nor production, gaining attention as the ultimate clean energy source of the future.

Hyundai E&C and Hyundai Engineering are participating in the construction of electrolysis-based green hydrogen production facilities in Buan and Boryeong, South Korea, respectively.

Regarding hydrogen storage and transportation, booth visitors can learn about a hydrogen logistics business process established by Hyundai Glovis and the ammonia carrier, one of the methods of transporting hydrogen.

A stable hydrogen supply is essential for providing hydrogen energy to everyone equally. Hyundai Glovis is preparing for a future hydrogen society by using its hydrogen logistics and distribution capabilities. Specifically, Hyundai Glovis is actively preparing for hydrogen society by strengthening its capabilities in hydrogen transportation.

The flow of hydrogen transportation and distribution can be divided into four stages: production, shipping, transportation and consumption. After production, hydrogen undergoes processing for distribution, is injected into tube trailers after high-temperature compression and is then shipped to various locations worldwide. Given the challenges of storing gaseous hydrogen for extended periods, managing an appropriate supply schedule that is tailored to production quantities is crucial. After being transported via hydrogen transport trucks, the stored hydrogen is finally sold and utilized at hydrogen fueling stations, industrial facilities and elsewhere.

Regarding onshore transportation, hydrogen can be transported by sea in two ways: transported as liquid hydrogen or stored and transported in the form of ammonia. Ammonia carriers are gaining attention as an effective means of transporting hydrogen. Although liquid hydrogen transport allows for mass transport, maintaining a temperature as low as -253 degrees Celsius incurs significant costs. Ammonia transport, on the other hand, has gained popularity as an alternative to liquid hydrogen transport.

Hyundai Glovis has successfully procured orders for two very large gas carriers (VLGCs) for ammonia transport and is set to begin operation in 2024. Hyundai Glovis is dedicated to advancing its maritime transportation capabilities in the realm of hydrogen energy by operating ammonia transport carriers, thereby broadening its business portfolio.

Notably, the company handles hydrogen transportation from the Dangjin hydrogen shipping center in South Korea to hydrogen fueling stations, coordinating the fueling schedule and dispatch plans for tube trailers and establishing a systematic hydrogen logistics business.

Regarding hydrogen utilization, booth visitors can explore various hydrogen mobility solutions provided by the Group that can be tailored to customers' desired purpose and scale.

Hyundai Motor's XCIENT Fuel Cell is the world's first mass-produced fuel cell Class 8 heavy-duty truck. It has been recognized for its eco-friendliness and excellent technological prowess in major global markets, such as Switzerland and Germany. Furthermore, the company has successfully launched tractor models specifically designed for the North American market.

Hyundai Motor continues to strengthen its collaborations with partners, including global e-commerce

players in the fields of green logistics transformation. The company is committed to providing optimized hydrogen mobility solutions, building on the foundation of its hydrogen fuel cell trucks.

Also on display, the mobile fuel cell generator supplies electricity solely through the fuel cell stack without the need for additional auxiliary power storage devices. It can be used in various fields and can provide power in emergencies, such as power outages, or challenging environments where accessing another power supply is difficult.

The mobile fuel cell generator is actively used in Electric Touring Car Racing (ETCR) competitions. To ensure the seamless operation of high-performance electric vehicles for all participating companies in the competition, Hyundai Motor has established a charging infrastructure using its hydrogen fuel cell system. The racing cars in the ETCR series recharge their batteries using electricity generated by the fuel cell generator produced by the Group.

Next to the media table, a sectional model displays the operating principle of a portable hydrogen fuel cell generator, allowing a detailed examination of its structure for easy understanding.

The hydrogen fuel cell tram provides environmentally friendly public transportation, contributing to the purification and production of clean air. The hydrogen fuel cell tram is equipped with four hydrogen fuel cells with a capacity of 95 kW and can travel up to 150 km. It purifies approximately 800 µg of fine dust and produces 107.6 kg of clean air per hour of operation.

The hydrogen fuel cell tram is wireless, which does not require tram overhead lines, improving the aesthetics of the city and reducing infrastructure costs. Hyundai Rotem will continuously expand its lineup, including hydrogen high-speed trains, electric multiple units and locomotives.

Booth visitors can also learn about how Hyundai Steel is preparing to establish a green steel production system to cut carbon emissions in the steel production process. It aims to reduce both direct and indirect carbon emissions by 12 percent by 2030 and achieve net-zero emissions by 2050.

