

Intellectual Property Report 2021

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Introduction

I would like to welcome you to the intellectual property report by the Furukawa Electric Group. Continuing from the previous report, we introduce various initiatives which we conduct as intellectual property activity investment aimed at strengthening business competitiveness.

As part of our research and development efforts toward achievement of the Furukawa Electric Group Vision 2030, we have established the Digital Innovation Center in 2020, and the Sustainable Technology Laboratory and the Incubator Department in 2021. We have also newly established the Intellectual Property Utilizing Department and the Intellectual Property Analysis Section under the Intellectual Property Department that collaborates with research and development activities. Utilizing core technologies of our group as management resources, and analyzing intellectual property information to enhance our management and business strategy planning capabilities

are becoming increasingly important in strengthening digital technology, promoting digital transformation (DX), and creating and nurturing seeds of new businesses to solve environmental and social issues. The Furukawa Electric Group is promoting group-wide and global intellectual property activities with the trinity management of business, research and development, and intellectual property.

I hope that you will have a better understanding of the intellectual property activities of the Furukawa Electric Group by reading this Intellectual Property Report 2021.



October 2021
General Manager of Research &
Development Division
Tetsuro Ijichi

1 Management of Intellectual Property

1-1. Intellectual Property Strategy of FEC Group

The Furukawa Electric Group has adopted the basic policy of defining and utilizing intellectual property as an important management resource. With the trinity management of business, research and development, and intellectual property, we promote group-wide and global intellectual property activities.

Our basic policy consists of the following three pillars:

1	Utilizing intellectual property with Open & Closed strategies	Run a cycle that starts from utilization of intellectual property (utilization, creation, and then protection)*1, and formulate and implement Open and Closed strategies to enhance business strategies.
2	Strengthening management and business strategy planning capabilities by IP Landscaping	Strengthen management and business strategy planning capabilities by IP Landscaping that analyzes and utilizes intellectual property information by incorporating it into strategy planning processes.
3	Stabilizing business by reducing intellectual property risks	Identify four categories of risks, which are infringement risk, technology outflow risk, contract risk, and counterfeit risk, as frequent risks with a significant impact, and continuously reduce such risks to stabilize business.

In view of the above three pillars, we have set the following two major aspects of our activities aimed at the achievement of the Furukawa Electric Group Vision 2030 and SDGs:

(1) Risk Minimization

Minimize business risks by protecting our unique technologies that differentiate our products from others with intellectual property rights and technical know-how.

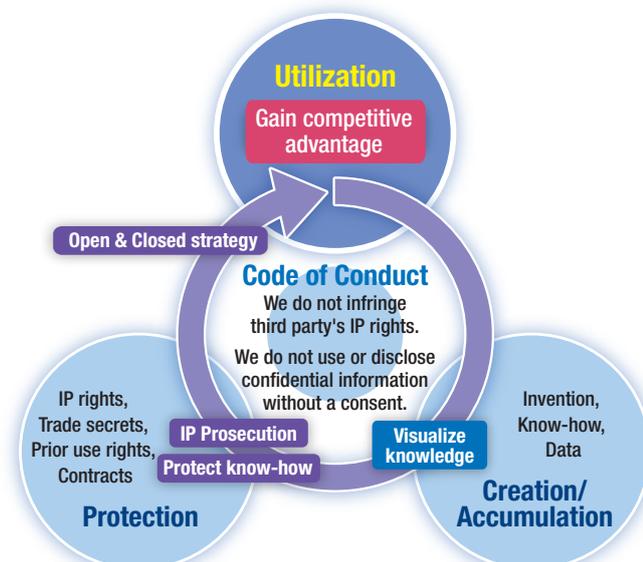
Specifically, in the fields of information, energy, and mobility, which we focus on, we ensure to develop and use intellectual property portfolios on the basis of detailed competitor analysis in order to support stable revenue.

(2) Chance Maximization

Seek new business fields and business models by IP Landscaping, which analyzes competitive environment and market environment including intellectual property information of our own and other companies.

Specifically, we support creating businesses that solve social issues by focusing on businesses that support next-generation infrastructures and environmentally friendly businesses.

*1 The basic concept of promoting intellectual property management: In order to enhance our business, we implement intellectual property strategies for our unique differentiating technologies and run a cycle starting from the utilization of intellectual property.



1-2. Risk Management

The Code of Conduct of the Furukawa Electric Group addresses: 1) protection of intellectual property rights; and 2) management of confidential information.

Under the Code of Conduct, we strategically use our intellectual property rights on the basis of patent portfolio management that involves competitor monitoring and promote activities to reduce intellectual property risks globally such as preventing technical information outflow.

We have defined the following four categories of intellectual property risks and continuously call attention to risk management.

We have been raising the awareness of intellectual property risk reduction across the entire Furukawa Electric Group in Japan and overseas by providing intellectual property education and various awards.

Infringement risk

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

Risks of direct damage to businesses and loss of opportunity are avoided.

Technology outflow risk

Conceal technologies at development and manufacturing sites and enhance information preservation using a timestamp system. Regularly check external announcements including press releases.

Risks of unintended disclosure of confidential information and other risks are avoided.

Counterfeit risk

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

Risks of loss such as declined market share are avoided.

Contract risk

Ensure that the Intellectual Property Department reviews the content of each external technical contract before signing it.

