

Energy Policy Review

Japan 2026

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Executive summary

Japan is reshaping its energy system, while balancing its multiple objectives and managing geopolitical and market volatility. Its approach is pragmatic and deeply rooted in the long-standing S+3E principle: safety, energy security, economic efficiency and environment. The 7th Strategic Energy Plan and the Green Transformation (GX) framework set out a strategy that links energy diversification, industrial competitiveness and innovation. This Energy Policy Review offers constructive advice on how Japan can translate that strategy into delivery, paying particular attention to natural gas, hydrogen and ammonia, and geothermal energy.

The GX framework aims to deliver three objectives simultaneously: stable energy supply, economic growth and decarbonisation. It seeks to mobilise large-scale public and private investment, supported by the gradual introduction of carbon pricing. It frames the energy transition not only as an emissions-reduction agenda, but also as a way to strengthen industrial competitiveness through efficiency, electrification, innovation and new fuels. Under the GX Promotion Strategy, Japan aims to mobilise JPY 150 trillion (around USD 1 trillion) of public and private investment over a ten-year period, while the 2023 GX Promotion Act provides a stable basis for long-term investment. Japan can further improve alignment and continuity across the innovation ecosystem and reinforce the effectiveness of carbon-pricing instruments to support its longer term objectives.

Japan's progress over the past decade provides a strong foundation; the next phase would benefit from more technology-neutral and competitive policy instruments. Energy consumption and greenhouse gas (GHG) emissions have fallen while economic output has grown, reflecting Japan's world-leading efficiency policies, strong institutions and deep innovation base. Yet due to the country's unique structural circumstances, including its high import dependence (a self-sufficiency rate

of 16.3% in 2024), fossil fuels still account for over 80% of total energy supply. To address this challenge while maintaining flexibility and resilience, Japan's strategy supports a wide array of low-emissions technologies, including innovative options like hydrogen and ammonia, carbon capture and storage, advanced nuclear technologies, perovskite solar cells and next-generation geothermal energy. Wider use of competitive mechanisms that allow different technologies to compete on performance would improve cost-effectiveness and reinforce policy stability.

Natural gas remains a cornerstone of Japan's energy security, and greater transparency could strengthen an already resilient supply framework. Imported liquefied natural gas (LNG) accounts for around one third of Japan's electricity generation. Diversification, overseas equity participation, long-term contracts and strategic LNG buffers have created resilience. Building on this foundation, enhanced third-party access to LNG terminals and increased information disclosure in low-competition regions would support more efficient infrastructure use, increase regulatory oversight and enhance market confidence, provided these measures are carefully calibrated to the country's security objectives.

Electricity sits at the intersection of rising demand, an evolving generation mix and affordability. Japan is already one of the most electrified economies in the IEA. After a decade of decline, electricity demand is expected to grow again, driven by data centres, semiconductors and wider electrification. This reinforces the importance of accelerating the deployment of nuclear energy and renewables. Japan has committed to ending new unabated coal and is phasing out inefficient units while maintaining sufficient thermal capacity for system stability. To attract timely investment and contain costs, the capacity, spot and balancing markets should send consistent and technology-neutral signals, including through stronger scarcity pricing and expanded market access for flexibility providers.

Accelerating grid modernisation and connection is essential for electricity security if Japan is to integrate more renewables, storage and new sources of demand. Renewables supplied nearly one-quarter of electricity in 2024 and are projected to account for 40-50% of supply by 2040. Japan is already a global leader in installed solar capacity per unit of land area, while offshore wind is an important strategic priority. The dual-frequency grid, with 50 hertz (Hz) in eastern Japan and 60 Hz in western Japan, continues to constrain interregional flows, and the deployment of grid-scale battery storage remains modest despite a large number of applications for new projects. Stronger incentives to modernise and expand the

network – e.g. through performance-based regulation and targeted investment frameworks – and faster connection processes for new generation, storage and large loads, would help unlock investment and improve system flexibility.

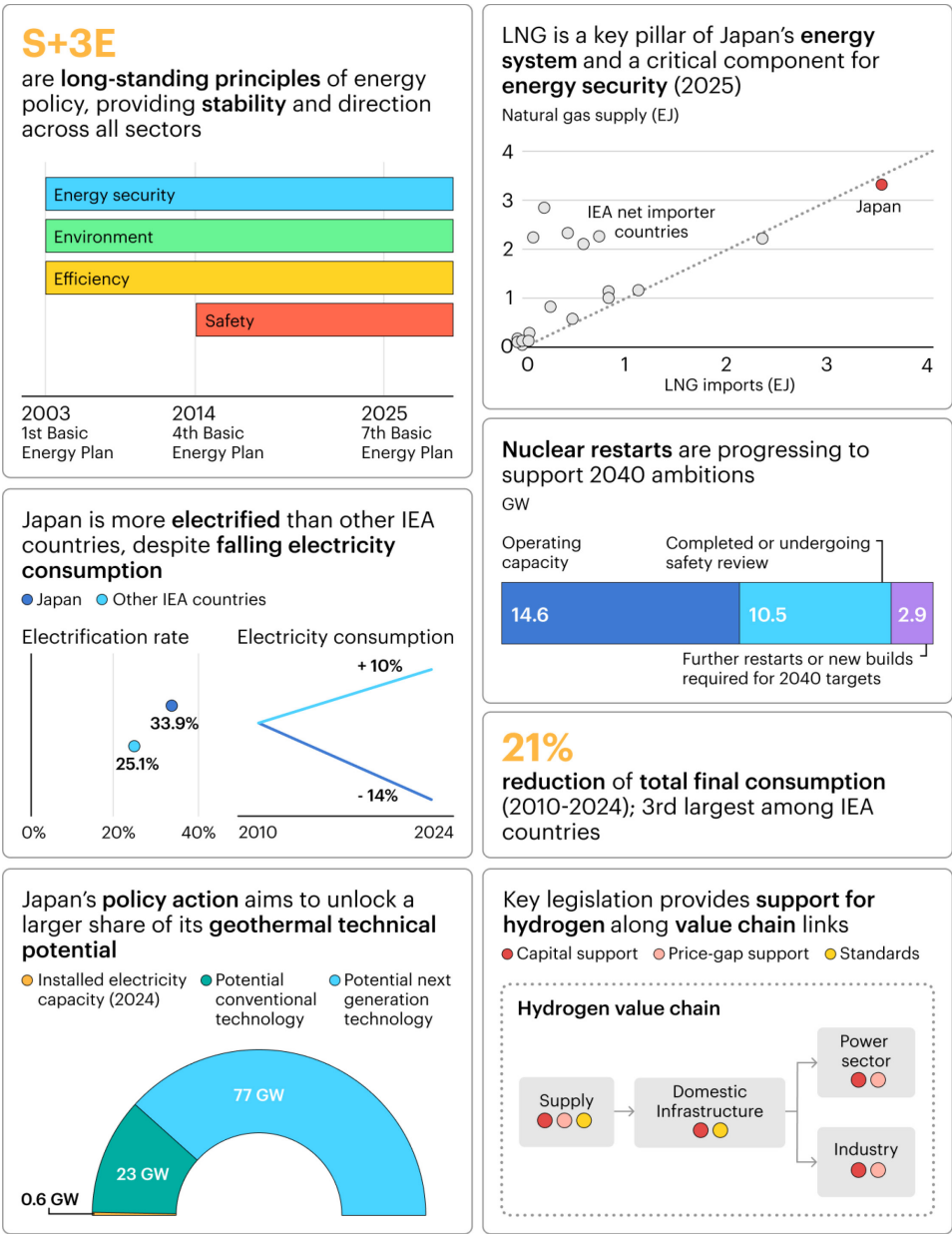
Nuclear energy is regaining an important role in Japan’s energy mix. A clear timetable for restarts and new builds would help system planning, operations and investments. The government has made significant efforts to raise public awareness and acceptance of nuclear power. By the end of 2025, 14 reactors, representing around 13 gigawatts (GW), had resumed operation and a further 12 GW were advancing through approval processes. Kansai Electric Power’s 2025 decision to begin surveys for a replacement reactor at Mihama was a notable step towards possible new construction. However, long lead times and licensing uncertainties may deter investment. Japan can increase confidence by setting transparent licensing and deployment timelines for large-scale reactors and small modular reactors (SMRs), while continuing to prioritise nuclear restarts on the basis of assured safety and the understanding of local communities.

A policy push in buildings and transport would help sustain Japan’s efficiency leadership and broaden the benefits of the transition. Japan has long been a global leader in energy efficiency, particularly through its Top Runner Program. Mandatory energy performance standards for new buildings took effect in 2025, but much of the existing building stock is under-insulated. A clearer roadmap towards zero-energy buildings, aligning standards, incentives, finance and skills, would support faster renovation. In transport, Japan’s leadership in hybrids and its “range of pathways” approach offer flexibility. Faster charging deployment towards its 2030 target, clearer life cycle assessments, stronger price signals for road fuels and a sharper focus on zero-emission mobility would increase the sector’s contribution.

Hydrogen and ammonia are distinctive pillars of Japan’s strategy. Their impact will depend on deploying them where they are the most competitive and needed. Japan published the world’s first national hydrogen strategy in 2017 and has set clear supply targets to 2050, supported by a price-gap mechanism based on a 15-year contract for difference model. Japan should focus low-emissions hydrogen, ammonia and derived fuels in sectors with limited alternatives, including energy-intensive industry, while using early power sector demand carefully to anchor supply chains, build experience and reduce costs without locking in inefficient pathways.

Geothermal energy is a major domestic opportunity that could be unlocked through stronger risk-sharing, clearer permitting and local partnership. Japan has large untapped geothermal resources, yet installed electricity capacity remains below 1 GW despite an estimated technical potential of around 100 GW from conventional and next-generation resources. Development has been slowed by high early-stage exploration risk; long lead times; complex permitting, particularly in national parks; and the need to build durable local acceptance. To reach its target of 1.5 GW by 2030, and a longer term ambition of around 7.7 GW, Japan could further strengthen a milestone-linked risk-sharing approach that crowds in private investment while streamlining permitting requirements according to project size, location and risk.

Japan is well-placed to demonstrate how a resource-constrained economy can advance a secure, affordable, technology-rich energy transformation. The priority now is implementation. This requires stronger market signals; clearer links across innovation and deployment; faster infrastructure delivery; and consistent prioritisation of cost-effective pathways across sectors. Japan looks to advance its energy policy goals with significant advantages, including strong institutions, technological capabilities, well-developed policy frameworks and a long tradition of strategic energy planning. Matched by timely execution, they can help Japan strengthen its own energy security and competitiveness while offering valuable lessons for the wider region and the world.



Policy recommendations for Japan

Energy policy landscape

- 1 Increase technology neutrality in energy policy to promote greater cost efficiency and bolster policy stability.
- 2 Strengthen alignment across the innovation ecosystem, in both the public and private sectors.
- 3 Pursue greater policy stability to improve predictability of costs and revenues to support expanding investment in the power sector.
- 4 Further enhance electricity grid development with a focus on incentivising grid modernisation and streamlined grid connection processes.
- 5 Establish clear timelines for deploying new nuclear projects, including licensing for large-scale and small modular reactors, and continue the prioritisation of nuclear restarts.
- 6 Accelerate road transport decarbonisation through a strategic mix of sustainable biofuels, electrification, charging infrastructure and smart charging.
- 7 Develop a roadmap and implement measures to achieve zero-energy buildings by 2050.

Natural gas

Focus area

- 8 Enhance transparency and access conditions to support effective competition while safeguarding security of supply.

Hydrogen and ammonia

Focus area

- 9 Prioritise low-emissions hydrogen, ammonia and hydrogen-derived fuels in sectors with limited decarbonisation alternatives while leveraging early demand creation in the power sector to support supply chain scale-up and cost reduction.

Geothermal energy

Focus area

- 10 Further strengthen early-stage geothermal risk-sharing to crowd in private investment while streamlining permitting.

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Energy policy landscape

Energy and climate strategy

Energy and climate policy framework

Japan's policy framework is anchored in several documents adopted in February 2025: the 7th Strategic Energy Plan, the GX2040 Vision (Green Transformation) and the Global Warming Countermeasure Plan to achieve Japan's new Nationally Determined Contribution. These strategic documents provide a comprehensive roadmap for transforming Japan's energy landscape, guided by the "S+3E" principle: safety, energy security, economic efficiency and environment. Applying this principle, Japan pursues "triple breakthroughs" – the simultaneous achievement of decarbonisation, economic growth and energy security – positioning it as a leader in clean energy technologies and industrial decarbonisation.

Japan's international commitments reinforce domestic action. As a signatory to the Paris Agreement, Japan aligns its policies with global climate objectives, including pledges to accelerate renewable deployment and phase down unabated coal. These commitments shape the design of domestic instruments. Recognising that climate change requires global co-operation, Japan established the Asia Zero Emission Community in 2022 to promote decarbonisation across Asia.

Japan's high dependence on imports (see the Fuels section) places energy security at the heart of domestic energy policy. The 7th Strategic Energy Plan sets out Japan's medium-term energy policy priorities through fiscal year (FY) 2040.¹ Among other topics, it addresses the following points:

¹ The fiscal year in Japan is 1 April to 31 March.

- **Energy security:** Diversification of energy sources and strategic reserves, as well as efforts to improve energy self-sufficiency.
- **Decarbonisation:** Expansion of renewables, use of nuclear power, and the development of hydrogen and ammonia.
- **Resilience and competitiveness:** Large-scale investments in decarbonised power sources and grids, promotion of the use of distributed energy resources, and digitalisation.

These reflect the changes in Japan's energy landscape since the adoption of the 6th Strategic Energy Plan, including increased energy security concerns and the projected growth in electricity demand.

While the government has committed to phasing out unabated coal capacity and ending construction of new unabated coal-fired power generation, it stresses coal's role in security of supply, given its cost, storability and low geopolitical risk. This reflects the challenge of managing the transition in a way that maintains adequate thermal capacity while progressively strengthening alignment with net zero pathways. Japan's strategy of maintaining thermal power capacity (kW) while reducing electricity output (kilowatt-hours; kWh) – primarily from inefficient coal-fired power – and promoting a range of decarbonisation options – including hydrogen and ammonia utilisation, biomass co-firing, and carbon capture and storage (CCS) – represents a pragmatic, though not risk-free, attempt to reconcile energy security, affordability and decarbonisation objectives.

The GX 2040 Vision outlines a long-term roadmap for Japan's Green Transformation while maintaining industrial competitiveness. Green Transformation is positioned as a growth-oriented transition, leveraging technology and investment to revitalise the Japanese economy while meeting climate targets and maintaining energy security. Its priorities include renewables; nuclear energy; hydrogen and ammonia; carbon capture, utilisation and storage; grids, system integration and demand-side measures; and GX investment mechanisms. The 2023 GX Promotion Act – the GX 2040 Vision's legislative basis – has persisted through successive political cycles, establishing the policy stability and credibility necessary for long-dated investments.

The GX Promotion Strategy plans to mobilise [JPY 150 trillion \(USD 1 trillion\)](#) in investments from the public and private sectors over a ten-year period. The government will provide an upfront investment of JPY 20 trillion (USD 133 billion) through subsidies, tax reductions and research support, financed by issuing GX Economy Transition Bonds.

The Ministry of Economy, Trade and Industry (METI) and its Agency for Natural Resources and Energy (ANRE) lead policy formulation and implementation, supported by the Cabinet Secretariat for cross-sectoral co-ordination. Over 1 000 [local governments](#) including Tokyo, Osaka and Kanagawa announced their commitment to net zero carbon emissions by 2050. The GX League mobilises corporate action on decarbonisation and carbon-pricing readiness.

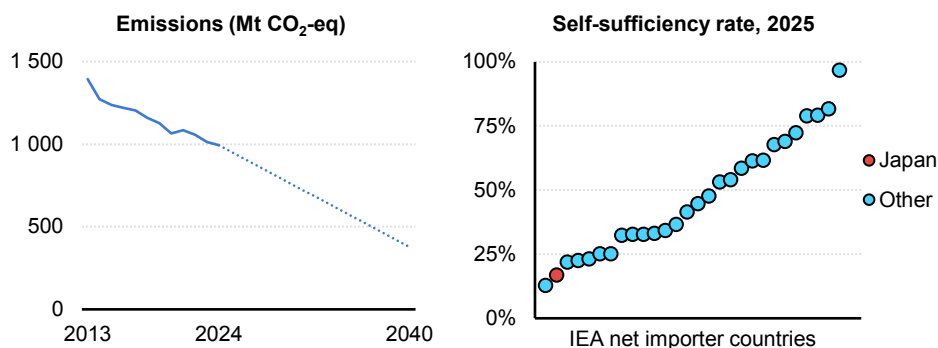
Policy spotlight: The GX League

The GX League (Green Transformation League) is a voluntary initiative launched by the Ministry of Economy, Trade and Industry in 2022 to accelerate corporate decarbonisation and prepare businesses for Japan's transition to a low-carbon economy. It brings together companies, financial institutions and other stakeholders. Members commit to aligning their business strategies with Japan's 2050 carbon-neutrality goal and interim 2030 targets and share best practices on emissions reduction. The GX League serves as a sandbox for emissions trading, allowing companies to test mechanisms before the full-scale Emissions Trading System launches in FY2026-2028. It also creates a structured platform for consultation between industry and government.

Trends and targets

Over the past decade, Japan has achieved a steady decline in GHG emissions while maintaining modest reductions in energy consumption. National GHG emissions (including carbon removals) fell by roughly 29% [between FY2013 and FY2024](#), driven primarily by the gradual restart of nuclear reactors, rapid expansion of renewables – especially solar photovoltaics (PV) – and improvements in industrial energy efficiency. Total final energy consumption decreased at a slower pace, reflecting structural changes in Japan's economy, efficiency gains in buildings and transport, and demographic trends such as population decline. Importantly, emissions and energy use have continued to decline even as real gross domestic product (GDP) grew moderately over the period, indicating a clear decoupling between Japan's economic performance and its energy-related carbon footprint. Despite these improvements, Japan's energy mix remains carbon-intensive, with fossil fuels – particularly LNG – still accounting for a large share of electricity generation. CO₂ emissions from energy use accounted for [over 86%](#) of Japan's total GHG emissions in FY2024.

Economy-wide emissions in Japan, FY2013-FY2040, and self-sufficiency rate in Japan and IEA net importer countries, FY2025



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Note: Mt CO₂-eq = million tonnes carbon dioxide equivalent.

Sources: IEA analysis based on Japan, Ministry of the Environment, [Japan's National Greenhouse Gas Emissions and Removals in FY2024](#), (accessed in June 2026); IEA (2026), [World Energy Balances](#).

Japan's Nationally Determined Contribution sets a target for carbon neutrality by 2050, targeting GHG reductions from FY2013 levels of 46% by FY2030, 60% by FY2035 and 73% by FY2040. The [Outlook for Energy Supply and Demand in FY2040](#) published alongside the 7th Strategic Energy Plan provides a forecast of energy supply and demand for FY2040, presenting a range of possibilities based on multiple scenario analyses that take various uncertainties into account.

Select energy indicators in Japan, FY2024, and outlook for FY2040

	FY2024	FY2040 outlook
Self-sufficiency rate	16.3%	30-40%
Electricity generation	990 TWh	1 100-1 200 TWh
Final energy consumption	11.3 EJ	10.1-10.4 EJ

Notes: TWh = terawatt hour; EJ = exajoule.

Sources: Japan, Ministry of Economy, Trade and Industry (2025), [Outlook for Energy Supply and Demand in FY2040](#), (accessed in June 2026); Japan, Ministry of Economy, Trade and Industry (2026), [Comprehensive Energy Statistics](#), (accessed in June 2026).

Energy taxation and carbon pricing

Japan's energy taxation framework is structured around the beneficiary-pays principle, aiming to ensure that energy users contribute to the costs of energy security and environmental protection. One core tax is the Petroleum and Coal Tax, which applies broadly to fossil fuels and is passed on to end-use energy products such as electricity, kerosene and city gas. Revenues from the Petroleum and Coal Tax fund fuel stockpiling, refining and distribution measures, resource development, energy efficiency programmes, and renewable energy deployment. The Global Warming Countermeasure Tax is Japan's national carbon tax. Introduced in October 2012 as an additional surcharge on top of the existing Petroleum and Coal Tax, it is applied to all fossil fuels upstream, based on their carbon content at a rate of JPY 289 per tonne of CO₂ (t CO₂) (about USD 2-3 /t CO₂). The Electric Power Development Promotion Tax is levied on electricity sales and used to provide grants to municipalities hosting a powerplant, enhance nuclear safety and support regulatory oversight of nuclear facilities. Starting in FY2028, a GX surcharge will be introduced to fuel importers and domestic extractors, in addition to the GX emissions trading.

Japan's [GX Emissions Trading System](#), introduced by the Pro-Growth Carbon Pricing Concept, has a phased architecture. Phase 1 (FY2023-FY2025) involved voluntary participation of GX-engaged firms and large emitters in emissions reporting without binding caps. Phase 2 (FY2026-FY2032) introduced compliance obligations. Phase 3 will launch allowance auctioning for the power sector in FY2033. Revenues from carbon pricing will be dedicated to redeeming GX Economic Transition Bonds, which mobilise around JPY 20 trillion in upfront investment for industrial decarbonisation. The government sees this mechanism as a GX investment-mobilisation tool rather than a near-term emissions-constraint mechanism. Some stakeholders argue that the current design prioritises investment predictability over near-term emissions constraint and recommend accelerating the transition from free allocation to auctioning allowances and raising the effective carbon price.

Japan does not operate permanent energy price subsidies, but since 2023 it has intermittently deployed temporary electricity and gas price relief to mitigate inflation and fuel price spikes, including targeted support during high-demand months in 2025. The Transport section provides more details on fuel taxation.

Energy research and development

Japan's energy innovation system differs from that of many other IEA Member countries. Public research and development (R&D) support is strongly oriented toward long-term, mission-driven programmes, often implemented in close partnership with large industrial incumbents and aimed at developing domestic technologies for global deployment. This approach has delivered world-leading capabilities in several energy technologies, but it also entails trade-offs, including limited flexibility to redirect funding and slower entry of new firms. Alongside strong public funding and a clear strategic orientation, Japan's energy innovation system reflects a number of structural characteristics that influence its overall performance. Co-ordination across ministries and programmes can be complex, long-term evaluation practices vary across initiatives and public support is often channelled through established actors rather than new entrants. Compared with peer countries, start-ups and venture capital currently play a more limited role in Japan's clean energy innovation ecosystem. Together these features shape the pace and pathways through which R&D outcomes are translated into commercial deployment, with implications for how emerging technologies scale and compete internationally.

