FURUKAWA ELECTRIC GROUP

Intellectual Property Report 2024

FURUKAWA ELECTRIC

Contents

Introduction

I would like to welcome you to the FEC Group Intellectual Property Report. Following the fiscal year 2024 in which recovery and change were clearly visible, we intend to make this fiscal year 2025, the final year of the 2025 Mid-term Management Plan, a year in which we will further enhance our corporate value by demonstrating more than ever that FEC Group is an indispensable company group for solving social issues.

Our value creation process is essentially based on "strength building," "value creation," and the "human resources development" to support such "strength building" and "value creation". This means we "build our strengths" by creating and reinforcing strengths of our technologies, products, and services; "create values" by identifying, visualizing, obtaining rights for, and utilizing the intellectual assets generated through the process of such strength building to transform the strengths into customer values; and "develop human resources" by fostering employees who master the intellectual property necessary to sustain these activities of strength building and value creation.

This report highlights our efforts to support the utilization of intellectual assets that will contribute to such transformation of strengths into values.

I hope this Intellectual Property Report 2024 will provide you with a better understanding of the intellectual property management of FEC Group.

September 2025
President and
Representative Director
Hideya Moridaira

1 Feature Stories

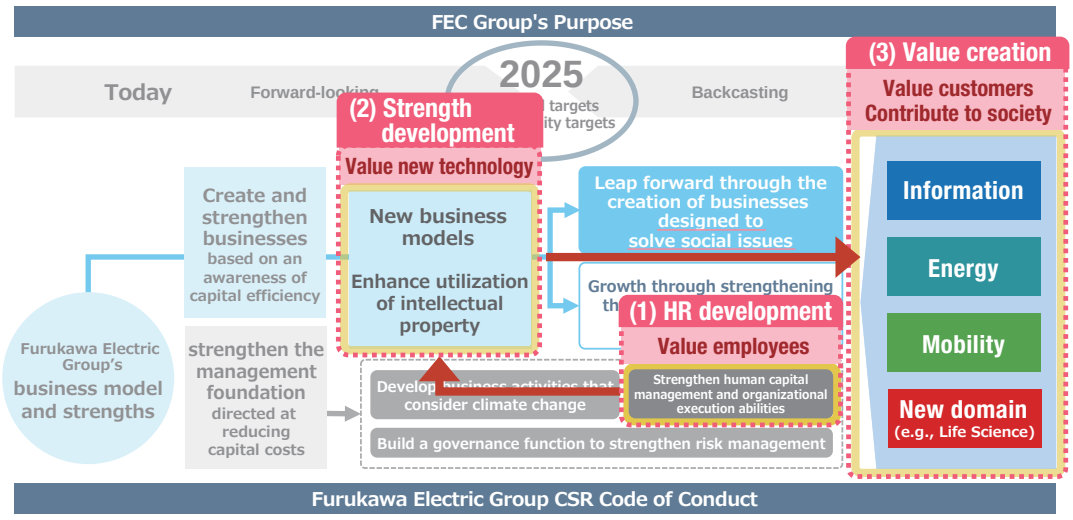
How We Make Our Intellectual Property Activities Contribute to Transformation of Strengths into Values

The year 2024 marked the 140th anniversary of Furukawa Electric Co., Ltd. (FEC) Group's founding. When we began copper refining in Honjo, Tokyo, and electric wire manufacturing in Takashima-cho, Yokohama in 1884 (Meiji 17), Ichibei Furukawa, FEC Group's founder, set out to build a new Japan with his aspiration to "brighten Japan." This aspiration has passed down to our Group's purpose defined in March 2024: "Composing the Core of a Brighter World."

FEC Group has inherited the words of Ichibei Furukawa as part of our DNA: "Value Employees, Value Customers, Value New Technology, and Contribute to Society." "Value Employees" means to us "human resources development," "Value New Technology" means "strength building," and "Value Customers, and Contribute to Society" means "value creation." As stated in our People Vision, human resources are the most important asset for our Group. To achieve "value creation," we will support the utilization of intellectual assets and "build strength." To this end, we believe it is crucial to constantly strengthen human resources with high execution capability (intellectual property human resources) who know the importance of intellectual property and intangible assets and are capable of utilizing them, and a framework that enables the development and utilization of intellectual property and intangible assets.

This report provides case examples of the strengths generated by intellectual property human resources and intellectual property activities as a framework for transforming the strengths into value.

Furukawa Electric Group's Value Creation Process toward 2030



1-1. FEC Group's Intellectual Property Activity Policy

FEC Group considers its intellectual assets as crucial management resources. Such intellectual assets include not only intellectual property such as patents and know-how, which are the sources of our strength, but also human assets, organizational capabilities, and customer networks. To support utilization of such intellectual assets, we have three basic policies below, under which we integrate business, R&D, and intellectual property to implement intellectual property activities on a group-wide and global basis. Our intellectual property activities are being advanced from two perspectives: Risk Minimization (for safer business) and Chance Maximization (for greater business opportunities).

Three Basic Policies

1	**Reinforcing management and business strategy planning capabilities by IP Landscaping**	Reinforce management and business strategy planning capabilities by IP Landscaping that incorporates, analyses and utilizes intellectual property information into strategy planning processes.
2	**Utilizing intellectual assets with Open & Closed strategies**	Strengthen business competitiveness by: using Open and Closed strategy to utilize intellectual assets; and then, running an activity cycle of creating and accumulating intellectual assets and protecting business and core technology, while using IP landscaping to analyze environments for change.
3	**Making business safer by reducing intellectual property risks**	Identify four kinds of risk with significant impact and frequency: infringement risk, technology outflow risk, contract risk, and counterfeit risk. Make business safer by continuously reducing such risks.

Risk minimization

We protect our unique and differentiating technologies with intellectual property rights and technical know-how management to minimize business risks.

In order to achieve growth in the information, energy, and mobility sectors, we develop and make the most of our intellectual property portfolios based on detailed competitor analyses to strengthen social-issue-solving businesses. We expect this will support our existing businesses in which we commit ourself to focus on capital efficiency and maximize profits in the year 2025, the final year of the Furukawa Electric Group's Medium-Term Management Plan 2022-2025 (2025 Mid-term Plan).

Chance maximization

We use IP Landscaping and analyze the environment of competition and market based on intellectual property information of our own and other companies to seek new business fields and business models.

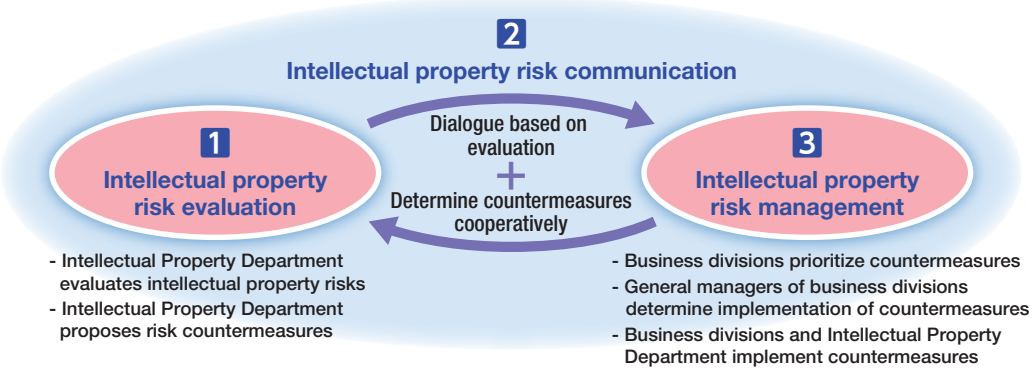
To ensure that we are successful in creating new social-issue-solving businesses, we promote the uses of IP Landscaping in the field of next-generation infrastructure-supporting businesses and environmental businesses, and support the development of foundation for creating new businesses toward 2030.

Intellectual Property Risk Management

FEC Group's CSR Code of Conduct provides two principles to be followed: "Protecting Intellectual Property Rights" and "Managing Confidential Information." In accordance with these principles, we are committed to building and utilizing intellectual property portfolios based on detailed competitor analyses, and to promoting global risk reduction activities for intellectual property such as the prevention of technical information leakage.

The FEC Group's approach for Risk Minimization involves intellectual property risk management that consists of three steps: (1) IP risk assessment, (2) IP risk communication, and (3) IP risk management.

In the step of IP risk assessment, we evaluate priority products of each business division from three aspects: whether the products are covered by our intellectual property portfolio to prevent other companies from making similar products; whether the products are not covered by a right of other company; and whether the products are protected against leakage of associated technical know-how. We arrange the opportunity to talk with the relevant division to discuss what we do to deal with these risks. In principle, such IP risk assessment for the products are reviewed once a year.



