R&D (Innovation) Strategy

R&D Supporting the Growth Strategy

Basic policies

The Toagosei Group's basic policies on research and development for 2025 are as follows.

- Early commercialization of next-generation materials
- Taking challenges in cutting-edge technology
- Discovery of research and productive technology themes through more opportunities for collaboration

In August 2024, we opened the Kawasaki Frontience R&D Center as a new base for research. Together with the Nagoya Criatio R&D Center this new center will form a core R&D base, where we aim for the early commercialization of next-generation materials. As a technical team taking challenges in cutting-edge technology, it is also promoting product development through collaboration.

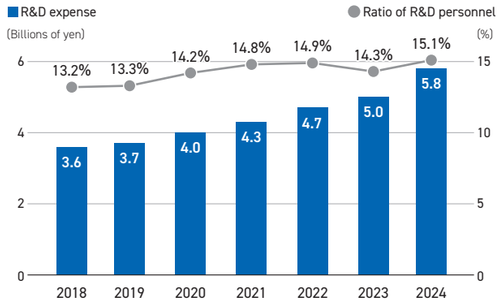
Strategy

R&D strategy

Aiming for product development that contributes to the Sustainable Development Goals (SDGs), we are advancing research and development that suits the needs of society while taking into consideration the environmental impact of manufacturing products. In particular, we are focused on R&D in the areas of medical care, cellulose nanofibers, and next-generation battery materials, aiming for early commercialization. We are actively investing resources in growth areas like semiconductors and electronic materials and promoting the continuous creation of competitive and creative products and technologies.

R&D expense in 2024 was 5.8 billion yen (3.4% of net sales). We are making positive efforts to enhance resources with the view to increasing R&D expense by 20% (from 2022) for the 2025 Medium-Term Management Plan. We are also strengthening our collaborative research with universities and investing in start-ups as we work toward acquiring and cultivating new core technologies.

◆R&D expense and ratio of R&D personnel*



*Ratio of R&D personnel (%): number of research, technology and development personnel ÷ Consolidated number of employees × 100

IP strategy

Our Group has established IP Strategy Committees tasked with formulating and implementing IP strategies. These committees meet regularly with operating departments, research and technology development departments, and other related departments to establish effective IP strategies in line with the Group's business strategy. These committees work toward achieving offensive and defensive IP strategies that take into account the trends in markets, our customers, and our competitors.

System

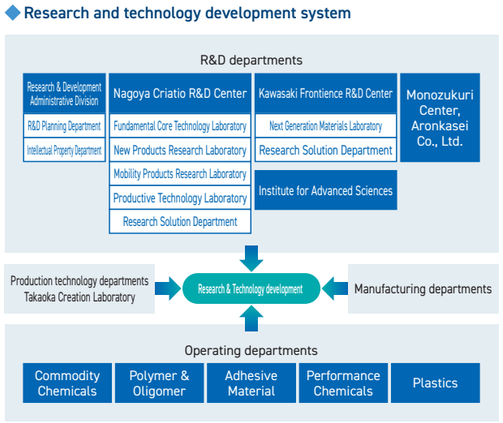
Research and technology development system and initiatives

Our Group aims to benefit society while ensuring sustainable group development by supplying a wide range of useful, appealing chemical products. We opened the Kawasaki Frontience R&D Center in August 2024. We have commenced operation of this new center as a core R&D base together with the Nagoya Criatio R&D Center.

The operation of these two R&D centers will enable us to respond more quickly to the needs of customers and cultivate new fields through active external collaboration, thus serving to strengthen our core competencies.

To accelerate product development in areas with growth potential, research personnel have also been deployed flexibly on key projects to maximize R&D efficiency.

◆Research and technology development system



Nagoya Criatio R&D Center

The center is positioned as a core base for the development of promising technologies and high-value-added products that will underpin the Toagosei Group's future. This year, we have established the new Research Solution Department in addition to the four existing laboratories: the Fundamental Core Technology Laboratory, the New Products Research Laboratory, the Mobility Products Research Laboratory, and the Productive Technology Laboratory. In this way, we aim to further expand our core businesses. We also advance research and technology development aimed at acquiring higher-order processing technologies at our two technology development laboratories.