Japan ranks among the top IEA Member countries in energy R&D spending in absolute terms, but places [about 10th](#) when comparing R&D spending per unit of GDP. Japan's energy R&D priorities are primarily defined through the GX Strategy; the Strategic Energy Plan; and cross-ministerial science and technology strategies led by METI, ANRE, the Ministry of Education, Culture, Sports, Science and Technology, and the Cabinet Secretariat. Japan directs public energy R&D funding toward technologies it identifies as strategic priorities, with a strong focus on applied research, demonstration and early deployment. Priority areas include hydrogen, ammonia and fuel cells, CCS technologies, advanced power generation and system technologies, nuclear energy, renewables, energy storage, and energy efficiency.

Japan views innovation as central to achieving its Green Transformation. Achieving the changes outlined in the GX Vision, therefore, hinges on strengthening the full innovation value chain, from basic research to large-scale demonstration and commercial deployment. Japan's early-stage innovations in solar cells (both perovskite and commercial silicon configurations), lithium-ion batteries and hydrogen fuel cell vehicles have all emerged from a strong, policy-supported innovation ecosystem. Perovskite solar cells (see the Policy spotlight) illustrate Japan's broader R&D approach: long-term public support, close industry involvement, and a clear pathway from laboratory research to domestic manufacturing and early deployment.

Japan's funding instruments include the [Green Innovation Fund](#) (see the Policy spotlight) and complementary programmes such as the [Moonshot R&D system](#), the [Strategic Energy Conservation Technology Innovation Program](#) (2012-2024), and the [Green Growth Strategy](#), which further expand support for high-risk, high-impact innovation. These instruments are intended not only to enable timely future emissions reductions but also to position Japanese firms to lead in emerging global clean-technology markets, strengthen Japan's industrial competitiveness and crowd in private investment. Systematic ex post evaluation of large energy R&D programmes remains limited, making it harder to assess long-term cost-effectiveness and inform reprioritisation.

The Ministry of the Environment (MOE), in its [Basic Environment Plan \(2024\)](#), positions GX as a core policy for building a nature-based “Regional circular and ecological sphere”, committing to designate over 100 decarbonisation leading areas, achieve net zero CO₂ emissions from electricity use in the residential and commercial sectors by 2030, and scale region-led GX social implementation models nationwide.

Policy spotlight: The Green Innovation Fund

Japan's Green Innovation Fund (GIF) of approximately JPY 2.8 trillion, established by the Ministry of Economy, Trade and Industry and managed by the New Energy and Industrial Technology Development Organization ([NEDO](#)), is a core pillar of the country's Green Transformation (GX). The GIF provides long-term, milestone-based support for research, development and demonstration, and for social implementation of priority fields for which implementation plans have been formulated within the Green Growth Strategy or in the Basic Policy for Achieving GX, including hydrogen and ammonia supply chains, next-generation batteries, carbon capture and utilisation, sustainable aviation fuels, and low-carbon industrial processes. The GIF operates through public-private partnerships, requiring participating firms to commit to clear commercialisation pathways and emissions-reduction outcomes. By reducing investment risks and supporting multi-year demonstration projects, the GIF aims to accelerate breakthrough technologies, strengthen Japan's industrial competitiveness and mobilise substantial private investment.

Japan's nuclear energy R&D and innovation agenda has a strong focus on safety enhancement and on next-generation light water reactors, SMRs, and high-temperature gas-cooled reactors with enhanced safety and load-following capabilities. The Japan Atomic Energy Agency plays a central role, conducting research on advanced reactor systems, nuclear safety technologies, severe accident mitigation, and nuclear fuel cycle and waste management. Academic institutions contribute through fundamental research, often in collaboration with the Japan Atomic Energy Agency and international partners.

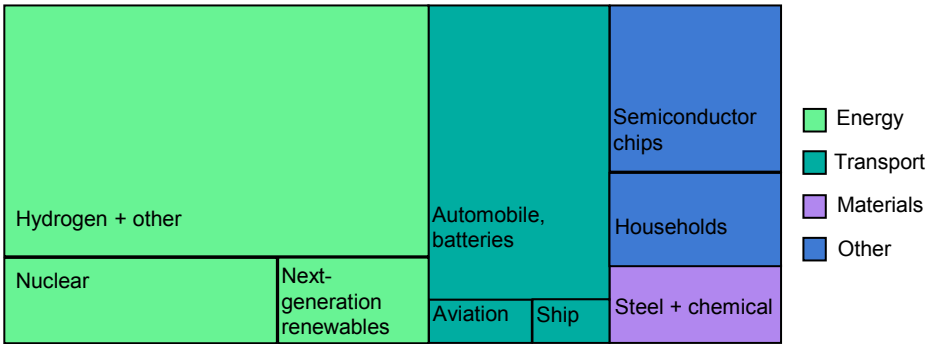
Policy spotlight: Perovskite solar cells

The 7th Strategic Energy Plan targets the installation of about 20 GW of perovskite solar cells (PSCs) by 2040. PSCs offer a promising solution to Japan's structural limitations to continued large-scale deployment of solar photovoltaics (PV): a high proportion of mountainous and forested land and dense urban areas.

As an ultralight and flexible thin film technology, PSCs can be installed on building façades, lightweight roofs and other surfaces unsuitable for conventional silicon modules. Their potential for low-cost production and high efficiency, including in tandem structures with silicon, makes them well-suited to Japan's objective of expanding distributed and building-integrated PV.

Japan has become a global frontrunner in PSC research and demonstration. The government, primarily through the Ministry of Economy, Trade and Industry (METI) and the New Energy and Industrial Technology Development Organization (NEDO), is providing substantial support for development and scale up. NEDO programmes are advancing large area coating techniques, durability improvements and pilot-scale manufacturing, while METI's Green Innovation Fund targets next-generation PV materials and domestic production to strengthen supply chain resilience. Japanese firms such as Sekisui Chemical, Panasonic and Toshiba are moving toward commercial prototypes, focusing on stability under humid conditions and integration into buildings, vehicles and infrastructure. Continued progress on durability, upscaling and cost reductions will be crucial to achieving widespread deployment.

Committed sector-specific research, development and demonstration investment and support by NEDO under the GX Policy



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Note: Planned funds range over a 10-15 year period.
Source: IEA analysis based on Japan, Ministry of Economy, Trade and Industry (2023), [Sector-specific Investment Strategy](#), (accessed in June 2026).

Carbon capture and storage

Carbon capture and storage is a critical component of the government’s plans for achieving net zero by 2050. CCS in Japan today is primarily a research, demonstration and early-deployment activity, supported through innovation funding instruments rather than a fully commercialised mitigation pathway. The 7th Strategic Energy Plan identifies CCS as a pathway for decarbonising thermal power generation and industrial processes that are resistant to fuel switching. The government is targeting a storage capacity of [120-240](#) million tonnes per annum (Mtpa) by 2050 to meet Japan’s decarbonisation commitments. Japan’s Tomakomai CCS project with an estimated capacity of [0.18 Mtpa](#) is the country’s [first full-chain CCS project](#), injecting 300 000 t CO₂ from a local oil refinery between 2016 and 2019 and currently continuing post-injection monitoring. Plans for a commercial project in this region are also moving forward, aiming to start operation in 2030. The project will store [1.5-2.0 Mtpa](#) of carbon and invest in [synthetic fuels production](#) through Idemitsu and the Japan Organization for Metals and Energy Security (JOGMEC).

The government aims to establish a supportive regulatory and social environment for CCS by [2030](#) and to develop full-scale CCS businesses between 2030 and 2050. Companies can already acquire [CCS licences](#) through a public tender process. In addition, JOGMEC is providing technical and engineering support to [nine CCS projects](#),

with a planned combined storage capacity of 20 million tonnes (Mt) per year. The projects were selected to test the feasibility of different segments of Japan's CCS value chain. The selected projects – which include transportation by pipeline and by ship – represent a policy setting that promotes large-scale storage “hubs”, drawing CO₂ from multiple, widespread sources.

Development of this model will need to manage uncertainty about storage potential across major projects' value chains. For instance, industrial users may choose to import low-emission fuels that use CCS in their country of origin or they may choose to use fossil fuels and capture the carbon onsite for later transport offshore. Japan must balance the need to reach the volumes of carbon capture required to justify the development of large-scale hub infrastructure with the limits imposed by pipeline and maritime transport capacity.

Private sector co-ordination on carbon utilisation is supported by the [Carbon Recycling Fund](#). This Fund was established in 2019 as a cross-industry platform with over 250 members, including businesses, prefectural and municipal governments, individuals, and academics. It has granted research funding to 93 projects (totalling around JPY 540 million), often providing recipients a launchpad to government funding. Funded projects have covered CO₂ separation, conversion of CO₂ to fuel and chemicals, and research into market design, among other areas. The Carbon Recycling Fund supports an additional [policy workstream](#) across four pillars: 1) oceans and international; 2) energy and materials; 3) regional and agriculture; and 4) innovation and education.

With [government support](#), Japanese companies are assessing the feasibility of storing CO₂ overseas, including in Malaysia and Oceania. Overseas storage circumvents some of Japan's domestic geological and social licensing concerns. Increased seismic risk resulting from CCS operations, the potential for naturally occurring earthquakes to cause CCS leakages, and a lack of exhausted oil and gas fields to serve as promising sites all increase the cost and complexity of CCS site survey and monitoring in Japan. But transporting large amounts of captured carbon by ship, especially over long distances, is not yet an established technology. Japan's exploration of overseas CO₂ storage reflects a pragmatic approach to managing domestic geological and social constraints, particularly in the near to medium term. In parallel, domestic CO₂ utilisation is being pursued mainly as an innovation and industrial strategy, with the potential to create value-added products and support longer term decarbonisation. These approaches address different objectives and time horizons and their relative roles are likely to evolve as technologies, infrastructure and international supply chains mature.

Skills, competencies and employment in the energy transition

Japan's strategic documents recognise that an effective transition requires a workforce equipped with the adequate competencies. METI's Workforce Development Plan (2025) outlines a comprehensive approach to strengthening technical skills in areas such as hydrogen and ammonia engineering, battery manufacturing, energy management, grid digitalisation, and advanced manufacturing. Japan's strategic documents also highlight the need to maintain and renew competencies in nuclear safety, reactor operation, decommissioning, waste management, and advanced reactor R&D.

Under the GX Promotion Act and the GX 2040 Vision, Japan emphasises a smooth human capital transition, supporting workers affected by structural change through reskilling programmes, career mobility assistance and targeted support for firms transforming their manufacturing processes. In addition, the government has introduced reskilling support in GX-related sectors, launched industry-academia programmes to expand engineering talent pipelines and promoted the participation of diverse individuals in labour mobility. Japan's strengths include strong industrial training capacity, well-established technical colleges (KOSEN) and robust public-private partnerships.

However, despite growing policy attention, Japan faces several challenges in developing the workforce needed for a rapid and equitable energy transition. A persistent shortage of engineers, technicians and digital specialists, exacerbated by demographic ageing and declining enrolment in science, technology, engineering and mathematics (STEM) fields, limits the pace at which new technologies can be deployed. Labour mobility in Japan remains low by [OECD](#) standards, limiting the speed at which workers can transition from conventional manufacturing roles into emerging GX sectors during structural change. Small and medium-sized enterprises, which form much of Japan's industrial base, often need support to enhance their financial and organisational capacity to invest in reskilling. Gender gaps in STEM education and technical careers also constrain the available talent pool. If not addressed, co-ordination challenges across ministries, gaps in skills forecasting, and limited integration between vocational training systems and emerging clean-technology industries risk slowing the development of strategic competencies.

Financing the energy transition

Japan has placed financing at the centre of its GX Strategy, aiming to mobilise more than JPY 150 trillion in public and private investment over a ten-year period. Under the GX Promotion Act and the GX2040 Vision Strategy, the government combines large-scale upfront public investment with long-term institutional reforms to catalyse private capital. The Japan Climate Transition Bonds are a cornerstone of this approach (see the Policy spotlight).

Policy spotlight: Japan Climate Transition Bonds

In 2024, Japan became the first country in the world to issue sovereign transition bonds, labelled Japan Climate Transition Bonds, as part of its strategy to mobilise over JPY 150 trillion in public and private investment for the Green Transformation (GX). These bonds provide upfront public financing for decarbonisation projects across energy, industry and transport, aligned with sector-specific investment strategies under the GX framework. The government plans stable annual issuance and ensures transparency through detailed allocation and impact reporting. Japan Climate Transition Bonds also aim to deepen the domestic sustainable finance market by establishing clear expectations for credible transition pathways and by complementing Japan's wider green and transition finance guidelines.

Japan has also taken significant steps to strengthen its domestic green finance ecosystem by developing comprehensive green and transition finance frameworks, aligned with international standards. METI, the MOE and the Financial Services Agency have issued national guidelines for transition bonds, transition loans, green bonds and green loans and offer subsidy schemes to reduce incremental costs for issuers, such as external reviews and verification.

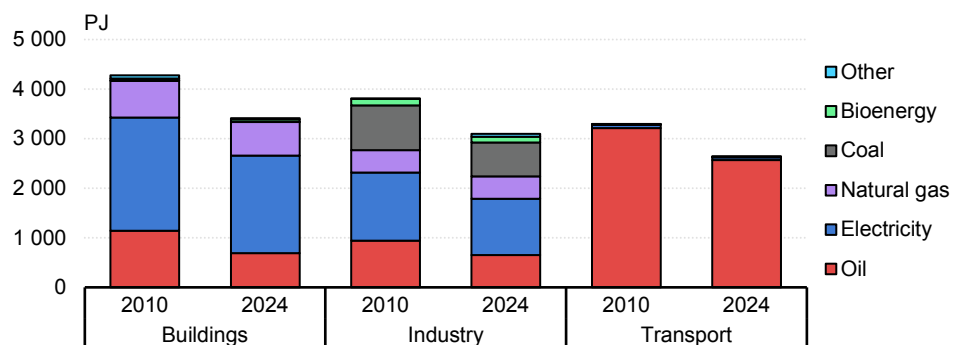
Recognising that decarbonisation requires credible pathways for hard-to-abate industries and the power sector, Japan is promoting transition finance to support technologically grounded emissions-reduction trajectories. The government has updated the Basic Guidelines on Climate Transition Finance, expanded the sectoral technology roadmaps, and introduced follow-up guidance to support effective implementation by financial institutions and corporate issuers. These instruments aim

to crowd in private capital, expand credible financing options for companies at different stages of decarbonisation, and ensure that Japan's financial system is equipped to drive the large-scale investment needed to meet its long-term climate and energy goals.

End-use sectors

In 2024, buildings accounted for the largest share of total final energy consumption (TFEC) at 36.3%, closely followed by industry at 35.5% and transport at 28.1%. Oil (43%) remains the dominant fuel, followed by electricity (34%) and natural gas (12%). Japan has one of the highest shares of electricity in TFEC globally (34%² in 2024), and this share rose by 2 percentage points between 2010 and 2024. For comparison, the global electrification target in COP31 discussions is 35% by 2035.

Total final energy consumption by sector and fuel in Japan, FY2010 and FY2024



IEA. CC BY 4.0.

Note: PJ = petajoule.

Source: IEA (2026), [World Energy Balances](#).

² Calculated as electricity consumption divided by total final energy consumption, excluding non-energy use.

Policy spotlight: Japan's energy efficiency policy package

Japan has developed one of the world's most comprehensive and durable energy-efficiency policy packages, spanning buildings, transport, industry and appliances. It combines regulatory standards ("sticks"), financial incentives ("carrots"), and sustained public-awareness and information programmes to reduce energy consumption and emissions while supporting economic competitiveness and innovation. Together these elements have delivered significant energy savings over several decades, forming a central pillar of Japan's energy security and decarbonisation strategies.

Regulatory measures are at the core of this framework. Efficiency performance standards apply across a wide range of sectors, including minimum energy performance requirements for buildings, vehicle fuel-economy standards and mandatory energy-efficient design for equipment. These standards are regularly revised to reflect technological progress and market developments. Complementing regulation, Japan deploys substantial financial support to accelerate the uptake of efficient technologies. Subsidies for building insulation; zero-energy buildings (ZEB) and zero-energy homes (ZEH) construction; efficient heating, ventilation and air conditioning (HVAC) systems; industrial energy management upgrades; and clean energy vehicles help reduce upfront costs for households and firms. Awareness policies – ranging from appliance labelling and public information campaigns to training programmes for builders, energy managers and installers – ensure that efficiency is visible to consumers, public bodies and industry.

A prominent example of Japan's success is the Top Runner Program, which is widely regarded as an international benchmark in appliance and equipment efficiency regulation. Introduced under the Energy Conservation Act, the Program identifies the most efficient product model in each category and uses it as the future mandatory performance baseline for all manufacturers. Over time, this dynamic, forward-looking structure has driven repeated cycles of innovation and performance improvement. The Program covers dozens of product categories, including vehicles, HVAC systems, motors, lighting, consumer electronics and IT equipment, and has delivered considerable reductions in energy use, often exceeding 30% in major categories such as room air conditioners and refrigerators.

In the last 20 years, Japan has seen a consistent decrease in energy consumption across all end-use sectors. TFECE decreased by a quarter while economy-wide output increased by around 12%. This reduction in energy demand was driven by a combination of economy-wide energy efficiency improvements (see the Policy spotlight) and a moderate decline in total population in recent years.

Buildings

Energy use in buildings

Energy consumption in buildings in Japan has moderately declined over the past decade, driven by demographic trends, strong appliance standards and behavioural changes following the 2011 energy crisis. Residential and commercial/public buildings each represent roughly half of total building energy demand. In residential buildings, appliances (36%), space heating (27%) and water heating (25%) dominate consumption.

While Japan has been a global leader in energy-efficient products such as advanced HVAC systems, its buildings sector faces structural challenges related to the thermal performance of the existing stock. This reflects a long-standing policy emphasis on efficient equipment and appliances, combined with a historically more flexible approach to regulating building envelopes. Although the average age of buildings in Japan is relatively low compared with other advanced economies, Japan historically prioritised flexibility in building design and rapid construction, with mandatory insulation and whole-building energy performance requirements being introduced more recently than in many peer countries. In addition, the culture of underheating introduced during the post-World War 2 energy shortages persists, meaning that gains from insulation are much smaller than in other countries. As a result, for a large share of dwellings – and particularly detached houses – scope remains for improved insulation performance.

Climate change is intensifying the need for cooling, especially in dense metropolitan regions. As the number of extreme heat days rises, peak electricity demand becomes more sensitive to cooling loads. The [IEA Energy Efficiency 2025](#) publication reports the growing number of cooling degree days and electricity demand for cooling in Japan since 2010. This trend underscores the importance of high-performance building envelopes, shading and smart control technologies to moderate peaks.

Heating and cooling

Japan's heating and cooling patterns reflect its varied climate, from the cold winters of Hokkaido to the subtropical conditions of Okinawa. Cooling demand is rising faster in some Japanese regions than in others, while overall heating demand is falling in Japan and other Asian economies. Improved thermal envelopes, shading, ventilation strategies and the deployment of advanced heat pumps are essential for reducing peak loads and improving comfort.

The heating and cooling sector is predominantly served by individual systems. Cooling demand is met primarily by electric air conditioning units. Natural gas is used for cooling in the commercial sector, accounting for about 40% of commercial buildings' cooling demand (or 30% across the whole buildings sector). Space heating relies on a mix of technologies, including electric heat pumps, kerosene heaters and city-gas boilers, with fuel use varying by region and dwelling type. Oil-based fuels remain particularly important for residential space heating, especially in colder regions, contributing to Japan's comparatively high oil use in buildings relative to other IEA Member countries.

District heating and cooling systems remain limited in scale and are concentrated in dense urban districts serving clusters of offices, commercial developments, hotels and residential complexes. District heating and cooling systems have maintained stable heat supply levels since the early 2000s, primarily using city gas and electricity. Decarbonisation of district heating and cooling schemes relies on greening the electricity and gas supply, alongside efforts to boost efficiency and integrate lower carbon heat sources.

Japan is a global leader in heat pump deployment, with widespread adoption of electric heat pumps across residential and commercial buildings. Reversible air conditioners are common in homes, while commercial properties often use advanced variable refrigerant-flow systems. Despite this progress, a significant proportion of older homes still depend on less efficient heating units and have limited thermal insulation, resulting in elevated winter peak electricity demand. Commercial building stock also includes many outdated HVAC systems, which are expensive to upgrade and less amenable to modern load-shifting and smart control.

Policy framework

Japan has progressively strengthened its building energy efficiency policy framework over several decades, with a strong and internationally recognised focus on equipment standards, appliances and industrial energy efficiency. However, binding requirements for building envelopes and whole-building performance were introduced significantly later than in most other advanced economies. Recent reforms mark a significant shift. Amendments to the Building Energy Efficiency Act (2022) and the Building Standards Act (2024) made compliance with national energy conservation standards mandatory from 2025 for all new buildings, including residential ones. Prior to this reform, compliance with national energy conservation standards for residential buildings was largely voluntary, which limited uptake despite available technical solutions. These reforms provide a stronger legal foundation for improving thermal performance and reducing energy demand in new construction while placing a greater emphasis on the role of local governments in implementing them. Prefectural governments play a growing role through local information campaigns, demonstration buildings, and simplified subsidy procedures for homeowners and small businesses.

The recent reforms offer clearer and more predictable compliance pathways for builders and developers. In Japan's current building energy efficiency framework, performance grades are used to classify compliance levels under the Building Energy Efficiency Act. Grade 4 corresponds to the legally binding national minimum energy performance standard, covering thermal insulation and primary energy consumption, and has been mandatory for all new buildings since the 2022 amendment. Grade 5 serves as a higher performance benchmark, aligned with ZEH-equivalent insulation and energy performance levels. It is not a nationwide legal requirement but a policy reference and is selectively applied by some local governments, notably in "leading decarbonisation regions" defined by the MOE.

The government provides subsidies for ZEB and ZEH construction, supporting insulation upgrades, high-efficiency HVAC systems, building automation systems and onsite renewable energy installations. In addition to large, dedicated subsidy programmes administered by METI; the Ministry of Land, Infrastructure, Transport and Tourism; and the MOE, the Green Innovation Fund provides complementary support for development and demonstration of selected advanced technologies such as high-performance façades, building-integrated PV and smart building controls.

