

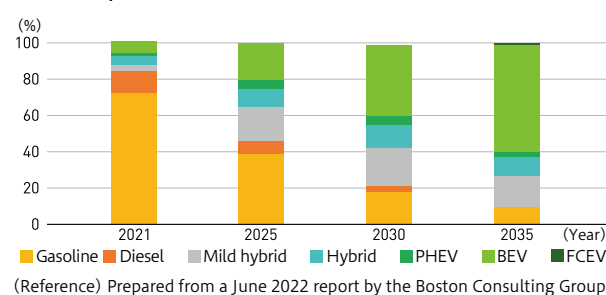
# Developing Products for BEVs

A major shift toward electrification is taking place in the automobile industry, and we are developing new products by bringing together the polymer material technologies we have cultivated in multiple business fields and our technical capabilities in product design and production based on these technologies. In developing products for battery electric vehicles (BEVs), we seek to create new value ahead of needs, while expanding the scope of our efforts to all of CASE and contributing to the creation of safe, secure, and comfortable vehicles.

## BEV Trends

A joint statement was issued at COP26 in 2021 with the aim of making all new cars sold in major markets zero-emission vehicles by 2035, and all new cars sold worldwide zero-emission by 2040. A proposal by the European Commission in 2021 to ban the sale of internal combustion engine vehicles in the EU by 2035 was passed in June 2022, a move that further accelerates the shift to BEVs by automakers worldwide.

Forecast Spread of Electric Vehicles



## Toyota Gosei's BEV Initiatives

The biggest challenge for the widespread adoption of BEVs is to extend their cruising range. Environmental friendliness and user safety and comfort in response to changes in vehicle structure are also important. Toyota Gosei's technological potential lies in its plastic and rubber material technologies and its product technologies in each business area. We believe that we can increase our potential for providing value with tech-

nologies that span multiple fields in response to the changes in vehicles and needs associated with the shift to BEVs.

We have established the following four development targets based on Toyota Gosei's business areas, and, viewing change as an opportunity, are promoting product development while optimizing resources to quickly respond to changes in the business environment.

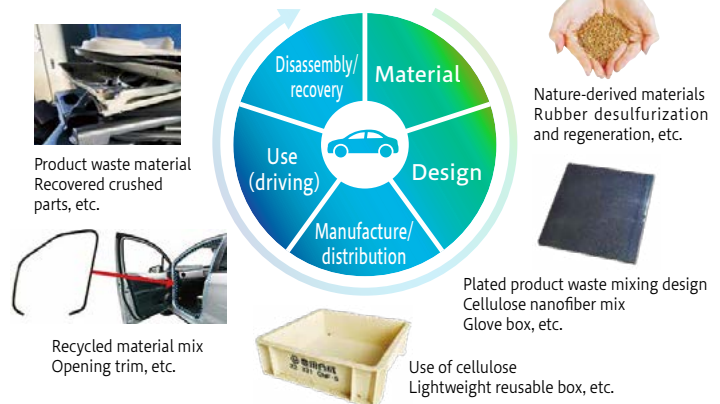
Development targets	2022	2025	Future
<b>① Environmental friendliness</b> Disassembly/recovery Use (driving) Manufacture/distribution	<b>Raise recycling rate, provide new value with recycled materials, use nature-derived materials</b> Rubber desulfurization and regeneration technologies	Cellulose nanofiber mixed products	Use of natural rubber Vegan leather
<b>② Extension of cruising range</b>	<b>Higher electric mileage with lighter weight using plastic, better cooling around battery</b> Cooling pipes Battery cases	Image of seamless exterior Transparent garnish (electromagnetic waves, light)	
	<b>Compatible with simple front design, contributes to BEV-like design and aerodynamic performance</b>		
<b>③ BEV-like interior space</b>	<b>Achieves occupant comfort and innovative feel</b> Novel steering wheel shape Interior functional illumination Heat managing air conditioning (near occupants)	Thin instrument panel compatible passenger-side airbag	
<b>④ Safety assurance</b>	<b>Improved occupant protection performance in response to changes in impact G force</b> High performance airbag (far side) Next-generation active vent Driver-side airbags	Wrap airbag Higher performance steering wheel	<b>Compatible with changes in interior layout, autonomous driving</b>

