Japan Clean Energy Policy Roadmap

SUMMARY BRIEF

Executive Summary

Japan's position as a cornerstone of the global economy rests on its technological leadership, advanced manufacturing base, and critical inputs to global supply chains. Developing and deploying clean energy to enhance Japan's energy security, economic efficiency, and environmental protection — in line with the country's "3E" framework — is a key measure for strengthening this position.

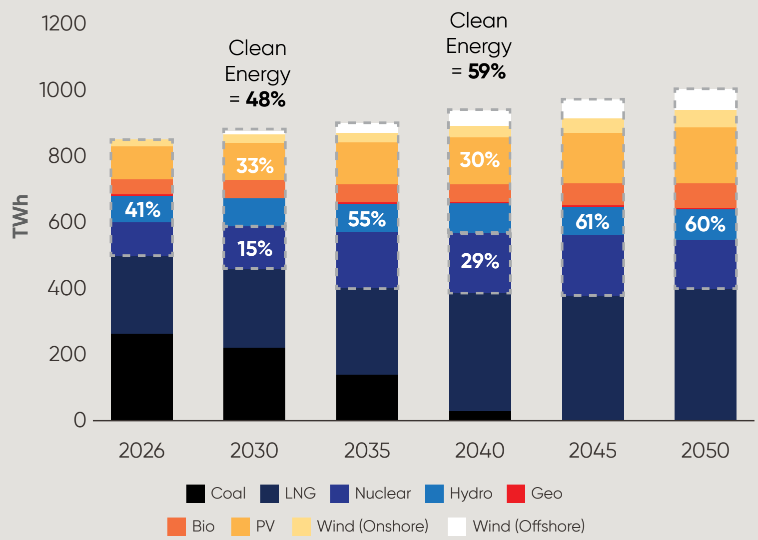
For the first time in decades, electricity demand from data centers and semiconductor fabrication plants is driving power load growth in Japan. At the same time, the largest corporate energy buyers have committed to powering their expanding operations with clean energy — some with targets as early as 2030. This momentum is reflected in Japan's growing corporate power purchase agreement (CPPA) market, which reached a record of **181 deals[1] totaling over 1 GW in 2025**. Taken together, these trends underscore the importance of corporate procurement as a key lever for mobilizing private capital at the scale necessary to accelerate clean energy deployment in Japan.

The **Corporate Energy Buyers Association** (CEBA) — a business association that activates the world's largest energy buyers and partners to advance low-cost, reliable, carbon emissions-free global electricity systems — developed the Japan Clean Energy Policy Roadmap to benchmark Japan's current and stated policy trajectory against its clean energy targets and to identify key policy and regulatory actions needed to close the gap.

1 This number includes only off-site PPA contracts with a capacity of 5 MW+. It does not cover undisclosed projects, and disclosed projects whose offtaker is unknown. Source: Renewable Energy Institute.

CEBA's analysis shows that under current and stated policies (the "Base Case"),[2] Japan will fall short of the targets set forth in its 6th and 7th Strategic Energy Plan (SEP) of at least 56% clean energy by 2030 and 60%–70% by 2040 (see Figure 1). These shortfalls undermine the 3E framework by prolonging reliance on imported fossil fuels and exposure to fossil fuel-related price volatility and risks, reducing economic efficiency and slowing the pace of greenhouse gas (GHG) emissions reductions. In addition, decisive near-term action is required to realize the Long-term Master Grid Plan ("Master Plan") of the Organization for Cross-regional Coordination of Transmission Operators (OCCTO) and to enable the deployment of clean energy and battery energy storage systems (BESS) at the scale and speed needed to meet Japan's energy, economic, and climate goals.

FIGURE 1:
Japan's Projected Power Generation Mix Under Current & Stated Policies (Base Case)



Note: *Clean energy refers to wind, solar, hydro, geothermal, biomass and nuclear power

Scenario Analysis

Using a supply-demand dispatch model designed for Japan's power sector, CEBA evaluated four plausible scenarios to accelerate clean energy deployment and/or address variable renewable energy (VRE) integration challenges like curtailment and interregional power-balancing constraints (see *Appendix* for more details). The four scenarios are:

BESS Expansion: Deploy BESS at sufficient scale to eliminate VRE curtailment and displace thermal generation currently needed for balancing and peak support.