Energy conservation policies include a mix of innovative behavioural measures and more systematic market-oriented approaches. These include the Power-Saving

Challenge, launched in 2020, which uses a gamification approach to encourage household energy savings, as well as the Energy Efficiency Communication Ranking, under which retailers are assessed and ranked based on the quality of their energy-saving communication and consumer programmes. More recently, Japan launched the Home Energy Saving Campaign in 2025, which combines financial incentives with information tools to accelerate the uptake of energy-efficient housing measures. Behavioural campaigns also remain an important pillar of policy, notably the long-running Cool Biz initiative, which promotes higher air conditioning temperature set points (28°C) and lighter clothing to reduce cooling demand, particularly in offices. Public awareness and capacity-building programmes include national campaigns on insulation benefits, heat pump efficiency and heat resilience measures; training for architects, builders and local officials; guidance documents for retrofitting older homes; and the dissemination of model ZEB and ZEH designs.

Energy performance labelling and voluntary disclosure schemes are increasingly used to make building energy performance more visible to occupants and investors. However, comprehensive mandatory disclosure at point of sale or rental has not yet been implemented nationwide. These measures are intended to make energy performance more visible to occupants and investors, and to encourage renovation decisions based on life cycle cost considerations.

As cooling demand and peak loads increase, Japan is placing a greater emphasis on demand-side flexibility in buildings. While smart meters have been deployed at [near universal scale](#), policy efforts are increasingly focused on expanding the use of digital solutions, such as Home Energy Management Systems and Building Energy Management Systems, which enable real-time monitoring and optimisation of household appliances, distributed energy resources, and building services. These systems underpin the development of demand-response programmes, smart HVAC controls and dynamic pricing, but their uptake remains more gradual and uneven compared with metering infrastructure. In parallel, building policy is also increasingly integrating heat-resilience measures, including insulation, shading, ventilation and passive cooling, responding to rising heat-stress risks in urban areas.

Japan's research ecosystem for building energy performance is broad and well-established. METI; the Ministry of Land, Infrastructure, Transport and Tourism; and the MOE jointly support research through NEDO and other agencies, focusing on next-generation building envelopes, advanced heat pumps, demand-response compatible HVAC systems, digital-twin building models and building-integrated renewable energy. The Green Innovation Fund plays a vital role in demonstration

projects. Translating these research efforts into widespread improvements in the existing building stock will require stronger links between innovation programmes, renovation incentives and workforce training.

Zero-energy buildings and zero-energy homes

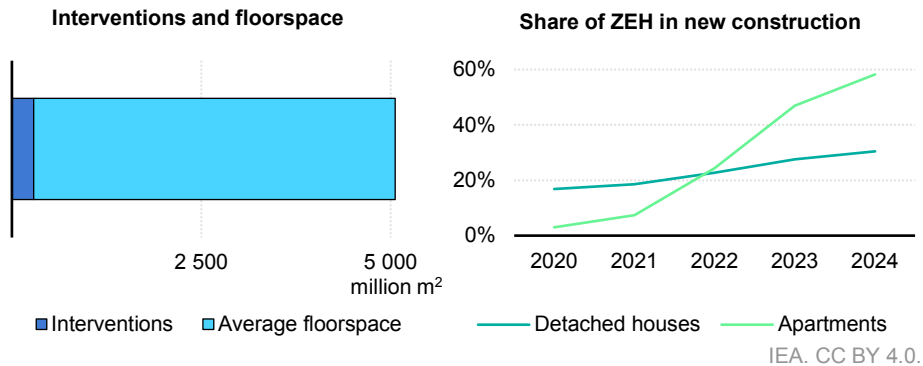
Japan has built a comprehensive ecosystem around ZEB and ZEH, offering a progressive set of performance categories: ZEB-oriented, ZEB-ready, nearly ZEB and full ZEB. These categories enable a gradual scaling of performance expectations and support incremental market transformation. Beyond direct energy savings, the ZEB and ZEH programmes play an important role in shaping the market by standardising high-performance design practices; strengthening supply chains for insulation, windows and HVAC systems; and reducing costs through learning effects.

By the end of FY2024, around 1 900 non-residential buildings had achieved some form of ZEB certification, with ZEB-ready accounting for the majority. The cumulative certified ZEB floor area exceeded 20 million m², reflecting steady but still partial market penetration relative to total new construction. Offices, logistics facilities and educational buildings have been dominant categories, supported by relatively favourable economics and strong corporate demand for energy-efficient facilities. In the residential sector, ZEH uptake has been at around 20% of annual new detached home construction, with substantial regional variation. Prefectures with strong local incentives and active municipal campaigns show noticeably higher levels.

Public procurement plays an important role in accelerating market diffusion. In principle, new national government buildings are required to meet at least ZEB-ready performance. This approach strengthens supply chain capability and encourages learning effects in design, construction and materials.

While Japan has significantly strengthened requirements for new buildings, emissions reductions in the buildings sector will increasingly depend on improving the performance of the existing stock.

Total rebuilds and energy-related renovations compared to average housing stock and share of zero-energy homes in new constructions, FY2020-FY2024



Notes: ZEH = zero-energy homes. “Interventions” refers to renovations for the purpose of energy conservation, as well as all construction starts for rebuilding.

Sources: IEA analysis based on Japan, Ministry of Land, Infrastructure, Transport and Tourism (2025), [Construction Statistics Survey](#), (accessed in June 2026); Japan, Ministry of Land, Infrastructure, Transport and Tourism (2025), [Building Renovation and Renewal Survey](#), (accessed in June 2026); IEA (2026), [Energy End-uses and Efficiency Indicators](#); ZEH Web, [2025 ZEH Conference](#), (accessed in June 2026).

Renovation of existing buildings

Renovation remains the core challenge for achieving deep emissions reductions in Japan’s building stock. Most residential buildings were constructed before effective insulation requirements were introduced, and many of them have great potential to strengthen high-performance insulation envelopes or efficient ventilation equipment.

Recent policy developments include the phased introduction of renovation-triggered energy performance requirements from FY2025 onwards and subsidies to support insulation upgrades and the replacement of inefficient HVAC equipment. For example, the [Energy Conservation Subsidy](#) and the [Eco-Home grant](#) promote building upgrades, efficient water heaters and window replacement. However, despite expanded subsidy programmes and recent regulatory steps, renovation activity has not yet reached the scale required to fully align the existing building stock with Japan’s 2035, 2040 and 2050 climate objectives. Accelerating progress will require a stronger mix of regulatory drivers, accessible financing tools for households and small building owners, and expanded workforce capacity to deliver high-quality retrofits. Without sustained policy reinforcement, emissions reductions in the buildings sector will increasingly lag those achievable in other end-use sectors.

Industry

Japan's industrial sector is pivotal to the Green Transformation because it combines high energy use and emissions with a central role in exports, productivity and economic security. Many core sectors, including steel, chemicals, cement, refining and advanced manufacturing, are both energy-intensive and globally exposed, so decarbonisation costs and policy credibility will strongly influence future investment and location decisions.

Industry contributed [28.8%](#) of GDP (2023) and accounted for 36% of TFEC and 40% of energy-related emissions in 2024. Manufacturing (particularly in energy-intensive subsectors) dominates industrial energy demand; basic metals and chemicals alone account for more than half of industrial energy use. Coal remains structurally important as an energy source and feedstock. It has supplied, on average, 40% of total energy demand in manufacturing over the past decade. This also reflects the prevalence of high-temperature processes that remain difficult to electrify.

Government policy anchors the industrial transition around a triple mandate: energy security, economic growth and decarbonisation. Japan's industry energy policy benefits from METI's mandate to direct industry and energy policy; energy policy is formulated with industrial sectors as a key concern. Green Transformation instruments are designed to improve investment predictability for large emitters and energy-intensive sectors. Switching production processes in heavy industry is subject to long planning and investment cycles, as much of the equipment is CAPEX-intensive and tends to be depreciated over long time horizons. Making such investments attractive means Japan must preserve its stable industry policy environment.

The GX framework includes [Sector-specific Investment Strategies](#) for several energy-intensive industries such as steel, chemicals and cement. These roadmaps provide useful long-term signals on expected emissions-reduction pathways and investment needs, but they often emphasise particular technologies or fuels – such as hydrogen, ammonia or CCS – rather than defining outcomes in performance or cost terms. In parallel, major public support instruments, including the Green Innovation Fund, price-gap support schemes and GX-related transition finance, tend to be aligned with these predefined pathways, reinforcing technology-specific choices at the deployment stage. While this approach can accelerate first-of-a-kind projects and reduce early investment risk, it may also limit competition between alternative decarbonisation options.

Energy efficiency remains Japan's first lever of industry sector energy policy and a long-standing policy strength. Manufacturing energy intensity fell by 23% between 2014 and 2024. The [Energy Conservation Act](#) (amended 2022) applies to over 10 000 businesses and requires either an annual 1% intensity improvement or sector benchmarks, with escalation mechanisms for persistent underperformance (see also the energy efficiency Policy spotlight).

Deep decarbonisation of heavy industry will require a combination of major changes in production processes and improvements to supporting infrastructure. Electrification (including expanded use of electric arc furnaces) becomes a key decarbonisation pathway as the power mix becomes cleaner. Recent legislation introduced 2030 [electrification-related targets](#) for selected subsectors (e.g. cement and electric furnaces in iron and steel). Electricity demand in Japanese industry has declined over the past 20 years, but at a slower pace than overall industrial energy demand. Future electrification will also rely on sufficient grid investments and rapid connection processes (see the Electricity chapter). This becomes increasingly important as Japan continues to develop sectors that attract high site-level loads, like [semiconductor industries](#). Further, many production processes with electrified heat and energy sources still rely on fossil fuels as feedstocks, particularly in chemicals and cement. Decarbonising these sectors will require additional low-emissions alternatives.

Fuel switching is another decarbonisation path for high-temperature heat and feedstocks. Japan's strategic approach to alternative fuels emphasises low-emissions hydrogen and ammonia, among other options, supported on a sector basis by the sector-specific investment strategies and on a fuel basis by enabling policy instruments (see Focus Area on Hydrogen and ammonia). Although alternative fuels can be used for heat, electricity and process uses, current supplies are limited. Ultimately, decarbonisation along electrolytic hydrogen-based routes could prompt [multi-million tonne](#) hydrogen demand.

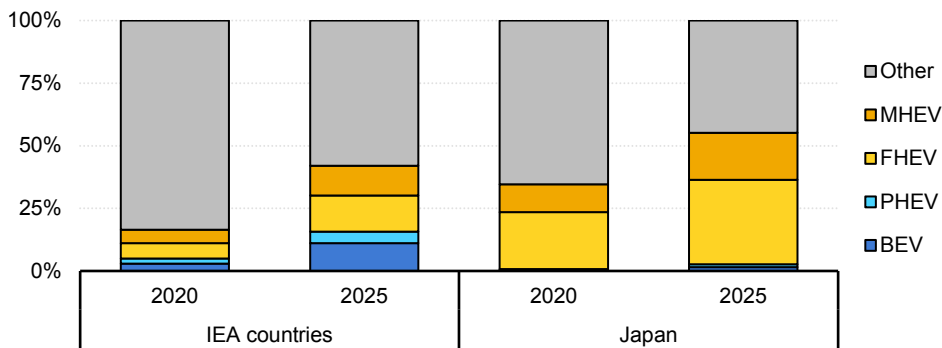
Industry decarbonisation supports progress towards the three objectives of Japan's GX policy: energy security, economic growth and decarbonisation. Greater use of electrification; hydrogen; carbon capture, utilisation and storage; and other low-emissions technologies can strengthen energy security by diversifying energy sources, reducing dependence on imported fossil fuels and broadening the range of potential supplier countries. At the same time, the development and domestic deployment of next-generation technologies can support economic growth and industrial competitiveness by creating new value chains and reinforcing Japan's technological leadership in clean energy industries. These measures also contribute

to decarbonisation by reducing emissions from energy-intensive sectors such as steel, chemicals and cement, where alternative mitigation options remain limited. In this context, Japan’s industrial policy seeks to align long-term emissions reductions with industrial resilience and secure energy supply while maintaining flexibility regarding technology pathways and future market developments.

Transport

Transport is responsible for roughly two fifths of Japan’s energy-related GHG emissions and 28% of final energy consumption. Road transport, which includes passenger cars, buses, two-/three-wheelers and road freight vehicles, accounts for around 85% of energy use and emissions within the transport sector. Given the size of Japan’s vehicle stock and relatively slow turnover, road transport emissions reductions in the 2020s and early 2030s will continue to depend heavily on improving the performance and fuel mix of existing vehicles. Domestic maritime moves close to 40% of freight volumes, and rail (including the metro) carries 30% of all passenger movements (see the Policy spotlight).

Car market shares by powertrain in Japan and IEA countries, FY2020 and FY2025



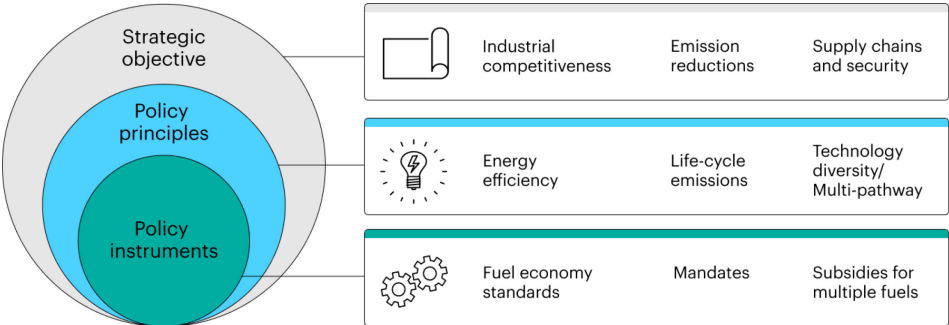
IEA. CC BY 4.0.

Notes: BEV = battery electric vehicle; PHEV = plug-in hybrid electric vehicle; FHEV = full hybrid electric vehicle; MHEV = mild hybrid electric vehicle.

Sources: IEA analysis based on IEA (2025), [What Next for the Global Car Industry](#); MarkLines, [Automotive Industry Portal](#), (accessed in April 2026); Autovista, [EV Volumes](#), (accessed in April 2026).

Japan has adopted a “range of pathways” approach to road transport decarbonisation, which includes “electrified vehicles”³, low-carbon fuels (especially for segments where electrification remains hard) and hydrogen (prioritised for heavy-duty and long-distance commercial applications). The so-called “electrified vehicles” category is broader in Japan compared to the IEA methodology, and includes BEVs, the so-called full hybrid electric vehicles (i.e. vehicles that combine an internal combustion engine with an electric motor and a battery that cannot be recharged externally), PHEVs and fuel-cell electric vehicles (FCEV). This diversified “range of pathways” approach is intended to reduce transition risks and strengthen resilience to fuel and mineral market volatility while recognising Japan’s unique energy mix constraints. This approach offers flexibility, but requires metrics to evaluate cost-effectiveness across pathways.

Illustration of transport policy in Japan



IEA. CC BY 4.0.

Key targets for Japan’s road transport sector by 2030-2035 include having all passenger car sales coming from clean energy vehicles (so-called “electrified” vehicles in Japanese policy documents), expanding domestic battery manufacturing to 150 gigawatt hours (GWh), deploying 300 000 public charging plugs and 1 000 hydrogen stations, increasing biofuel use, and commercialising synthetic e-fuels. Japan is a global leader in hybrid vehicles sales (2024). Efficient hybrid vehicles have reduced road transport energy intensity and decreased oil demand.

³ Japanese definitions differ from IEA usage, where electrification typically refers to externally chargeable vehicles.

Japan also implements [a range of other measures](#) to decarbonise transport, including modal shifts in passenger and freight transportation, eco-driving, sustainable logistics systems, etc.

Japan's automobile sector is a strategic pillar of the economy, employing over [one million people](#) and accounting for about one-fifth of manufacturing output. Domestic manufacturers lead in battery innovation, commercial FCEV deployment and fuel cell manufacturing. Hybrid vehicles, produced mainly by Japanese companies, dominate domestic sales. Japanese original equipment manufacturers also play a major role in global vehicle production and technology diffusion. Companies such as Toyota, Honda and Nissan account for a significant share of worldwide vehicle sales and operate extensive manufacturing networks abroad, meaning that technology choices made by Japanese original equipment manufacturers influence emissions outcomes well beyond Japan. Japan's diversified approach has supported incremental global emissions reductions, notably through the widespread uptake of hybrids.

Fuel efficiency standards

Japan has one of the world's longest running energy efficiency regulatory frameworks for transport. The Top Runner Program (see the Policy spotlight) sets mandatory efficiency standards using the most efficient vehicle model in each class as the benchmark. Manufacturers must meet these targets across their fleet within a set time frame, encouraging continuous innovation. Successive Top Runner fuel-economy standards for light-duty vehicles – i.e. passenger cars and light commercial vehicles – have contributed to the reduction in fuel intensity over the past two decades. The latest standards establish targets through 2030. For heavy-duty vehicles, Japan introduced a separate Top Runner framework in 2013 and updated it with 2025 standards; the next regulatory phase has not yet been defined. Thanks to successful efficiency policies in the transport sector, Japan has reduced oil imports [by 18% since 2000](#). Building on the success of the Top Runner Program, which delivered substantial efficiency gains, meeting post-2030 targets can be also supported by increasing the use of zero-emission vehicles and further improving efficiency in conventional and hybrid powertrains where it is technically feasible.

Clean Energy Vehicle support programme

Japan's Clean Energy Vehicle (CEV) programme is a core instrument under the Green Growth Strategy, administered by METI and ANRE. The scheme provides

purchase incentives for clean vehicle technologies, including BEVs, PHEVs, FCEVs and micromobility (Kei cars, small lightweight vehicles for short-distance travel), along with supplementary support for charging and hydrogen refuelling infrastructure. Subsidy levels vary by vehicle category and performance, with additional bonuses linked to the installation of renewable-compatible charging equipment and smart charging capabilities. From FY2026, CEV subsidy caps were revised to incentivise high-quality, sustainable vehicle models: up to JPY 1.3 million for BEVs, JPY 580 000 for Kei car BEVs, JPY 850 000 for PHEVs and JPY 1.5 million for FCEVs. Eligibility criteria include vehicle performance and convenience, life cycle sustainability (CO₂ footprint, recycled materials, battery reuse), and cross-sectoral benefits. In FY2025, Japan spent about JPY 110 billion to fund purchase subsidies for BEVs and FCEVs.

Kei cars have played an important role in Japan's passenger car market, supported by long-standing regulatory and fiscal incentives, including relaxed parking requirements, lower vehicle taxes and insurance costs, and policies favouring domestic production. Although several incentives were reduced after 2014, Kei cars continue to account for a significant share of [new vehicle sales](#). Targeted incentives for electric Kei cars could, therefore, offer a cost-effective lever to accelerate vehicle electrification, particularly in urban and regional contexts where these vehicles are most prevalent, and where driving patterns suit them best.

The CEV programme supports the installation of public chargers for electric vehicles (EVs), with a target of 300 000 by 2030, up from around 68 000 in June 2025. While Tokyo and Osaka offer relatively good access to charging infrastructure, many rural areas are still underserved, resulting in coverage gaps. The recent slowdown in charging deployment, despite generous subsidies, suggests that non-financial barriers, such as grid connection procedures, site availability and business model viability, may increasingly constrain roll-out.

Sustainable fuels and hydrogen

Japan is promoting sustainable fuels, targeting transport segments where electrification faces structural limits. Policy priorities focus on biofuels and synthetic fuels for aviation, shipping and long-distance road transport. The [target](#) for the aviation sector is to replace more than 10% of fuel consumption with sustainable aviation fuels by 2030. The Bioethanol Action Plan (2025) sets out a phased transition toward E10 by 2030 and E20 by 2040, covering vehicle and infrastructure compatibility, misfuelling prevention, and consumer communication. Sustainable

aviation fuels are promoted under aviation policy frameworks to support domestic production and international sourcing. Despite these initiatives, sustainable fuels still account for less than 1% of transport energy use, underlining the need for careful prioritisation and scale-up to ensure that limited volumes deliver the highest decarbonisation impact.

Policy spotlight: Rail

Rail is a keystone of Japan's net zero transport strategy for passenger and freight movement. Japan has the highest share of rail passenger transport among IEA Member countries. Rail is the dominant mode of travel in the major metropolitan regions, carrying far more passengers than private cars. Japan's world-renowned high-speed rail network – the Shinkansen – offers fast, reliable and energy-efficient intercity travel. This strong reliance on rail is underpinned by high public acceptance and trust, supported by the network's reliability, safety and energy efficiency. With one of the IEA's most extensive usages of electricity as an energy source (over 90% in 2024) and high utilisation, Japan's railways deliver globally leading levels of energy efficiency. The sector already plays a critical role in reducing oil dependence, air pollution and congestion while enabling systemic decarbonisation through integration with an increasingly renewable electricity mix and the country's push toward digitalised, multimodal mobility services.

Despite these strengths, the sector faces several challenges. There has been [little improvement](#) in the number of passenger-kilometres travelled by rail in recent years. Demographic decline, uneven regional demand and the lack of demand drivers place fiscal pressure on passenger rail operators, especially in rural areas. Construction of new railway lines is challenging in mountainous regions. [Freight rail capacity](#) is constrained in key east-west and north-south logistics corridors. These challenges also present substantial opportunities for policy action. In particular, stronger co-ordination between rail investment and electricity system reforms; targeted support for low-carbon freight corridors; and deeper integration of rail with EV car sharing, buses and active mobility could further enhance rail's role in delivering a resilient, efficient, low-carbon transport system.

Japan positions FCEVs primarily in heavy-duty and commercial applications, where hydrogen's fast refuelling and long range offer potential advantages over batteries. Policy support concentrates on [regional deployment clusters](#) (including Fukushima, Tokyo/Kanagawa, Aichi, Hyogo and Fukuoka) where vehicle roll-out, hydrogen refuelling infrastructure and fleet demand are developed in parallel. FCEVs are supported through the CEV programme, while broader hydrogen supply chain development is addressed under the GX framework (see Focus Area on Hydrogen and ammonia). Uptake remains limited to date ([422 FCEVs](#) were sold in 2023), reflecting high vehicle and fuel costs and infrastructure constraints, reinforcing the importance of targeting FCEVs to use cases where they provide clear system value, particularly for buses, trucks and logistics fleets.

