Renewable Power Is Key to Japan's Energy Security

Summary

Energy security underpins national defence, economic resilience, and strategic autonomy. For Japan, strengthening domestic energy production is no longer solely a matter of climate or economic policy; it is increasingly central to the credibility of its national security and defence position in a more contested geopolitical environment.

With the Liberal Democratic Party securing a supermajority under Takaichi's administration, Japan's energy security challenge has gained renewed urgency – and opportunity. The government has a mandate to address security challenges and to push through necessary policy changes.

The government's intention is to now revise the National Security Strategy (NSS), National Defense Strategy (NDS), and Defense Buildup Program. Energy security can now be positioned as a core pillar in Japan's broader defence and national resilience strategy.

Japan's over-dependence on energy imports is nothing new; it has been constant since the industrial revolution. It now stands at 87.4% in 2024, the highest level among major economies. Successive governments have sought to reduce this vulnerability by diversifying the energy mix through initiatives such as the 7th Strategic Energy Plan and the Green Transformation (GX), while elevating security as a national priority. Japan's energy system must be recognised as a strategic vulnerability that requires systematic integration into security planning.

These ambitions rest on a simple reality: advanced defense systems cannot function without a reliable and resilient domestic power supply. Japan's energy system must be acknowledged as strategic vulnerability to be addressed as a part of its security planning.

Expanding investment in clean power - including solar, wind, and nuclear can strengthen energy independence while enhancing economic competitiveness and social stability.

The NSS signals Japan will maximize energy sources that contribute to self-sufficiency, however, achieving this objective will require a substantial and sustained expansion of domestic renewable power.

Given limited attention to energy constraints in the current draft, the forthcoming revisions under the Takaichi government will shed light on its strategic priorities and its intentions to address this long-standing energy security gap. If the renewed NSS fails to integrate energy security, and specifically renewable expansion, Japan will remain strategically vulnerable. Such a context is an opportunity for Japan to scale up investment in clean power - power generated from solar, wind and nuclear sources, to deliver energy independence and security while simultaneously enhancing its economic and social performance as a country.

Japan enjoys ample physical space availability to ramp up offshore wind along its coastline; on land, solar deployment is a winner, both for former farm conversion and for shared agricultural photovoltaics. In fact, according to Ministry of Environment research, wind and solar resources could power the country twice over.[1,2] The latest 7th Strategic Energy Plan takes stock of this potential by targeting an ambitious 60-70% share of clean power on the grid by 2040. Our research shows that the level of ambition could even be pushed further by aiming for 80% or more clean power by 2040. This could be achieved with a four-step systematic and fast policy action:

1. Upscale transmission and distribution capacity in power grids, as per METI's plan

2. Fast-tracking planning and permitting for renewable energy deployment

3. Expand distributed energy

4. Use long-term offtake agreements to mobilize low-interest capital

Elevating energy policy to the level of national security concern is also an opportunity for consolidating political capital both at the national and regional and local levels.

Climate Bonds INITIATIVE

Prepared by the Climate Bonds Initiative

Strategic autonomy via more renewable power investment

Japan's security significantly depends on the resilience of its electricity system.[3] Power is the foundational block of digital infrastructure, manufacturing, and economic security. Power autonomy and resilience mean winning over strategic risks such as natural hazards and supply chain disruptions.

The 2025 Energy White Paper describes renewables as core domestic energy sources for national resilience, while the Seventh Strategic Energy Plan stresses that lowering import dependence is essential for economic security.[4] Together, this points to a clear direction: scaling up domestic clean power is not only about mitigating emissions but about securing a more stable and economically resilient future for Japan.

Japan possesses far more renewable energy resources than required to meet its energy demand, with solar potential (excluding mega-solar) holds 1.5 to 2.3 times and floating offshore wind potential alone holding 2-9 times Japan's annual electricity.[5] Therefore, current issues do not lie in resource constraint, but rather how fast Japan can deploy renewables given the security imperative and the window of opportunity.

