Electric Power

Expanding BEV Business through Alliances with the Automotive Industry

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Summary

- Electrification in non-electric sectors, especially in the transportation sector, is progressing based on the premise of decarbonized power sources, with the aim of achieving CN.
  - Considering the Japanese government's aim of achieving 100% electric vehicle sales for new passenger cars by 2035, and that complete vehicle OEMs are promoting electrification on a global scale, the introduction of BEVs on a large scale is expected to increase electricity demand by 55.5 billion kWh by the year 2050 for passenger cars alone.
- To meet the increasing electricity demand, suppliers are advancing investments in decarbonized power sources, and use of renewable energy is increasing. On the demand side, the introduction of solar power, storage batteries, BEVs, etc., is expected to lead to a transition to an electricity system where large-scale and distributed power sources coexist.
  - However, the increase in variable renewable energy (solar and wind), means it is necessary to address the changing supply-demand balance. Amid these changes, BEVs are expected to be an important resource for supply-demand stabilization. By maximizing the use of renewable energy, there is a possibility that up to approximately 144.3 billion kWh per year of zero-emission thermal power can be replaced by 2050, with anticipated reductions in fuel costs for Japan.
- The large-scale introduction of BEVs and the introduction of low marginal cost renewables are expected to diminish the dominance of large-scale power sources. At the same time, complex supply-demand adjustments utilizing a diverse range of distributed resources will become necessary. However, for the electricity industry, there is potential for expanded business opportunities through increased electricity demand and developing charging infrastructure through leveraging customer touchpoints.
- The mass introduction of BEVs, the integration of distributed power sources into the electricity system and the incorporation of IoT into most equipment and devices constituting the power system will allow for real-time assessments of electricity information. These changes are advancing the development of a smart grid, which supplies high-efficiency, high-quality, and highly reliable electricity through integrated control on both supply and demand sides. The connection between power systems and the transportation sector will lead to coupling between sectors, creating new business domains.
- In light of this, creating a comprehensive alliance framework between the electricity and automotive industries is essential. This strategy involves not only monetization through the effective use of BEVs but also enhancing the value of owning BEVs through providing value-added experiences to users. This multifaceted business approach will be a key success factor for the electricity industry in the era of mass BEV introduction.
  - Addressing the automotive industry's need for non-fossil fuel energy sources and contributing to decarbonization across the entire value chain through providing solutions are crucial steps. These efforts are essential for paving the way for alliances and must start from the present.

A Winning Strategy for the Electricity Industry - Expanding BEV Business through Alliances with the Automotive Industry

Changes in External Environment

- CN Trends
- Electrification of Automobiles
- Increase in Electricity Demand Due to Electrification

Changes in Industrial Structure

- Changes in the Electricity Supply-Demand Structure
- Distributed Power Sources such as BEVs Play a Role in Adjustment Functions
- Integration of Large-Scale and Distributed Power Sources into the Electricity System

Strengths

- Ownership of Large-Scale Power Sources
- Transmission and Distribution Networks, Supply-Demand Adjustment Know-how & Technology
- Touchpoints with Corporate & Individual Customers

Implementation of CPS (Cyber-Physical Systems)

- Smart Grid Development and Sector Coupling

Winning Strategy

Expanding BEV business through alliances with the automotive industry

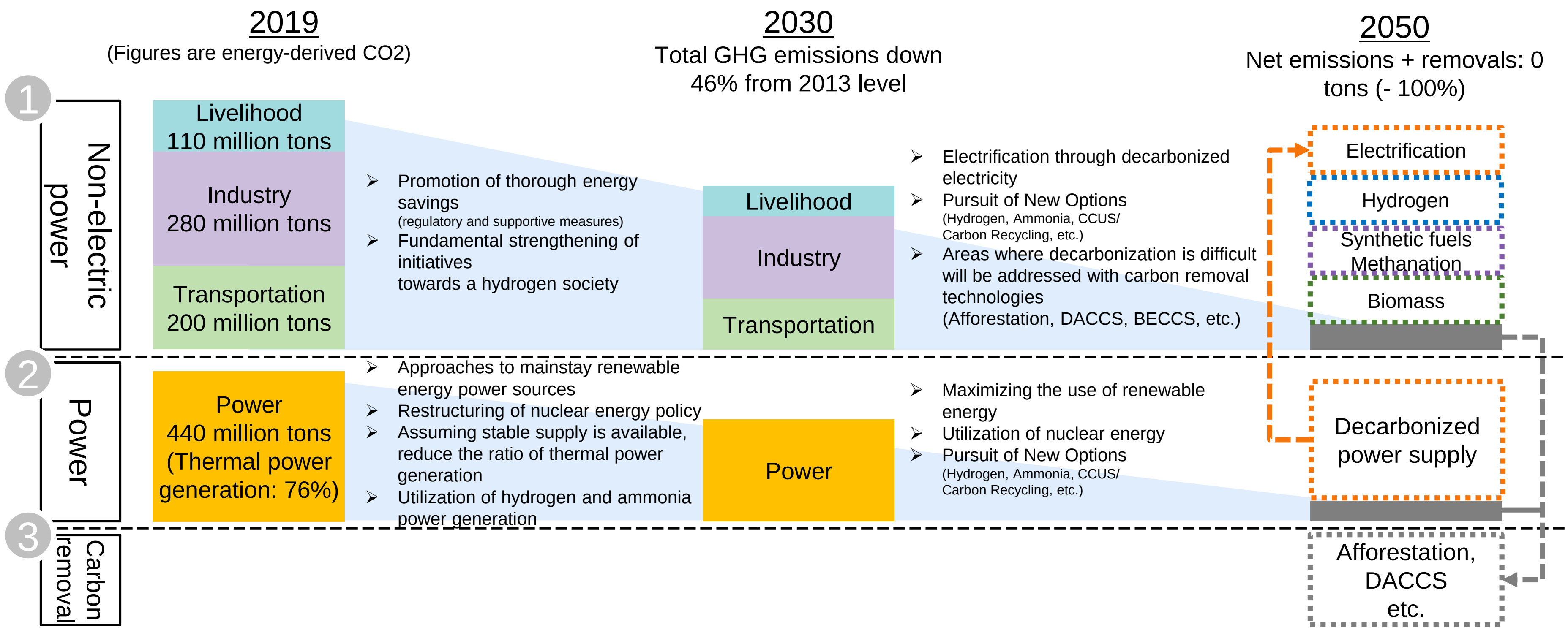
With the mass introduction of BEVs, a portion of the thermal power generation electricity volume can be undertaken by BEVs, contributing to fuel cost reductions for Japan

Source: Compiled by Mizuho Bank Industry Research Department

Advancement in electrification in all sectors based on the premise of decarbonization of power sources and producing carbon neutrality

- To achieve carbon neutrality, it is important to: (1) reduce CO2 emissions from the non-electric power sector, (2) reduce CO2 emissions from the electric power sector, and (3) absorb/utilize CO2 emitted in areas where decarbonization is difficult.
  - In non-electric sectors, advancing electrification as much as possible allows for the procurement of decarbonized electricity, thereby reducing CO2 emissions. For areas that cannot be electrified, it will be necessary to utilize hydrogen, methanation, and synthetic fuels.
  - Decarbonization is a fundamental requirement for the power sector. This necessitates maximizing the use of renewable energy and nuclear power, in addition to reducing CO2 emissions from thermal power generation through the use of hydrogen and ammonia. Capturing, utilizing, and storing CO2 through CCUS and carbon recycling will also be essential.

