

# Enabling Measures Roadmap for Low-Emission Hydrogen



Japan

*Version: July 2023*

# Executive Summary (1/2)

Japan has pledged to reduce its GHG emissions by 46% by 2030 (from 2013 levels) and achieve carbon neutrality by 2050. As the country is among the world's top five energy consumers and is the third-largest economy, its transition towards net zero will be significant for global efforts to achieve the Paris Agreement targets. **Hydrogen** has been positioned in the [Green Growth Strategy Through Achieving Carbon Neutrality in 2050](#) as a “new resource”, which will be a key technology to decarbonize various sectors including power generation, industry and transport.

This report by the World Economic Forum, in collaboration with Accenture, is an updated version of the [Enabling Measures Roadmap for Green\\* Hydrogen](#) released after COP26 (January 2022). The purpose of the initial Roadmap was to identify key enablers to achieve a scaled and traded low-emission hydrogen market.

The goal of this updated Roadmap is two-fold:

1. To **identify policy developments, funding and initiatives** related to low-emission hydrogen in Japan.
2. To **take stock of the current progress** made towards previously defined objectives and associated timeline.

*\*This version of the Roadmap uses the term “low-emission” hydrogen – as compared to the previous version’s term ‘green’ hydrogen – as the Japanese government recently defined the priority of Japan as being low-emission hydrogen in the [Basic Hydrogen Strategy Revision \(draft\)](#), focusing on the emissions intensity rather than the colours (i.e. production routes) of hydrogen.*

The outcomes of the report can be summarized as follows:

1. **Progress has been made for the deployment of hydrogen in Japan; however, more robust and accelerated actions for the shift towards low-emission hydrogen can further support the scale-up of the hydrogen market.**
2. **To accelerate private investments, guiding principles such as sharing a short and long-term vision with market participants, sharing progress among stakeholders, as well as standardization and legal certainty will be essential.**

First, an overview and timeline of the key Japanese strategies and legislations, financial instruments and institutions related to low-emission hydrogen are presented; highlighting multiple updates since the release of the initial Roadmap in January 2022 and a multifaceted funding and institutions landscape in Japan.

More details on these policy updates are presented in the section “Reference Library: Key Japan Policy Update”:

1. [Basic Policy for the Realization of GX](#): sets out the initiatives to realize GX (Green Transformation) including a package of financial policies to accelerate the required investments, which is estimated at over \$1.15 trillion (JPY 150 trillion) in the next decade in combined private and public funding.
2. [Basic Hydrogen Strategy Revision](#) (proposed): seeks to set new targets for hydrogen and its derivatives, including the supply of 12 Mtpa (million tonnes per annum) of H<sub>2</sub> equivalent in Japan by 2040 and the deployment of electrolyzers by Japanese companies (including the ones located overseas) by 2030. The Revision will be the comprehensive foundation of support and regulatory

policies, including CfD (Contract for Difference) subsidies, infrastructure support, the definition of low-emission hydrogen, and safety rules.

3. [GX Economy Transition Bonds](#) (proposed): will be issued by the government every year for 10 years starting from 2023. \$154 billion (JPY 20 trillion) will be financed in total and spent on the support for up-front investments in GX-related projects.
4. [ETS](#) (Emissions trading system, proposed): uses baseline-and-credit system, where the GX League participants will set voluntary targets, report the actual emissions data, and trade earned emission credits. Pilot phase will start in 2023, followed by full-scale operation in 2026. Auctioning of emissions allowance for the electricity sector is expected to start in 2033.
5. [Carbon Surcharge](#) (proposed): for the importers of fossil fuels will be implemented in 2028, and the burden will gradually increase onwards.
6. [Support for Large-Scale Hydrogen Supply Chain](#) (proposed): introduces a CfD subsidy scheme for hydrogen and ammonia.
7. [Support for Shared Infrastructure at Hydrogen Hubs](#) (proposed): supports the development of tanks, pipelines, etc. at ~8 potential hydrogen/ammonia hubs in Japan in the next 10 years.
8. [Revised JOGMEC Act](#): enables JOGMEC (Japan Organization for Metals and Energy Security) to provide financial assistance (e.g. capital contribution and debt guarantee) to hydrogen/ammonia projects.
9. [GX League](#): is a forum for cooperation between a group of companies and the government, universities, and academic institutions in order to meet greenhouse gas reduction targets and increase industrial competitiveness by using Japan’s goal of carbon neutrality by 2050 as an opportunity for economic growth.

# Executive Summary (2/2)

Next, the 2030 objectives and enabling measures identified in the 2022 Roadmap are assessed against current developments as following:

- **Cost:** The [technology roadmaps](#) in hard-to-abate sectors, published by the Japanese government, aims to promote transition finance. [Policy support for hydrogen suppliers \(through CfD subsidies\) and shared infrastructure at potential hydrogen hubs](#) have been announced (policy design under consideration).
- **Standards & Certification:** In the [draft of Basic Hydrogen Strategy Revision](#) (expected to be finalized by the end of July 2023), Japan's Ministry of Economy, Trade and Industry (METI) proposes to set a national standard for the emissions intensity threshold for low-emission hydrogen at an "internationally acceptable level", based on the calculation methodology presented by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE).
- **Demand:** Hydrogen and ammonia are positioned as critical energy sources and as part of Japan's power supply mix in 2030 in the [6th Strategic Energy Plan](#).
- **Infrastructure:** [Policy support for the development of shared infrastructure at potential hydrogen hubs](#) has been announced, in order to create large-scale demand and build efficient supply chains that enable stable and inexpensive supply of hydrogen/ammonia.
- **Pace of Development:** JOGMEC has signed MoUs (Memoranda of Understanding) with potential hydrogen supply countries such as the [Province of Alberta, Canada](#) and the [State of Western Australia](#). Japanese private companies, including [ITOCHU Corporation](#) and [Sumitomo Corporation](#), have signed MoUs with overseas businesses for the production of green hydrogen/ammonia.

- **Technology:** The [Green Innovation Fund](#) is in place to support the development of more efficient hydrogen transportation, including liquefaction, LOHC (liquid organic hydrogen carrier) hydrogenation/dehydrogenation, and ammonia production. Direct use of ammonia for power generation is also being developed.
- **Available Clean Electricity:** Renewable target was adjusted upward to 36-38% of power mix in 2030 in the [6th Strategic Energy Plan](#), compared to 22-24% in the previous one.

Upon reviewing the various enabling measures in place, it is evident that Japan has made progress towards meeting its 2030 objectives to establish a scaled hydrogen market. The Japanese government's efforts in this regard are noteworthy, as it has demonstrated a strong commitment to promoting the growth of the hydrogen market through various policy instruments including subsidies/grants and regulations. To ensure that these efforts translate into achieving the 2030 objectives, however, it is crucial to strengthen the momentum on the deployment of low-emission hydrogen in Japan. Especially, we emphasize the importance of accelerating the actions for the following three enabling measures:

1. **Provide commitments to fund major electrolyser and trade facility anchor projects:** The government's financial assistance through the ongoing [Green Innovation Fund](#) and the [Revised JOGMEC Act](#), and the upcoming implementation of Support for Large-Scale Hydrogen Supply Chains (i.e. CfD) and Support for Shared Infrastructure at Hydrogen Hubs all increase the pace of development.
2. **Create action plan to phase out grey and blue hydrogen including fossil fuel-based technologies:** The thresholds for low-emission hydrogen and ammonia

are under discussion, based on the proposals by industry organizations such as the [Japan Hydrogen Association](#) and the [Clean Fuel Ammonia Association](#). As a mechanism to incentivize the phase out, the thresholds are expected to be integrated with the criteria for the upcoming CfD subsidies programme.

3. **Carbon tax to internalise carbon cost of grey hydrogen and distribute revenues:** The Growth-Oriented Carbon Pricing, consisting of an ETS (full-scale operation expected from 2026) and a Carbon Surcharge (expected from 2028) will incentivize the phase out of grey hydrogen.

Finally, to accelerate low-emission hydrogen market development in Japan, it will be important to continue the current path by following these guiding principles:

- Sharing a **short and long-term vision** with market participants, such as specific competition conditions to bring hydrogen cost down, to accelerate the consensus building process which characterizes Japanese policy making.
- Maintaining **smooth communication among stakeholders** by setting milestones and keeping the progress visible to all stakeholders.
- Utilizing **preceding cases in foreign countries** to accelerate the discussion of the definition of low-emission hydrogen and the objective of phasing out hydrogen that does not meet the definition.
- Ensuring legislation is **future-proof and flexible** by regularly reviewing and revising laws to account for technological and market changes.
- Developing **global standards** to maintain a level playing field for businesses in different countries, and to facilitate international trade.
- Providing investors with **legal certainty** by establishing clear and consistent guidelines.

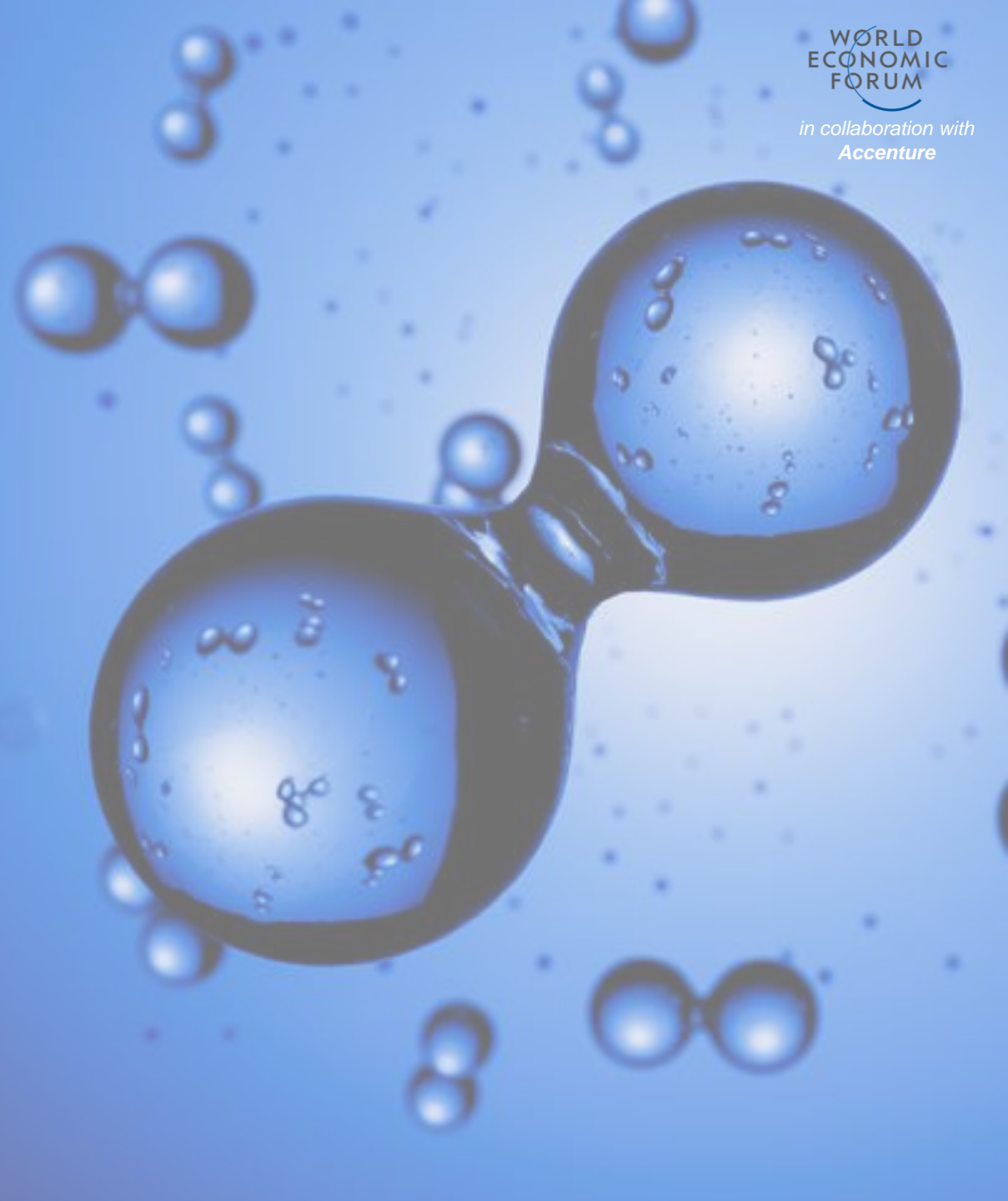
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2 [Key Policy and Funding Updates](#)

