

Hydrogen

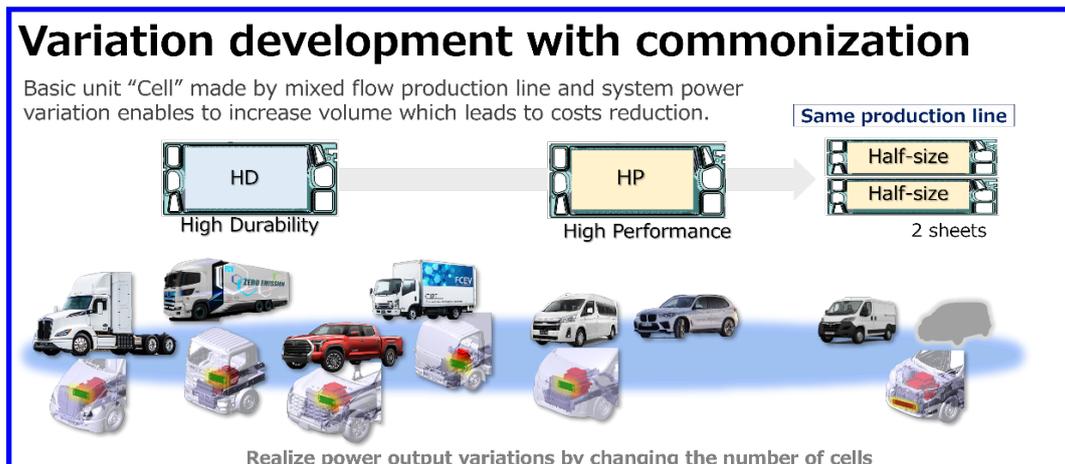
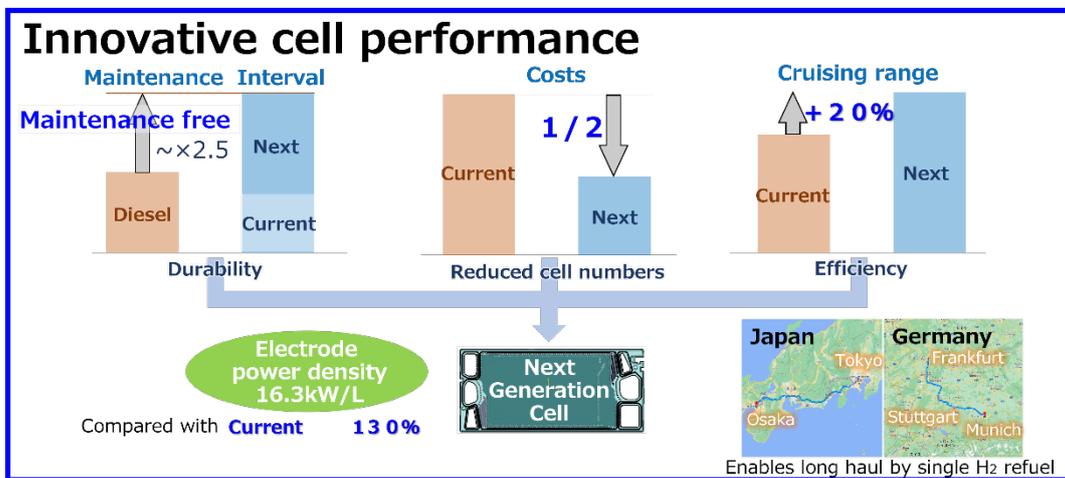
▽ **An innovative next-generation FC system aims to expand demand for hydrogen, especially for commercial use.**

As Toyota moves forward in reducing CO2 emissions with the aim of achieving carbon neutrality, Toyota positions **hydrogen as an important fuel** in its efforts to reduce CO2 emissions with the aim of achieving carbon neutrality.

To contribute to **the creation of a “hydrogen society”** through the promotion of hydrogen utilization, we are **working with various industry partners in the areas of producing, transporting, and using hydrogen**. We are also developing and demonstrating fuel cell electric vehicles (FCEVs) such as passenger and commercial trucks and buses, FC stationary generators and hydrogen engine vehicles with internal combustion engines.

