

Research and Development

Basic Policies

We are engaging in R&D initiatives based on the following policies aimed at the creation of new social value using energy and environmental technologies.

- Acceleration of technology development for the solution of social issues such as carbon neutrality and others, and for the creation of customer value through digital transformation
- Strengthening the search for research themes and the formulation of product plans in order to respond to major changes in the external environment, such as markets and technologies
- Creation of competitive advantages through new combinations of technologies
- Strengthening of research into advanced technologies leading to the next new products anticipating trends in 2030 and beyond
- Promotion of intellectual property portfolio formation and international standardization activities meeting the requirements of the globalization of business and new technologies and new products

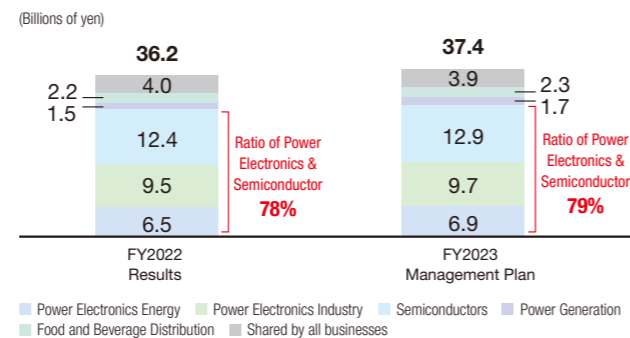
R&D Expenditures

As part of the growth strategy in the FY2023 Medium-Term Management Plan, we have invested approximately 80% of our R&D expenditure in our power electronics and semiconductor businesses.

The FY2022 result was ¥36.2 billion, and we allocated 78% of that amount to the fields of power electronics and semiconductor businesses. In power electronics, we focused our efforts on the development of global products including substation equipment and automation monitoring control systems and the development of products for the mobility field including electrified vehicles (xEVs) and ships. In semiconductors, we expanded the series of RC-IGBT modules for xEVs and evolved silicon carbide (SiC) technologies.

Also in FY2023, we plan to continue priority development investment in power electronics and semiconductor

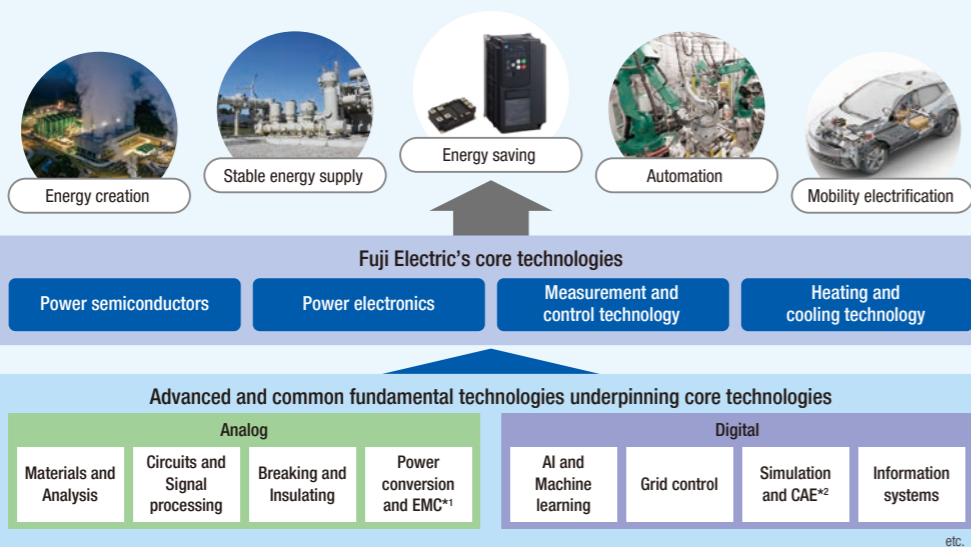
businesses, and to increase the amount of investment in food and beverage distribution and power generation businesses from the previous fiscal year.



Fuji Electric's Core Technologies

Fuji Electric has four core technologies, centered on power semiconductors with the industry's top-of-the-line power conversion efficiency and power electronics to convert and utilize electric power freely and without waste, as well as measurement and control technology, which supports industrial automation and energy saving, and heating and

cooling technology cultivated in our industry-leading vending machines. These core technologies are supported by both analog and digital advanced technologies and common fundamental technologies, including power conversion and EMC^{*1}, and AI and machine learning.