Image of transition to carbon neutrality



Source: Compiled by Industry Research Department Mizuho Bank, Ltd. from the Agency for Natural Resources and Energy

With the Japanese government and complete vehicle OEMs pushing for electrification, Japan's electricity demand is set to increase

- The Japanese government is aiming for 100% electric vehicles in new passenger car sales by 2035 and complete vehicle OEMs are advancing electrification globally.
- As electric vehicles are introduced on a massive scale, Japan's electricity demand will increase

Japanese Government / Complete Vehicle OEM Electrification Targets

Japanese Government's Electrification Target (Green Growth Strategy)

Passenger cars

- ✓ Achieve 100% electric vehicle sales in new car sales by 2035

Commercial vehicles

- ✓ For small vehicles, achieve 20-30% electric vehicle sales in new car sales by 2030, and 100% electric or decarbonized fuel vehicles by 2040
- ✓ For large vehicles, initiate the introduction of 5,000 units in the 2020s. Set a target for electric vehicle proliferation in 2040 by 2030.

Toyota

- ✓ Aim for annual sales of 1.5 million EVs worldwide by 2026
- ✓ Annual BEV sales target of 3.5 million units by 2030
- ✓ Lexus aims for 100% BEVs in Europe, North America, and China by 2030, and globally by 2035

Honda

- ✓ Plan for annual production of over 2 million EVs/FCEVs worldwide by 2030
- ✓ Aim for a 100% EV/FCEV sales ratio worldwide by 2040

Nissan

- ✓ From the early 2030s, all new models launched in major markets will be electric vehicles
- ✓ Aiming for a global electric vehicle model mix of over 55% by 2030

The Japanese government and complete vehicle OEMs are advancing electrification, leading to an increased share of electric vehicles in Japan

With the mass introduction of electric vehicles, electricity demand will increase

Source: Compiled by Industry Research Department Mizuho Bank, Ltd. based on a variety of published materials.

[Our Estimate] With the mass introduction of BEVs, electricity demand is expected to increase by 55.5 billion kWh

- The estimated increase in domestic electricity demand with the mass introduction of BEVs was produced by focusing on passenger cars
  - By the cross-section in 2050, both privately owned vehicles and MaaS vehicles will be widespread
- By the 2050 cross-section, the number of BEVs introduced is expected to exceed 12.34 million vehicles, more than 76 times the current figure, and assuming annual mileage and electricity consumption remain the same, electricity demand will significantly increase to 55.5 billion kWh

Basis for electricity demand estimation due to the electrification of vehicles (focusing only on passenger cars)

Estimation logic	2023	2050 (Estimate by Industry Research Department)
BEV introduction volume (units)	Passenger cars: 162,000	Privately owned cars: 8,872,000 MaaS vehicles: 3,467,000
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Annual mileage (km)	Passenger cars: 7,800km	Privately owned cars: 7,800km MaaS vehicles: 25,500km
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Electricity consumption (km/kWh)	Passenger cars: 6.1km/kWh	Privately owned cars: 6.1km/kWh MaaS vehicles: 2.0km/kWh
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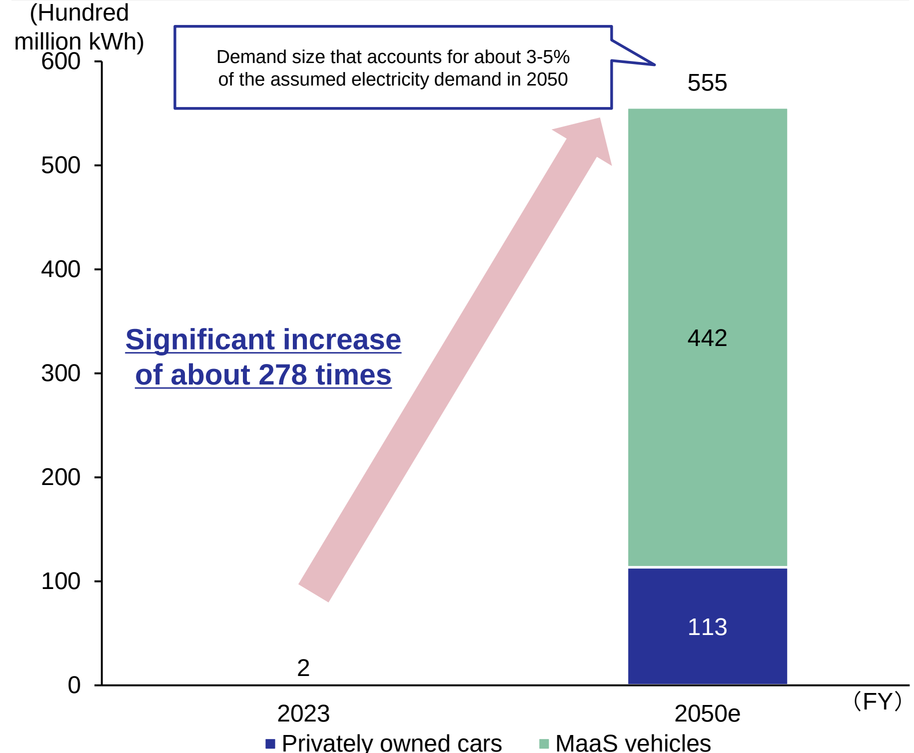
Electricity demand for BEVs	Passenger cars: 200 million kWh	Privately owned cars: 11.3 billion kWh MaaS vehicles: 44.2 billion kWh

