NEDO's Geologic Hydrogen Program

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OUTLINE

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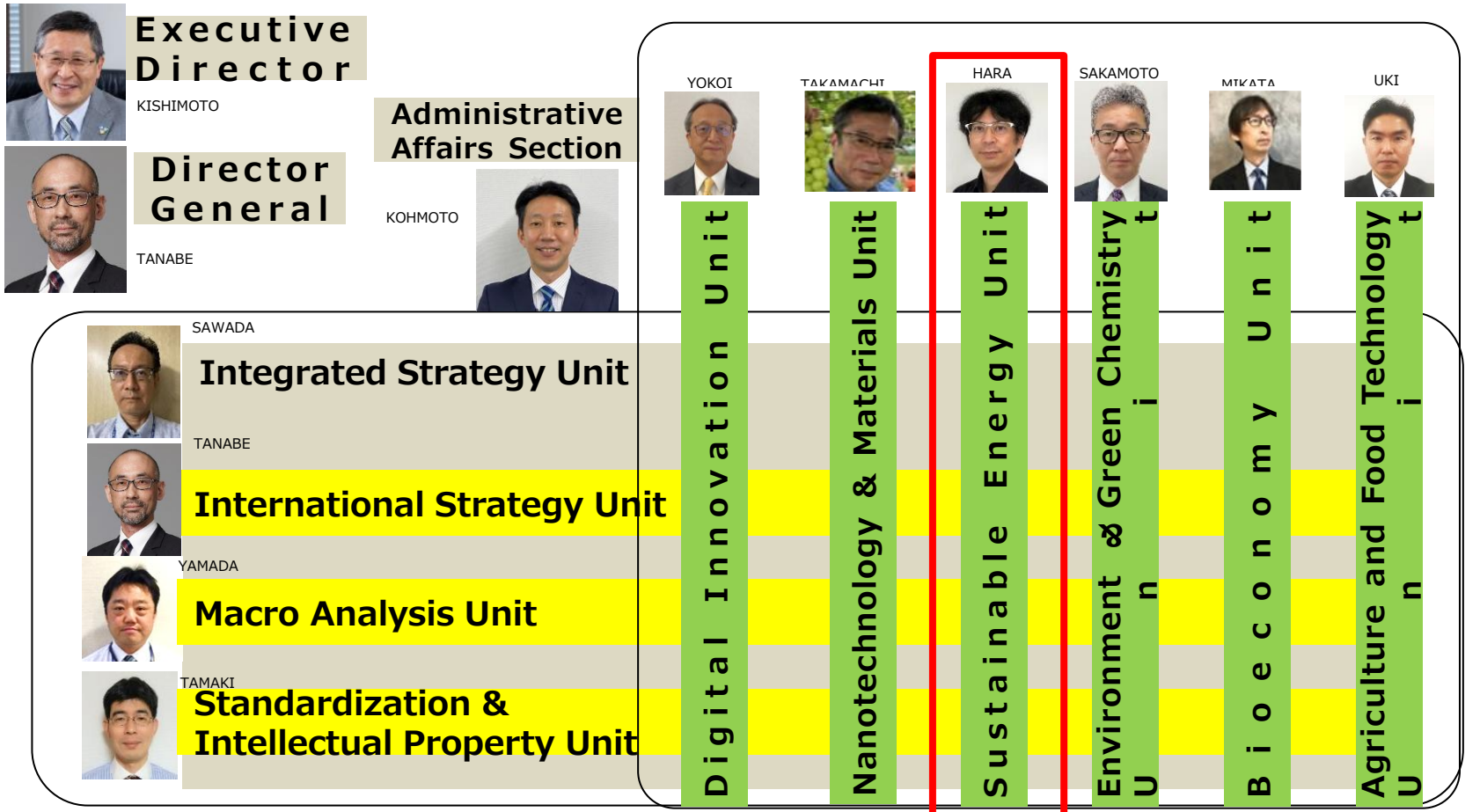
Organization of Technology and Innovation Strategy Center (TSC)

Mission: Foresight, Design, and Co-creation for Our Future

- NEDO TSC is a think tank established based on NEDO's mission.
- Collect and analyze domestic and international technology information, and provides and disseminates technology intelligence to support policy planning and project promotion.