Risks of future disputes concerning the terms of non-disclosure agreements, joint research agreements, purchase and sale agreements, and other agreements are avoided.

Initiative

Tacit Knowledge Externalization and Information Preservation

■ Tacit Knowledge Externalization

Proposal for **concealed technical know-how** and trade secret management

Concealed technical know-how: Technology that has been determined to be concealed within our company from a strategic point of view. Concealment of such technology is ensured by trade secret management.

In accordance with the information security basic policy and countermeasure standard serving as rules of trade secret management, we protect information assets by employing organizational and personal measures, and technical measures such as enhanced network security.

Connection with our group's intellectual property strategy (the three pillars)

The first pillar of our basic policy, "Utilizing intellectual property with Open & Closed strategies," places importance on the identification of our unique differentiating technologies to be the source of our competitive advantage. For technologies to be closed among such technologies, we determine whether we obtain intellectual property rights or conceal the technologies as know-how. By ensuring concealment, we support development and maintenance of our competitive advantage.

Creation, submission, and publication of **technical reports**

Technical reports: Electronic documents including research reports and investigation reports. The documents are managed on a database based on their confidentiality. The number of issued reports is increasing year by year and reached 920 reports in FY2020.

These technical reports contribute to the utilization of outcomes, knowledge, findings, information, and other matters related to our unique technologies as valuable management assets.

Connection with our group's intellectual property strategy (the three pillars)

The second pillar of our basic policy, "Strengthening management and business strategy planning capabilities by IP Landscaping," involves the analysis and utilization of these technical reports in order to incorporate them into strategy planning processes as valuable intangible asset data.

■ Information Preservation

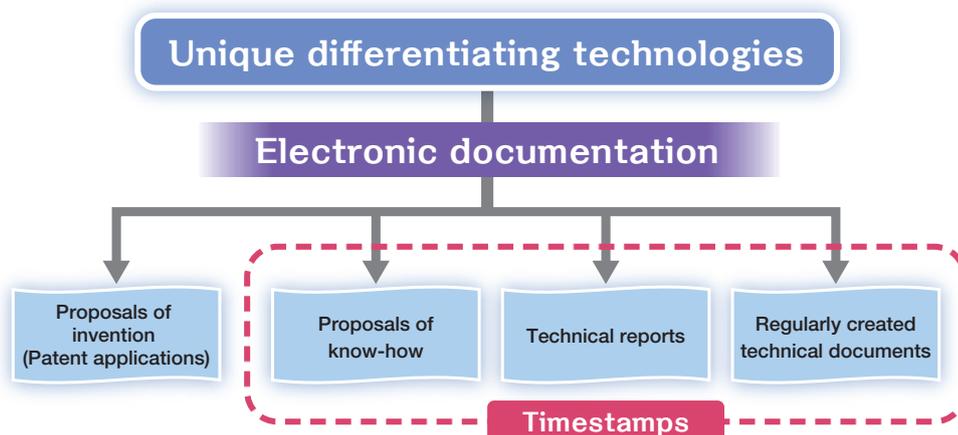
Introduction of a **timestamp** system

Timestamp: Timestamping can prove that a document with a timestamp was present at the marked time and that the document has not been modified since that time.

For technical reports and concealed technical know-how, a system that provides "timestamps" on all electronic documents has been employed to reinforce information preservation.

Connection with our group's intellectual property strategy (the three pillars)

The third pillar of our basic policy, "Stabilizing business by reducing intellectual property risks," promotes information preservation by marking timestamps on documents containing technical know-how even if they are regularly created electronic documents.



2 Activities

2-1. Within FEC

- Intellectual Property Officers (assigned to each business unit and research laboratory)
- Bases of the Intellectual Property Department (Yokohama, Chiba, Hiratsuka, and Shiga)
- Intellectual property education
- Patent awards, invention compensation, etc.

Furukawa Electric assigns an Intellectual Property Officer to each business unit and research laboratory, and implements a three-part strategy of business, research and development, and intellectual property, led by a team consisting of members from the business units, research centers, and intellectual property departments. The Intellectual Property Department has four offices in Japan, and conducts activities in close daily communication with business units and research laboratories.

Intellectual property education is organized and continuously implemented in-house. We encourage inventions by providing means such as patent-award citations and invention compensation.



2-2. Within FEC Group

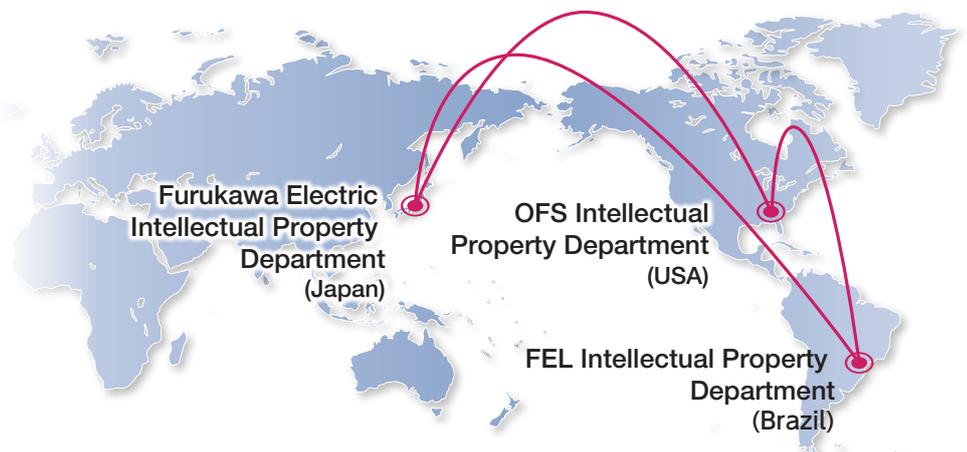
- Designated persons in charge of intellectual property activities (domestic and overseas group companies)
- Intellectual Property Department bases (USA, Brazil)
- Publicizing intellectual property activities

We shared Furukawa's intellectual property policy across all group companies in Japan and overseas.