Forecast of increased electricity demand due to vehicle electrification

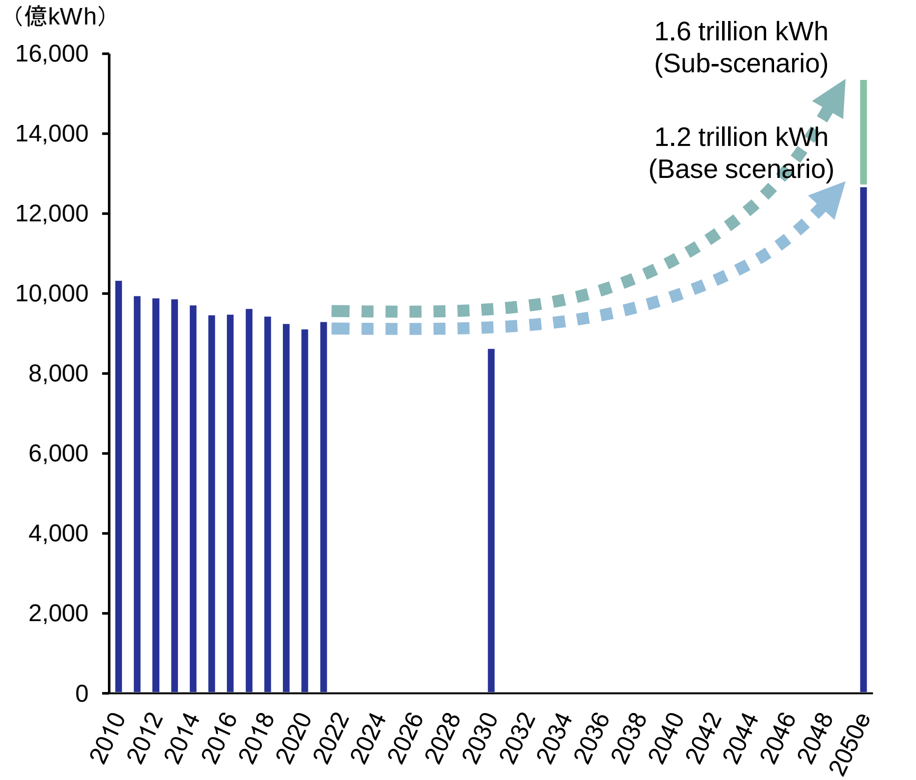


Note: The volume of BEV introduction for 2050 is estimated on a CY basis, but the electricity demand estimate assumes the volume of BEV introduction is the same on an FY basis
Source: Both charts created by Industry Research Department Mizuho Bank, Ltd. from the Ministry of Economy, Trade and Industry materials

[Our Estimate] In pursuit of CN, supply from decarbonized sources must meet increasing electricity demand

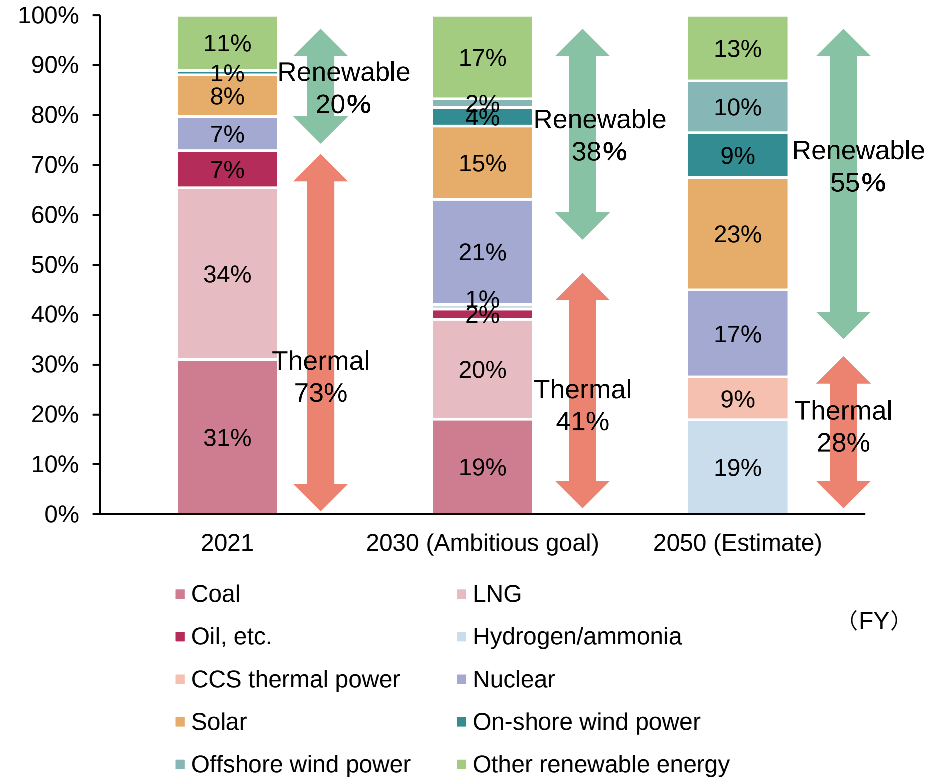
- Aiming to achieve carbon neutral by 2050, electricity demand will increase due to the progression of electrification, etc., and is assumed to be about 1.2-1.6 trillion kWh by 2050
- A simulation the power source composition required to meet the electricity demand of 2050, assuming decarbonization of the power sector
  - Solar and wind power will significantly expand, increasing renewables to about 55%, while thermal power is expected to decrease to about 28%

Forecast of domestic electricity demand



Source: Actual figures up to 2021 and forecast figures for 2030 are from the Agency for Natural Resources and Energy, with forecast figures for 2050 prepared by Mizuho Bank's Industry Research Department.

