Hydrogen/CCUS Policy for 2025
–Challenges toward social implementation–

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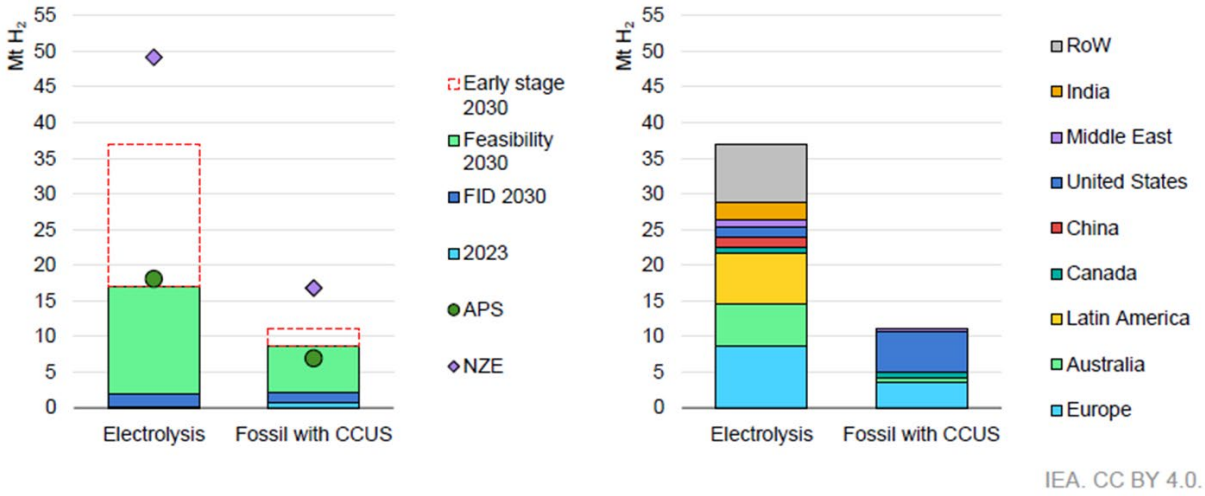
Key points of this report

- ✓ The development of hydrogen supply projects worldwide appears to be decelerating somewhat, due to factors such as the recent cost inflation and the stagnation of purchase commitments on the demand side.
- ✓ With policy support set to play a major role in the expansion of the hydrogen supply capacity going forward, the selection of projects eligible for government support is already ongoing in Europe, and it is expected that project support in Japan and the United States will fully materialize in 2025.
- ✓ With regard to the carbon dioxide capture and storage (CCS) business in Japan, for which a legal framework is now in place following the formation of the CCS Business Act, there is now a need to push forward the creation of support systems and a business environment for encouraging final investment decisions on future projects by businesses.

At a standstill: The development of hydrogen supply projects around the world

- According to the IEA, the world's hydrogen supply capacity will reach a maximum of 49 million tons/year in 2030. The scale of potential supply is also expanding.
- However, due to factors such as recent cost inflation and the stagnation of purchase commitments on the demand side, the number of projects reaching the actual investment decision stage remains small, and project development is at a standstill.
- Providing a boost on the policy side will be essential to breaking through this impasse.

Outlook for hydrogen supply volume in 2030
(Left: By degree of progress; Right: By region)



Sources: IEA, *Global Hydrogen Review 2024*

Real economics of hydrogen electrolysis projects is becoming clear

- In Europe, the selection of projects eligible for government support is ongoing, focusing on hydrogen produced by electrolysis.
- The details of the actually selected projects suggest high supply costs or low supply volumes per project.

Overview of projects receiving support in Europe

Country (program)	Products supplied (supply source)	Annual supply volume	Supply costs/prices
Germany (H2Global)	Green ammonia (imported from Egypt)	**259,500-397,000 t-NH_3**/year	H2Global's procurement price is **€1,000/t-NH_3**
UK (Hydrogen Allocation Round)	Hydrogen electrolysis (domestic)	Total of 125 MW across 11 projects (assuming a 50% utilization rate, this corresponds to approx. 10,000 t-H2/year)	The weighted average for the contract for difference (CfD) strike price is £241/MWh (approx. **$10/kg-$H_2$**)
EU European Hydrogen Bank	Hydrogen electrolysis (within the EU)	Total of **158,000t-H_2**/year across 7 projects (1,580,000 t-H_2/year over 10 years)	Fixed support is **€0.37-0.48/kg-H_2**

Sources: Materials created by IEEJ based on press releases by various governments and organizations

Policy support expected to fully materialize in Japan and the U.S.

- Policy support plays a major role in the development of hydrogen projects, which seem to have stagnated recently.
- Europe has been in the vanguard of support for supply projects. Yet, it is Japan and the United States that have prepared the most ample support packages, expected to become a new catalyst for hydrogen project development worldwide from the next fiscal year.