Taxation

Several transport-related tax instruments, as well as the Petroleum and Coal Tax and Global Warming Countermeasure Tax (see the Energy taxation section), interact with subsidies to influence consumer choices. EVs and FCEVs currently benefit from the minimum rate of the annual vehicle ownership tax and are exempt from the weight-based vehicle tax at registration and at the first periodic inspection. Discussions are ongoing to reform this system.

At the same time, Japan has one of the lowest taxes on transport fossil fuels among IEA countries, which also impacts consumer choices. Japan's long-standing [gasoline tax](#) surcharge of 25.1 JPY/L (in place since 1974) was abolished at the end of 2025. The diesel fuel tax surcharge of 17.1 JPY/L (in place since 1976) ended on 1 April 2026. These changes have reduced gasoline excise to 28.7 JPY/L and diesel excise to 15 JPY/L. In addition, the government launched a Fuel Price Mitigation subsidy in 2022 to counter surging oil prices. This subsidy, paid to fuel wholesalers, capped retail gasoline prices (targeting ~168-172 JPY/L) by offsetting part of the cost. The subsidy was phased down in late 2023, expanded temporarily in late 2025 to facilitate the tax cut and reactivated in early 2026 amid a new price spike. Japan also operates a "tax-free diesel" programme for approved users in specific industries, including agriculture, forestry, fisheries and construction. Relatively low fuel taxation moderates operating cost signals for vehicle efficiency and electrification, increasing the importance of subsidies and other measures to drive behavioural change.

Electricity

System transformation

Japan has developed one of the most reliable electricity systems in the world, with some of the [lowest outage rates](#). Following the Fukushima Daiichi accident in 2011, Japan's reliance on imported fossil fuels for electricity generation has increased, making energy security a central policy concern. The government is reforming the electricity sector to address its structural challenges: high import dependency, limited grid flexibility, the dual-frequency grid, and the need to integrate growing shares of variable renewable energy (VRE) while maintaining reliability and affordability.

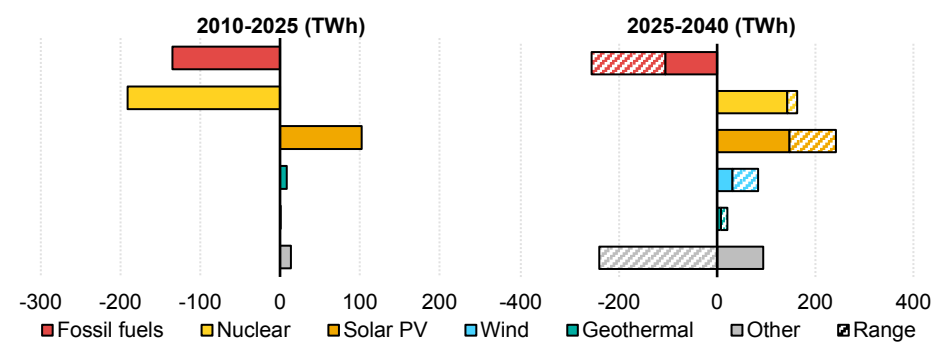
Japan's liberalised electricity market is relatively young compared to many IEA countries, although partial retail competition already started in 2000. The 2011 Fukushima accident triggered additional reforms and Japan's electricity market has undergone significant transformation over the past decade. Major milestones include the creation of a national system operators' co-ordinator in 2015, the full liberalisation of the retail competition in 2016 and the legal unbundling of utilities in 2020.

In 2026, Japan's thermal and nuclear power generation capacity continues to be dominated by incumbents and system operation remains the responsibility of ten regional transmission and distribution companies, each managing its own grid and integrating increasing shares of renewable energy. The Organization for Cross-regional Coordination of Transmission Operators (OCCTO) provides national-level co-ordination, overseeing system adequacy, balancing and planning cross-regional transmission investment. However, the combination of regional autonomy and limited interconnection continues to constrain market integration.

Japan's electricity mix is expected to shift substantially again in the coming years. In 2024, renewables supplied around 24% of electricity, nuclear 10% and fossil fuel-based thermal power continued to provide the majority, supplying almost two-thirds of all electricity. The Outlook for Energy Supply and Demand in FY2040 published alongside the 7th Strategic Energy Plan projects renewables to rise to approximately 40-50% by FY2040, driven especially by solar PV, which is projected to account for approximately 23-29% of the electricity mix. Nuclear power is expected to double its share in electricity supply, while thermal generation is projected to decline to approximately 30-40%.

A secure and stable electricity supply continues to be the priority, with thermal power as one of the anchors and balancing resources. Policy measures on coal, which supplied around 30% of electricity in 2024, focus on reducing electricity generation from inefficient coal units, restrictions on new unabated capacity, and increased co-firing with biomass and ammonia (see the Fuels and Hydrogen sections for more details).

Changes in electricity generation in Japan, FY2010-FY2025, and projected changes, FY2025-FY2040



IEA. CC BY 4.0.

Note: Electricity generation values for FY2025-FY2040 represent the generation ranges between scenarios provided in Japan's Outlook for Energy Supply and Demand in FY2040.
Sources: IEA analysis based on IEA (2026), [World Energy Balances](#); Japan, Ministry of Economy, Trade and Industry, [7th Strategic Energy Plan](#), (accessed in April 2026).

This shift in the electricity supply mix is accompanied by a reversal in electricity demand trends. Electricity demand has been declining since a peak in 2010, in part thanks to strong energy conservation policies (see End-use sectors chapter); in 2024, it was lower than almost 30 years ago. Electricity demand is projected to return to growth in the years ahead, reversing previous trends despite continued conservation efforts. Growth will be mainly driven by data centres, semiconductor manufacturing and GX-related electrification. OCCTO estimates national demand will climb 5% by 2035 compared to FY2025, returning to 2014 levels.

Policy spotlight: Community engagement for energy development

Japan centres community engagement in policy to support its system transformation. The Ministry of Economy, Trade and Industry builds elements of [community engagement](#) into its power system design and legislative frameworks, while the Ministry of the Environment directly oversees citizens' participation in [environmental impact assessments](#). Local and prefectural governments serve an additional role through local permitting; they often act as a conduit between citizens and developers. In recent policy action, Japan has attached new engagement requirements to feed-in premium eligibility, bolstered community outreach on geothermal development and continued to support social licensing activities for nuclear developments. There has also been growing activity related to offshore wind: projects ranging from [Nagasaki](#) to [Hokkaido](#) are demonstrating robust engagement between local civic groups and developers.

Electricity grids and system flexibility

Japan has one of the most efficient and reliable power networks in the IEA. Despite its mountainous and island geography, losses have been at or below 5% for over three decades. It, however, faces mounting operational strain as shifting demand patterns and growth in renewable generation reshape system requirements. A core structural challenge is the dual-frequency grid, with eastern Japan operating at 50 Hz and western Japan at 60 Hz. These two systems are connected only through limited frequency converter stations, which constrain power flows across regions and can increase the cost of integrating VRE.

These structural constraints have become more visible as VRE penetration rises and new loads emerge in certain regions. The number of times renewable curtailment occurred increased more than sixfold between FY2020 and FY2024. In FY2024, Japan's overall national curtailment rate (1.4%) was quite low compared, for example, to Australia's (2.5%), one of the few IEA countries to share the characteristics of an isolated grid and separate supply and demand centres. However, several Japanese regions, including Kyushu (with 4.8% curtailment in FY2024), Shikoku (3.2%) and Chugoku (2.3%) are particularly affected as they host high solar PV capacity, low local demand and limited transmission capacity. Data centres, semiconductors and digital industries are expected to increase peak load

on a national level by around 6 GW between FY2026 and FY2035 and intensify competition for grid capacity. At the same time, the demand outlook differs greatly by region. While electricity demand and peak demand in regions such as Hokkaido and Tokyo are expected to grow by around 8% between FY2026 and FY2035, Shikoku is projected to see a decline of roughly the same rate.

As digital and electricity infrastructure become increasingly intertwined, Japan established the “Watt-Bit” initiative. This initiative aims to encourage effective collaboration between electricity and telecommunication entities and integrate electricity infrastructure planning with digital infrastructure needs such as data centres. To meet new demand for data centres, it will be important to tap Japan’s regional renewable potential, and the growing use of VRE will require transmission expansion.

Limited transmission capacity and congestion on cross-regional interconnection lines have become a key concern in Japan, including between Tohoku and Tokyo and Hokuriku and Chubu. Despite ongoing reinforcements, interregional transfer capacity remains insufficient to fully smooth regional imbalances in supply and demand. Japan uses an indirect auction mechanism that generates zonal price differentials across regions as a means of providing price signals for transmission congestion between regions. However, within regional transmission networks, congestion management is mainly handled through transmission system operator-led redispatch, and zonal pricing and locational marginal pricing remain under consideration as future options.

In light of the need for large-scale integration of renewable energy and enhanced system resilience, Japan formulated the “Master Plan of Nation-wide Power Transmission Networks” in March 2023, outlining the future vision of the power grid. Building on the Master Plan, Japan is reinforcing congestion-prone interconnectors, upgrading converter stations and preparing new high-voltage direct current corridors. The Master Plan estimates investments between JPY 6 and 7 trillion, mainly for large cross-regional transmission corridors, by 2050. These large interregional transmission projects typically face long planning and implementation timelines, such as the 2 GW Hokkaido-Honshu interconnection with an estimated construction timeline of 6-10 years. Without proactive grid planning, grid development can be much slower than renewable deployment and the emergence of new loads, which generally have shorter lead times.

Much of Japan's grid infrastructure was built in the late 20th century. OCCTO has highlighted that the challenges associated with the ageing infrastructure cannot be addressed at the current pace of replacement. In addition, Japan's expansion of renewables and electrification point to the need for substantial grid expansion. A critical aspect of transmission and distribution investment is the framework for cost recovery and the extent to which it provides incentives for modernisation, upgrades and expansion. In 2023, Japan reformed the tariff regulation of transmission and distribution companies to encourage grid investment, moving from cost-plus to a system that approves multi-year revenue caps based on operators' five-year investment plans, including network expansion, renewal and resilience investments. The regulatory framework for electricity networks is still evolving following the reform. One example is the introduction of generation-side transmission tariffs in 2024.

Japan's structural constraints and fragmented regional grids increase the need for system flexibility within balancing areas. Japan's flexibility assets are currently mainly based on existing thermal power plants and pumped hydropower. However, this is about to change: driven by subsidies and other factors, grid-scale battery storage project applications surged to 171 GW by the end of 2025. However, only 1 GW of grid-scale batteries are connected to the grid. As clear operational rules and grid connection procedures are still being developed, this contributed to delays, and may also have encouraged speculative applications. As a result, Japan has started to introduce interim measures to improve the situation and accelerate grid connection processes. Market reforms (see below) have technically opened additional revenue streams for batteries and other distributed flexibility assets. However, frequent changes in the market design, limited price signals, and structural barriers such as high minimum bid sizes or unclear rules for small resources added to uncertainty and limited the participation potential. The integration of demand response is also progressing. As in most other markets, demand response is mainly driven by industrial consumers participating in capacity and balancing markets. From FY2026 onward, low-voltage resources can also participate in the balancing market.

Electricity market

The current electricity market design consists of short-term and mid- to long-term markets as well as complementary mechanisms to secure long-term generation adequacy. The Japan Electric Power Exchange operates the electricity markets in Japan. While the full retail liberalisation and the creation of new wholesale market mechanisms have laid the groundwork for a more competitive system, challenges such as low liquidity in certain markets and insufficient price signals to secure investment in

capacity and flexibility still exist. In response, Japan is advancing a suite of reforms to strengthen market functioning while safeguarding security of supply. It has also progressively opened markets for all participants, including distributed resources.

Exchange-traded electricity volumes in Japan's long-term markets are relatively small compared with those in Europe, equivalent to around [10%](#) of total electricity demand in Japan in FY2024. To facilitate access to baseload electricity for new market entrants, Japan established a baseload market that requires incumbents to sell part of their output into this market. Japan seeks to [develop](#) the medium- to long-term trading environment to improve the predictability of investments and fuel procurement and enable retailers stable access to medium- to long-term supply capacity. The spot market is the most important platform in terms of trading volumes, accounting for around [40% of total electricity generation](#). It is split into ten bidding zones, corresponding to regional utility areas. Following [record price spikes](#) driven by extreme weather in the winter of 2021, Japan introduced price caps for the spot market which are set at JPY 200/kWh. On the other end of the scale, the spot market has a price floor at zero, limiting signals of oversupply to market participants. The balancing and ancillary service market for all products was launched in 2021 and fully rolled out by 2024. It continues to be subject to [design changes](#).

Starting in [2020](#), Japan introduced complementary mechanisms to address investment gaps, ensure capacity adequacy in the long run and provide targeted support for low-emissions sources. The capacity market contracts future supply capacity four years before target delivery. Auctions have been held annually since 2020, including price caps. Successful bidders are required to provide capacity in the delivery year and receive capacity payments in return. Prices differ by region and reached, on average, more than [11 000 JPY/kW](#) per year in FY2024, with regions such as Hokkaido and Tokyo reaching the price cap. Japan's capacity market volumes are set according to total capacity requirements, which are derived from peak demand and reserve margins.

In addition, in FY2023, Japan introduced a Long-Term Decarbonized Capacity Auction as a core instrument to mobilise investment in firm, low-emissions electricity supply while safeguarding security of supply. It helps bridge the investment gap left by energy-only mechanisms, the capacity market and feed-in tariff/feed-in premium (FIT/FIP) schemes by providing long-term revenue certainty, lowering financing costs and enabling investment in technologies critical for decarbonisation and reliability. The Auction includes new capacity, such as LNG power plants and battery storage, as well as the retrofit of thermal power plants and safety upgrades of existing nuclear power plants.

The Auction's key design features include:

- Long-term capacity contracts for a period of 20 years, with remuneration linked primarily to availability rather than energy output.
- Separate, technology-specific auction categories, with individual calls, caps and conditions for each technology.
- Strict delivery and performance requirements, including penalties for non-delivery, to reduce project risk and ensure it contributes to system adequacy.

Initial experience with the Long-Term Decarbonized Capacity Auction underscores the need to maintain effective competition despite limited project pipelines for some technologies, notably for nuclear and power plants equipped with carbon capture, while also managing long-term consumer cost exposure, preserving strong investment signals and ensuring credible emissions outcomes (through clear definitions and monitoring). It is also important to align auction allocations with permitting processes, grid development and fuel supply chains. There is also potential to improve the cost-effectiveness of the mechanism through greater technology neutrality, i.e. competitive auctioning across a range of technologies, not only within individual technologies.

Nuclear energy

Overview

After more than a decade of uncertainty following the Fukushima Daiichi accident, nuclear energy is gradually regaining a clearer role in Japan's energy and climate strategy. In the immediate aftermath of 2011, Japan took all commercial reactors offline and introduced comprehensive safety reviews under a new, substantially strengthened regulatory framework. Nuclear output collapsed, forcing a sharp increase in fossil fuel imports and raising concerns over energy security, electricity prices and emissions. The 7th Strategic Energy Plan and the Outlook for Energy Supply and Demand in FY2040 now reaffirm nuclear power as a key decarbonised baseload option, and the government aims for nuclear to provide around 20% of electricity generation by 2040. Most nuclear power plants have limited use of waste heat, also due to the lack of district heating networks.

METI and its ANRE are responsible for overall energy policy, including the strategic role of nuclear in the power mix. The Nuclear Regulation Authority (NRA),

established as an independent body after Fukushima, oversees safety regulation under the Reactor Regulation Act, including design certification, operational licensing, ageing management and periodic inspections. Local governments play a decisive role: as a matter of policy, the central government does not proceed with restarts without the consent of host prefectures and municipalities, reflecting the importance of public acceptance.

Safety and public trust are, therefore, at the centre of Japan's nuclear policy. Current policy emphasises that restarts and long-term operation are contingent on rigorous compliance with NRA standards and ongoing improvements in safety culture. At the same time, the government seeks to communicate how nuclear contributes to the "S+3E" principle (safety, energy security, economic efficiency and environment). See the Fuels chapter for a more in-depth discussion of nuclear fuel supply and fuel cycle policy.

Because nuclear projects – whether restarts with major safety upgrades, long-term refurbishments or new builds – require large upfront investments and long payback periods, the government is examining mechanisms to reduce revenue and cost risks for long-lived decarbonised power assets. Options under discussion include public credit enhancement, the use of government creditworthiness to support loans alongside private finance, and new tools to hedge inflation and cost escalation risks. See also the Financing energy transition section.

Nuclear restart

Maximising the restart of existing nuclear reactors will be critical to achieve Japan's long-term electricity mix targets. Reactor restarts have progressed gradually but steadily as operators complete safety upgrades and navigate NRA reviews and local consent processes. As of May 2026, 15 reactors with a combined capacity of around [14.6 GW](#) had resumed operations. Another group of units representing roughly 10.5 GW is advancing through the approval process. Commercial operations at the world's biggest nuclear power plant also started in [April 2026](#). In parallel, 21 reactors (about 16 GW) have been permanently shut down since 2011, highlighting the scale of capacity loss that must be offset to reach the government's nuclear generation targets.

Japan's regulatory system applies a phased approval process. When establishing or modifying a reactor facility, utilities must first obtain approval from the NRA for the basic design and safety measures. At this stage, applicants must demonstrate their technical capability to construct and operate the facility, outline a robust financial plan,

and show that the basic design can prevent and mitigate severe accidents in line with regulatory standards. Subsequent approvals cover detailed equipment design and operational safety measures, including onsite procedures, staffing and emergency preparedness. This staged approach is designed to ensure that safety is rigorously assessed at each step, from design to operation, with clear opportunities for regulatory scrutiny and public oversight.

Local acceptance remains critical. Many of the reactors that have restarted or are under review are located in regions where utilities and local governments have developed structured engagement processes with residents, including information sessions on safety measures and emergency planning. Nevertheless, public opinion remains mixed, and the pace of restarts continues to depend on case-by-case local deliberations as well as operators' ability to demonstrate continuous safety improvements.

New construction

Japan is targeting a nuclear share of around 20% in electricity generation in FY2040, a level slightly below pre-Fukushima output. However, more than 20 reactors were permanently shut down following the Fukushima accident and a growing share of the remaining fleet is approaching retirement age. Aligning stated nuclear ambitions and maintaining nuclear electricity production over the longer term will, therefore, require the construction of new reactors to replace decommissioned capacity. Kansai Electric Power's [decision](#) to start surveys for the construction of a new nuclear power plant in 2025 to replace Mihama Nuclear Power Plant marks the first step to start new constructions since the Fukushima accident. Two other reactors with a combined capacity of [2.8 GW](#) are currently listed as under construction, and have either not been fully completed or are awaiting regulatory approval. Both reactors started construction before 2011. TEPCO's Higashidori project, whose construction was initially launched in 2011, is [suspended](#).

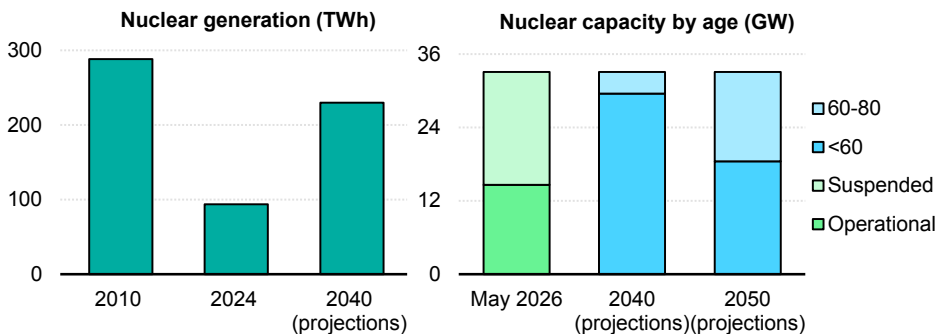
The 7th Strategic Energy Plan introduces the concept of replacing decommissioned nuclear power plants with next-generation advanced reactors, including designs with enhanced safety features such as advanced light water reactors, SMRs, high-temperature gas-cooled reactors and fast reactors. At this stage, operators and local stakeholders have not advanced any concrete proposals. Policy documents focus instead on developing the regulatory, financing, and R&D frameworks that would be required if operators and communities choose to pursue such projects in the future.

Decommissioning and ageing fleet management

As more reactors approach or pass 40 years of operation, ageing management and decommissioning have become central priorities. Under the Reactor Regulation Act, units must undergo detailed ageing reviews at 30 and 40 years, and operation beyond 40 years requires explicit NRA approval based on material degradation, seismic resilience and safety systems assessments. Even when national policy supports extended operation, the NRA may withhold approval if safety standards are not met.

The GX Decarbonized Power Source Act (June 2023) retains the 60-year operational limit under the Electricity Business Act but introduces, from June 2025, a rule excluding periods of outage beyond an operator’s control – such as lengthy regulatory reviews or court-ordered shutdowns – from the 60-year calculation. This aims to provide more predictable utilisation horizons without weakening safety requirements.

Nuclear generation and nuclear capacity without retirements and new constructions in Japan



IEA. CC BY 4.0.

Notes: Nuclear capacity includes plants with suspended operation. The suspended category includes plants undergoing the approval process. New constructions are not included. The chart excludes potential retirements from suspended and operational plants. The 2040 projections for nuclear generation are an average of the published lower and upper ranges for electricity generation.

Source: IEA analysis based on IEA (2026), [Electricity Information](#); Japan, Ministry of Economy, Trade and Industry, [7th Strategic Energy Plan](#) (accessed in April 2026); IAEA, [Power Reactor Information System](#) (accessed in April 2026).