## Four Development Targets

### ① Environmental Friendliness

Since BEVs have a higher environmental impact than gasoline-powered vehicles during the manufacturing stage, it is important to make life cycle assessments. As a manufacturer specializing in the polymer field, we aim to provide environmentally friendly products by improving their recyclability, expanding the application in our products of rubber regeneration technology, and developing the use of naturally derived materials. Products containing cellulose nanofibers are expected to reduce CO<sub>2</sub> emissions through both weight reduction and recyclability. We are also working on the practical application of natural rubber and vegan leather. Furthermore, we are striving to impart new value by using recycled materials, for example by using waste materials from plated products to achieve new surface designs.

#### Example of Lifecycle Assessment Efforts



### ② Extension of Cruising Range

Toyota Gosei is contributing to extended BEV cruising ranges mainly through heat management, weight reduction and aerodynamic design. We have brought together engineers from our functional component business to develop cooling systems (for example, piping and battery cases) that extract greater battery efficiency.

We utilize our materials technologies to replace metal with plastic, to make plastic and rubber products thinner by improving the material strength, and to make products lighter using our foam production engineering. In the exterior product field, seamless design with no openings is needed to improve aerodynamic performance. To achieve this design, we are differentiating our exterior products by enhancing their functionality, including decorative technologies that allow radio waves and light to pass through.



Battery cases

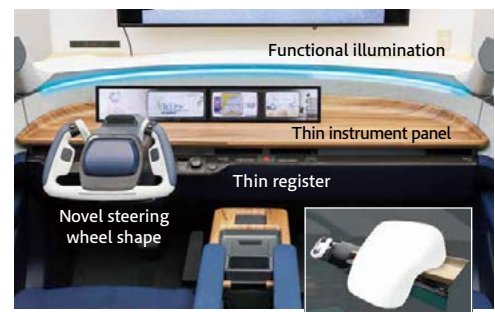


Seamless exterior image with functional consolidation garnish

### ③ BEV-like Interior Space

The design trend for BEV interior spaces will be for forward-looking spaces that differ distinctly from gasoline-powered vehicles. We aim to achieve such forward-looking vehicle interior spaces through a combination of our strengths in interiors and safety systems. For example, we are developing airbags and registers that contribute to smart, thin instrument panels, and functional illumination such as driver notifications that use the entire cockpit including the steering wheel.

Our advanced steering wheels with a novel shape provide not only an ergonomic grip shape for comfortable steering, but also reflect airbag technology that ensures the same occupant restraint performance even with a steering wheel shape with vertical cutouts.



Thin instrument panel compatible passenger-side airbag

### ④ Safety Assurance

The increased strength of the parts around the battery with the shift to BEVs will affect how vehicle occupants are impacted during collisions. This will require better protection performance from the restraint system. Toyota Gosei ensures safety with high-performance airbags and internal pressure control technology. We are also developing systems together with Tokai Rika Co., Ltd. and Ashimori Industry Co., Ltd. to achieve optimal protection performance for each vehicle model through the combination of airbags and seatbelts. In addition, we are developing wrap around airbags that are integrated with seatbelts to ensure safety in response to future changes in cabin layout and occupant posture. Toyota Gosei will continue to provide safety and security to all while adapting to various vehicle changes in the future, with the ultimate aim of zero fatalities in traffic accidents.