82 Members
(as of Aug. 1st, 2025)



Frontier Development Projects (tentative)

The followings are excerpt from the NEDO's press release on May 23rd.

- NEDO has launched the Frontier Development Program to promote R&D and commercialization in the frontier fields that the country should tackle, with the aim of creating new industries by 2040.
- This time, NEDO has selected "utilization of unused subsurface resources" as one of the frontier areas, and appointed a program director to select R&D issues and to promote them consistently from technology development to social implementation.
- Geologic hydrogen was selected as one of the research topics in the "utilization of unused subsurface resources" area, and a call for proposals was made.

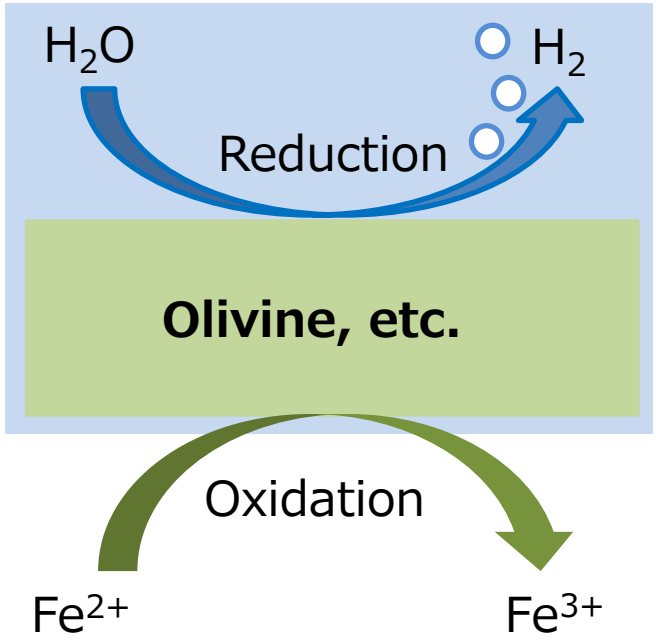
Why Geologic Hydrogen ?

- Many countries announced their H_2 strategies, accelerating efforts to reduce the cost and to increase the supply of clean H_2.
- The blue and green H_2 are the main clean H_2 production methods. The green H_2 remains expensive at 4.0–9.0 USD/kg as of 2021.
- Geologic H_2 is considered to be very clean, potentially cheaper ($0.5-1/kg) , and can be produced in large quantities. For Japan, with its limited resources, geologic H_2 could diversify H_2 supply and can be a valuable domestic energy resource.
- In February 2024, the US ARPA-E announced funding of $20 million for 16 natural hydrogen projects. The IEA is also launching an international task force on natural hydrogen, further demonstrating international activity.
- Startups from various countries started drilling in the areas like the US Mid-continent Rift and South Australia. Japanese companies are also investing in overseas geologic hydrogen startups: Koloma (US): MHI, Osaka Gas; Gold Hydrogen (Australia): Toyota, Mitsubishi Chemical, ENEOS.
- While the laboratory-scale production process of geologic H_2 is known to some extent, the details of its generation, migration, and accumulation in deep underground formations remain unclear, making R&D essential for its practical application.