Interregional Interconnection Expansion: Realize OCCTO's Master Plan and increase transmission capacity to major demand centers by 8 GW beyond the Master Plan in 2050 to promote grid flexibility and more efficient interregional balancing.

Clean Energy Expansion: Scale the generation of high-potential renewable and clean firm sources, including solar photovoltaic (PV), offshore wind, nuclear, and geothermal.

All Options: Pursue an integrated scenario that combines all three of the above scenarios to maximize system benefits.

Each scenario is modeled against the Base Case and assessed on its ability to grow the share of clean energy in Japan's power mix, with a particular emphasis on advancing the country's 3E framework. Through our analysis, we find that the All Options scenario yields the strongest outcomes through clean energy generation and BESS capacity expansion. This integrated approach would deliver the greatest increase in Japan's domestic energy supply and clean energy share — 5% by 2030 and 12% by 2040, relative to the Base Case — while reducing GHG emissions by 19% in 2030 and by 67% in 2040, relative to 2026 levels.

2 See *Appendix* for Base Case assumptions.

Key Results

Energy Security: Stable Domestic Clean Energy Supply

Increasing domestic clean energy supply delivers clear near- and long-term gains for energy security, while expanding BESS deployment supports VRE integration and grid reliability (see Figure 2).

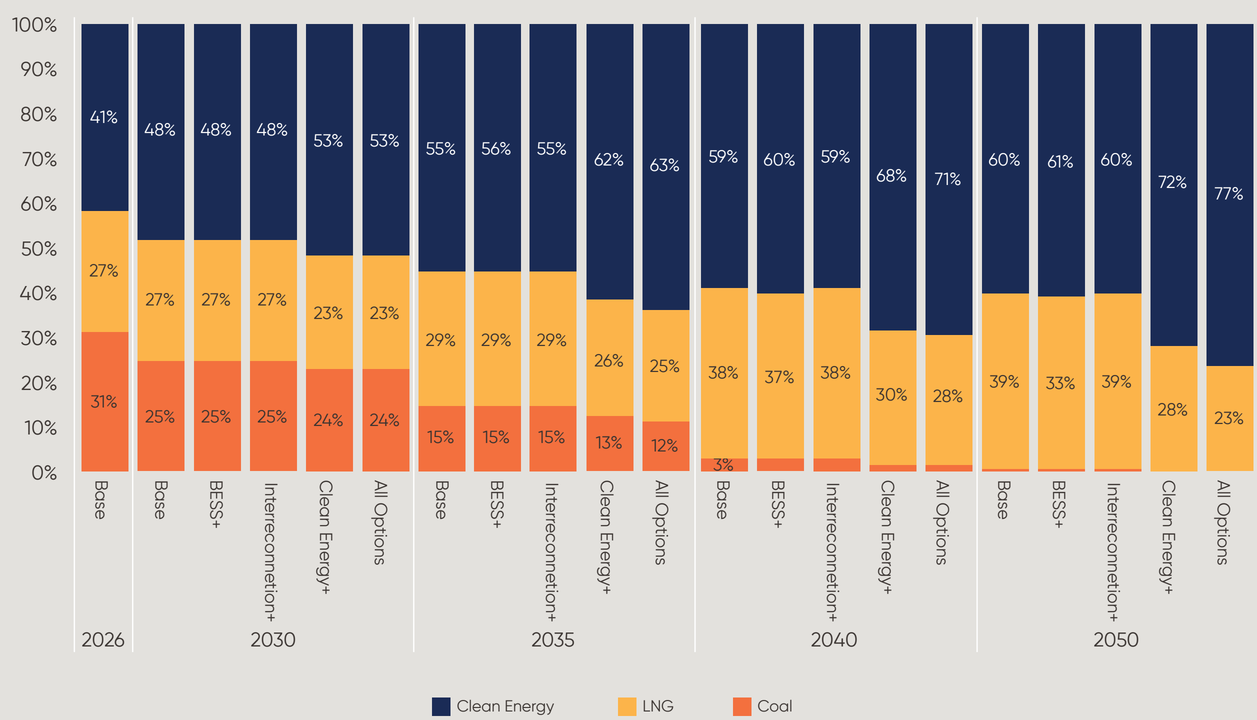
BESS Expansion: 31–43 GWh of BESS generation is required by 2030 to eliminate VRE curtailment. However, BESS expansion absent clean energy expansion yields no material increase in the clean energy share before 2040.

