Our Challenges (2)

Innovations Starting from Networking

Coming together across the Group as "One Kuraray," we will continue to take on the challenge of creating innovation.

Toshinori Tsugaru
Managing Executive Officer
Officer Responsible for Innovation Networking Center;
Officer Responsible for Research and Development Division;
Officer Responsible for IP Management Center

Roots of Our Innovation

The Kuraray Group originated with the commercialization of synthetic rayon. Under our mission, "For people and the planet—to achieve what no one else can," we have consistently worked to fulfill our social obligations and create unique technologies. In commercializing KURALON™, Japan's first synthetic fiber, we recognized the importance of integrated production—we could not ensure quality unless we were involved from the raw materials stage. We overcame numerous challenges to establish the in-house production of the raw material PVOH resin. We've done this since the origin of the Kuraray Group, and it has enabled us to create products that capture a high market share. Since then, we have drawn on our base of unique polymer and synthetic chemistry technologies to transition from being simply a fiber manufacturer. We've evolved to become a Specialty Chemical Company creating numerous products and businesses that have won top market share globally in the vinyl acetate sector and beyond.

Innovation Strategy under the Medium-Term Management Plan "PASSION 2026"

Under "PASSION 2026," as part of our ongoing evolution, in January 2022, we established the Innovation Networking Center (INC) as a step to create a new driver of growth. In an age of VUCA—volatility, uncertainty, complexity, and ambiguity—the mission of the INC is to lead the way in creating frameworks. It is shaping the corporate culture and developing human resources in such a way as to accelerate innovation by integrating internal and external resources, including our ties with customers and partner companies, both worldwide and across the Group. As well as digitalizing collaboration, dialogue, and other customer activities to enable shared access, we will put in place other platforms to drive continued innovation through globally collaborative utilization of the Kuraray Group's comprehensive strengths. These range from proprietary technologies and equipment to a diverse pool of talent.

We also expect this to act as a catalyst to stimulate the corporate culture to create new organizational structures that do not exist under the existing divisional framework.

On the R&D front, we are channeling efforts into "Development based on the customer perspective," "Development that contributes to sustainability," and the "Planning and promotion of an intellectual property (IP) strategy." We have numerous technologies in the R&D pipeline at present and envision that, with the help of INC in obtaining market information and identifying unmet needs, these technologies will feed into the development of materials that offer new value. By outlining a future corporate vision based on the consumer and customer perspective and then undertaking a backcasting process to identify research themes, we will make inroads into new areas beyond the scope of our current research domains. To promote development that contributes to sustainability, we will not only accelerate the development of greenhouse gas reduction technologies, which is a Group policy, but also continue to offer solutions and develop materials that contribute to improving the natural and living environments. Our efforts will be in the areas of waste reduction, use of biomass and biodegradable products, health and beauty, and high-speed telecommunications. In January 2022, we established the Environment and Energy Research Laboratory, whose mission includes actively developing biomass-derived new carbon materials. To drive the planning and promotion of an IP strategy, we also established the IP Management Center in January 2022. This Group-wide organization supports the IP strategies of our various divisions. The Center will formulate and implement a global strategy for the effective use of IP, including monetizing IP rights through expanded out-licensing.

Pursuing the Creation of New Technologies

Our greatest mission is to create technologies that lead to new businesses. To do so, coordination with other divisions in areas ranging from customer information to the design of large-scale production equipment is vitally important. Through our current initiatives, we plan for the entire Kuraray Group to come together as "One Kuraray" under a framework that enables closer collaboration toward achieving the corporate mission, as we continue pursuing innovation for the next generation.