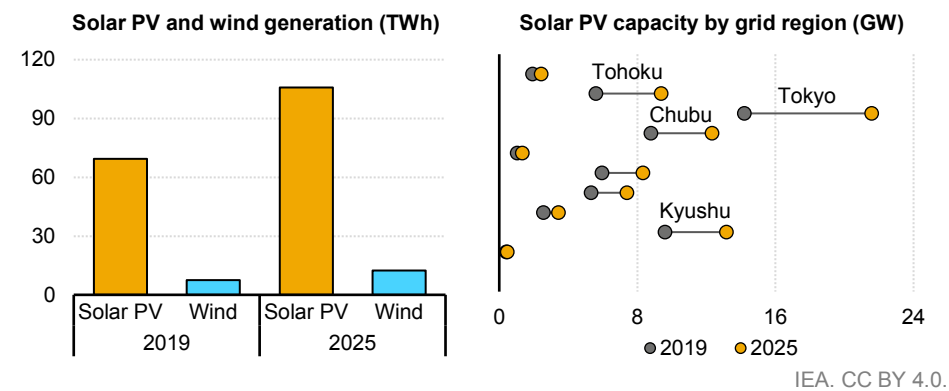
With large-scale decommissioning underway – one reactor has completed decommissioning to date (Japan Power Demonstration Reactor) and the process for 26 reactors has started or is scheduled – Japan has strengthened its institutional

framework. Since April 2024, the Nuclear Reprocessing and Decommissioning Facilitation Organization has been responsible for “decommissioning facilitation work”, including comprehensive management of decommissioning across Japan; addressing common issues faced by nuclear operators; and securing, managing and paying for decommissioning funds. Operators are required to contribute funds for these activities. While this does not replace operators’ own decommissioning obligations, it is intended to ensure consistent progress across the fleet and support the sharing of technical expertise on decommissioning practices across the industry.

Renewable energy

Renewables, including solar PV, wind, bioenergy and geothermal, supplied 9% of all electricity in Japan in 2010. This share increased to around 24% in 2024. Japan aims to further raise it to around 40-50% by FY2040. Solar PV has been the main driver of renewable development since 2010: solar PV generation increased almost ten times more than wind output between 2010 and 2024. This expansion has positioned Japan as the leader in installed solar PV capacity per land area and flat area among major solar PV countries. The following section mainly focuses on solar PV and wind; geothermal energy is discussed in the Focus area on Geothermal energy. The Energy R&D section includes a policy spotlight on perovskite solar cells.

Solar PV and wind generation in Japan and solar PV capacity by grid region, FY2019 and FY2025



Note: Regions listed in the right panel (from top to bottom): Hokkaido, Tohoku, Tokyo, Chubu, Hokuriku, Kansai, Chugoku, Shikoku, Kyushu and Okinawa.
Sources: IEA analysis based on OCCTO (2026), [Annual Reports](#), (accessed in June 2026); IEA (2026), [World Energy Balances](#).

Japan revised its renewable energy support scheme following the rapid solar PV expansion under the FIT. It has now mainly shifted toward a more market-oriented framework with the FIP scheme introduced in 2022. Under FIP, generators can receive a premium in addition to a market reference price, encouraging production in periods of high wholesale prices and system needs while limiting any burden on electricity consumers. Japan has announced that from FY2027, FIT and FIP support [will exclude ground-mounted commercial solar PV](#). METI sets FIP auction volumes [annually, considering](#): deployment targets, expected project pipelines, system constraints (grid capacity and curtailment risk), costs to consumers and market development outside FIP (power purchase agreements or merchant development).

Japan's mountainous terrain and limited land availability constrain the deployment of renewables, especially of large ground-mounted solar PV. Some projects have sparked local backlash in some areas due to land degradation concerns, safety and disaster risk worries, and insufficient early communication with residents. As a result, Japan [strengthened](#) business discipline and the enforcement of existing regulations for renewable power plants. The goal is to reinforce community engagement, improve project discipline and introduce renewable energy that coexists with local communities. METI can [suspend](#) premium payments in case of non-compliance with relevant regulations. An inter-ministerial council, established in 2025, co-ordinates policy responses around environmental damage, safety concerns and community opposition around large solar PV installations. As a first result, Japan [adopted](#) the "Mega-Solar Countermeasure Package" in late 2025. In addition, since 2024, developers of large-scale projects must organise briefing sessions for local residents before obtaining project certification and in cases of major changes such as ownership transfers.

Japan has also reformed grid connection rules toward a more pragmatic and integration-friendly approach to facilitate renewable energy deployment. Since FY2021, the government has introduced a non-firm or "connect and manage" grid access policy to enable renewables to connect without waiting for grid reinforcements. From April 2022 onward, all new renewable generators receive by default non-firm contracts, but they accept the risk of curtailment during congestion. Solar PV and wind are prioritised in the curtailment priority following a reform in 2022. While the grid connection reforms opened the grid to rapid renewable growth, physical grid limits and congestion are increasing concerns. As a consequence, transmission and distribution operators must disclose grid information such as grid capacity and supply and demand data to help developers target less congested areas. Information disclosure is not uniform and can take different shapes, including capacity maps.

Offshore wind is a strategic priority, with targets of 10 GW by 2030 and 30-45 GW by 2050, reflecting in part the limited availability of suitable onshore sites. Japan's deep coastal waters compared to other areas such as the North Sea adds complexity to offshore wind deployment. Floating offshore, which is still in its early stage of commercialisation, is particularly well-suited to these conditions. Japan aims to deploy around [15 GW](#) of floating offshore wind capacity by 2040. The first [commercial-scale floating wind farm](#) started operation in January 2026, supported by the Green Innovation Fund. Support under the Fund focuses not only on demonstration projects for floating offshore wind, but also on the development of offshore wind technologies more broadly. Japan's offshore wind strategy also targets a domestic [procurement ratio of 65%](#). In addition, Japan aims to transfer its knowledge internationally, aiming to expand the total capacity of overseas floating capacity by domestic companies to [30 GW](#) by 2040.

Japan has introduced a competitive auction framework for offshore wind under the Marine Renewable Energy Act, expanded in 2025 to include exclusive economic zone areas and centralised environmental assessments. Despite this strong policy push, Japan's offshore wind sector has faced delays and significant barriers. All three projects from the first round of the auction withdrew following cost increases related to [tight supply chains, inflation and exchange rates](#), as well as deteriorating financing conditions. The second and third rounds were characterised by aggressive zero premium bidding under the FIP scheme. The successful bids continue to face a challenging environment, with rising interest rates, inflation, currency depreciation and immature domestic supply chains. Lengthy permitting processes, limitations of government-led site surveys, grid congestion (with estimates of curtailment levels of up to 30% in [Hokkaido](#) without countermeasures), and high upfront grid connection and expansion costs further hinder development. Based on the experience of the first auction rounds, Japan plans to revise the future auction scheme to ensure the successful introduction of offshore wind in Japan's early stage of deployment while continuing to emphasise cost reduction. The close integration of industry and energy policy is also reflected in the support measures aimed at attracting manufacturing facilities of [wind power equipment](#) in Japan.

Fuels

Fossil fuels account for more than 80% of total energy supply (TES), a share that has changed only marginally over the past two decades, apart from an increase following the Fukushima accident. Japan has very limited domestic fossil fuel resources and

production remains minimal. As a result, almost all fossil fuels are imported, making energy security a central policy concern. Energy policy thus seeks to reduce reliance on fossil fuels under the GX Vision while balancing this objective against the need to ensure security of supply across all time horizons. To maintain stable supplies of oil and natural gas, Japan promotes fossil fuel exploration and production with the direct involvement of domestic companies. The government aims to raise the independent development [ratio of oil and natural gas to 50%](#) or more by FY2030 and to 60% or more by FY2040, compared with [42.1%](#) in FY2024. The Strategic Energy Plan positions fossil fuels as part of the transition energy mix, and Japan anticipates a continued role for natural gas, including as a feedstock of hydrogen production. The Focus area on Natural gas discusses natural gas in more detail.

Oil

Japan is among the top six oil importers in the world and fully relies on imports for crude oil. In 2025, it imported around 2 350 thousand barrels per day (kb/d), with the United Arab Emirates and Saudi Arabia as its main trade partners. Net trade for oil products adds another 650 kb/d, with the United States being Japan's largest supplier for oil products, followed closely by Korea. Japan also has a significant refining capacity, which mainly delivers for domestic needs.

Emissions from oil represent around 35% of all of Japan's energy-related emissions. The main users of oil are transport and industry. While oil is the biggest energy source in Japan and covers around half of total final consumption, demand continuously dropped over the ten-year period from 2014 to 2024 by more than 1 000 kb/d. The largest decline came from oil-fired power plants, as many older units have been mothballed. Other factors helped to considerably reduce oil demand. One of the success stories are Japanese hybrid cars, which boosted vehicle efficiency and have been the main driver for reducing oil consumption in transport. While the use of oil in buildings is lower compared to other end-use sectors, Japan has one of the highest level of oil consumption for heating in the world. Increasing [competitive pressure](#) is also affecting the domestic petrochemical sector, contributing to lower oil demand amid a challenging economic environment.

Ensuring a stable and reliable supply of oil remains a central priority of Japan's broader energy policy. Japan's oil strategy focuses on reducing vulnerability to global supply disruptions through the diversification of import routes and trading partners. In addition, Japan seeks to secure upstream interests by promoting oil production with the direct involvement of Japanese corporations.

Coal

Japan has a phased transition policy that places coal as a secure and economically viable energy source. Japan is almost entirely dependent on imports to meet its coal demand and is thus the world's third-largest coal importer, with imports reaching around 162 Mt in 2025. Australia is Japan's primary supplier, accounting for just over two-thirds of total imports, or 112 Mt in 2025, while Indonesia has consistently provided a significant share, supplying around 29 Mt in 2025.

Ensuring a secure supply of coal continues to be a main priority for Japan, as coal has relatively low geopolitical risks and provides security of supply due to its ease of storage. Japan has secured a large share of its imported coal through long-term contracts. While spot purchases have been more common in recent years, Japan aims to maintain a stable procurement environment, targeting a 60% share of the independent development ratio for coal.

Coal is the second-largest contributor to TES after oil and accounts for around 40% of Japan's energy-related emissions. It is mainly used for electricity generation, which represents just under two-thirds of coal consumption. The remaining third is used in industry. Between 2014 and 2024, emissions from coal combustion declined by around 75 Mt CO₂-eq, driven primarily by reduced demand in the iron and steel sector. Japan was historically the world's third-largest steel producer but fell to fourth place in 2025 as output declined to levels not seen since the late 1960s, reflecting lower domestic demand, particularly from the construction sector, and intensifying global competitive pressures.

Policy efforts to reduce coal use focus mainly on the power sector, notably through the fade-out of inefficient units and restrictions on new unabated capacity, reflecting the direction of the 2024 G7 Climate, Energy and Environment Ministers' communiqué. Existing coal-fired power plants in Japan are among the most efficient in the world, with widespread deployment of ultra-supercritical compared with around 38% for conventional plants. Coal use in power generation peaked in 2017 and declined by 10% by 2024. Progress in reducing inefficient coal-fired generation has slowed due to concerns about supply capacity shortages, as coal-fired power is considered important for grid stability due to its system inertia and ability to provide essential grid services. Japan, therefore, pursues the decarbonisation of coal-fired power generation on the premise of maintaining a secure and reliable electricity supply, including through increased co-firing of solid biofuels and ammonia and the development of fuel-switching pathways.

Japan expects coal demand to persist in hard-to-abate industrial sectors such as steel, chemicals and cement. It recognises that, from the perspective of supply and demand, steel production through the reduction of iron ore using coking coal will continue to be necessary. At the same time, the 7th Strategic Energy Plan supports the gradual deployment of decarbonisation technologies to reduce the carbon footprint of coal use in these sectors, including the promotion of hydrogen-based and other innovative steelmaking processes. Carbon capture, utilisation and storage is also positioned as an important lever for decarbonisation in sectors where electrification is difficult (see the Industry chapter).

Nuclear fuel

With no significant domestic uranium resources, Japan relies on diversified long-term import contracts with suppliers such as Australia, Canada and Kazakhstan. It also maintains strategic fuel inventories to reduce geopolitical and supply risks. Nuclear power is regarded as a quasi-domestic energy source, as it can ensure a stable and secure supply for several years based on domestic fuel stockpiles, given that nuclear reactors normally only need to be refuelled every 18 months.

Japan pursues a closed fuel cycle policy, aiming to reduce dependence on imported uranium, recover usable uranium and plutonium from spent nuclear fuel, manage waste disposal, and improve energy self-sufficiency. The Japan Nuclear Fuel Limited site in Rokkasho is the cornerstone of this strategy. Key facilities at the Rokkasho site include waste storage facilities; a uranium enrichment plant (operational); a reprocessing plant that is nearing [commercial readiness](#) after significant construction delays (under testing, awaiting approval); and a MOX fuel fabrication plant (under construction, expected around 2030).

While most enriched uranium is currently imported, Japan's sole enrichment facility received a [first delivery](#) of uranium in October 2025 for the first time in 11 years. The current production capacity is expected to increase from [150 tonnes in 2025](#) to around 450 tonnes by early 2029. Domestic capacity expansion is part of Japan's strategy to improve energy security. The planned enrichment capacity corresponds to around [15% of domestic demand](#) if nuclear electricity generation supplies around 20% of total electricity generation.

Japan started the screening process for potential geological disposal sites for radioactive waste. Radioactive waste management is an important aspect for nuclear acceptance in Japan.

Bioenergy

Bioenergy accounts for around 3% of TES in Japan, which is among the lowest among IEA countries. Solid biofuels are, by far, the dominant fuel, whereas gaseous and liquid biofuels play a minor role. Japan aims to promote the technological development of advanced biofuels, including for use in aviation, maritime and road transport. As Japan has limited domestic feedstock, it plans to [import](#) bioethanol from countries with high domestic production to meet blending targets for road transport fuels. This approach also supports the diversification of trading partners, as bioethanol supplier countries often differ from Japan's traditional oil-trading partners.

Recommendations

1 Increase technology neutrality in energy policy to promote greater cost efficiency and bolster policy stability

Japan's policy framework combines ambitious long-term climate targets with extensive technology-specific support across the innovation chain. While this has accelerated progress in priority areas such as hydrogen, ammonia, batteries, ZEBs and next-generation renewables, the strong reliance on targeted subsidies and bespoke support schemes at the commercial deployment stage risks creating uneven incentives across technologies. In several sectors, including power generation, industrial decarbonisation and end-use electrification, support is tied to predetermined technology pathways rather than performance or cost-effectiveness. This can weaken competition, slow the adoption of emerging low-cost solutions, and reduce the system's ability to adapt as technologies and market conditions evolve.

To address these challenges, Japan could expand the use of technology-neutral, competitive mechanisms that allow a broad set of low-emission solutions to compete on equal terms. For example, the rules of Japan's low-carbon capacity auctions could be modified so that various technologies providing firm, flexible or dispatchable capacity would compete based on cost and emissions performance. Another example is technology-neutral industrial decarbonisation pathways that would support emissions reductions at least cost rather than through predetermined fuels or processes. Strengthening carbon-intensity and performance-based requirements in public support schemes, and ensuring that pricing instruments – such as Emissions Trading System design, incentives and auctions – are neutral between eligible

technologies, will further encourage efficient outcomes. These tools can coexist with targeted R&D support, but deployment-stage instruments should increasingly rely on open competition.

A more technology-neutral approach would improve cost efficiency, minimise the risk of over-compensation and avoid premature lock-in to higher cost pathways. It would enhance investor confidence by providing stable, predictable mechanisms insulated from shifts in specific technology preferences, and ultimately help protect consumers by ensuring that scarce public resources are allocated where they deliver the greatest emissions reductions per yen spent. By strengthening competition and focusing support on performance rather than prescribed technology choices, Japan can accelerate its transition while maintaining affordability and policy stability.

2 Strengthen alignment across the innovation ecosystem, in both the public and private sectors

Japan has long been a global leader in energy and industrial innovation, underpinned by substantial public investment; strong corporate R&D capacity; and a dense network of universities, research institutes and technology platforms. As the scope and complexity of the energy transition expand – encompassing digitalisation, electrification, hydrogen, CCS, advanced materials and system integration – ensuring strong alignment across the innovation ecosystem becomes increasingly important to sustain momentum and maximise impact.

Building on its existing strengths, Japan could further enhance co-ordination and information-sharing across ministries, agencies and programmes, with a view to strengthening continuity along the full innovation chain, from basic research and applied R&D to demonstration, early deployment and market formation. Strengthening strategic oversight of energy-related R&D funding and clarifying linkages between large public funding instruments, such as the Green Innovation Fund, sectoral GX initiatives and longer term industrial strategies, would help reinforce predictable development pathways and crowd in private investment.

Encouraging interdisciplinary and cross-sector collaboration – bringing together engineering, digital technologies, system integration and social sciences – would further support the development of integrated solutions suited to future energy systems. Deepening structured dialogue between public authorities and private actors, including established firms and emerging innovators, can help ensure that innovation priorities remain responsive to technological progress and market developments.

A more closely aligned and collaborative innovation ecosystem would support the timely commercialisation of strategic technologies, strengthen public-private partnerships and enhance Japan's ability to deploy competitive low-carbon solutions domestically while contributing to global decarbonisation through international markets and standards.

3 Pursue greater policy stability to improve predictability of costs and revenues to support expanding investment in the power sector

Japan's electricity system is undergoing a profound transformation as renewable energy expands, electricity demand rises with electrification and digitalisation, and thermal generation operates with declining utilisation rates. Meeting the ambitions of the 7th Strategic Energy Plan will require substantial new investment in clean sources of electricity, long-duration storage, system flexibility and transmission infrastructure. Frequently adjusting market rules reflects the system's rapid evolution, but can make long-term revenue expectations more complex for investors. Overlapping support schemes and some constraints on price formation are additional factors that reduce the predictability of costs and revenues, which can discourage capital-intensive projects and slow the replacement of ageing assets.

To strengthen predictability and improve investment conditions, Japan should streamline co-ordination across the capacity, spot and balancing markets and ensure these mechanisms send consistent, technology-neutral signals for new resources. This includes expanding market access for storage, demand response and other flexibility providers, and reducing distortions by allowing a more complete expression of scarcity pricing, such as increasing the upper limit on spot market bid prices and enabling negative prices. These changes, together with stable long-term market design and transparent timelines for reforms, would help investors assess revenue streams more confidently and manage project risk more effectively.

Greater policy stability and a clearer investment framework would support continued deployment of clean and flexible resources, support cost-efficient achievement of the 7th Strategic Energy Plan's goals and reduce the long-term cost of capital for essential power sector infrastructure. Over time, this would strengthen system reliability; lower consumer costs; and allow nuclear, renewables and storage projects to scale at the pace required to achieve Japan's energy security and decarbonisation objectives.

4 Further enhance electricity grid development with a focus on incentivising grid modernisation and streamlined grid connection processes

Japan's power system is entering a period of growth driven by electrification, data centre expansion and the scaling up of renewable energy. However, long lead times for grid upgrades, limited regional interconnection and protracted grid connection approval processes risk slowing the integration of wind, solar PV and battery storage. Existing grid assets remain heavily constrained and operational practices continue to evolve to better support the flexibility needs of a system with significantly higher shares of variable renewables. Without clearer investment signals and faster connection procedures, transmission bottlenecks and curtailment risks will likely increase, raising system costs and undermining the reliability and economic efficiency of the energy transition.

This can be addressed by strengthening incentives for transmission and distribution operators to modernise existing assets and expand grid capacity where it delivers the greatest system value. Performance-based regulation and targeted investment frameworks can help accelerate reinforcement projects, digitalisation and grid modernisation, covering next-generation equipment replacement as well as data-driven asset utilisation and operational optimisation. At the same time, streamlining grid connection procedures for new large loads (such as semiconductor facilities and data centres) and new sources of electricity and storage will be essential. Establishing clearer timelines, more transparent processes and strengthened co-ordination with OCCTO can significantly reduce delays and increase grid connection certainty.

The combination of these measures would bolster electricity security, lower integration costs and support the faster deployment of renewables and storage. A more modern, agile grid will also improve affordability for consumers by reducing congestion, curtailment and unnecessary investment, and will provide the backbone for Japan's broader decarbonisation and economic growth ambitions.

5 Establish clear timelines for deploying new nuclear projects, including licensing for large-scale and small modular reactors, and continue the prioritisation of nuclear restarts

Nuclear power plays a vital role in Japan's energy transition, as the country retains deep industrial and regulatory expertise across the nuclear value chain. Japan has made important progress recently in restarting reactors after rigorous safety reviews. The IEA praises the government for its efforts to engage local stakeholders and raise public awareness and acceptance of nuclear power. Ensuring continued progress on reactor restarts remains critical, provided that all safety requirements and local community engagement processes are fully met.

In addition to restarts, Japan's electricity system will require new nuclear projects to meet growing demand (including round-the-clock supply for data centres and energy-intensive industries), replace nuclear reactors that are eventually retired and ensure system reliability. However, long project lead times and uncertainties surrounding the extensive licensing process for each reactor, including design approval, create uncertainty for investors and limit the potential contribution of nuclear energy. To address these challenges, Japan should establish clear and transparent timelines for licensing milestones and the deployment of large-scale reactors and emerging SMR technologies. Strengthening policies to support innovative financing models, nuclear workforce development and domestic supply chain resilience, including nuclear fuel security, can further reduce project risks and improve deliverability.

Greater clarity on nuclear deployment timelines would facilitate timely investment decisions and improve long-term system planning. This would support the delivery of the new nuclear capacity needed to complement renewable energy, meet growing electricity demand and ensure the availability of 24/7 low-carbon power. Over time, it would help Japan maintain industrial leadership, strengthen energy security and provide reliable foundations for an electrified, digitalised economy.

6 Accelerate road transport decarbonisation through a strategic mix of sustainable biofuels, electrification, charging infrastructure and smart charging

Japan has adopted a comprehensive and flexible approach to decarbonising transport, pursuing a range of technological pathways including BEVs, hybrids and plug-in hybrids, FCEVs, and the use of low- and zero-carbon fuels. This strategy reflects Japan's specific circumstances, including energy security considerations, industrial structure and the importance of reducing emissions from the existing vehicle stock, and is intended to mitigate the risks associated with reliance on a single technological solution.

At the same time, the breadth of policy support across multiple vehicle technologies and fuels implies significant and growing demands on public finances and infrastructure development. In this context, it becomes more important to ensure that policy instruments are guided by transparent assessments of life cycle emissions impacts, cost-effectiveness and system value. Strengthening such assessments would help clarify the respective roles of different pathways over time while preserving flexibility and technological neutrality.

In road transport, Japan's long-standing fuel-efficiency standards and support for hybrid vehicles have delivered substantial reductions in fuel consumption and oil dependence. However, as efficiency gains from conventional and hybrid powertrains approach technical limits, further emissions reductions after 2030 will increasingly depend on a higher uptake of vehicles capable of operating with zero tailpipe emissions and on continued reductions in the carbon intensity of electricity supply. Closer alignment between transport electrification policies and power sector decarbonisation trajectories will, therefore, be essential to maximise the climate benefits of vehicle electrification.