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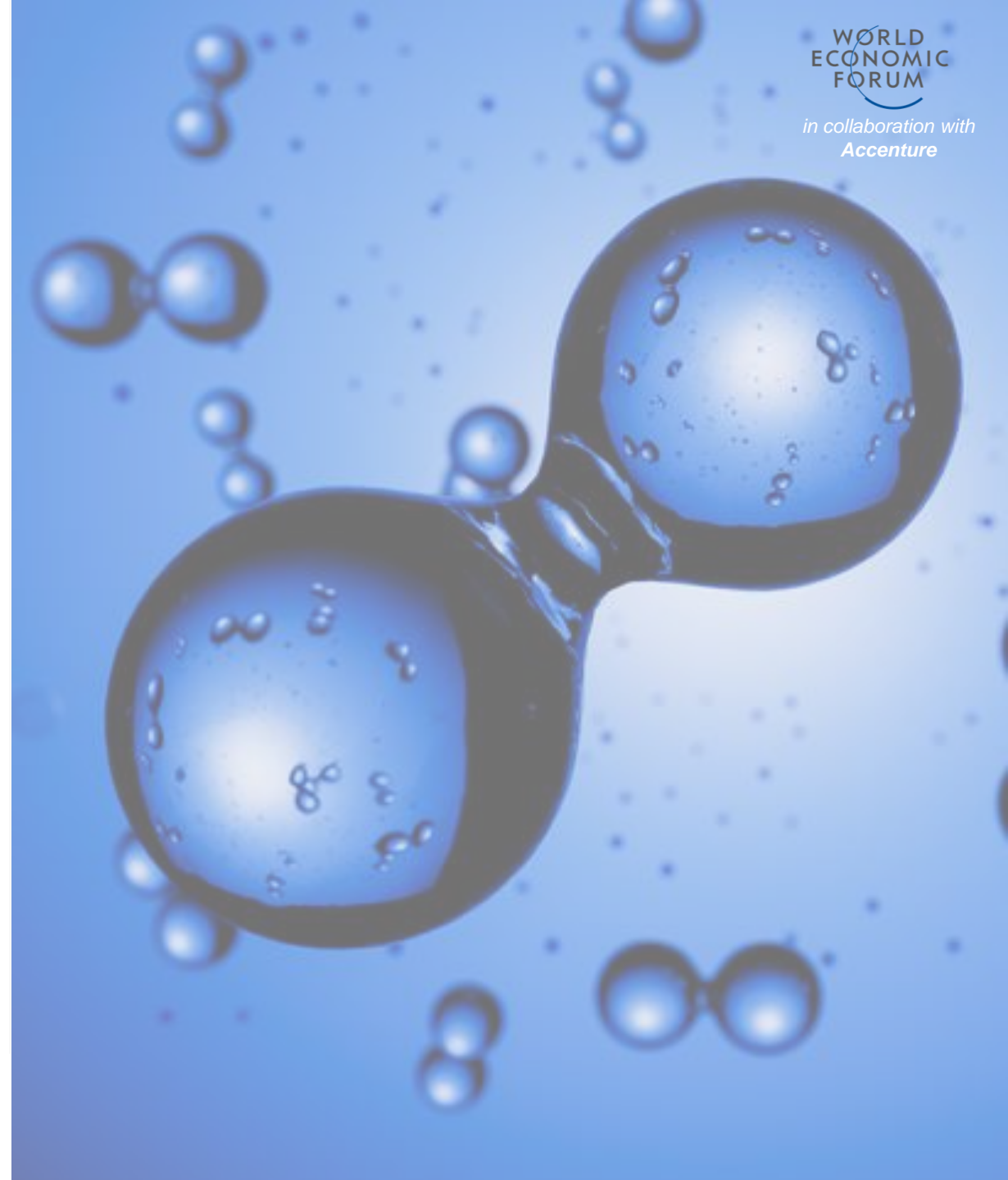
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# Since 2020, the World Economic Forum is Driving the Acceleration of Clean Hydrogen

## Focus of report

### 1: Enabling Measures Roadmap

- The Roadmap identifies measures required to boost the clean hydrogen economy and enhance public-private dialogue.
- The Roadmap focuses on the 7 barriers to market development and enabling measures to overcome them.
- The initial Roadmaps were launched at COP26 to scale the clean hydrogen market in Europe and Japan; further regions are included in 2023.
- This report is the **updated version** of the initial [Enabling Measures Roadmap for Green\\* Hydrogen](#).



### 2: Clean Hydrogen Project Accelerator

- The Accelerator accelerates implementation of the Roadmaps by coalescing stakeholders across policy, finance and industry.
- The Accelerator explores project financing and clean hydrogen offtake as key challenges to projects approaching final investment decisions.
- Initially worked with 2 European and 2 Japanese projects across the value chain, looking to further expand that approach in 2023.



\*The term "green" hydrogen has been replaced by the term "low-emission" hydrogen as the Japanese government recently defined the priority of Japan as being low-emission hydrogen, focusing on the emissions intensity rather than the colours (i.e. production routes) of hydrogen.

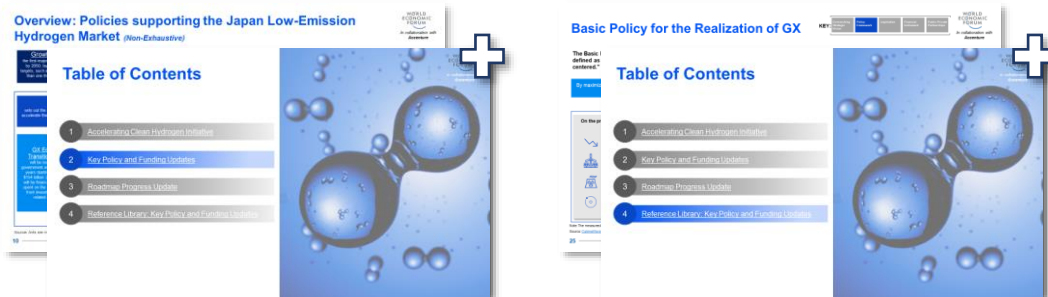
# Objectives of Updating the Enabling Measures Roadmap

The Roadmap is a toolbox for policy makers, identifying the top ten enabling measures and critical timelines required to achieve a low-emission hydrogen market at scale.

The objective of this updated Roadmap is two-fold:

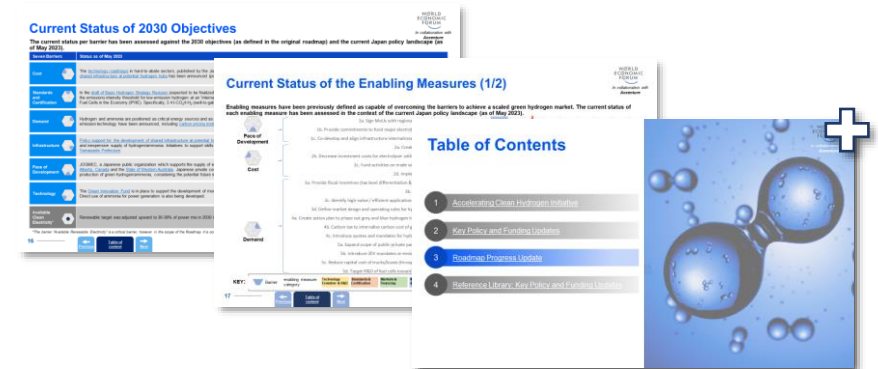
## 1. Japan Hydrogen Policy and Funding Landscape

To identify policy developments, funding and initiatives related to low-emission hydrogen in Japan.



## 2. Japan Roadmap Progress Update

To take stock of the current progress made towards previously defined objectives and associated timeline.



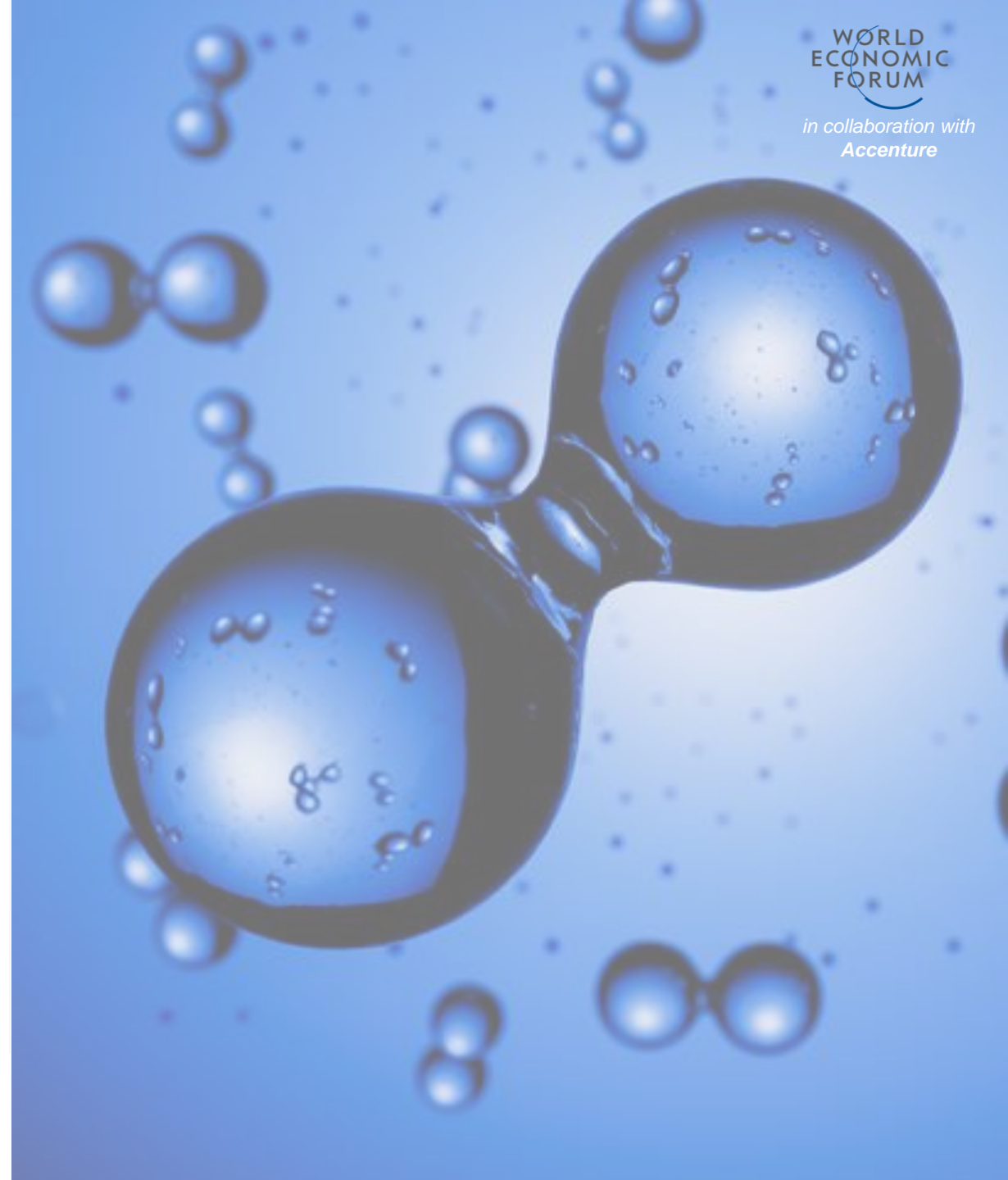
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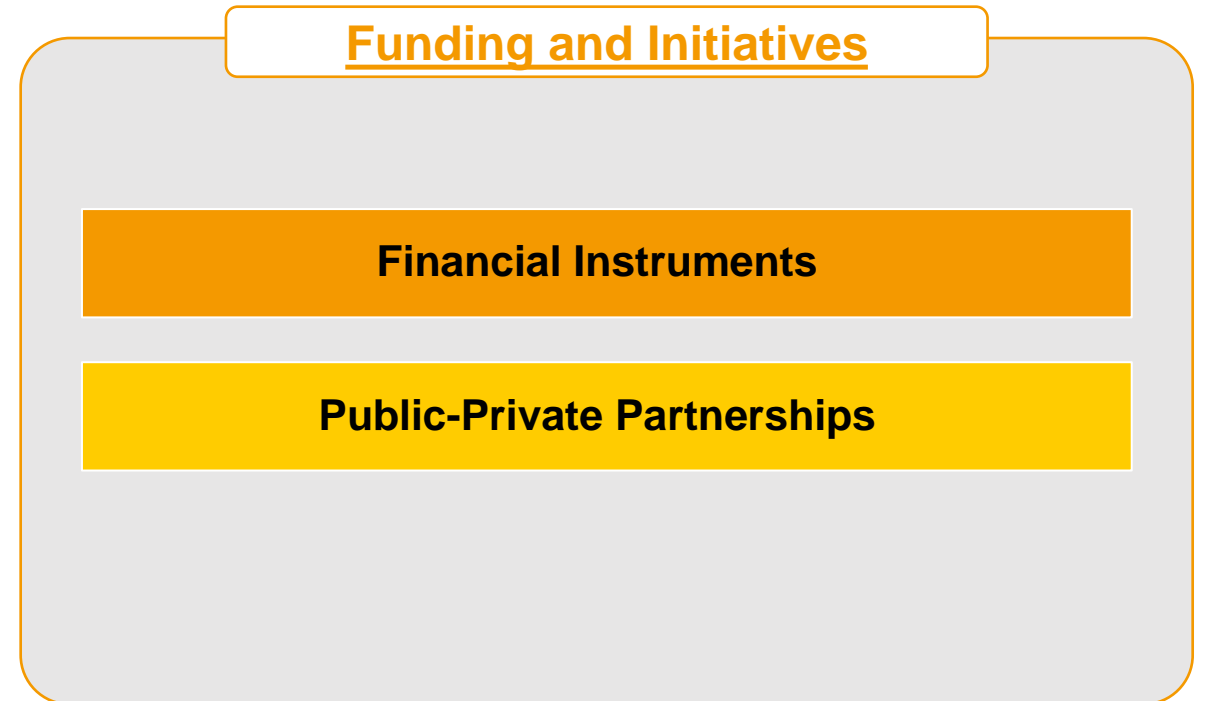
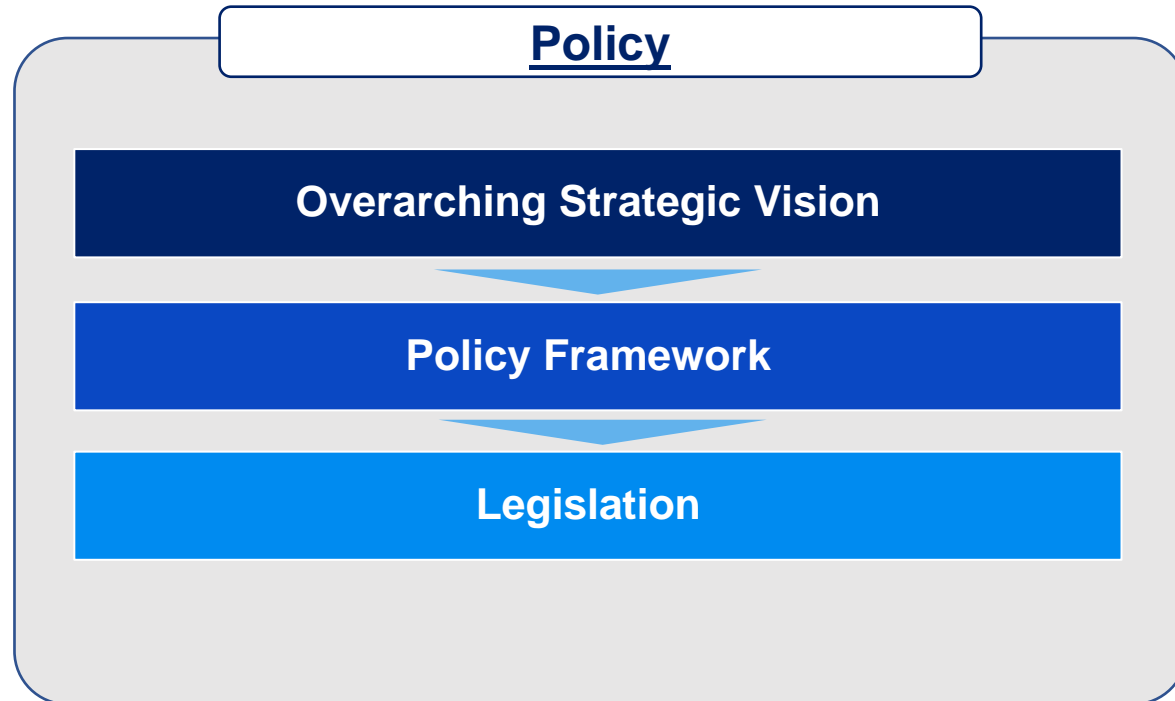