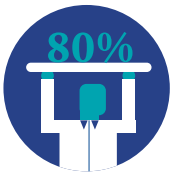
Japan's power demand is projected to increase by 5.8% by 2034 from 2024 levels, notably due to construction of new data centers, AI facilities and semiconductor factories. Peak demand associated with new data centers and semiconductor factories is projected to be approximately 13 times higher in 2034[6] compared to 2025. If this growth is not supplied by domestic sources, Japan risks locking in additional[7] strain. At the same time, if managed effectively, rising demand from AI data centers could help support the securing of long-term power supply agreements for renewables to match projected demand growth. As an island nation without cross-border gas pipelines or electricity interconnections, Japan relies heavily on domestic generation and imported fuels, making energy security a central concern in its power system planning. Japan's main import routes pass through strategic chokepoints including the Malacca Strait, Straits of Hormuz, and Taiwan Strait, exposing the nation to concentrated risks during regional crises.

While diversifying fuel suppliers or shifting transport routes may offer limited relief, it does not fundamentally reduce exposure, as volatility in global energy markets and long-distance shipping risks cannot be avoided.

As stated in Japan's National Security Strategy, "Turning our eyes to the neighboring region, Japan's security environment is as severe and complex as it has ever been since the end of World War II".

Expanding domestic renewable energy reduces these structural barriers by lowering exposure to supply interruptions, stabilizing long-term energy costs, and limiting the need for foreign-currency outflows for fuel purchases. In an era of heightened geopolitical risk, strengthening domestic clean power capacity therefore appears as an essential component of Japan's national resilience.

A feasible 80% in 2040 clean power plan



Expanding clean power generation to 60% by 2030, and then to 80% by 2040, can be done and will bring the much needed energy security. One possible scenario[8] even models a 90% share of clean power on the grid. This is achieved by generating about 20% of consumption from nuclear sources while balancing peaks with flexible gas. Renewable generation grows from 188 to 254 GW from 2030 to 2035, a significant ramp up which is also a massive investment opportunity to building a resilient domestic based power system in Japan. More details are provided in the Annex below.

Ending fossil fuel dependency

Currently, Japan provides on the order of JPY 1 trillion per year in direct fossil fuel support. Increasing domestic clean power sharply reduces the need for imported fossil fuels and could save up to JPY 3.4 trillion by 2035. This would not only save precious currency flows but also reduce exposure to heightened price shocks and volatility. The resulting budget quantitative and qualitative improvement will benefit Japan's economic expansion in multiple ways.[9]

Affordable cost and price

Given the long-term trend of declining costs of solar PV, offshore wind, floating wind, and battery storage, it is feasible to expand renewable wholesale power prices declining by 6% by 2035. The required investment, approximately JPY 38 trillion through 2035, represents approximately 25% of Japan's planned JPY 150 trillion GX programme and is offset by avoided fossil fuel imports. Clean energy therefore increases affordability as well as sustainability.

There is concern that the supply of solar PV cells is dominated by Chinese suppliers. However, the key difference is that this would be replacing the constant supply challenges of fossil fuels with one-off purchasing; this could be done as part of a trade agreement with Japan to help calm rough seas.

Scaling up domestic demand also has significant potential to improve the financial viability for domestic manufacturers, especially in new technologies like perovskite cells.

It must be emphasized that even where panels are imported from China, this substitutes a one-off capital purchase for decades of volatile fossil fuel imports, while creating domestic value through Japanese installation, grid integration, operations, and, increasingly, next-generation technologies such as perovskite and floating solar in which Japan already holds a competitive edge.

Manageable grid investment

Japan has already initiated reforms to expand grid capacity and interregional connectivity. METI and OCCTO's Master Plans outline an unified backbone transmission network linking renewable-rich regions to major demand centres. Digital-twin modelling, successfully used in Europe, can help optimize timing, routing, and prioritization. Battery storage, demand response, pumped hydro, and inter-regional transfers collectively allow renewables to operate reliably even during low-generation periods. The grid is not a barrier; it is the enabler for a secure, domestic-led power system.

