Platinum Renewable Energy Industry Initiative

2050 Energy Vision

Platinum Society Network

March 2026

Contents

1. Platinum Society Network

Hiroshi Komiyama, former President of the University of Tokyo, established the Platinum Vision Network in 2010 with the aim of addressing Japan's complex societal challenges through private-sector–driven initiatives. The Network brings together diverse individuals and organizations to collaboratively develop and implement solutions.

At the outset, in order to accurately identify the issues confronting Japan, Dr. Komiyama introduced the concept of Japan as a "country at the forefront of emerging challenges." This concept subsequently evolved into a vision of Japan as a leading problem-solving nation. Since then, numerous individuals and organizations have contributed to identifying key challenges, formulating solutions, and advancing the social implementation of concrete projects.

In December 2024, the Renewable Energy Industry Initiative was launched as one of the central efforts to further this problem-solving agenda. This document outlines its purpose, scope, implementation framework, required policy measures, and principal projects.

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2. Concept and Rationale of the Renewable Energy Industry Initiative

Global average temperatures continue to rise due to greenhouse gas emissions associated with industrialization, leading to increasingly severe impacts on the climate, marine environment, and ecosystems. In recognition of the seriousness of this issue, the international community adopted the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, establishing a foundation for coordinated global action. Since 1995, the Conference of the Parties (COP) has convened annually to advance international consensus on emissions reduction and to assess progress made by participating countries.

At COP21 in 2015, the Paris Agreement was adopted with the aim of limiting the global temperature increase to well below 2°C above pre-industrial levels and pursuing efforts to limit it to 1.5°C. Today, many countries are undertaking ambitious decarbonization efforts aligned with their respective circumstances and capacities.

However, variations in economic structure, energy resources, social conditions, and political priorities mean that pathways toward these goals are far from uniform. Japan has been advancing its decarbonization efforts as well, yet its progress is often perceived as slower than that of some European countries. In response, we are conducting comprehensive, sector-specific analyses to clarify the necessary actions and to identify how Japan can accelerate its transition.

3. Toward a Circular Material Society Beyond Fossil Fuel Dependence

Anchored in the 1.5°C target, many industrial sectors are pursuing technological innovation and transformations in production systems and product design to achieve carbon neutrality. While these initiatives represent significant progress, we view the required shift as a far broader, historic transformation at the planetary scale.

Long before the Industrial Revolution, humanity extracted minerals, refined and synthesized materials, produced metal tools, and enhanced agricultural and industrial productivity. Following the Industrial Revolution, these processes evolved into mechanized industries, railways, and automobiles, giving rise to a societal structure founded on mass production, mass consumption, and the pursuit of convenience and comfort. Throughout this trajectory, fossil resources were extracted and consumed in vast quantities, and greenhouse gases were continuously emitted. Consequently, developed countries bear substantial historical responsibility for the degradation of the global environment.

At the same time, even energy systems long reliant on fossil fuels are beginning to show pathways toward stable substitution through the appropriate integration and coordinated control of renewable energy.

Moreover, cities have already accumulated vast material stocks. The medals for the Tokyo 2020 Olympic and Paralympic Games, produced from smartphones and other small electronic devices donated by citizens, symbolize this shift. These urban “mines” include not only rare metals but also materials that are approaching saturation—such as iron, glass, and plastics. With effective recovery and circulation systems, these urban resources can exceed natural mines in both material quality and energy efficiency.

The prolonged global expansion of excessive production, consumption, and large-scale energy use under this “extractive civilization” has directly contributed to the planetary conditions that now necessitate urgent climate action.

プラチナ構想ネットワーク

4. Backcasting Methodology

The above sections outline the core concept of the Renewable Energy Industry Initiative. We have set 2050 as our target year and aim to build a society in which the majority of Japan's total energy demand is met by domestic renewable energy. This vision is intended to serve as a guiding foundation for government policy and corporate strategy.

To achieve this transformation, we clearly define the desired state in 2050 and apply a backcasting methodology, tracing the pathway from that future point back to the present.
We assume that total electricity demand in 2050 will be approximately 2,000 TWh, with more than 1,600 TWh supplied by domestic renewable energy. On this basis, we estimate sectoral demand patterns, supply capacity, and the overall supply–demand balance.

Assuming maximum utilization of domestic renewable energy, we spent roughly one year analyzing supply, demand, and system-balancing requirements. In both urban areas and industrial facilities, expanded deployment will proceed alongside rigorous energy conservation and efficiency improvements, and systems incorporating resource circulation are also envisioned. Our estimates include both building-integrated solar PV and agrivoltaics.

Haruo Shimada
Chairperson, Steering Committee, Platinum Renewable Energy Industry Initiative
Professor Emeritus, Keio University / Former President, Tokyo Metropolitan University

1

Introduction

Purpose of the Vision | Scope and Approach | Key Points

プラチナ構想ネットワーク

Transition from a Fossil Fuel–Dependent Civilization

Achieving carbon neutrality by 2050 requires a fundamental shift to decarbonized energy.

Japan, with its high reliance on fossil fuels, will transform its own economy and lead the transition toward a sustainable future.

Achieving Energy Self-Sufficiency Through Indigenous Energy Sources

Transform Japan’s energy supply structure to one centered on renewable energy, enabling domestic energy production.

This transformation also strengthens energy security.

Accelerated Deployment of Renewable Energy

Design a 2050 energy supply-and-demand vision and the roadmap to reach it.

In parallel, implement swift action to drive Japan’s Green Transformation (GX).

プラチナ構想ネットワーク

1

Formulate the “2050 Vision”

Articulate the ideal future of Japan’s renewable energy industry and share this vision broadly with citizens, businesses, and government.

2

Identify Priority Energy Technologies

Identify the key energy technologies that require focused development to realize the 2050 energy supply–demand vision.

3

Develop Policy Recommendations

Clarify necessary regulatory and legislative reforms, propose government roles and policy priorities, and establish an effective implementation structure to enable social implementation and viable business models.

4

Accelerate Early Deployment of Renewables

Without waiting for the full completion of the vision or roadmap, promptly launch leading initiatives aligned with its direction and foster broad social consensus to advance the democratic transition to renewable energy.

Key Points

Assumption	Assume total energy demand in 2050 will reach 2,000 TWh, with more than 80% (1,600 TWh) supplied by domestic renewable energy.(Figures will be reviewed and updated as analysis progresses.)
Approach	Define the 2050 vision and derive required actions through a backcasting approach, examining not only the end state but also the transition pathway.
Technology	Base the vision on realistic forecasts and achievable technological progress.Exclude highly uncertain technologies, such as nuclear fusion.Also consider the potential residual role of fossil fuel technologies in 2050.
Legal Framework	Propose a cross-ministerial legal framework that supports domestic market growth.
Comprehensive Social Deployment Strategy	Aim for integrated societal implementation encompassing technologies, legal frameworks, social systems, business and investment models. - Redirect national savings and investment toward domestic renewable energy and energy self-sufficiency. - Encourage capital flow into primary industry operators and regional energy companies. - Support corporate ownership and shared-use models for high-efficiency energy systems to reduce upfront costs.

2

Governance and Initiative Framework

Steering Committee and Subcommittees

プラチナ構想ネットワーク

Steering Committee

Oversees the overall direction and subcommittee activities

Subcommittee

Deepen discussions in line with the Steering Committee's direction

Demand Subcommittee

Reviews energy demand for 2050.

Supply Subcommittee

Analyzes renewable energy capacity and annual generation in 2050.

Supply–Demand Stabilization Subcommittee

Examines systems that contribute to supply-demand stability.

Consensus Subcommittee

Examines policy measures and regulatory reforms to promote social consensus, based on the successes and challenges of renewable energy projects.

Steering Committee

Chairperson	Haruo Shimada	Keio University Tokyo Metropolitan University	Professor Emeritus Former President	–
Vice Chairperson	Hiromichi Iwasa	Mitsui Fudosan Co., Ltd.	Executive Advisor	–
Vice Chairperson	Atsumi Kanaya	Mitsui Fudosan Co., Ltd.	Managing Officer and Chief Operating Officer Sustainability Promotion Division	–
Vice Chairperson	Hiroshi Okamoto	TEPCO Power Grid, Inc.	Member of the Board, Executive Vice President, and Chief Technology Officer	–
Vice Chairperson	Hiroshi Komiyama	Platinum Society Network	President	–
Vice Chairperson	Masakazu Sugiyama	The University of Tokyo	Director and Professor, Research Center for Advanced Science and Technology	–
Vice Chairperson	Yukari Takamura	The University of Tokyo	Professor, Institute for Future Initiatives	–
Vice Chairperson	Kenji Murai	Tokyu Corporation Tokyu Power Supply Co., Ltd.	Executive Officer and Executive General Manager, Social Infrastructure Division President	**Demand**
Vice Chairperson	Hirotaka Mitsui	Tokyu Power Supply Co., Ltd.	Technical Advisor	**Demand**
Vice Chairperson	Kazumichi Matsumoto	Kyushu Electric Power Co., Inc.	Executive Officer and General Manager of the Research Institute, Technical Solution Headquarters	**Supply**
Vice Chairperson	Nobuaki Nara	Tokyo Steel MFG. Co., Ltd.	President	**Supply-Demand Stabilization**
Vice Chairperson	Tatsuya Okubo	The University of Tokyo	Presidential Advisor and Director, Center for Strategic Promotion of Green Transformation	**Consensus**
–	Takeshi Shirota	Chubu Electric Power Miraiz, Inc.	General Manager, Solution Service Division	–
–	Toru Takakura	Sumitomo Mitsui Trust Group, Inc.	Director and President, Representative Executive Officer and CEO	–

Names are listed in Japanese alphabetical order without honorifics. Sub-leaders of each subcommittee are also included as members.