Each domestic group company has a designated person who promotes intellectual property activities in cooperation with the Intellectual Property Department.

Furukawa's intellectual property department also interacts with the Intellectual Property Departments of OFS (USA) and FEL (Brazil) and holds regular meetings.

In addition, we are promoting intellectual property activities throughout the Group by providing intellectual property education tailored to each company's needs and providing patent-award citations for domestic and overseas group companies.



Initiative

1 Intellectual Property Education

We conduct training to gain a better appreciation of the importance of intellectual property and enable strategic intellectual property activities, leading to improvement in the skills of individuals.

- Five training courses that provide systemic learning of necessary knowledge based on the work experience of each individual
- Lectures by experts who are active in the field of intellectual property
- Specifically designed e-learning materials that allow learning around the clock
- Intellectual property basic training for sales divisions (from FY2020)
- IP Landscaping seminars for technology divisions (from FY2021)

For overseas affiliates, we provide individual training sessions aimed at raising awareness while taking into consideration their local circumstances or requests. We also regularly provide an intellectual property publication (IP-Newsletter) to all the group companies to inform them of intellectual property risks and other concerns with the goal of encouraging them to conduct intellectual property activities.



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	Foreign application prosecution practice		←→			
(4) Contract basic course	Basics of contract		←→	→		
(5) Intellectual property management course	Strategy planning and contract case studies				←→	
Lecture by intellectual property expert	Lecture by invited outside lecturer		←→	→		→

2 Awards System

We have arranged President's Patent Awards for excellent intellectual property activities that will contribute to the growth of our group and further motivate our teams.

- [Invention award] for patents that are recognized as having high value.
- [Intellectual property activity award] for excellent intellectual property activities such as strategic patent application and concealment of technical know-how.

Other than the Patent Awards, we have been presenting various President's Awards such as Technology Awards, Sales Division Awards, ESG Awards, and Health and Safety Activity Awards. Our overseas affiliates also apply for these awards every year, turning awards ceremonies into global technical exchange opportunities where people can share their achievements.

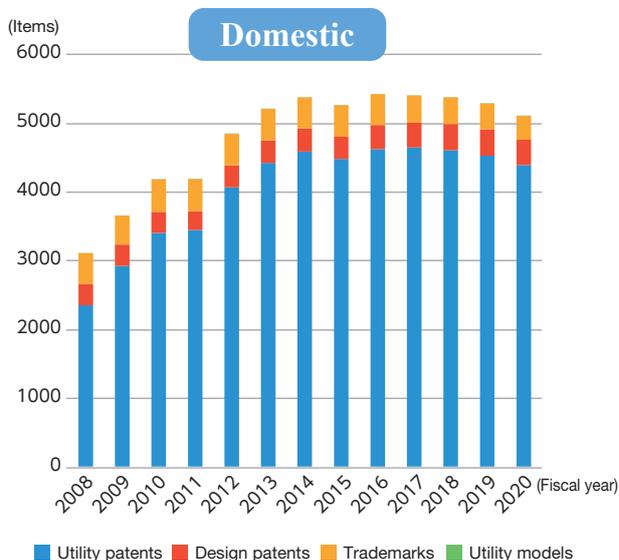
	Award	Candidate	Evaluation	FY2020
	Invention award	Excellent patent award	Patented inventions recognized as having high value.	1
Intellectual property activity award	(1) Strategic application activity division	Divisions that strategically filed patent applications by conducting searches for and analysis of patents of ours and other companies.	Operability of patents, technical value, strength, etc.	1
	(2) Concealed technical know-how proposal activity division	Divisions that proposed concealment of technical know-how, which is recognized as having high value.	Operability of know-how, technical value, strategic value, etc.	1
	(3) Counterfeit product countermeasure activity division	Divisions that achieved outstanding results with countermeasures for counterfeit products using trademark rights, design rights, and copyrights.	Results of discontinuation of and injunction against the sale of counterfeit products, and other countermeasures.	None