Regulatory and fiscal frameworks that continue to favour compact, efficient vehicles, including Kei cars – and that increasingly differentiate in favour of zero-emission variants within this segment – can provide a cost-effective lever to accelerate electrification while maintaining affordability for households. At the same time, the continued roll-out of charging infrastructure will be a critical enabler of transport

electrification. Ensuring that charging infrastructure planning and support schemes explicitly take into account local needs will be important to ensure equitable access to electrification and avoid reinforcing regional disparities.

Japan's strategy for FCEVs and hydrogen infrastructure is explicitly focused on commercial vehicles and geographically concentrated deployment, reflecting infrastructure costs, utilisation challenges and hydrogen supply constraints. Maintaining this targeted approach while regularly reviewing progress against utilisation, cost and emissions benchmarks would help ensure public support is aligned with realistic market development and emissions-reduction outcomes.

Finally, low fuel taxation and extensive purchase and infrastructure subsidies mean that public support currently plays a significant role in transport decarbonisation, with comparatively less reliance on price-based incentives. Over time, closer alignment between fiscal measures, emissions objectives and technology performance could help gradually rebalance the policy mix, reducing reliance on subsidies while maintaining affordability.

Strengthening evaluation, transparency and sequencing within Japan's multi-pathway transport strategy would thus help maximise emissions reductions, contain public costs and support an orderly transition consistent with Japan's energy security, industrial and climate objectives.

7 Develop a roadmap and implement measures to achieve zero-energy buildings by 2050

Japan has taken major steps to strengthen efficiency requirements for new buildings, yet the existing building stock (much of it constructed before modern insulation standards) remains far from aligned with the country's 2035, 2040 and 2050 climate objectives. Renovation rates are currently limited, and heat pump deployment and building automation uptake are progressing more slowly than needed. A long-term, co-ordinated strategy would help ensure that efficiency gains in new construction are complemented by steady improvements in the existing building stock.

Developing a clear ZEB-by-2050 roadmap would help align regulatory measures, financial incentives, information tools and workforce development, providing predictable signals to households, developers and industry while allowing flexibility in how performance outcomes are achieved. It would provide a structured pathway for progressively raising buildings' performance requirements and benchmarks at points

of sale or lease (including demand-response requirements for appliances and equipment); accelerating deep renovations; and expanding the adoption of high-efficiency heat pumps, digital controls and other sustainable heating and cooling solutions. The roadmap should define milestones for 2030, 2035 and 2040; outline renovation trigger requirements and workforce training programmes; and integrate financial support for low-income households. Continued strengthening of energy performance disclosure and consumer awareness would also drive demand for high-performance buildings.

A comprehensive ZEB roadmap, and its effective implementation, would lower energy bills, reduce peak electricity demand and facilitate the integration of renewable energy. It would give industry, local governments and households the clarity and confidence needed to mobilise investment at scale, supporting Japan's broader goals for energy security, resilience and carbon neutrality.

Focus areas

Natural gas

Strategic role of natural gas

Natural gas remains a central element of Japan's energy strategy, accounting for 21% of its primary energy (FY2024). LNG supplies 33% of electricity generation and nearly all city gas. Japan relies almost entirely on imported LNG, reflecting limited domestic resource availability and geographic constraints. This import dependence places security of supply at the heart of Japan's gas policy. At the same time, another key policy objective is reforming the gas market to improve efficiency, increase competition and lower prices for consumers. These two objectives do not always move in the same direction, as measures to enhance security of supply – such as diversification, redundancy or long-term contracting – can entail higher costs. Nevertheless, some policies can support both goals: a more flexible and competitive market does not automatically increase physical resilience, but it can contribute to energy security by enabling more efficient use of infrastructure, encouraging innovation, and facilitating more diversified and responsive sourcing of gas.

The 7th Strategic Energy Plan positions gas as an “important energy source”, even as Japan pursues carbon neutrality by 2050, reflecting the government's view that a secure and affordable transition requires a pragmatic role for LNG alongside accelerating the deployment of renewables, nuclear power, hydrogen and CCS. As of 2023, 57% of imported LNG was used for power generation, 37% for city gas, and the remainder for other uses such as vehicles and gas-fired air conditioning. This end-use structure reflects LNG's strategic importance for electricity adequacy and for household and industrial gas supply.

The Outlook for Energy Supply and Demand in FY2040 projects the primary energy supply of natural gas to be 53-61 Mt (LNG-equivalent) under a scenario in which a 73% reduction in GHG emissions is achieved. However, in an alternative scenario where slower technological progress leads to a lower level of decarbonisation (around a 61% reduction), natural gas supply is estimated to increase to around 74 Mt. Given that Japan relies almost entirely on LNG imports for its natural gas supply, these projections imply a similar range for LNG import demand. This scenario-based outlook recognises that gas demand may remain structurally significant if renewables, hydrogen or CCS deployment lags, and reinforces why Japan continues to prioritise secure LNG procurement and infrastructure resilience in parallel to decarbonisation.

Supply chain fundamentals

Japan's gas system is structurally different from many pipeline-connected markets. Its resilience depends heavily on LNG terminals, tank storage and shipping logistics rather than pipelines and large-scale underground storage. Japan has 45 receiving terminals with relatively low terminal utilisation (around 30% on a vaporiser capacity basis), indicating valuable redundancy for supply security and potential scope for optimising this capacity for more efficient use of assets.

Given Japan's mountainous geography and dispersed coastal demand hubs, building a nationwide pipeline network has been economically challenging. High-pressure pipelines (over 1 megapascal) total approximately 2 500 kilometres (km). City gas services cover only about 6% of Japan's land area, but [nearly 50%](#) of all households and business establishments.

Security of supply

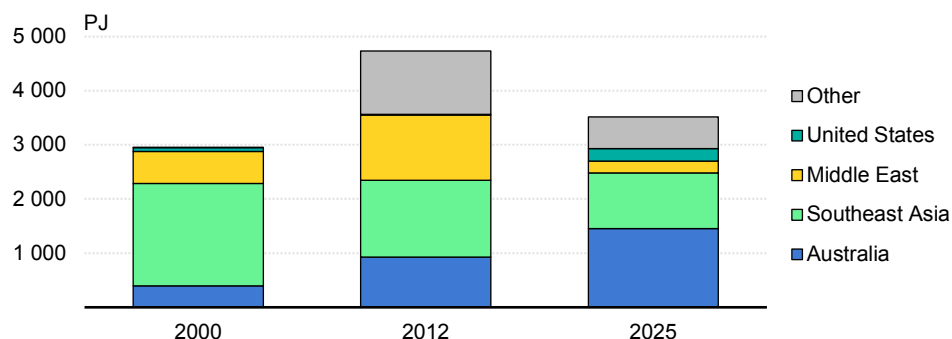
In the Japanese context, this report defines security of gas supply as the ability to ensure reliable procurement of natural gas at affordable prices under normal market conditions as well as during periods of stress. Security of supply involves inherent trade-offs between reliability, affordability and cost. It, therefore, encompasses three key dimensions. First, it distinguishes between levels of security measures: 1) those delivered through market-based, commercial arrangements; 2) those that enhance resilience but involve additional system costs; and 3) those that are mandated or supported by government intervention, often to manage low-probability but high-impact risks. Second, it recognises different time horizons, ranging from short-term security (operational reliability and emergency response over the next few years) to long-term security (investment, diversification and system resilience over a 10-20-year horizon).

Japan's commitment to gas supply security has been relatively consistent across different governments. Key strategies for ensuring a stable supply of LNG include diversification of supplies, equity participation in LNG projects overseas, long-term contracts, enhancements to procurement practices to increase contractual flexibility, utilisation of tank facilities abroad, joint procurement and strengthening of trading, Strategic Buffer LNG (SBL), and developing LNG frameworks and education in growing Asian markets.

Supply diversification and equity participation

Japan's LNG import portfolio is broadly diversified across regions, with approximately 40% from Australia – a result of energy security strategy to avoid over-reliance on Middle East suppliers and leverage Japanese equity in Australian projects, low geopolitical risks and short transportation distances. In 2025, Japan imported approximately 65 Mt of LNG from Australia, Malaysia, the United States, Indonesia and Qatar, among others. This portfolio diversification reduces dependence on any single supplier, but Japan remains exposed to global oil-indexed contract pricing and spot market volatility, shipping constraints, and potential disruptions in key maritime chokepoints. Qatar and the United Arab Emirates provide about 6% of supply via the Strait of Hormuz and Oman provides about 4%.

Japan's LNG imports by region, FY2000, FY2012 and FY2025



IEA. CC BY 4.0.

Source: IEA (2026), [Natural Gas Information](#).

While Australia has been Japan's key LNG supplier, evolving policies including domestic gas security measures and tightening emissions requirements have increased uncertainty about the future availability of Australian LNG exports.

In addition to contracting, Japan has long pursued upstream equity participation in LNG projects as a strategic instrument to secure supply and reduce vulnerability to market shocks. The Japan Organization for Metals and Energy Security provides equity injection, financial guarantees and technical assistance to support Japan's overseas interests, and co-invests equity in LNG projects alongside Japanese companies, providing “risk money” to secure supply. The Japan Bank for International Cooperation provides financing for LNG projects. The Nippon Export and Investment Insurance provides insurance to Japanese companies in overseas transactions. These public funds help lower the barriers to investment and encourage private Japanese companies and banks to participate in gas liquefaction projects. This approach contributes to strengthening Japan's bargaining position, diversifying procurement channels and improving long-term predictability of volumes. Japan has “independent development ratio” targets: by 2030 and 2040, it aims for 50% and 60% or more, respectively, of its oil and gas supply to come from projects in which Japanese companies have upstream ownership stakes (including any domestic production), [from 42.1% in FY2024](#). This underlines the relevance of upstream participation within Japan's broader security strategy.

Although the Middle East energy crisis blocked LNG supplies from the region coming to the market, over the medium term, Southeast Asian countries may still turn to LNG as a cleaner backup for renewables, with demand expected to grow as spot prices fall towards 2030. The region needs enhanced systems to support a robust LNG supply chain. Japan, with its global LNG expertise, can offer financial and technical support for upstream investments and LNG facilities in Southeast and South Asia, while sharing operational and safety know-how. Japan develops educational programmes centred on LNG handling, legal frameworks and regulatory standards in Asia and other regions where energy demand is growing.

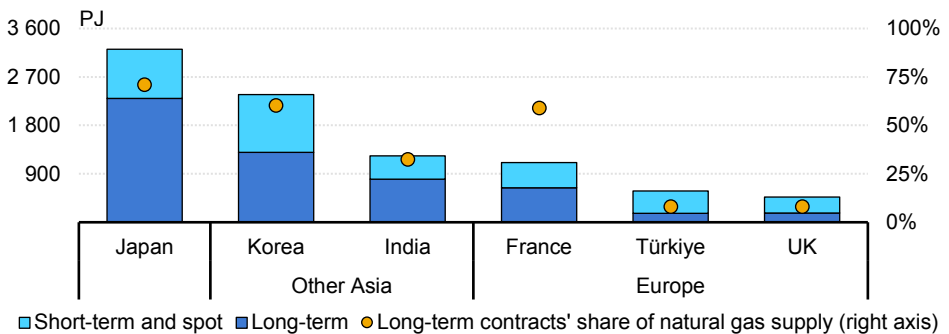
Long-term contracts

Japan's cumulative long-term contract volumes represent one-third of the world's LNG liquefaction capacity (excluding portfolio players). The 2022 energy crisis caused global LNG prices to surge, with gas prices in Germany rising sixfold while prices in Japan remained more stable. This was largely due to Japan's reliance on long-term contracts linked to crude oil prices. Europe's spot LNG share has increased to around 50% since the 2022 crisis, whereas Japan's spot share has stayed near 20%.

Japan expects to continue its emphasis on long-term contracts to ensure adequate volumes and reduce exposure to future tightening market conditions. The IEA's *World Energy Outlook 2025* reports that investment in new oil and gas fields has dropped

sharply over the past decade, with global exploration spending expected to remain around USD 50 billion in 2025 – about half of the level in 2015. According to METI’s outlook, new investment will be needed after the mid-2030s to meet global LNG demand. This underpins Japan’s strategy to prioritise long-term contracts to stimulate upstream investments.

Long-term LNG contracts and overall imports in Japan and selected countries, FY2025



IEA. CC BY 4.0.

Notes: Long-term contract amounts are LNG received under a contract with a duration of more than four years. UK = United Kingdom.
Sources: IEA analysis based on GIIGNL (2025), [GIIGNL Annual Report](#), (accessed in May 2026); IEA (2026), [World Energy Balances](#).

At the same time, Japan’s buyers increasingly operate in a context of demand uncertainty: nuclear restarts, renewables growth and electrification trends can limit gas demand; procurement strategies, therefore, need to balance long-term security with flexibility. Some LNG contract clauses have historically constrained resale and optimisation, and policy attention has focused on ensuring contractual flexibility compatible with competition and security goals. The Gas market reform section discusses contractual flexibility in more detail.

Transportation and maritime security

LNG shipping is a critical component of energy security for all LNG-importing countries, including Japan. While global LNG carrier construction capacity is currently sufficient, it is concentrated in a limited number of countries. Japan’s reliance on seaborne energy imports also underscores the importance of secure and efficient

maritime routes. As with other LNG-importing countries, risk assessments consider potential disruptions at key chokepoints (such as the Strait of Hormuz). Japan's diversified LNG procurement strategy, combined with measures such as contractual flexibility, adequate storage and well-functioning LNG terminal operations, supports the resilience of its supply system.

Storage

Japan's gas resilience relies heavily on LNG tank capacity at terminals, which acts as an operational buffer (11.6 billion cubic metres [bcm], which is equivalent to approximately 46 days of domestic gas consumption) but they cannot be operated at 100% capacity in practice. Initiatives to increase usable storage capacity must respect operational requirements such as the need to maintain headroom for the next cargo, retain mandatory heel volumes and manage quality/safety constraints. Constructing new LNG tanks within existing LNG-receiving terminals offers cost advantages compared to building new LNG-receiving terminals or installing floating storage and regasification units. Saibu Gas and JERA are collaborating to add LNG tanks to LNG-receiving terminals and use them for trading purposes. Use of unused tanks as storage tanks (e.g. at the Bontang LNG terminal) can be a cost-effective solution. In the past, Kyushu Electric Power Company used idle tanks at the Arun LNG terminal in Indonesia as storage tanks.

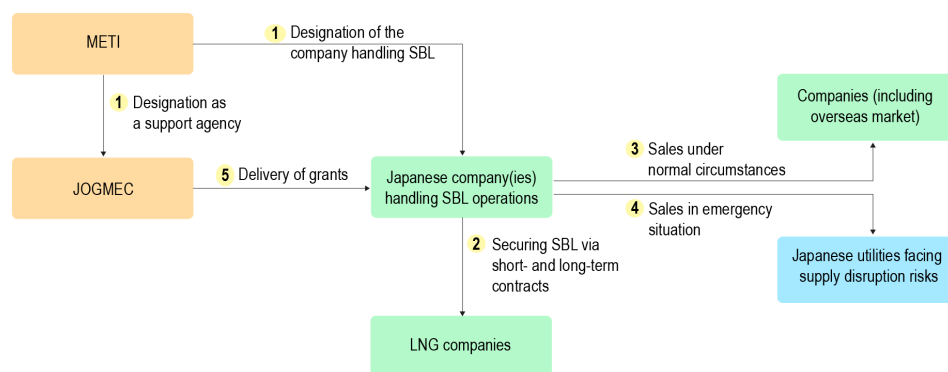
Japan has small underground gas storage facilities in depleted fields, with a total capacity of just 0.1 bcm due to its unsuitable geology and remote locations. Southeast and South Asia, where energy demand is rising, have more depleted fields that could be used for regional storage with Japanese support. Japan could even consider developing regional swap agreements, as recent developments have increased market liquidity, facilitated swap transactions and improved options for short-term, hub-based storage.

Emergency response and strategic reserves

Japan lacked emergency response legislation for gas and LNG until the cold wave in early 2021, which prompted the creation of guidelines to ensure fuel supply during high demand and improve transparency. The plan includes updating LNG procurement, disclosing tank limits, forecasting supply and demand, monitoring inventories, and implementing government-led fuel arrangements. The Gas Business Act was amended after the 2022 energy crisis to allow METI to restrict gas usage for large consumers during supply shortages. The Information disclosure section provides additional information on energy security measures.

The SBL is one of Japan's key instruments. It provides a mechanism for additional LNG procurement and storage as a resilience measure. Under the SBL policy, METI designates private LNG operators with extra procurement capacity to manage SBL operations. If a supply issue occurs, these companies are requested to sell LNG to utilities at risk, with government compensation for losses and costs. JERA became the first designated supplier in November 2023. Initially, the scheme was only applicable for three months in winter, but was expanded to a year-round basis in January 2026.

Operation of Japan's Strategic Buffer LNG



IEA. CC BY 4.0.

Source: IEA (2024), [Secure gas and LNG value chains call for greater international co-operation](#).

Gas market reform and competition

Overview

Since 2017, Japan's gas market reform has aimed to secure stable supply, lower prices through competition, expand consumer choice and uses for natural gas while recognising the unique structure of Japan's gas sector. The Amended Gas Business Act (April 2017) split "general gas utilities" (businesses that supplied city gas through pipelines) into producers, pipeline operators and retailers, each requiring separate notification and licensing.

To support network development and supply stability, pipeline operators continue to operate under regional monopolies and price regulation while being required to facilitate interconnection and, if necessary, comply with government orders to resolve disputes.

To boost third-party access, the three largest gas companies (Tokyo Gas, Osaka Gas and Toho Gas) are barred from operating pipelines alongside production and retail, with legal unbundling effective from April 2022; other companies retain separate accounts. Each operator must ensure pipeline safety and co-operation rules are in place for disaster response, with regular training to maintain resilience post-liberalisation.

Japan has introduced measures to support competition in wholesale supply. The “Start Up Wholesale” initiative was launched in FY2020 as a voluntary measure by former general gas utilities to support new entrants into household retail gas markets, including through “one-touch wholesale” arrangements. According to METI, 27 start-up wholesale contracts have been concluded to date, and the government continues to monitor the implementation.

Gas retail has been fully liberalised, ending former monopolies and allowing new entrants. This encourages competition, cuts costs and benefits consumers. Retail price controls have mostly been abolished, though transitional regulations remain where competition is limited. METI is assessing the gas market reform, and the results of this review are expected to inform any further adjustments.

Japan’s unbundling of gas infrastructure and the introduction of third-party access to LNG terminals aim to spur competition and lower prices. These reforms improve efficiency and consumer choice and can also have a positive impact on resilience: a more open market can encourage innovative sourcing (including portfolio LNG sellers), which over time might enhance security through diversification.

LNG terminals and third-party access

Japan has already introduced a formal third-party access regime for LNG terminals as part of its gas system reform. Operators of LNG terminals above a certain scale are required under the Gas Business Act to file terms and conditions for gas-tolling services. An annual outlook for spare capacity is disclosed in accordance with Article 90 of the Act and Article 142(2) of its Enforcement Ordinance. Guidelines on proper gas trade also set out desirable transparency practices, including quantitative disclosure of spare capacity under room-rent and room-share methods,⁴ prompt

⁴ Room-rent method: Spare LNG tank capacity is calculated and disclosed on the basis of tanks (or parts of tanks) that can be “rented” by third parties. Room-share method: Spare capacity is calculated by assuming shared use of LNG tanks, with available capacity derived from average inventory levels and operational margins.

presentation of indicative charges once confidentiality agreements are concluded, and calculation of charges based on fee standards reflecting average inventory levels and tank occupancy.

In practice, while the effectiveness of third-party access is improving, there is room for further progress. According to METI, there were 24 third-party use requests/applications for LNG-receiving terminals as of 2025, up from 2 in 2016. Capacity disclosures are often aggregated and not always sufficient for prospective users to assess terminal-level availability, inventory conditions or likely costs. Access conditions continue to be negotiated bilaterally, which raises transaction costs for new entrants and reduces comparability across terminals. Improving the granularity and consistency of information, especially terminal-level inventories and use, would strengthen the practical functioning of the existing third-party access framework and help ensure that the system's sizeable LNG infrastructure base supports security and competition, leading to lower prices for consumers. Reporting should distinguish between requests/applications and concluded arrangements, recognising that outcomes depend on operational constraints and contract structures.

Where disputes arise over third-party access, parties can request mediation or arbitration by the Electricity and Gas Market Surveillance Commission (EGC). The EGC was established under METI; its chair and commissioners hold the authority for report collection, onsite inspections, recommendations and formal dispute resolution. To date, there have not been any cases of formal mediation or arbitration related to LNG terminal third-party use. However, some operators have approached ANRE and/or the EGC for consultations regarding third-party use arrangements. This underlines the importance of transparent information and predictable processes that reduce the need for case-by-case escalation.

Contractual flexibility

Current long-term contracts pose challenges for Japanese buyers, especially regarding flexibility in trading surplus LNG. In 2017, the Japan Fair Trade Commission found that some LNG contract clauses – such as destination restrictions, unreasonable profit-sharing requirements and certain take-or-pay terms – may violate the Antimonopoly Act in cases where they unfairly hinder switching after investment recovery. Most of Japan's long-term LNG contracts include take-or-pay terms, which are integral to LNG project economics. Future contracts could seek more flexibility while maintaining mechanisms that underpin investment and safe operations. For example, flexibility could increase once initial capital costs are recovered.

Information disclosure

Information disclosure in the natural gas sector plays an important role in supporting effective regulation, enabling competition and ensuring system preparedness. However, the appropriate scope and granularity of disclosure depend on its intended purpose and must reflect Japan's specific market structure, policy objectives and security considerations. Transparency objectives related to system-level adequacy and emergency preparedness differ from those related to commercial price discovery and market entry. They should, thus, be dealt with separately.

Japan has established a framework for gas sector transparency through the Gas Business Act and related regulations. They call for updating of LNG purchase and delivery plans, especially during periods of high demand, to ensure appropriate inventory levels; publicly disclosing LNG tank operation limits; preparing electricity supply and demand forecasts incorporating the latest weather forecasts and Japan Electric Power Exchange trading volume estimates; disclosing fuel constraint information through the Power Generation Information Disclosure System (HJKS) and monitoring fuel inventories, among other measures. In addition, government authorities conduct supply risk assessments and co-ordinate preparedness measures with market participants. These arrangements primarily support security of supply.