# Navigating the Policy and Funding Update

Japan's policy objectives are implemented through legislative acts and funding schemes, and in some instances are supported by public-private partnerships.

The next slides provide a non-exhaustive overview of the main policy developments, funding and initiatives related to low-emission hydrogen:



Find in the [“Reference Library: Key Policies Update – Japan”](#) section the detailed description of all updates.

# Overview: Policies supporting the Japan Low-Emission Hydrogen Market *(Non-Exhaustive)*

## Growth Strategy through Achieving Carbon Neutrality in 2050

the first major energy/industry-focused national strategy after the declaration to achieve carbon neutrality by 2050, laying out action plans in 14 priority sectors, including hydrogen/ammonia. This includes the targets, such as the supply cost of hydrogen being \$0.23 (JPY 30)/Nm<sup>3</sup> (normal cubic meter), which is less than one third of today, by 2030, and the hydrogen supply of 3 Mtpa by 2030 (incl. 0.4 Mtpa of clean hydrogen) and 20 Mtpa by 2050.

## The 6<sup>th</sup> Strategic Energy Plan

outlines Japan's energy policy guided by the principle of "S+3E," with the ambition outlook to ramp up the share of non-fossil resources in the power mix to ~59% by 2030, including 36-38% renewables, 20-22% nuclear and 1% hydrogen/ammonia.

## Basic Policy for the Realization of GX

sets out the initiatives to realize GX (Green Transformation) including a package of financial policies to accelerate the required investments, which is estimated at over \$1.15 trillion (JPY 150 trillion) in the next decade in combined private and public funding.

## Basic Hydrogen Strategy Revision

seeks to set new targets for hydrogen and its derivatives, including the supply of 12 Mtpa-H<sub>2</sub> equivalent in Japan by 2040 and the deployment of electrolyzers by Japanese companies (including the ones located overseas) by 2030. The Revision will be the comprehensive foundation of support and regulatory policies, such as CfD subsidies, infrastructure support, standards on cleanliness of hydrogen, and safety rules.

Proposed

## GX Economy Transition Bonds

will be issued by the government every year for 10 years starting from 2023. \$154 billion (JPY 20 trillion) will be financed in total and spent on the support for up-front investments in GX-related projects.

## Growth-Oriented Carbon Pricing

### 1) ETS

uses baseline-and-credit system, where the GX League participants will set voluntary targets, report the actual emissions data, and trade earned emission credits. Pilot phase will start in 2023, followed by full-scale operation in 2026. Auctioning of emissions allowance for the electricity sector is expected to start in 2033.

### 2) Carbon Surcharge

for the importers of fossil fuels will be implemented in 2028, and the burden will gradually increase onwards.

## Support for Large-Scale Hydrogen Supply Chain

introduces a Contract for Difference (CfD) subsidy scheme for hydrogen and ammonia

## Support for Shared Infrastructure at Hydrogen Hubs

supports the development of tanks, pipelines, etc. at around 8 potential hydrogen/ammonia hubs in the next 10 years

## Revised JOGMEC Act

enables JOGMEC to provide financial assistance (e.g. capital contribution and debt guarantee) to hydrogen/ammonia projects

Source: links are in the titles of the policy and legislative boxes

# Overview: Funding Mechanisms and Initiatives supporting the Japan Low-Emission Hydrogen Market *(Non-Exhaustive)*

## Green Innovation Fund

- **The Green Innovation Fund is a \$15 billion (JPY 2 trillion) fund**, established by METI (Ministry of Economy, Trade and Industry), over the period 2020-2030.
- **Its operation has been assigned to NEDO** (New Energy and Industrial Technology Development Organization), a public organization that promotes the RD&D of industrial, energy and environmental technologies.
- Through the Fund, the government provides **consistent support** to businesses that undertake ambitious innovations in projects such as a **large-scale hydrogen/ammonia supply chain, hydrogen-based steelmaking processes, and plastic production from captured CO<sub>2</sub>**.

## GX League

- **GX (Green Transformation) League is a forum for cooperation** between a group of companies and the government, universities, and academic institutions in order to meet GHG emissions reduction targets and increase industrial competitiveness by using Japan's goal of carbon neutrality by 2050 as **an opportunity for economic growth**.
- As of January 2023, **679 companies** have endorsed the basic concept of the GX League, and they are working together to **develop a vision** of the future society, **make rules** for market creation, and **prepare a carbon credit exchange scheme** with the aim of having the league **fully operational from 2023** onward.

New

## Japan Hydrogen Association (JH2A)

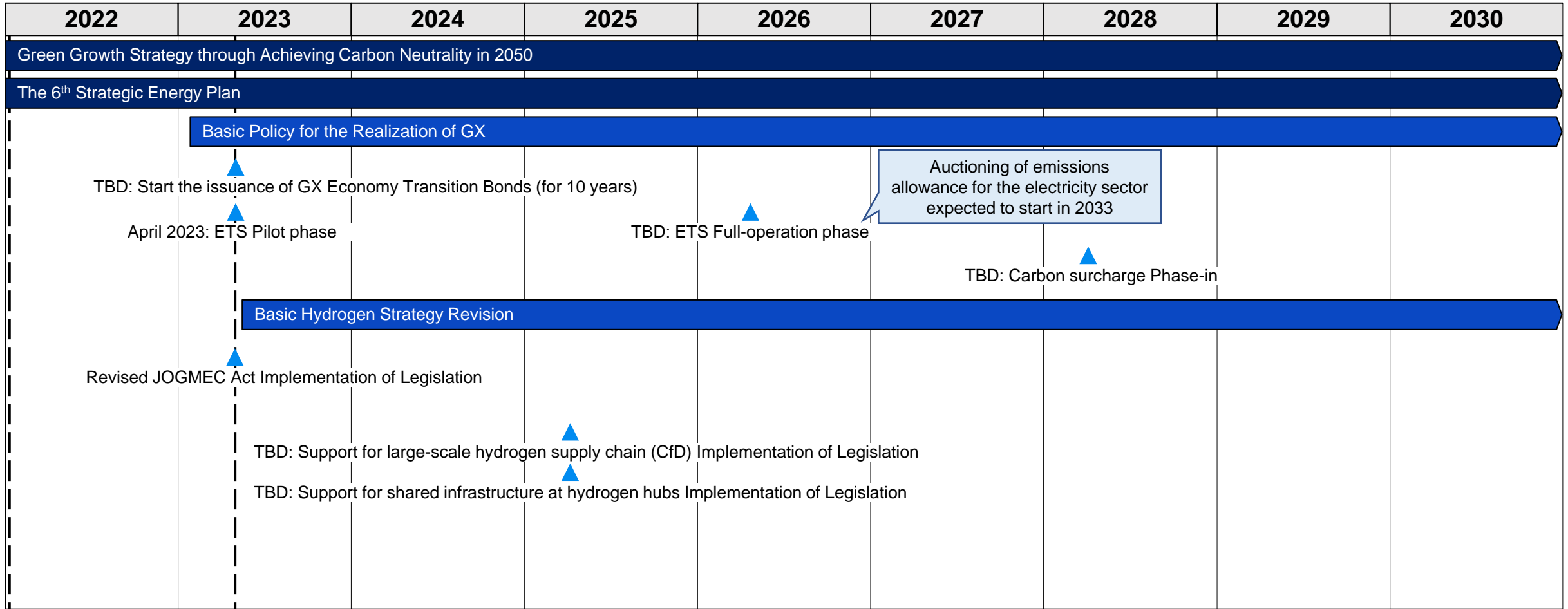
- JH2A is a council with **370 members** (as of April 2023), working with the full hydrogen supply chain, together with academia and local governments, which aims to accelerate the establishment of a hydrogen society.
- In November 2022, JH2A submitted a **proposal on the definition of low-emission hydrogen**, with the aim of achieving an emissions intensity of **3.4 t-CO<sub>2</sub>/t-H<sub>2</sub> (well-to-gate) by 2030**.

## Clean Fuel Ammonia Association (CFAA)

- CFAA is a council with **208 members** (as of April 2023), aiming to promote the establishment of clean ammonia supply chains.
- In July 2022, CFAA published a **draft definition of clean ammonia**, which sets the threshold for emissions intensity at **0.84 t-CO<sub>2</sub>/t-NH<sub>3</sub> (gate-to-gate)**.