Subcommittee

Group	Role	Name	Organization	Title
Demand	Leader	Kenji Murai	Tokyu Corporation Tokyu Power Supply Co., Ltd.	Executive Officer and Executive General Manager, Social Infrastructure Division President
		Hirotaka Mitsui	Tokyu Power Supply Co., Ltd.	Technical Advisor
	Deputy Leader	Toru Asai	Heat Pump & Thermal Storage Technology Center of Japan	Executive Director
		Katsuhiko Kawazoe	NTT, Inc	Representative Member of the Board, Senior Executive Vice President, and Chief Technology Officer
		Hideto Sakata	Dai Nippon Printing Co., Ltd.	Corporate Officer and General Manager, R&D and Engineering Management Division, Technology Development Center
		Satoru Matsuda	Daikin Industries, Ltd.	Deputy General Manager, Air Conditioning Sales Division, and General Manager, Equipment Sales Department
Supply	Leader	Kazumichi Matsumoto	Kyushu Electric Power Co., Inc.	Executive Officer and General Manager of the Research Institute, Technical Solution Headquarters
	Deputy Leader	Tomokazu Akita	i Grid Solutions Inc.	Head Office
		Takuzo Shimizu	Penta-Ocean Construction Co., Ltd.	resident, Chief Executive Officer, and Representative Director
		Hiroshi Segawa	The University of Tokyo	Professor, Komaba Organization for Educational Excellence Director, Special Division of Environmental and Energy Sciences
		Takeshi Sekiguchi	Shimizu Corporation	Executive VicePresident and Director
		Katsushi Tsujimura	Kubota Corporation	General Manager, Business Innovation Unit Agri Solution Headquarters
		Go Banzashi	AGC Inc.	Senior Manager, Business Exploration Group, Business Development Division
		Ken Fujita	Toda Corporation	Executive Vice President, and Group General Manager, Civil Engineering Business Group
		Takeshi Magami	Chiba Ecological Energy Inc.	President

All names are listed in alphabetical order. Honorifics omitted, names in alphabetical order. In addition to the above, each participating organization is included in the membership.

Subcommittee

Subcommittee	Role	Name	Organization	Title
Supply–Demand Stabilization	**leader**	Nobuaki Nara	Tokyo Steel MFG. Co., Ltd.	President
	Deputy Leader	Toru Asai	Heat Pump & Thermal Storage Technology Center of Japan	Executive Director
		Yoshihiko Ichikawa	Sumitomo Corporation	Head of Cross-industrial Collaboration & Development Unit, Energy Transformation Group
Consensus	**leader**	Tatsuya Okubo	The University of Tokyo	Presidential Advisor and Director, Center for Strategic Promotion of Green Transformation
	Deputy Leader	Tatsuya Kameda	Meiji Gakuin University	Director, Center for Interdisciplinary Informatics and Professor, Faculty of Mathematical Informatics
		Kosaku Nagano	Kaneka Corporation	Excective Fellow
		Mariko Hasegawa	Japan Arts Council The Graduate University for Advanced Studies, SOKENDAI	President Professor Emeritus
		Takeshi Magami	Chiba Ecological Energy Inc.	Representative Director
		Toru Miyake	Dai Nippon Printing Co., Ltd.	Senioe Managing Director

All names are listed in alphabetical order. Honorifics omitted, names in alphabetical order. In addition to the above, each participating organization is included in the membership.

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構想ネットワーク

3

Energy Supply and Demand in 2050

Summary

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Demand

Industry | Commercial | Residential | Transport

Projected demand in 2050 : **1,999 TWh – 2,092 TWh**

Approximately 80% supplied by renewable energy

Supply–Demand Stabilization

Supply and Demand Adjustment Measures

Characteristics and issues of promising technologies that contribute to supply and demand adjustment in the short-, medium-, and long-term

Load-Increase DR Study

Although load-increase DR is highly effective in addressing curtailment, it cannot eliminate all curtailment, and additional measures such as battery storage will still be required.

Supply

Solar PV 728 TWh
- Promotion of agrivoltaics
- Maximize building installation
- Expanding application areas for next-generation photovoltaic power generation

Wind 640 TWh
- Design a system that generates stable, long-term income .
- Regional symbiosis , including those involved in the fishing industry
- Publicly owned and privately operated base port development
- Establishment of offshore wind power supply chain, industrialization of recycling, fostering of domestic manufacturers
- Development of electric carriers and development of deep-water areas

Hydro 126 TWh
- Effective use of existing dams

Geothermal 90 TWh
- Development of deep, supercritical geothermal power generation
- Promotion of Closed Loop
- Mountainside PV replacement by deep geothermal

Bioenergy 53 TWh
- Establishment of Wood Cycle

Consensus

Definitions and policies for the general public and industry are discussed and the following measures are planned

Consensus building and Behavior change: Communicate the vision of the Initiative to university students and consider ways to encourage them to take action on renewable energy.

Regulatory reform and Policy Advocacy: Participated in the "Consortium for Social Implementation of Agrivoltaics" to focus on agrivoltaics and to study its policies.

3.1

Demand

Objective

- Shift Japan's energy supply-demand structure away from "fossil imported energy" such as oil, coal, and natural gas and toward "domestically produced renewable energy“.
- The total energy demand in 2050 is set at 2,000 TWh and the supply from domestic renewable energy is set at 1,600 TWh.
- Assuming supply from renewable energy, including hydrogen (or ammonia), etc.
  Estimate energy use patterns and demand by sector (industry, business, residential, transportation) in 2050.Decarbonization of current non-electricity demand is the basis for the study.

Consideration Points

Examine measures to convert each form of fossil energy use in Japan to domestically produced renewable energy

- Heat pumps for low-temperature heat demand in the commercial and residential sectors.
- Electrification of the transportation sector (passenger cars, conversion of buses and trucks to electric vehicles, etc.).
- Industrial Sector
  - Use as raw material (non-energy use)
    Steel industry, coal and coke from blast furnaces and crude oil from petrochemicals converted to renewable electrolytic hydrogen.
  - Fuel for power generation
    Convert fuel for thermal power plants, in-house power generation and cogeneration to domestic renewable energy.
  - Direct heat utilization of fossil fuels
    Converting fuel for heating and combustion furnaces, and generated energy for steam and hot water boilers to heat pumps, electric furnaces, and renewable energy electrolytic hydrogen boilers.

Results

Assumed demand

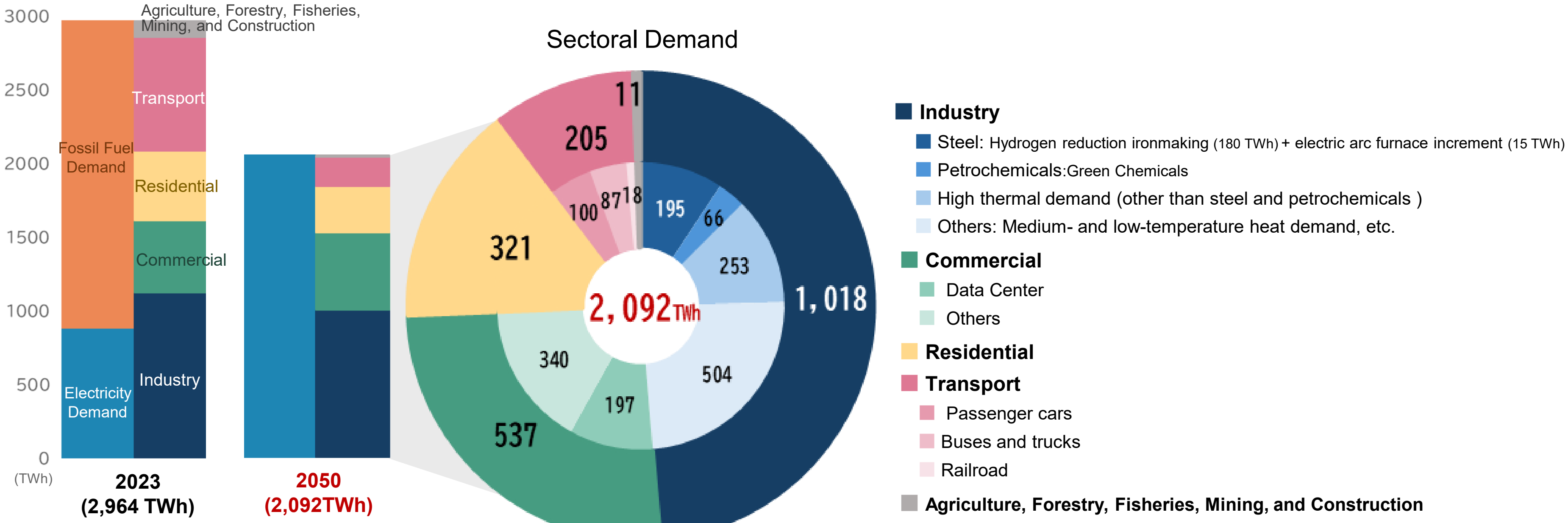
Demand in 2050 was estimated for each of the following sectors: industrial, commercial, residential, and transportation .

- Current Situation(2023) 862 TWh
- **Future(2050) 1, 999 TWh – 2,092 TWh**

Future actions

- High-temperature heat demand in the industrial sector was assumed to be hydrogen combustion (or ammonia), buses and trucks were assumed to be BEVs, and transportation fuels such as aviation and ships and fuels for agriculture, forestry, fisheries, mining and construction were assumed to be biomass fuels, but these will be further examined as necessary.
- We will continue to monitor the magnitude of data center power demand in 2050.
- Consideration will also be given to addressing electrification barriers. Even if electrification is not technically problematic, other factors (cost, existing infrastructure, lack of expertise, etc.) may be a constraint, and the enhancement of subsidy programs and policies may be important.

- The energy demand in 2050 is projected to be 2,092 TWh, but electrification-driven energy efficiency improvements will reduce this figure by 30% compared with 2023.
- For steel (excluding electric arc furnaces), petrochemicals, and high-temperature heat demand (excluding steel and petrochemicals), it was decided to meet these needs through combustion using hydrogen produced by water electrolysis.