By introducing eco-friendly processes that replace blast furnaces with electric arc furnaces and utilizing hydrogen and renewable energy instead of coal energy, the carbon emissions in the steel production process are significantly reduced.

Hyundai Motor is emphasizing its commitment to realizing the hydrogen vision at the Group level by showcasing a video inside the exhibition booth that explains the hydrogen demonstration projects and core technologies conducted by the group. This effort aims to highlight the company's ongoing dedication to making the hydrogen vision a reality.

Fostering a paradigm shift with the expansion from SDV to SDx ('Software-defined Everything')

At CES 2024, Hyundai Motor showcases exhibits and videos introducing core 'software-defined

vehicle' (SDV) technologies under development by the Group's global software center, 42dot, emphasizing the importance of software (SW) and AI in becoming a smart mobility solutions provider.

Hyundai Motor aims to redefine everything from vehicles to all surrounding environments with SW and AI, promoting the expansion from SDV to SDx ('Software-defined Everything'). Its CES exhibit highlights the Group's current practical software-defined mobility services alongside technologies fostering the extension of SDx.

The SDV Electrical/Electronic (E/E) Architecture represents the core hardware structure of SDV, showcasing the operational framework and functional structure where the vehicle's cameras, radars and sensors gather driving environment data, enabling autonomous driving through the integrated controller, a High-Performance Vehicle Computer (HPVC) embedded within the vehicle. This exhibit illustrates how the vehicle's hardware structure gets simplified through the transition toward SDV, providing a more intuitive view.

Based on driving scenes in Pangyo, South Korea played on the display in the front of the exhibit, actual road scenarios, such as left and right turns, are staged to illustrate the data flow where the HPVC and zone controllers for autonomous driving are activated according to the road environment. This flow is visualized through LED lights. Moreover, it's possible to observe the operation of a 'fault-tolerant' function within SDV safety features, where even if one controller malfunctions, another controller takes over to ensure safe driving.

The HPVC exhibited alongside the SDV architecture serves as the integrated hardware consolidating core SDV technologies. It controls all other controllers within the SDV, functioning as the brain of the SDV, enabling the application of software technologies in the vehicle. The HPVC aids in driving assistance and acts as a gateway between data generated within the vehicle, facilitating the application of software technologies in the vehicle. It plays a significant role, vastly enhancing the vehicle's performance, safety and convenience.

Two HPVC models developed by 42dot are available at one of the six media tables in the central software section within the booth. These models differ in their cooling methods: one uses air cooling, dissipating heat through air, while the other utilizes liquid cooling with water.

42dot is not only developing HPVC and controllers but also developing an SDV operating system, SDV OS, to ensure stable and efficient operation of in-vehicle applications. On the additional five media tables positioned to the right and above the HPVC exhibits, visitors can watch videos introducing the five core SDV technologies under development by 42dot and a film of various Group-wide practical software-defined mobility services in motion that are being operated today.

The five core technologies introduced through the videos include:

- HPVC and SDV OS: A modern data center-like network architecture and fault-tolerant system for SDVs

- Data-Driven Learning Systems: Continuous integration and deployment of autonomous driving from R&D to commercial robo-taxi service through MLOps and DataOps
- Safety-Designed Vehicle: Technology for cybersecurity and safe driving control
- LLM for Advanced Mobility: Conversational AI assistant that enhances human-like interaction between SDVs and drivers/passengers
- Self-Managed Smart City: SDV technologies extending beyond vehicles into the city

Furthermore, Hyundai Motor displays a video on software-defined mobility services in motion equipped with advanced technologies operated by various companies within the Group. The video features the on-demand shuttle 'Shucle', autonomous mobility platform 'TAP!' and Motional's IONIQ 5-based autonomous taxi service 'Robotaxi'.

DICE • SPACE • CITY POD: Experience future mobility realizing the human-centered vision

The Group will unveil a hydrogen-based mobility service concept that connects everyone's life, providing an experience of convenience and freedom of movement in line with the vision of 'Ease every way,' as presented at CES 2024.

In this exhibition, visitors can explore the Group's future mobility solutions, spanning from personal mobility to public mobility and logistics, realizing a human-centered vision that extends from individuals to cities.

DICE (Digital Curated Experience) infused with AI is a personal mobility platform that provides curated services through software technology customized to individuals. Through a display surrounded on three sides, a more immersive mobile experience is possible.