Source: links are in the titles of the financial instruments and Industry bodies

# Upcoming Policy Timeline



Original Roadmap      Updated Roadmap publication

**KEY:**

- Overarching Strategic Vision
- Policy Framework
- Legislation
- Financial Instrument
- Public-Private Partnerships

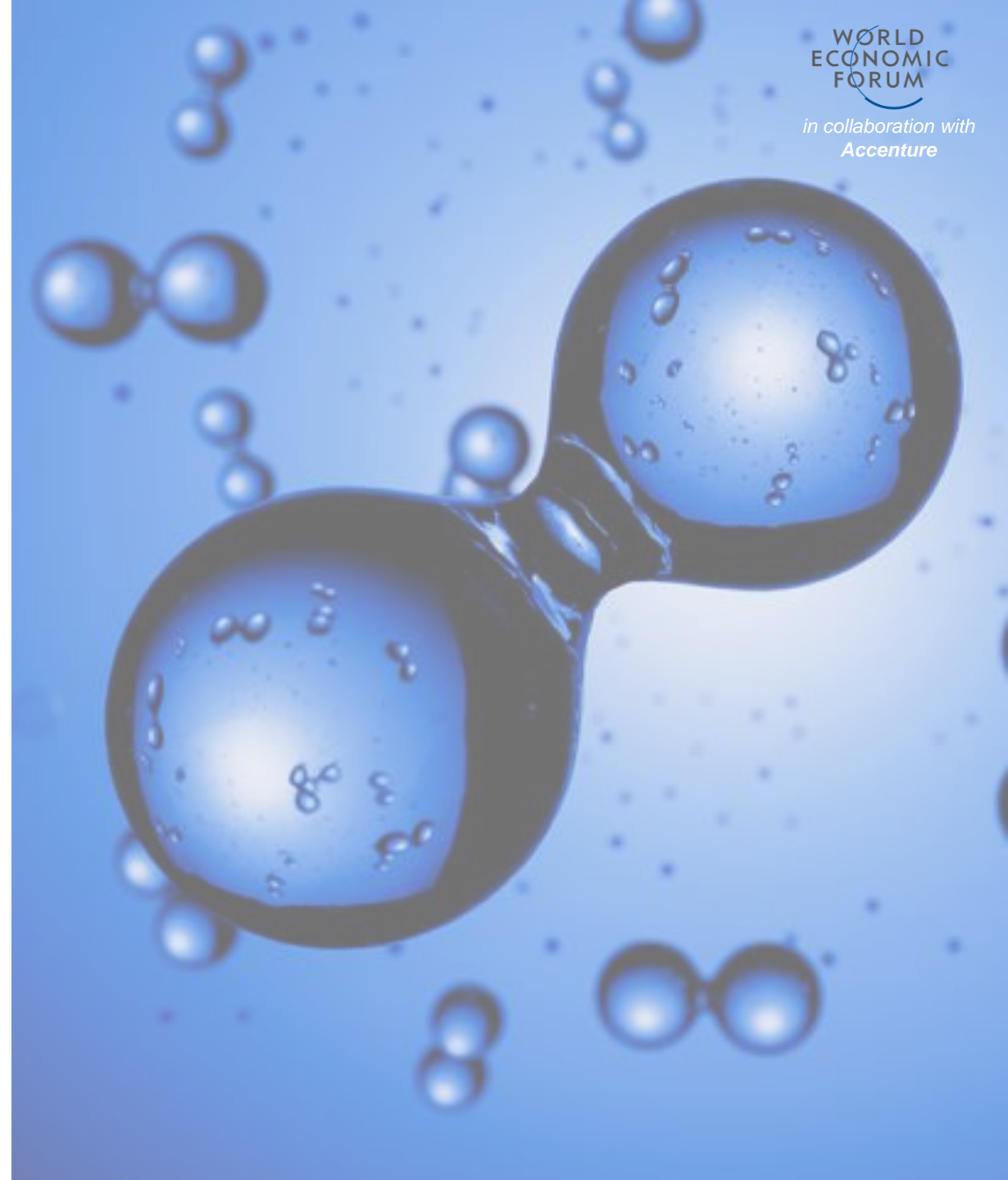
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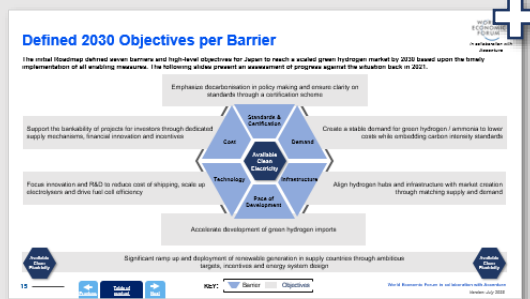
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# Navigating the Updated Roadmap

This updated Roadmap analyses the previously defined enabling measures timeline against the current Japanese hydrogen policy landscape. In this section, the Roadmap's current status has been assessed through four steps:

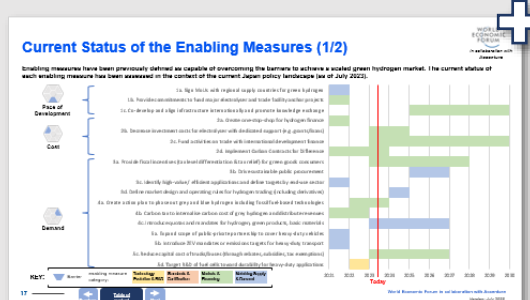
## Step 1: Reintroduce the defined 2030 objectives per barrier



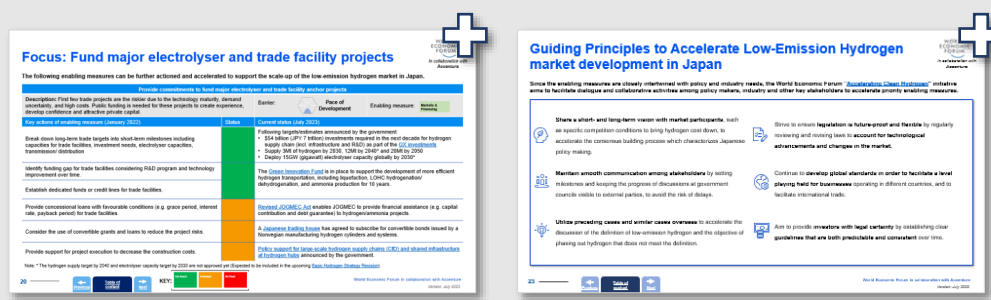
## Step 2: Assess current status per barrier against the objectives



## Step 3: Review the timeline of enabling measures

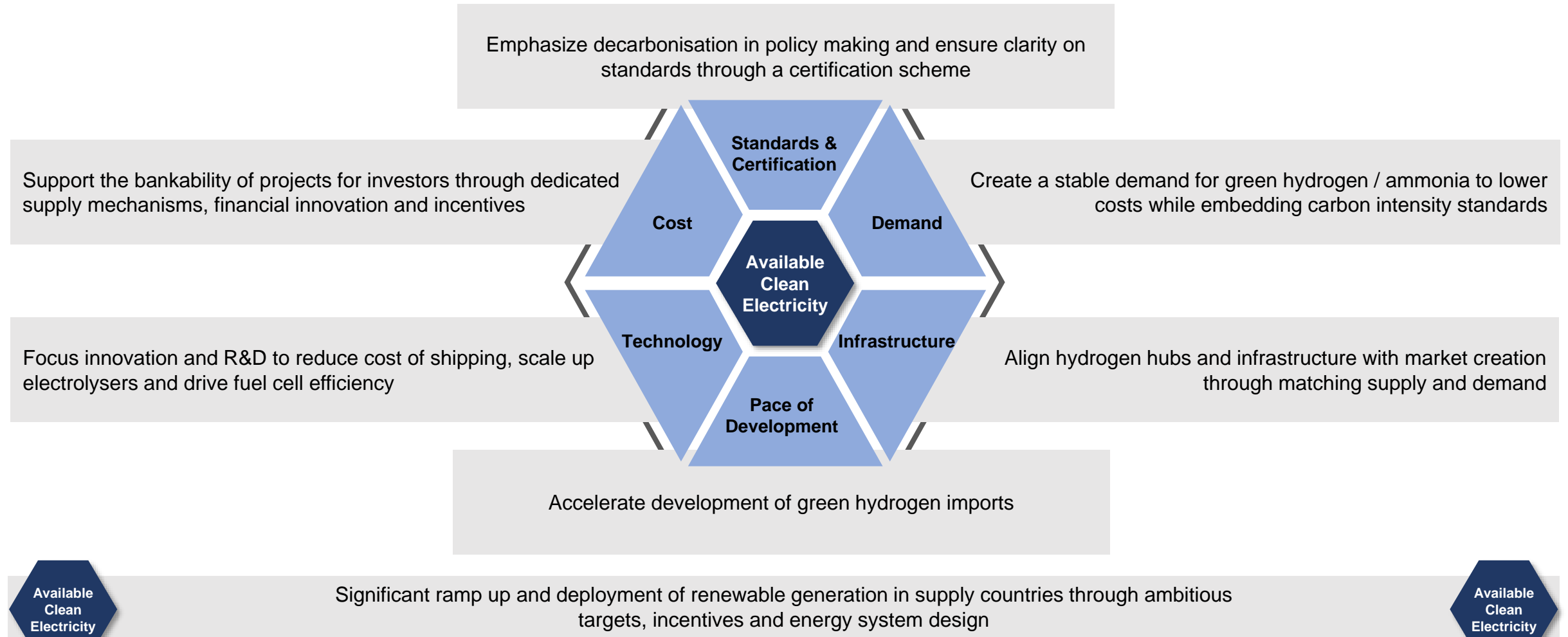


## Step 4: Progress to the next level










# Defined 2030 Objectives per Barrier

The initial Roadmap defined seven barriers and high-level objectives for Japan to reach a scaled green hydrogen market by 2030 based upon the timely implementation of all enabling measures. The following slides present an assessment of progress against the situation back in 2021.



# Current Status of 2030 Objectives

The current status per barrier has been assessed against the 2030 objectives (as defined in the original roadmap) and the current Japan policy landscape (as of July 2023).

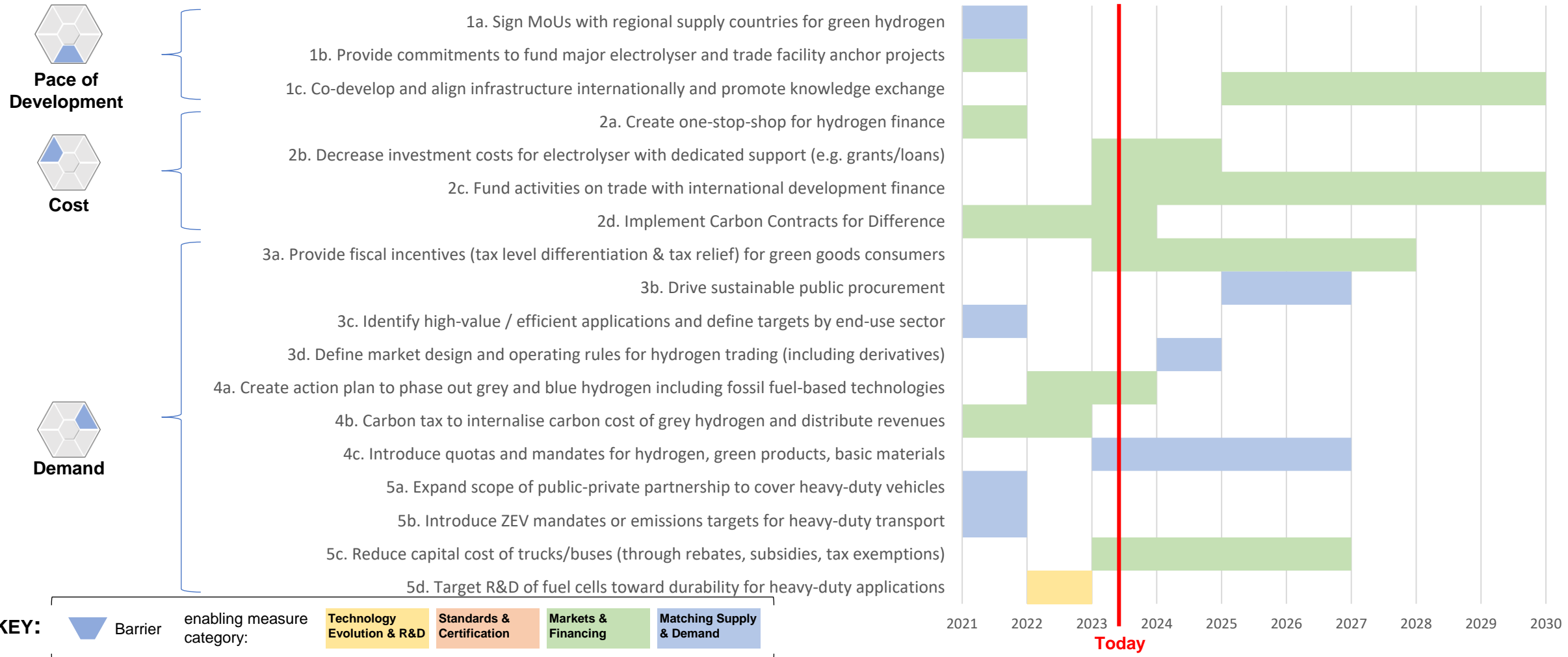
Seven Barriers	Status as of July 2023
<b>Cost</b> 	The <a href="#">technology roadmaps</a> in hard-to-abate sectors, published by the Japanese government, aims to promote transition finance. <a href="#">Policy support for hydrogen suppliers (through CfD subsidies) and shared infrastructure at potential hydrogen hubs</a> has been announced (policy design under consideration).
<b>Standards and Certification</b> 	In the <a href="#">draft of Basic Hydrogen Strategy Revision</a> (expected to be finalized by the end of July 2023), Japan's Ministry of Economy, Trade and Industry (METI) proposes to set a national standard for the emissions intensity threshold for low-emission hydrogen at an "internationally acceptable level", based on the calculation methodology presented by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE). Specifically, 3.4 t-CO <sub>2</sub> /t-H <sub>2</sub> (well-to-gate) for low-emission hydrogen and 0.84 t-CO <sub>2</sub> /t-NH <sub>3</sub> (gate-to-gate) for low-emission ammonia are considered as the thresholds.
<b>Demand</b> 	Hydrogen and ammonia are positioned as critical energy sources and as part of Japan's power supply mix in 2030 in the <a href="#">6<sup>th</sup> Strategic Energy Plan</a> . Mechanisms to incentivize the shift towards lower emission technology have been announced, including <a href="#">carbon pricing instruments</a> .
<b>Infrastructure</b> 	<a href="#">Policy support for the development of shared infrastructure at potential hydrogen hubs</a> has been announced, in order to create large-scale demand and build efficient supply chains that enable stable and inexpensive supply of hydrogen/ammonia. Initiatives to support skills development for hydrogen-related industries launched by multiple local governments including <a href="#">Fukushima Prefecture</a> and <a href="#">Yamanashi Prefecture</a> .
<b>Pace of Development</b> 	JOGMEC, a Japanese public organization which supports the supply of energy and resources including hydrogen, has signed MoUs with potential hydrogen supply countries such as the <a href="#">Province of Alberta, Canada</a> and the <a href="#">State of Western Australia</a> . Japanese private companies, including <a href="#">ITOCHU Corporation</a> and <a href="#">Sumitomo Corporation</a> , have signed MoUs with overseas businesses for the production of green hydrogen/ammonia, considering the potential future imports to Japan.
<b>Technology</b> 	The <a href="#">Green Innovation Fund</a> is in place to support the development of more efficient hydrogen transportation, including liquefaction, LOHC hydrogenation/dehydrogenation, and ammonia production. Direct use of ammonia for power generation is also being developed.
<b>Available Clean Electricity*</b> 	Renewable target was adjusted upward to 36-38% of power mix in 2030 in the <a href="#">6<sup>th</sup> Strategic Energy Plan</a> (approved October 2021), which was 22-24% in the previous one.