We define the following four categories to classify intellectual property risks and continuously call attention to risk management to stabilize business execution.

Infringement risk

Regularly and continuously search for other companies' rights information to ensure that our products do not infringe other companies' intellectual property rights.

Avoid risks of direct damage to businesses and loss of opportunity.

Technology outflow risk

Manage technologies at development and manufacturing sites and use a timestamp system to reinforce information preservation. Regularly check external announcements, including news releases.

Avoid risks of unintended disclosure of confidential information and other risks.

Technology counterfeit risk

Obtain patent rights, utility model rights, design rights, and trademark rights to protect our products. Bring an action for injunction or damages if another company counterfeited our product.

Avoid risks of loss due to declined market share or other.

Contract risk

Ensure that every technical contract is reviewed by the Intellectual Property Department before being signed.

Avoid risks of future disputes concerning the terms of technical contracts, including non-disclosure agreements, joint research agreements, purchase and sale agreements.

1-2. Intellectual Property Activities for Strength Building

[Risk Minimization]

Protecting Intellectual Property Rights and Managing Confidential Information

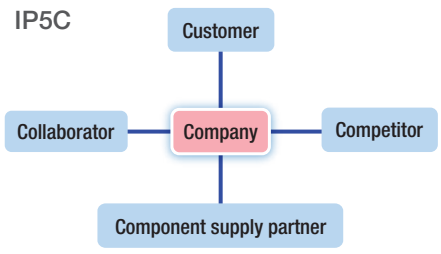
Peripheral Monitoring Radar

FEC Group protects its unique and differentiating technologies through intellectual property rights and technical know-how management to minimize business risks. While filing patent applications results in exclusive rights, it may unnecessarily disclose in-house technological information to the public. Thus, when inventors make initial decisions on whether to seek exclusive rights for their invention, they choose to obtain exclusive rights (i.e., protect the technology with intellectual property rights) for visually identifiable or measurable technologies, or they choose to keep the technological information as know-how (i.e., keep the information confidential) for visually unidentifiable systems and algorithms.

Portfolio Building Using IP5C

Green Trough™

FEC Group uses its unique framework "IP5C" to analyze intellectual property environments and develop intellectual property strategy tailored to each market. Placing Company (our company) in the center of a business environment consisting of Customers, Competitors, Collaborators, and Component Supply Partners, the IP5C framework analyzes each entity's intellectual property capability and their mutual relationships to provide perspective analysis of the intellectual property environment that is useful for developing our company's intellectual property strategies. It is particularly effective in visualizing potential intellectual property risks and is also utilized where the products are to be deployed globally or where existing products are to be released into new markets.



Managing Confidential Information

BRACE™

FEC Group is operating Application Laboratory (App Lab, described later), where customers can actually manipulate our equipment and discuss such issues as processing conditions. The App Lab is a place where not only innovations start but also know-how accumulates.

The App Lab has been developing an information management system in place, including a defined set of management levels and allowable disclosure levels for know-how, to prevent inadvertent leakage of important know-how. The system requires the information to be time-stamped before disclosure to the customer so that we can clearly distinguish our own know-how from the results of co-creation with the customer.

Pre-disclosure Information Review

Disseminating technical information externally through news releases, academic presentations, and other channels has many advantages, such as showing our Group's advanced technological capabilities to the world and increasing customer recognition at exhibitions and similar events. Such public disclosure, however, may result in the loss of novelty of an invention included in the information, which means that the invention comes into public domain and thus is ineligible for patent protection. In addition, failure to identify possible infringement risk of other companies' intellectual property rights, which may be incorrectly implied by the information to be disclosed, could create management risks. To eliminate such risks, FEC Group conducts pre-disclosure review by intellectual property department of any information from both intellectual property and contractual aspects prior to any external announcements.

[Chance Maximization]

Open & Closed Strategies BRACE™

Open & Closed strategy for intellectual property refers to an approach for utilizing intellectual properties and maximizing business profits by combining an "open strategy" allowing other companies to use our technologies and a "closed strategy" restricting others from using them. As will be explained in the case example of Blue-IR Hybrid laser products (BRACE™) on page 11, FEC Group obtains exclusive rights to downstream technologies in the value chain. This allows for broad protection of its products, which prevents imitation by competitors and ensures its products' competitive advantage in the market.

FEC Group not just strives to expand the market by encouraging our customers to use its patented products as part of such open strategy, but also strives to obtain exclusive rights jointly with customers for technologies related to the processes to be implemented by such customers. Expanding FEC Group's intellectual property portfolio into the customers' areas of business will increase the likelihood that its products are adopted by the customers.

Intellectual Property Rights Mix (Combined Intellectual Properties)

BRACE™ Green Trough™ Peripheral Monitoring Radar

For some products, FEC Group builds its intellectual property portfolio to include not only patent rights but also utility model rights, design rights, and trademark rights. This allows for multi-faceted protection and augmented brand value of FEC Group's products. FEC Group is a business-to-business (B2B) company group, and believes that it is important to make its customers have a broad awareness of the value it provides.

Expansion to Global Market Green Trough™

Building intellectual property portfolios in target countries is essential for global expansion of the market. FEC Group holds approximately 5,200 rights in Japan and around 4,000 outside Japan. Since procedures for filing applications, obtaining and maintaining rights in foreign countries are more time-consuming and costly than in Japan, FEC Group uses IP5C analysis for some products to carefully determine which country to file applications in order to strategically conduct application and patenting activities.

1-3. Intellectual Property Activities Transforming Strengths into Customer Value

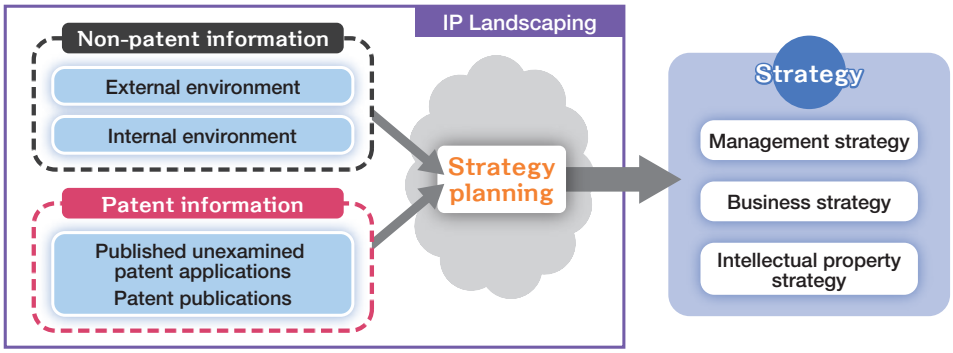
[Overview of Our IP Landscaping Activities]

Based on the first pillar of our intellectual property strategy: "Reinforcing management and business strategy planning capabilities by IP Landscaping," FEC Group is working to establish IP Landscaping as a tool to augment its strategy formulation capabilities. Started in 2019, IP landscaping activities have been conducted by a dedicated team set up within the Intellectual Property Department in 2021. The team uses IP Landscaping in its co-creation efforts with business divisions to formulate strategies for new business development, such as forecasting market trends and analyzing the value needed by our customers.

The upper figure on page 7 shows a concept of our IP Landscaping. Patent information is considered

highly reliable. Our IP Landscaping combines such patent information with non-patent information, which has conventionally been used in strategy formulation, and conduct repeated analysis, examination, and hypothesis testing based on such patent and non-patent information to extract insights useful for strategic decision-making. The results of these analyses are then used for strategy formulation.

Thus, our IP Landscaping is unique in that it is done through the co-creation effort between business divisions and Intellectual Property Department.