Stronger industrial base and regional economies

Prefectures such as Fukushima, Saga, Akita, and Hokkaido demonstrate that coordinated regional targets, community engagement, and local financing can accelerate clean energy deployment. These subnational examples show that understandable local resistance to change can be overcome through structured engagement and shared benefits.

The global PV market is still heavily concentrated in crystalline silicon (c-Si), where China controls over 80% of manufacturing. However, next-generation technologies offer room for innovation and leadership. Japan can lead in perovskite solar cells (PSC) thanks to its world-class research and strong domestic supply of iodine, a key raw material for perovskites. The government targets 20 GW of perovskite capacity by 2040, supported by the Green Innovation Fund (JPY157 billion subsidy). Sekisui Chemical and Panasonic are developing commercial-scale production by 2027.

Japan also holds competitive advantages in next-generation technologies such as floating solar, agrivoltaics, and advanced geothermal, enabling domestic alternatives to Chinese crystalline-silicon PV. Japan already holds 60% of global floating solar capacity, leveraging its water reservoirs.

For offshore wind, fishermen and their communities can be integrated through revenue sharing, discounted electricity, co-ownership models, or benefit-sharing agreements within Power Purchase Agreements (PPAs) and project finance structures.

Abandoned farmland represents a proven and expanding land pool available for solar deployment, as demonstrated by existing conversion rates. Case studies presented show agrivoltaics projects in Tochigi and Kanagawa where solar structures co-exist with rice, wheat, soybeans and berries, illustrating how solar "sharing" can simultaneously raise energy and food self-sufficiency while returning abandoned farmland to productive use. Besides, properly designed agrivoltaics are also adding space availability to solar deployment, while offering the multiple benefits for agriculture of diversifying produce mix and securing cheap and clean power.

Domestic clean energy can therefore anchor new industrial clusters, stimulate regional revitalization, and reduce external dependencies.

Actively engaging with communities, coupled with transparent and efficient planning, builds trust and delivers tangible benefits such as improved energy security and local economic opportunities. The implementation of community benefit agreements ensures shared value. Such measures have the potential to turn resistance into partnership, by aligning infrastructure development with local priorities and global climate leadership.

The four steps to energy security through clean power opportunity

1. Upscale Transmission and Distribution Capacity in Power Grids

The expansion of renewable energy in Japan has faced multiple, interrelated barriers. Among the most structurally significant has been the lack of a unified national transmission security grid to move renewable power to demand centers, unlock regional resources, and maintain resilience in emergencies.

Regional energy generators have difficulty scaling up because they do not have the ability to sell into Tokyo's electricity market.

Grid fragmentation and limited interconnection capacity constrain deployment and expose the power system to supply risks.

METI has developed a comprehensive plan for a unified, expanded transmission backbone that will serve as Japan's strategic energy shield. It enables emergency energy routing, strengthens industrial continuity under stress, and unlocks domestic power potential at scale, including regions with strong renewable resources that are currently constrained by limited grid access.

For an island nation with no cross-border electricity transmission connections, grid infrastructure is a national security asset, not only an energy asset. Expanding transmission capacity, building undersea cables, and strengthening interregional links are essential to unlocking renewable potential, ensuring supply continuity in emergencies, and supporting future industrial hubs.

2. Fast-tracking Planning and Permitting for Renewable Energy Deployment

Renewable energy development has the potential to revitalize regional economies but is currently blocked by lengthy and complex permitting and approval processes due to regulatory uncertainties, limited availability of land for large-scale projects, and the dominant role of incumbent utilities, which can slow the deployment of renewables.

Legislating for fast-track permitting and regulatory approval to build critical clean energy and grid infrastructure, for example through designated renewable energy zones, clearer approval pathways, and modernized grid access rules, will accelerate investment and improve energy security.

Strategic permitting agility is not just administrative reform; it is a national capability in an era of geopolitical competition and energy vulnerability. Countries that can build infrastructure faster gain economic and security advantages. Japan's regulatory modernization must match the scale of its ambition and potential, treating clean energy deployment as critical national strategic infrastructure rather than a standard infrastructure approval flow.