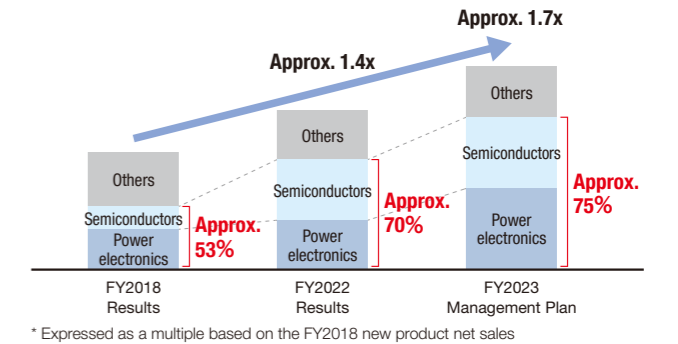
*1 EMC: Electromagnetic Compatibility *2 CAE: Computer Aided Engineering

New Product Net Sales

Regarding the net sales of new products*, which are positioned as the most important KPI for R&D, the FY2022 result grew by approximately 1.4 times compared to FY2018. Power semiconductors for electrified vehicles drove this growth in particular.

In FY2023, we will work to further expand sales of new products, especially for power electronics, aiming for 1.7 times compared to FY2018.

* New products: Within five years after market launch



Medium- to Long-Term R&D Initiatives

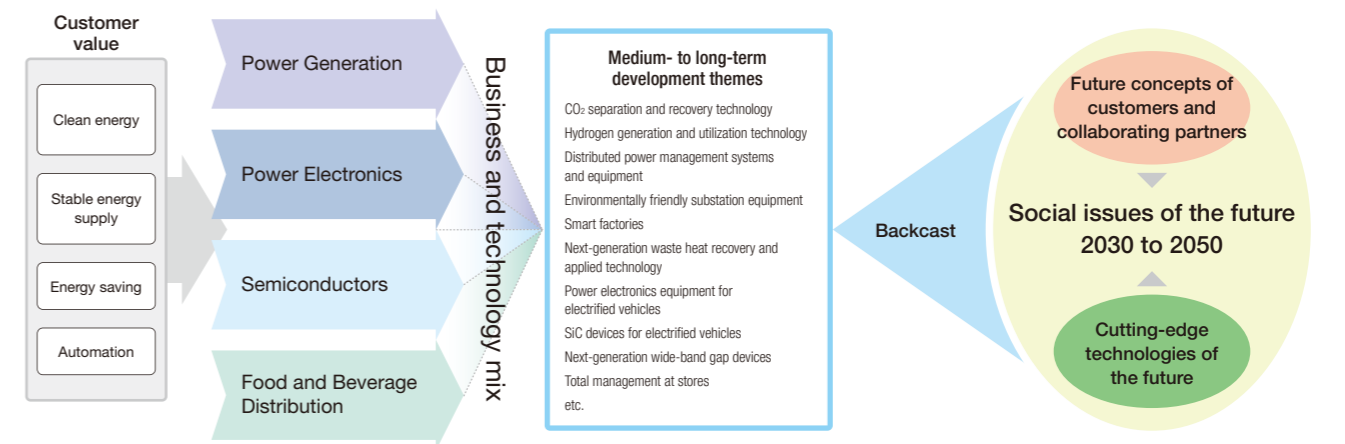
For the sustained growth of Fuji Electric, we will match market needs related to energy and the environment to the business and technology mix of Fuji Electric, with the aim of creating new business opportunities and social value using our products.

The New Products Development Office established in FY2021 is the hub for initiatives to plan and promote new development themes based on analyses of market and customer trends from medium- to long-term perspectives.

In FY2022, we planned and promoted development

themes centered on issues related to green transformation (GX), such as hydrogen generation and utilization technology, CO₂ separation and recovery technology, or next-generation waste heat recovery and applied technology to contribute to carbon neutrality.

Moreover, we ascertain and analyze future concepts of customers and collaborating partners and closely monitor the trends of cutting-edge technologies to imagine the social issues from 2030 onwards and determine the development themes we should tackle.



TOPICS

Aiming to upgrade electricity supply and demand predictions, a social collaboration research department has been opened in the University of Tokyo

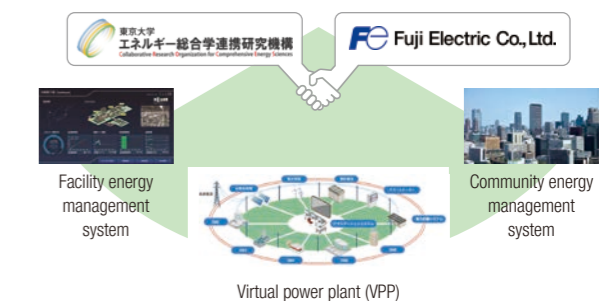
In April 2023, Fuji Electric and the Collaborative Research Organization for Comprehensive Energy Sciences at the University of Tokyo opened "Realization of Electric Systems Innovation," a social collaboration research department with the objective of joint research to contribute to expanded adoption of renewable energy.