Image of large, comfortable vehicle interior



Wrap airbag



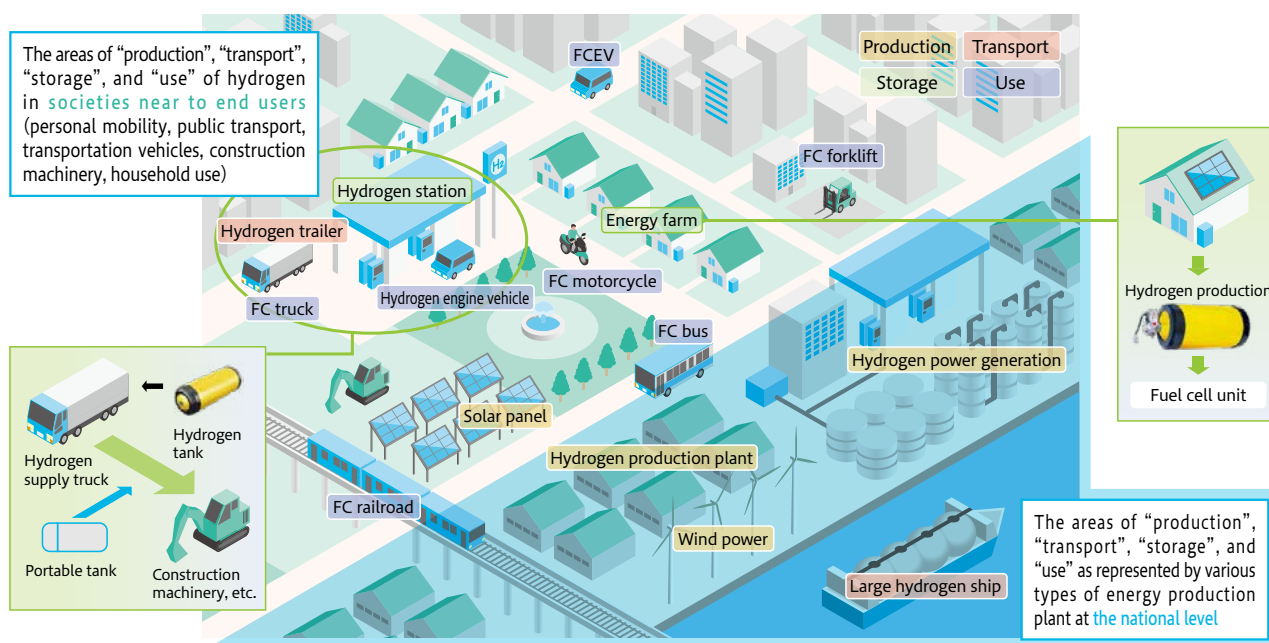
# Moving From “Storage” and “Use” to “Transport” and “Production” for Hydrogen Societies

Toyota Gosei has completed the development of its first hydrogen tank for automobiles, and we began mass production at one of our own plants in 2020. In moving toward hydrogen societies, we started out in the areas of hydrogen “storage” and “use”, which are familiar to end-users. In the future, we will spread this technology to the “transport” and “production” of hydrogen, further contributing to hydrogen societies.

## The Future of Hydrogen Societies

Hydrogen can be produced from a variety of resources, and has the characteristics of not emitting carbon dioxide when used and enabling renewable energy to be stored, transported, and used.

In Japan, initiatives are underway for the utilization of hydrogen as a key energy source so that carbon neutrality can be achieved by 2050, and we are committed to contributing to these hydrogen societies.



## Toyota Gosei’s Involvement with Hydrogen

Using our strengths in polymer materials, we began developing compressed natural gas (CNG) tanks with plastic liners for natural gas vehicles in 1995, and obtained Japan's first certification in 2001. Tanks with plastic liners are lighter and less expensive than tanks with conventional aluminum liners.