Generating Ongoing Innovation

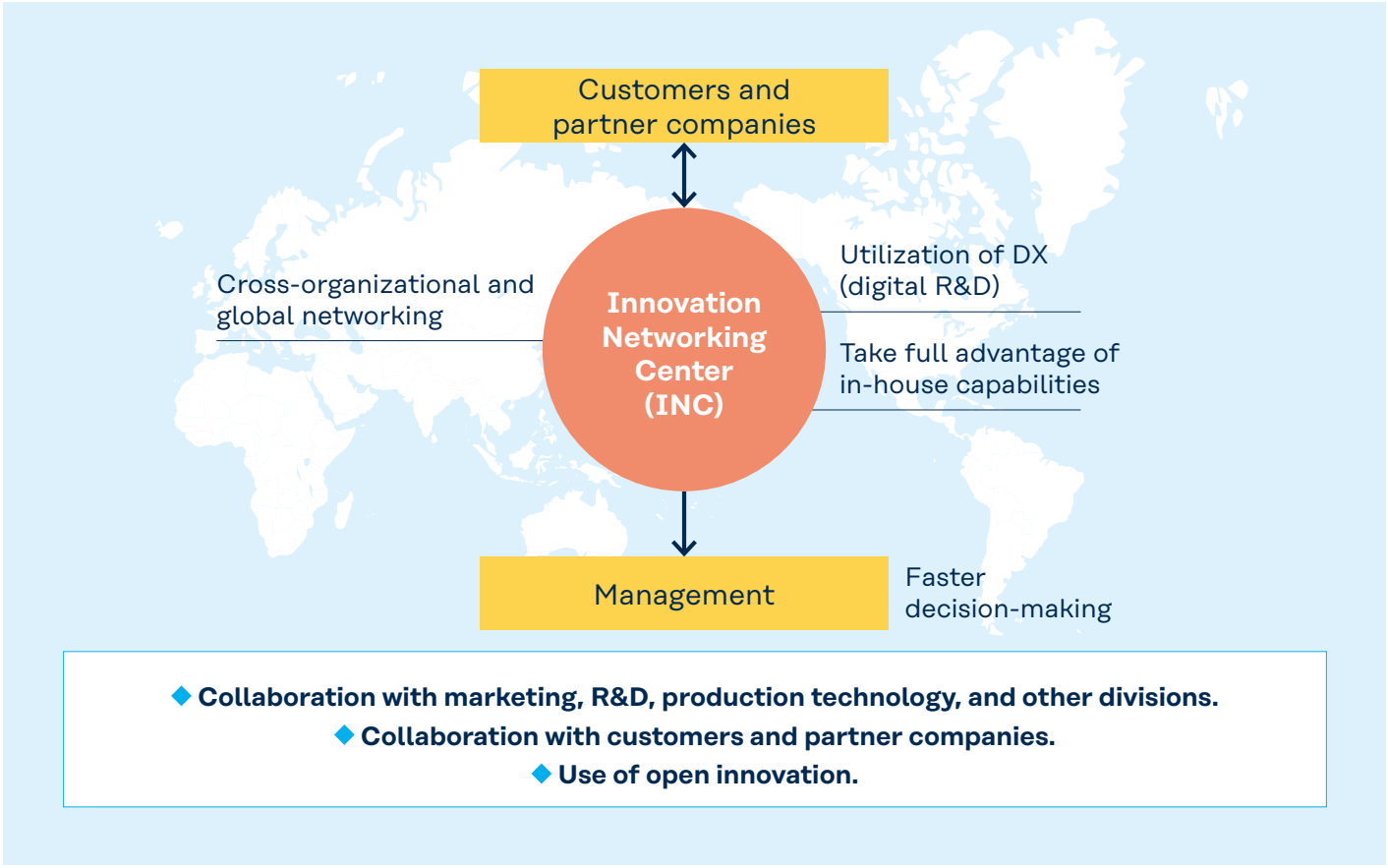
Establishment of an Innovation Networking Center (INC)

The most important objective of the INC is to generate innovation by integrating internal and external resources.

To empower individual divisions and customers to take the initiative in generating ongoing innovation, the Center will play the role of accelerator in the Kuraray Group's innovation efforts, promoting activities involving the participation of all corporate divisions and employees. We have adopted an ambassador system for the Center, whereby around two dozen core members from diverse backgrounds are collaborating globally in digital venues with over 50 ambassadors representing various Group organizations.

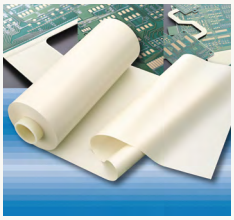
By leveraging the Kuraray Group's resources on a global scale, from its diverse human resources in Japan and overseas and its unique technical capabilities to the customer relationships and market approaches it has cultivated over the years, we will continue to create new business opportunities over the longer term.