NEDO's Research Target

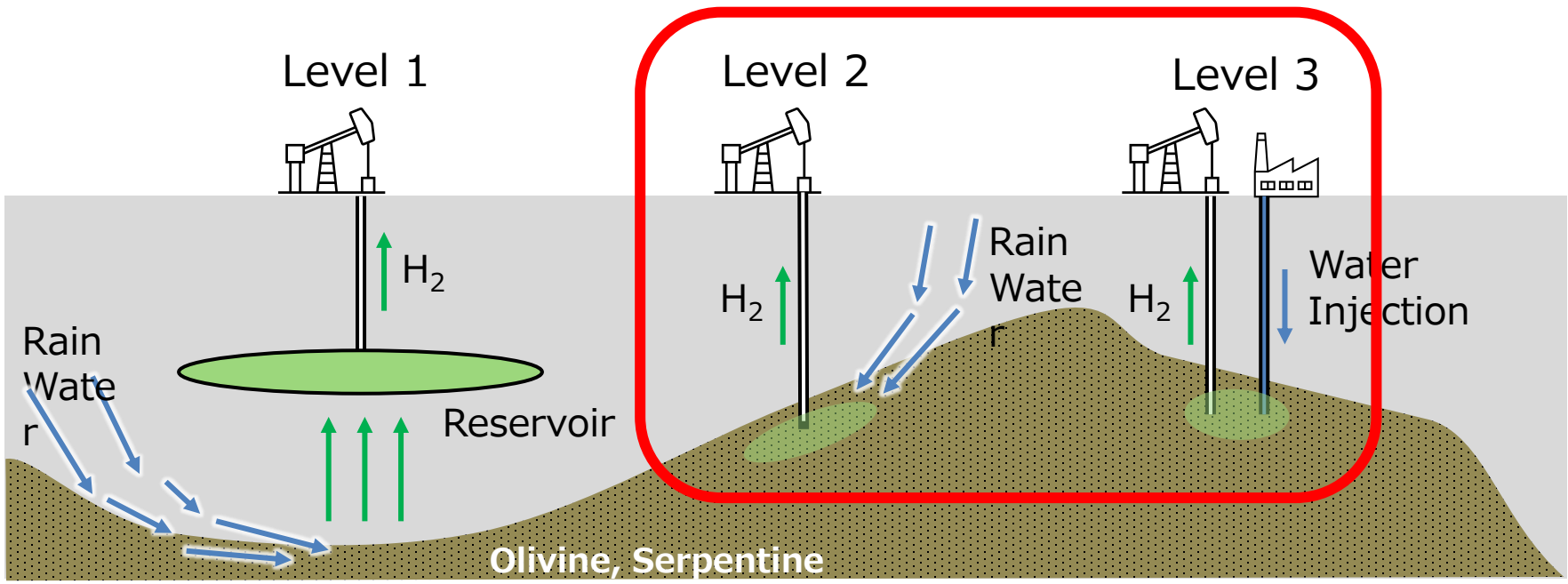
- NEDO focuses on stimulated hydrogen production similar as ARPA-E
- Stimulate the hydrogen production using the earth as a reactor

Serpentinization



chemical reaction between olivine and water to produce hydrogen.

Our Target



Level 1 is assumed to be an extremely rare case, and it is doubtful whether it exists in accessible areas, and the quantity is assumed to be insufficient.

The key to changing the game is to develop stimulation technologies that can utilize Levels 2 and 3 and to evaluate the potential in Japan.

Frontier Development Program on Geologic Hydrogen

- Frontier Development Program on geologic hydrogen has already started.
- NEDO accepted 5 awardees for the NEDO geologic H_2 program. (May 2025-March 2026)

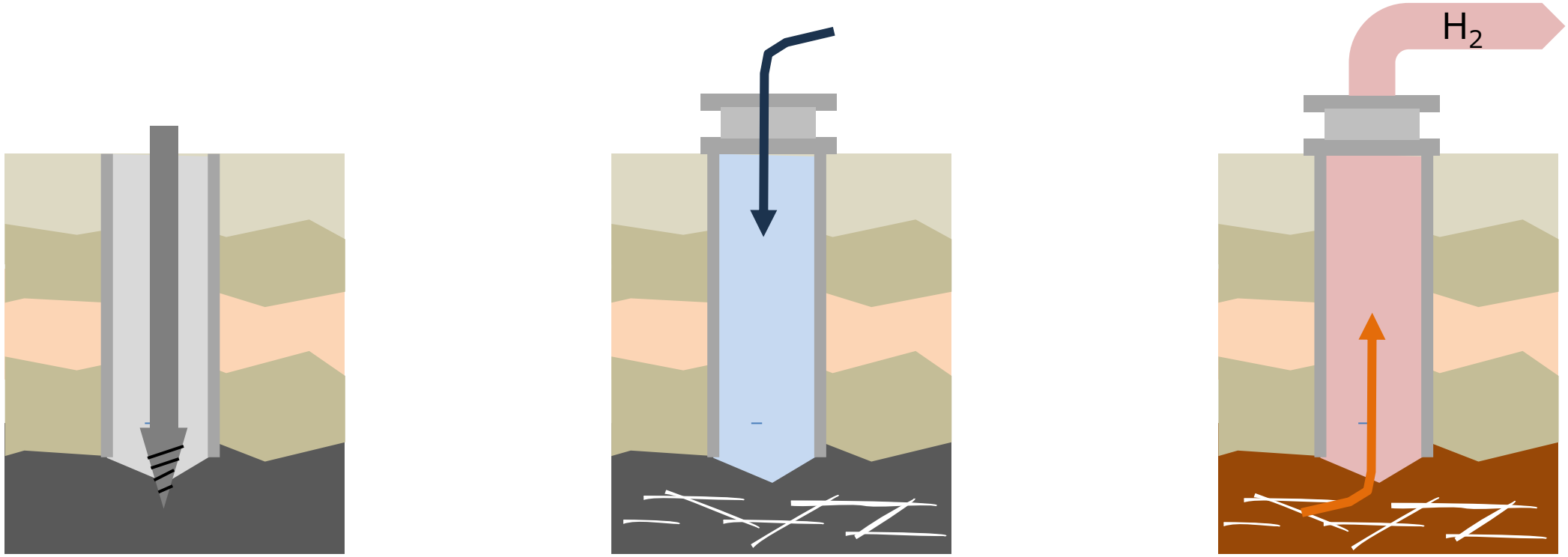
Organization	Theme
Tohoku University PL: A. Okamoto	Recovery and enhanced generation of natural hydrogen from ultramafic rocks (hydrogen production potential on degree of serpentinization)
ENEOS Xplora Inc. PL: H. Murakami	Assessment of natural hydrogen potential in Japan and R&D for stimulated hydrogen
Hokkaido University PL: T. Otake	Geochemical factors affecting generation and stimulation of geologic hydrogen (low temperature serpentinization)
AIST, JAPEX PL: T. Yamasaki	Exploration and evaluation of hydrogen-generable rocks from a stimulation perspective (potential map of geologic hydrogen in Japan)
Kyushu University, Kyushu Electric Power Co. Inc. PL: Y. Yamada	Natural hydrogen resources in the Kyushu region (potential in Kyushu island)