Information disclosure in a country or region can bring benefits beyond the immediate area covered. In particular, this applies to information related to inventory levels, which not only provides transparency to market participants, but also supports supply security assessments on a broader scale, particularly in times of market tightness. Increased transparency bolsters market confidence and aids resilience because it enables swifter response to supply issues and allows governments and industry to identify risks early and co-ordinate. In principle, measures should be designed with safeguards to avoid revealing commercially confidential data of individual companies.

In Japan, the EGC collects information necessary for monitoring gas transactions and publishes area-level data such as sales volumes, number of contracts and switching rates. Japan currently does not have a widely used public LNG price assessment that reflects import costs and can support benchmarking, contract negotiations and hedging. In the future, as the procurement mix evolves toward more flexible contract structures, Japan could consider more enhanced reporting of LNG import price information and the publication of a Japanese LNG price assessment, with appropriate safeguards for commercially confidential data. This would strengthen price discovery and encourage more effective competition among suppliers and retailers.

Decarbonising gas

Japan's 7th Strategic Energy Plan states that it is important to build a gas system that contributes to decarbonisation and that various approaches will be combined to achieve carbon neutrality in city gas by 2050, including the introduction of e-methane and biogas. The government has highlighted hydrogen derivatives – including e-methane and e-fuels – as part of a broader transition strategy, and has indicated that integrated regulatory and support policies will be used to reduce costs and expand use. The logic is that low-carbon gaseous fuels could leverage parts of existing infrastructure while reducing life cycle emissions, although scale, cost and certification remain significant challenges.

Reducing methane emissions across the LNG value chain is also becoming more prominent internationally. Japan supports the Coalition for LNG Emission Abatement toward Net-zero, a voluntary, market-based mechanism to reduce methane emissions through transparency and the sharing of best practices across the LNG supply chain. Strengthening methane emissions measurement and disclosure can complement Japan's gas security strategy by improving environmental performance and reducing reputational and trade risks as global methane policy tightens. See the Fuels section and the Focus area on Hydrogen and ammonia for more detailed discussions of low-carbon fuels.

Recommendation

8 Enhance transparency and access conditions to support effective competition while safeguarding security of supply

Japan has built a robust natural gas supply system with a strong and consistent focus on security of supply, reflecting its near-total dependence on imported LNG and exposure to global market and geopolitical risks. Through long-term contracting, diversified sourcing, extensive LNG terminal infrastructure and strategic buffer arrangements, Japan has demonstrated a high level of resilience, including during recent periods of global gas market tightness. These achievements underscore the central role of security considerations in gas policy and the importance of maintaining measures that may entail additional costs but deliver reliability. Building on this solid foundation, well-designed transparency and access frameworks can play a complementary role by enabling effective competition and supporting regulatory oversight, provided they are carefully calibrated to Japan's market structure and security objectives.

Japan has already implemented a legal framework for third-party access for LNG terminals, annual disclosure of spare capacity, and the establishment of a market regulator responsible for oversight and dispute resolution. These measures form a solid legal and institutional foundation. Practical use of the framework has progressed, with METI reporting a growing number of third-party requests/applications. It has also concluded wholesale arrangements. However, information disclosure remains constrained in practice, limiting new entrants' ability to assess available capacity, compare access conditions or optimise LNG procurement. Japan can enhance its framework by extending disclosure requirements and broadening access to information. Targeted transparency, such as more frequent disclosure of spare capacities, terminal-level inventories in low-competition regions, utilisation rates, and overviews of third-party access requests, would lower transaction costs for new entrants and help regulators better monitor markets, spot barriers to entry and co-ordinate during supply stress.

Where access issues persist in regions with limited competition, authorities should enhance third-party access frameworks so that they operate in a transparent, non-discriminatory and effective manner while recognising that operational constraints and long-term contractual arrangements may legitimately limit access in some cases. Greater clarity around access conditions, processes and outcomes can improve confidence in market governance and increase competition without undermining security of supply arrangements. In parallel, introducing reporting obligations for LNG import prices and developing a Japanese LNG price assessment that maintains necessary commercial confidentiality would improve wholesale price transparency.

More effective access to LNG infrastructure could potentially foster greater competition, lower procurement costs and support more efficient use of existing LNG capacity. Over time, as the procurement mix evolves toward more flexible contract structures, improved transparency and access frameworks would enhance Japan's gas market resilience, provide clearer price signals to market participants and ultimately benefit consumers through a more competitive, efficient and secure gas system. Regular review of disclosure practices and access outcomes can help ensure that they are proportionate and effective, aligned with market realities, and responsive to evolving risks and opportunities.

Hydrogen and ammonia

Strategic role

Japan has been a global pioneer in hydrogen and ammonia policy, having published the world's first national hydrogen strategy in 2017. Since then, the government has steadily expanded and refined its policy framework, which includes the revised Basic Hydrogen Strategy (2023) and the Hydrogen Society Promotion Act, which entered into force in October 2024. Hydrogen and ammonia are positioned as central components of Japan's Green Transformation, supporting the simultaneous objectives of energy security, economic growth and decarbonisation under the S+3E principle.

Japan's hydrogen strategy reflects the structural characteristics of its energy system. The country is highly dependent on imported energy, has limited domestic fossil fuel resources, and hosts a large industrial base with significant energy demand and several hard-to-abate processes. In this context, hydrogen and ammonia are envisaged as complementary options within a multi-pathway transition, alongside renewables; nuclear power; energy efficiency; electrification; and carbon capture, utilisation and storage.

Japan's hydrogen demand is currently almost entirely met by hydrogen produced from unabated fossil fuels, which is mainly used in industry. Total supply is approximately 1.8 Mt per year, largely produced from natural gas reforming or as industrial by-products and consumed onsite within refineries and petrochemical facilities. Ammonia is currently mainly used as fertiliser and chemical feedstock.

Japan's hydrogen strategy envisages deployment across multiple sectors. In the power sector, hydrogen and ammonia are expected to contribute to dispatchable capacity and system flexibility during the transition, complementing the expansion of variable renewables and supporting energy security. In industry, hydrogen and ammonia are seen as key options for decarbonising processes such as steelmaking, chemicals and refining, where full electrification may be technically challenging or costly. In transport, hydrogen has been promoted for fuel-cell vehicles and heavy-duty applications, while hydrogen-based fuels are being explored for shipping and aviation. Looking ahead, clearer articulation of how hydrogen deployment is expected to evolve across sectors, particularly as electrification, storage and other low-carbon options advance, could help guide investment and ensure that hydrogen delivers maximum system value over time.

Policy framework

Japan's hydrogen policy is anchored in a stable legal and institutional framework. The revised [Basic Hydrogen Strategy](#) sets hydrogen supply targets of about 3 Mt per year by 2030, 12 Mt by 2040 and 20 Mt by 2050. While the targets are technology-neutral (applicable to any type of hydrogen), the Strategy introduces parallel policy mechanisms to steer the mix toward low-emissions hydrogen. Recognising that cost is one of the main barriers to widespread hydrogen and ammonia adoption, [Japan's Long-term Strategy under the Paris Agreement \(2021\)](#) and the revised Basic Hydrogen Strategy set up hydrogen supply cost objectives of 30 JPY per normal cubic metre (Nm³) by 2030 and 20 JPY/Nm³ by 2050 from around 100 JPY/Nm³ today.

Japan's stepwise approach emphasises early market creation and scale while gradually decarbonising existing hydrogen supply. The government is seeking to stimulate demand across multiple sectors, including power generation, industry and transport, on the premise that large volume deployment would enable cost reductions, infrastructure development and learning effects across the hydrogen value chain. The Strategy also aims to position Japanese companies as leaders in emerging global hydrogen and ammonia markets.

At the same time, Japan expects a large share of its future low-emissions hydrogen supply to come from imports. To support the scale-up of supply and improve cost competitiveness, Japan is actively developing international supply chains, notably an [ammonia project in the United States](#), in which Japanese firms hold significant equity stakes. Japan is also strengthening co-operation with other demand-side countries, such as Germany, through memoranda of understanding that cover hydrogen distribution, liquefied hydrogen stations and industrial applications. Japan also develops bilateral partnerships (Australia, the Middle East) for low-emissions hydrogen supply.

The updated 6th Strategic Energy Plan sets a 1% target for ammonia and hydrogen as a share of the electricity generation mix by 2030. Japan's strategy of deploying ammonia and hydrogen to decarbonise thermal power generation can contribute to energy security by maintaining firm capacity and enhancing fuel diversification. At the same time, these applications involve relatively high fuel costs; they, therefore, benefit from being positioned within a broader, well co-ordinated decarbonisation strategy. Careful policy design and periodic review can help ensure that support for hydrogen and ammonia in the power sector is well-aligned with parallel efforts to accelerate renewable energy deployment, strengthen system flexibility and advance other

cost-effective decarbonisation options. In this way, hydrogen and ammonia can play a complementary role in the power system, supporting the energy transition while preserving optionality as technologies and costs continue to evolve.

The Hydrogen Society Promotion Act provides the legal foundation for implementation. It introduces a system for approving integrated supply and demand business plans, enables long-term financial support for eligible projects, and allows for special regulatory measures where necessary. Importantly, the Act requires that projects receiving support align with Japan's Green Transformation policy objectives and demonstrate credible supply and demand commitments.

This framework is reinforced by complementary instruments. The Green Innovation Fund provides milestone-based funding for research, development, demonstration and social implementation across the hydrogen and ammonia value chain, including production technologies, transport and storage, power generation, and industrial applications. The GX Promotion Act further supports long-term investment through the issuance of GX Economy Transition Bonds and the introduction of carbon-pricing mechanisms.

Together these instruments provide a high degree of policy continuity and predictability, which has been instrumental in mobilising private sector interest and advancing project development.

Market creation instruments

Japan has put in place a set of instruments to create demand for low-emissions hydrogen and ammonia and to reduce investment risk across the value chain. These include a contract for difference (CfD)-type price gap support scheme, a Long-Term Decarbonized Capacity Auction for the power sector, targeted measures for transport (see the Transport section), and dedicated support for hub development and infrastructure.

Price gap support mechanism

Japan established a JPY 3 trillion (USD 19 billion) price gap support scheme, one of the largest globally in financial size, accounting for around 15% of the GX budget. The scheme takes the form of a 15-year CfD-type mechanism and targets suppliers developing commercial-scale supply chains for low-emissions hydrogen and its derivatives.

Eligibility requirements are designed to ensure that public support catalyses durable markets rather than short-lived pilot projects. Production projects must be backed by a major hydrogen or ammonia consumer, begin supply by FY2030, and commit to continuing supply for at least ten years beyond the support period. The CfD bridges the price gap between low-emissions hydrogen or ammonia and conventional fossil fuels, in line with Japan's hydrogen cost-reduction targets. Applicants are required to submit detailed business plans covering supply volumes, emissions profiles, timelines and demonstrated demand.

By April 2026, around 128 kilotonnes (kt)/year of hydrogen equivalent had been supported under the CfD scheme. The first application window, which closed in March 2025, attracted 27 applications, with total requested funding exceeding the initial budget envelope. METI assesses the applications with input from third-party experts and projects are selected on a rolling basis.

Six supply chain projects had been selected as of April 2026, providing early insight into the types of value chains Japan aims to prioritise. The two largest projects are ammonia co-firing projects at coal-fired power plants. The JERA-led project plans to import and use approximately 500 kt of ammonia per year, primarily at Japan's largest coal-fired power plant, the Hekinan Thermal Power Station (see the Innovation section). The Mitsui-led project in Hokkaido is designed to supply around 280 kt of ammonia per year, with part of the volume allocated to industrial furnaces.

[Four other projects](#) focus on industrial applications, with significantly smaller volumes than those in the power sector. By April 2026, these projects corresponded to more than 4 kt per year of low-emissions hydrogen and around 20 kt per year of low-emissions ammonia for industrial use. Targeted sectors include steelmaking, chemicals and textiles, the food industry, and non-metallic minerals. These projects provide early examples of credible industrial use of low-emissions hydrogen, demonstrating how it can be integrated into existing industrial processes to produce low-emissions materials while leveraging domestic technological capabilities.

The initial CfD awards reflect a hydrogen policy that seeks to cluster demand, combine different support instruments and reduce risk across the entire value chain. Both the JERA-led and Mitsui-led projects also secured support under Japan's Long-Term Decarbonized Capacity Auction and the hub development programme for infrastructure (see below). In addition, these projects allocate part of their ammonia supply to nearby industrial users, reinforcing local demand aggregation.

Overall, the early project selections demonstrate the operationalisation of Japan's hydrogen policy instruments and the government's ability to translate long-term

strategic objectives into concrete project support. They also highlight a pragmatic focus on projects capable of delivering large volumes in the near term, particularly where existing infrastructure and demand can be leveraged. At the same time, the current portfolio underscores the importance of sequencing and learning. A substantial share of supported volumes is associated with ammonia use in the power sector, reflecting the readiness of large-scale demand and the role of power generation in anchoring early supply chains. By contrast, domestic green hydrogen projects remain comparatively small in scale, consistent with higher production costs and current constraints on renewable electricity availability. This experience points to the value of periodic review and adjustment of support mechanisms as costs decline and additional decarbonisation options mature across sectors.

Long-Term Decarbonized Capacity Auction

The Long-Term Decarbonized Capacity Auction (see the Electricity chapter) includes support for retrofitting or replacing thermal power plants through hydrogen or ammonia co-firing. As part of the bidding process, applicants must submit a decarbonisation roadmap to 2050. Japan capped support at 1 GW in each of the first two auction rounds, although the full volume was not awarded. Three coal-fired power plants were successful in these rounds for ammonia co-firing at a 20% blending ratio, corresponding to around 770 megawatts (MW) of coal capacity effectively operating on ammonia. While the total coal-fired capacity of these plants is larger, the effective ammonia-based capacity reflects the blending ratios. In addition, one power plant with an ammonia blending ratio of approximately 30% was selected, with effective ammonia-powered capacity of around 55 MW.

Most of the selected projects are expected to begin ammonia co-firing by FY2030, with the JERA project scheduled to start earlier, by [FY2029](#). The first auction rounds did not account for variable costs, such as fuel prices. Following the initial outcomes, Japan revised the auction design to include compensation for the price difference between hydrogen or ammonia and conventional fuels such as LNG or coal, based on a reference annual utilisation rate of 40%. Applications for the third auction round closed in [January 2026](#).

Hub development and import infrastructure

Japan places a strong emphasis on cluster-based development to anchor the uptake of low-emissions hydrogen and ammonia. These hubs are expected to play a central role in enabling domestic value chains by connecting import infrastructure, storage, transport and multiple end users.

Under the Hydrogen Society Promotion Act, Japan established a dedicated support scheme to subsidise domestic transport and storage infrastructure serving multiple users. A total budget of [JPY 219.6 billion](#) (USD 1.46 billion) has been earmarked for FY2026-FY2030 to support the engineering and infrastructure phases of hub development. The subsidy covers up to 50% of eligible engineering, procurement and construction costs for infrastructure facilities, including shared pipelines, storage tanks and front-end engineering and design costs. Such supported assets are required to have a planned operational life of at least ten years and begin operation no later than FY2030.

The [application](#) and selection process mirrors that of the CfD scheme. As of April 2026, METI and the Ministry of Land, Infrastructure, Transport and Tourism had selected [two import hub projects](#) for funding. Both are anchored in demand mainly from power generation. As a result, they are aligned with the major projects supported under the CfD scheme and the Long-Term Decarbonized Capacity Auction, notably the Hekinan and Tomakomai projects. These projects are expected to create diverse and high environmental value markets for products such as automotive components, cement and chemicals for semiconductors.

Many of Japan's major industrial clusters are located along the coastline, close to ports, and the two supported hubs are no exception. For these projects, the main infrastructure requirements relate to storage capacity and port adaptations. Given the cost and technical complexity of hydrogen transport, Japan is exploring multiple carrier options, including ammonia, liquefied hydrogen, liquid organic hydrogen carriers, methanol and synthetic fuels. Carrier choices reflect trade-offs between transport efficiency, infrastructure readiness, end-use compatibility and opportunities for domestic value creation. As the two selected import hubs are ammonia-based, Japan can draw on its extensive experience with LNG to develop port and storage infrastructure. Delivering ports, hubs and storage assets at scale requires close co-ordination among the central government, local authorities, utilities and private investors.

Innovation, supply chain and demonstration projects

Japan is the world leader in demonstrating and testing large-volume fuel ammonia substitution at a large-scale coal-fired power plant. In 2024, a NEDO-supported project at JERA's Hekinan Power Plant successfully achieved 20% ammonia co-firing. JERA plans to increase the share of co-firing ratios and develop burners

for [100%](#) ammonia combustion. In March 2026, IHI and GE Vernova [demonstrated](#) 100% ammonia firing in a commercial-scale gas turbine. Japan also has the [world's first](#) commercial ammonia-fuelled vessel, in use since 2024.

As part of its GX policies, Japan promotes a close integration between industry and energy policy. This is also reflected in the support of a hydrogen supply chain that builds upon domestic elements such as manufacturing. For example, Japan provides funding for seven projects, with a total investment of nearly JPY 151 billion (USD 1 billion), to develop the domestic manufacturing of electrolyzers and fuel cells.

NEDO supports a range of activities across the hydrogen value chain. In shipping, it funds the “Next-Generation Ship Development” project, which aims to accelerate the implementation of hydrogen-fuelled ships. In aviation, NEDO supports the development of hydrogen aircraft. In parallel, it backs R&D on hydrogen and ammonia carriers, bunkering and port infrastructure, and safety standards to enable large-volume imports.

Improved co-ordination across the value chain can help distribute the cost premium of low-emissions hydrogen and its derivatives across multiple actors, where it represents a smaller share of final product costs. A typical example is the use of low-emissions steel in passenger vehicles, where the cost premium is often less than 2% of the total vehicle price. Low-emissions hydrogen and its derivatives thus offer a promising decarbonisation option in applications where direct electrification or other low-carbon alternatives are not technically or economically viable.

Japanese steelmakers are also actively exploring the use of importing hot briquetted iron, a material that can be used in blast or electric arc furnaces. Approaches range from using natural gas-based routes to the use of renewable energy, as well as hydrogen over time.

Emissions accounting

Japan places strong emphasis on life cycle carbon intensity. The Hydrogen Society Promotion Act establishes a certification framework that defines eligibility thresholds for low-emissions hydrogen and ammonia, including a benchmark of 3.4 kg CO₂-eq per kilogramme of hydrogen on a well-to-gate basis. Compliance

with this threshold is required for projects seeking price gap support. This threshold is aligned with the European Hydrogen and Gas Market Package, which sets a 70% GHG reduction target compared to a fossil fuel reference.

Detailed methodological guidance is being further refined to support consistent carbon intensity assessment. Current approaches focus primarily on production emissions, with further work underway to clarify methodologies for calculating carbon intensity to be used in upcoming projects. Japan has signalled its intention to align methodologies with relevant ISO standards and emerging international practices, and to strengthen verification arrangements as the market matures.

As international markets for low-emissions hydrogen and ammonia develop, certification frameworks and methodologies to assess life cycle emissions are gaining importance in many countries. Robust and transparent approaches can help ensure environmental integrity and build confidence among market participants. Over time, greater convergence or mutual recognition of such frameworks could facilitate international trade and reduce transaction costs, particularly for countries developing global supply chains. The [COP28 declaration](#) on the mutual recognition of certification schemes, to which Japan is a signatory, is a positive step in this direction.

International co-operation

Japan plays a prominent role in international low-emissions hydrogen market development, including through its leadership in the Hydrogen Energy Ministerial Meeting (HEM). The HEM, first convened in Tokyo in 2018, brings together countries and organisations to discuss hydrogen policies and emerging issues. In 2025, Japan held the [seventh HEM](#) in Osaka alongside the Expo 2025 and the Ministerial Meeting on Sustainable Fuels. The HEM emphasised the importance of demand creation, co-ordinated policy support, infrastructure development, safety, regulatory alignment and innovation. Japan's role as chair and organiser reinforced its position as a key advocate for hydrogen and ammonia in global decarbonisation strategies. Japan also plays an important role in the Asia Clean Energy Forum, the International Hydrogen Trade Forum, the Clean Energy Ministerial and Mission Innovation.

Recommendation

9 **Prioritise low-emissions hydrogen, ammonia and hydrogen-derived fuels in sectors with limited decarbonisation alternatives while leveraging early demand creation in the power sector to support supply chain scale-up and cost reduction**

Japan has positioned low-emissions hydrogen, ammonia and hydrogen-derived fuels as core pillars of its GX Strategy, reflecting their potential role in decarbonisation and energy security. In the near term, the power sector plays a critical role in creating large-volume initial demand, enabling first-of-a-kind projects, and supporting the establishment of large-scale international supply chains and economies of scale. At the same time, the supply of low-emissions hydrogen or hydrogen-based fuels remains limited and costly, and domestic production potential is constrained, underscoring the importance of carefully sequencing deployment to maximise long-term decarbonisation impact and cost-effectiveness.

Building on the 7th Strategic Energy Plan, Japan could further clarify the sequencing of hydrogen and ammonia use across sectors, recognising the power sector's role as an early demand anchor in the near term while ensuring that expanding supply increasingly and measurably supports hard-to-abate sectors with limited alternatives, such as steel, chemicals, refining, shipping and aviation. Clear sectoral roadmaps with time-bound milestones can help distinguish between near-term scale-up needs and longer term prioritisation, guide the allocation of public support, and reduce the risk of prolonged reliance on high-cost applications once alternative decarbonisation options become available. Strengthening demand-side signals – through price-gap support, emissions-intensity requirements, mandates and carbon pricing – will remain essential: it provides offtake certainty and underpins investment across the value chain.