- **Fundamental Core Technology Laboratory**
  Coordinates efforts for advancing research by strengthening assessment and analysis technologies that form the foundation of research and development, accelerating development through establishing and utilizing environments for machine learning and computational chemistry, and developing applied technologies that lie at the heart of our core technologies.
- **New Products Research Laboratory**
  Covers development of high-value-added products based on our Company's core technologies. Promotes the development of new, differentiated products through development in close cooperation with customers. The laboratory also collaborates with our overseas bases to promote the overseas expansion of high-performance products.
- **Mobility Products Research Laboratory**
  Aims to develop innovative materials such as functional adhesives and battery materials in the battery materials field, with a primary focus on automotive applications. At the same time, we are improving our evaluation capabilities and promoting development efficiency.
- **Productive Technology Laboratory**
  Establishes production technologies such as the selection of raw materials and improving and tuning each process, to ensure that materials with positive test results can be supplied at fair and stable costs during development at product laboratories. The laboratory also addresses long-term technical issues faced by manufacturing sites.
- **Research Solution Department**
  Engages in business expansion by creating new markets different from our existing businesses through the exploration of new applications for our high-value-added products and collaborative creation with customers.

Institute for Advanced Sciences

Works toward the commercialization of cell penetrating peptides for the next-generation Drug Delivery Systems (DDS), which are expected to be used for nucleic acid drug delivery and gene delivery. The Institute also actively conducts activities from fundamental research to applied study in a broad range of functional peptide research and nucleic acid research via partnership programs with the Center for iPS Cell Research and Application at Kyoto University and with the Graduate School of Agricultural and Life Sciences at the University of Tokyo.

Kawasaki Frontience R&D Center

The Kawasaki Frontience R&D Center, newly opened in 2024, is a core base for our research and development, together with the Nagoya Criatio R&D Center. It is engaged in the research and development of next-generation materials and also facilitates the expansion of existing businesses with customers in the Tokyo metropolitan area through the concept of collaborative creation. With excellent access to Haneda Airport, the center is aiming to spearhead global research and development efforts.

- **Next Generation Materials Laboratory**
  Conducts research and development into innovative technologies such as medical products, cellulose nanofibers, and next-generation battery materials that have potential as new businesses.
- **Research Solution Department**
  Matches our core technologies with market trends, identifies promising new large-scale project topics, and develops products through collaborative creation with customers, especially in the Tokyo metropolitan area, and practical verification.

Takaoka Creation Laboratory

The Takaoka Creation Laboratory has been established at the Takaoka Plant, our manufacturing base for Adhesive Material business. Using this laboratory, we promote product development that is closer to our customers through an integrated manufacturing system encompassing all processes from development to manufacturing for various functional adhesives, including instant adhesives.

Monozukuri Center, Aronkasei Co., Ltd.

As part of our Plastics business, this center contributes to society by addressing social issues (natural disaster risks, aging infrastructure, super-aged society, and global warming) through the development of sewer pipeline repair materials and nursing care products, as well as the development of recyclable materials. Going forward, it will shift toward a development system that can propose solutions, including systems, while working on research and development focused on growth areas (semiconductors, mobility, and healthcare).

Tokyo Technology Laboratory

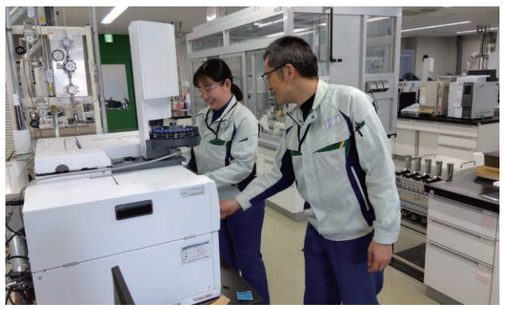
Taking advantage of its excellent location (next to our Head Office), the facility promotes swifter solutions for the issues faced by our customers using tests attended by customers and evaluation and analysis of customer-provided base materials.

Human resources development

R&D human resources development

We actively promote joint research with universities and other institutions with the aim of acquiring new technologies. We also aim to revitalize our human resources through exchanges, including dispatching research staff to universities and accepting internship students from universities. Furthermore, our personnel make presentations at academic conferences and submissions to academic papers, and are engaged in education as researchers.

A support system has also been developed catering to young researchers in particular, to allow them to come up with research topics based on a flexible approach to thinking. We further promote the development of human resources to train research personnel capable on the global stage, by providing language learning opportunities and training programs at overseas research institutions.