3 Intellectual Property Portfolio

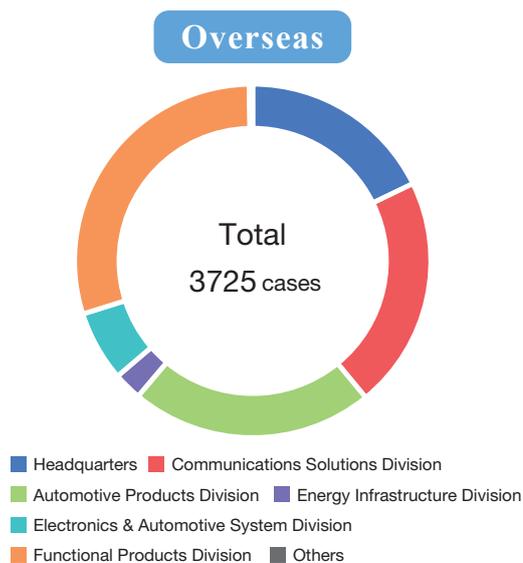
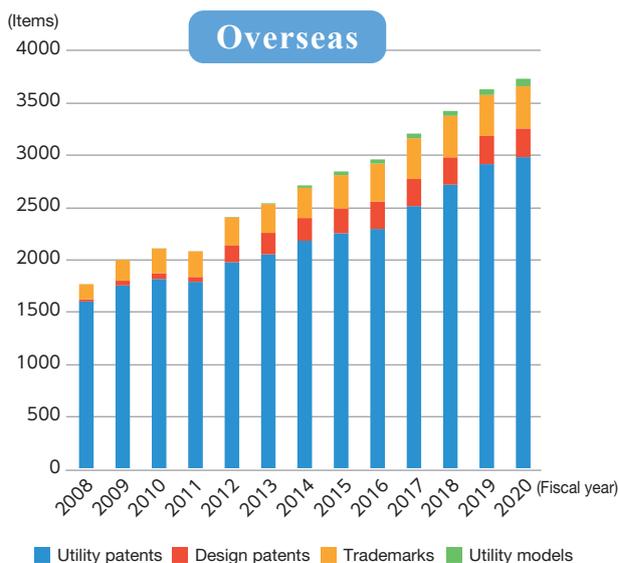
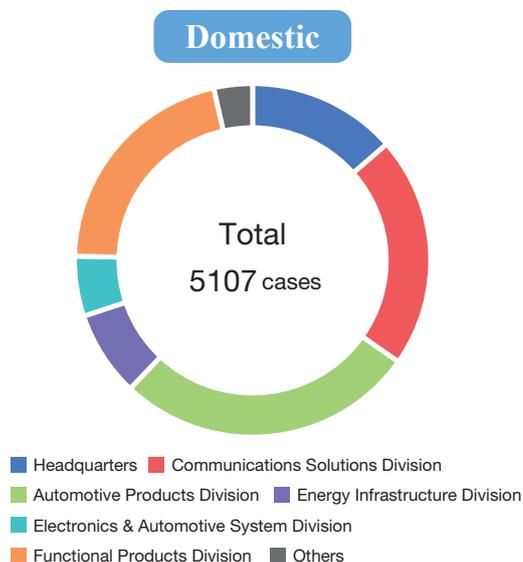
3-1. Intellectual Property Portfolio

Rights held by FEC over the years and breakdown of rights by division in FY2020

Rights held by Furukawa Electric (fiscal 2008-2020)



Breakdown of rights by division in fiscal 2020



In order to strengthen our business competitiveness through intellectual property, the Furukawa Electric Group has held over 5,000 domestic rights annually for the past seven to eight years including FY2021. With the expansion of sales in global markets, the number of overseas rights in the US, Europe, and China has increased.

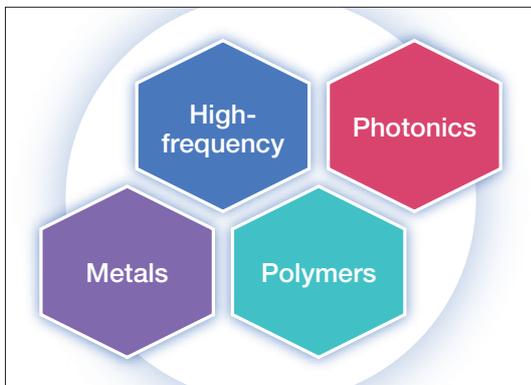
3-2. Development and Maintenance of Intellectual Property Portfolio

“Group” management of intellectual property rights and building of entry barriers

Intellectual property portfolios greatly affect the freedom and competitiveness of our businesses. A single patent obtained for the results of R&D and product improvement tends to be easily circumvented, making our competitive advantage difficult to maintain. Thus, obtaining collective intellectual property rights including patents is important. By managing “groups” of intellectual property rights in terms of technology and products, the Furukawa Electric Group fully understands its intellectual property capability, and develops and maintains portfolios in accordance with its R&D and business policies. Aiming at a prompt building of entry barriers for new technology, we have established a system that files patent applications collectively for inventions related to new businesses and technologies to support commercialization of the inventions.

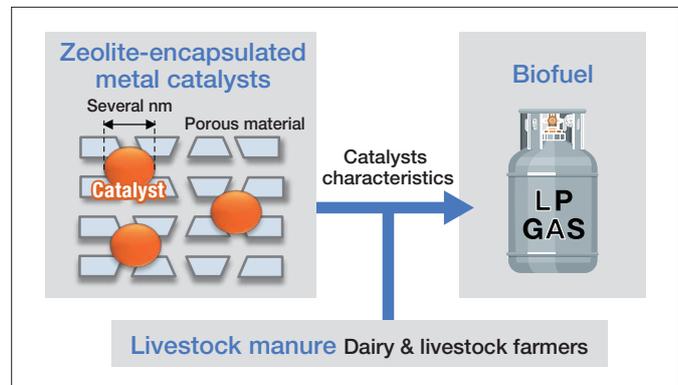
Four core technologies

(Technologies developed through years of development and fabrication of advanced materials)



Inventions related to new businesses and technologies

(Example: Zeolite-Encapsulated Metal Catalysts. Please refer to “4. Example of Intellectual Property Activities” for details.)