3. Expand distributed energy

Japan should secure industrial and community resilience through distributed energy and local microgrid systems.

Distributed energy systems reduce the load on centralized electricity generation and are more resilient in the face of emergencies, whether natural or security related.

Aided by smart-power management systems, distributed energy systems are playing an important part in the switch to electrified economies that are more resilient and more secure in the face of conflict.

Japan is already seeing success in Hokkaido and Kyushu where communities produce electricity locally, and prefectures such as Fukushima, Saga, Akita, and Hokkaido provide replicable models for local energy deployment.

Local mini grids provide continuity of electricity for hospitals, semiconductor plants, defense

facilities, and essential services even if national supply chains are disrupted. Battery storage significantly contributes to dependability. Distributed systems create the condition for the formation of a secure, flexible, and future-ready power system.

4. Use long-term offtake agreement to mobilize low-interest capital

Japan will have to mobilize private finance to deliver clean energy investment at national defence scale.

The single most important measure will be the provision of long-term renewable energy purchase contracts. In markets all around the world, successive waves of contracts have driven down the costs of generation. Security of offtake agreements will deliver low-cost capital.

Renewable energy development requires high levels of capital and low operating costs. Japan has a critical advantage over most countries — it has large pools of capital working and a low-interest rate environment with an appetite for long-dated investments.

The primary challenge for renewable energy development is not technological or construction; it's the cost of capital. Apart from fast-tracking permitting, the most important means of reducing capital costs is to provide long-term offtake agreements. This can be initially supported by credit guarantees.

Subsequent financial engineering will be what liberates Japan to achieve energy security.

Elevating energy security to a matter of national concern

To scale up clean energy as a core power source, Japan must prioritize energy at the level of national security concern. Achieving this requires two complementary approaches: regulatory reform and local benefit-sharing.

First, regulatory changes must be made to ensure that relevant energy infrastructure is treated as a matter of national importance. Germany adopted the national-priority approach alongside sweeping permitting and land-use reforms, which has dramatically accelerated wind energy approvals.[10,11] Reforms included digitized permitting, streamlined approval pathways, more flexible repowering conditions, and expanded permitted sites.[12]

Second, tangible benefits must be ensured to flow back to local communities in the form of financial benefits (e.g. shared taxation revenue from renewable energy), coupled with transparent planning to build trust, deliver lower-cost energy, and create economic opportunities. In Japan, policy guidance and energy-transition strategies emphasize that renewable-energy development should be accompanied by financial returns to local areas and transparent planning processes that build trust and social acceptance.[13,14] This includes mechanisms such as local revenue sharing, community funds, and participatory planning. Offshore wind port development should be designed not only as an energy infrastructure but as an engine for regional growth through supporting jobs, supply chains, and wider economic activity.[15,16]

Achieving Japan's energy security

- The needed technology exists; Japan's engineering, construction and financial sectors are world-leading, as are the country's managers of capital. What is required is political will and supportive policy.
- Japan has already increased renewable generation 2.5-fold over the past 12 years; it can and must do so again by 2040.
- Reaching 80% clean power will make Japan stronger - energy secure, economically resilient, and a global technology and climate leader. A truly sustainable pathway requires prioritizing domestic renewable deployment, grid modernization, and demand-side efficiency, rather than substituting one imported energy source for another.
- The transition may not be easy, however, maintaining the status quo is both more risky and more costly. The time to accelerate is now.

ANNEX : Raising the ambition level of the 7th Strategic plan

The 7th Strategic Energy Plan

To achieve 2030's targets and carbon neutrality by 2050, Japan's biggest challenge is to introduce maximum practicable amount of renewable energy sources while solving the lack of transmission capacities and weak grid connections traversing regions. Japan's Strategic Energy Plan functions as a framework for Japan's energy policy and is revised every three years.