Forecast of domestic power source composition

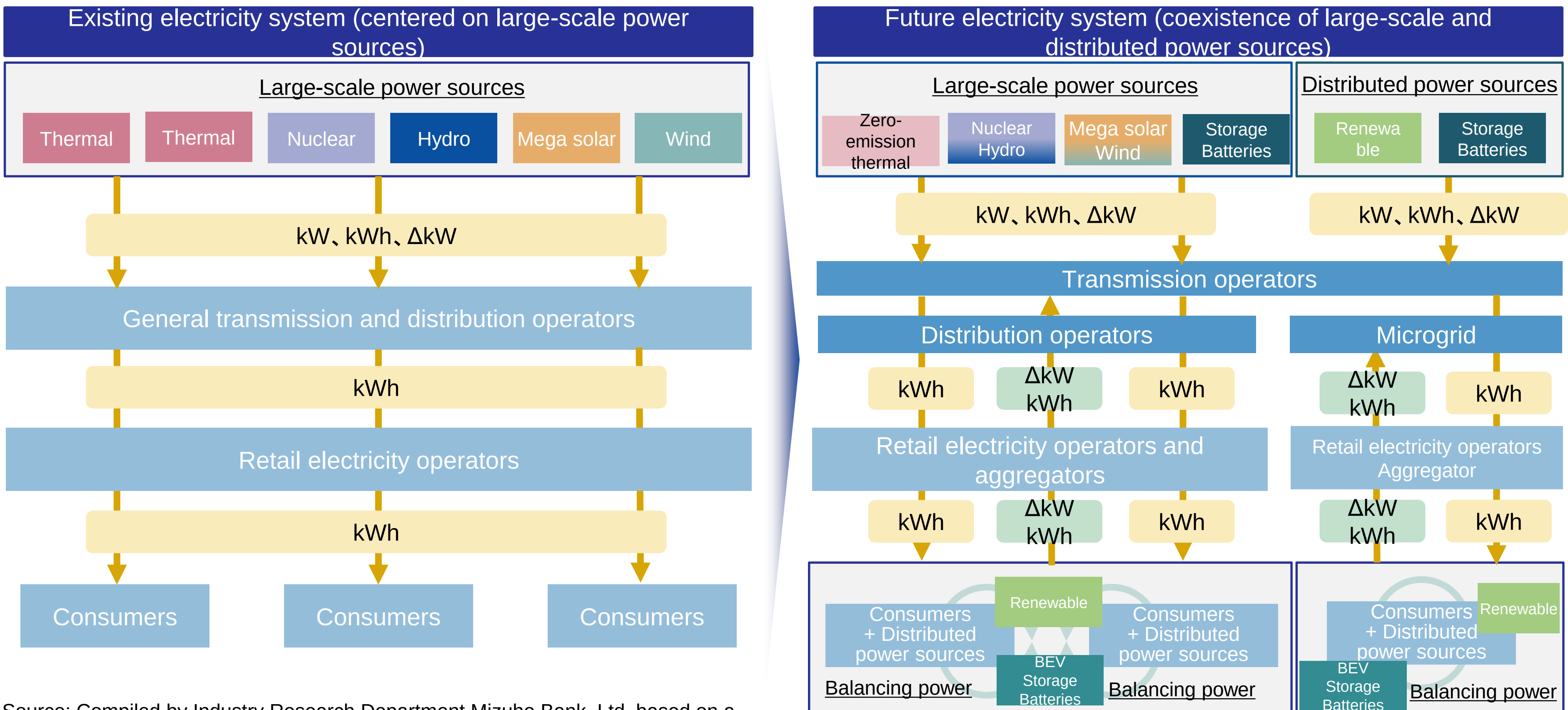


Source: Actual figures for 2021 and forecast figures for 2030 are from the Agency for Natural Resources and Energy, with forecast figures for 2050 prepared by Mizuho Bank's Industry Research Department.

A transition to an electricity system where large-scale and distributed power sources coexist is anticipated.

- Currently, the electricity system is centered around thermal and nuclear power, but with the increase in distributed power sources such as renewables on the generation side, and the increase in solar power, storage batteries, BEVs, etc., on the demand side, a transition to an electricity system where large-scale and distributed power sources coexist is envisioned.
  - The introduction of microgrids, which optimally control distributed power sources within an area, is also possible.

Transition to an electricity system where large-scale and distributed power sources coexist

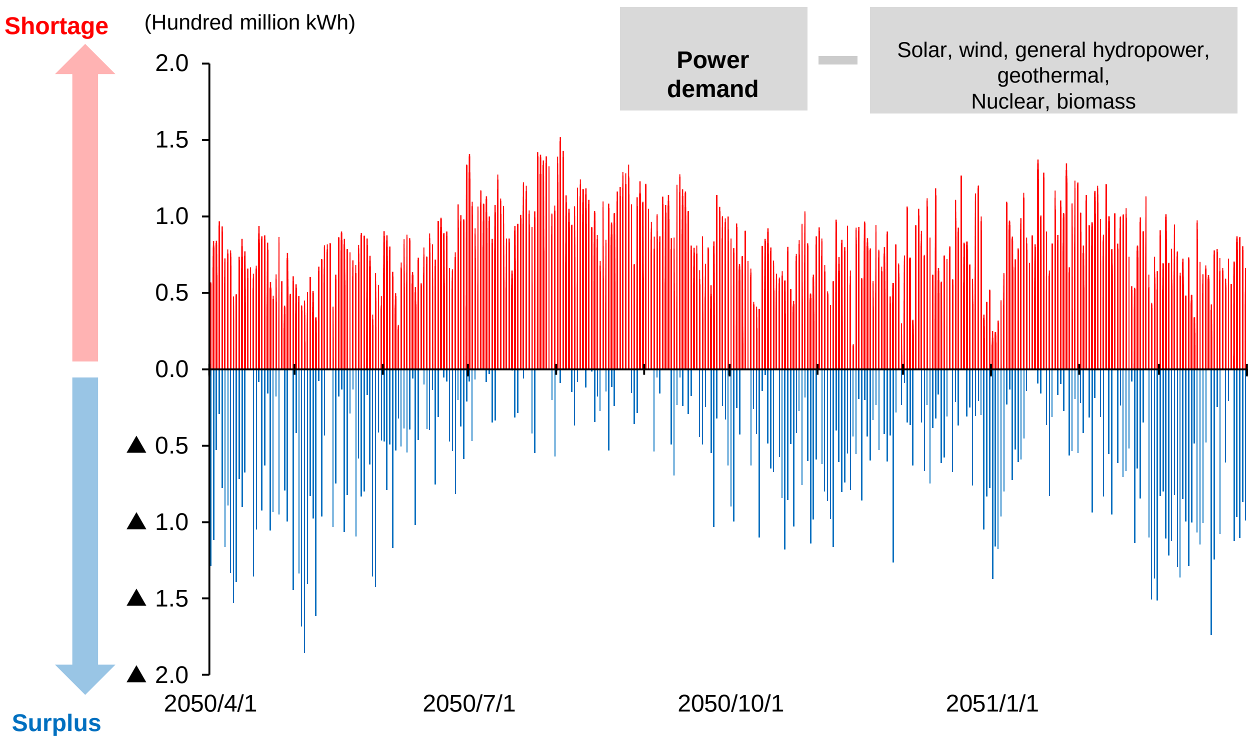


Source: Compiled by Industry Research Department Mizuho Bank, Ltd. based on a variety of published materials.