\*The barrier "Available Renewable Electricity" is a critical barrier, however in the scope of the Roadmap it is considered as out of scope. More information can be found with the [Clean Power and Electrification initiative of the World Economic Forum](#).



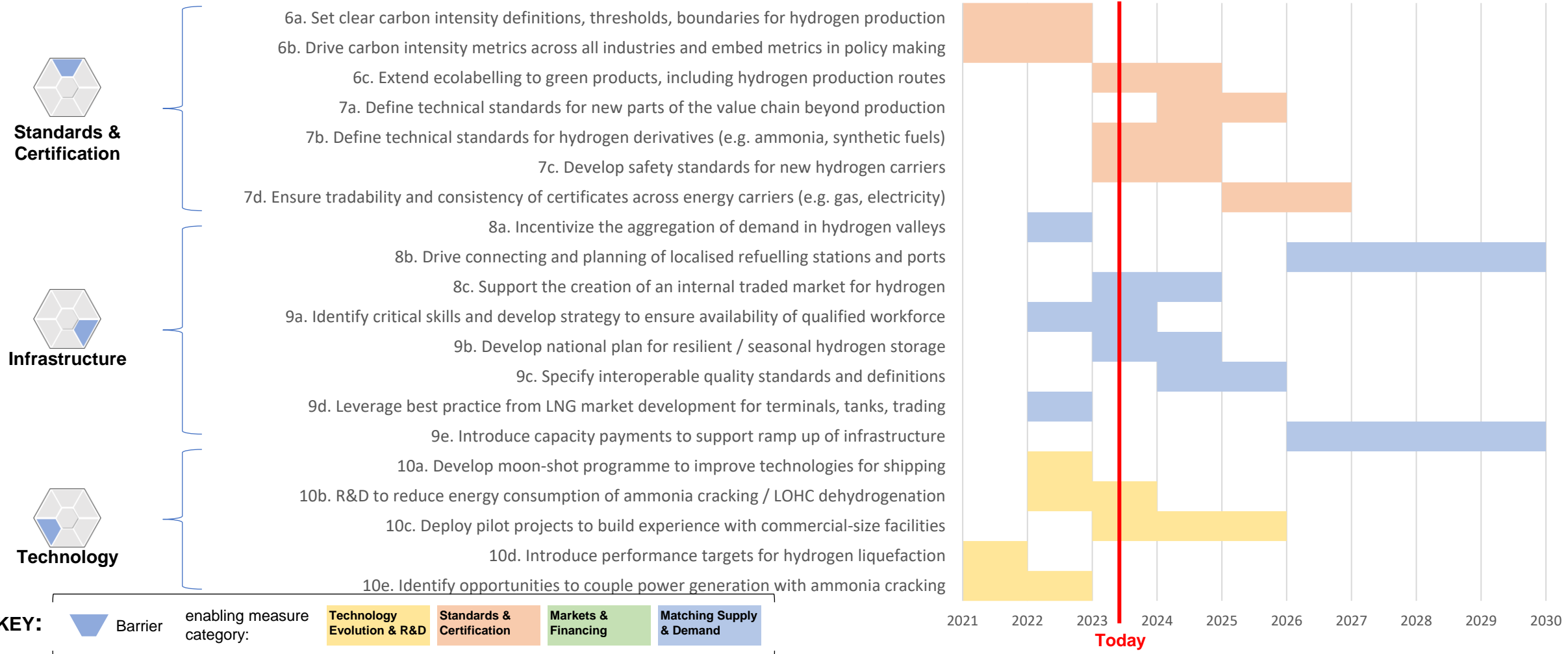
# Current Status of the Enabling Measures (1/2)

Enabling measures have been previously defined as capable of overcoming the barriers to achieve a scaled green hydrogen market. The current status of each enabling measure has been assessed in the context of the current Japan policy landscape (as of July 2023).



# Current Status of the Enabling Measures (2/2)

Enabling measures have been previously defined as capable of overcoming the barriers to achieve a scaled green hydrogen market. The current status of each enabling measure has been assessed in the context of the current Japan policy landscape (as of July 2023).



# Progress has been made for the deployment of hydrogen in Japan; however, more robust and accelerated actions for the shift towards low-emission hydrogen can further support the scale-up of the hydrogen market

Upon reviewing the various enabling measures in place, it is evident that Japan has made **progress** towards meeting its 2030 objectives to establish a scaled hydrogen market. The Japanese government's efforts in this regard are noteworthy, as it has demonstrated a **strong commitment to promoting the growth of the hydrogen market** through various policy instruments including subsidies/grants and regulations.

To ensure that these efforts translate into achieving the 2030 objectives, however, it is crucial to **strengthen the momentum on the deployment of low-emission hydrogen** in Japan. Especially, we emphasize the importance of accelerating the actions for the following three enabling measures:

## 1. Fund major electrolyser and trade facility projects

### Focus: Fund major electrolyser and trade facility projects

The following enabling measures can be further actioned and accelerated to support the scale-up of the low-emission hydrogen market in Japan.

Provide commitments to fund major electrolyser and trade facility anchor projects		
Description: First few trade projects are the riskier due to the technology maturity, demand uncertainty, and high costs. Public funding is needed for these projects to create experience, develop confidence and attractive private capital.	Barrier: Demand	Enabling measure: <b>Market &amp; Financing</b>
<b>Key actions of enabling measure (January 2022)</b>	<b>Status</b>	<b>Current status (July 2023)</b>
Break down long-term trade targets into short-term milestones including capacities for trade facilities, investment needs, electrolyser capacities, transmission/distribution	Green	Following target/estimates announced by the government: <ul style="list-style-type: none"> <li>554 billion JPY/7 billion investments required in the next decade for hydrogen supply chain (incl. infrastructure and R&amp;D) as part of the <a href="#">CX Investments</a></li> <li>Supply 2M of hydrogen by 2030, 12M by 2040 and 20M by 2050</li> <li>Deploy 15GW (gigawatt) electrolyser capacity globally by 2030*</li> </ul>
Identify landing gas for trade facilities considering R&D program and technology improvement over time.	Green	The <a href="#">Green Innovation Fund</a> is in place to support the development of more efficient hydrogen transportation, including liquefaction, LOHC (hydrogenation/ dehydrogenation), and ammonia production for 10 years.
Establish dedicated funds or credit lines for trade facilities.	Green	
Provide concessional loans with favourable conditions (e.g. grace period, interest rate, payback period) for trade facilities.	Green	<a href="#">Revised JOGMEC Act</a> enables JOGMEC to provide financial assistance (e.g. capital contribution and debt guarantee) to hydrogen/ammonia projects.
Consider the use of convertible grants and loans to reduce the project risks.	Green	A <a href="#">Japanese trading house</a> has agreed to subscribe for convertible bonds issued by a Norwegian manufacturing hydrogen cylinders and systems.
Provide support for project execution to decrease the construction costs.	Green	<a href="#">Public support for large-scale hydrogen supply chains (CPE) and shared infrastructure at hydrogen hubs</a> announced by the government.

Note: \*The hydrogen supply target by 2040 and electrolyser capacity target by 2030 are not approved yet (E-commerce to be included in the upcoming [Basic Hydrogen Strategy Revision](#))

## 2. Phase out grey and blue\* hydrogen including fossil fuel-based technologies

### Focus: Phase out grey and blue\* hydrogen including fossil fuel-based technologies

The following enabling measures can be further actioned and accelerated to support the scale-up of the low-emission hydrogen market in Japan.

Create action plan to phase out grey and blue* hydrogen including fossil fuel-based technologies		
Description: Phasing out fossil fuel-based industrial technologies in hard-to-abate sectors	Barrier: Demand	Enabling measure: <b>Market &amp; Financing</b>
<b>Key actions of enabling measure (January 2022)</b>	<b>Status</b>	<b>Current status (July 2023)</b>
Various sectors have set their own decarbonization targets, including 2030 targets for GHG reduction or emissions intensity have been set by most of the major industrial and energy sectors, such as <a href="#">steel</a> , <a href="#">chemicals</a> and <a href="#">diesel</a> .	Green	Under the <a href="#">Society 5.0</a> and <a href="#">Society 5.0</a> , the government will support the target of transition to non-fossil energy for the five top energy-consuming industries (steel, chemical, cement, paper, and automobile).
Draft sectoral targets for decarbonization that use a holistic approach (including energy efficiency, electrification and shift to low-carbon fuels like hydrogen).	Green	The assessment of various technologies is underway in both hydrogen supply side (e.g. hydrogen carriers) and demand side (e.g. thermal power generation, steel, chemicals).
Assess competing technologies to substitute the phased out ones.	Green	Standards for cleanliness of hydrogen and ammonia have been proposed by industry organizations such as the <a href="#">Japan Hydrogen Association</a> and the <a href="#">Clean Fuel Ammonia Association</a> , and the criteria for CO2 subsidies are discussed based on the proposals.
Bring together key industry players and policy makers to co-develop a phase-out strategy.	Green	Japan's energy policies are guided by the principle of S-3E (Safety, Energy security, Energy efficiency and Environment), and the principle is also mentioned in the <a href="#">Basic Hydrogen Strategy Revision</a> .
Include system value elements e.g. jobs over and above LCOH (levelized cost of hydrogen) for the regional area.	Green	Mechanisms to incentivize the shift towards lower emission technology are under discussion, including setting a threshold of emissions intensity for hydrogen eligible for CO2 subsidies and implementing a <a href="#">carbon pricing</a> instrument.
Define and agree a national roadmap for the phase out of fossil fuel technologies.	Green	

Note: \*There is a growing momentum within the Japanese government towards evaluating hydrogen based on emissions intensity rather than colours (i.e. production routes). This shift is evident in the [draft of the Basic Hydrogen Strategy Revision](#).

## 3. Carbon tax to internalise carbon cost of grey hydrogen and distribute revenues

### Focus: Carbon tax to internalise carbon cost of grey hydrogen and distribute revenues



The following enabling measures can be further actioned and accelerated to support the scale-up of the low-emission hydrogen market in Japan.