The 'Ring Pad' controller, a kinetic interface that is an evolved form of a fixed interface of existing vehicles, allows you to communicate with AI and adjust the environment of DICE. It includes a bio-sensing camera to create an optimized environment and an airbag for safety.

When using DICE for travel, you can receive curated journey suggestions through personal device integration, which considers your schedule, destination and more. In addition, DICE can reroute in response to a sudden change in schedule and activate 'Therapy Mode,' which monitors the user's condition through continuous bio-sensing.

Hyundai aims to showcase the evolution into a platform with infinite possibilities, going beyond the traditional driver-passenger roles through spatial computing-based interfaces of DICE.

While DICE is about personalized digital experiences during transportation, SPACE (Spatial Curated Experience) is about providing customized spatial experiences by incorporating individual lifestyles into the mobility space to embrace users across a wide spectrum of needs, along with free mobility.

To meet the varied needs of passengers, SPACE Mobility provides optimized space and adaptive seats. It also supports wheelchair users, micro-mobility users and pets through comfortable boarding height control.

Along with that, booth visitors can enjoy customized content through a large transparent display placed on doors. The AI service agent located in the interior console interacts with users, providing various information needed throughout the journey.

Not only that, but SPACE also extends to an open area called the 'Pavilion', which is constructed from reused obsolete mobility modules. It is a concept that architecturally reinterprets the life cycle of mobility. It is characterized by the ability to impart various functions and usability to each module.

It interacts with the software environment through a hologram interface and provides portable battery slots and various charging modules for sharing energy through a hydrogen fuel cell system. It functions as a hub that connects people, city, robot and mobility, incorporating an air-cleaning algae module and a smart farm that utilizes water from the byproduct of a hydrogen fuel cell, along with a rest area featuring mobility seats.

Also on display is CITY POD, an unmanned large-scale mobility system that surpasses the limits of the existing logistics systems based on software. It presents an 'automatic logistics sorting system' that moves organically and actively at all stages.

CITY POD with hydrogen energy technology adopts a modular system combining Plug & Drive and PnD POD, presenting an efficient and systematic middle mile and last mile logistics vision. Each POD is automatically combined or separated as needed, allowing logistics to be delivered directly to customers not only on the road but also inside buildings.

Hyundai Motor plans to provide a demonstration during CES so that visitors to the exhibition hall can directly experience future mobility.

In addition, Hyundai Motor also exhibited 'Stretch', a logistics loading and unloading robot developed by Boston Dynamics. 'Stretch' is an autonomous robot for more efficient and safer logistics operations, mainly helping to empty loaded trailers and shipping containers in warehouses.

Stretch uses AI to make real-time decisions on all boxes and sort logistics according to self-established rules, so it can work without entering additional information in advance. Its main feature is that it can carry boxes weighing up to 50 pounds (approximately 22.7 kg) and can even pick up multiple boxes at once. At the booth, Stretch performs a continuous demonstration of picking up and putting down a box on the floor.

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[Appendix]

Link to web articles on Hyundai's message and core technologies presented at CES 2024:

- Main article
<https://www.hyundai.com/worldwide/en/brand-journal/mobility-solution/ces-2024>
- HTWO Grid solution
<https://www.hyundai.com/worldwide/en/company/innovation/hydrogen-value-chain#section-1>
- SDV technologies
<https://www.hyundai.com/worldwide/en/brand-journal/mobility-solution/sdv>

About Hyundai Motor Company

Established in 1967, Hyundai Motor Company is present in over 200 countries with more than 120,000 employees dedicated to tackling real-world mobility challenges around the globe. Based on the brand vision 'Progress for Humanity,' Hyundai Motor is accelerating its transformation into a Smart Mobility Solution Provider. The company invests in advanced technologies such as robotics and Advanced Air Mobility (AAM) to bring about revolutionary mobility solutions, while pursuing open innovation to introduce future mobility services. In pursuit of sustainable future for the world, Hyundai will continue its efforts to introduce zero emission vehicles equipped with industry-leading hydrogen fuel cell and EV technologies.

More information about Hyundai Motor and its products can be found at:

<https://www.hyundai.com/worldwide/en/> or [Newsroom: Media Hub by Hyundai](#)

Contact:

SooHo Jung

Global PR Contents Team / Hyundai Motor Company

sooho.jung@hyundai.com