Of the fossil fuel consumption in 2023, aviation (3.5 TWh) and ships (26.5 TWh) in the transportation sector and agriculture, forestry, fisheries, mining and construction (99.4 TWh) in the transportation sector are assumed to be biomass fuels in 2050.

プラチナ構想ネットワーク

The incremental electricity demand for each sector compared to the current situation is shown below.

Industry Sector

Breakdown of Incremental Electricity Demand	Electricity demand (TWh) 2023	Electricity demand (TWh) 2050
● Heat demand in low temperature range (below 100˚C) ,mainly hot water demand 100% conversion to heat pumps [21.4 TWh].	294	**925-1,018 (3.1-3.5x)**
● Heat demand in the medium and low temperature range (100˚C-180˚C) ,mainly steam demand 100% conversion to heat pumps [94.8 TWh]. Or 100% conversion to renewable energy electrolytic hydrogen boilers [188.2 TWh].		
● Steel Industry Crude steel production in 2050 is assumed to be 90 million tons (current 83 million tons) ⇒ 50% produced by hydrogen reduction ironmaking, 50% by electric furnace [195.0 TWh].		
● Petrochemical 9.72 million tons of resin use (currently from petroleum such as propylene) in 2050 will be recycled. 6 million tons, the remaining 3.72 million tons to green chemicals ⇒ 3.72 million tons converted to green chemicals with hydrogen [66.2 TWh].		
● Industrial heating other than the above Converted to high-temperature, high-pressure steam or heating furnace by hydrogen combustion [253.2 TWh].		

プラチナ構想ネットワーク

Commercial

Breakdown of Incremental Electricity Demand	Electricity demand (TWh)	
	2023	**2050**
● All heat demand 100% conversion to heat pumps [66.5 TWh] ● Data center power demand Adopts Central Research Institute of Electric Power Industry's forecast as of 2025 [177.0TWh] Estimating power demand is an issue and may be revised upward or downward.	294	**537 (1.8x)**

Residential

Breakdown of Incremental Electricity Demand	Electricity demand (TWh)	
	2023	**2050**
● Heat demand for hot water, heating, and kitchen 100% conversion to heat pumps [74.0 TWh]	247	**321 (1.3x)**

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Transport and others

Breakdown of incremental electricity demand	Electricity demand (TWh)	
	2023	**2050**
● Passenger cars Convert to 100% electric vehicles [102.0 TWh] ● Buses and Trucks Although it differs depending on whether it is a green hydrogen FCV or BEV and requires closer scrutiny, assumed BEV this time [86.5 TWh] ● Railways Current passenger electrification rate: 91%, freight electrification rate: 71% ⇒ 100% electrification [2.1 TWh] ● Aviation and Shipping biomass fuel. Fuel development is the key.	16	**205 (12.8x)**
● Agriculture, Forestry, Fisheries, Mining, and Construction Assumes that biomass fuel will be used for the increase	11	**11 (1.0x)**
Total	862	**1,999-2,092 (2.3-2.4x)**

3.2

Supply

プラチナ構想ネットワーク

Objective

- The goal is to "shift from a civilization dependent on fossil fuels" and to "domestically produce Japan's energy resources," 80% of which are to be secured from domestically produced renewable energy.
- There are many issues to be addressed to promote the introduction of renewable energy, such as restrictions on the locations where it can be introduced and its cost and economic efficiency. In order to realize our goals speedily and reliably, we will take a comprehensive and concrete approach by making full use of all possible means, including technology development, business model building, and institutional design.

Consideration Points

- Supply assumption: Assumed installed capacity and generation of renewable energy in 2050
- Developing supply potential: Examine issues and solution directions with high-impact projects to realize goals.

Assumption

- **Electricity demand in 2050 is assumed to be 1,999 TWh - 2,092 TWh.**
- **80%** of total electricity demand **(1,636 TWh) is supplied by domestic renewable energy**
- **Targeted power sources: solar PV, wind, hydro, bioenergy, geothermal,**
  *Storage energy mainly for variable renewable energy(pumped storage, storage batteries, demand esponse, hydrogen)
- Other sources include nuclear power, natural gas-fired power assuming CCUS

Results

- **Assumption of renewable energy supply in 2050**
- **Developing Supply Potential**

Future actions

- Scrutinize supply and demand assumptions: by 10 regions, by 8,760 hours (24 hours x 365 days)
  Utilize optimal facilities planning model and hourly economic feed-in model in collaboration with UC Berkeley
- Acceleration of concrete actions in the development of supply potential e.g. "Consortium for Social Implementation of Agrivoltaics

プラチナ構想ネットワーク

Solar PV	Assumes that about one-third of the potential (1,876 TWh) indicated by REPOS[1] will be realized Particular emphasis on agrivoltaics, to be realized on 5% (approx. 250,000 ha) of the nation's farmland, pasture land, and abandoned farmland (5.1 million ha).
Wind	Onshore wind (30% capacity factor): **15%** of REPOS's estimated potential realized. Offshore wind (Fixed-bottom, 35% capacity factor): **10%** of offshore grid's potential realized. Offshore wind (Floating, 35% capacity factor): **5%** of offshore grid's potential realized. EEZ (0-300m, 35% capacity factor): **3%** of offshore grid's potential realized. EEZ (300-2000m, 40% capacity factor): **1%** of offshore grid's potential realized.
Hydro	Based on JAPIC[2] information, etc., incorporate **existing + hybrid dam (operation upgrading, raising)**
Bioenergy	Assumed based on **existing (5 GW) + certified (8.2 GW**) installed capacity (40% facility utilization)
Geothermal	**10% of the approximately 140 million kW geothermal potential** including EGS[3] estimated by NEDO[4] will be realized
Pumped Storage Storage Batteries DR Hydrogen	Maximize the use of the excess of variable renewable energy (solar PV and wind), subject to technological innovation and efficient and effective deployment of electricity storage means. Assumption that the excess supply (20%) of variable renewable energy in 2050 on a 8,760-hour basis will be stored by pumped storage, storage batteries, DR, and hydrogen, of which 70% will be effectively utilized (tentative, to be refined).

1 Ministry of the Environment: Renewable Energy Information Provision System
2 Japan Project Industry Council
3 New Energy and Industrial Technology Development Organization
4 Next-generation geothermal power generation (Enhanced Geothermal System)

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	Installed capacity (GW)	Annual power generation (TWh)
Solar PV	639	728
Wind	216	640
Hydro	37	126
Bioenergy	15	53
Geothermal	15	90
Total	922	1,636

- Breakdown of wind power generation

	Installed capacity (GW)	Annual power generation (TWh)
Onshore wind	73	191
Offshore wind (Fixed-bottom)	30	90
Offshore wind(Floating)	53	163
EEZ(0-300m)	41	125
EEZ(300-2000m)	20	70
Total	216	640

1. Assuming that 80% of the demand estimated by the Demand Subcommittee (2,046 TWh, the middle value between 1,999 and 2,092 TWh) will be supplied by renewable energy.
2.Solar PV: Assumes that about one-third of the potential indicated by REPOS will be realized.
3.Wind: Assumed based on the potential from REPOS and offshore power grids (15% manifestation rate for onshore wind and 10% manifestation rate for landing-based offshore wind, Floating offshore wind manifestation rate 5%, EEZ (0-300m) manifestation rate 3%, EEZ (300-2000m) manifestation rate 1%.)
4.Hydro: Based on JAPIC information, etc., incorporate existing + hybrid dam (operation upgrading, raising)
5.Bioenergy: Assumed by existing + certified installed capacity
6.Geothermal: 10% of geothermal potential including EGS (next generation geothermal power generation) is assumed to be realized.
7.It is assumed that the excess output of variable renewable energy (solar PV and wind) will be about 20%, and that 70% will be effectively utilized by storing energy through pumped storage, storage batteries, DR, and hydrogen.
8.Other power sources are assumed to be
Nuclear: 220-240 TWh (11% of total 2050 supply of 2,092 TWh)
Natural gas-fired power based on CCUS: 8-9% of total supply in 2050
9.Rounding errors may cause discrepancies between item totals and the overall total.

- Assumption of solar PV generation by installation location
  - Overall solar PV potential is about 1/3 of the potential indicated by REPOS (especially expected for agrivoltaics and building installations).
  - Agrivoltaics is realized on 5% (250,000 ha) of farmland, pastureland, and abandoned farmland

  *Conversion efficiency of 30%, shading rate of 35%, and equipment utilization rate of 13% were used in the calculations.
  Other installation locations are assumed based on estimates by the Japan Photovoltaic Energy Association.