Interregional Interconnection Expansion: This scenario supports VRE integration and interregional balancing but yields no meaningful increase in the clean energy's share of generation.

Clean Energy Expansion: By deploying additional solar PV and offshore wind and restarting an additional 3 GW of existing nuclear capacity by 2030, a meaningful 4% reduction in imported fossil fuels is achieved. By 2040, this translates to a 9% reduction in fossil fuel generation and a 9% increase in the clean energy share of generation relative to the Base Case, ultimately raising Japan's energy self-sufficiency rate[3] to 68%.

All Options: When BESS deployment keeps pace with projected VRE curtailment resulting from increased clean energy generation, fossil fuel generation falls an additional 2%, while the clean energy share of generation rises an additional 2% by 2040. This allows Japan to exceed its 2040 target while reinforcing grid flexibility and reliability through VRE integration.

FIGURE 2:
Scenario Analysis Results of Japan's Power Grid Mix



3 Energy self-sufficiency is calculated as the share of energy supply produced domestically relative to total energy supply.

Economic Efficiency: Improving Wholesale Electricity Prices & Cost-Effectiveness

To measure the economic efficiency of each scenario, we analyzed effects on VRE curtailment and wholesale electricity prices, alongside required generation and grid investments as well as cost-effectiveness[4] of emissions reductions relative to the Base Case. **The All Options scenario results underscore that expanding both clean energy generation and BESS deployment is a cost-effective pathway to reducing GHG emissions while achieving Japan's SEP targets.**

BESS Expansion: This scenario improves economic efficiency by eliminating VRE curtailment and shifting low-cost renewable energy from periods of surplus to periods of higher demand, reducing reliance on higher-cost fossil fuel generation. In relation to the other scenarios, BESS expansion is the most cost-effective scenario.

Interregional Interconnection Expansion: In 2050, VRE curtailment falls, particularly in the lower-demand regions of Hokkaido, Tohoku, and Kyushu; however, a notable increase in wholesale prices relative to the other scenarios is also observed in Hokkaido and Kyushu. This demonstrates that while transmission expansion improves interregional balancing, it may increase electricity prices in exporting regions.

Clean Energy Expansion: Increasing clean energy generation to at least 470 TWh by 2030 — 45 TWh beyond the Base Case — results in a 4% reduction in average wholesale electricity prices, with additional cost savings anticipated from reduced reliance on imported fossil fuels. To achieve a level of clean power generation consistent with the 7th SEP, more than ¥82 trillion of public and private investment must be mobilized by 2030, followed by an additional ¥16–38 trillion between 2030 and 2040. However, increasing investment in clean energy absent BESS expansion substantially increases VRE curtailment from 2.1 TWh in 2030 to 8.2 TWh by 2040, reflecting growing grid and flexibility constraints that reduce overall economic efficiency (see Figure 3).

All Options: By 2040, the complementary expansion of clean energy generation and BESS improves cost-effectiveness by 5%, reducing abatement costs from ¥580 per kgCO_2 in the Clean Energy Expansion scenario to ¥550 per kgCO_2 (see Figure 4). By 2050, the All Options scenario delivers a 13% improvement in cost-effectiveness relative to the Clean Energy Expansion scenario.