In February 2025, the 7th Strategic Energy Plan was approved.[17] It outlines the fundamental direction of Japan's energy policy, and maintains the S+3E principles (Safety, Energy Security, Economic Efficiency, and Environmental Protection). It emphasizes the need to respond to energy crises and economic security demands.

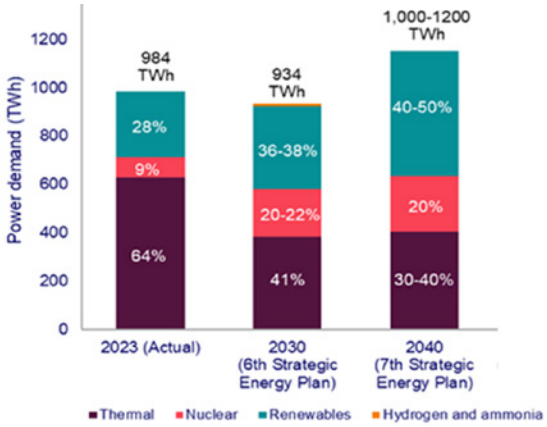
The plan does not indicate an exit from coal and maintains high thermal power generation targets even in 2040. Think tanks and NGOs have issued statements and opinions criticizing the draft plan as inadequate to limiting the temperature rise to 1.5°C, on top of the serious energy security challenge from over reliance on imports.[18] The government predicts that electricity demand in FY2040 will have increased from the current level (985.4 billion kWh in 2023) to around 1.1-1.2 tn kWh.

Excess share of thermal power generation is not consistent with 1°5 C target

The biggest issue with the new Strategic Energy Plan is that thermal power will be 30-40% of Japan's energy mix in 2040, which is inconsistent with the 1.5°C target demanded by the rest of the world. The government also states that it will continue to use nuclear power to the maximum extent possible and set it to around 20% in 2040, a target that may be exceedingly difficult to achieve. If nuclear power cannot supply electricity as expected, thermal power will have to be used to cover the cost, and the ratio of thermal power could increase further.

The previous 6th Strategic Energy Plan divided the share of thermal power into 19% coal, 20% LNG, 2% oil, and 1% hydrogen in 2030, but the new 2040 energy mix only indicates about 30% to 40% for thermal power, without a breakdown of the fuel sources. At the April 2040 Climate, Energy and Environment Minister's meeting, the G7 members including Japan agreed to phase out coal-fired plants without emissions reductions measures by 2035. Japan maintains that ammonia co-firing constitutes "implementing emissions reduction measures", showing no more stringent stance to phase out coal. Similarly, there is no specific target given regarding LNG, which has been steadily increasing over the past few years, and to what extent high-cost hydrogen/ammonia co-firing will be utilized.

Japan's power generation mix based on current policies



Source: https://www.woodmac.com/blogs/the-edge/walking-japans-energy-tightrope/#:~:text=Driven%20by%20AI%2Dled%20data%20centres%20and%20wider,remain%20in%20the%20generation%20mix%20for%20longer.

Table 1: Preliminary (2023, actual) and target (2040) figures for the composition of each energy

	Fiscal Year 2023	Fiscal Year 2040
Energy self-sufficiency rate	**15.2%**	**Approx. 30-40%**
Renewable energy	**22.9%**	**Approx. 40-50%**
Solar PV power	**9.8%**	**Approx. 23% to 29%**
Wind power	**1.1%**	**Approx. 4-8%**
Hydropower	**7.6%**	**Approx. 8-10%**
Geothermal power	**0.3%**	**Approx. 1-2%**
Biomass	**4.1%**	**Approx. 5-6%**
Nuclear power	**8.5%**	**Approx. 20%**
Thermal power	**68.6%**	**Approx. 30-40%**

Source: METI (2025) https://www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/7th_outline.pdf

A technically feasible 1°5 C pathway for Japan's power

To stay on the Japan's 2050 net zero path, Japan could adopt a 1.5°C compatible target by 2035, supported by clear renewable deployment goals and enabling policy reforms, while recognizing that renewable expansion alone may be insufficient and that continued innovation in complementary technologies, as well as infrastructure build-out and permitting timelines.[19]

With costs for solar, offshore wind, and battery storage on a rapid declining trend, Japan could reach a 90% clean electricity share by 2035, with a goal of non-fossil energy commanding a 59% share of electricity generation by 2035.