[Our Estimate] Demand-side adjustments are necessary to respond to the output fluctuations of renewables.

- In power supply and demand, it is necessary to properly control fluctuating demand and supply to achieve simultaneous and equal amounts.
- Assuming certain premises for the power source composition and its operation, we have estimated hourly supply and demand under a scenario where zero-emission power is achieved.
  - Estimating the difference between power demand and variable renewable energy (solar and wind) + baseload power sources (general hydropower, geothermal, nuclear, biomass) on an hourly basis to calculate the surplus or deficit of supply.
  - Surplus and shortage times occur during numerous hours throughout the year. During times of surplus, charging to pumped storage, batteries, BEVs, etc., is required, and during shortages, discharging from BEVs or generation from zero-emission thermal power, etc., is required.

Hourly non-fossil power supply and demand in FY2050 (Concept)



Time periods with supply shortages with non-fossil sources

- BEVs and batteries
- Pumped storage
- Generation needed by zero-emission thermal (hydrogen, ammonia, CCS) etc.

Time periods with supply surplus with non-fossil sources

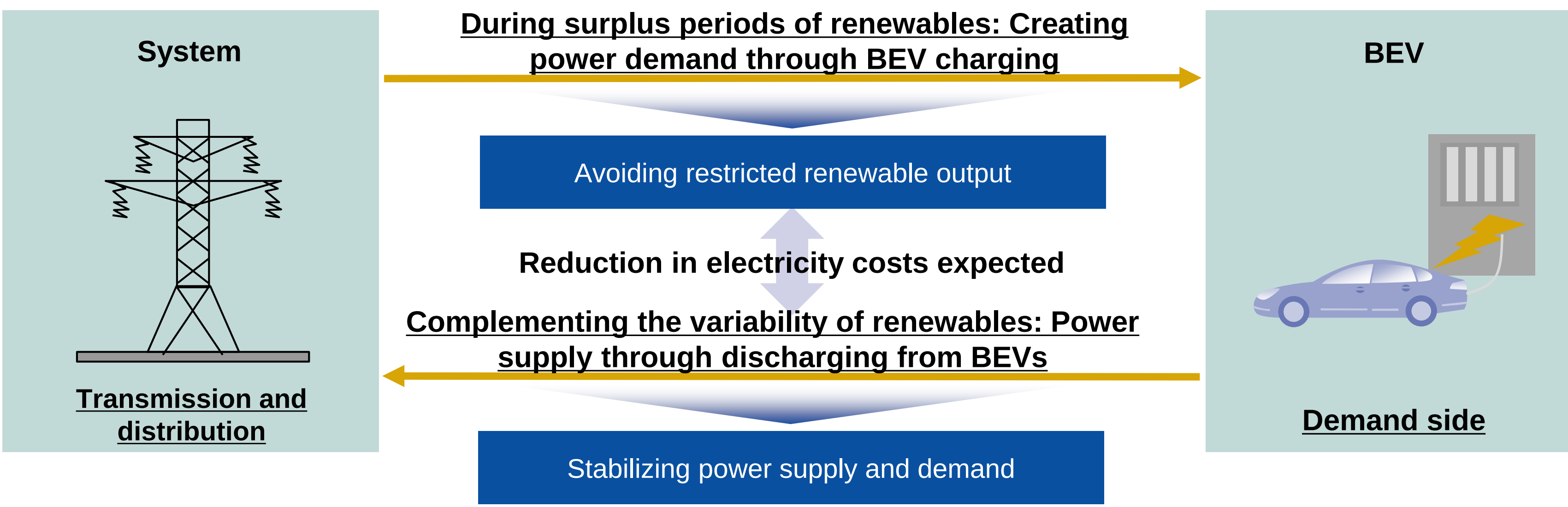
- BEVs and batteries
- Pumping for pumped storage
- Electrolysis for hydrogen production
- Adjustments such as output restriction needed

Source: Compiled by Mizuho Bank Industry Research Department

BEVs can become an important resource for stabilizing supply and demand.

- In 2050, the large introduction of variable renewables means charging BEVs during surplus periods of renewable energy and then utilizing their balancing function to complement the variability of renewables has become vital for supplying power.
  - During surplus periods, charging BEVs to create power demand can help avoid the restrictions in renewable output, promoting the effective use of surplus renewable power.
  - During periods without renewable generation, discharging from BEVs charged during surplus periods contributes to the stabilization of power supply and demand.
  - From a consumer perspective, charging during surplus periods of renewables allows for cheaper electricity rates. There is also the potential for reducing electricity bills through selling power.

The role of BEVs in an era with mass introduction of renewables

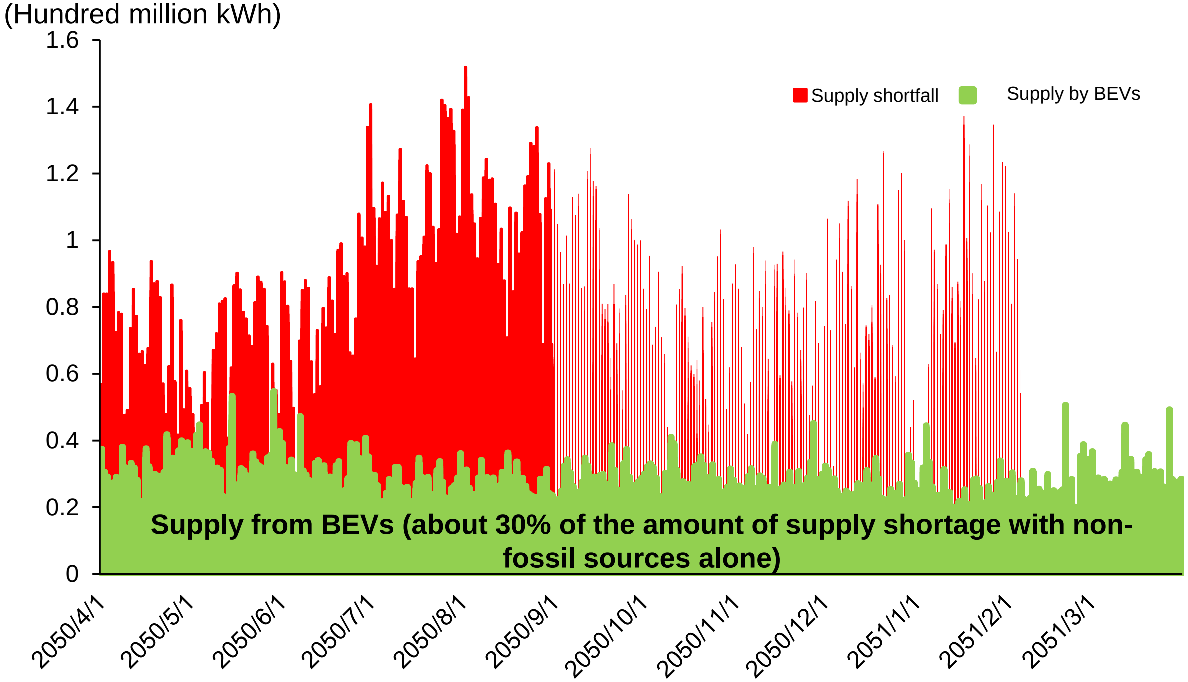


Source: Compiled by Industry Research Department Mizuho Bank, Ltd. based on a variety of published materials.