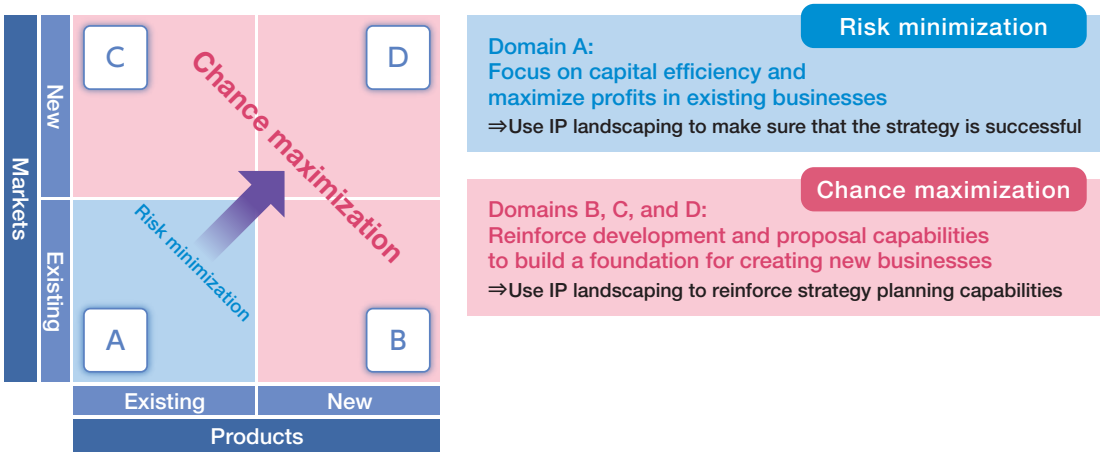
In addition, Intellectual Property Strategy Dialogues is used to share the results obtained from IP Landscaping with general managers of business divisions. The outcomes shared there are then used for decision-making and formulating intellectual property strategies of the business divisions and are regularly shared with executive management through Intellectual Property Strategy Meetings and Board of Directors meetings as well.

We have been using the IP Landscaping implementation rate as a sustainability indicator for revenue opportunity since 2022, as we view it serves as a measure to confirm that management is conducted so as for intellectual assets to be utilized in a chance-maximizing way.

[What We do with IP Landscaping]

FEC Group uses IP Landscaping to strengthen its strategy formulation capabilities in order to reinforce existing businesses and create new ones. See the Ansoff's Growth Matrix below. For existing markets and existing products (Quadrant A), we should focus on improving capital efficiency to maximize profits, so we use IP Landscaping to reinforce strategies. Specifically, we use IP Landscaping to analyze competitors and customer trends to forecast the outlook of our business.

For new markets or new products (Quadrants B, C, and D), on the other hand, we should enhance our developing capabilities and proposing capabilities to customers to build a foundation for creating new businesses, so we use IP Landscaping to strengthen our strategy formulation capabilities. Specifically, we predict technology trends and conduct research activities such as exploring of co-creation partners and new markets.



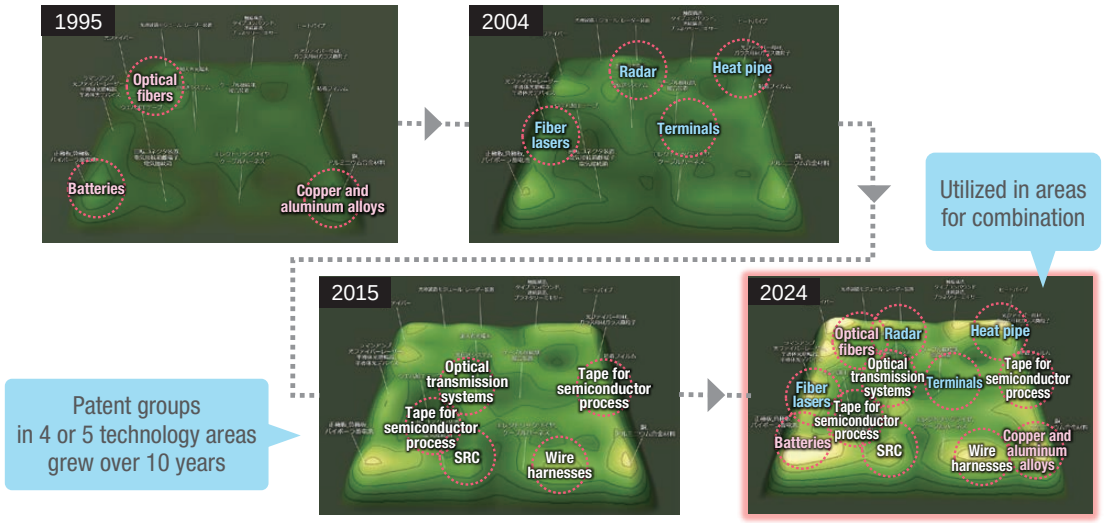
Here, products/markets in quadrant A require short-term activities, while those in quadrants B, C, and D require medium- to long-term activities.

Thus, FEC Group's IP Landscaping, implemented from Chance Maximization point of view, includes market analyses (analyses of business continuity, competitors, product sales expansion, etc.) in the short term, formulation of partner strategies and exploration of a new market in the medium term, and formulation of strategies for a new business in the long term.

[IP Landscaping Visualizes Our Strengths]

Strength building efforts by each R&D division result in the formation of a new group of patents, which indicates an increasing number of core businesses that will support FEC Group. Shown below is an example of a heat map representation of groups of patent application portfolios visualized at every 10 years from 1995 to 2024. It can be seen that groups of patents in 4 or 5 technology areas have been emerging, particularly in the decade since 2015, indicating a steady increase in the seeds of our strength.

Strength Building: Growing Patent Groups (patent applications in heat map representation)



Ultra-high-performance devices, the constituent elemental technologies of data center markets we will be focusing, handle and deliver large volumes of data. There are a wide variety of elemental technologies supporting such devices, including technologies for high-speed communication and the discharge of enormous amount of heat generated by such communications. The figure shows that groups of our patents are emerging and extending to cover these elemental technologies as well. This suggests that approaching specific social issues with a variety of technologies in a comprehensive manner, instead of approaching them with a single technology, allows us to supply our products from multiple fields. We believe that combining FEC Group's technologies from various fields will be the key to the successful development of FEC Group.

[Case Examples]

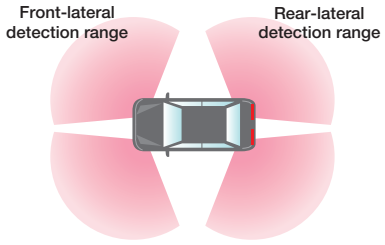
To build a foundation for achieving sustainable growth, FEC Group uses IP Landscaping to visualize our "strengths," enhance our competitiveness in existing markets and expand into new markets. For example:

- The AT & Functional Plastics Division is developing and manufacturing tape for semiconductor process. The division supplies existing products evolved for existing markets (corresponding to Quadrants A and B). Driven by a demand for the development of highly functional and differentiated products in the rapidly developing semiconductor market, the division used IP Landscaping to visualize FEC Group's strengths, predict technology trends and reinforce its development strategies, which resulted in sales growth.
- The Social Design & New Business Development Department introduces existing technologies to new markets, applying semiconductor laser technology cultivated in optical communication technology (corresponding to Quadrant C). Prior to entering new markets, the department used IP Landscaping to analyze status quo and the intellectual property status of our own and other companies.

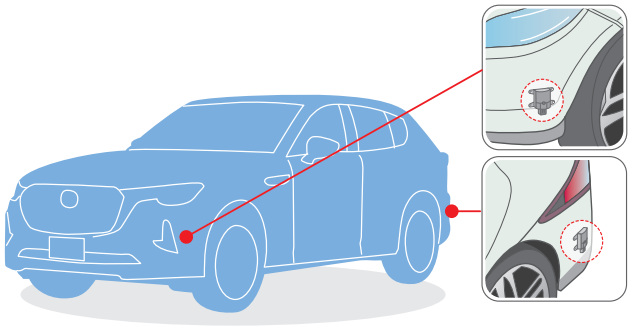
Case Example (1)

Peripheral Monitoring Radar

Peripheral monitoring radars are one of the Automotive Products Division's priority products to achieve the 2025 Mid-term Plan. The division has set forth strategies of "expanding in-vehicle application of high-performance, next-generation products" and "entering new markets of construction machinery, industrial vehicles, and transportation infrastructure," and has been utilizing intellectual assets forming its strengths to create values.



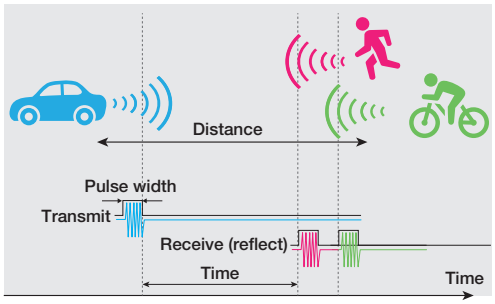
Application example of a peripheral monitoring radar



Strength of our products

Peripheral monitoring radars are critical components of Advanced Driver-Assistance Systems (ADAS), a generic term for systems that assist drivers in safe driving operations, such as automatic braking, lane change assistance, and collision prevention during right or left turns. Such a periphery-monitoring radar senses peripheral vehicles, motorcycles, pedestrians and other objects and alerts the driver to potential collision risks.

