

Status of development of hydrogen-powered train toward achieving carbon neutrality —Development of a hydrogen engine hybrid system

Based on the Japanese government's 2050 carbon-neutrality policy, we are developing technology to reduce CO₂ emissions from railcars to net zero as part of our efforts to achieve carbon neutrality by 2050. As one of the means to achieve this, we are working to develop hydrogen-powered train, which use hydrogen as fuel, to replace conventional diesel railcars, which run on diesel fuel.

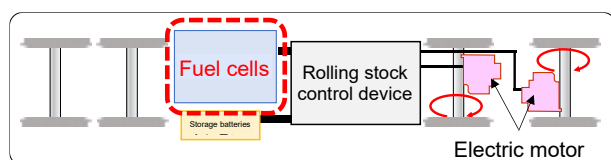
For hydrogen-powered train, we are considering using fuel cells and hydrogen engines as power sources, with the Series HC85 hybrid system used as the base. For a fuel cell hybrid system, simulated running tests have been conducted since FY2023. Meanwhile, we have been working on the development of a hydrogen engine hybrid system since FY2024 and have now completed a prototype, for which we will conduct performance evaluation tests and simulated running tests at the Komaki Research Center.

1. Development of hydrogen-powered train

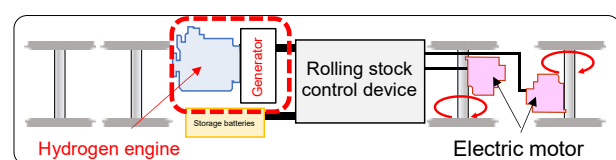
- In order to introduce hydrogen-powered train to our non-electrified routes, it is necessary to realize a drive system with high power output that allows for running on continuous gradients in mountainous areas and with high efficiency that allows for long distance running.
- Accordingly, we will advance technological development for a hydrogen-powered hybrid system that runs both on electricity generated from fuel cells or hydrogen engines as power sources and on electricity from storage batteries, using our Series HC85 hybrid system as the base.
- We will continue to verify the applicability of hydrogen power to railway vehicles through running tests simulating harsh environments such as steep gradients and repeated acceleration and deceleration, using equipment at the Komaki Research Center.

2. Overview of a hydrogen engine hybrid system prototype (Attachment)

- The system combines a hydrogen engine, developed by i Labo Corporation (Head Office: Chuo-ku, Tokyo; Representative Director: Nobuhiro Ota) based on an industrial diesel engine, with a generator, a rolling stock control device, and storage batteries used in our Series HC85. Hydrogen engines are expected to offer high durability, high power density, and high efficiency at heavy loads. They also have the advantage of being able to operate with lower hydrogen purity than fuel cells.
- In developing the prototype, the hydrogen engine was modified so that it could operate at a constant revolution speed in order to be used in railcars, and a control function that optimizes the output of the hydrogen engine and storage batteries according to the load conditions, such as when accelerating or running on a slope, was implemented in the vehicle control device.