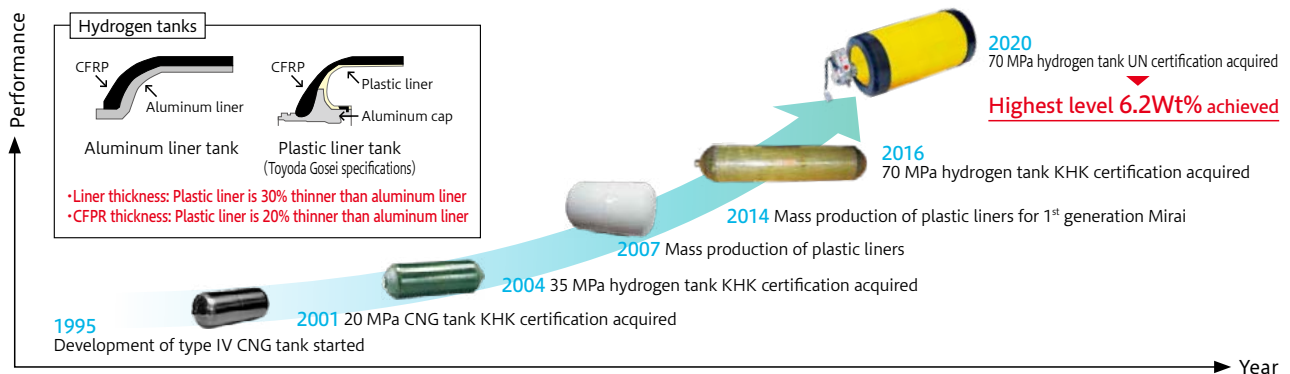
In 2002, we began developing hydrogen tanks for fuel cell electric vehicles (FCEVs) utilizing our CNG tank technology. This was recognized in a NEDO<sup>\*1</sup> subsidized project. Hydrogen molecules are smaller than those of natural gas, and the development of materials to prevent fuel permeation was a challenge. This was solved by modifying the plastic material.

In 2007, we began production of 70 MPa<sup>\*2</sup> plastic liners for leased FCEVs, and in 2014 we began mass production of plastic liners for the first generation of the Toyota Mirai. This was a stepping stone to the development of hydrogen tanks, and carbon fiber winding and epoxy curing technologies were brought in-house. In 2016, we obtained certification for 70 MPa hydrogen tanks, and in 2020 we began mass production of hydrogen tanks in one of our own plants for the second generation Mirai. This contributes to hydrogen “storage” and “use”.

