



Hideyuki Taguchi,
Senior Researcher,
Japan Aerospace Exploration Agency

Hydrogen Aircraft Research in JAXA

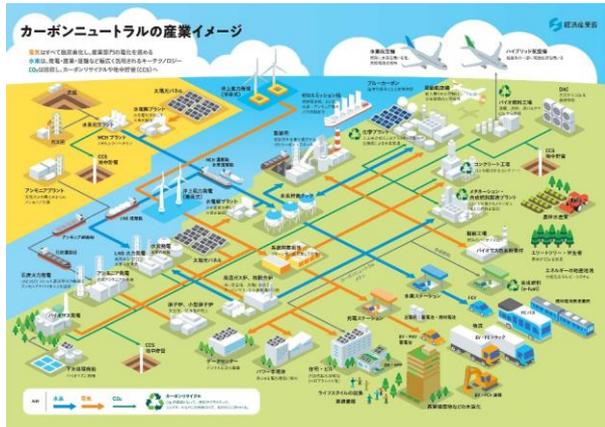


Hideyuki Taguchi

Hydrogen Aerospace Plane Team

Japan Aerospace Exploration Agency

- Sustainable development is the most important subject to keep the global environment.
- Japanese government has declared to establish Carbon neutral society until 2050.
- Tokyo metropolitan is planning to build hydrogen-based society using CO2 free Hydrogen at Tokyo Bay area.
- Hydrogen aircraft, which will fly from Tokyo, will be a part of hydrogen-based society and contribute to the sustainable and global community.



Carbon-Neutral Society Concept in Japan



Tokyo Olympic Village with Hydrogen supply



Hydrogen Aircraft

<https://blog.evsmart.net/ev-news/japan-meti-announced-2050-carbon-neutral-green-growth-plan/>

<https://www.kankyo.metro.tokyo.lg.jp/en/climate/others.html>



H-IIA Hydrogen Rocket



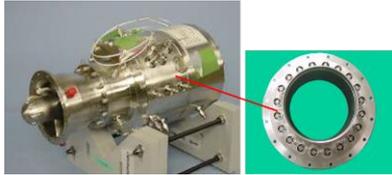
Hydrogen Hypersonic Turbojet



Hydrogen Aircraft for Civil Aviation

- JAXA has a long history to develop H-IIA hydrogen rocket with LH2 fuel tank, rocket engine.
- JAXA has been developed hydrogen fueled turbojet and ramjet engines for hypersonic aircraft.
- There are technological potentials to develop safe and reliable hydrogen aircraft with proper investment.
- Hydrogen aircraft concept with the following components has been studied:

Stable Hydrogen Combustor, LH2 Electric Pump, LH2 Composite Tank



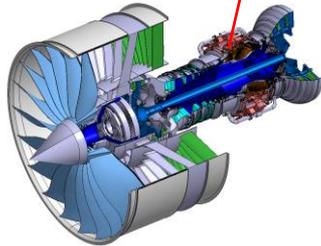
Stable Hydrogen Combustor
(Low Nitrogen Oxide)



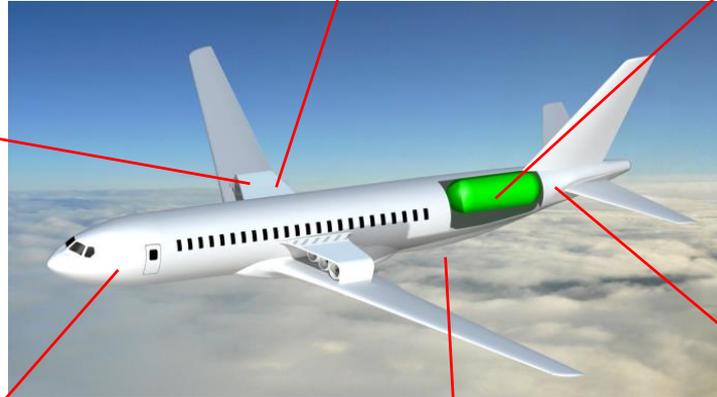
LH2 Electric Pump
(Small Flow Rate, High Pressure)



LH2 Composite Tank
(No Leakage, Metal interface)



Hydrogen Jet Engine



*Hydrogen Aircraft Concept
(2035 EIS)*

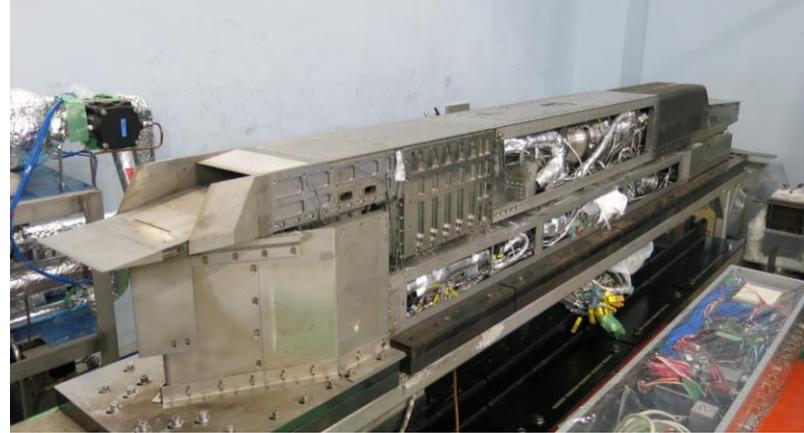
Safety Management
(Leakage Detection)

Evaluation of Environmental Impact
(Fuel Production, Water Vapor Exhaust)

Power Management
(Fuel Cell, APU)



Hypersonic Aircraft Concept



Hydrogen Pre-Cooled Turbojet Engine

- Hydrogen pre-cooled turbojet engine has been developed aiming at Mach 5 class hypersonic aircraft.
- **Stable hydrogen combustor** has been demonstrated by **LH2 fuel supply system** with supercritical condition at ground level test and Mach 4 wind tunnel test.
- Technologies for the stable hydrogen combustor and fuel supply system can be also applied to subsonic hydrogen jet engines.