Activities with the trinity management of business, research and development, and intellectual property

The Furukawa Electric Group assigns a chief intellectual property officer to each division and promotes intellectual property activities with a core team formed of the business divisions, the research and development divisions, and the Intellectual Property Department. From various aspects including strategy planning, searches, application, and contract, the Intellectual Property Department promptly supports the business divisions and the research and development divisions, which are inventor divisions, from the early stages of development.



Maintenance of the quality of intellectual property portfolios

Improvement in the quality of specifications during application processes

- Joint meeting with the inventor division and the Intellectual Property Department to refine an application
- Review of application strategies and the validity of the scope of claims based of the importance
- Evaluation at each stage from filling to registration according to specific criteria
- ▶ Use for determination of establishment or waiver of rights

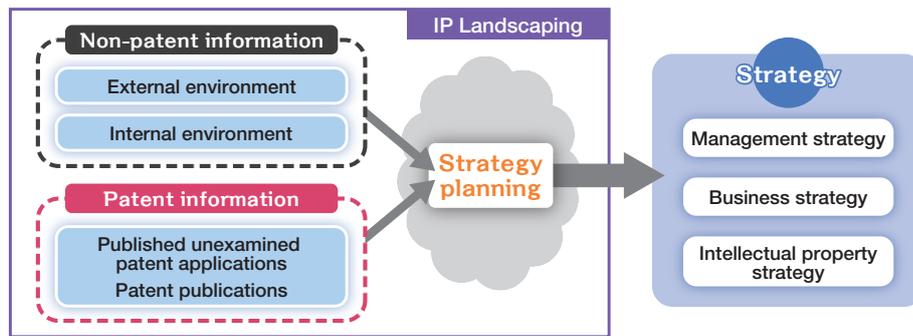
Confirmation of waiver of rights at a post-registration process

- Examination by the Intellectual Property Department of applicability to other technical fields and possible use outside our group

Initiative

■ IP Landscaping

The Furukawa Electric Group lists “Strengthening management and business strategy planning capabilities by IP Landscaping” as one of the basic policies of its intellectual property strategy. IP Landscaping allows us to use internal and external intellectual property information for analyzing competitive environment and market environment. By doing so, we have started activities to look for new business fields and business models.



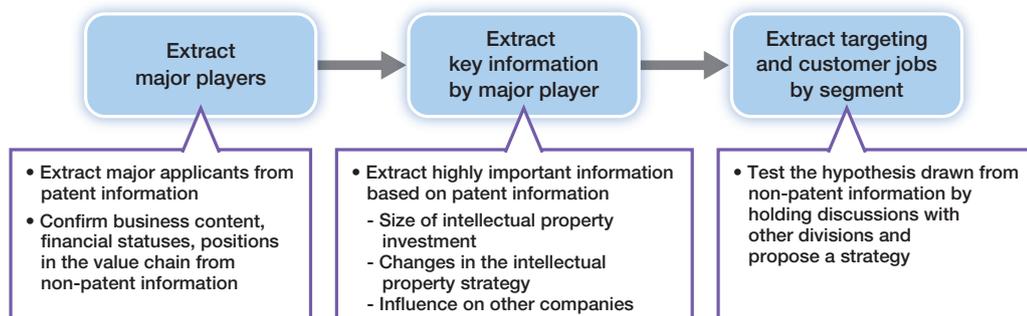
What is IP Landscaping?

IP Landscaping has been gathering attention since its listing in “Intellectual Property Personnel Skills Standard Version 2.0” released in April 2017 by the Ministry of Economy, Trade and Industry. This standard defines IP Landscaping as follows:

As opposed to patent maps, IP Landscaping includes research and development information, trends in management strategies, technical information on individual patents, and other information on your company, competitors, and markets. IP Landscaping provides a broad view of the current status and future perspectives with respect to the market positioning of your company.

In 2021, the FEC has established a special organization in the Intellectual Property Department to utilize IP Landscaping for predicting market trends and analyzing the value that customers need, in proposing strategies for developing new businesses by co-creation with other divisions. To stimulate co-creation with other divisions, we incorporate IP Landscaping into activities (such as marketing activities) regularly conducted in each division to ensure viability. In accordance with the purposes of management and businesses, we repeatedly conduct analysis, evaluation, and hypothesis testing based on patent and non-patent information in tandem with marketing activities in order to enhance our strategy planning capability.