1. Next-generation FC System

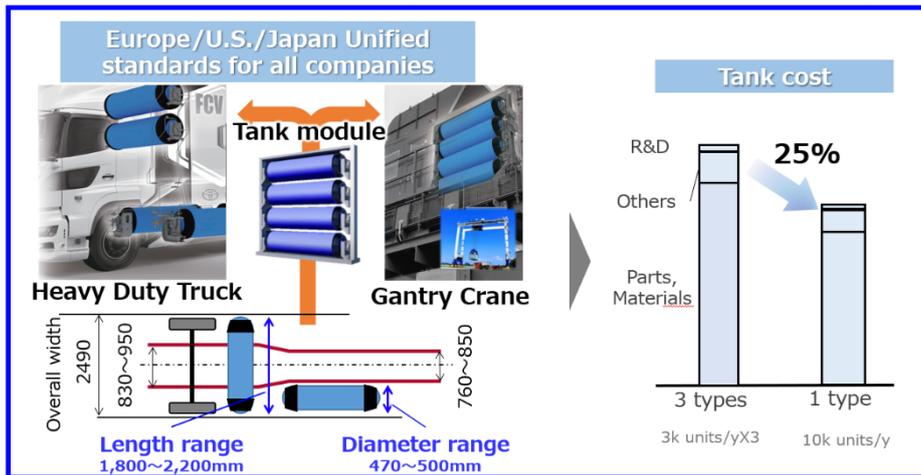
- We are developing innovative next-generation fuel cells that deliver industry-leading performance for commercial use (long life, low cost, and low fuel consumption), aiming for commercialization in 2026.
- With these cells, we are pursuing easier maintenance than diesel engine vehicles and 1/2 the cost of a stack (compared to current models). We also expect to improve the cruising range by 20% (compared to the current range).



2. Large Commercial Tanks

- We are taking on **the standardization of tanks for large commercial vehicles**, which are expected to consume hydrogen on a large scale, to **accelerate the expansion of hydrogen demand**. We **aim to reduce manufacturing costs by 25%** by unifying the tank standards of European, U.S., and Japanese companies and consolidating their quantities.
- We are also developing liquid hydrogen tanks for large commercial vehicles.

Size standardization (Base unit for commercial tanks)



3. Multi Hydrogen Tank (Concept)

- We are developing hydrogen tanks **designed for ease of installation and compatibility with various types of vehicles**, from large to small. It will be possible to convert existing vehicles to FCEVs and hydrogen engine vehicles.

4. Hydrogen production: Production by water electrolysis or from biogas

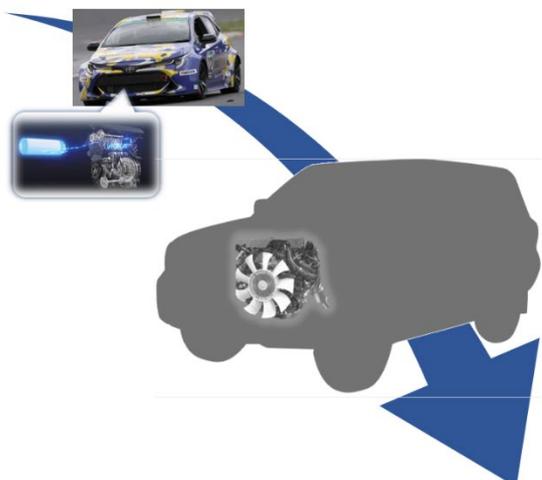
- We have developed a new water electrolyzer that produces hydrogen by **electrolyzing water**, applying the fuel cell stack and cell technologies developed for the Mirai, and **started its public trials at the DENSO Fukushima plant**.

- We have started an initiative to **produce hydrogen from biogas derived from local chicken manure and food waste** in Thailand by the end of 2023 in collaboration with Mitsubishi Kakoki Corporation and Toyota Tsusho Corporation.

H2 production with water electrolyzer	H2 production from biogas
 <p>Water electrolyzer stack (FC technology was applied)</p>	 <p>三洋化成工業株式会社 MITSUBISHI KAKOKI KASEI CO., LTD. TOYOTA</p>
<p>The demonstration started for commercialization (DENSO Fukushima)</p>	<p>Start of h2 production by demonstration unit at the end of the year (Thailand).</p>

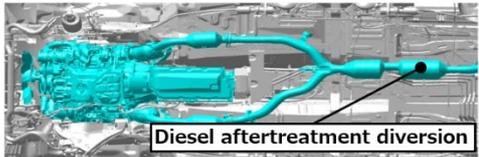
5. Hydrogen engine vehicle: Trial vehicle (license plate number already obtained; can be driven on public roads)

- **We will accelerate development of hydrogen engine vehicles for commercialization** as a new option in contributing to carbon neutrality.
- We will promote consideration of the entire vehicle by incorporating an exhaust purification system that utilizes diesel engine vehicle technology, etc.