FIGURE 3:
Annual Curtailment Rate of Renewable Energy in Japan

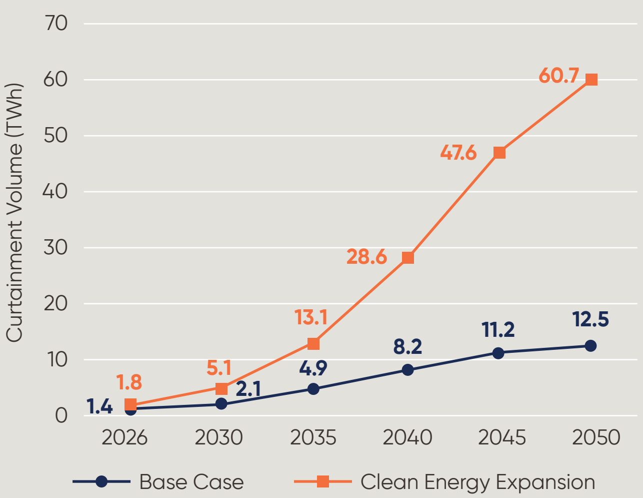


FIGURE 4:
Cost-Effectiveness Analysis Results Across Scenarios

Cost-Effectiveness (¥/kgCO2)			
	FY 2030	FY 2040	FY 2050
BESS Expansion	354	439	388
Interregional Interconnection Expansion	-	-	3722
Clean Energy Expansion	328	580	727
All Options	330	550	630

Cost-effectiveness is calculated in relation to the Base Case.
The Interregional Interconnection Expansion scenario does not yield any results until 2050, when 8 GW of new capacity is added, in relation to the Base Case.

4 Cost-effectiveness is defined as the cost per kilogram of GHG emissions abated, enabling a direct comparison of which scenario achieves emissions reductions at the lowest cost.

Environment: Reducing GHG Emissions

Simultaneously accelerating the expansion of clean energy generation and BESS in the All Options scenario delivers the largest GHG emissions reductions of all scenarios.

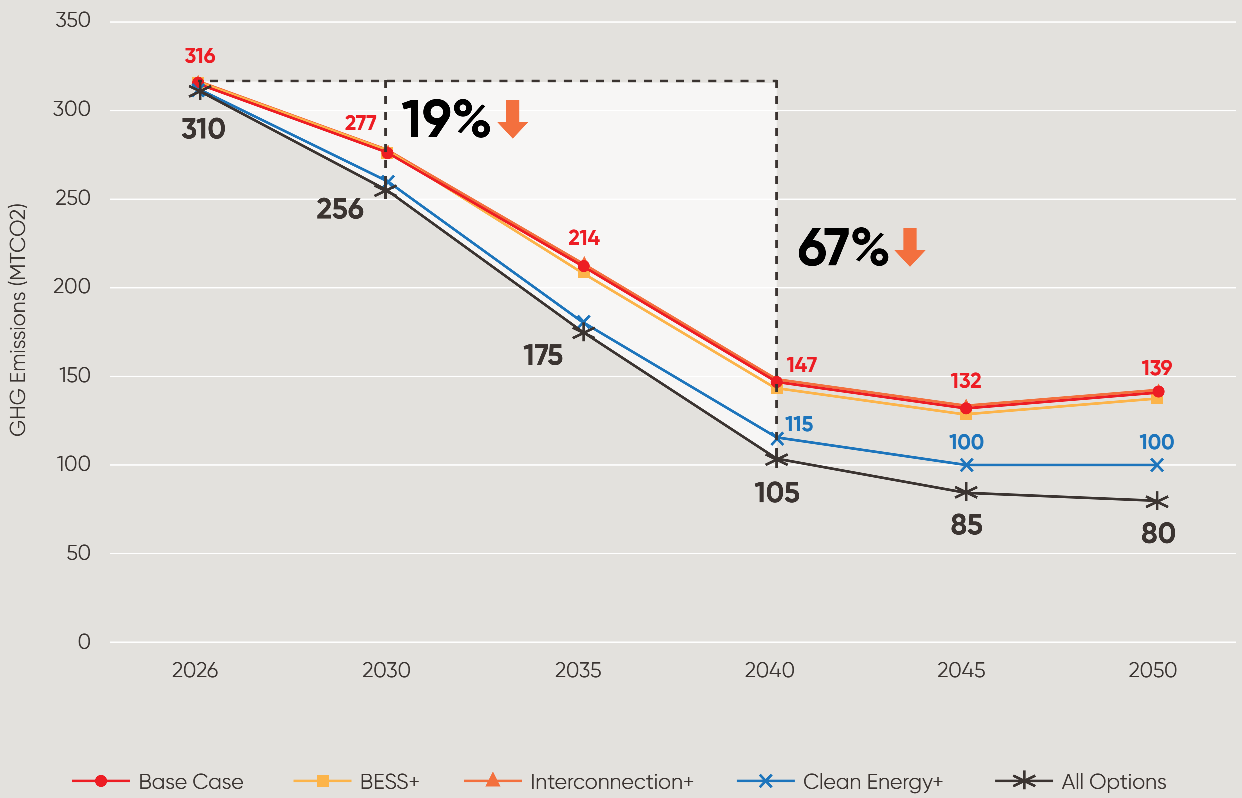
BESS Expansion: This scenario does not materially increase the clean energy share before 2040 and likewise yields no further GHG emissions reductions relative to the Base Case.