Stimulated Hydrogen Looks Simple, Conceptually

Drill a well

Put something into the well

Take H_2 out of the well



Exploration Drilling

Fracturing Production

Recovery Maintenance
Risk Management

but not so easy

Source: Prepared by NEDO-TSC, based on Dr. Douglas Wicks presentation , Natural Hydrogen Workshop in Japan (Feb. 14, 2025).

Questions to be Answered for Utilizing the Geologic Hydrogen

- **Potential**: Suitable locations for stimulated H_2 in Japan? The potential for stimulated H_2?
- **Exploration/Modeling**: What exploration/monitoring technologies and modeling are needed?
- **Reactive Surface Area**: How much reactive surface area is needed for sustainable H_2 production? How can this area be increased? Which fracturing technology is needed?
- **Hydrogen Production**: Which minerals are suitable for H_2 production? What conditions (physical and chemical) are optimal? Can Fe^{2+}-containing minerals other than peridotite be used for H_2 production?
- **Microorganisms**: What microorganisms enhance or inhibit H_2 production?
- **Hydrogen Capture**: Can existing natural gas, oil, and geothermal technologies be used for H_2 capture, or are new methods required?
- **O&M/Risk Management**: The long-term operation and risk management methods?
- **Techno-Economic Analysis**: The cost and carbon intensity of geologic H_2 in Japan?
- **Derivative and Innovative Technologies**: What are the combined effects of CO_2 mineralization, rare metal recovery, etc.? Natural ammonia, etc.

Source: Prepared by NEDO-TSC, based on Dr. Douglas Wicks presentation , Natural Hydrogen Workshop in Japan (Feb. 14, 2025).

Summary and Future Direction

- NEDO accepted 5 awardees for the NEDO geologic H_2 program, and the results were announced on May 23rd .
- The proposals were innovative based on their knowledge and experience.
- Geologic Hydrogen attracted much attention not only from academia but also industry in Japan.
- The portfolio of this program is limited on issues such as evaluating the potential of H_2 production subsurface and clarifying the conditions for H_2 production.
- In order to commercialize and put subsurface hydrogen production into practical use, various technologies are required such as exploring the potential sites, drilling, fracturing, stimulation and recovery, etc.
- By sharing the results of this program with academia and industry, we hope to strengthen the human resources and organization in the field of geologic H_2, and take the next step toward "in-situ hydrogen stimulation and recovery subsurface.“
- International collaboration is critical to make geologic H_2 being key technologies for demonstrating the carbon neutrality though the subsurface conditions differ considerably from country to country.