With electricity, it is necessary to constantly match the amount of power generation to the amount of consumption. In order to expand the introduction of renewable energy such as solar and wind power, adjustments to achieve equilibrium between electricity supply and demand are essential.

In order to solve this issue, we will develop a technology to predict the amount of renewable energy power generation and the market prices of renewable energy with high precision using AI. This technology will be obtained by combining the outstanding insights of the University of Tokyo concerning electricity supply and demand predictions with the experience in storage battery systems for the power

system* and community energy management systems* that Fuji Electric has been working on to date. Through the provision of Fuji Electric products that have applied the outcomes of those predictions, we will aim for expanded adoption of renewable energy.

* For details, refer to "Promotion of the Energy and Environment Businesses" on P24 and P25



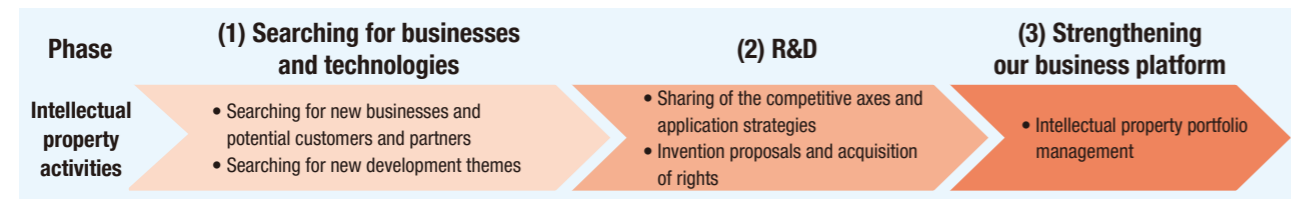
Intellectual Property Strategy

Fuji Electric has positioned intellectual property as an important management resource, and it will secure the competitive advantage of Fuji Electric through the strategic acquisition and utilization of intellectual property rights, most

notably patent rights and design rights, and is strengthening initiatives concerning the international standards with which compliance is required in the markets for each of our products aiming for expanded global sales.

Initiatives concerning intellectual property rights

In order to maintain and strengthen our business competitiveness through intellectual property rights, the business division, the R&D division, and the intellectual property division collaborate closely to take initiatives in three phases: searching for businesses and technologies, R&D, and strengthening our business platform.



(1) Utilization of intellectual property information analyses for searching for businesses and technologies

When searching for new businesses and new technologies focused on opportunities for major social transformations such as carbon neutrality and digital transformation, we increase the effectiveness of our measures by utilizing the IP landscape.*

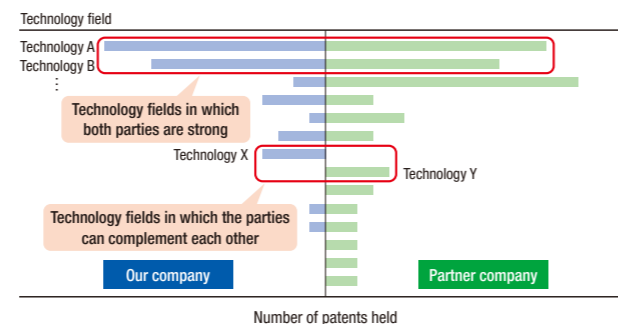
By analyzing patents and research papers, we not only produce corroboration and counterevidence with respect to new technologies but also ascertain the future needs of our customers in order to promote initiatives utilizing them in the development of competitive new products.

Furthermore, in the case that collaboration in business expansion of new domains becomes necessary, we analyze the patents held by our company and the partner candidate companies (see the figure on the right) in order to clarify the development history and accumulation of each of the technologies and realize the extraction of partner candidates

that will lead to win-win relationships.

* IP landscape: Analyzing information concerning intellectual property to ascertain technology trends and the competitive environment

Partner extraction using patent technology comparisons



(2) Strengthening of intellectual property rights linked to R&D

Regarding intellectual property generated through R&D, we aim for strategic acquisition of rights to ensure that we can continue expanding profit through differentiation in our business activities. After sharing the “competitive axes” in

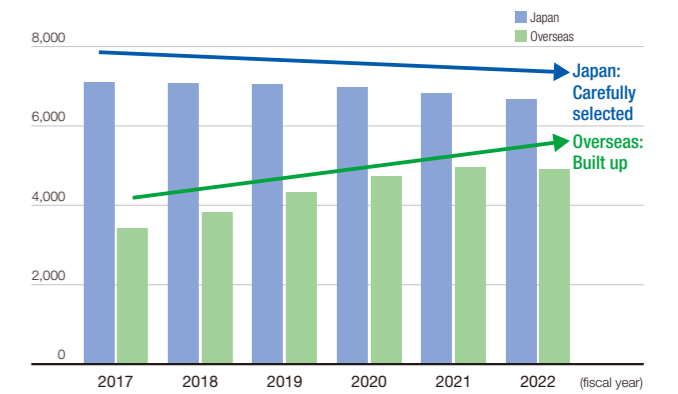
the markets of the products subject to development with the business, R&D, and intellectual property divisions, we promote activities to build a patent network linked to R&D.