[Our Estimate] The use of BEVs could partially substitute for zero-emission thermal power

- The estimate of the amount of power BEVs can provide hourly makes assumptions about BEV battery capacity and the utilization rate of BEVs based on charging and discharging during hours of non-usage, ensuring the necessary power for driving is secured.
  - The annual power amount BEVs can provide in FY2050 is expected to be about 144.3 billion kWh (about 30% of the supply shortage).
- In FY2050, there are hourly cross-sections where supply capability is insufficient with non-fossil sources alone, but the use of BEVs can improve the supply shortage to a certain extent.
  - Utilizing BEVs can reduce the generation volume of zero-emission thermal power needed during supply shortages, potentially reducing fuel costs.

Hourly supply shortage amount and power amount BEVs can provide in FY2050



Utilization rate	Privately owned vehicles	Fluctuates hourly, considering usage time (0 to 20%)
	MaaS vehicles	About 80%
Storage Batteries Capacity	Privately owned vehicles	45 kWh/vehicle
	MaaS vehicles	126 kWh/vehicle
Power amount (Annual)	Privately owned vehicles	121.2 billion kWh
	MaaS vehicles	23.1 billion kWh

Source: Compiled by Industry Research Department Mizuho Bank, Ltd. based on a variety of published materials.

The mass introduction of BEVs impacts the advantages held by various sectors of the power industry

- Up until now, each segment of the generation, transmission, distribution, and retail value chain in Japan was regulated to ensure stable supply, cultivating strengths within each sector.
- The large-scale introduction of BEVs and the introduction of low marginal cost renewable energy are expected to reduce the dominance of large-scale power sources, and the expansion of local consumption of distributed power sources is anticipated to reduce system power demand. However, there is also potential for an expansion in business opportunities through increased power demand and charging infrastructure development.

Anticipated changes in strength on the power value chain

	Strengths of major power companies	Anticipated environmental changes	Impact on existing strengths
Power Generation	■ Own large-scale power sources such as thermal and nuclear power	■ Introduction of distributed renewables	■ **The dominance of large-scale power sources is reduced** by the introduction of low marginal cost renewables ■ **BEVs could partially replace the balancing capability that thermal power had provided**
Transmission and distribution	■ Possess the necessary transmission and distribution networks and supply and demand adjustment technology and know-how to match supply and demand domestically ■ Results in a low rate of power outages	■ Increase in BEV system connections	■ Investment in facilities is required to resolve system congestion ■ Complex supply and demand adjustments utilizing a variety of distributed resources are required
Retail	■ Abundant touchpoints with corporate and individual customers (potential aggregation resources) through supplying power	■ Increase in power demand due to an increase in BEVs using electricity ■ Changes in demand patterns due to BEV charging	■ If abundant touchpoints with customers can be maintained, **it's possible to capture increased power demand through promotions such as menus in EVs** ■ **Opportunities for involvement in new areas** through charging infrastructure development and aggregation

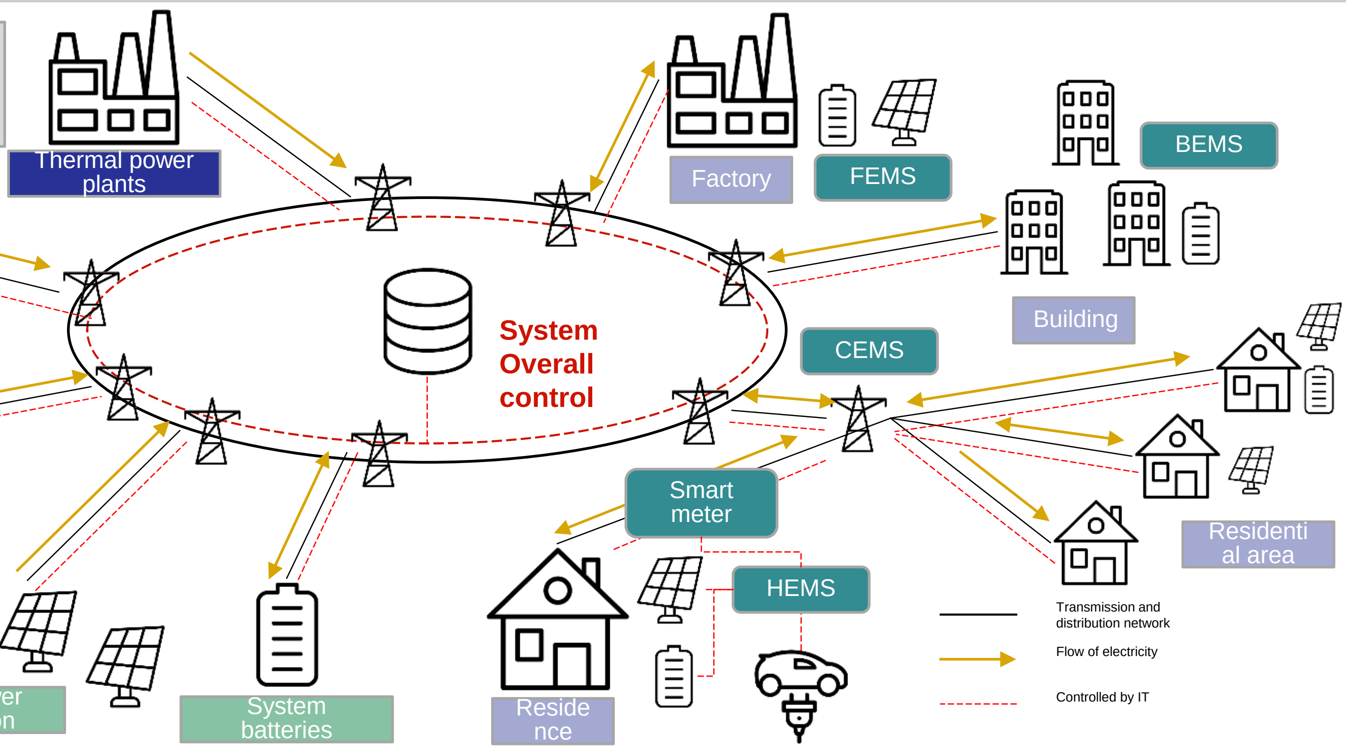
Source: Compiled by Mizuho Bank Industry Research Department