Sums spent in major countries on key hydrogen introduction support measures

Countries/regions	Contents and sums of key support measures
Japan	CfD support (**3 trillion yen**)
United States	Regional hub development (**USD8 billion**), production tax credits (**USD4.7 billion**)
EU	Fixed-sum support for manufacturing costs (**1.9 billion euros**)[2], initial investment support (**200 million euros**)
UK	CfD support (**£2 billion**)[3], initial investment support (**£240 million**)
Germany	H2Global (**4.73 billion euros**, Europe portion), CfD support (**4 billion euros**)
Australia	Product support/tax support (**10.7 billion Australian dollars**)[4], hydrogen hub development (**500 million Australian dollars**)

[1] Portion for fiscal years 2023-2027
[2] Total sum of the contribution stated in the first tender and the allocation of the second tender
[3] Allocation amount in the first round
[4] Total amount for the Hydrogen Headstart Program plus the Hydrogen Production Tax Incentive

Natural hydrogen (white hydrogen): Growing interest, persistent uncertainties

- Natural hydrogen: Hydrogen found in underground mineral ores
  - It is believed that natural hydrogen is generated through the serpentinization that results from the reaction of peridotite and water, and from water-splitting caused by the radioactivity created from uranium decay, but further verification is required.
- Commercial production is taking place in Mali. Development plans are also making progress in France, Australia, the United States, and Canada.
- There is tremendous potential, yet also considerable variation in the estimated values. As export infrastructure is also required, there is still considerable uncertainty about this area.

Examples of the estimated potential for natural hydrogen

Estimated potential volumes	Starting assumptions
10^8 Mt-H_2	Assuming that all peridotite in the upper crust (10 trillion Mt) is serpentinized[1)] Reference: Peridotite produced through tectonics amounts to 1,000 Mt every year [2)]
260 Mt-H_2	Assuming that 50% of ultramafic rock (olivine being the principal component) is serpentinized[3)]
23 Mt-H_2	Koloma Inc's publicized materials[4)]

Sources: 1) P.B. Kelemen, J. Matter, E.E. Streit, J.F. Rudge, W.B. Curry, J. Blusztajn, "Rates and mechanisms of mineral carbonation in peridotite: natural processes and recipes for enhanced, in situ CO 2 capture and storage", *Annu Rev Earth Planet Sci*, 39 (1) (2011 May 30), pp. 545-576
2) Rubén Blay-Roger, Wolfgang Bach, Luis F. Bobadilla, Tomas Ramirez Reina, José A. Odriozola,Ricardo Amils, Vincent Blay, "Natural hydrogen in the energy transition: Fundamentals, promise, and enigmas", *Renewable and Sustainable Energy Reviews*, Volume 189, Part A, January 2024
3) N.J.P. Smith, T.J. Shepherd, M.T. Styles, G.M. Williams, "Hydrogen exploration: a review of global hydrogen accumulations and implications for prospective areas in NW Europe", *Geological Society*, London, Petroleum Geology Conference Series, 6 (1) (2005 Jan), pp. 349-358
4) Koloma, Inc. Geologic Hydrogen – Koloma

Points to watch out for in Japan's domestic hydrogen policy in 2025

- Selection of projects for domestic CfD support
  - Support system started to invite roject proporals in November 2024.
  - This project is the world's largest support program, whether in terms of the financial sums involved, the broad range of recipients provided, or the period of the support, and is expected to serve as a catalyst for the development of hydrogen projects inside and outside Japan
  - Business models for the projects that could not receive the support and the projects following the end of the support need to be developed.

- Hub development support
  - Currently, feasibility studies are underway for 10 projects (while additional public recruitment processes also were concluded in December 2024)
  - Based on the feasibility studies, a total of 8 hub development projects will be selected for support

- Combinations of support
  - Higher supply costs than originally envisaged are becoming apparent from European projects
  - During the introduction phase, it is vital to ensure organic combinations of CfD support, hub development, and Long-Term Decarbonization Power Source Auctions