Flow of IP Landscaping (Example)

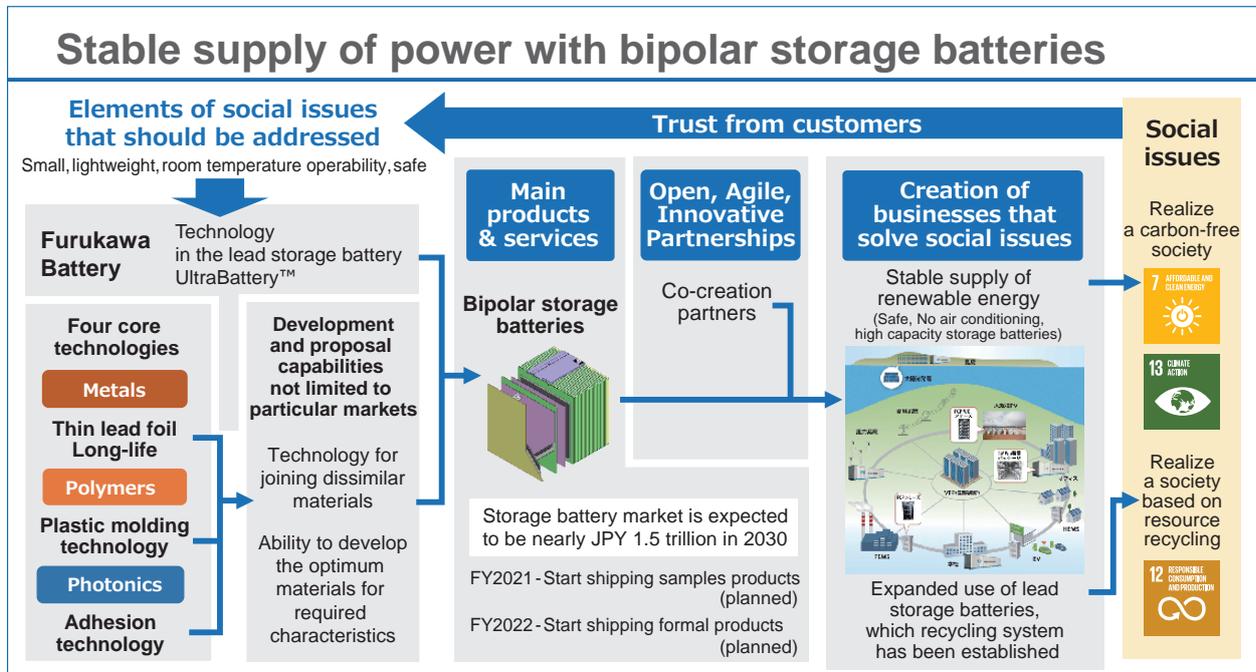


As stated in the Furukawa Electric Group Vision 2030, “in order to build a sustainable world and make people’s life safe, peaceful and rewarding, the Furukawa Electric Group will create solutions for the new generation of global infrastructure combining information, energy, and mobility”. For this purpose, we will use IP Landscaping as a powerful tool to create businesses that solve social issues through open innovation and co-creation with our partners. For example, we will conduct IP Landscaping for bipolar storage batteries that contribute to the use of renewable energy, and fiber lasers, including hybrid lasers, which contribute to the electrification of mobility, with the goal of enhancing strategy planning capability.

4 Example of Intellectual Property Activities

Creation of Businesses that Solve Social Issues

4-1. Bipolar Storage Batteries



One of the approaches to achieve a carbon-free society is to increase the introduction of renewable energy such as solar power and wind power generation. Power storage batteries are essential to a stable supply of power. The Furukawa Electric Group has been developing bipolar lead storage batteries for power storage jointly with The Furukawa Battery Co., Ltd. The bipolar structure (structure having positive polarity on the front side and negative polarity on the back side of one electrode) of bipolar lead storage batteries provides the following advantages, making them ideal power storage batteries.

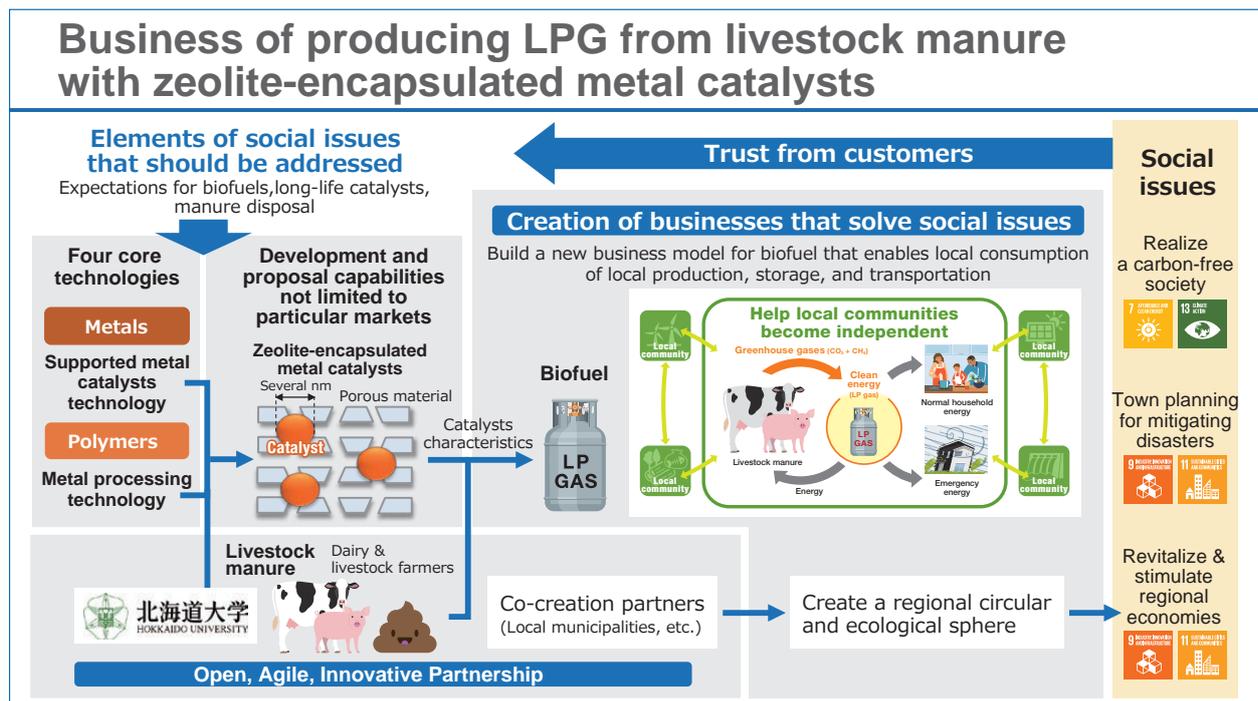
- Substantial cost reduction, weight reduction, and simplified temperature control facility
- Improved capacity per unit volume, improved large current characteristics
- Improved safety (by eliminating hazardous materials specified in the Fire Defense Law from battery materials)
- Improved economy (by allowing the use of established recycling systems)