Ground Level Test

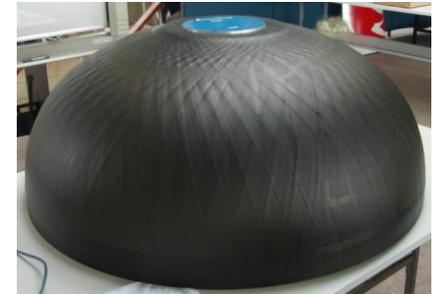
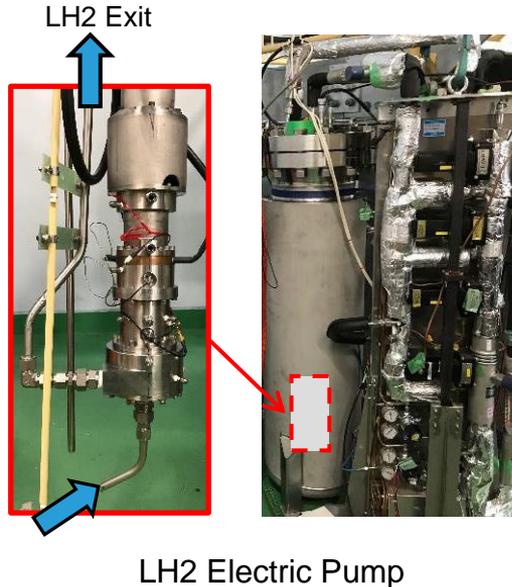
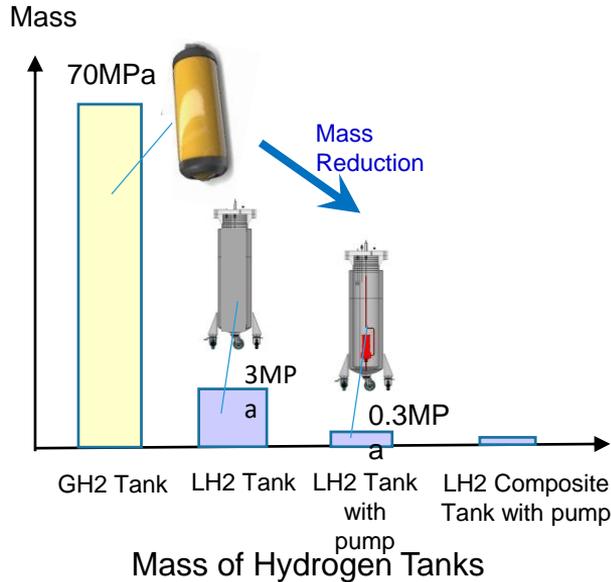


Mach 4 Wind Tunnel Test

Liquid Hydrogen Composite Tank with Electric Pump

LH2 fuel supply system will be improved to attain light weight feature by composite tank and electric pump.

- **GH2 Tank:** Tank volume can be reduced by pressurizing GH2 to 70MPa, but it tends to be heavy.
- **LH2 Tank:** Tank volume can be reduced by liquefaction of hydrogen, but it is necessary to pressurize it to about 3MPa in order to stably supply the fuel with supercritical condition.
- **LH2 tank with pump:** Tank pressure can be reduced to 0.3MPa by using a LH2 electric pump.
- **LH2 composite tank with pump:** Minimum tank mass can be attained with composite tank with electric pump.



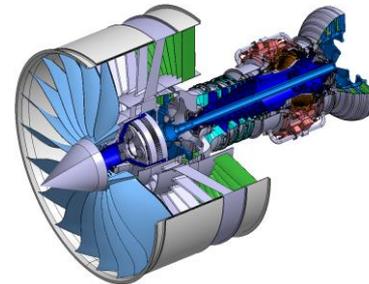
- Japan is promoting Carbon-Neutral society and Hydrogen supply infrastructure will be improved in Tokyo.
- JAXA has been developed hydrogen engines and has a potential to develop hydrogen aircraft technologies.
- Stable hydrogen combustor, LH2 electric pump and LH2 composite tank are key technologies to realize efficient and reliable hydrogen aircraft.

Future Work:

- Technology demonstration of stable hydrogen combustor, LH2 electric pump and LH2 composite tank.
- Investigation of environmental impact of hydrogen jet engine by high altitude chemical research.



Hydrogen Aircraft



Hydrogen Jet Engine

Hydrogen Aircraft Research Member

Sadatake Tomioka, Hideyuki Taguchi, Hisashi Kumazawa, Keiichi Okai, Takayuki Kojima, Tomonari Hirotsu, Hidemi Takahashi, Shunsuke Nishida, Junichi Oki and Motoyuki Hongoh



AVIATION CO₂ REDUCTIONS

PRE-STOCKTAKING WEBINARS

TECHNOLOGY · OPERATIONS · SUSTAINABLE AVIATION FUELS