Achieving this would cut power costs, almost eliminate dependence on imported LNG and coal, and sharply reduce power sector emissions — all while maintaining a reliable and resilient grid without adding new gas or coal capacity, if infrastructure deployment, permitting, and system integration progress in a timely manner.

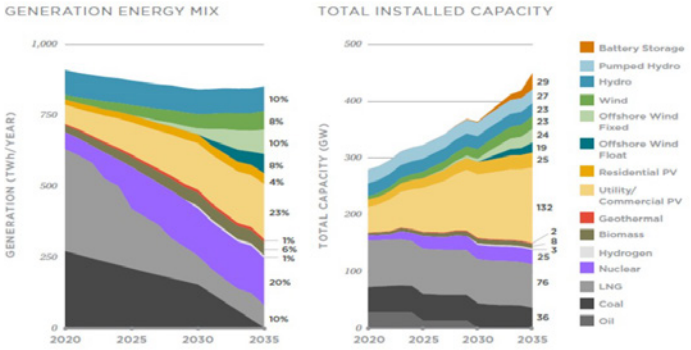
The Japan 2035 report from Berkeley LAB[20] presents one scenario, alongside other domestic and international analysis, in which a 90% clean energy grid that features accelerated solar and wind capacity additions, new battery storage, and new interregional transmission infrastructure can be combined with a small percentage of the existing fossil fuel-based generation capacity to dependably meet Japan's electricity demand, while maintaining planning reserve margin and operating reserves.

An addition of 116 gigawatt hours (GWh; 29 gigawatts for 4 hours) of battery storage and 11.8 gigawatts (GW) of new interregional transmission lines, coupled with existing flexible methods of generation (dispatchable hydropower, pumped hydropower, and natural gas), can cost-effectively contribute to balancing operation of a 90% clean energy grid, even during periods of low RE generation and/or high demand.

In this Clean Power Scenario, RE generated mainly from solar photovoltaic, (residential and utility scale), and wind sources (on-shore, off-shore and floating) forms the backbone of the system, totals 70% of annual electricity generation by 2035, Nuclear power and natural gas-fired power account for 20% and 10% of electricity generated, respectively.

All existing coal plants, which generated 32% of the total electricity supply in FY 2019, are phased out by 2035, and no new fossil fuel-powered plants are built.

The graph below shows the energy mix and the total capacity changes between 2020 and 2035.

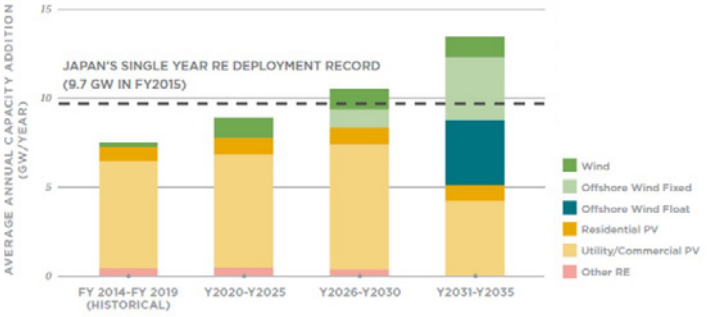


Source : Shiraishi et al., (2023) p.4 https://www.connaissancedesenergies.org/sites/connaissancedesenergies.org/files/pdf-actualites/lbnl_2035_japan_report_english_02.27.pdf

Scaling up renewables

Achieving a 90% clean electricity mix appears technically feasible under modelled conditions, however real-world deployment speed will be shaped by permitting processes, grid expansion, and construction timelines. Solar power additions are dominant in 2020s, while offshore wind's continued technology cost declines and high-capacity factors make it the dominant growth area in the 2030s. This shift to clean energy will require to rapidly break down institutional, market, and regulatory barriers, along with swift advancements in battery storage and interregional transmission lines to balance variable renewable energies generation against loads.