On-the-job training

R&D (Innovation) Strategy

Intellectual Property Strategy

Promoting key focus areas under the Medium-Term Management Plan and strengthening our technology base

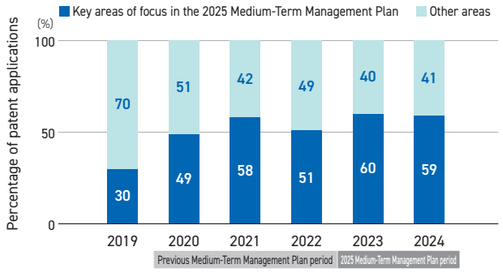
We have identified mobility-related, electronic materials-related, and medical care-related fields as the key areas of focus under our 2025 Medium-Term Management Plan, and we are investing management resources in these areas.

We are working to exploit the Group's technologies and strengthen its competitiveness in these focus areas. Research and development are advancing, and we are steadily accumulating achievements such as patent applications.

At the same time, we are also working to strengthen our technology base and explore future technologies outside of our focus areas.

Through this simultaneous "exploitation" and "exploration," we will enhance the Group's overall research and development capabilities and strive to secure medium- and long-term technological competitiveness.

◆Trend in the percentages of patent applications by the Group



*Percentage of patent applications = Percentage of all patent applications made by the Group in Japan

Initiatives to create new technologies

Our Group is utilizing the IP (Intellectual Property) landscape and engaging in stimulating discussion among related staff including management in order to create new business and enhance corporate value. In the IP landscape, we map news, academic papers, patents and other information to visualize the relationships between technologies and the competitive landscape. This enables us to identify areas where the competition is intensive and others that are unexplored, facilitating the generation of innovative ideas.

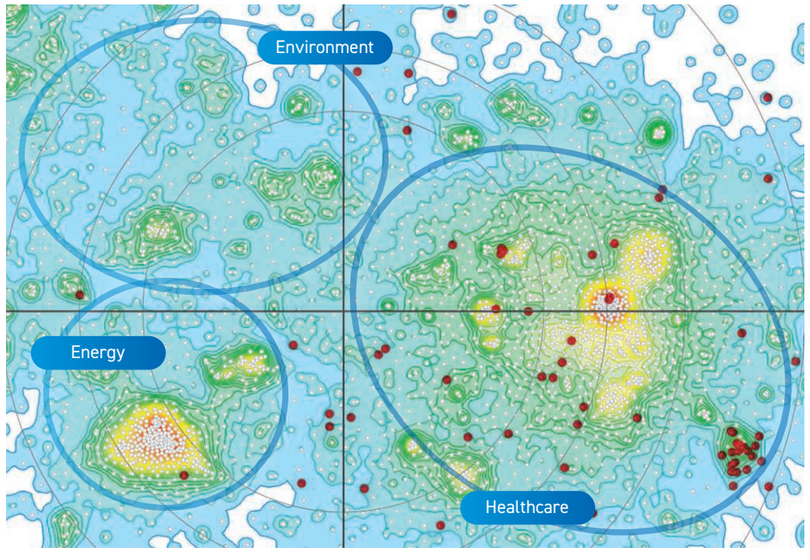
The diagram below maps an overview of research papers and patent information relating to inorganic functional materials. A point represents an academic paper or a patent, and the distance between points indicates their technological similarity.

By highlighting our own technologies and those of our competitors (shown in red in the diagram below), we have explored the possibilities of new technologies and utilized them for idea generation. We also apply this method to the development of solid electrolytes for next-generation batteries.

Furthermore, we are strengthening collaboration through the use of management design sheets to understand the current situation and sharing and integrating perspectives between different departments.

We regularly review and improve these initiatives. We will be continuing with such activities to ensure the sustainable growth of our Group.