While peripheral monitoring radars are typically installed behind the bumper and in the four corners of the vehicle, our radars are designed to use a quasi-millimeter wave band (24 GHz band), making them less susceptible (more robust) to environmental factors including bumper thickness, paint, body shape, and weather conditions such as snow deposition or rainfall. In addition, our radars use an unique pulse radar processing that enables separate measurements of distance and relative velocity, providing excellent multiple target detection capability in complex environments and enabling detection of objects at distances of 70 meters or more in the presence of strong reflective objects nearby. In 2016, we began full-scale mass production of rear lateral peripheral monitoring radars having the world's top class detection performance.



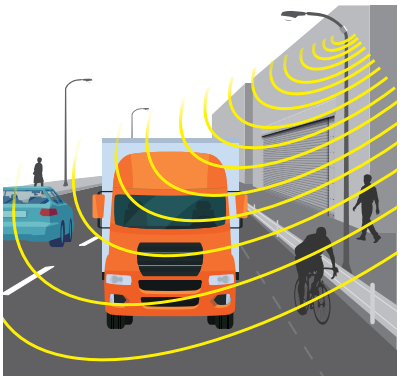
Approach for reinforcing our strength

In 2022, we developed and began mass production of the second-generation peripheral monitoring radars "MMR2." The developed radars have achieved enhanced detection range and accuracy of measured velocities, and are now the size of a business card. The pulse radar that enables accurate recognition of objects in diverse environments has allowed the radars to be adopted for forklifts used in work sites such as factories and logistics warehouses. Radars with this scheme can also be deployed in various other fields such as construction, agriculture, and transportation. Because such radars are able to perform stationary monitoring when fixed in a specific location, they are applied to monitoring systems for vehicles traveling on roads as well as to detection systems of vehicles traveling in the wrong direction, which can lead to serious accidents.

With a view to global deployment of the radar products, we are conducting joint product evaluations with our overseas group company FETI to develop radars compatible with European road environments.

Peripheral monitoring radar MMR2

For use in implementing Open and Closed strategies, we have built a strong patent portfolio that consists of over 200 patents and designs, both domestic and foreign, for visually identifiable hardware among the key technologies related to the product. In addition, we keep information relating to a large number of technologies for visually unidentifiable system and software as technical know-hows. We collaborate with FEC's research division (Electronics Laboratory) in conducting such intellectual property activities as well as technological development activities. As for risk management, we regularly check other companies' patent information delivered through Selective Dissemination of Information (SDI) system within our division to monitor technology trends.



Application of radar for infrastructure (passage detection sensor)

Value creation through the utilization of intellectual assets

Future increases in the number of ADAS-equipped vehicle models and the development of autonomous driving technology are expected to bring about new or different requirements for radars. In particular, downsizing of a radar is an important need for our customers, as it allows the radar to be installed in more vehicles. The installation of peripheral monitoring radars in more vehicles in the future will enable the prevention and reduction of accidents. It is also expected to contribute to SDGs and carbon neutrality policy by, for example, extending the lifespan of vehicles, alleviating traffic congestion caused by accidents, and reducing CO_2 emissions through a decrease in the deployment of emergency vehicles.

To address the declining working population, we are expanding our business not only to forklifts, but also to excavators and dump trucks. Utilizing the intellectual assets accumulated through the development of these in-vehicle radars is expected to lead us to find new applications outside the field of transportation that take advantage of the features of peripheral monitoring radars. Such application examples may include sensors that prevent children from being left unattended in vehicles and passive infrared (PIR) sensors that detect residents' motion in nursing homes while protecting their privacy.

We will continue our research and development of periphery monitoring radars and pursue their further-high functionality for in-vehicle use to make our radars widely-used and indispensable systems to solve social issues.

Words from our engineer

ELD Dept., Engineering Division 3,
Furukawa Automotive Systems Inc.

Koji Oishi

Peripheral monitoring radars are a complex system involving closely intertwined subsystems, hardware, and software. As a hardware engineer, I always had to consider the impact on all the processes involved and work across divisions to advance development, which was extremely challenging. And there are a great deal of skills and experiences I have gained from this effort, and I felt a tremendous sense of satisfaction and joy when we have achieved the commercialization of the product.

I am confident that the development and intellectual property activities like what we have done in the processes so far will bring about similar values in the development of next-generation radar products as well. I will continue to work on the development of periphery monitoring radars to provide safety and peace of mind to users.

Words from our engineer

RA Dept., Engineering Division 3,
Furukawa Automotive Systems Inc.

Tosei Terayama

Peripheral monitoring radars play a crucial role in realizing a safe automotive society. I am proud that the algorithm development I am involved in comes into closest contact with users, and because of that, I feel a great sense of responsibility as well as worthwhileness every day.

We are currently developing radars for in-vehicle use, and we are considering entering infrastructure and industrial vehicle markets in the future. I intend to use intellectual property activities to further elevate our technology and create radar products that will be appreciated by even more customers.

Case Example (2)

Blue-IR Hybrid Laser BRACE™

BRACE™ series BR2200

The Communications Solutions Division has been utilizing its highly functional products and technologies to make a difference. According to the 2025 Mid-term Plan, the division will contribute to the goal of Vision 2030: “Create social infrastructure integrating information, energy and mobility” by evolving its cultivated elemental technologies of optical communications and providing them as solutions.

Our key product, BRACE™, has now been transferred to the Laser business department of the Global Marketing Sales Division, where the product’s application is being developed through co-creation with partner companies.

Strength of our products

The development of higher-power fiber lasers and processing technologies have been progressing that enables efficient processing of copper, which is frequently used in key components of electric vehicles (xEVs), and the range of applications of such fiber lasers has been expanding. Fiber lasers do not require optical axis adjustment and are capable of providing stable output because their light-amplifying medium and resonator are composed of fibers. As a pioneer company of fiber lasers in Japan, we have applied advanced technologies that we have cultivated in the field of optical communications to develop fiber lasers.

Our fiber lasers use world’s top class technologies in each of the elemental technologies including the pumping light source, amplification medium, and high power, to achieve high-power and high-efficiency. They have superior beam controllability that enables high-quality cutting and welding, making them the choice of many customers.

Strength building through co-creation with partner companies

Recent accelerated electrification of automobiles increasingly requires laser processing solutions that improves productivity in the welding process of copper materials, which are frequently used in such key components of EVs as electric axles and batteries. In June 2020, FEC and Nichia Corporation (hereinafter, “Nichia”) have jointly developed a new laser welding solution that uses a hybrid laser combining a jointly developed high-power blue laser oscillator and FEC’s near-infrared single-mode fiber laser.

In 2021, FEC and Nichia agreed to a long-term business alliance, strengthening collaboration on core technologies that support the electrification of automobile. The new Blue-IR hybrid laser oscillator “BRACE™ X” launched in 2022 uses a jointly developed blue laser for preheating that offers excellent light absorption for copper and a fiber laser for the main process of welding. The product achieves world’s top class welding quality and industry-leading spatter-less processing of copper.

FEC also had a collaboration with NITTOKU CO., LTD. (hereinafter, “NITTOKU”), which resulted in commercialization of a laser welding machine for electric vehicle motors in November 2020. This product combined NITTOKU’s precision factory automation technology and FEC’s laser processing technology to achieve improvements in both quality and productivity in the welding process.

Intellectual property activities supporting solution-providing business

In developing a solution-providing business as outlined in our division policy, we have built a strong intellectual property portfolio covering a wide range of areas from light source devices to laser processing methods. Our laser processing solutions solve specific customer challenges faced by processing-machine manufacturers and end users, and the intellectual property portfolio provides the customers, on top of such laser processing solutions, with extra value of creating a secured IP environment where customers can use our solutions with peace of mind. We also advise our customers that we have such intellectual property

portfolio to encourage them to adopt our products. As for information management, because we carry out the development of laser processing solutions for each customer in our Laser Application Labs(described later), we have a strict information management system in place to prevent mixing of know-how among different customers.

Value creation through the utilization of intellectual assets

To date, we have established three Laser Application Labs in Japan: FEC's Chiba Works (Ichihara, Chiba); CALL (Toyota, Aichi); and Nichia's Yokohama Research Center (Yokohama, Kanagawa). We have the latest BRACE™ lasers equipped in each Labs and have been conducting test processing on partners' samples. In October 2024, we have opened another Lab in Furukawa Electric Institute of Technology Ltd., FEC's group company in Budapest, Hungary, to provide on-site laser solution development capability to respond to rapid evolution of automobile electrification in Europe.