Main category	Subcategory	Installation Location	Installed capacity (GWAC)	Annual power generation (TWh)
Building Installation	Housing	detached house	117	133
		housing complex	19	21
		BIPV[1] (residential)	11	12
	nonresidential	Commercial buildings	2	2
		public buildings	23	26
		Industrial buildings	32	36
		Other buildings	26	30
		BIPV (non-residential)	40	45
Ground Mounting	Ground installation (excluding agriculture)	facility site	15	17
		parking lot	10	11
		Road related facilities	3	4
		Airport-related facilities	2	3
		Railroad-related facilities	2	2
		Parks, forests, etc.	5	5
		Other ground	21	24
	Agriculture related		263	299
Water-related		Water space, etc.	32	36
Other types of installation		EV Vehicles	20	22
Total[2]			639	728

1 Building-Integrated Photovoltaics
2 Rounding errors may cause discrepancies between item totals and the overall total.

Details 2.Development of Supply Potential: Basic Policy

プラチナ構想ネットワーク

- In solar PV, focus on agrivoltaics and building installations utilizing perovskite, etc.
- In wind power generation, in addition to the development of onshore wind power, it is important to develop offshore wind power potential.
- In geothermal power generation, focus on deep, high-efficiency power generation with large potential based on technological progress.

power (button on TV, etc.)	(data) item
Solar PV	● Promotion of agrivoltaics ● Primarily maximize building installations (residential, non-residential, carports) ● Development and deployment of perovskite and other next-generation photovoltaics ● Compensation for purchase of solar cell production (domestic production of panels) + Establishment and industrialization of recycling technology
Offshore wind	● Institutional design for long-term stable income ● Publicly owned and operated base port development ● Industrialization of supply chain construction and recycling of floating offshore wind turbines and development of domestic wind turbine manufacturers ● Building wind power generation in symbiosis with local communities, including those involved in the fishing industry ● Development of electric carriers and development of deep-water areas = Energy Island concept (Izu Islands, etc.)
Advanced use of existing hydropower	● Increased power through advanced utilization ● Raise existing dam
Next-generation geothermal power generation	● Development of supercritical geothermal power generation ● Promoting Closed Loop ● Mountainside PV Replacement by Deep Depth Geothermal
Expansion of variable renewable energy adjustment functions	● Storage batteries, pumped storage, DR ● Hydrogen: Promote development and diffusion of "Yabusame" fuel cells and storage batteries

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3.1 Development of community symbiosis type Solar PV

- Minimize impact on the environment and landscape.
- Emphasis on coexistence with local communities.
  ➡Promotion of agrivoltaics
- Abandoned land is also a point of interest.
- Utilizing the latest technologies such as perovskite solar cells.
- Leading the world in the commercialization of panel recycling.
- Domestic production of panel manufacturing against a backdrop of large-scale new and renewal demand.
- Maximum expansion of building installation to residential and non-residential buildings.

3.2 Promote Agrivoltaics

- **Significant expansion of area**: 1,000 ha (2021) ➡ **250,000 ha (2050)**

*5% of the nation's farmland, pastureland, and abandoned farmland (5.1 million hectares)

- Core Technologies, Schemes and Actions
  - Finding agricultural operators: improving profitability and creating a business model that facilitates the participation of non-traditional players.
  - Building a Good Leading Model Agricultural Circle Nationwide, Supporting councils, forming deals in earthquake recovery areas.
  - Develop best practice guidelines and guidance documents.

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- Policy recommendations on deregulation and licensing issues
- Technology development for technical and cost issues

Regulation / Licensing	Challenges and Responses
Licensing process Licensing authority	● Existence of **local rules** (e.g., power producer must be a cultivator) ● Uncertainty due to additional regional planning requirements
Temporary diversion period	● 3 years by default; up to 10 years with conditions ● Investment recovery unlikely within 10 years ➡ Extend the temporary diversion period by approximately **5 years** Add "power producer reliability" as a requirement for diversion extension
80% yield requirement	● Yield must not decrease by more than 20%. ● Challenges with meeting requirements in low-yield fields
Technology / Cost	
Trestle	● Requires minimum ground clearance of 2m ➡ Additional requirements to preserve agricultural function Cost reduction by establishing a **standard design**
Panel	● Crystalline silicon is currently the only choice ● **Perovskites** are lightweight, flexible, and have selective light transmission, ideal for agrivoltaics. ➡ Offer **public subsidies** for adoption (installation cost, tax credits)

Source: Kubota Corporation

3.3 Maximize building installations (residential, non-residential, carports)

- **Acceleration of residential installation**

  Challenges: Older roofs, heavy roofs, roofs not facing south, salt-affected areas, scaffolding in replacements

  Responses: Cost reduction, reuse, recycling, replacement, use of perovskite solar cells, roof reinforcement

- **Development and diffusion of building-integrated photovoltaic (BIPV)**

  - Horizontal development of initiatives in advanced municipalities (Tokyo, Kawasaki).
  - Introduction of mandatory PV installation in public buildings overseas.
  - Utilization of perovskite solar cells.

- **Acceleration of installation in carports** : Proposal to the Ministry of Land, Infrastructure, Transport and Tourism to revise and deregulate the Building Standard Law

  - Clearly define solar carports as “structures” instead of “buildings“.
  - Exempt carports from building coverage ratio (even with conditions such as disaster prevention features).
  - Relax restrictions on structural calculation, materials, etc.

- **Utilize surplus power throughout the region**

  - Circulate surplus power that cannot be consumed by the onsite PPA, Maximize the self-sufficiency rate of renewable energy.
  - Speed up the use of surplus electricity by shortening the time to consider connection.
  - Support electric utilities in connecting to the grid, clarify and standardize rules.
  - Expand subsidies and support for storage batteries, EVs, DR, etc.

3.4 Developing application areas for next-generation photovoltaics such as perovskite

- **Supporting the differentiation of installation locations and promotion of introduction** , based on the characteristics of crystalline silicon.
- Development of **perovskite,silicon tandem**

3.5 Solar cell production purchase guarantees and recycling technology industrialization

- Blocked pricing power of Chinese manufacturers (70–80% of global production)
- 639 GW by 2050 = **26 GW/year domestic demand** *Market size about 10 times larger than current
- **Government purchase compensation** for domestic demand ➡ **Domestic production of panels**
- **Industrialization of recycling** through development and improvement of technologies and systems
  - Establishment of collection and recovery network at module removal
  - Innovation of recycling technologies (chemical/laser treatment, hybrid methods, etc.)
  - Introduction of easy recycling from the design stage (in conjunction with domestic production of manufacturing)
  - "Solar panel recycling obligation bill" currently under consideration for legislation Promptly develop a "bill for mandatory recycling“
  - Consider institutional design that incorporates the value chain of module manufacturing → utilization → removal and recycling
  - Maximize the value of recovered resources and create a market

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4.1 Basic Strategy - Maximize the exploitation of offshore wind potential by the entire country

- Maximizing Japan's potential to become an Advanced Offshore Wind Power Country.
- Watching the country 's moves in response to the withdrawal of business in the first round,further strong implementation of the measures.
- Institutional design for long-term stable income.
- Development of base port by public and private sectors.
- In the initial phase, establish priority locations and make concentrated investments.
- Establishing a domestic supply chain for floating offshore wind power.
- Looking at using new technology, M&A of foreign manufacturers, etc. Wind turbines to be produced domestically.
- Develop offshore wind power in harmony with local communities, including the fishing industry.

4.2 Institutional design to generate stable long-term income

- **Introduction of a central system that goes beyond Europe**
  - Strengthening the involvement of the national government in designating sites, identifying developable areas, coordinating with fisheries, and securing and maintaining the grid.
  - Implementation of state-led **basic surveys and coordination with fishery stakeholders** in designated areas, and bidding.
  - **Enhancement of site surveys**, etc.

- **Consideration of government involvement in development and ownership of facilities**

  Japan Energy and Metals National Corporation (**JOGMEC**) develops and owns facilities (base ports, submarine main cables, anchors, onshore transmission and substation facilities, etc.) and leases them to private operators.

4.3 Development of community-based wind power, including the fishing industry

Building Win-Win Relationships in Fishing and Wind Power Generation Businesses

プラチナ構想ネットワーク

4.4 Publicly owned and privately operated base port development

- **Development of a container terminal for simultaneous use by multiple operators**
  - Public: Develop infrastructure for base ports and marine work bases and provide long-term loans to operating companies
  - Operating companies: Develop cargo handling and transport machinery, yards, etc. → Collect usage fees from businesses
  - Establishing a dedicated base port operating company (tentative name) to manage multiple base ports and offshore work bases as an integrated operation.

- **Selection and concentration of sites**
  - Landing type: Build one after another in suitable locations
  - Floating type: Set 3-4 priority sites nationwide

- **Expected effects**
  - Multiple operators can use the system at the same time, accumulation of operational know-how.
  - Reduced burden on operators due to periodic use, contribution to strengthening defense capabilities.

4.5 Establishment of a supply chain for floating offshore wind power generation, industrialization of recycling, and fostering domestic wind turbine manufacturers

- **Establish offshore wind supply chain and strengthen domestic manufacturing of turbines, foundation structures, and specialty vessels**
  - Target for 2050 is 216 GW (total wind power generation), with domestic demand of **about 9GW per year,** assuming a 25-year service life.
  - Developing domestic wind turbine manufacturers with a view to M&A of European and U.S. manufacturers with similar production scale.
  - Reuniting displaced wind turbine manufacturing engineers.
  - Also looking at developing proprietary technologies (e.g., **Imadesto 's "spindle-less distribution & speed increase method"**).
  - Reinforcement of **special work vessels** (SEP vessels, etc.) in preparation for increased installation volume.
  - Establishment and industrialization of recycling technologies (especially **recycling of rare earths in wind turbine nacelle parts**, etc.).

4.6 Improvement of electric carriers and development of deep-water areas

- **Development of electric carriers**

  - Submarine cables are inefficient for laying cables over tens of kilometers, requiring offshore substations.

  - Storage in storage batteries or conversion to hydrogen at the power generation site for transport is practical.

  - Use of electric carriers equipped with storage batteries.

  - Potential application areas: remote island power transmission, grid supplement, offshore wind power.

- **Development of large water depth areas (Energy Island concept)**

  - Concept underway in the Izu Islands and other areas not far from areas of.

  - Government has designated five offshore areas around the Izu Islands in Tokyo as preparation areas for offshore wind power generation.

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5.Hydro: effective use of existing dam

- **Sediment Control**
  Sediment mainly results in "reduced power generation" and "reduced facility utilization".
- **Advanced use of existing dams (hybrid dams)**
  - Plans to shift to advanced operation at all feasible existing dams after FY2026 (about 20% of all dams).
  - Need to consider deployment at prefectural auxiliary dams.
- **Raise the existing dam**
  - Raise 1m to increase water storage by about 3%.
  - Raise the dam at a lower cost compared to building a new dam, while adding discharge pipes to flush out sediment.