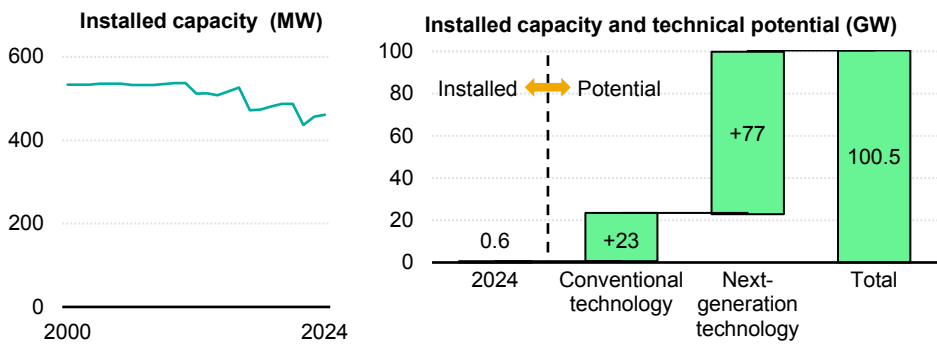
Co-ordinated development of demand hubs and shared infrastructure will continue to be critical to implementing this approach in practice. Co-location of power generation and industrial users can allow large-volume demand from the power sector to support early supply chain development while progressively serving hard-to-abate industrial applications as markets mature. Early experience under Japan's CfD scheme, where certified projects combine ammonia use in power generation with supply to industrial end users, illustrates how such hybrid demand models can accelerate learning, reduce costs and strengthen supply chain resilience. By aligning sectoral prioritisation with sequencing, infrastructure planning and robust governance, Japan can leverage the power sector to build scale while ensuring hydrogen and ammonia deployment remains aligned with long-term decarbonisation efficiency and system value.

Geothermal energy

Japan has one of the world’s largest geothermal resources, with an estimated technical potential of [nearly 23.5 GW](#) based on conventional hydrothermal systems at depths up to 3 km.

Next-generation geothermal technologies could significantly expand this technical potential by enabling deeper drilling to depths of 7-8 km and accessing more and much higher temperature reservoirs. Conventional systems in Japan already reach [250-300 °C](#), with evidence of superhot conditions above 350 °C in volcanic areas, particularly in the Hokkaido, Tohoku, Chubu and Kyushu regions. This geological profile positions Japan as a strong candidate for next-generation geothermal deployment, with reservoir temperatures confirmed to exceed [500 °C](#) in specific volcanic contexts. Ongoing research to map and quantify these deep resources suggests additional technical potential exceeding [77 GW](#). Geothermal energy, therefore, offers a strategically important domestic source of low-carbon, dispatchable power.

Installed electricity capacity (2000-2024) and technical potential for conventional and next-generation geothermal energy in Japan



IEA. CC BY 4.0.

Sources: IEA analysis based on IEA (2026), [Electricity Information](#); Japan, Ministry of Economy, Trade and Industry (2025), [Interim Report of the Public-Private Council for the Promotion of Next-Generation Geothermal Energy](#).

Despite its vast potential, long-standing history and roughly 30% growth over the past decade, geothermal installed capacity remains limited compared to other energy sources. For power, total installed capacity is about 0.6 GW, accounting for just 0.3% of Japan’s power generation. For heat, 2.4 GW is installed (2.2 GW direct heat use

and 0.2 GW geothermal heat pumps, which capture low-enthalpy heat). This means that existing geothermal generation capacity represents only 2-3% of current technical resource potential, or less than 1% of expected potential when including next-generation technologies. Further expansion has been hindered by high early-stage development risks; long development timelines; economic aspects; regulatory challenges, particularly in national parks; and public acceptance.

Governance and policies

Geothermal governance in Japan is split across national agencies in collaboration with local and regional governments. The [Ministry of the Environment](#) regulates hot springs and natural parks, [ANRE](#) sets energy policy and targets, [JOGMEC](#) supports exploration and drilling, with legacy input from [NEDO](#) surveys, and the [Institute of Advanced Industrial Science and Technology](#) supports R&D. Local governments play a pivotal role in permitting, co-ordinating community buy-in and securing *onsen* (a common word used in Japan for thermal baths) council consents. Most geothermal projects are initiated and owned by private actors (such as electric utilities, mining companies or local developers). A significant share of early-stage risk is temporarily and selectively absorbed or mitigated by public instruments (see the Policy spotlight).

Japan's geothermal policy has evolved in several phases. Development surged after the 1973 oil crisis, with nationwide surveys conducted by NEDO, which culminated in the construction of seven power plants in the 1990s. Momentum declined under nuclear and thermal dominance until the 2011 Fukushima disaster, which renewed interest in geothermal. The post-2011 period saw JOGMEC taking over geothermal responsibilities from NEDO, a partial easing of restrictions in national parks, and the introduction of FIT. Small-scale (1-5 MW) binary geothermal projects, often near hot springs, have increased, but large-scale development has remained limited.

Growth has been limited though by a complex regulatory framework designed to balance energy development, environmental protection and local interests. Key instruments include the [Hot Spring Act](#) (1948, latest amendment 2022), which protects *onsen* resources and requires local government and Hot Springs Council approval for drilling. [Roughly 80%](#) of Japan's geothermal resources lie within national parks, where the [Natural Parks Act](#) imposes strict limits on development, although partial relaxations since 2012 have allowed limited projects in less restrictive zones.

Large-scale projects are further regulated under the [Electricity Business Act](#) (2017) and the [Environmental Impact Assessment Law](#) (2014), which impose stringent safety requirements and lengthy assessment processes. Following the Rankoshi blowout

incident, Japanese authorities revised safety guidelines under the [Hot Spring Act](#). Additional challenges include unclear resource ownership, overlapping jurisdiction across ministries and agencies that can create conflicts and inefficiencies, and local opposition from hot spring operators.

Policy spotlight: Geothermal Development Acceleration Package

The Committee on Resources and Fuels, which is in charge of geothermal policy, adopted the [Geothermal Development Acceleration Package in 2024](#). The Package sets out policy measures covering permitting reform, resource assessments and early-stage risk reduction. As part of its implementation, the Ministry of Economy, Trade and Industry (METI) launched a [public-private council on next-generation](#) geothermal technologies in 2025 to accelerate their commercialisation by the early 2030s. The Council [identified](#) various challenges and is now working with stakeholders to address these challenges while also aligning innovation priorities with public funding under the Green Innovation Fund and the Japan Organization for Metals and Energy Security (JOGMEC) (see more details in the Next-generation geothermal development section).

The objective to reduce early-stage exploration risks is being realised through the Geothermal Frontier Project (2024), supported by METI and JOGMEC. Through this Project, JOGMEC leads pre-competitive surveys, drilling and discharge testing to reduce early-stage geological risk. Depending on project structure and developer preference, JOGMEC may subsequently transfer derisked wells to private developers for project development. The first two sites have been selected in [Yuzawa](#) City and [Shizukuishi](#) Town. JOGMEC also provides a suite of financial instruments, including subsidies for exploration and drilling surveys, equity capital, and debt guarantees, spanning the project life cycle from geological exploration to plant construction.

To resolve permitting bottlenecks and reduce lengthy development times (previously often exceeding ten years), the government has also established a “one-stop follow-up” framework uniting METI and its agencies, the Ministry of the Environment, the Forestry Agency, and local governments.

Recent policy initiatives have sought to accelerate development (see the Policy spotlight). The Outlook for Energy Supply and Demand in FY2030, published alongside the [6th Strategic Energy Plan](#) (2021), targeted 1.5 GW of geothermal capacity by 2030. More recently, the Outlook for Energy Supply and Demand in FY2040, published alongside the [7th Strategic Energy Plan](#) (2025), sets a more ambitious goal of approximately 11-24 TWh of geothermal generation annually by 2040.

Social acceptance remains critical, especially in hot spring tourism areas and national parks. The government supports communities through JOGMEC-led hot-spring monitoring, reservoir evaluation and low-impact development methods, while METI and JOGMEC facilitate dialogue via symposia and study groups with residents and hot spring operators. The Institute of Advanced Industrial Science and Technology and NEDO are developing plant designs that harmonise with local landscapes, ensuring that geothermal development aligns with environmental and cultural considerations.

Conventional geothermal development

Power

Conventional geothermal power in Japan is technically proven but structurally constrained, accounting for less than 1% of installed capacity and power generation. Development has favoured small to mid-scale flash and binary plants, often added to existing fields rather than built as large greenfield projects. Japan currently operates nearly 100 geothermal power plants, accounting for just above 540 MW, of which only [23 power plants](#) exceed 1 MW. Hatchobaru Power Plant remains the largest operating facility at 112 MW.

Geothermal provides high-capacity factors, baseload and dispatchable, weather-independent generation, yet its contribution remains limited by long lead times, high upfront drilling costs and exploration risk, making conventional geothermal a niche, location-specific resource.

Market design reinforces this pattern. Since 2012, FIT has been its primary revenue mechanism, providing long-term price certainty. METI's [FIT for 2025](#) ranges from [USD 256 per megawatt hour \(MWh\)](#) for plants under 15 MW to [USD 166/MWh](#) for larger units. In practice, this has enabled mainly small binary projects, while large-scale development remains constrained by exploration risk, permitting complexity and social acceptance. Although Japan's liberalised electricity market allows bilateral and corporate power purchase agreements (see the Electricity

chapter), geothermal has not leveraged these options, particularly due to high upfront risk and long lead times that limit bankability. This limits the ability of geothermal energy to link to large loads such as data centres, despite growing policy support under [zero-emission and resilience-enhanced data centres](#), which encourages the use of renewable energy. Regional and local initiatives in Tohoku and Niigata Regions aim to attract data centres based on their climate and renewable availability, but geothermal energy is not explicitly integrated despite its potential.

Geothermal has also been largely excluded from competitive auctions, as is the case for [solar](#) and [wind](#), and from other market-based instruments. The 2023 [Long-Term Decarbonized Capacity Auction](#), managed by OCCTO, while theoretically open to geothermal, excludes almost all projects because FIT plants are ineligible due to double subsidy, and the 100 MW threshold only captures Hatchobaru. This leaves public intervention, particularly via JOGMEC, as the main mechanism to derisk exploration and bridge early-stage financing gaps (see the Governance, policies and regulatory framework section).

Conventional geothermal can grow incrementally but is unlikely to scale rapidly under the current market and regulatory conditions. This structural reality drives growing policy interest in next-generation geothermal, which aims to unlock Japan's high-temperature resources at scale.

Heat

Japan's geothermal direct use is currently concentrated entirely on low-enthalpy resources (<150 °C). Hot springs dominate, with around 1 500 *onsen* bathing sites, alongside smaller but established applications in aquaculture, greenhouses and snow-melting, particularly in colder, rural regions. These rely on relatively simple systems, typically involving direct pipelines or heat exchangers, and are often linked to local economies and tourism.

Geothermal district heating and cooling remains marginal in Japan, where district heating itself is limited, serving just 140 districts via around 80 heat operators and accounting for less than 1% of total energy use, mostly in vertical high-rise networks rather than broad community grids. Small-scale geothermal pilots, such as in [Tokyo](#), demonstrate technical feasibility, but have not scaled due to limited policy support, fragmented heat demand, high retrofit costs for legacy systems and a lack of heat planning integration.

Despite narrow deployment, significant potential exists for geothermal in public buildings, residential clusters, agri-food processing and rural district heating, particularly to displace imported fossil fuels while supporting regional development. Growing interest from regional energy companies signals momentum, but scaling requires a policy focus on heat and cooling (beyond power), local co-ordination due to the local nature of heat, and business models such as heat purchase agreements.

Cascading use of geothermal energy for heat

Japan demonstrates cascading use of geothermal heat, where residual heat (50-100 °C) from power production is used for heating, which increases overall energy efficiency, lowers fuel use and generates local economic value. Greenhouses and *onsen* are the most prominent examples: [Yamagawa](#) Geothermal supplies waste heat to nearby greenhouses for flowers and vegetables; [Okuhida Onsengo](#) uses waste heat from several plants to support indoor heating, aquaculture and greenhouse cultivation, reducing electricity costs and diversifying rural incomes; and [Beppu](#) uses residual heat for district cooling. Other applications exist in [Hokkaido](#) and [Iwate](#).

While currently limited in scale, these cases show the potential to integrate power and heat, particularly where electricity alone underutilises the available geothermal resource. Targeted policy support could expand co-generation deployment, strengthen community acceptance, and improve project bankability for small and mid-scale plants close to agricultural and industrial demand.

Next-generation geothermal development

Next-generation geothermal policy in Japan aims to overcome the geographical and scale constraints of conventional geothermal, which is largely confined to national parks and small to mid-scale capacities. Technologies such as supercritical geothermal, which target deeper and high-temperature reservoirs, potentially exceeding 500 °C, enhanced geothermal systems and closed-loop systems could vastly expand the geographical scope and enable larger scale projects with a potential of [77 GW](#).

Next-generation geothermal technologies are being developed under a risk-sharing framework that aims to crowd in private investment. Recognising the very high geological uncertainty, deep drilling costs and unproven reservoir behaviour associated with supercritical, enhanced and closed-loop geothermal systems, Japan's approach relies on public instruments to mitigate early-stage risks and enable

learning. Through targeted subsidies under the Green Innovation Fund, the government absorbs or mitigates a significant share of initial exploration risk while private developers remain involved from the early stages and progressively assume greater technical and financial responsibility as resource viability is clarified.

This approach reflects a deliberate sequencing of risk allocation: public support focuses on reducing uncertainty in early phases that are difficult to finance commercially while project ownership, construction and long-term operational risks are intended to shift to private developers once projects reach defined development milestones. By partially socialising early-stage risks and linking support to clear technical and regulatory benchmarks, Japan seeks to accelerate the emergence of a commercially viable next-generation geothermal project pipeline while preserving incentives for cost discipline, innovation and private capital mobilisation.

As part of the implementation of the challenges identified by the public-private council on next-generation geothermal technologies (see the Governance and policies section), METI and industry consolidated a [national roadmap](#) in 2025. The roadmap targets early demonstrations by 2030, initial operation in the early 2030s and substantial scale-up toward mid-century. It includes indicative deployment pathways, aiming to develop roughly 7.7 GW of next-generation geothermal capacity between mid-2030 and 2050, with an initial capacity of around 1.4 GW targeted before 2040 under various scenarios. The roadmap focuses on key technical and non-technical priorities, including drilling and well design, thermal recovery, cost reduction, resource surveys, and regulatory frameworks, including safety guidelines and institutional reforms under the Hot Springs Act. Early-stage demonstrations are supported by the Green Innovation Fund (under METI), with a new [public tender to be launched in June 2026](#) to allocate USD 691 million in subsidies over 2026-2030, covering up to two-thirds of eligible survey and test-drilling costs.

International collaboration with partners such as the [United States Department of Energy and METI](#) (via a memorandum of co-operation) and private start-ups accelerates technological learning. For example, Chubu Electric Power is a strategic investor in Eavor Technologies to gain early practical experience from their closed-loop system's pilot in Germany and knowledge that could be applied in Japan.

In co-ordination with the [public-private council](#) on next-generation geothermal, Japan is advancing several pilot and demonstration projects: [Mitsui Oil Exploration Co., Ltd and Chevron](#) are piloting an advanced closed-loop system in Hokkaido that extracts heat without direct steam production to lower exploration risk. JOGMEC has commissioned feasibility studies with private companies such as [Toyo Engineering](#) to

assess closed-loop designs and other next-generation concepts, generating critical technical data ahead of field deployment. These pilot and preparatory activities lay the groundwork for scaling Japan's next-generation geothermal capacity.

To support commercialisation, METI will establish a [Study Group](#) on the Appropriate Utilisation of Next-Generation Geothermal Energy, integrating expertise on underground structures, social acceptance, environmental impacts, risk assessment and regulatory pathways.

Recommendation

10 Further strengthen early-stage geothermal risk-sharing to crowd in private investment while streamlining permitting

Geothermal development is constrained primarily by high geological uncertainty, long lead times and complex permitting requirements rather than operating costs. Japan has made important progress in addressing these barriers through JOGMEC-led pre-competitive drilling surveys, subsidies for exploration and test drilling, and the use of equity participation and debt guarantees to reduce early-stage risks. These instruments have supported private developers' engagement from the exploration phase and helped advance conventional and, to some extent, next-generation, geothermal projects. To further expand geothermal deployment, Japan should continue evolving from predominantly subsidy-based support toward clearer, milestone-linked risk-sharing arrangements that strengthen incentives for early private participation and learning. This could include scaling cost-shared exploration and drilling programmes, expanding the use of equity and guarantee instruments in pre-FID phases, and clarifying pathways for the transfer of derisked resources to project developers. Support levels should reflect geological and technological risk and be linked to transparent development milestones to improve bankability and the efficient use of public funds.

International experience shows the effectiveness of differentiated approaches to managing early-stage geothermal risk. In [Kenya](#), Geothermal Development Company leads exploration and resource confirmation with the explicit aim of transferring derisked resources to private developers. In [New Zealand](#), early-stage risks are more structurally shared, with private developers directly engaged in exploration supported by strong public data, faster learning and institutional frameworks. In the United States, the [Department of Energy](#) complements these models through

cost-shared funding explicitly targeting the “[valley of death](#)” between research and commercial deployment. These experiences show that while public support is essential to managing early-stage geothermal risk, cost- and risk-sharing approaches are [effective](#) in mobilising private investment, expanding project pipelines and accelerating development beyond what can typically be achieved through purely public funding models. Japan’s model represents a hybrid approach, combining public risk mitigation with private project leadership, but it could further increase private early-stage exposure through clearer, cost-shared investment frameworks.

At the same time, permitting remains a critical bottleneck. Despite improvements under METI’s “one-stop follow-up” framework, geothermal projects still require sequential approvals under multiple laws, resulting in lengthy timelines. Large projects (>10 MW) often exceed ten years for permitting alone, even with JOGMEC support, then approximately an additional decade is required for exploration and resource confirmation. Smaller projects, despite partial exemptions from environmental impact assessments, still typically require four to six years. These timelines are incompatible with Japan’s target of expanding geothermal capacity from 0.6 GW to 1.5 GW by 2030 and risk constraining conventional and next-generation projects. Japan should continue streamlining and co-ordinating permitting procedures, with differentiated requirements by project size and risk, clearer and potentially shorter timelines, and early engagement with local authorities and hot-spring stakeholders.

Strengthening risk-sharing mechanisms in parallel with permitting reform would accelerate project pipelines; improve learning effects; and enable geothermal energy to play a greater role as a domestic, dispatchable, low-carbon energy source.

Annexes

Acknowledgements

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Abbreviations and acronyms

ANRE	Agency for Natural Resources and Energy
BEV	battery electric vehicle
CCS	carbon capture and storage
CEV	Clean Energy Vehicle
CfD	contract for difference
EGC	Electricity and Gas Market Surveillance Commission
EV	electric vehicle
FCEV	fuel cell electric vehicle
FIP	feed-in premium
FIT	feed-in tariff
FY	fiscal year
GDP	gross domestic product
GHG	greenhouse gas
GIF	Green Innovation Fund
GX	Green Transformation
HEM	Hydrogen Energy Ministerial Meeting
HVAC	heating, ventilation and air conditioning
IEA	International Energy Agency
JOGMEC	Japan Organization for Metals and Energy Security
JPY	Japanese yen (currency)
LNG	liquefied natural gas
METI	Ministry of Economy, Trade and Industry
MOE	Ministry of the Environment
NEDO	New Energy and Industrial Technology Development Organization
NRA	Nuclear Regulation Authority
OCCTO	Organization for Cross-regional Coordination of Transmission Operators
PHEV	plug-in hybrid electric vehicle
PSC	perovskite solar cell
PV	photovoltaic
R&D	research and development
S+3E	safety, energy security, economic efficiency and environmental sustainability
SBL	Strategic Buffer LNG
SMR	small modular reactor
STEM	science, technology, engineering and mathematics
TES	total energy supply
TFEC	total final energy consumption
USD	United States dollar (currency)
VRE	variable renewable energy
ZEB	zero-energy building
ZEH	zero-energy home

Units of measurement

bcm	billion cubic metres
EJ	exajoule
GW	gigawatt
GWh	gigawatt hour
Hz	hertz
kb/d	thousand barrels per day
km	kilometre
kt	kilotonne
kW	kilowatt
kWh	kilowatt hour
Mt	million tonnes
Mt CO ₂ -eq	million tonnes carbon dioxide equivalent
Mtpa	million tonnes per annum
MW	megawatt
MWh	megawatt hour
Nm ³	normal cubic metre
PJ	petajoule
t	tonne
t CO ₂	tonne carbon dioxide
TWh	terawatt hour

See the [IEA glossary](#) for a further explanation of many of the terms used in this report.

Infographic notes

Electrification: “Other IEA countries” refer to the consumption-weighted average of all IEA countries except Japan.

Nuclear: Capacity requirements for 2040 targets are determined by IEA modelling, taking into account Japan’s 220 TWh generation target for nuclear in 2040.

Hydrogen: “Key legislation” refers to measures outlined in the 2025 Energy White Paper and Hydrogen Society Promotion Act.

Infographic sources

S+3Es: IEA analysis based on Japan, Ministry of Economy, Trade and Energy (2025), [Basic Energy Plans](#), (accessed in May 2026).

LNG: IEA (2026), [World Energy Balances](#); IEA (2026), [Natural Gas Information](#).

Electrification: IEA (2026), [World Energy Balances](#).

Nuclear: IEA analysis based on International Atomic Energy Agency (2026), [Power Reactor Information System](#), (accessed in May 2026); Japan, Ministry of Economy, Trade and Industry (2025), [Outlook for Energy Supply and Demand in FY2040](#), (accessed in May 2026).

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Hydrogen: IEA analysis based on Japan, Ministry of Economy, Trade and Industry (2025), [2025 Energy White Paper](#), (accessed in June 2026); Japan, Ministry of Economy, Trade and Industry (2024), [Hydrogen Society Promotion Act](#), (accessed in June 2026).

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Energy Policy Review

Government action plays a pivotal role in ensuring secure and sustainable energy transitions. Energy policy is critical not just for the energy sector but also for meeting environmental, economic and social goals. Governments need to respond to their country's specific needs, adapt to regional contexts and help address global challenges. In this context, the International Energy Agency (IEA) conducts Energy Policy Reviews to support governments in developing more impactful energy and climate policies.

This *Energy Policy Review* was prepared in partnership between the Government of Japan and the IEA. It draws on the IEA's extensive knowledge and the inputs of expert peers from IEA Member countries to assess Japan's most pressing energy sector challenges and provide recommendations on how to address them, backed by international best practices. The report also highlights areas where Japan's leadership can serve as an example in promoting secure and clean energy transitions. It also promotes the exchange of best practices among countries to foster learning, build consensus and strengthen political will for a sustainable and affordable energy future.