Interregional Interconnection Expansion: Even with the addition of 8 GW of new interregional interconnection capacity in 2050, there are no material changes in GHG emissions (less than 1 mtCO2 reduction) before 2050.

Clean Energy Expansion: This scenario achieves more than 30 mtCO2 in GHG emissions reductions by 2040 and the complete phaseout of coal-fired generation shortly thereafter, with lost generation from coal replaced by clean energy and lower-carbon LNG.

All Options: This scenario delivers an additional 50 TWh of clean energy generation by 2030 and 112 TWh by 2040, relative to the Base Case. Overall, this integrated approach achieves the greatest reduction in GHG emissions of all scenarios — 19% by 2030 and 67% by 2040, relative to 2026 levels (see Figure 5).

FIGURE 5:
GHG Emissions From Power Generation 2026-2050



Key Policy Actions for Realizing Scenario Results

As demonstrated in the All Options scenario, accelerating the expansion of both clean energy and BESS — while delivering on OCCTO's Master Plan for interregional interconnection expansion — is the most effective pathway to achieve or even exceed Japan's SEP targets.

Key policy actions for realizing the scenario results include:

CLEAN ENERGY EXPANSION

- **Strengthen corporate power purchase agreement (CPPA) market:** As highlighted in last year's paper from CEBA and the Asia Clean Energy Coalition (ACEC), key reforms to Japan's CPPA market include allowing corporate buyers to trade on the wholesale electricity market, boosting Japan Electric Power Exchange market liquidity, standardizing grid-related charges to improve cost predictability, strengthening ownership rules, and expanding the transferability of environmental attribute certificates.
- **Enhance feed-in-premium (FIP) market:** Consider introducing measures such as negative pricing to better reflect power system conditions and provide stronger investment signals. For large-scale solar projects that have already obtained FIP certification, a grandfather clause might be introduced to allow the projects to continue under the current Environmental Impact Assessment process.
- **Improve grid interconnection process:** Publish transparent and granular interconnection capacity maps to reduce uncertainty and shorten lead times.
- **Accelerate nuclear restarts:** Restart all inactive nuclear power plants by 2037 to align with required clean energy expansion.
- **Mobilize around offshore wind:** Launch a coordinated national effort to accelerate progress toward the Public-Private Council for Offshore Wind Power's upper target of 45 GW by 2040, including streamlined permitting and siting within Japan's exclusive economic zone, alongside investment in floating wind technology, domestic supply chains, and port and grid infrastructure.
- **Reform land-use regulations:** Enable solar development on abandoned agricultural land and other underutilized sites to deliver near-term gains for clean energy expansion.

BESS EXPANSION

- **Promote revenue diversification:** Scaling BESS deployment to reduce curtailment and support VRE integration requires a regulatory framework that compensates grid-scale storage for its value-added benefits and provides durable revenue streams to improve project bankability and investment readiness. Key actions include establishing an incentive scheme to reduce curtailment through grid-scale storage deployment, enabling negative pricing for greater energy arbitrage, and ensuring flexible and clear value-stacking rules.
- **Streamline interconnection process:** Prolonged grid connection application procedures and timelines have emerged as a major bottleneck for BESS projects. Streamlined, transparent, and time-bound interconnection procedures are needed to reduce project lead times, lower development risk, and accelerate deployment at scale.