In November 2024, FEC and Nichia have further set up the Cutting-Edge Laser processing solution Lab. (CELL) in Kariya, Aichi, consolidating all technologies including the latest 5 kW blue laser oscillators, the BRACE™ series, and near-infrared fiber lasers. Although some functions are still retained at the FEC's Chiba Works and Nichia's Yokohama Research Center, the CELL serves as a hub for developing various laser processing solutions ranging from laser processing to light source development, all in a single location. The CELL will allow us to propose new laser processing solutions that better meet the diverse needs of our customers.

Inside CELL

The BRACE™ series has received increasing recognition from the industry, as evidenced by the joint receipt with Nichia of the Laser Industry Encouragement Award for 2024. Through the continued co-creation with Nichia, we will strive to accurately identify market needs in copper processing, continue to provide high-quality, high-speed, and highly-reliable laser processing solutions that meet those needs, and enhance our market presence.

■ See the following websites for details:

Receipt of the Laser Industry Encouragement Award
at the 16th Industry Award of The Laser Society of Japan
News release page: https://www.furukawa.co.jp/release/2024/comm_20240402.html (in Japanese)
Industrial laser website: https://www.furukawa.co.jp/fiber-laser/en/

Column Thoughts Behind the Trademark

Desiring to become the world's number one solution provider in blue laser processing of copper, we have named our Blue-IR hybrid laser product group BRACE: B for "Blue," R for "InfraRed," and ACE for "leading, the best." The word "BRACE" also means "a pair, a couple, and to invigorate," carrying our desire to connect us, our customers, and the world, and invigorate the world through the use of BRACE™ in our customers' manufacturing process.

Interview

Mr. Yasuoka Mr. Kayahara Mr. Sakai

Laser Application department,
Global Marketing Sales Division
Takashi Kayahara

Laser Process and Thermal Technology Dept.,
Electronics Lab, Research & Development Div.
Tomomichi Yasuoka
Toshiaki Sakai

— Tell us about the background of how BRACE™ was developed.

Sakai There has been a need for using fiber lasers in copper welding for about 15 years, but there were technical challenges. We had a hunch that blue lasers might be a good choice. Although the collaboration with Nichia had made blue lasers available, the output was still insufficient.

Kayahara And some were skeptical about combining a blue laser with a near-infrared fiber laser because they are afraid of high technical hurdles in using the two lasers simultaneously.

Yasuoka Others doubted whether the combination of the two could lead to something truly user-friendly for our customers. It resulted in an excellent processing technology after all. And the Lab provided an efficient place for co-creation because it allowed our customers to actually use our system to do their experiments.

— How have you been carrying out intellectual property activities for this technology?

Kayahara We had already been developing laser processing technology even before we took on BRACE™, so we took advantage of the already-accumulated knowledge there.

Sakai While we had to wait for improvements in laser output, we filed patent applications for inventions covering concepts of copper welding processing we are to develop.

Yasuoka The patents deriving from those applications are now forming a strong foundation. Now we are filing application on related inventions to make our patent portfolio more robust.

Kayahara The IP department took the lead in conducting our intellectual property activities, and we worked together in regular meetings to develop our patent filing strategies.

Yasuoka When some application seemed difficult to get allowance, the IP department made us pull through in responding to examiner's rejections and interviews, so we could proceed without giving up.

— What are your thoughts on future product development and intellectual property activities?

Kayahara I think the reason why we acquire patents is because our customers can use our products with confidence. It takes a lot of effort to gain customer confidence, so we put intellectual property activities first. We will continue to strengthen our intellectual property portfolio and develop products that our customers can use with confidence. And we want to turn our IP strategy from defensive to aggressive.

Sakai Initially, I viewed patent applications merely as a quota to make, but now that we have some patents that are important to our business, I realize the significance of securing intellectual property. Since we are considering overseas expansion of our business, we need to reinforce our patent portfolio in a strategical manner.

Yasuoka Since new technologies are being developed, I think we need to build a new patent portfolio that covers such new technologies. I also hope that other divisions in FEC that is developing a new technology involving application of lasers will take advantage of our laser patent portfolio.

Words from FEC-IP members

Masahiko Sagawa

Since our fiber lasers are part of a solutions business aimed at solving customer challenges, things change so often that close communication between intellectual property department and business or research divisions are essential. We have meetings on a regular basis to discuss a wide range of topics, from patent-related matters to development challenges, and work together to find solutions. Sometimes the IP department is part of an important decision, and I feel happy when the decision we made in such situations has led to positive outcomes.

Case Example (3)

Green Trough™

The Functional Products Division has been advancing the development of environmentally friendly products to achieve a sustainable society by promoting the reduction of greenhouse gas emissions and the use of waste plastics-derived recycled materials throughout the value chain, as stated in the Furukawa Electric Group Environmental Vision 2050.

In recent years, extreme weather events and natural disasters have become more frequent, requiring rapid restoration of damaged social infrastructures. Construction sites are facing serious issues such as a shortage of workers and an aging workforce.

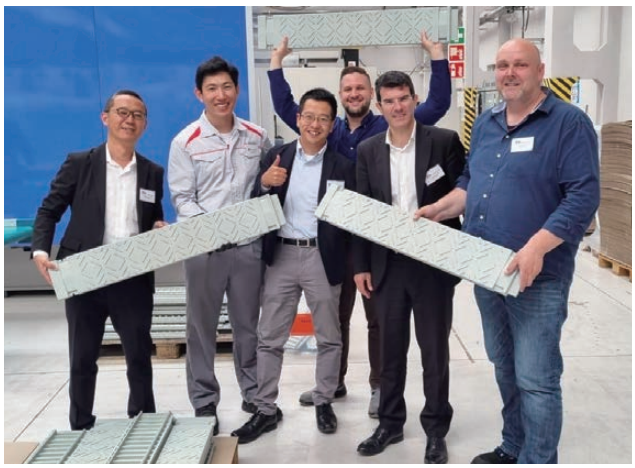
Strengths of our products

Cable troughs are trough-shaped openable protective conduits for various cables laid for communication, signaling, power distribution, and power transmission on railroads and roads. Most of such cable troughs have been made of concrete. Green Trough™ is a cable trough made primarily from recycled plastic. It weighs approximately one-quarter that of concrete troughs, making it easy to carry and allowing for manual transport. Since its first production and sale in 2003, it has been adopted in numerous projects due to its environmental friendliness and its ability to shorten work time and ensure worker safety as well. In recent years, the growing environmental awareness in Europe has led to an increasing demand for Green Trough™ overseas.

Approach for reinforcing our strength

Because recycled plastics are a mixture of various types of plastics which are often degraded, they are difficult to process and have problems in terms of strength and durability. Our unique additive-blending technology, however, enables us to produce highly durable and degradation-resistant cable troughs from such recycled plastics.

Green Trough™ has been Environmental Product Declaration (EPD)-certified in accordance with the international standard ISO 14025. The EPD-certification certifies that the environmental impact of a product is quantified and verified by a third party. In Europe in particular, EPD certification is increasingly required during bidding and contracting processes, and such EPD certification has led to increased credibility for our products. Starting in July 2023, we have begun local manufacturing of Green Trough™ in order to respond the growing demand in Europe, utilizing locally generated recycled materials to shorten transportation distances, thereby to contribute to CO_2 emission reductions.



Commemorating the first successful local manufacturing of Green Trough™ in Europe.
From right to left: Mr. Andreas from Trocellen, Mr. Francesco from Trocellen, and Mr. Alexander from a partner company

The challenges we faced in starting local manufacturing of Green Trough™ included procurement of materials that balanced performance and price. We sought the cooperation of Trocellen GmbH (Troisdorf, Germany), one of our group companies, to search for material suppliers and manufacturing contractors. Swiftness was also an important factor to consider, so we locally set up a special project team to receive extensive support, including gathering of information, careful and quick reporting, and offering of advice on local deployment efforts.

Intellectual property activities to enhance our strength

Overseas expansion required us to build a global intellectual property portfolio. However, Green Trough™ itself had been in the market for more than 20 years, so the basic patents had already been expired and the technology then used had been in a public domain. Thus, when expanding into new markets, we needed to conduct not only a feasibility study on entering these markets but also had to develop an intellectual property strategy tailored to each national market by conducting a detailed examination of the IP5C framework analysis (see the article in Feature Stories for details) for each national market. Specifically, we have tailored our inventions to include new features that meet country-specific needs and construction methods for each country in order to improve the inventive step of our technology.

In addition, because the trademark GREEN TROUGH™, registered to enhance recognition and customer appeal in various countries, may be taken as a generic name in some countries, we also have another trademark FURUKAWA GREEN TROUGH™ registered. We hope these marks will receive more recognition as a global brand.