Promotion Structure and Strategies



Innovation in Practice 01

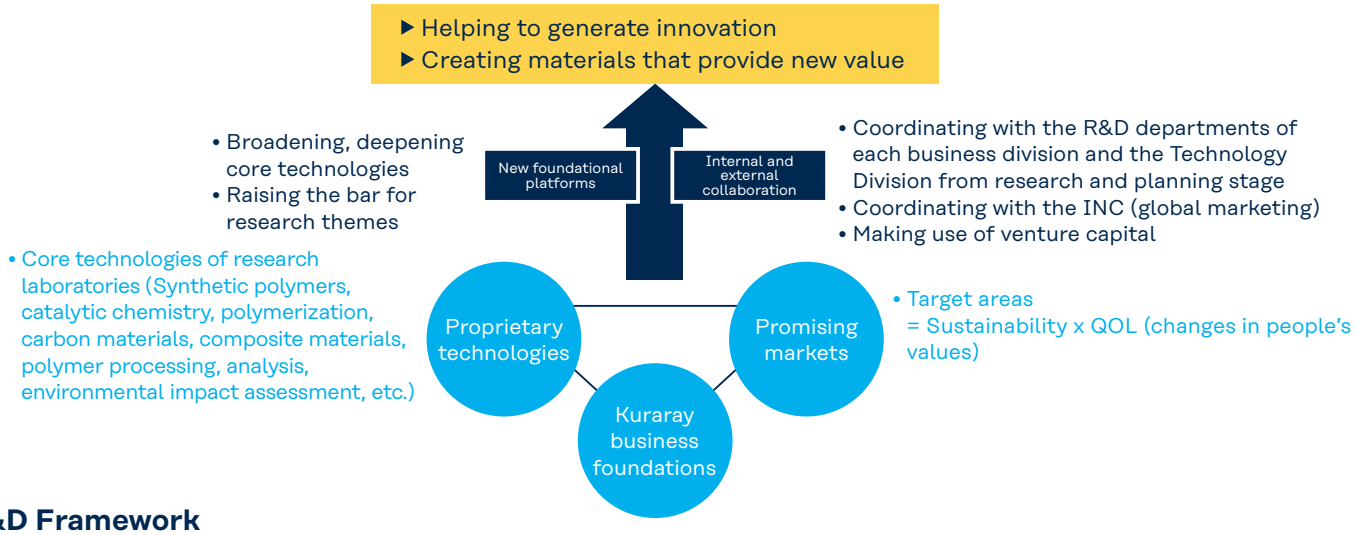
VECSTAR™ (Liquid crystalline polymer film), VECSTAR™ FCCL (Flexible copper-clad laminates)
Demand for VECSTAR™ is expected to increase further as an electronic circuit board for electronic devices such as smartphones and vehicle-mounted high-speed communications devices, thanks to its reputation for low transmission loss in the high-frequency wave range and excellent workability. This led us to upgrade existing production facilities in 2018. In 2020, we also upgraded existing production facilities for flexible copper-clad laminates VECSTAR™ FCCL, which uses liquid crystalline polymer film, at the Kashima Plant. We are currently considering further reinforcement.



Innovation in R&D

Basic Strategy for R&D

In the Research and Development Division, the corporate organization which is the heart of the Kuraray Group's technological development capabilities, we promote projects that contribute to Group-wide business expansion and profit growth under the corporate missions of "creating new business," "strengthening and expanding existing businesses," and "establishing and deepening core technologies," through close collaboration with in-house companies, business divisions, and R&D divisions in the Group companies. In 2016, we launched the Supporting Project to support the sustained enhancement and expansion of existing businesses. In 2017, we began the full-scale rollout of "new business creation activities" aimed at both discovering promising new opportunities in areas peripheral to our businesses and broadening the scope of Kuraray's business foundation. Under "PASSION 2026," while carrying on existing approaches, we will coordinate with the INC to promote marketing activities for items under development worldwide as well as seek to accelerate innovation by incorporating new foundational platforms through R&D pursued under a backcasting process.