6.Geothermal: Deep-Depth High-Efficiency Power Generation

- **Development of Deep Depth Supercritical Geothermal Power**
  - Supercritical water at a temperature of about 500 degrees Celsius deep in the earth 's crust enables power generation equivalent to that of large thermal power plants.
  - **Generate power "anywhere" at depths of 3 to 5 km or more** by utilizing Quaise's millimeter-wave deep drilling technology.
  - Kyushu Electric Power and MC have signed an NDA with Quaise and are **discussing its application in Japan based on the demonstration in the U.S.**
  - **Sites for fossil fuel-fired power generation** are promising (existing power lines, industrial water, and ports can be used).
- **Promotion of closed loop**
  Development of drilling technology and utilization of heat demand are important in terms of practical application and business security.
- **Replacing PV on mountainsides with deep geothermal**
  - After panels are removed, reforestation and reforestation and replacement with deep geothermalwill increase power generation, **regenerate forests, reduce CO2, improve water retention, and restore the landscape**.
  - Supercritical power generation if injection water is sufficient, otherwise closed-loop system.

3.3

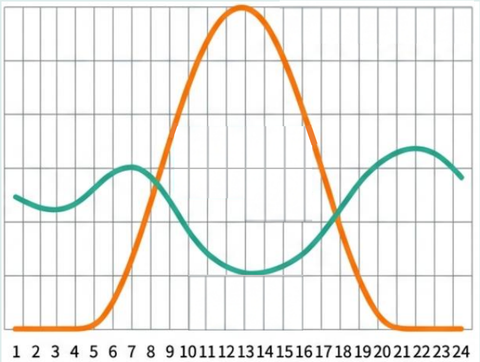
Supply–Demand Stabilization

Objective

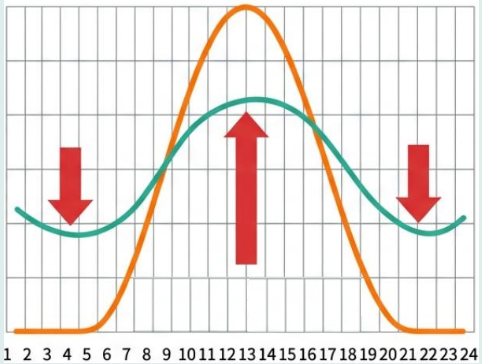
Fossil fuels can supply the necessary amount of electricity and energy (through direct combustion) whenever needed. However, in the case of renewable energy, output is not stable because solar power depends on sunlight and wind power depends on wind conditions. As a result, renewable energy cannot supply electricity in a stable manner depending on the location, season, or time of day. Conversely, there are times when surplus renewable electricity is generated and must be curtailed. To address these mismatches, we will consider measures to stabilize supply and demand.

Concept of load-increase DR

Load-increase DR: When renewable energy is high, electricity demand is increased to balance supply and demand
Curtailment: Temporarily disconnecting generated electricity from the grid to prevent oversupply



Solar PV is due to the large amount of electricity generated during the daytime,Demand cannot keep up and there is a surplus.



Shift demand to times when electricity is in surplus and use it effectively

プラチナ構想ネットワーク

Consideration Points

1.Adjustment Measures

Organize the characteristics and issues of promising technologies for energy storage and thermal storage.

2.Study on the Potential of load-increase DR

- Estimate the demand that can be adjusted by time and region, and examine whether it can be matched with surplus renewable energy.
- Categorize the load-increase DR patterns, assume adjustable demand by time and region for each category, and estimate the renewable curtailment reduction rate over 8,760 hours across 10 regions for the two cases below.

  Closed Type: Surplus renewable power used within the power company's service area

  Open Type: Surplus renewable power shared across Japan, regardless of service area

Results

1.Adjustment Measures

- Energy Storage

  - In Short Duration Energy Storage (SDES[1]), lithium-ion batteries, solid-state batteries, and sodium batteries are promising.
  - In Long Duration Energy Storage (LDES[2]), hydrogen, synthetic fuels, pumped storage, and flow batteries are promising.

1 Technology for matching fluctuations on an hourly or daily basis

2 Technology for matching over months or seasons

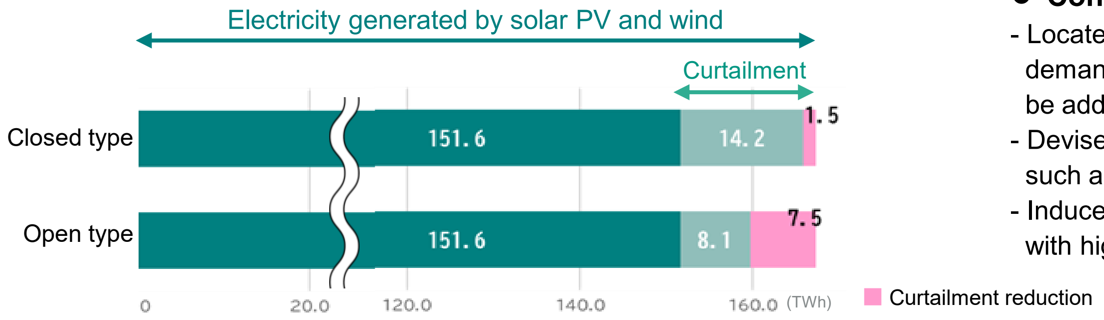
プラチナ構想ネットワーク

Results

2.Efforts on load-increase DR

As the curtailment volume for 2050 is not yet available, we conducted the matching analysis using the 2033 curtailment data calculated by the Agency for Natural Resources and Energy for its long-term renewable curtailment outlook.

● **Curtailment reduction (Nationwide) Closed type: 11% Open type: 56%**



● **Considerations based on the results**

- Locate renewable energy in areas with high electricity demand in order to reduce the amount of DR that must be addressed.
- Devise ways to match openly without limiting the region, such as by increasing the number of transmission lines.
- Induce data centers with high potential to locate in areas with high renewable energy supply.

Future actions

1.Call for the implementation of load-increase DR

Highlight economic benefits **to encourage more participants.**

Specifically, create opportunities to distribute brochures andinvite businesses to join.

2.Study of measures for 2050

Although time- and region-specific demand and supply estimates are not yet available, once they are developed, we will examine how best to ensure supply–demand stability, including the degree of curtailment and the use of load-increase DR.

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Characteristics and Challenges of Promising Energy Storage Technologies for 2050

SDES[1]	Characteristics	Challenges
lithium ion battery (advanced version)	● Good balance of cost and performance ● Derivatives enhance safety (e.g., LFP)	● Fire risk due to liquid electrolyte ● Vulnerable to resource price fluctuations
all solid-state battery	● Nonflammable, very safe ● High output, long life, fast charging possible	● High manufacturing cost ● Mass production likely after 2027–2030
sodium ion battery	● Low cost, abundant resources ● No lithium or cobalt required	● High manufacturing cost ● Mass production likely after 2027–2030

LDES[2]	Characteristics	Challenges
hydrogen and synthetic fuels (chemical formula)	● Ultra-long-term storage (seasonal) ● Easy to scale up (depending on tank)	● Low energy efficiency ● Conversion losses: ● electricity → hydrogen → electricity
pumped storage (mechanical)	● Proven technology, well-established ● Large-scale energy storage possible	● Geographically limited for construction ● Requires large-scale civil engineering
flow battery*. (electrochemical equation)	● Flexible capacity design ● Low fire risk, safe	● Requires installation space ● System tends to be large (low energy density)

1 SDES: Short Duration Energy Storage, a technology for matching fluctuations on an hourly or daily basis.
2 LDES: Long Duration Energy Storage, a technology for matching over months or seasons.

2.1 Basic Concept

- Examine whether the load-increase DR potential* can be matched with the curtailment (surplus renewable power).

  *Demand that can be adjusted by time and region

- The matching was conducted assuming 8,760 hours across 10 regions, with the following cases considered for adjusting demand in terms of location and time.

  - Closed Type: Surplus renewable power used within the power company‘s service area
  - Open Type: Surplus renewable power shared across Japan, regardless of service area

Load-increase DR Potential
Targeting industrial demand, estimate the demand volume usable for load-increase DR (see next page for categorization)

matching

Curtailment amount
Estimated curtailed renewable output in 2033 (8,760 hours, 10 regions)*

Load-increase DR potential utilization rate
Curtailment reduction rate

Load-increase DR potential utilization rate
The rate of the Load-increase DR potential that has been matched through Load-increase DR
Curtailment reduction rate
The rate of the curtailment amount that has been matched through load-increase DR.

*Data provided by Chubu Electric Power Miraize Co., Ltd. from the '53rd Comprehensive Resource and Energy Survey Committee, Energy Conservation and New Energy Subcommittee / Electricity and Gas Business Subcommittee, Electricity and Gas Basic Policy Subcommittee, Grid Working Group.

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2.2 Types of load-increase DR

- Based on domestic and international cases, six implementation patterns were identified.
- For the load-increase DR potential assessment, four patterns (shown in green) were analyzed.

Types of DR	Feature	Corresponding example
Production-hour shifting	Shift electricity-consuming manufacturing to different hours.	**Tokyo Steel Co., Ltd.:** Additional electric furnace operation on days with expected renewable surplus, per utility request.
Replacement of on-site generation with grid electricity	Stop on-site power generation and purchase electricity from the grid.	**Chuetsu Pulp & Paper Co., Ltd.:** Load-increase DR implemented by reducing on-site generation.
DR in Data Centers	Conduct data processing in regions/times with surplus renewable electricity.	**Google:** Shift workloads to times and locations when carbon-free electricity is available.
Thermal Energy Storage	Produce and store thermal energy for later use.	**European cold storage/frozen warehouse:** Overcooling compressors to utilize thermal inertia of storage.
Electrical Energy Storage	Charge energy storage systems (batteries, EVs, etc.) during periods of surplus electricity.	**Tohoku Electric Power Co., Inc. Sendai City**, etc.: Charge batteries installed with solar PV using surplus power.
Electrical Energy Storage	Convert surplus electricity to hydrogen and store it for later use.	**Yamanashi Prefectural Enterprise Bureau:** Produce green hydrogen by water electrolysis.