◆Example mapping of research papers and patent information relating to inorganic functional materials



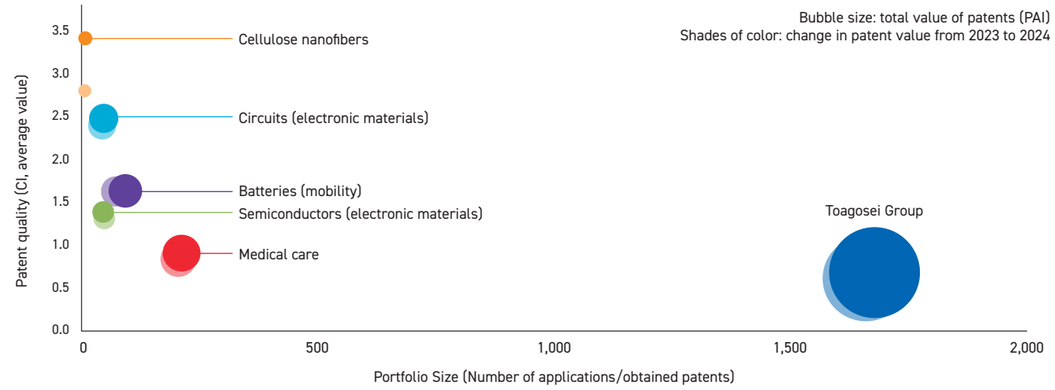
*Created using the VALUENEX Inc. Radar analytical tool.

The value of patents supporting our business competitiveness

Our Group views IP as an investment for long-term profitability, and promotes the improvement of patent value. The quality of patents has shown significant improvemet since 2023, especially related to batteries (mobility), semiconductors and circuits (electronic materials), medical care, and cellulose nanofibers, and these are enhancing the value of the Group's patents.

We will continue to strengthen our research and development capabilities and effectively protect intellectual property, including patents. By strategically utilizing the high-quality intellectual property created, we aim to strengthen our business competitiveness and maximize corporate value.

◆Value of our Group's patents



*Prepared by our Group using LexisNexis® PatentSight+, a patent analysis tool of LexisNexis Intellectual Property Solutions, USA. The shades of color show the transition of patent value from 2023 (light) to 2024 (dark) (patent value at the end of each year 2023 and 2024). Competitive Impact (CI): an average value index per patent family calculated by multiplying the technical value calculated based on the number of citations by the market value calculated based on the status of country application/rights. Patent Asset Index (PAI): total patent value obtained by multiplying average CI by the number of patents.

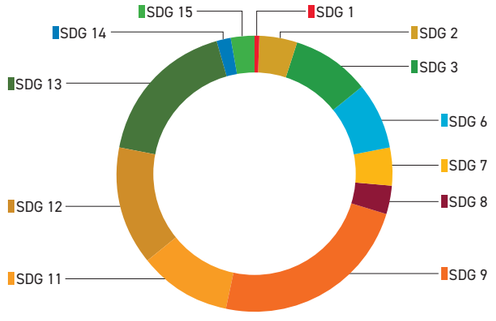
Contributing to the SDGs through R&D

We are actively contributing to the SDGs through research and development. Specifically, we are enhancing our contribution to SDG 3 (Good Health and Well-being), SDG 9 (Industry, Innovation and Infrastructure), and SDG 13 (Climate Action) through research and development in the areas of focus established in the Medium-Term Management Plan.

We are also continuing research and development aimed at strengthening our technological base in other areas. These initiatives have substantial socially significance and contribute to addressing other SDGs.

We will continue to contribute to society through research and development as we work toward building a sustainable society.

◆Proportions of the Group's SDGs-related patents



*Prepared by our Group using LexisNexis® PatentSight+, a patent analysis tool of LexisNexis Intellectual Property Solutions, USA. This diagram is a visualization of the relative proportions of the number of the Group's patent families related to SDGs as of the end of 2024.

◆Some of the SDGs addressed by the Group's technology and related patents

SDGs	Related technology	Examples of the Group's patented technologies
3 GOOD HEALTH AND WELL-BEING	Medicine and health	● Advanced medicine ● Regenerative medicine ● Infection control measures
6 CLEAN WATER AND SANITATION	Water resource management	● Drinking water purification ● Wastewater and water-saving technologies ● Water supply infrastructure
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	Energy and new materials	● Next-generation batteries ● New materials and manufacturing technologies ● Environmental impact reduction technologies
11 SUSTAINABLE CITIES AND COMMUNITIES	Urban infrastructure and transport	● Disaster-resistant infrastructure ● Barrier-free equipment ● Mobility support technologies
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	Sustainable production and consumption	● Recycling technologies ● Waste processing ● Energy-saving manufacturing
13 CLIMATE ACTION	Decarbonization and renewable energy	● Environmentally friendly materials ● GHG reduction ● Renewable energy