R&D Framework

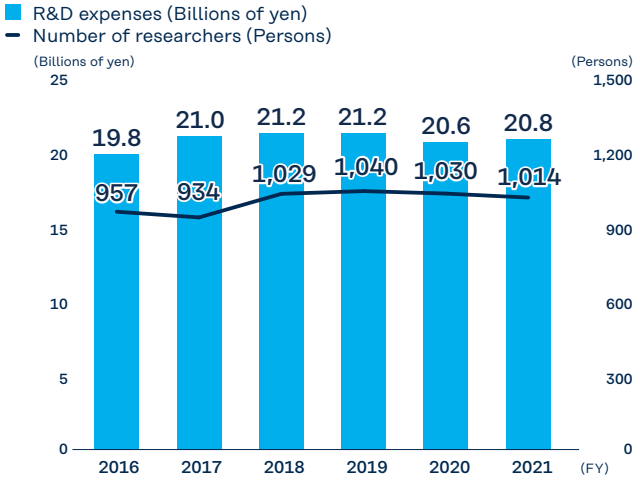
Central to realizing the Kuraray Group's vision as a Specialty Chemical Company achieving sustained growth is the Research and Development Division, the main thrust of our corporate R&D and new business development activities. The Research and Development Division manages the Kurashiki Research Center, Tsukuba Research Center, Vecstar Business Promotion Department, Functional Products Development Department, Intellectual Property Department, New Business Management Department, and Planning and Administration Department.

Our research centers pursue R&D of new businesses, products, and technologies using their core technologies, which include organic synthesis and synthetic polymer technologies, catalytic chemistry, polymer materials technology, environment- and energy-related technologies, precision polymerization and polymer modification, compound materials, polymer processing, and computational science. Taking advantage of their analytical capabilities and safety assessment techniques, the research centers also serve as analysis hubs for all Kuraray Group companies to address technical problems. We are also actively engaged in R&D of digital technologies to accelerate our research and development efforts.

The Research and Development Division evaluates and analyzes IP data to support business strategies. Each business division has an R&D department at its base plant. Including overseas bases, these plants engage in R&D activities while working closely with corporate and business divisions' research, development, and production bases.

The Technology Division, responsible for corporate production technology development, manages the Technology Development Center and the Technology and Maintenance Management Department. It promotes progress in production technology by partnering with the Production and Technology Management Division of each Group company and the Production and Technology Development Department of each plant. It has also begun collaborating with the Research and Development Division in the early stages of development to accelerate the evolution of new businesses and products. Since 2018, this department has taken the lead in implementing digital strategies for Group-wide R&D as well as production technology.

R&D Expenses and Number of Researchers



Priority Issues of "PASSION 2026"

"PASSION 2026" set forth the priority issues of "development based on the customer perspective," "development that contributes to sustainability," and the "planning and promotion of an intellectual property (IP) strategy." By steadily addressing these issues, we will accelerate innovation in R&D.

Development based on the customer perspective

To bring the ideas and seed technologies generated by the Research and Development Division to market, we will pursue global marketing activities through the INC. With a view to new business creation, we will outline our vision for future business areas based on the consumer and customer perspective and use this vision to inform our selection of research themes the Kuraray Group needs to address.

Development that contributes to sustainability

Seizing the challenge of sustainability as an opportunity, we will develop materials that contribute to improving the natural and living environments to deliver solutions to the world. Particularly with regard to reducing greenhouse gas emissions, in line with Group policy, we are accelerating the development of technologies for the capture, storage, and use of CO_2. In January 2022, we established the Environment and Energy Research Laboratory to drive powerful research into environment- and energy-related fields.

