

R&D

Message from the Officer in charge



Taking on innovative advances in R&D through the wonders of science

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Research and development serves as the universal origin of TAIYO YUDEN's competitiveness. What distinguishes us is our commitment to quality in materials, characterized by the integration of everything from materials R&D to product development. This commitment helps us create competitive products as well as refine and accumulate core technologies needed to make new products. As a result, these technologies, which are capable of bringing out the full potential of a material's unique properties, serve as one of the Group's greatest strengths.

In 2021, TAIYO YUDEN adopted a mission of becoming "stronger and more socially aware through the wonders of science," aiming for sustainable growth and the creation of a prosperous society. "The wonders of science," which open the door to the future through exciting experience, unexpected discoveries and surprises, and the development of new fields are the very source of TAIYO YUDEN's corporate value enhancement.

For these wonders of science to materialize, cooperation between people and technology is imperative. I believe it is important that we adeptly utilize the discontinuous, free, and unexpected ideas, conceptions, and flashes of genius unique to human beings, as well as the comprehensive nature and efficiencies of the latest digital technologies and AI in order to uncover new solutions. In fact, in recent years we have begun to achieve significant results in the form of innovative advances that have stemmed from discoveries made thanks to the extensive knowledge and past experience of our researchers, collaboration, etc. between engineers working in different fields at our Research and Development Laboratory, and so on. These achievements have all been triggered by serendipity, a uniquely human experience, and I see this belief in "the wonders of science" steadily taking hold amongst our employees.

On the other hand, however, engineers tend to become absorbed in the technologies they are in charge of or

interested in. Getting engrossed in your work is vital in order to solve technical issues at hand, and expertise is, of course, necessary to do so, but it can narrow one's perspective and limit testing to a scope that is based on one's own past experience, which could potentially cause the optimal solution to be missed. To avoid falling prey to this trap, we train our researchers to view things from a diverse range of perspectives and established the Shin-Kawasaki Center SOLairoLab to facilitate active interaction between our researchers and those outside of the Group.

Another issue to consider, especially in fields closely related to the development process, is the tendency to forecast and think about how we can improve upon what we already have. To combat this, I have encouraged our team members involved in R&D to take a backcasting stance, envisioning ten years from now, depicting five years from now, and setting concrete goals to be realized three years from now. It is important that we define what we should become and what we want to be, identify the gaps with where we are today, and use that to draw a timeline and roadmap to reaching our goals. "Ten years from now, the world will be like this. So five years from now, we will need a device like this. We should thus aim to hit this bar in three years' time." This is the type of thinking I hope to see our employees develop so that we can create technologies unlike anything seen before and that can help solve major social issues.

Moving forward, TAIYO YUDEN will work to break free of the specialization trap through future-oriented initiatives as we remain committed to material technology, one of our core technologies, and we hope to maintain our position as a top organization that possesses the technologies needed in the coming new era.

➔ [p.32 Smart Product Development System](#)

Fundamental Stance on Research and Development

The Foundation of Our Research and Development Activities

Hikohachi Sato, the founder of TAIYO YUDEN, was a researcher in ceramic materials, and since its establishment, has believed that product commercialization should start from the development of materials. This has been one of the

strengths of TAIYO YUDEN, and has resulted in us creating many products that have been "world firsts." TAIYO YUDEN's research and development activities are aimed at further honing the many elemental technologies it has so far developed to create products that contribute to the ongoing development of electronic devices.

— Research and Development Principles —

"Innovative advance"

- Technology precedence**
Promote leading edge technological development as the precursory to innovative product development and become a global leader in technology
- Reproducibility**
Logically verify the reproducibility of the technology we develop
- Technological applicability**
Devise technologies which can be applied not only to specific products but also to other areas useful to the markets we serve
- Environmental consideration**
Develop technologies that are feasible and applicable economically to our manufacturing process and that meet critical environmental standards



Approach to Research and Development

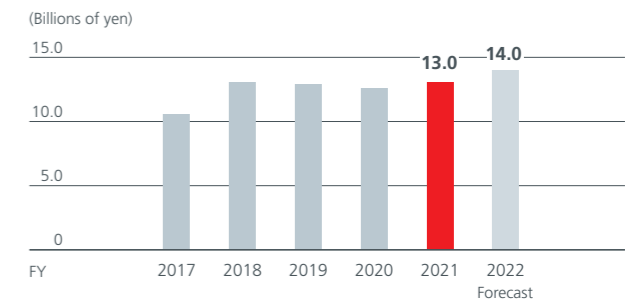
Achievement of Our Vision through Development of Smart Products

TAIYO YUDEN aims to manufacture "smart products" and is actively working to develop and supply steadily such products.

We develop smart products to eliminate the three M's— *muda* (wastefulness), *mura* (inconsistency) and *muri* (overburden)— over their entire life cycle from design through production, sales, and incorporation into the final product right up to final disposal, to add value for customers and local communities we serve as well as our employees. We believe that our research and development activities aimed at creating a higher standard of smart products will enable us to realize our vision of "To be an excellent company that enjoys the trust and highest regard from all stakeholders."

R&D Expenses

We recognize that continuing innovations and advancement in our technologies through R&D is the foundation for TAIYO YUDEN to create the future. As such, in recent years we have continuously invested a fixed amount into R&D activities.



R&D

R&D Themes

At the Research and Development Laboratory, the center of TAIYO YUDEN's R&D activities, our core concept is "envisioning ten years from now, depicting five years from now, and setting concrete goals to be realized three years from now." Our development activities are underpinned by two basic policies: 1. Developing outstanding material technologies to become a No. 1 player; and 2. Proposing solutions that meet the needs of society.