Conventional engine technology can be used

Merit of engine



Diesel aftertreatment diversion

Typical example : Countermeasures against water Generated by hydrogen combustion

Challenge



Engine inside (combustion chamber)

Carbon neutral (CN) fuel

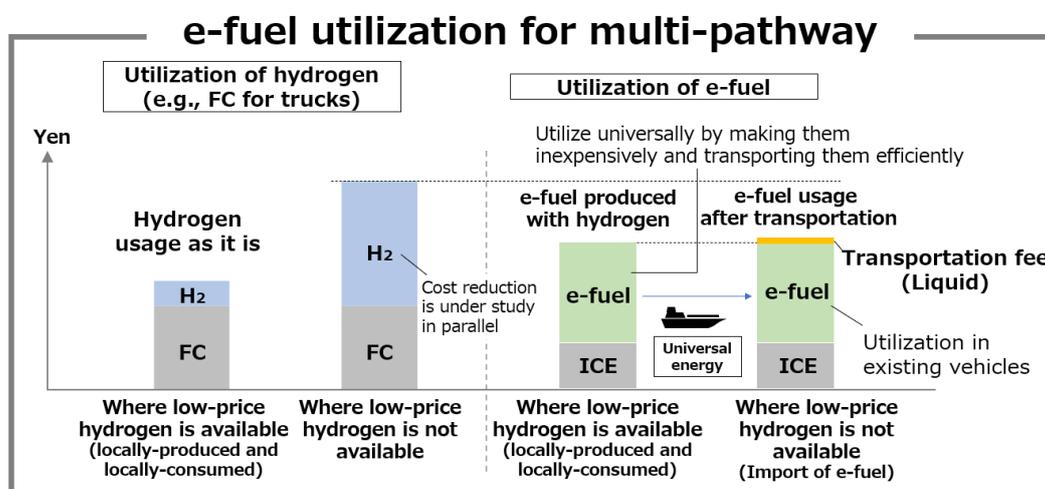
▽ **We will work with various partners to promote the use of biofuels, which will lead to CN for vehicles owned by customers.**

To achieve carbon neutrality, it is important not only to promote the spread of electrified vehicles, especially in new car sales, **but also to reduce CO2 emissions during driving of vehicles already owned by customers who use them in their daily lives.**

To meet the needs of diverse vehicles, regions, and customers, we must **offer a variety of energy options.** We are **working with various partners** across industry boundaries to reduce CO2 emissions and public trials of **hydrogen, synthetic fuels, and bioethanol fuels based on electricity derived from renewable energy sources**, from raw material procurement through the manufacturing process.

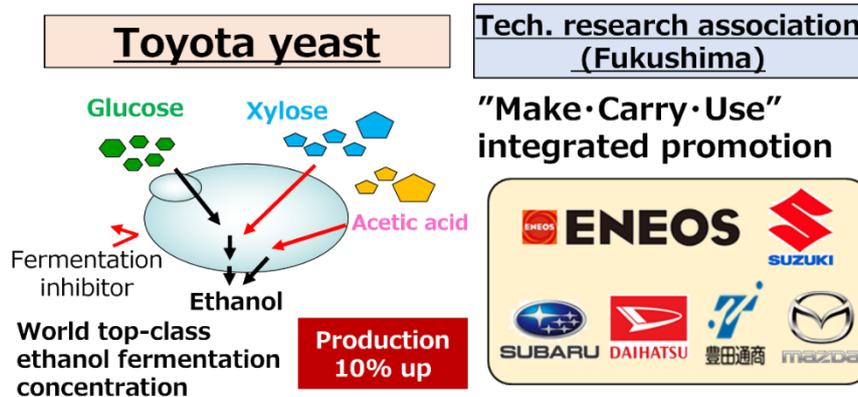
1. e-fuel

- In regions where hydrogen is inexpensive, **hydrogen is produced and consumed locally using FC as-is.** In regions where hydrogen is expensive, we will examine the potential for total cost advantages by producing and transporting e-fuel to regions where production costs are low.



2. Biofuels

- In July 2022, seven private companies including Toyota established the **Research Association of Biomass Innovation for Next Generation Automobile Fuels** to promote research of a production technology structure for second generation bioethanol fuel.



- We are expanding use in emerging countries by promoting deployment of the **right vehicle in the right place at the right time**, including the introduction of biofuel (ethanol)-compatible vehicles.

Vehicle Capability

- Biofuel (10%) can be used in all vehicle types
- In Brazil, 100% biofuel-compatible HEVs are sold.



- India also announced the launch of HEVs adaptable to biofuels('22/11)