The power system is advancing towards smart grids

- Alongside the expansion of distributed power sources, most of the equipment and devices constituting the power system will have IoT functionality. This shift will produce a smart grid that provides real-time information and supplies high-efficiency, high-quality, and high-reliability power through integrated controls on both the supply and demand sides.
- Large-scale power sources, transmission and distribution networks, distributed power sources, and consumer devices producing demand are connected both physically and over the internet, enabling the optimization of power supply and demand at the level of individual buildings such as homes, factories, buildings, or regions.

Image of a smart grid

- Real-time assessment of power information
- Integrated control of both supply and demand
- High-efficiency, high-quality, high-reliability power supply

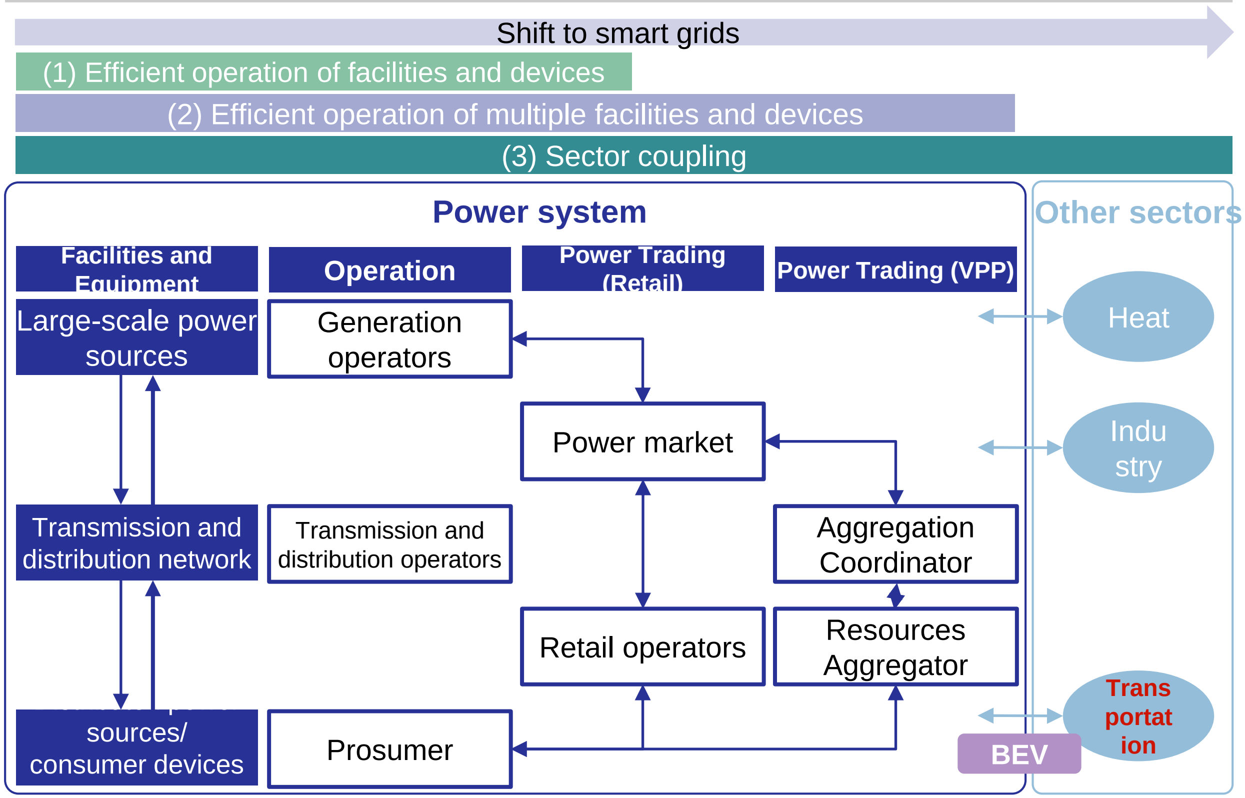


Note: EMS: Energy Management System, HEMS: Home EMS, BEMS: Building EMS, FEMS: Factory EMS CEMS: Community EMS
Source: Compiled by Mizuho Bank Industry Research Department

Decentralization, shift to smart grids, and mass introduction of BEVs lead to sector coupling with the transport sector.

- Currently, alongside efficient operation of individual facilities and devices using AI, etc., the construction of virtual power plants (VPPs) bundling distributed power sources and consumer devices that produce demand is progressively advancing towards smart grids.
- A power system with smart grids, starting with BEVs, can potentially lead to sector coupling through connections with the transport sector.

Examples of new business areas through the smart grid



Examples of new business areas

(1) Efficient operation of facilities and devices

- AI-based prediction of renewable generation volume
- Formalization of tacit knowledge of technicians in O&M of power plants
- Inspection of transmission lines by AI and drones

(2) Efficient operation of multiple facilities and devices

- Integrated control of distributed power sources and devices producing consumer demand at site level by HEMS, BEMS, FEMS
- Construction of VPP using aggregators
- Construction of microgrid using a distribution license

(3) Sector coupling

- Producing hydrogen with surplus renewables and utilizing it in industrial and transport sectors
- **Integration of energy management and fleet management**

Source: Compiled by Mizuho Bank Industry Research Department

Growth opportunities exist in expanding BEV business through a comprehensive alliance between the power and automotive industries

- Construction of a comprehensive alliance framework between the power and automotive industries, envisioning a growth strategy for the power industry in an era of mass BEV introduction
  - Not only monetizing the effective use of BEVs but also enhancing the value of BEV ownership through providing value-added experiences to BEV users is important for multifaceted business development

Comprehensive alliance concept between the power and automotive industries

Power industry

Growth opportunities through BEV business triggered by mass introduction of BEVs

Comprehensive alliance in BEV business

Automotive industry

Entry into energy business through BEV-based supply and demand adjustment

Growth strategy through providing value from combining power and BEVs

Monetizing through effective use of BEVs

- ✓ Expanding BG* with resource utilization in mind through making offers on BEV menus to leverage the customer base
- ✓ Monetization through using power supplied from BEVs as an aggregator
- ✓ Provision of adjustment power through the systematized use of used BEV batteries as power storage

BEV usage platform

Users

Enhancing BEV ownership value

- ✓ Providing experiential value to users by offering a common platform integrating mobility, space, and energy
- ✓ Optimal operation of BEVs and power usage
- ✓ Ongoing service improvements based on vehicle and power data

Individual and corporate users (BEV ownership)

Charging at cheaper rates during renewable peak times
Reducing electricity bills by supplying power derived from BEVs

MaaS operators (BEV operation)

Efficiency of operations through optimal control of charging timing for MaaS vehicles
Improved profitability through integration of charging infrastructure operation and MaaS operation

Note: Abbreviation for Balancing Group. Refers to a group of operators who serve as the adjustment unit for imbalances (deviations between planned values and actual supply and demand) under the simultaneous and equal amount planning system.