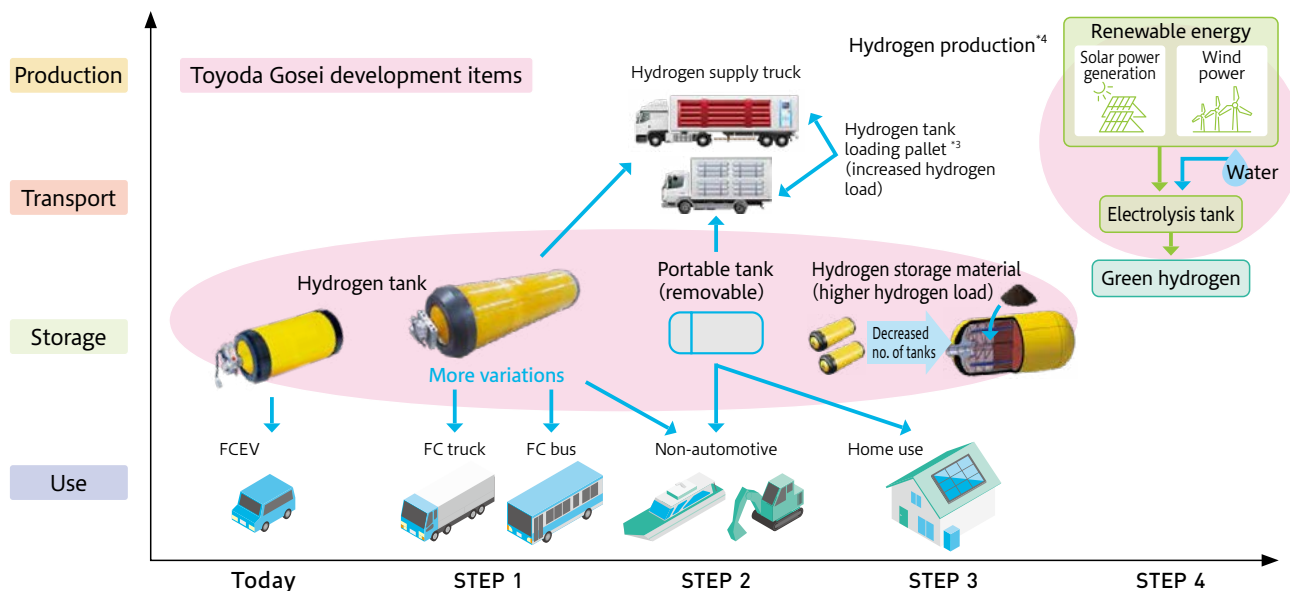
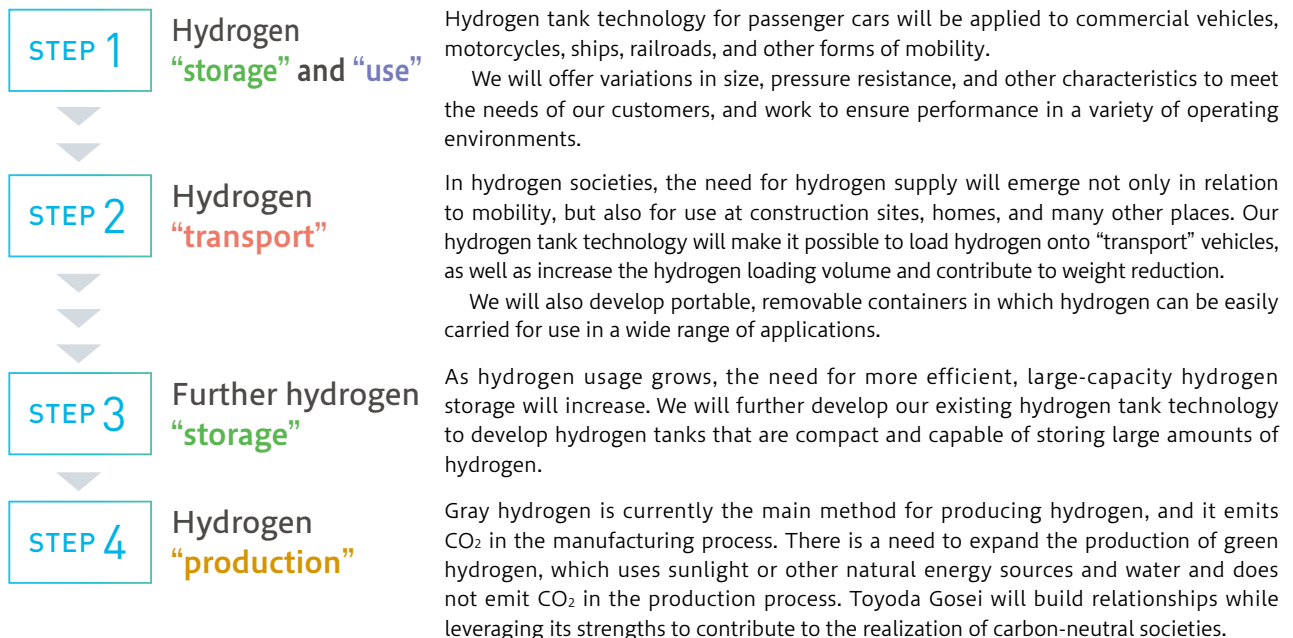
<sup>\*1</sup> New Energy and Industrial Technology Development Organization (National Research and Development Agency)

<sup>\*2</sup> Megapascal (unit of pressure)

## Toyota Gosei's History of CNG / Hydrogen Tank Development



## Contributing to Hydrogen Societies



<sup>\*3</sup> Collection container in which several tanks are attached to frame

<sup>\*4</sup> Concept includes collaboration with partners

# New Value Creation for the Future

As the environment undergoes drastic changes, we cannot expect to make significant progress if we continue along the same path as in the past. In order to achieve sustainable growth, it will be necessary to create new value by adding outside knowledge and resources to the management resources we have cultivated to date. We will build new growth engines by incorporating outside capabilities while maintaining the foundations of our existing businesses, continuing to take steps forward by changing the way we think and developing our human resources in order to promptly respond to changes that may arise as we address these challenges.

## Achieving Sustainable Growth

To achieve sustainable growth for the future, we will need to venture out from the path we have been on. For this we will need to develop new products and cultivate new markets. At the same time, we need to respond quickly, and within our limited available resources, to various social challenges such as the SDGs and carbon neutrality.