Value creation through the utilization of intellectual assets

The excellent characteristics of Green Trough™ in terms of light weight, weather resistance, impact resistance, and workability has led to their adoption in 2011 by Sanriku Railway Co., Ltd. that was striving for early recovery from the Great East Japan Earthquake. Not only has the improved installation efficiency of the Green Trough™ significantly shorten the construction period, but its high corrosion resistance has been protecting cables from salt damage caused by sea breezes. Green Trough™ has also contributed to the railroad company's recovery efforts from the landslides during the East Japan Typhoon in 2019.

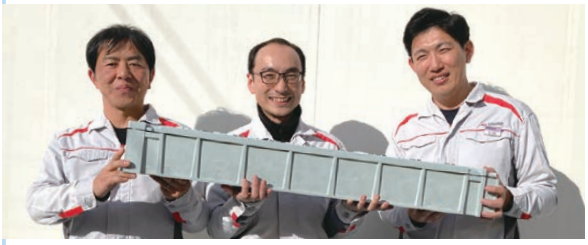
We will continue to refine our technologies and contribute to solving environmental issues worldwide as we develop various resin products using recycled materials, not limited to Green Trough™.

See the following websites for details:

News release page: https://www.furukawa.co.jp/en/release/2023/fun_20231013.html
Furukawa Electric Platform page: https://www.furukawa.co.jp/en/platform/17green-trough.html

Words from our engineer

Functional Plastics Engineering & Development Dept.,
AT & Functional Plastics Div.
Yuichi Shirayama



Mr. Shirayama (center) with the development team members

Green Trough™ was born 22 years ago (in 2003) when we started with the recycling of cable scraps, embracing the mission to contribute to environmental protection and technological innovation, and took on the development of new product to solve social issue of effectively utilizing container- and packaging-derived waste plastics discharged from households.

Our patent application filing activity had mainly been domestic until 2010. The increased adoption of our products in the UK in 2011, however, prompted us to actively file foreign applications, and since then, we have successfully expanded our business overseas, especially in Europe and Australia. We will continue to contribute to society through continued technological innovation and global expansion.

Words from FEC-IP members

Natsumi Ueda

**Expanding Green Trough™ business overseas:
How do we secure required IP rights required for such business expansion?**

We had a team approach to between business division and FEC-IP to fulfil this new mission of acquiring intellectual properties for Green Trough™. Basic inventions in this technical field had already been public and it appeared that we could come up with few inventions for which a patent could be filed. But the team was smarter than individual, and we could build a patent portfolio essential for our business expansion. Brands are also an important aspect of intellectual property. The product name "Green Trough" has been registered as a trademark and contributing to enhanced customer recognition of our product in many countries around the world. In some countries, however, the trademark "Green Trough" might be deceptively descriptive of the product as it means "flowerpot" in those countries. This made us realize that the brand approach must differ depending on the country and region.

3 Topics

Topic (1)

President Made Presentation at IP and Intangible Assets Symposium

On October 8, 2024, the 2nd NIKKEI IP and Intangible Assets Symposium was held. The symposium included a panel discussion titled "*Aggressive IP and Intangible Asset Strategy as Told by Management: Looking Back on Two Years Since the Setting-Up of the IP and Intangible Asset Management Forum*," which focused on how management turns non-financial information into financial value. FEC's President and Representative Director, Moridaira, participated as the Vice Chair of the IP and Intangible Asset Management Forum.

Moridaira emphasized that intangible assets are critical for changing traditional Japanese corporate culture amidst the market globalization. He also highlighted his view that transforming business portfolio requires renewal of businesses, and that the foundations for such renewal are human resources, intellectual property, and intangible assets. Furthermore, he stressed the importance of visualizing intangible assets to foster a corporate culture that provides the breeding ground for these assets.

■ See the Nikkei Sustainable Forum page in Nikkei Channel for details:
https://channel.nikkei.co.jp/sustainableforum2024/ (in Japanese)

Topic (2)

President Made Presentation at the 20th Anniversary Seminar of KIT Toranomon Graduate School

On January 30, 2025, KIT Toranomon Graduate School, a most advanced educational center for working adults focusing on management and intellectual property, held a seminar commemorating its 20th anniversary. FEC's President Moridaira, who has a decade of experience in the FEC-IP, spoke at the seminar as a lecturer.

Moridaira used case examples to explain FEC Group's intellectual property and intangible asset management, emphasizing that human resources development is the most fundamental and that it is human-created strengths that create value. He also shared his own experience and noted that his working experience in the FEC-IP provided him with opportunities to oversee the entire company across departments and to expand his scope of work beyond patent acquisition to include its peripheral activities, which helped him improve communication and negotiation skills .

■ See the KIT Toranomon Graduate School's web page for details:
https://www.kanazawa-it.ac.jp/tokyo/blog/2025/1222975_5827.html (in Japanese)

Topic (3)

Joint Production of “Secrets of Optical Fiber Cables” with Gakken

In May 2024, we had an opportunity to collaborate with a Japanese educational publishing company Gakken Inc. in the production of a book titled “Secrets of Optical Fiber Cables,” part of Gakken Inc.’s educational *manga* series for elementary school students: “Easy-to-Understand with *Manga*.” Published by Gakken, this series has over 20 years of history and introduces elementary school readers to a variety of topics in an easy-to-understand manner. The book was among a list of suggested reading by the National Congress of Parents and Teachers Association (PTA) of Japan. The books were donated through Gakken to approximately 20,000 elementary schools (including special-needs schools), 3,200 public libraries, and 800 children’s centers throughout Japan.

The book explains how optical fiber cables works and how they are manufactured in an easy-to-understand manner. It also shows how FEC has contributed to the history of the development of telecommunications and what it is doing for the next-generation telecommunications technology.

■ See the following FEC news release page for details:

https://www.furukawa.co.jp/release/2024/kei_20240520.html (in Japanese)

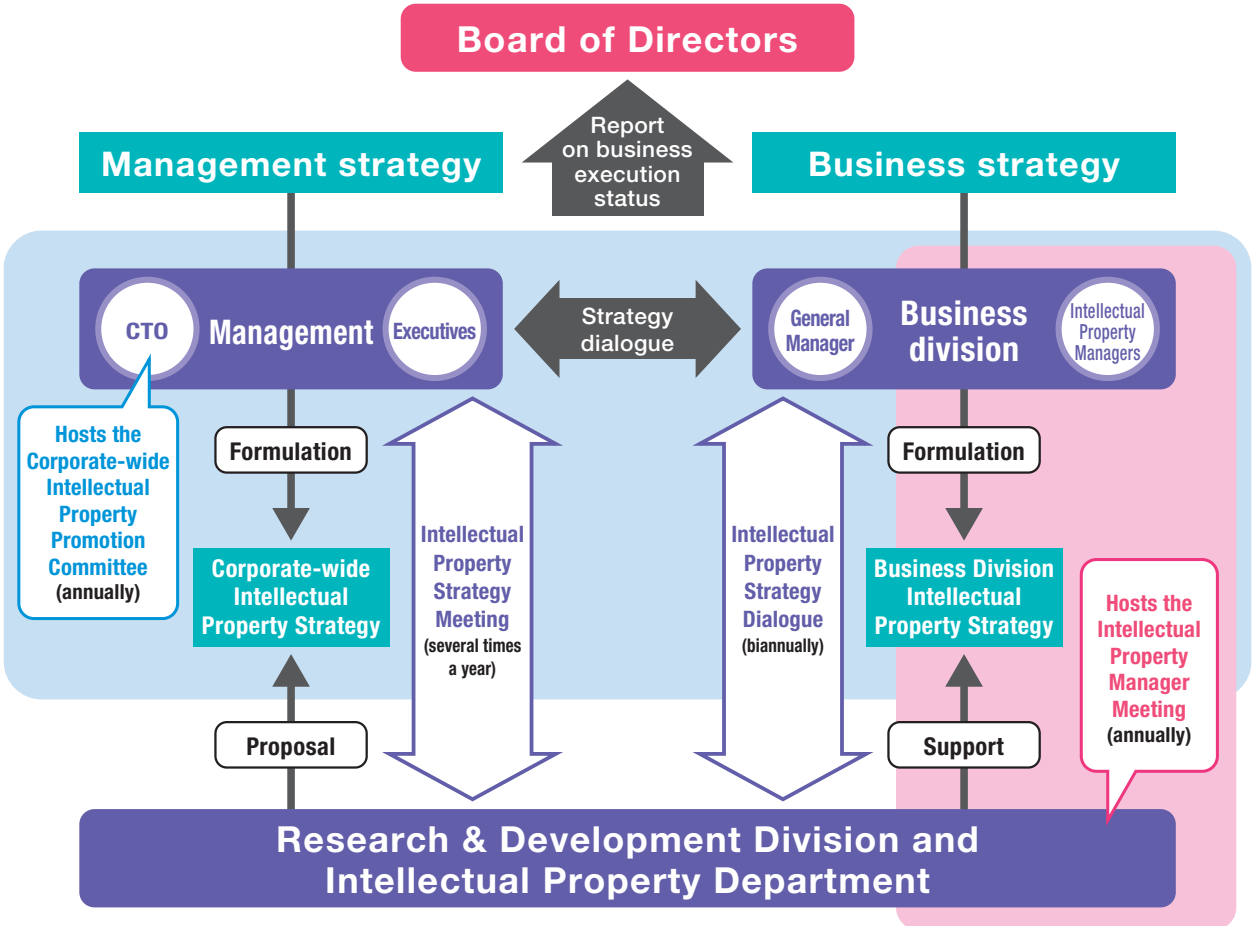
4 Intellectual Property Activities

4-1. Intellectual Property Promotion Framework

FEC Group has set up the Corporate-wide Intellectual Property Promotion Committee chaired by the General Manager of the Research & Development Division (CTO) to determine corporate-wide intellectual property activity policies. The intellectual property managers assigned to each business and research division promote the intellectual property activities of their respective divisions in accordance with the corporate-wide intellectual property activity policies.