Carbon tax to internalise carbon cost of grey hydrogen and distribute revenues		
Description: Introduce a carbon tax (or broaden current scope) to include hydrogen production and use associated revenues to finance clean hydrogen	Barrier: Demand	Enabling measure: <b>Market &amp; Financing</b>
<b>Key actions of enabling measure (January 2022)</b>	<b>Status</b>	<b>Current status (July 2023)</b>
Gradually reduce exemptions and allowances that do not expose grey hydrogen production to carbon prices.	Green	The Japanese government has presented a concept of <a href="#">Green, Shared, Carbon Cycles</a> as a price signal that encourages behavioural changes toward decarbonization of Japan. The policy consists of an ETS (full-scale operation expected from 2026) and a Carbon Surcharge (expected from 2023). Auctioning of an emissions allowance for the electricity sector is expected to start in 2023.
Alternatively, introduce a carbon tax that recognizes the externalities of grey hydrogen production.	Green	Expected to be started in 2023, the importers of fossil fuels in Japan will be charged a new Carbon Surcharge, and the burden will gradually increase onwards. This is expected to work as a disincentive to grey hydrogen production.
Provide visibility (either through volume-based or price-based targets) on the long-term carbon prices to improve certainty for investors and reduce project risk.	Green	For domestic companies, it is seen as a factor that has a significant impact on their business, so the timing to phase in the carbon pricing and how to ensure flexibility in legislation/EI does not go well, are being discussed.
Identify solutions (e.g. CCEDs) to distribute the revenues to green hydrogen producers or users.	Green	The criteria of selecting projects that receive CO2 subsidies for hydrogen suppliers are expected to include the cleanliness of hydrogen as a condition. Specific threshold is under consideration based on the proposals by the <a href="#">Japan Hydrogen Association</a> and the <a href="#">Clean Fuel Ammonia Association</a> .

Note: \*There is a growing momentum within the Japanese government towards evaluating hydrogen based on emissions intensity rather than colours (i.e. production routes). This shift is evident in the [draft of the Basic Hydrogen Strategy Revision](#).

# Focus: Fund major electrolyser and trade facility projects








The following enabling measures can be further actioned and accelerated to support the scale-up of the low-emission hydrogen market in Japan.

Provide commitments to fund major electrolyser and trade facility anchor projects		
<p><b>Description:</b> First few trade projects are the riskier due to the technology maturity, demand uncertainty, and high costs. Public funding is needed for these projects to create experience, develop confidence and attractive private capital.</p>	Barrier:	 <b>Pace of Development</b>
		Enabling measure: 
Key actions of enabling measure (January 2022)	Status	Current status (July 2023)
Break down long-term trade targets into short-term milestones including capacities for trade facilities, investment needs, electrolyser capacities, transmission/ distribution		<p>Following targets/estimates announced by the government:</p> <ul style="list-style-type: none"> <li>\$54 billion (JPY 7 trillion) investments required in the next decade for hydrogen supply chain (incl. infrastructure and R&amp;D) as part of the <a href="#">GX investments</a></li> <li>Supply 3Mt of hydrogen by 2030, 12Mt by 2040* and 20Mt by 2050</li> <li>Deploy 15GW (gigawatt) electrolyser capacity globally by 2030*</li> </ul>
Identify funding gap for trade facilities considering R&D program and technology improvement over time.		The <a href="#">Green Innovation Fund</a> is in place to support the development of more efficient hydrogen transportation, including liquefaction, LOHC hydrogenation/ dehydrogenation, and ammonia production for 10 years.
Establish dedicated funds or credit lines for trade facilities.		.
Provide concessional loans with favourable conditions (e.g. grace period, interest rate, payback period) for trade facilities.		<a href="#">Revised JOGMEC Act</a> enables JOGMEC to provide financial assistance (e.g. capital contribution and debt guarantee) to hydrogen/ammonia projects.
Consider the use of convertible grants and loans to reduce the project risks.		A <a href="#">Japanese trading house</a> has agreed to subscribe for convertible bonds issued by a Norwegian manufacturing hydrogen cylinders and systems.
Provide support for project execution to decrease the construction costs.		<a href="#">Policy support for large-scale hydrogen supply chains (CfD) and shared infrastructure at hydrogen hubs</a> announced by the government.

Note: \* The hydrogen supply target by 2040 and electrolyser capacity target by 2030 are not approved yet (Expected to be included in the upcoming [Basic Hydrogen Strategy Revision](#)).

# Focus: Phase out grey and blue\* hydrogen including fossil fuel-based technologies

The following enabling measures can be further actioned and accelerated to support the scale-up of the low-emission hydrogen market in Japan.







Create action plan to phase out grey and blue* hydrogen including fossil fuel-based technologies		
<b>Description:</b> Phasing out fossil fuel-based industrial technologies in hard-to-abate sectors	Barrier:  <b>Demand</b>	Enabling measure:  <b>Markets &amp; Financing</b>
Key actions of enabling measure (January 2022)	Status	Current status (July 2023)
Draft sectoral targets for decarbonization that use a holistic approach (including energy efficiency, electrification and shift to low-carbon fuels like hydrogen).		Various sectors have set their own decarbonization targets, including: <ul style="list-style-type: none"> <li>• 2030 targets for GHG reductions or emissions intensity have been set by most of the major industrial and energy sectors, such as <a href="#">steel</a>, <a href="#">chemicals</a> and <a href="#">electricity</a>.</li> <li>• Under the <a href="#">Revised Energy Conservation Act</a>, the government will suggest the target of transition to non-fossil energy for the five top energy-consuming industries (steel, chemical, cement, paper, and automobile).</li> </ul>
Assess competing technologies to substitute the phased out ones.		The assessment of various technologies is underway in both hydrogen supply side (e.g. hydrogen carriers) and demand side (e.g. thermal power generation, steel, chemicals).
Bring together key industry players and policy makers to co-develop a phase-out strategy.		Standards for cleanliness of hydrogen and ammonia have been proposed by industry organizations such as the <a href="#">Japan Hydrogen Association</a> and the <a href="#">Clean Fuel Ammonia Association</a> , and the criteria for CfD subsidies are discussed based on the proposals.
Include system value elements e.g. jobs over and above LCOH (levelized cost of hydrogen) for the regional area.		Japan's energy policies are guided by the principle of S+3E (Safety, Energy security, Energy efficiency and Environment), and the principle is also mentioned in the <a href="#">Basic Hydrogen Strategy Revision (draft)</a> .
Define and agree a national roadmap for the phase out of fossil fuel technologies.		Mechanisms to incentivize the shift towards lower emission technology are under discussion, including setting a threshold of emissions intensity for hydrogen eligible for <a href="#">CfD subsidies</a> and implementing a <a href="#">carbon pricing</a> instrument.

Note: \*There is a growing momentum within the Japanese government towards evaluating hydrogen based on emissions intensity rather than colours (i.e. production routes). This shift is evident in the [draft of the Basic Hydrogen Strategy Revision](#).



# Focus: Carbon tax to internalise carbon cost of grey hydrogen and distribute revenues

The following enabling measures can be further actioned and accelerated to support the scale-up of the low-emission hydrogen market in Japan.

Carbon tax to internalise carbon cost of grey hydrogen and distribute revenues		
<b>Description:</b> Introduce a carbon tax (or broaden current scope) to include hydrogen production and use associated revenues to finance clean hydrogen	Barrier:  Demand	Enabling measure:  Markets & Financing
Key actions of enabling measure (January 2022)	Status	Current status (July 2023)
Gradually reduce exemptions and allowances that do not expose grey hydrogen production to carbon prices.		The Japanese government has presented a concept of <a href="#">Growth-Oriented Carbon Pricing</a> as a price signal that encourages behavioral changes toward decarbonization of Japan. The policy consists of an ETS (full-scale operation expected from 2026) and a Carbon Surcharge (expected from 2028). Auctioning of an emissions allowance for the electricity sector is expected to start in 2033.
Alternatively, introduce a carbon tax that recognizes the externalities of grey hydrogen production.		Expected to be started in 2028, the importers of fossil fuels in Japan will be charged a new <a href="#">Carbon Surcharge</a> , and the burden will gradually increase onwards. This is expected to work as a disincentive to grey hydrogen production
Provide visibility (either through volume-based or price-based targets) on the long-term carbon prices to improve certainty for investors and reduce project risk.		For domestic companies, it is seen as a factor that has a significant impact on their business, so the timing to phase in the carbon pricing and how to ensure flexibility in legislation if it does not go well, are being discussed.
Identify solutions (e.g. CCfDs) to distribute the revenues to green hydrogen producers or users.		The criteria of selecting projects that receive CfD subsidies for hydrogen suppliers are expected to include the cleanliness of hydrogen as a condition. Specific threshold is under consideration based on the proposals by the <a href="#">Japan Hydrogen Association</a> and the <a href="#">Clean Fuel Ammonia Association</a> .

# Guiding Principles to Accelerate Low-Emission Hydrogen market development in Japan

Since the enabling measures are closely intertwined with policy and industry needs, the World Economic Forum “[Accelerating Clean Hydrogen](#)” initiative aims to facilitate dialogue and collaborative activities among policy makers, industry and other key stakeholders to accelerate priority enabling measures.



**Share a short- and long-term vision with market participants**, such as specific competition conditions to bring hydrogen cost down, to accelerate the consensus building process which characterizes Japanese policy making.



**Maintain smooth communication among stakeholders** by setting milestones and keeping the progress of discussions at government councils visible to external parties, to avoid the risk of delays.



**Utilize preceding cases and similar cases overseas** to accelerate the discussion of the definition of low-emission hydrogen and the objective of phasing out hydrogen that does not meet the definition.



Strive to ensure **legislation is future-proof and flexible** by regularly reviewing and revising laws to **account for technological advancements and changes in the market**.



Continue to **develop global standards in order to facilitate a level playing field for businesses** operating in different countries, and to facilitate international trade.



Aim to provide **investors with legal certainty** by establishing clear **guidelines that are both predictable and consistent** over time.

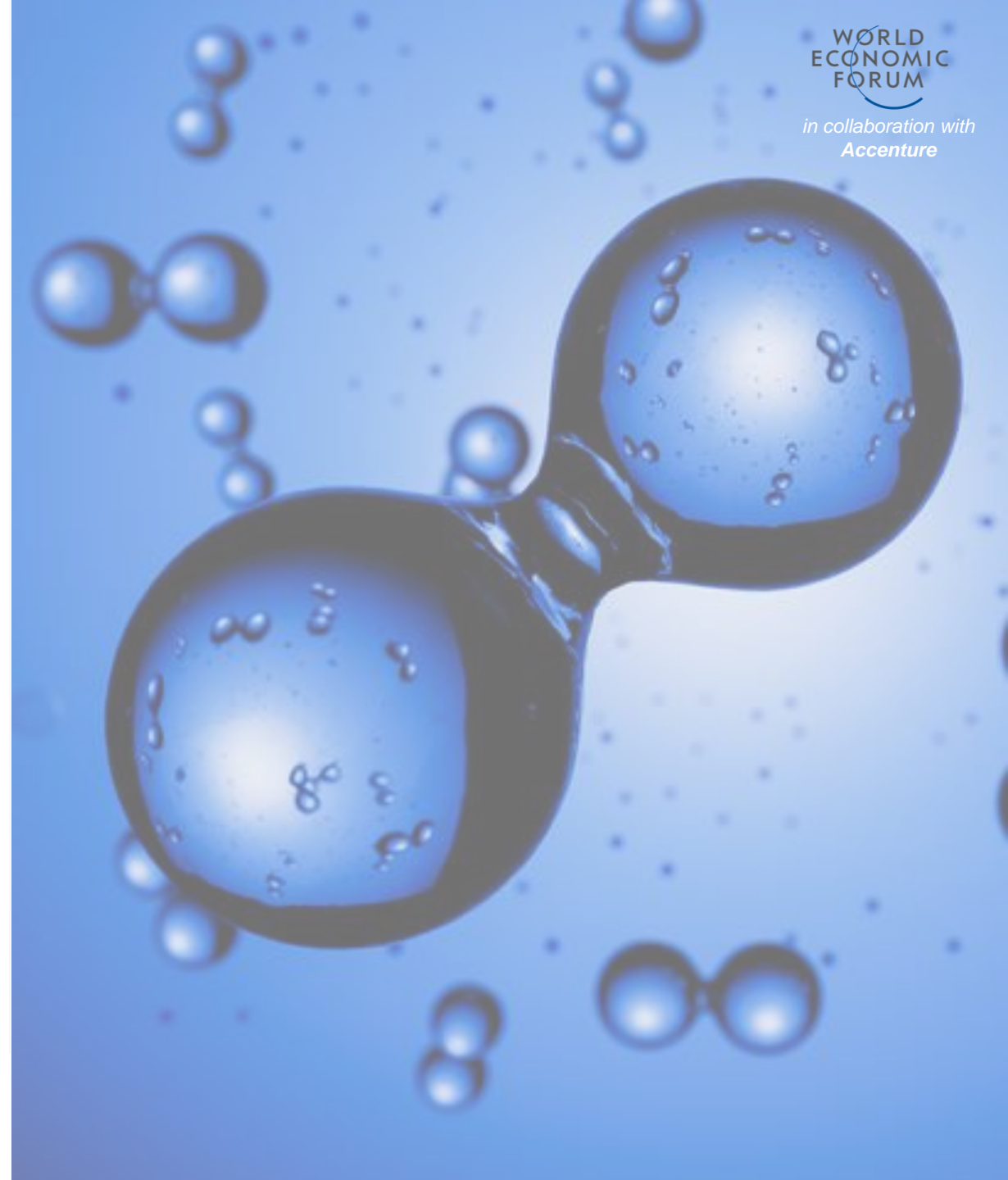
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# Basic Policy for the Realization of GX

KEY:

Overarching Strategic Vision

Policy Framework

Legislation

Financial Instrument

Public-Private Partnerships

The Basic Policy for the Realization of GX, approved by the Cabinet in February 2023, sets out Japan's approach towards the Green Transformation (GX), defined as an initiative to "shift the industrial and social structures that have been fossil energy-centered since the Industrial Revolution to clean energy-centered."