INTERREGIONAL INTERCONNECTION EXPANSION

- **Enable cost recovery:** To mobilize the capital required for infrastructure expansion and improvement — including investments in dynamic line rating, grid-enhancing technologies, and artificial intelligence-enabled optimization — a clear, credible cost recovery framework should be established by 2030 so utilities and developers can confidently pursue projects aligned with OCCTO's Master Plan without unduly burdening ratepayers.

Appendix: Approach & Methodology

Modeling Approach

Developed in 2016, the load dispatch simulation model employed for this study can simulate electricity supply, demand, and wholesale market outcomes in Japan during all 8,760 hours of the year under a range of policy and market scenarios. The model dispatches generation by order of marginal cost to meet hourly demand, enabling detailed analysis of wholesale electricity prices, generation volumes by technology, and renewable energy curtailment by region. Additionally, by incorporating regional balancing requirements and the operational rules governing interregional transmission lines for all of Japan's transmission and distribution areas except Okinawa, the model can simulate both intraregional balancing and interregional power exchanges.

Key model limitations include:

- Is not designed to quantify cumulative historical investment levels
- Focuses on medium- to long-term system outcomes and therefore is not suitable for analyzing short-term operational constraints or real-time price volatility
- Does not capture secondary macroeconomic impacts
- Does not endogenously simulate feedback loops (e.g., reduced renewable deployment in response to high curtailment, accelerated deployment driven by cost declines)

Base Case Assumptions

Assumptions are grounded primarily in METI's 7th Strategic Energy Plan (SEP) and OCCTO's Master Plan and **Electricity Supply Plan**. In general, where Japanese policy guidance becomes less explicit beyond the mid-2030s, the assumptions align with the International Energy Agency's World Energy Outlook (WEO) 2024 Stated Policies Scenario (STEPS).

Electricity demand: Electricity demand is based on OCCTO's 2025 demand forecast, which projects 0.6% average annual growth through 2034, or 5.5% cumulatively. Beyond 2034, demand follows the 7th SEP's "Limited Progress Scenario," reaching approximately 940 TWh by 2040. From 2041 to 2050, demand follows WEO 2024 STEPS.

Nuclear energy: A more conservative outlook is adopted than implied in the 7th SEP. Total operational nuclear capacity peaks at approximately 28 GW in 2037, followed by 4 GW of decommissioning beginning in 2045.

Renewable energy: Deployment through FY2034 is based on OCCTO's Electricity Supply Plan and thereafter on WEO 2024 STEPS. However, onshore wind targets are based on the 6th SEP, while offshore wind is based on individual project commitments through 2034. Afterward, offshore wind is based on the status of designated development zones through 2037 and then assumed to reach 20 GW by 2040.

Energy storage: BESS deployment through 2030 reflects existing installations, announced policies, budget allocations, and auction outcomes. From 2031 onward, BESS deployment follows WEO 2024 STEPS. Under these assumptions, cumulative BESS installations reach approximately 26 GWh by 2030 and 64 GWh by 2050.

Thermal power: Coal-fired power plants are generally assumed to be retired after 35 years of operation, except for units classified as supercritical, which are allowed extended operation consistent with current policy treatment.

Fuel prices: Fuel price assumptions are based on World Bank commodity price forecasts and WEO 2024 STEPS projections.

Interregional interconnection: Expansion of interregional transmission capacity follows OCCTO's Master Plan.

Carbon pricing: Carbon price trajectories are based on EU-level prices assumed in WEO 2024 STEPS, informed by projections of renewable energy surcharges and petroleum and coal tax revenues under Japan's GX Promotion Act. Under these assumptions, the carbon price reaches approximately ¥5,000/tCO_2 in 2035, doubles by 2040, and rises to more than ¥24,000/tCO_2 by 2050, consistent with EU benchmarks.