The corporate-wide intellectual property activity policies are proposed and reported to corporate executives including the President, who oversee business execution, in the Intellectual Property Strategy Meeting (held at least twice a year) hosted by the CTO. The corporate-wide intellectual property strategies are followed in determining specific activities in the Intellectual Property Manager Meeting (held once a year) hosted by the General Manager of the Intellectual Property Department. In addition, information on each business division's intellectual property strategies are shared for co-creation in the Intellectual Property Strategy Dialogues (held twice a year) hosted by the General Manager of the Intellectual Property Department and attended by business division general managers.

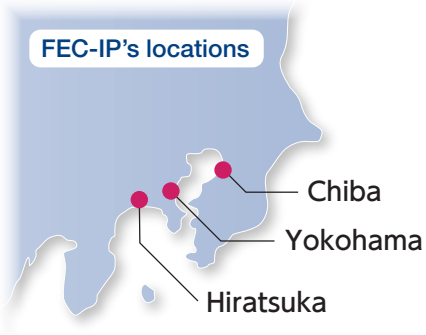
The execution statuses of the corporate-wide intellectual property activities are regularly reported to the board of directors.



4-2. What We Do at Our Activity Bases

How Intellectual Property Activities are Operated in FEC

- **Intellectual Property Managers (assigned to each business unit and research laboratory)**
- **Intellectual property education**
- **Patent awards, invention compensation, etc.**



FEC-IP is structured into the following departments: the IP Utilizing Department respoinsible for intellectual property strategy and external relations; and the IP Engineering Department responsible for implementing intellectual property strategies for each business. The IP Utilizing Department has three separate sections: the Strategic Planning Section responsible for formulating and implementing corporate-wide intellectual property activity policies; the Legal Affairs Section responsible for external relations and contracts; and the IP Analysis Section responsible for promoting IP Landscaping activities. In addition, the IP Engineering Department has three separate sections, each located close to the business divisions for which it is responsible, in order to facilitate close daily communication with business divisions and research laboratories.

We organize meetings to discuss specific details of intellectual property activities. The meetings are participated by a team consisting of the business divisions, research laboratories, and the Intellectual Property Department. The team includes an Intellectual Property Manager assigned to each business division and research laboratory.

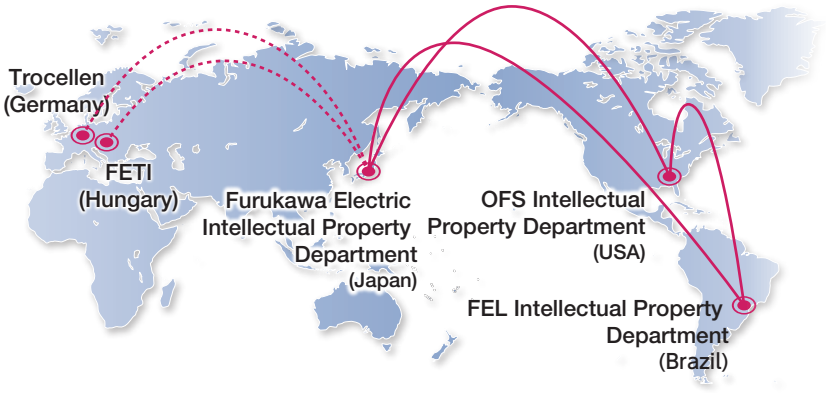
We also provide systematic intellectual property education within the company and offer continuous internal training. We have an established systems for patent awards and invention compensation to encourage invention.

FEC Group's bases for intellectual property activities

- **Assign persons responsible for intellectual property activities (in each domestic and overseas group companies)**
- **Raise group-wide awareness of intellectual property activities**

FEC Group's intellectual property policy is shared across all group companies in Japan and overseas.

Each domestic group company has an assigned person who is responsible for cooperating with FEC-IP and implementing the company's intellectual property activities.



As for overseas group companies, in particular, we hold regular meetings with the intellectual property departments of OFS (US) and FEL (Brazil). We also collaborate with intellectual property representatives at FETI (Hungary), Trocellen (Germany), and others.

In addition, to raise awareness of intellectual property activity throughout the Group, we provide opportunities for intellectual property education tailored to each group company's needs, and patent-awards to domestic and overseas group companies.

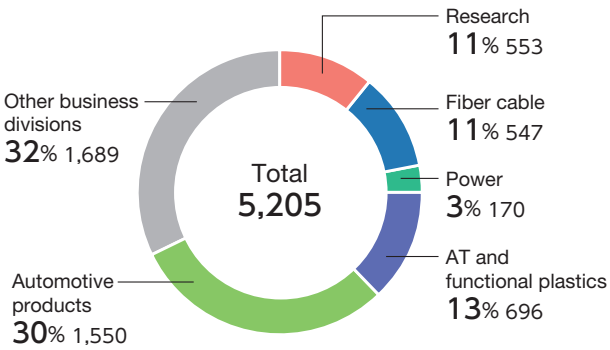
4-3. Intellectual Property Portfolio

FEC Group protects its unique differentiating technologies with intellectual property rights and technical know-how to minimize business risks.

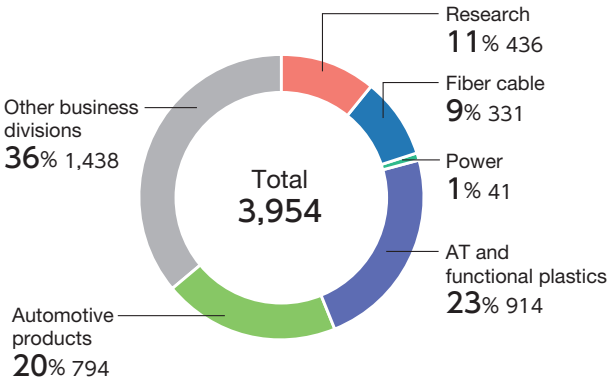
In order to achieve growth in the information, energy, and mobility sectors, we will develop and make the most of our intellectual property portfolios based on detailed competitor analysis to strengthen social-issue-solving businesses. We expect this will support our existing businesses in which we commit ourselves to focus on capital efficiency and maximize profits in the year 2025.

FEC Group's intellectual property rights (consisting of patents, utility models, designs, and trademarks) held in portfolios related to optical fiber cables, power cable systems, wire harnesses, and semiconductor manufacturing tapes account for approximately half of the Group's total intellectual property rights. The rights covering these products have been filed and managed by 4 business divisions: Optical Fiber and Cable Products Division, Power Cable Division, Automotive Products Division, and AT & Functional Plastics Division, respectively. We will utilize the intellectual assets in these business areas through Open and Closed strategies and reduce intellectual property risks to make our business safer.