Source: Compiled by Mizuho Bank Industry Research Department

To produce alliances, the power industry needs to contribute to the decarbonization of the automotive industry

- Addressing the automotive industry's need for non-fossil fuel energy sources and contributing to decarbonization across the entire value chain through providing solutions are crucial steps. These efforts are essential for paving the way for alliances and must start from the present.
- Deepening cross-industry discussions is necessary, such as incentivizing individual users to participate in BEV utilization platforms and exploring the role of MaaS operations, which only offer limited power supply capabilities.

Strategies for building an alliance with the automotive industry

BEV Value Chain	Storage Batteries / Component Manufacturing	BEV Manufacturing	Sales	BEV Utilization	Storage Batteries Recycling / Reuse
Responsible Parties	~Tier1	Complete Vehicle OEMs	Dealer Complete Vehicle OEMs	Individual MaaS Operators	Complete Vehicle OEMs, etc.

Power industry Strategies

Zero-Emission Power Supply

Contributing to the decarbonization of the entire value chain by addressing the automotive industry's need for non-fossil fuel energy sources through solutions

- Decarbonization of thermal power
- Reactivation of nuclear power
- Development of renewables domestically and abroad
- Investment in new energy technologies

Challenges for Realizing a Winning Strategy for the Power Industry

Comprehensive alliance concept between the power and automotive industries

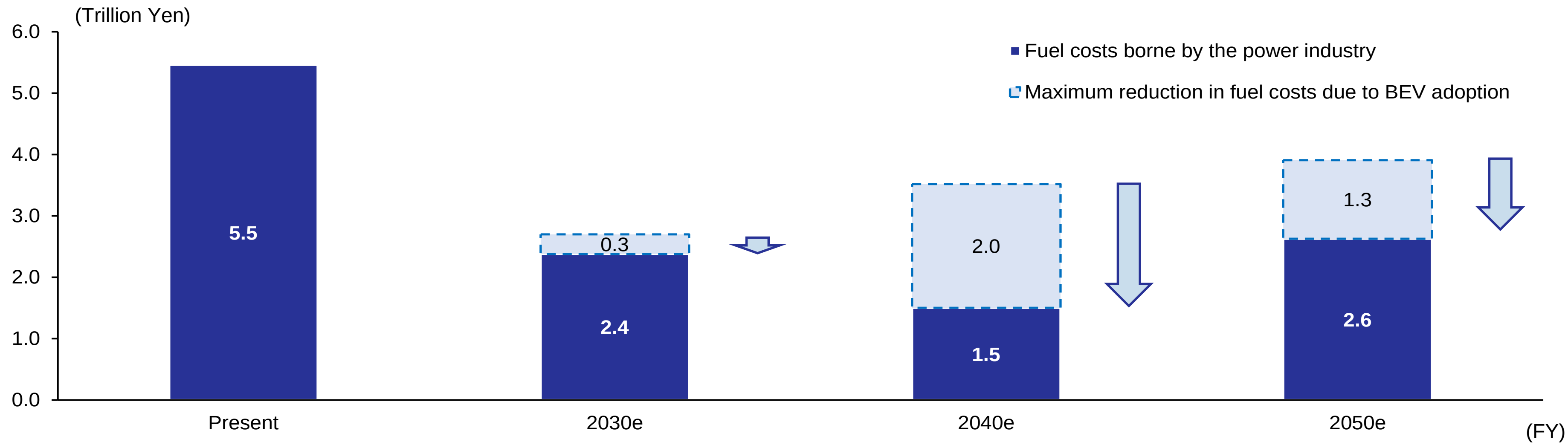
- Deepening cross-industry discussions is necessary, such as incentivizing individual users to participate in BEV utilization platforms and exploring the role of MaaS operations, which only offer limited power supply capabilities.

Source: Compiled by Mizuho Bank Industry Research Department

A fuel cost reduction for Japan's power industry is expected with the introduction of BEVs.

- By substituting a portion of zero-emission thermal power with BEVs, a fuel cost reduction of up to 1.3-2.0 trillion yen is expected in the cross-sections of 2040 and 2050.

Prospects for potential fuel cost reductions through BEVs



	Present	2030e	2040e	2050e
Comments	• The total fuel cost of Japan's power industry is estimated at 5.5 trillion yen. • Entry into the supply and demand adjustment market for low-voltage resources such as BEVs is planned from FY2026. Currently, a power supply that utilizes the balancing functionality of BEVs is not available.	• Assuming the 6th Strategic Energy Plan is realized, the Japanese power industry's total fuel cost is estimated at 2.7 trillion yen. • The number of BEVs expected to be introduced by 2030 is about 3.36 million units, accounting for just over 5% of the total on a stock basis. • BEVs can substitute about 45.9 billion kWh of power, with a maximum fuel cost reduction potential of about 0.3 trillion yen.	• The Japanese power industry's total fuel cost for 2040 is estimated at 3.5 trillion yen. • About 15.12 million units of BEVs expected to be introduced by 2040, accounting for 27% of the total on a stock basis, expanding the possible amount of power supplied. • BEVs can substitute about 205.8 billion kWh of power, with a maximum fuel cost reduction potential of about 2.0 trillion yen.	• The Japanese power industry's total fuel cost for 2050 is estimated at 3.9 trillion yen. • The number of BEVs expected to be introduced by 2050 is about 12.34 million units, a decrease, but the BEV ratio of the total has expanded to 89%. The amount of power from BEVs decreases with the decrease in BEV numbers. • BEVs can substitute about 144.3 billion kWh of power, with a maximum fuel cost reduction potential of about 1.3 trillion yen.

Source: Compiled by Industry Research Department Mizuho Bank, Ltd. from the Agency for Natural Resources and Energy

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