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2.3 Target industries

Types of DR	Type of industry	Concept of load-increase DR
Production-hour shifting	Cement	Assumption that **businesses without on-site power generation facilities will change their production plans** during periods of electricity surplus.
	Caustic soda (electrolyzer)	Assumption that **businesses without on-site power generation facilities will change their production plans** during periods of electricity surplus.
	Iron and steel (including electric arc furnaces)	Assuming that **the melting and refining processes of electric furnaces, which are concentrated at night and on holidays, will be shifted to the surplus electricity hours**.
	Water supply system	**Increased pumping** during periods of electricity surplus to deliver more water than usual to the water distribution reservoirs.
	Sewerage system	**Increase operation of pumps and blowers (aeration equipment)** during periods of electricity surplus.
Replacement of on-site generation with grid electricity	Industries with a high proportion of self-generation	Assuming that the sharing of DR implementation methods will increase and implementation will progress in **industries that generate a certain amount of their own power**.
DR in Data Centers	Data center	Assumes that the batch* rate of data center power consumption is targeted for load-increase DR.
		Increase the amount of heat stored in the heat storage tanks for air conditioning during periods of electricity surplus.
Thermal Energy Storage	District Heat Supply	**Increase heat storage capacity of water (chilled water) and ice thermal storage tanks** during periods of electricity surplus.
	Hospitality sector	During periods of electricity surplus, **the set temperature limit of the hot water tank is raised, and the heat pump water heater heats and stores thermal energy**.
	Commercial laundry services, Hairdressing and beauty services and Public bathhouses	
	Medical industry	
	Freezer/refrigerated warehouse	**Reduce the temperature of F-class freezers (freezers below -20°C) by 10°C** during periods of electricity surplus.

*Businesses that do not require immediacy or real-time responses and can process large volumes of data in batches during late-night or off-peak hours when system load is low.
(e.g., machine learning for AI model development, generation of daily updated analysis data, etc.)

2.4 Load-increase DR potential

- The results of the load-increase DR potential calculation by the target industries on the previous page are as follows.
- In terms of the total amount, 13,437 GWh, which is 86% of the 2033 curtailment amount (15,634 GWh).
- The breakdown shows that electric furnaces, private power generation, and data centers have high potential results.

*DR potential for district heat supply, etc. is calculated seasonally, since the DR potential varies depending on the season.

Overall Summary of load-increase Potential

Overall(average)	cement	caustic soda	electric furnace	waterworks	drainage system	freezer	private power generation	data center	
								workload shift	air conditioning
13,437 GWh/year	2.1%	2.7%	23.6%	0.6%	0.6%	1.0%	28.3%	31.2%	9.3%

District Heat Supply				lodging business			
spring	summer	autumn	winter	spring	summer	autumn	winter
0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

Laundry, hairdressing, beauty, and bathhouse business				medical industry			
spring	summer	autumn	winter	spring	summer	autumn	winter
0.1%	0.1%	0.1%	0.2%	0.5%	0.3%	0.3%	0.6%

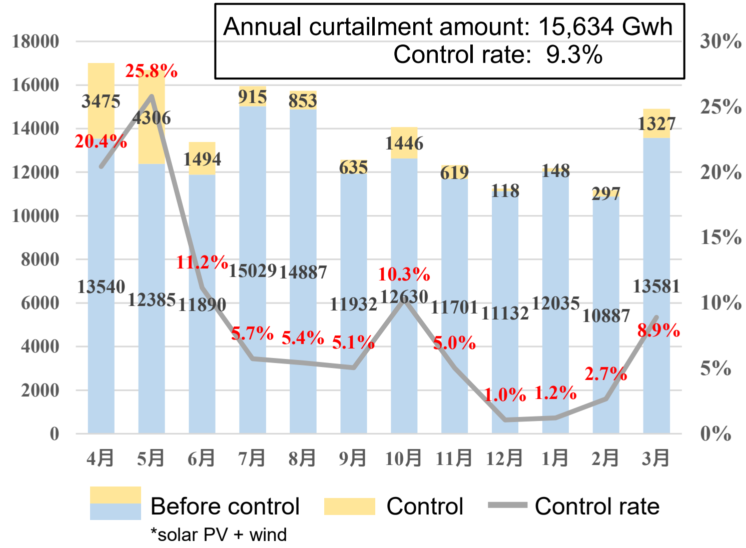
2.5 Curtilment amount in 2033

- Based on the data provided below, on a national basis, the demand is 960,778 GWh, which is a slight increase from the current forecast.
- Curtailment is for 9.3% of solar PV and wind, especially in Tohoku, Kyushu, and Hokkaido.

Area-wise power demand/supply and curtailment estimates (GWh)

	Area demand	Area supply	Solar PV	solar PV curtailment	Wind	Wind curtailment	Curtailment total	Control rate
Nationwide	**960,778**	**960,902**	**132,813**	**-10,830**	**34,449**	**-4,804**	**-15,634**	**-9.3**
Hokkaido	35,090	35,191	3,740	-705	4,886	-935	-1,640	-19.0
Tohoku	87,116	87,138	21,003	-5,986	13,905	-3,228	-9,215	-26.4
Tokyo	322,722	322,722	33,356	-224	1,626	-10	-235	-0.7
Hokuriku	29,681	29,681	2,514	-170	5,033	-174	-344	-4.6
Chubu	140,217	140,217	18,578	-262	732	-2	-264	-1.4%.
Kansai	150,984	150,984	14,709	-266	316	-6	-272	-1.8%.
Chugoku	66,704	66,704	11,820	-549	2,026	-46	-595	-4.3
Shikoku	26,426	26,426	6,435	-216	1,470	-27	-243	-3.1
Kyushu	93,478	93,478	20,105	-2,451	4,440	-375	-2,826	-11.5%.
Okinawa	8,360	8,360	553	-0	16	-0	-0	-0.1

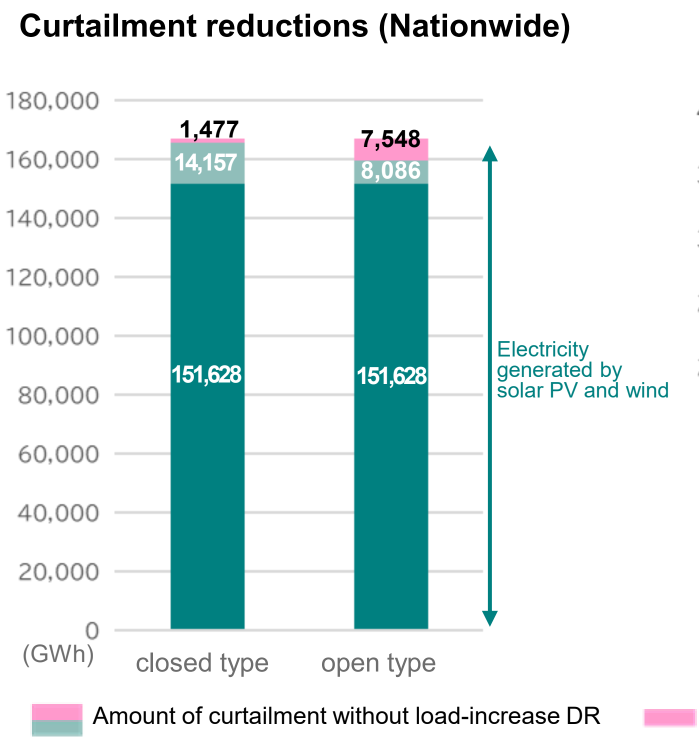
Monthly Curtailment (Nationwide)

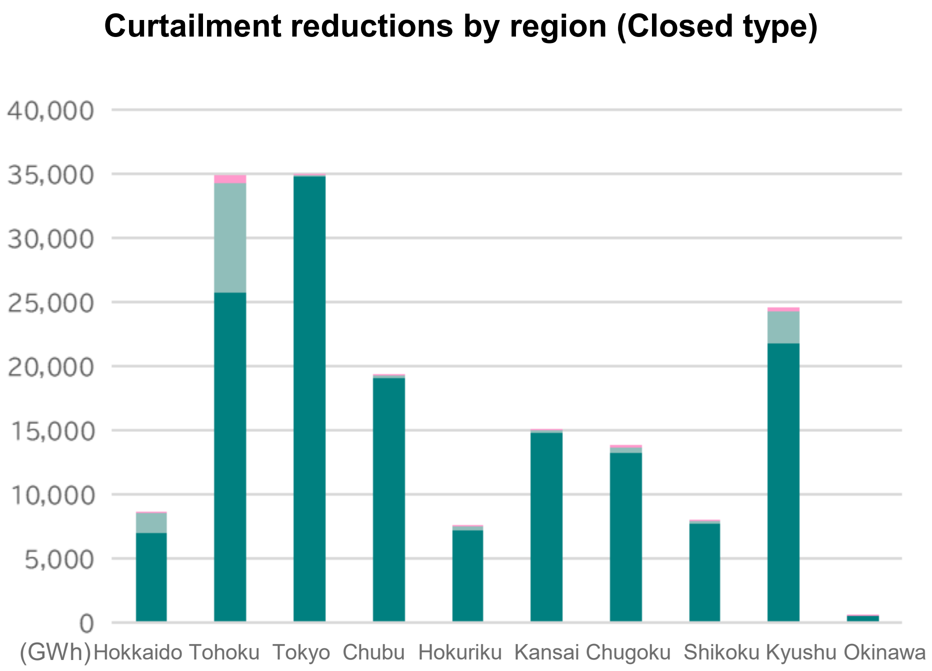


*Data provided by Chubu Electric Power Miraize Co., Ltd. from the '53rd Comprehensive Resource and Energy Survey Committee, Energy Conservation and New Energy Subcommittee / Electricity and Gas Business Subcommittee, Electricity and Gas Basic Policy Subcommittee, Grid Working Group.