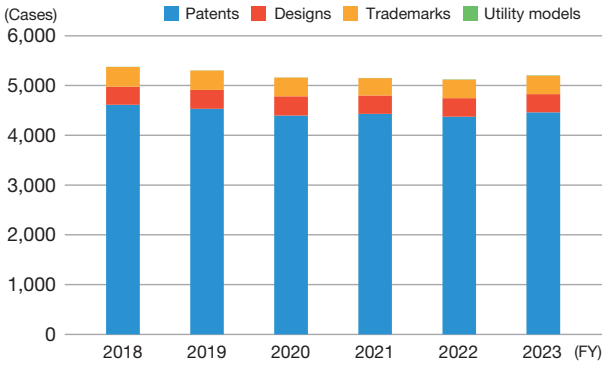
Number of domestic intellectual property rights held



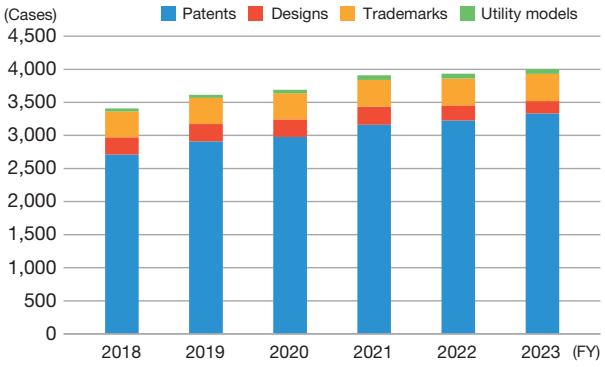
Number of foreign intellectual property rights held



Number of rights held in Japan



Number of foreign rights held



Intellectual property (patent) data

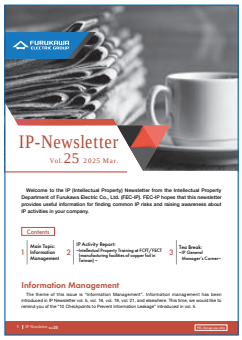
Number of intellectual property rights held	Held by	Result				
		FY2019	FY2020	FY2021	FY2022	FY2023
Domestic	Furukawa Electric	5,288	5,107	5,175	5,106	5,205
Filed by research divisions		–	–	475	509	553
Filed by 4 business divisions*		–	–	2,964	2,864	3,188
Overseas	Furukawa Electric	3,625	3,725	3,869	3,893	3,954
Filed by research divisions		–	–	327	400	436
Filed by 4 business divisions*		–	–	1,995	1,998	2,124

* Number total for the Optical Fiber and Cable Products Division, Power Cable Division, Automotive Products Division, and AT & Functional Plastics Division

4-4. Intellectual Property Education System

We provide intellectual property trainings to our employees to ensure that each employee understands the importance of intellectual property and has improved skills of reducing FEC Group's intellectual property risks and of implementing strategic intellectual property activities. The trainings include:

- Five training courses that allow trainees to systemically learn the knowledge they need according to their work experience
- Lectures by leading experts in the field of intellectual property
- Proprietary e-learning materials that allow trainees to learn at any time
- Basic training for sales divisions



For overseas group companies, we provide trainings tailored to local conditions and needs on an individual company basis to raise awareness of the intellectual property. We also deliver an information magazine (IP-Newsletter) on a regular basis for all group companies to raise awareness of intellectual property risks and other matters.

In these trainings, FEC-IP staffs who are responsible for prosecution of applications and external relations serve as instructors. They use case examples that are based on actual cases and selected to fit for the participants' positions and experiences. Such efforts serves not only to raise the trainees' awareness of intellectual property, but also to improve the skills of the FEC-IP staffs.

Education program	Content	New employee	Middle-level employee		Managerial employee	Management
		Technical, Administrative	Technical	Administrative		
(1) Introductory course	Outline of intellectual property system	●				
(2) Prosecution basic course	Patent application		●			
(3) Prosecution advanced course	Prosecution practice and foreign application		●			
(4) Contract basic course	Basics of contract		●	●		
(5) Intellectual property management course	Strategy planning and Use of IP Landscaping				●	
Lecture by intellectual property expert	Lecture by invited outside lecturer		●	●	●	●

Column Intellectual Property Trainings to Deal with Practical Issues

Intellectual property activities in product development are becoming increasingly important for strength building, and there is growing demand for opportunities to learn expertise in intellectual property. We provide on-site trainings during ongoing development projects, in which experienced R&D members, cooperating with FEC-IP members, take the initiative to provide internal trainings to other R&D members to improve their intellectual property skills. We aim to raise the overall intellectual property skills within the department and improve the number and quality of patent applications.

For example, we have a monthly study session on topics selected according to each division's intellectual property strategy and request. Lectured by experienced R&D or FEC-IP staffs with extensive intellectual property experiences, the study session deals with topics that may range from some practical issues in prosecutions of applications to defense-building activities against third parties' rights, and to know-how management as well. It may deal with added topics as needed, depending on the business environment at any given time. We also provide continuous on-the-job trainings (OJTs) for employees with few experiences of filing patent applications. It is these educational activities that form the foundation for our strength building.

4-5. Intellectual Property Awards System

In order to enhance team motivation, we have the President's Patent Awards system in place to recognize outstanding intellectual property activities that will contribute to the growth of FEC Group. The President's Patent Awards include:

- Invention Award, for patents of recognized high value; and
- Intellectual Property Activity Award, for outstanding intellectual property activities such as strategic patent application activities and the confidential technical know-how protecting activities.

The President's Patent Awards is part of the President's Awards that include plural awards such as the Technology Awards, the Sales Division Awards, the ESG Awards, and the Health and Safety Activity Awards. The President's Awards have been applied for by our group companies as well every year, including overseas companies. The awards ceremonies of the President's Awards are global opportunities for technology exchange, where participants can share their achievements with each other.

Award		Given for	Judged on	FY2023
Invention award	**Excellent patent award**	Patented inventions of high value.	Effectiveness, technical significance and strength, etc. of the invention.	1
Intellectual property activity award	**(1) Strategic application-proposing activity division**	Divisions that strategically filed patent applications by conducting research and analysis of the company's own or other companies' patents.		2
	(2) Technical knowhow-proposing activity division	Divisions that proposed technical know-how of high value.	Effectiveness, technical significance, strategic value, etc. of the know-how.	None
	(3) Anti-counterfeiting activity division	Divisions that used trademark rights, design rights or copyrights to achieve outstanding result in its efforts to combat counterfeit products.	Discontinuation or injunction etc. against the sale of counterfeit products.	None

In addition to the President's Patent Awards, the FEC-IP has initiated its own awards system for excellent patent applications starting this year. The new award system recognizes one or two patent applications selected each month from among the patent applications during that month that have received high FEC-IP's evaluations scores at the time of filing, except for divisional or continuation applications from prior applications. The new system also selects a few "Best Patent Applications of the Year" from the applications that have won the monthly awards. Award winners will be widely announced on the internal FEC-IP website. Such new awards system is designed to recognize high-quality patent applications early to increase motivation for daily intellectual property activities.

4-6. Sustainability Indicator (IP Landscaping Implementation Rate)

To ensure that we are successful in creating new social-issue-solving businesses, we promote the use of IP Landscaping in the field of next-generation infrastructure-supporting businesses and environmental businesses, and support the development of foundation for creating new businesses toward 2030.

We use the IP Landscaping implementation rate as an indicator of sustainability. Subject issues for IP Landscaping includes issues related to business-reinforcement and new business creation which had been set in 2022: issues related to "profit maximizing for existing business toward 2025 by focusing on capital efficiency improvements" (in such business fields as optical fiber cables, power cable systems); and issues related to "developing foundations for creating new businesses to be realized by 2030 (in such business fields as green LP gas). The figure of that indicator for such subject issues achieved 77% in 2023, exceeding the target number of 45%*1. In 2024*2, the figure has already achieved full implementation (100%) ahead of the 2025 target (100%)*3.

In 2025, we will look at important products such as data center-related products and energy management-related products*4 and include them in the subject issues for implement IP Landscaping.

	FY2022	FY2023	FY2024	FY2025
Target	**30%**	**45%**	**100%*2**	**–*4**
Result	**40%**	**77%*1**	**100%*3**	**–*4**

On issuing the Intellectual Property Report 2024

FEC Group aims to create and utilize intellectual assets, which we view as future finance, to support the building of business competitiveness. Such creation and utilization of the intellectual assets are conducted from the viewpoint of both risk minimization and chance maximization.

This report focuses on some creation activities of FEC's intellectual property portfolio supporting FEC Group's wide-ranging business portfolio, and in particular, it focuses on our unique activities and unique human resources that support such activities. We believe "people" and "human resources development" are at the foundation of all our business activities. Now that each engineer's awareness of intellectual property has been increasing year by year and a common understanding is being formed that "intellectual property is something to be utilized," we hope to work more closely with business and research divisions by making our daily intellectual property activities even more active.

We hope this report will provide you with a better understanding of how we strive to create corporate value through our intellectual property activities.

September 2025

Senior Fellow, General Manager,
Intellectual Property Department,
Research & Development Division

Michio Ohkubo

Bound to Innovate

Intellectual Property Report 2024

FURUKAWA ELECTRIC CO., LTD.
Intellectual Property Department