Fuel cell hybrid system



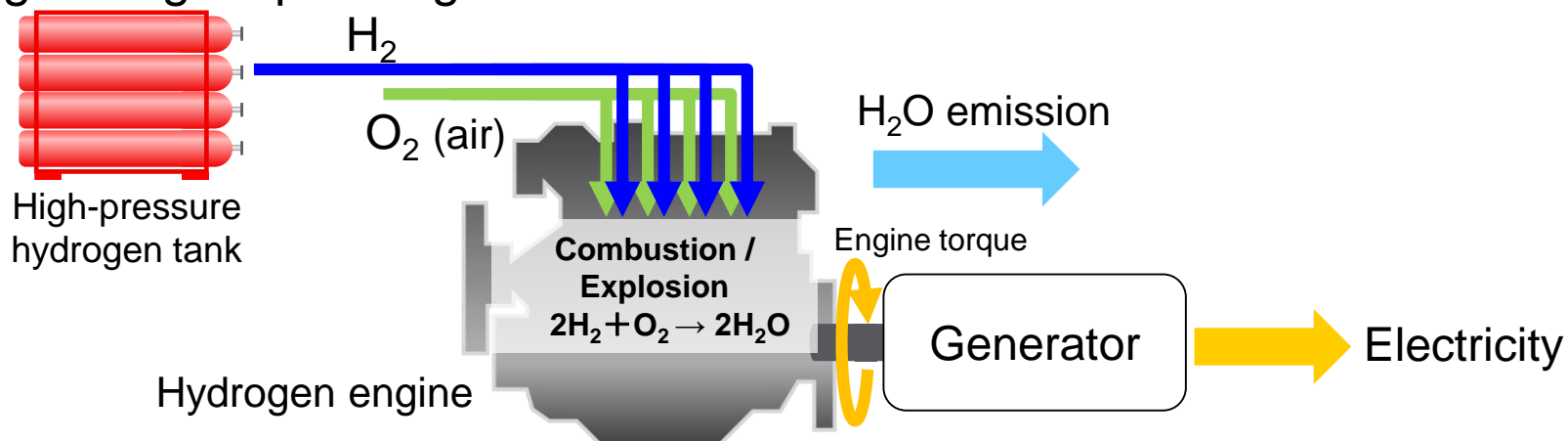
Hydrogen engine hybrid system

3. Development schedule for a hydrogen engine hybrid system

November 2024: Performance evaluation test of a hydrogen engine hybrid system alone

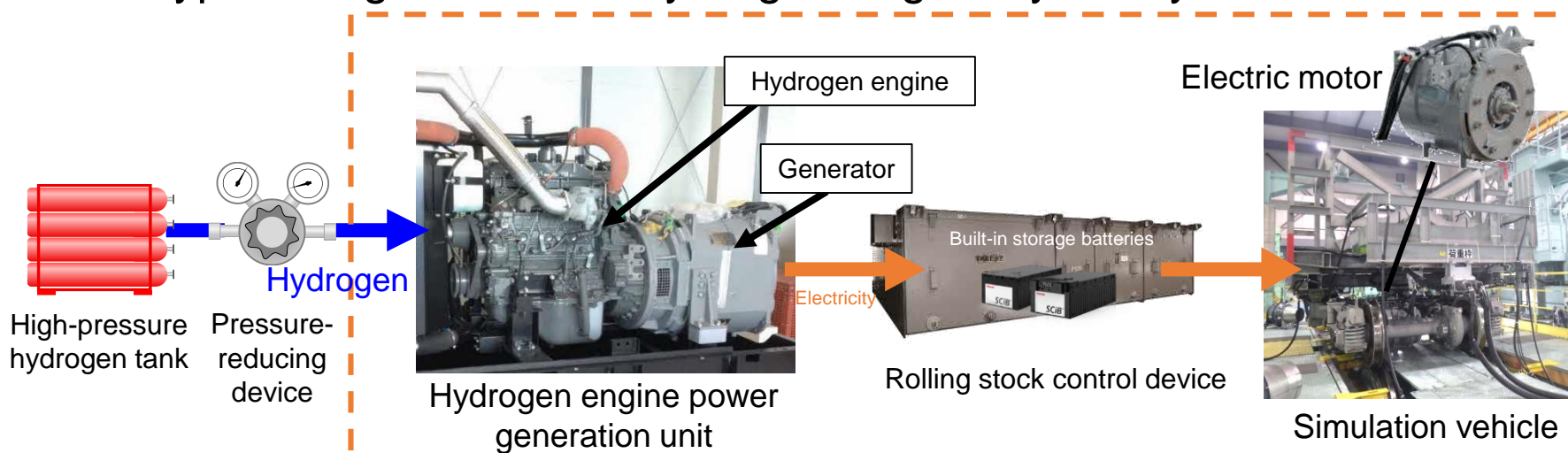
FY2025: Simulated running test combined with a simulation vehicle

○ Hydrogen engine power generation mechanism



The combustion and explosion of hydrogen and oxygen produces engine torque, which is then converted into electricity through a generator.

○ Prototype configuration of a hydrogen engine hybrid system



Hydrogen engine hybrid system