(3) Portfolio management of intellectual property for strengthening our business platform

Regarding the intellectual property rights held, we are continuously carrying out maintenance taking into account changes in business conditions, including the addition of application countries in conjunction with the progress of our overseas businesses, and the waiver of patents held in response to competitive axis changes and product lifecycles.

Regarding the number of patents held by Fuji Electric, we carefully select the patents in Japan in order to raise the cost-effectiveness of the intellectual property rights in our businesses, and we file about 1,000 new applications every year to maximize our opportunities for the acquisition of rights. On the other hand, we are building up our foreign patents in order to be able to respond to the expansion of our overseas businesses, globally strengthen our rights, and reduce the risk of intellectual property disputes.

Number of patents and utility models held



Initiatives concerning international standards

Fuji Electric is strengthening its initiatives concerning international standards. Company-wide committees with each Corporate General Manager as the committee members decide the policies and strategies, we establish working groups for each business field based on those policies and strategies, and we systematically advance the acquisition of certification according to international standards for each of our products.

Furthermore, we are promoting active involvement in international standardization institutions such as the International Electrotechnical Commission (IEC) in order to ensure that we can exercise leadership in rule-making activities pertaining to energy creation, energy saving and

other growth domains of Fuji Electric centered on the power electronics and power semiconductors fields. A Fuji Electric employee is in the position of the Japanese representative member of the Conformity Assessment Board (CAB), a top-ranked committee in the IEC, and is contributing to enhancement of the effectiveness of the certification system of the IEC.

In FY2022, we newly established the Global Business Strategy Office, which leads standard certification and rule-making activities, and we are accelerating initiatives for business expansion concerning carbon neutrality and DX in the power electronics business.

TOPICS

Acquisition of security certification in the development lifecycle

The Tokyo Factory and the Suzuka Factory, the flagship factories of the power electronics business, have acquired certification for the international standard IEC62443-4-1.*1 Going forward, both factories will develop new products including inverters and controllers (PLC) that enhance security functions, among others, and they are aiming to launch them on the market by about FY2024.

We acquired the certification of IEC62443-4-1 based on the first CB certification scheme*2 in Japan. Adopting this scheme enables us to efficiently acquire standards certifications in more than 50 countries; therefore, we will utilize it going forward as well.

*1 IEC62443-4-1: The international standard which specifies the requirements for the development of secure products used in industrial automation and control systems

*2 CB certification scheme: A system for mutually approving the test results for electrical equipment internationally. The scheme is operated based on the IEC System for Conformity Assessment Schemes for Electrotechnical Equipment and Components (IECEE). Institutions in more than 50 countries participate in it, and the issued CB certificates and other documents are accepted in the certification systems operated by the certification institutions that are members.



IEC 62443-4-1 CB certificate (Left: Suzuka Factory Right: Tokyo Factory)

TOPICS

Building the patent networks of the large capacity uninterruptible power supply systems (UPSs) for data centers

In the power electronics business, we are promoting a comprehensive electrical equipment business, and UPSs, the core product, have become the differentiating element in the growing business for data centers (IDCs) in particular.

With large capacity UPSs for IDCs, downsizing to increase the number of installed servers and the shortening of downtime in order to enhance the availability are the main competitive axes. The UPS7500WX Series employs “front maintenance” and “unit structure.” The level of difficulty of combining these is high due to the need for internal cooling; therefore, many ideas, or in other words intellectual property, are incorporated in order to achieve this. Through the Invention Discovery Meeting shared by the R&D division and the intellectual property division, we extract and systematically organize everything from the design concept to the flow channel of the cooling air, component layout and wiring route which embody the design concept, in order to quickly file patent applications without any omissions.

UPS7500WX Series

Front maintenance
Save further space using the mechanisms of top exhaust and front maintenance, and other methods

Unit structure
Reduction of man-hours for the wiring and other aspects

UPS7500WX manufactured by Fuji Electric
Maintenance space is not necessary between the main unit and the wall

UPS manufactured by another company
Maintenance space is necessary between the main unit and the wall