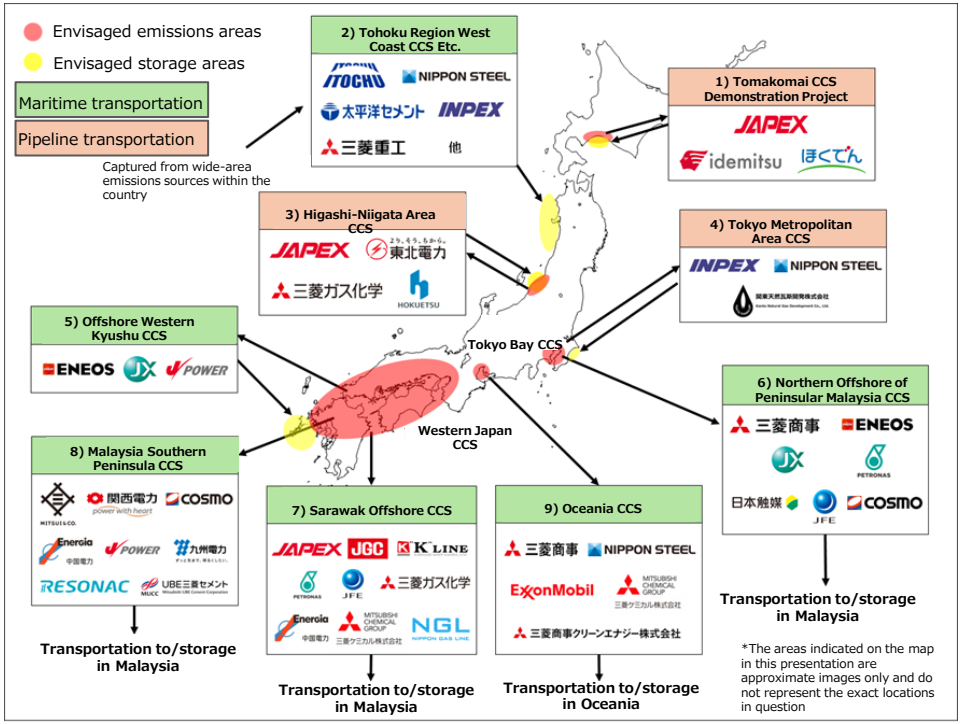
Progress of CCS policy in 2024

- Formulation of the CCS Business Act
  - Establishing rights and obligations for carrying out CCS projects
  - **Project support systems for CCS will be developed toward 2026.**

- Development of studies of CCS projects
  - Two additional studies were awarded the govrenment support for feasibility study (FS).
  - FS looking at transport vessels for CO_2 are also underway separately.
  - In addition, independent project discussions by Japanese companies in Indonesia, Europe, and the United States are also underway

- Acceptance by the Japanese Diet of the 2009 Amendment to the London Protocol

Nine projects selected as cutting-edge CCS projects



Source: Agency for Natural Resources and Energy

Support systems for CCS in various countries outside Japan

- Europe, the United States, and Australia are supporting CCS projects through preferential tax treatment, subsidies, and carbon pricing systems
- With these various support systems envisaged as lasting for 10-15 years, the question of how to design CCS business models that will enable these businesses to function independently after support comes to an end is a common challenge across all countries

Overview of CCS support systems in countries outside Japan

Model	Features	Support period
United States model	**A combination of tax credits** (including direct funding) and **subsidies for infrastructure development** These are established alongside tax credits for direct air capture (DAC)	Tax credits are for a **12-year period**
European/Canadian/ Australian model	A combination of **carbon credits** and **subsidies**	Subsidies for operating costs last for **a 10-year period** (Norway/Canada)
UK model	Different combinations of support systems that vary by sector/industry (applying the **regulated asset base (RAB) model** to the transportation and storage sector, while creating a **CfD support system** for the capture sector) This model also works in partnership with carbon removal support policies through combinations with DAC (established separately), and with support for biomass thermal power generation	The support period for the carbon capture sector is **10–15 years**

Impact of the advent of the Trump administration on support for CCS/hydrogen

- As CCS is inherently compatible with the oil and gas industries, support is likely to continue into the incoming Trump administration.
- For hydrogen, likewise, most of the states housing the regional hydrogen hubs that have been selected are primarily Republican (“Red States”), so support is expected to continue.

The 7 regional hydrogen hubs and their state locations, selected under the Infrastructure Investment and Jobs Act (IIJA)

Hydrogen hub name	State location	Hydrogen source
Appalachian	West Virginia, Ohio, Pennsylvania	Natural gas, biomass
California	California	Renewable energy, biomass
Gulf Coast	Texas	Renewable energy, natural gas
Midwest	Illinois, Indiana, Iowa, Michigan	Renewable energy, natural gas, nuclear power
Pacific Northwest	Washington, Oregon, Montana	Renewable energy
Heartland	Minnesota, North Dakota, South Dakota	Renewable energy, natural gas, nuclear power
Mid Atlantic	Pennsylvania, Delaware, New Jersey	Renewable energy, nuclear power

Note: States in red font are those which voted for Donald Trump in the 2024 presidential election, while those in blue voted for Kamala Harris.

Key points of Japan's 2025 domestic CCS policy

- Initiatives for encouraging final investment decisions by businesses
  - Getting legal frameworks established in concrete form for supporting projects, and securing revenue sources for this
  - Ministerial ordinances covering the detailed aspects of operation; establishment of technical standards; flexible operation of various regulations
  - Promotion of dialog with local communities

- Creating an environment to help make overseas CCS a reality
  - Development of intergovernmental agreements with host countries
  - Mapping-out of support systems between "capture countries" and "storage countries"
  - Optimizating the activities of the various firms involved in the operational aspects of the capture, transportation and storage sectors

- Sketching out a long-term picture for CCS businesses
  - Establishing support which will enable CCS to remain commercially viable after support comes to an end

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