By maximizing Japan's strengths and accelerating GX (Green Transformation) initiatives, the Japanese government aims to ensure a stable supply of energy and create new demand and markets in the areas of decarbonization, contributing to strengthening Japan's industrial competitiveness and economic growth.

## On the premise of ensuring a stable supply of energy, the government will work on the realization on GX through:



Promoting energy efficiency by introducing new subsidies to support multi-year investment plans, providing guidelines on the transition towards non-fossil energy to manufacturing sectors including steel and chemicals, etc.



Increasing the proportion of renewables in the power generation mix to 36-38% by 2030 by accelerating the update of power grid, introducing a new bidding rule for offshore wind project, etc.



Utilizing nuclear power by allowing the lifetime extension of existing reactors and developing a replacement plan for decommissioned reactors, on the premise of ensuring safety.



Designing and implementing comprehensive strategy and legislations for the deployment of hydrogen and fuel ammonia, e.g. the introduction of CfD subsidies to mitigate the risks for first movers.

## The government will strive to realize the "Growth-Oriented Carbon Pricing Concept" through:



Utilizing GX Economy Transition Bonds worth 20 trillion in the next 10 years, to support the up-front investments that will contribute to the GHG emissions reduction and economic growth of Japan's industries but would be difficult solely by the private sectors.



Improving the added value of GX-related products and businesses by introducing new carbon pricing instruments, consisting of an ETS (full operation expected to start in 2026) and a Carbon Surcharge imposed on fossil fuel importers (expected to start in 2028).



Providing financial assistance to GX-related investments by establishing a public organization to provide risk-mitigating measures (e.g. debt guarantee) and promoting the adoption of sustainable financing methods including transition financing.



Contributing to the decarbonization of other Asian countries by realizing the concept of "Asia Zero Emissions Community", which will work as a platform for various supports and policy harmonization in the region.

Note: The measures listed above are non-exhaustive.

Source: [Cabinet Secretariat](#)

# Basic Hydrogen Strategy Revision



The Japanese government plans to develop the revision of the Basic Hydrogen Strategy, originally formulated in 2017, by the end of July 2023 and to materialize the detailed policy designs based on the strategy.

## Key revision points under consideration (not approved yet):

1. Setting a new ambitious target for introduction of around 12 Mt of hydrogen in 2040, to accelerate the realization of a hydrogen society (Addition to the already set targets of 3 Mt by 2030 and 20 Mt by 2050)
2. Setting a target for the introduction of around 15GW of electrolysers by Japanese companies, both in Japan and overseas, to establish the foundation of hydrogen production assets.
3. Developing the legislative support for large-scale and resilient hydrogen supply chains and potential hydrogen hubs, to realize the commercial operation by around 2030.
4. Leading the global discussions regarding the formulation of the standards for the definition of “clean hydrogen”, aiming to set a standard based on the emissions intensity.



**Hydrogen Industry Strategy** will be developed, aiming for the realization of (1) decarbonization, (2) stable supply of energy, and (3) economic growth, by utilizing Japan's technological strengths through global expansion.



**Hydrogen Safety Strategy** will be developed, aiming for the optimization of the hydrogen-related laws and regulations throughout the entire supply chain, which will be essential for promoting large-scale use of hydrogen.

# GX Economy Transition Bonds



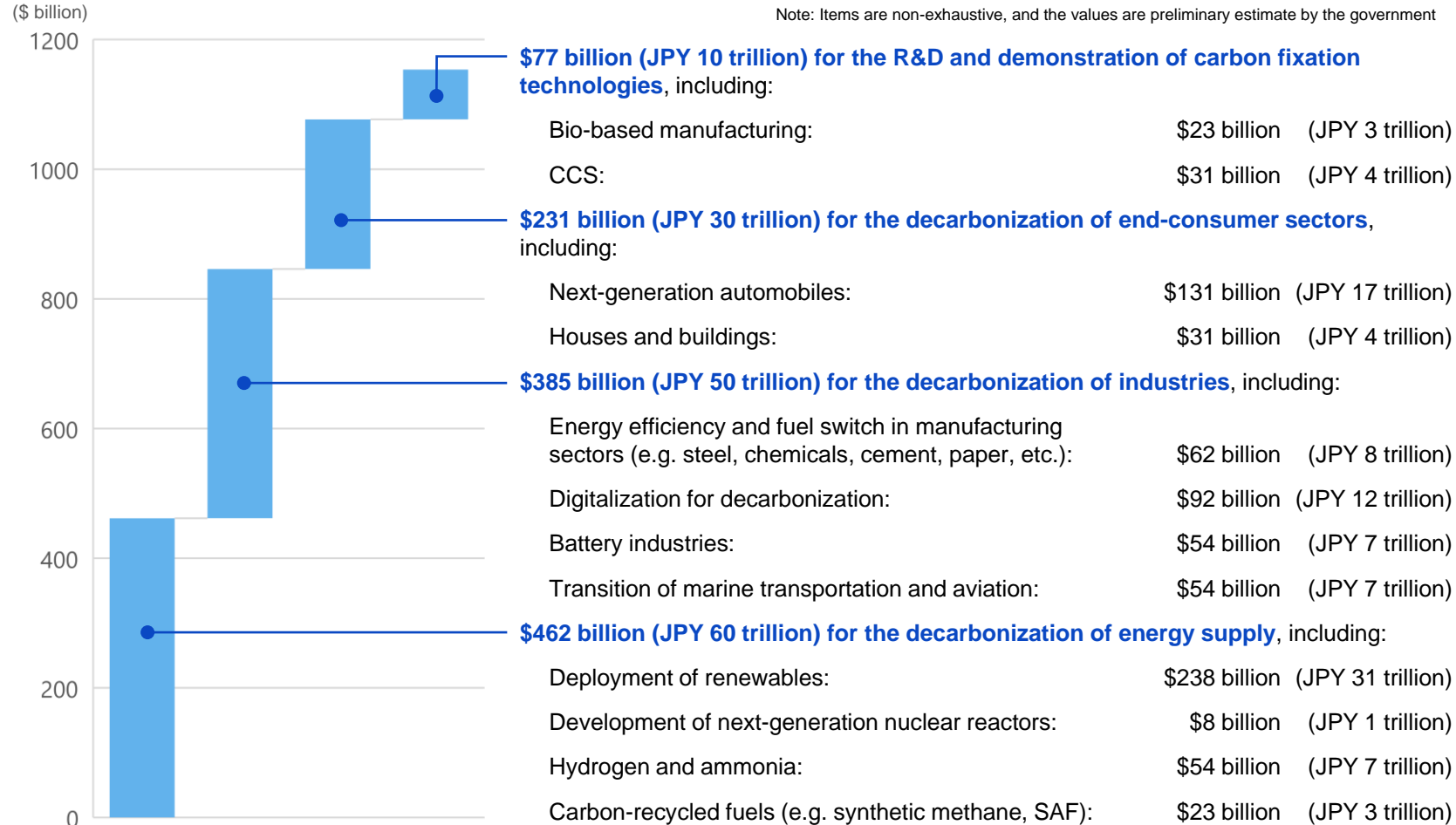
The Japanese government will support the up-front investments for the realization of GX through the issuance of the GX Economy Transition Bonds, worth \$154 billion (JPY 20 trillion) in the next 10 years.

## What is the GX Economy Transition Bonds?

- The Japanese government estimates that the investments of over \$1.15 trillion (JPY 150 trillion), in combined private and public funding, will be required in the next decade to realize the path towards carbon neutrality and economic growth of Japan.
- To support up-front investments, the government will issue GX Economy Transition Bonds worth \$154 billion (JPY 20 trillion) for 10 years, starting from 2023. The obtained funds will be used to support innovative technology development and capital investment that contribute to the decarbonization of energy and raw materials and the improvement of profitability.
- The Bonds will be redeemed through a newly introduced carbon surcharge, which will be borne by fossil fuel importers, and the auctioned emissions allowance in the ETS.

Sources: [METI](#), [Cabinet Secretariat](#)

## Estimated GX investments (in combined private and public funding) in the next decade



# Growth-Oriented Carbon Pricing (ETS and Carbon Surcharge)



To incentivize the transition towards carbon neutrality, the Japanese government plans to introduce “Growth-Oriented Carbon Pricing”, which consists of an Emissions Trading System and a carbon surcharge.

Improve the added value of GX-related products and businesses by pricing carbon emissions. Together with up-front investment support through the GX Economy Transition Bonds, the government will create a mechanism that gives incentives to businesses that work on GX.

## Emissions Trading System (ETS)



Japan’s Emissions Trading System (ETS) uses baseline-and-credit system, where the GX League participants will set voluntary targets, report the actual emissions data, and trade earned emission credits. Pilot phase will start in 2023, followed by full-scale operation in 2026



From 2033, the Ministry of Economy, Trade and Industry (METI) will allocate CO<sub>2</sub> emission allowances to power generation companies with partial compensation, and will collect contributions from the companies according to the amount of the allowances. Specific paid emission allowance allocations and unit prices are determined by bidding (paid auction).

## Carbon Surcharge



From 2028, the METI will collect a carbon (fossil fuel) surcharge from fossil fuel importers, etc. according to the amount of CO<sub>2</sub> derived from imported fossil fuels.



The surcharge start from a lower rate, and the burden will gradually increase to further incentivize the shift towards non-fossil energy.

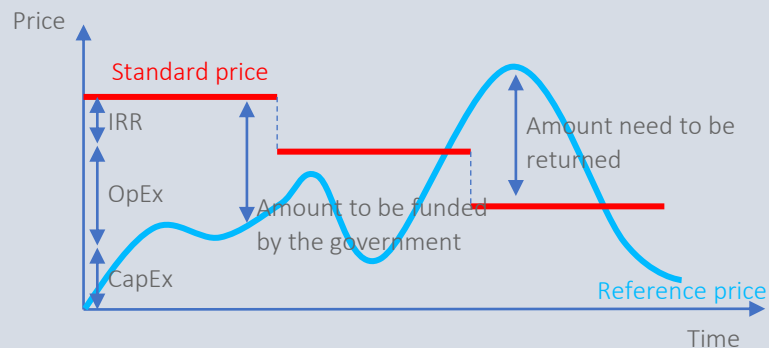
# Support for Large-Scale Hydrogen Supply Chain (CfD)



Aiming to establish a robust and large-scale supply chain, the Japanese government will introduce the concept of CfD and introduce support measures in which the government compensates for the difference between the “standard price” and the “reference price” for 15 years.

## How the policy works

- The government will compensate for the difference between the **standard price** and the **reference price**. The standard price will be reviewed and adjusted at regular intervals, based on actual results and outlook.

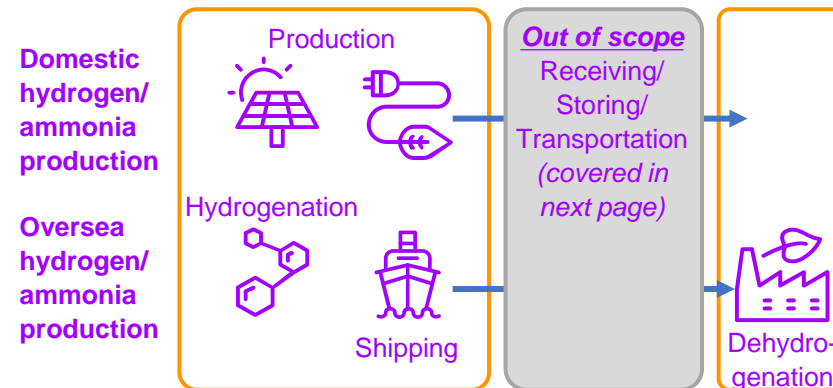


**Standard price:** A price at which this level of income is expected to reasonably recover the costs required to continue the business and to generate a reasonable profit.

**Reference price:** A price set based on the parity price of fossil fuel. Refers to LNG (liquefied natural gas) prices for hydrogen and coal prices for ammonia.

## Scope of the cost to be covered:

- Costs for domestic and overseas hydrogen/ammonia production, marine transportation, and conversion at dehydrogenation facilities (if carried as MCH (methylcyclohexane)) will be covered.