Our current research themes include the development of dielectric materials for multilayer ceramic capacitors and new materials for our metal power inductor MCOIL™. We are also stepping up our initiatives that address research themes which contribute to the creation of new value through items

including all solid-state batteries and smell sensors as well as research themes related to the SDGs, particularly the environment.

To strengthen the core technologies (material technology and process technology) that form the foundation of our business, we draw up research themes based on our roadmap and operate an oversight system that takes a unique twist on the phase-gate process. We have also established a new functional organization within the Research and Development Laboratory to serve as the foundation for TAIYO YUDEN's technological capabilities, such as benchmarking of things like intellectual assets, digital technologies centered around simulations, and measurement technologies in anticipation of 6G.

Research Personnel

TAIYO YUDEN is currently promoting an educational program designed to cultivate research personnel capable of backcasting. We train our researchers to be able to develop technological strategies from a long-term perspective by, for example, drawing roadmaps for future R&D activities with an eye to major technological trends. We are also making attempts to broaden our researchers' perspectives by, for example, holding guest lectures by experts and specialists in fields not directly tied to R&D, such as design and the social sciences. With these efforts, we aim to develop personnel capable of backcasting from our vision for what we should be in the future and solving social issues unfettered by the constraints of their particular

field of expertise during their R&D activities.



A training session on the decision-making process and mindset for creating markets

TAIYO YUDEN's Research Facility



R&D Center

We are committed to upholding our claim to be "the TAIYO YUDEN of technology and the TAIYO YUDEN of development." Based on this, we opened the R&D Center (Takasaki

City, Gunma Prefecture, Japan) in 1998 with the aim of continuing to create the world's best products. Establishing the R&D Center has accelerated our R&D activities and still drives the development and technological progress of TAIYO YUDEN today, taking a role of a foundation of creativity focusing on the future.

In November 2020, we also opened the Shin-Kawasaki Center SOLairoLab (Kawasaki City, Kanagawa Prefecture, Japan) as a satellite base closer to the market. Moving forward, we plan to take advantage of its location at Shin-Kawasaki Sozo no Mori ("Forest of Creation") where a large number of research institutes and start-ups have congregated to strengthen our information gathering and marketing functions as well as our application and solution development capabilities.

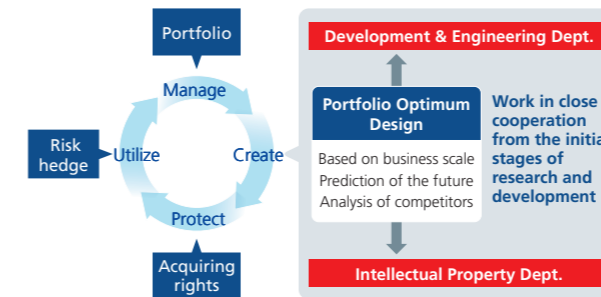
Activities on Intellectual Property Rights

Basic Policy

We, TAIYO YUDEN, endeavor to obtain, maintain and protect intellectual property rights for proper use, and also to respect the intellectual property rights of third parties, in accordance with our CSR Code of Conduct.

Protection of Intellectual Property Rights

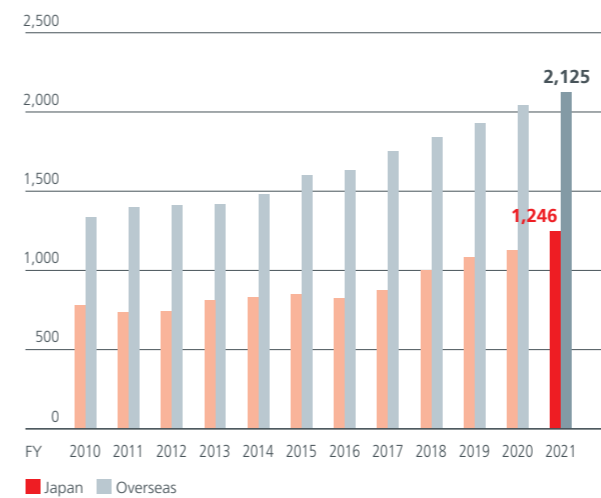
At TAIYO YUDEN, the Intellectual Property Department and the Development and Engineering Department work in close cooperation with each other from the early stages of developing new technologies and obtaining intellectual property rights. In addition, we pursue a unique management approach in a way that is optimized for each of our businesses to create, protect, and utilize intellectual property.



Number of Patents Held

TAIYO YUDEN has been acquiring the patent rights needed to conduct its business activities both in Japan and overseas, with

Fig. 1 Number of Patents Held



the number of patents held increasing year over year (Fig. 1). Broadly speaking, we file two types of patent applications, striking a balance between them: those meant to strengthen our core technologies in line with our product roadmap, and those meant to supplement areas in which we lack when looking at other companies' behavior. Maintaining these patents is not without cost, but I believe this to be a necessary investment to ensure a degree of freedom in our business. We also review the patents we hold when appropriate and stop maintaining our rights to obsolete technologies in order to reallocate funds to applications that will bolster our new technologies.

On the other hand, there are certain technical fields in which we deliberately do not apply for patents in order to avoid our technologies being disclosed to the public. We register this sort of know-how internally for use within the Group as a form of intellectual property and are working to encourage the creation of such intellectual property by providing incentives to those who invent it in the same way we do for patents.

Blocking Competitor Patent Applications

Patent applications are examined by the Japan Patent Office (JPO). The rate at which TAIYO YUDEN's patents are cited when other companies' applications are examined (the rate at which our patents help prevent competitors from obtaining patent rights) exceeds the industry average (Fig. 2). This indicates that we are successfully improving our competitive advantage by making appropriate patent applications in terms of both content and timing.

Fig. 2 Rate at which Competitor Patent Applications are Blocked