2.6 Matching Results

On a nationwide basis, curtailment of 1,477GWh in closed type and 7,548GWh in open type can be reduced.





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2.6 Matching results

- In the closed type, since the matching of DR is performed only within a region, the curtailment reduction rate is only 9% and the load-increase DR potential utilization rate is only 11%.
- In the open type, matching is carried out across regions through the reinforcement of transmission lines, etc., resulting in the curtailment reduction rate of 48% and the load-increase DR potential utilization rate of 56%, which means that increased DR functions more effectively than in the closed type.

	Closed type		Open type	
	Curtailment reduction rate	Load-increase DR potential utilization rate	Curtailment reduction rate	Load-increase DR potential utilization rate
April	7%	22%	29%	92%
May	8%	29%	25%	95%
June	7%	10%	52%	70%
July	11%	8%	83%	67%
August	11%	9%	83%	62%
September	14%	8%	74%	43%
October	10%	12%.	63%	80%
November	16%	9%.	85%	48%
December	37%	4%	100%	10%
January	37%	5%	100%	13%
February	17%	5%	91%	26%
March	10%	11%.	57%	66%
total	**9%**	**11%**	48%	56%

2.7 Considerations from the matching results

- Load-increase DR is highly effective as a response to curtailment, but it cannot eliminate all curtailment.

  - There is a need to explore measures to efficiently promote matching across regions such as strengthening the grid.

  - It is important to reduce the amount of DR needed by locating renewable energy in areas with high electricity demand. Locating high-potential DR demand (e.g., data centers) in regions with abundant renewable energy supply is also effective.

- Considerations for 2050
  - The potential for DR considering electrification in industries (steel, petrochemical) and the spread of heat pumps in commercial and residential sectors.
  - The positioning of on-site generation and the outlook for the spread of renewable energy by 2050.

2.8 Future issues

- Strengthening infrastructure, including the grid, to flexibly increase supply in response to demand.

- Flexibility in electricity contract limits.
  In the industrial sector, there are concerns that implementing load-increase DR may lead to electricity usage exceeding contract limits, resulting in high electricity costs, which reduces the motivation for load-increase DR.

- Developing incentives to expand load-increase DR implementation (e.g., designing a system where transmission fees can be flexibly adjusted according to demand).

- Clarifying indicators that show how load-increase DR contributes to promoting renewable energy adoption.

3.4

Consensus

Assumption

The objective is to **expand understanding and support for the "2050 Energy Vision"—**under which approximately **80% of total energy demand in 2050 would be met by domestic renewable energy**—and thereby contribute to the realization of a decarbonized society.

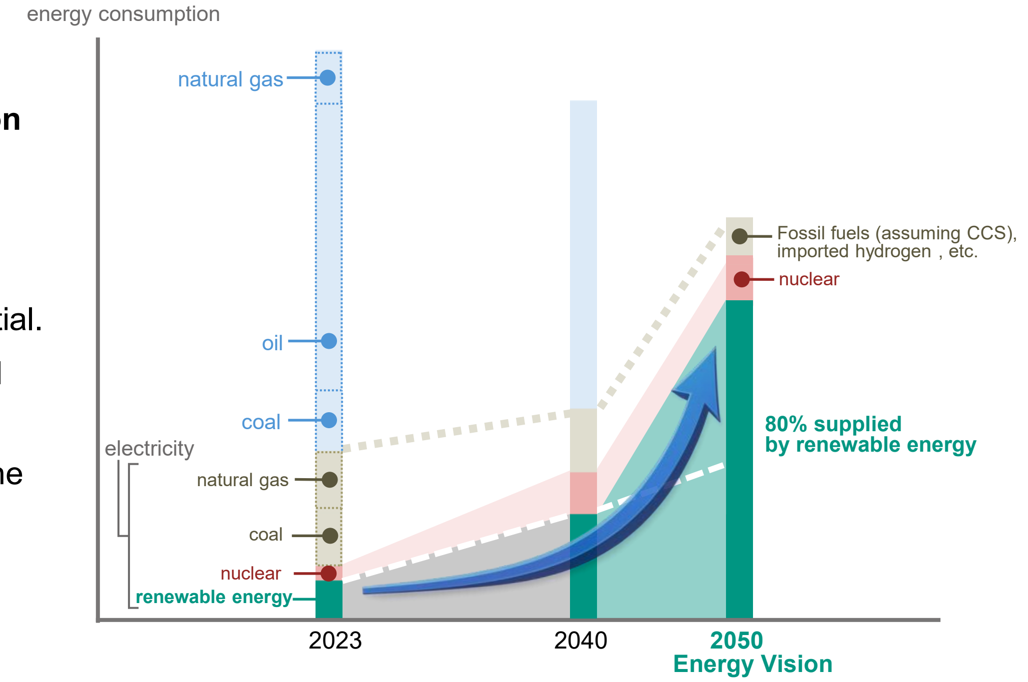
- From a backcasting perspective, achieving decarbonization requires **a substantial expansion of renewable energy deployment**.

There is a clear gap between this requirement and current forecast-based projections.

Broadening understanding of this gap is essential.

- The later we begin to take action, the harder it will be to achieve a decarbonized society.

Through **social consensus**, we must accelerate the shift from a fossil-fuel-centered system to a renewable-energy-centered system.



Objective

- Advance the transition to a **renewable energy–centered system** by:
  - Promoting **consensus-building** and stakeholder coordination
  - Demonstrating the **feasibility and practicality** of the Vision through real-world implementation
- In Phase 1:
  - Identify key barriers and priority areas for renewable energy deployment.
  - Develop measures to accelerate social implementation.

Consideration Points

- Define “consensus-building” and “behavioral change” in the Initiative.
- Identify high-impact target groups and formulate engagement strategies.
- Prioritize regulatory reforms and policy proposals to significantly expand renewable energy supply.

Results

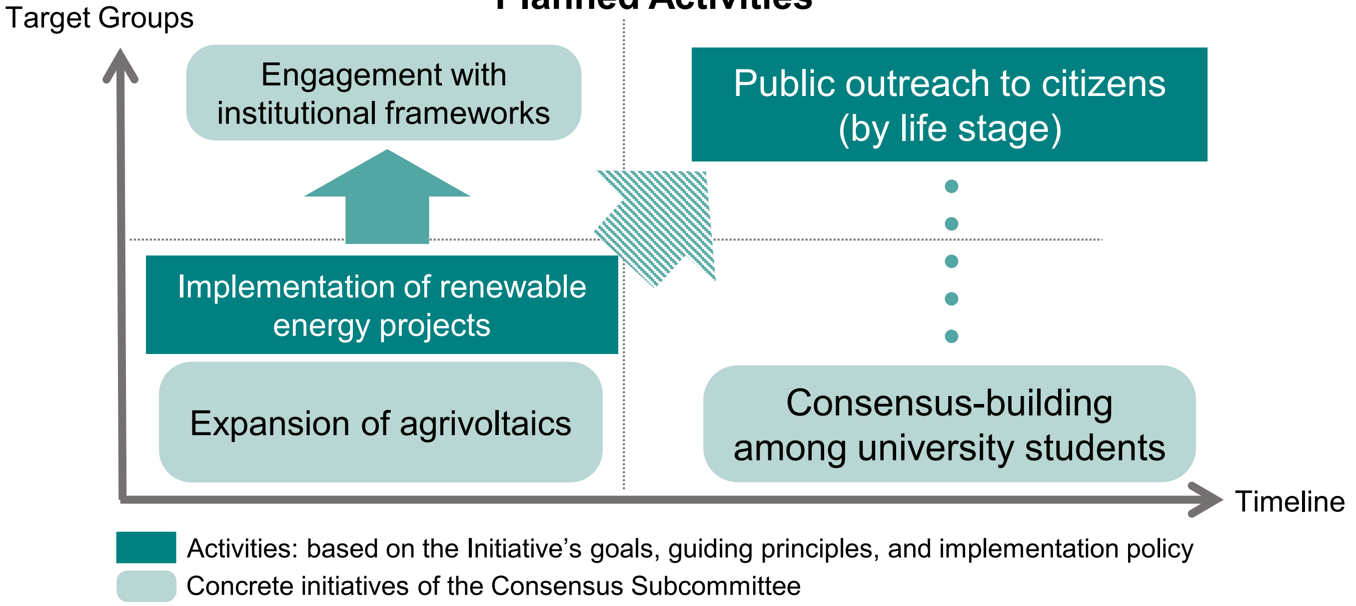
- Established definitions and policy directions for consensus-building and behavioral change targeting citizens and industry.
- Identified university students as a priority group.
- Focused on **agrivoltaics**, clarified key issues, and examined an action approach.
- Participated in the “Agrivoltaics Social Implementation Consortium”.

Source: Hiroko Murata, NHK Broadcasting Culture Research Institute, “Japanese Public Attitudes toward Climate Change – ISSP International Comparative Survey,” Nov 22, 2023. https://www.nhk.or.jp/bunken-blog/500/489504.html (accessed Feb 6, 2025)

Future actions

- Operationalize initiatives for **consensus-building and behavioral change**, and strengthen collaboration with relevant stakeholders.
- Advance targeted engagement programs, with a particular focus on university students.
- Participate in the Agrivoltaics Social Implementation Consortium to gather information, coordinate stakeholder views, and develop policy recommendations.

Planned Activities



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- Surveyed Initiative members on renewable energy deployment challenges.
- Prioritized **consensus-building/behavioral change** and **regulatory reform/policy advocacy** based on the results.

Key Challenges in Renewable Energy Deployment and Subcommittee Activities

Key Challenges in Renewable Energy Deployment

awareness	The introduction of renewable energy is not becoming a personal matter and is not linked to action.
cost	There are limits to the introduction and promotion of renewable energy within the framework of a capitalist economy. Public funds, etc. are necessary.
Regulation & Institutional Framework	
Cross-cutting	Regulatory reform, institutional review, and inter-ministerial coordination are needed to accelerate deployment.
PV	Further regulatory reform, institutional adjustments, and public awareness efforts are required for expansion.
Wind	Regulatory and institutional reforms are needed to enable smoother deployment.
Technology (grid, surplus power utilization)	Complex grid connection procedures Output curtailment limits effective use of surplus electricity.