By combining the battery technology and processing techniques that The Furukawa Electric Group has cultivated over the years, with our technologies of metals, polymers, and photonics, we aim to start shipping actual products in FY2022 to contribute to the realization of a carbon-free society and a resource recycling based society.

As for intellectual property activities, we will promote proactive patent application domestically and internationally as well as concealment management of know-how regarding various differentiating technologies that provide the above-described advantages.

We also strive to perform IP Landscaping with the cooperation of development divisions and the Intellectual Property Department. With IP Landscaping, we will analyze the value that customers need and apply the results to business strategy planning.

4-2. Zeolite-Encapsulated Metal Catalysts



The Furukawa Electric Group has succeeded in fixing a metal catalyst inside porous material through a joint research project with Hokkaido University. Having resistance to aggregation and coking, which have been a long-standing problem of catalysts, this catalyst boasts high activity and long life in dry reforming reaction that generates synthetic gas from biogas. It is called “Ramune ShokubaiTM” in Japanese.

Recycling of greenhouse gasses with this technology will help local production and local consumption of LP gas that can be used in general households and dairy farms as well as at disaster sites as emergency energy. This technology may also lead to a solution to potential problems livestock farmers have such as reduction in processing cost of livestock manure, odor generation, and water pollution. With this technology, we will drive local production and local consumption of energy and contribute to the creation of a regional circular and ecological sphere as new social infrastructure, and a carbon-free society.

Under the banner of “Furukawa Electric Group Vision 2030”, we aim to improve medium to long term corporate value considering ESG (Environment, Social, and Corporate Governance). Energy recycling of livestock manure helps solve “climate change”, which is one of our priority issues. As a leading company in a new ecosystem, we will design a new model that contributes to solving regional social issues.

From the early development stages of this technology, the Intellectual Property Department and research development teams jointly conducted invention excavation activities and developed a patent network to strengthen the inventions. We are planning to obtain diverse patent rights not limited to the catalyst structure but also including methods of using it.

We have continuously been conducting these activities since 2017, having filed over 60 domestic patents and 30 international patents (for international patents, the number includes family patents, application countries of which include the US and Europe).

■ Furukawa Electric Review

The Furukawa Electric Group publishes “Furukawa Electric Review,” which is a technology and research journal introducing the research and development results, technologies, and new products of our group.

Furukawa Electric Review introduces notable technologies of our group and key technologies in growing fields with the thoughts of researchers.

From our founding in 1884 through to the present day, the “conveying, connecting, and storage of energy, information, and heat” have been the pillars of our business. While developing a wide range of products around the world in the fields of infrastructure such as telecommunications and energy, as well as in the fields of automotive components and electronics, we are contributing to the achievement of a sustainable society.

We published our latest issue, No. 52 “Special Issue: Laser Processing for Copper” in August 2021. This is the first time for Furukawa Electric Review to receive two contributions from outside the Group.

Papers (PDF files) on No. 18 and later issues (since May 1999) are available from the following site:

<https://www.furukawa.co.jp/en/rd/review/>

Furukawa Electric Review Contents		» No.52 <2021.8 >
Special Issue : Laser Processing for Copper		
On issuing	<p>Furukawa Electric Group has upheld the theme of “Growth through the creation of businesses that solve the social issues” with the aim of achieving the Vision 2030. And under the evolutions slogan of “Open, Agile, Innovative”, the Group is promoting the formation of partnerships especially with outsiders to the Group as a materiality, which is an important management issue.</p> <p>This is the first time for Furukawa Electric Review to receive two contributions from outside the Group. Both are from strong partners who have mastered the technology and shared the success of our business in the field of the “Laser Processing for Copper”. Including these contributions, we hope that the author's passion for “Laser Processing for Copper” entrusted to each paper can be felt.</p> <p style="text-align: right; font-size: small;">Furukawa Electric Review Chief Editor: Intellectual Property Dept. General Manager Michio Ohkubo</p>	
Opening Remarks		
	Solving the Social Issues Through Marketing Orientation and Solution Proposals	Kazuyuki Umeno 1
Special Contribution		
	Advances in Material Processing Technology of Copper Using Short Wavelength Lasers – The Role of Blue Diode Lasers in The Smart Country Concept – Professor, Joining and Welding Research Institute, Osaka University Masahiro Tsukamoto Yuji Sato, Ritsuko Higashino, Nobuyuki Abe, Yoshinori Funada, Yu Sakon, Seigo Ouchi, Kohhei Asano, Koji Tojo 2
	Development of High-Power Blue Laser Diodes Principal Researcher, NICHIA CORPORATION Shinichi Nagahama10
Papers		
	High Quality Processing of Copper Using Fiber Lasers Keigo Matsuura, Taro Murayama15
	Development of the High-Power Blue Laser Diode Module and its Laser System Naoki Hayamizu, Hajime Mori21
	The Features of the Blue-IR Hybrid Laser and the Copper Processing Technique – High Quality Copper Welding by Using the Blue-IR Hybrid Laser – Masamitsu Kaneko, Nobuyasu Matsumoto, Takashi Shigematsu25
	Development of Laser Welding Applications With Blue-IR Hybrid-Laser Tomomichi Yasuoka, Nobuyasu Matsumoto, Masamitsu Kaneko, Takashi Shigematsu29
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Communications Solutions	Hollow Core Fiber Cable Kazuomi Mukasa36
Communications Solutions	The Development of a Nano-TTLA for Digital Coherent Datacenter Interconnects Masayoshi Nishita, Noritaka Matsubara, Junichi Hasegawa, Kazuki Yamaoka, Masako Ariga, Yusuke Inaba, Masayoshi Kimura, Masaki Wakaba, Masahiro Yoshida, Kazuomi Maruyama, Toshihito Suzuki, Hiroyuki Ishii, Yasumasa Kawakita44
New Products		
Communications Solutions	Super High End Fusion Splicer S185R0F / S185PMR0F49
Communications Solutions	Ultra-high Fiber Count (UHFC) 6912-Fiber Cable With 200 μm 16-Fiber Rollable Ribbon, Ribbon Fiber Mass Fusion Splicer S124M1B and Related Tools51
Electronics & Automotive Systems	Roughening Copper Plating With High Resin Adhesion54

Furukawa Electric Review Previous Special Issues

	Issued	Special Issue
No. 52	August 2021	Laser Processing for Copper
No. 51	March 2020	Collaborations for New Business Creation
No. 50	March 2019	Challenges to New Technologies and New Products
No. 49	March 2018	OneF Automotive Technology*
No. 48	March 2017	R&D Group and Global Expansion
No. 47	March 2016	—
No. 46	March 2015	Optical Communication
No. 45	March 2014	Polymer Material
No. 44	October 2013	Automobile Electronics
No. 43	March 2013	Smart Grid

* “OneF” is the abbreviation for “One Furukawa Electric.”

5 Topics

Registered Recycling Technology on WIPO GREEN

The Furukawa Electric Group has joined “WIPO GREEN” as a partner. It is a platform for promoting the utilization of green technologies run by the World Intellectual Property Organization (WIPO). We registered our intellectual property related to green technologies, such as waste plastic recycling technology, to the database managed by WIPO GREEN to promote the technologies. By doing so, we contribute to the achievement of a sustainable society through our entire value chain.

The Furukawa Electric Group has formulated the “Furukawa Electric Group Environmental Vision 2050” to strengthen our efforts to tackle the problems of the intensification of abnormal weather due to climate change and marine plastics of recent years. We will strengthen the “creation of environmentally-friendly businesses” and the “development of business activities that consider climate change,” important management issues (materiality) in the “Furukawa Electric Group Vision 2030.”



■ For details on the “Furukawa Electric Group Environmental Vision 2050,” please go to the following news release

https://www.furukawa.co.jp/en/release/2021/kei_20210304.html

Received the “Clarivate Top 100 Global Innovators 2021 Award”

We were chosen among the “Top 100 Global Innovators 2020” by Clarivate, a global information service company. This is the sixth award and the fourth-consecutive award since 2018 for Furukawa Electric.



About Issuing the Intellectual Property Report 2021

The importance of intellectual property and intellectual property activities has been increasing more and more in recent years. This year, Japan's Corporate Governance Code jointly established by the Financial Services Agency and the Tokyo Stock Exchange has been revised to include items regarding intellectual property for the first time. We are entering a new era where effective utilization of our intellectual property is crucial for improving our corporate value.

The Furukawa Electric Group has been promoting its intellectual property activities from the perspectives of Risk Minimization that we have conventionally practiced to stabilize our business, and Chance Maximization aimed

at expanding business opportunities and driving company growth. We expect that such intellectual property activities will truly contribute to our business and ultimately achieve enhanced company value and social contribution.

We hope that you will have a better understanding of the intellectual property activities of the Furukawa Electric Group after reading the report.

October 2021
General Manager,
Intellectual Property Department
Michio Ohkubo





Drawing on more than a century of expertise in the development and fabrication of advanced materials, we will contribute to the realization of a sustainable society through continuous technological innovation.

Intellectual Property Report 2021

FURUKAWA ELECTRIC CO., LTD.

Intellectual Property Department