Examples of development areas

- Waste reduction
- Recycling
- Biomass and biodegradable materials
- High-speed communications
- Electronic devices
- Health applications
- Beauty applications

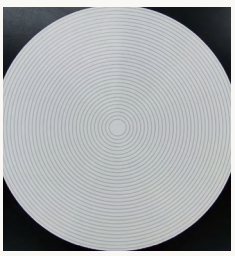
Planning and promotion of an IP strategy

The Kuraray Group's business development has typically concentrated on harnessing unique technologies to create unparalleled products. We have sought to stay out ahead of the competition by filing patent applications and securing IP rights on our R&D achievements in Japan, where our development bases are located. However, due to various pressures, notably mounting competition from startup enterprises and other products in different sectors that have accompanied the globalization of business activities, the existing IP framework alone is no longer sufficient to protect our businesses adequately and maintain our competitive edge. Moreover, in an increasingly complex IP environment, the importance of IP risk management is growing, especially in overseas markets. To meet this challenge, the IP Management Center established in January 2022 will work not only to support the IP strategies of each business division, but will also formulate and implement a globally integrated IP strategy. In this way, we will implement IP activities that go beyond the former strategy, focused on securing rights, to include business development activities.

Innovation in Practice 02

Polishing Pads for Semiconductors (CMP pads)

Polishing pads for semiconductors are made of high-hardness polyurethane, a new material developed by leveraging the polyurethane design and manufacturing technologies cultivated through the development of CLARINO™ man-made leather. Multiple customers have begun shifting to Kuraray's CMP pads since their super-hard surfaces offer outstanding device polishing and smoothening capabilities, create few scratches despite their hardness, and deliver a long service life due to their high abrasion resistance. In addition to these features, a combination with specific general-purpose slurries enables highly efficient polishing and reduction of polishing slurry usage. This has yielded cost reductions in customer production processes. We are currently expanding sales in Japan and gaining ongoing recognition from customers in Japan and overseas, as well as in relation to numerous processes. We have succeeded in strengthening our collaborative system for evaluation with customers and will continue to expand our customer base and sales volume.



Pursuing Innovations in Sustainable Products

The Kuraray Group has designated target fields based on five macrotrends: concerns for the global environment, food and water security, digitalization and communications, effective utilization of energy, and higher quality of life (QOL). With core capabilities in each of these areas, we are well positioned to help address these issues.

By channeling management resources into businesses and products related to these areas, and by exploring strategic acquisitions and corporate alliances, we will work to grow existing businesses and generate new businesses.

Target fields

Concerns for the global environment

Environmental load reduction

Air and water purification
- Adsorption

Reduce microplastics
- Biodegradable polymers
- Functional enhancement of paper products

Circular economy
- Shift to mono-materials
- Circular business models

Global warming prevention

GHG capture
- Absorption and separation

GHG utilization
- Consider applications for EOR*

* Enhanced Oil Recovery

- Polymer synthesized from CO_2

Reduce GHG emissions
- Promote the use of bio-based materials
- Contribute to weight reductions

Food and water security

Food loss reduction
- Prolongation of shelf life

Improve agricultural productivity
- Materials for insect prevention and seed coating

Safe water supply
- Removal of PFAS, organic fluorine compounds

Digitalization, communications

Electric and electronic device materials
- Electronic devices and circuit substrates
- Semiconductor manufacturing equipment-related

High-speed telecommunications device materials
- Mobile data terminals (electromagnetic wave shields)
- 5G tele-communication device-related

Effective utilization of energy

Materials for energy storage devices
- Secondary batteries (anode materials, etc.)

Energy-related materials
- Wind power generation materials

Materials for electric and electronics devices
- Next-generation vehicles (high-voltage parts)

Higher QOL

Medical and healthcare
- Dental materials
- Regenerative medicine materials

Beauty goods and living supplies
- Water-soluble films for individual product packaging
- Sanitary goods

Improve indoor and in-vehicle environments
- Air purification
- Highly functional displays
- Vibration control sealants
- Interior parts (car seats, etc.)

Innovation in Practice 03

Anode Materials for Lithium-Ion

We are working on R&D of a new hard carbon that possesses a distinctive structure made from plants for use as an anode material for lithium-ion secondary batteries, and moving forward with development of manufacturing technology for this material. Owing to its structure, the new hard carbon will enable both excellent output performance and higher battery capacity than graphite. We are currently evaluating its utility as a next-generation anode material, with a view to consumer applications including batteries for smartphones and tablet PCs and automotive uses.