The graph below shows renewable capacity additions in the clean energy scenario.



Source: Shiraishi et al., (2023) p.7 https://www.connaissancedesenergies.org/sites/connaissancedesenergies.org/files/pdf-actualites/lbnl_2035_japan_report_english_02.27.pdf

This transformation will require coordinated institutional, market, and regulatory reforms to enable rapid change across Japan's power sector.

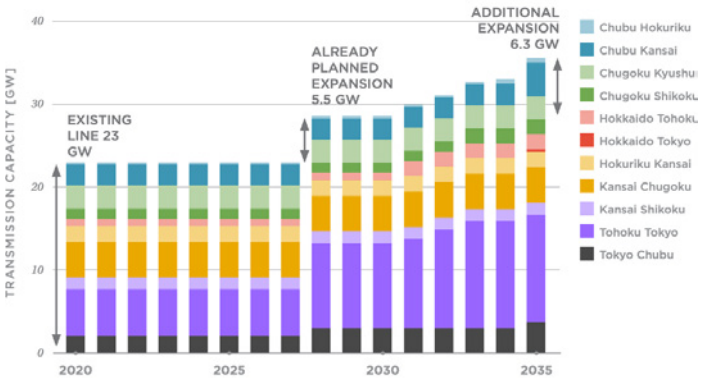
A rapid and cost-effective transition to a 90% clean energy grid depends on integrated and sustained policy support to overcome existing barriers.

Key priorities include:

- Consolidating support schemes such as feed-in tariffs, feed-in premiums, and auctions to streamline and accelerate renewable investment.
- Raising the carbon price to drive the phase-out of coal-fired generation.
- Reinvesting carbon revenues in research, development, and demonstration (RD&D) of technologies that enable a zero-carbon grid, such as storage, flexibility solutions, and advanced grid management systems.

Transmission capacity

The graph below shows the transmission capacity expansion by 2035 in the clean power scenario.



Source : Shiraishi et al., (2023) p.39 https://www.connaissancedesenergies.org/sites/connaissancedesenergies.org/files/pdf-actualites/lbnl_2035_japan_report_english_02.27.pdf

Rapid implementation of METI and the Organisation of Cross-regional Coordination of Transmission Operators' (OCCTO) JPY 7 trillion 'Master Plan' to strengthen interregional transmission lines which support regional access to Tokyo's energy market is needed. The plan includes a 6-8 GW transmission line to connect Hokkaido and Tokyo.

Nuclear

A 20% target for nuclear in the generation mix is technically feasible under certain assumptions but would require restarting 20 GW of capacity that's been offline since 2011, bringing all of Japan's 33 GW of installed nuclear capacity back into service.

Nuclear power should be positioned as a transitional and complementary source, maintained only until renewable capacity scales up sufficiently to ensure system reliability. Careful and transparent engagement will be essential to manage public concerns and maintain trust in the process.

Thermal power

The new analysis from ARE[21] examines the market forces reshaping Japan's electricity pricing and shows that ammonia co-firing cannot alter coal's declining financial trajectory.

The report predicts that Japan's coal-fired power generation is expected to become structurally unprofitable by early 2030s; this follows grid expansion and large-scale battery deployment being the primary forces, reshaping electricity pricing and driving the transition.

Regarding CCS, the government is planning to transport CO^2 that cannot be processed domestically to overseas for storage. The amount of emissions reduced by utilizing these technologies in the future is uncertain, and while continued exploration may be warranted, ensuring near-term emissions reductions requires steady progress in scaling renewable energy technologies that are already well-established, while acknowledging that additional solutions may be needed where deployment constraints bind.

Overall, the fast deployment of clean envergy sources required to achieve a 1.5°C pathway will require the pragmatic integration of a diverse set of solutions, adapting to both the challenges and the opportunities in the real-world.

Endnotes

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