## Standard for emissions intensity of hydrogen/ammonia:

- Although the standard for emissions intensity is not officially determined yet\*, hydrogen/ammonia that satisfy a standard at an internationally acceptable level will be subject to support.  
\*Japan Hydrogen Association (JH2A) has proposed to the government that projects that can achieve an emissions intensity of 3.4 t-CO<sub>2</sub>/t-H<sub>2</sub> by 2030 should be subject to support.

## Support period:

- Support period for the first movers is planned to be 15 years in principle, as they will take risks and make investments despite the uncertainty in the outlook of hydrogen/ammonia business.

# Support for Shared Infrastructure at Hydrogen Hubs



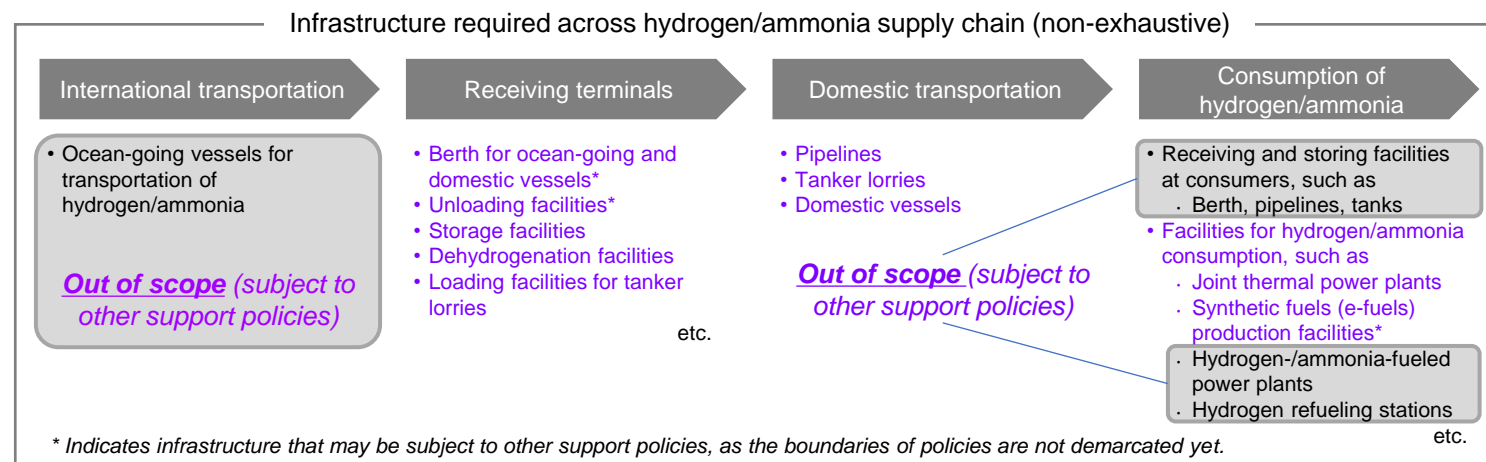
Aiming to create large-scale demand areas in order to realize a stable and reasonable price of hydrogen and ammonia, the Japanese government will make capital investments necessary for hydrogen and ammonia supply chains in industrial clusters.

## How the policy works

- The government will support the development of shared infrastructure at potential hydrogen/ammonia hubs.
- The support programme will be conducted in multiple timelines, because the required time for development will vary significantly depending on the maturity of selected technologies and the local conditions of the areas.
- Each timeline will be divided into three phases: (1) feasibility study, (2) FEED (Front End Engineering Design) and (3) infrastructure development, with stage gates set between them. Whether or not to continue the support for a project will be decided at each stage gate, so that more promising projects will be prioritised.

## Scope of infrastructure to be supported:

- Shared infrastructure for receiving, storing, distributing and dehydrogenating hydrogen and ammonia, as well as capturing, storing and distributing CO<sub>2</sub> associated with them, are subject to support.



## Government's target:

The government expects approx. 8 areas to be developed as hydrogen/ammonia hubs in the next 10 years. More specifically, the development of ~3 large-scale hubs in metropolitan areas and ~5 medium-scale hubs distributed across the country is expected, as the optimized layout of the hubs, like the hub-and-spoke model, is a key to building efficient supply chains and creating demand for hydrogen/ammonia.

# Revised JOGMEC Act



**JOGMEC (Japan Organization for Metals and Energy Security) has been given a new function to provide financial assistance (e.g. capital contribution and debt guarantee) to hydrogen/ammonia projects under the Revised JOGMEC Act.**

## Newly added functions of JOGMEC

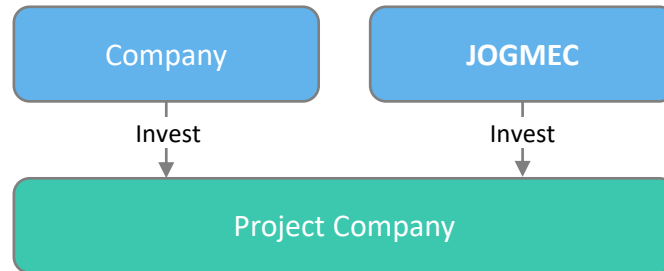
Under the Revised JOGMEC Act, the JOGMEC, a public organization which has been focusing on the stable procurement of oil, natural gas and non-ferrous metals for Japan, has been added the following functions:

- Financial assistance (e.g. equity investments, debt guarantee) to the following areas:
  - Production and storage of hydrogen and fuel ammonia
  - CCS projects
  - Overseas projects on exploration of large-scale geothermal power generation
  - Domestic processing and smelting of rare metals
- Geological structural surveys for
  - Offshore wind power generation
  - Sub-bottom profiling surveys for CCS

## Schemes of JOGMEC's financial assistance to hydrogen/ammonia projects

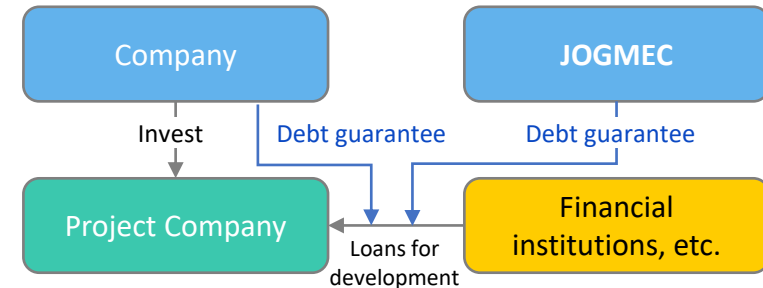
### Equity investments:

- For hydrogen production and storage businesses, it is expected that project companies will be established to carry out each individual project. The project company issues new shares to raise funds for hydrogen production and storage projects, and JOGMEC provides funding by underwriting these new share issuances. JOGMEC also provides funding for asset acquisitions.
- JOGMEC's policy is to sell its shares in principle when the business is successful and when the domestic companies it invests in request for a sale, or when JOGMEC determines that it is necessary to sell its own holdings of shares, while ensuring consistency with the government's energy policy.



### Debt guarantee:

- JOGMEC provides debt guarantees for loans related to hydrogen production and storage project funds and asset acquisitions. JOGMEC can also provide completion guarantees that may be required for fundraising.



Sources: [METI](#), [JOGMEC](#)

# GX (Green Transformation) League




The GX League is a forum for cooperation between a group of companies and the government, universities, and academic institutions in order to meet GHG reduction targets and increase industrial competitiveness by using Japan’s goal of carbon neutrality by 2050 as an opportunity for economic growth.

**Objective:** The GX League aims to create a society in which companies that take on the challenge of GX contribute to the reduction of emissions while being appropriately evaluated by the external parties.


**Members:** The basic concept of the GX League has been endorsed by 679 companies as of January 2023.

## The Four Activities of the GX League:




**GX-ETS:**

- The GX League members set their own goals, invest in GX, reduce GHG emissions, and disclose the performance to the society.




**Rulemaking for Creating Markets:**

- Based on future business opportunities, the public and private sectors discuss rules for the creation of new markets.
- Rules Working Groups (WGs), which are established by theme, aim to design rules, demonstrate them, and disseminate them to the world.



**Creation of Business Opportunities:**

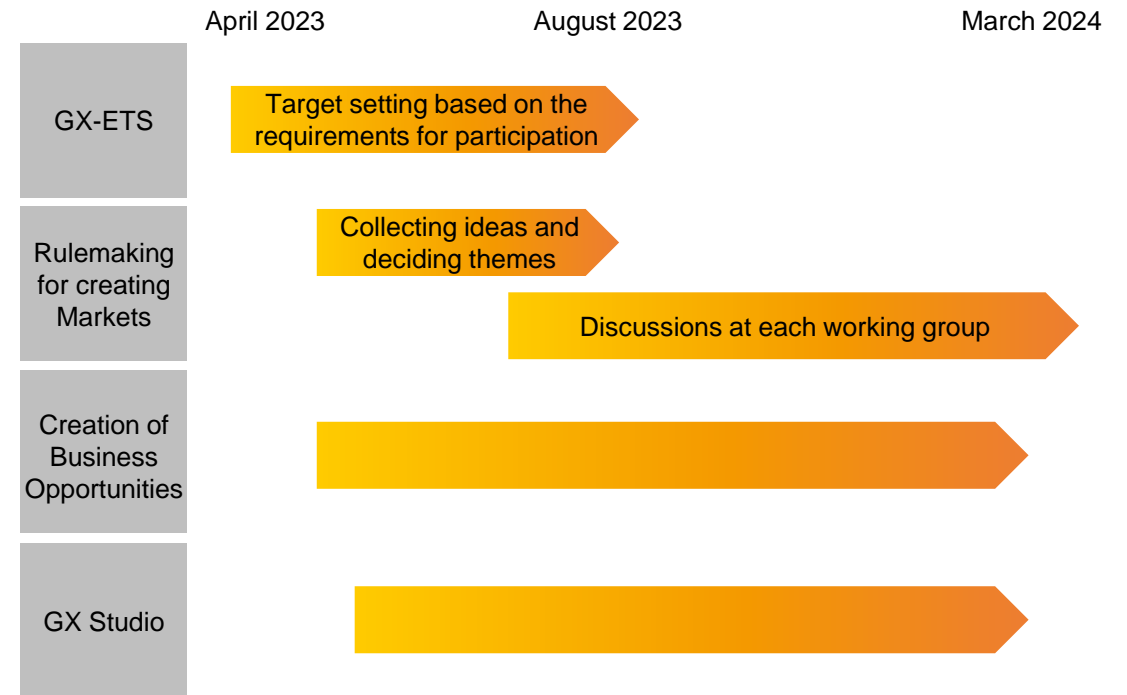
- Envision the future carbon-neutral socio-economic system as a business opportunity, and engage in cross-industry dialogue with the aim of utilizing it for public-private rulemaking, mid- to long-term management strategies, business development, and R&D.



**GX Studio:**

- The GX Studio will serve as a platform for knowledge sharing among the members, promoting collaboration and co-creation.
- The members discuss and exchange information on corporate concerns and practical challenges in addressing climate change.

## Timeline:



Source: [GX League](#)



# Alphabetical list of Acronyms

Acronym	Description
<b>CapEx</b>	Capital Expenditure
<b>CFAA</b>	Clean Fuel Ammonia Association
<b>CfD</b>	Contract for Difference
<b>CO<sub>2</sub></b>	Carbon Dioxide
<b>ETS</b>	Emissions Trading System
<b>FEED</b>	Front End Engineering Design
<b>FID</b>	Final Investment Decision
<b>GHG</b>	Greenhouse Gas (Emissions)
<b>GW</b>	Gigawatt
<b>GX</b>	Green Transformation
<b>H<sub>2</sub></b>	Hydrogen
<b>IPHE</b>	International Partnership for Hydrogen and Fuel Cells in the Economy
<b>IRENA</b>	International Renewable Energy Agency
<b>IRR</b>	Internal Rate of Return
<b>JH2A</b>	Japan Hydrogen Association
<b>JOGMEC</b>	Japan Organization for Metals and Energy Security

Acronym	Description
<b>LCOH</b>	Levelised Cost of Hydrogen
<b>LNG</b>	Liquefied Natural Gas
<b>LOHC</b>	Liquid Organic Hydrogen Carrier
<b>METI</b>	Ministry of Economy, Trade and Industry
<b>MCH</b>	Methylcyclohexane
<b>MoU</b>	Memorandum of Understanding
<b>Mt</b>	Million tonnes
<b>Mtpa</b>	Million tonnes per annum
<b>NEDO</b>	New Energy and Industrial Technology Development Organization
<b>NH<sub>3</sub></b>	Ammonia
<b>Nm<sup>3</sup></b>	Normal cubic meter
<b>OpEx</b>	Operating Expenses
<b>R&amp;D</b>	Research and Development
<b>RD&amp;D</b>	Research, Development and Deployment
<b>S+3E</b>	Safety + Energy security, Environment and Economic efficiency
<b>TBD</b>	To Be Defined

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