Subcommittee Activities

- Regulatory reform and policy recommendations
- Consensus-building and behavioral change

To be examined in Phase 2 by other subcommittees

Note 1) The survey also collected good practices.
Note 2) Survey results were shared with other subcommittees.

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2.1 Definition of consensus in the Initiative

Scope: Building consensus on renewable energy deployment and related initiatives

Target Groups: General public,Industry stakeholders

* To be expanded to government and broader industry through social implementation and policy advocacy

2.2 Policy Direction

- Recognize differences by life stage in understanding, feasible energy-saving/renewable actions, and effective communication approaches.
- Demonstrate successful social implementation cases under the Initiative.
- Promote distributed energy systems and approaches that lower adoption barriers for citizens.

2.3 Implementation Approach

- Support Initiative members in advancing social implementation.
- Collaborate with members, NPOs, educational institutions.
- Advance policy and regulatory reform.
- Organize workshops and dialogue platforms; develop educational programs and awareness campaigns.

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Based on survey findings showing that while environmental awareness in Japan is high, fewer people — especially youth — are willing to change their lifestyles for environmental action, Strategies targeting university students were examined.

3.1 Current Situation Surrounding University Students

Key challenges in university student engagement:

- No shared time/space for all students, and limited institutional involvement.
- Active students struggle to expand peer engagement, leading to disconnects.
  ➡ Need mechanisms for horizontal connection.
- Difficulty sustaining environmental activities after graduation.
  ➡ Need stronger links between students and society.

3.2 Policy Direction

Communicate the 2050 Energy Vision and create mechanisms linking awareness to action:

- Address generational differences.
- Support proactive first movers to prevent isolation.
- Leverage “loose networks”.

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Focusing on agrivoltaics—which enables power generation while continuing agricultural activities and allows dual use of limited land, giving it high potential—we examined measures to accelerate renewable energy deployment.

4.1 Current Regulations and Key Challenges

Under the current regulatory framework, many agrivoltaics projects provide only limited contribution to food production, and securing financing for the solar PV installation is often challenging.

Current Regulations	Challenges
Crop yields must not decline by more than **approximately 20%** compared to the municipal average.	● Introduction is difficult on already **low-yield farmland**. ● Prime farmland owners hesitate due to **potential yield loss**. ● Many projects rely on shade-tolerant or ornamental crops and fail to meet the 80% yield requirement.
Temporary land-use conversion approval is required for support structures. The standard period is **3 years**; up to **10 years** is permitted for certified farmers, idle farmland, or Type II/III farmland.	**Regulatory uncertainty** makes bank financing difficult.

4.2 Farmland and Agricultural Management

- The Ministry of Agriculture, Forestry and Fisheries promotes farmland consolidation and larger-scale operations to reduce production costs.
- Under the Regional Plan, about **30% of farmland** may lack identified operators in ten years, raising concerns about future labor shortages.
- Agricultural corporations are becoming increasingly important as recipients of farmland, and cross-industry investment to strengthen their management base is expanding.

4.3 Policy Direction

We refined the key elements of "Agrivoltaics as Envisioned by the Initiative" and developed proposals to promote social implementation, dissemination, and policy recommendations.

"Agrivoltaics as Envisioned by the Initiative"

- Maximize farmland potential through dual land use, creating a new "crop" of **green electricity**
- Contribute primarily to **food security**, while also supporting **energy security**
- Prioritize on-site use of renewable electricity for farms, farmers, and local communities
- Promote projects led by agricultural corporations or entities supporting agriculture

4

Final Thoughts

Energy Supply and Demand in 2050

We have formulated a 2050 Energy Vision that achieves full decarbonization of all energy used in Japan—including electricity, gas, fuel oil, gasoline, and diesel. If realized, Japan would become largely energy self-sufficient, producing nearly all of its energy domestically. The Vision is grounded in existing technologies and delivers substantial long-term national benefits.

- Total energy demand in 2050 is projected at 2,090 TWh, slightly more than double today's electricity generation. Of this, 80% (1,640 TWh) will be supplied by domestic renewable energy, with the remaining 450 TWh provided by nuclear power, fossil fuels with CCS, and imported hydrogen, including ammonia.
- To reach 1,640 TWh, we must develop an additional 1,430 TWh beyond today's 210 TWh. The projected renewable mix in 2050 consists of: solar (728 TWh), wind (640 TWh), hydropower (126 TWh), biomass (50 TWh), and geothermal (90 TWh), together with effective utilization of surplus variable renewable generation.
- Japan's total energy demand was 2,960 TWh in 2023. Through electrification and efficiency improvements—including EVs and heat pumps—we can reduce demand by approximately 30% by 2050. Further reductions will be examined in Phase 2 (see p.21).
- Achieving this transformation will require deployment at a scale far beyond current levels. The longer we postpone the shift from forecasting to backcasting, the steeper the annual expansion required. Delay is not a neutral choice—it increases the burden of transition. We must therefore act with urgency (see p.55).

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Policy Measures for Expanding Renewable Energy

We have identified anchor technologies for each domain. For solar, agrivoltaics (solar sharing) and building mounted systems are central. For wind, floating offshore is indispensable. For geothermal, deep, high efficiency development is essential. For hydropower, expanding the capacity of existing dams is important. For biomass, a sustainable wood cycle system is critical.

This vision is built entirely on technologies that already exist. The principal barriers, therefore, are not technical but social and institutional. Our task is to remove these barriers and convert potential into implementation.

- To advance social implementation, a dedicated driving body is required. As a first step, we have decided to establish the Agrivoltaics Social Implementation Consortium. Similar implementation platforms will be launched sequentially in other priority areas.
- We have examined concrete measures to address the variability of solar and wind power. Demand aligned with supply—in time and location—together with battery storage, pumped-storage hydropower, and reversible fuel cells will play a decisive role. Several types of reversible fuel cells are now under development and hold strong promise as breakthrough solutions to output fluctuation challenges.
- We have also analyzed load-increase DR, aligning electricity demand—such as electric furnace operations and AI training—with solar generation. Based on projections for 2033, we find that, depending on the development of interregional transmission lines, between 9% and 48% of potential curtailment can be absorbed. This demonstrates that variability can be managed through coordinated system design.

The Cost Structure of Renewable Energy and Its Contribution to Japan

The lifecycle cost structure of renewable energy differs fundamentally from that of thermal power. The bulk of expenditure is upfront capex; fuel costs are zero, O&M costs are limited, and re investment at renewal is far smaller than the original outlay. This structural difference should shape how we evaluate and finance renewable energy.

- There is a need for a key player to advance social implementation. As the first step, we have decided to establish the “Agrivoltaics Social Implementation Consortium”.We will sequentially establish similar mechanisms for promoting specific initiatives
- In agrivoltaics, mounting structures; in floating offshore wind, floating foundations and port-related facilities; in geothermal, deep drilling; and in transmission and distribution, grid infrastructure—these core components of initial cost are long-life assets designed for extended use. Once installed, they do not require full reconstruction at renewal. In light of this structure, financing initial investment through instruments such as long-term construction bonds deserves serious consideration.
- Investment in renewable energy is not merely an environmental measure. It can strengthen Japan’s energy security, revitalize regional economies through projects such as agrivoltaics, rebuild domestic industries through manufacturing of batteries and grid equipment, and accelerate the transition to a decarbonized society. Properly structured, it constitutes a strategic foundation for Japan’s sustainable growth.

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The Road Ahead

1. Advancing Cost Analysis in Strategic Areas

We will conduct deeper analysis of the costs in key technological areas where multiple development pathways are emerging—such as hydrogen production, next-generation wind turbines, reversible fuel cells, and energy storage. In doing so, we will compare the future cost of existing technologies -including rising fossil fuel price trajectories- with the projected cost of decarbonization technologies refined through cost engineering.

2. Strengthening Domestic Manufacturing Capacity

It is neither sustainable nor prudent for the supply of core renewable energy equipment to depend heavily on a single country. Japan possesses strong capabilities in areas such as solar panels, wind turbines, and rare earth processing. We should secure domestic production capacity in these strategic fields. To achieve this, a robust public–private framework should be established without delay.

3. Building a Circular Recycling System

As power generation becomes increasingly decentralized, establishing a comprehensive recycling system is an urgent priority. Recovering resources from retired devices will reduce the need for new raw materials and enhance resource security. At a time of growing concerns over rare earth supply, this is not optional—it is essential. Japan is already technologically advanced in this field, and we should move swiftly to build an integrated system linking manufacturing, recycling, and resource recovery.

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4. Establishing a Framework for Continuous Research and Analysis

R&D in renewable energy is advancing rapidly, both in Japan and globally. Even within this study, we identified promising technologies, such as reversible fuel cells, innovative wind turbines, deep drilling technologies, and upper reservoir pumped storage hydropower. With a global perspective, continuous and systematic research is indispensable. To this end, we will strengthen collaboration among industry, government, and academia to ensure our efforts remain forward-looking and strategically grounded.

5. Strengthening Engagement with Society to Build Consensus

Energy, alongside water, food, and materials, is indispensable to human life. The energy system is foundational infrastructure, directly linked to stable livelihoods, regional vitality, and national security. Transforming this system from fossil-based to renewable-based requires broad social consensus. We will therefore deepen engagement with society—particularly students and younger generations who will shape this transition.

Although the depth of analysis varies, our findings indicate that achieving full decarbonization by 2050—and meeting 80% of total energy demand with renewables—is technically feasible. From a long-term perspective, it also offers substantial economic benefits.
In Phase 2, we will proceed with more detailed analysis, guided by even greater confidence in the path ahead.

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