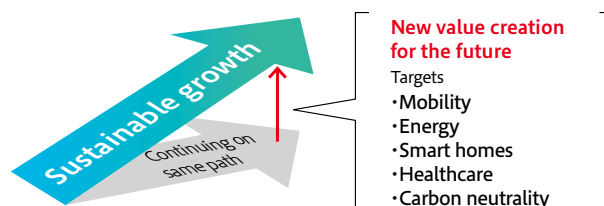
Currently, there is a gap between following the same path and sustainable growth. We believe that activities to bridge this gap are what will lead to new value creation for the future. Two things are needed for this. One is how well we are able to utilize external forces, such as start-ups. The other is how to awaken the latent potential within the company, especially among young people, and how well that potential is displayed.

Toyota Gosei has a history of venturing into new

businesses, such as blue LEDs. We have inherited this foundation and culture of taking on new challenges and will to pass it on to younger people in the company as we create new value for the future.

What is “New Value Creation for the Future”?

We are conducting **new value creation for the future** in which external forces (startups, others) and internal forces (young employees) serve as growth engines



## Use of Corporate Venture Capital (CVC)

For the effective use of external forces, we launched an internal organization dedicated to investing in startups (corporate venture capital; CVC) in January 2019. The idea is to accelerate our response to areas that cannot be handled with limited internal resources or where our knowledge and experience are limited, by leveraging the capabilities of startups and other outside organizations.

In these CVC activities, our investments are focused in five key areas: mobility, energy, smart homes, healthcare, and carbon neutrality. This is based on the idea of prioritizing fields that have high synergy with our core technologies (automotive-related technologies such as rubber and plastics, airbags, and hydrogen tanks; GaN-based semiconductor technologies such as blue LEDs).

Three years have passed since we began these CVC activities as one of our new growth engines. The current organization consists of a full-time staff of 10 and 30 young engineers also working in other departments. The annual budget is 1 billion yen, and investments have been made in 16 startups to date. We do not simply

invest in these companies, but also work with them on joint development. We will continue to promote activities to develop new products and cultivate new markets by utilizing technologies from different industries.

### Major Companies in Which We Have Invested

Category		Name of company	Content of development
Carbon neutrality	6 COMPANIES INVESTED	WOTA Corp.	Portable water purification unit
Carbon neutrality	12 COMPANIES INVESTED	Slab Inc.	Pellet 3D printer (for recycled materials)
Mobility Smart homes	9 COMPANIES INVESTED	Space Power Technologies Co., Ltd.	Microwave power supply device
Mobility	9 COMPANIES INVESTED	Global Walkers, Inc.	Visual recognition AI model development
Energy	9 COMPANIES INVESTED	E-ThermoGentek Co., Ltd.	Development of power generation element that uses waste heat
Healthcare	3 COMPANIES INVESTED	Provigate, Inc.	Development of medical device (blood glucose measurement)



## Projects in Which We Send Toyota Gosei Employees to Work at Startups

Another objective of the CVC is to broaden the outlook of the young employees who will be responsible for the future of the company. For this purpose, we assign young engineers not only to the dedicated CVC organization, but also to various engineering departments that serve as support organizations. They can experience new insights by coming into contact with technologies and cultures from different industries that they have previously been unexposed to, through which we hope to foster new ideas and flexible ways of thinking within the company.

We are also implementing a project in which young employees are sent to work at the startups in which

we have invested in order to make new discoveries and gain insights by looking at our company from the start-up's point of view.

So far, four young employees have been sent to these start-ups, where they are performing new work in environments they have never experienced before.



Together with S lab Inc. employees (Haruka Ibusuki, New Value Creation Division; front row 3<sup>rd</sup> from right)

### VOICE / Haruka Ibusuki New Value Creation Division

I was sent to work at S lab Co., Ltd., a 3D printer manufacturer, in April 2022. Here I work with management in looking at how to strengthen the company's organizational structure, as well as its management and sales strategies, with a view to a future stock listing. I am also involved in the implementation and follow up of plans that have been made. This industry is different, and I have had to work at a speed that I could not have imagined before. I felt a little lost at first, but it has been a very valuable experience that I would not have known without actually working in a start-up.

## New Business Creation Process

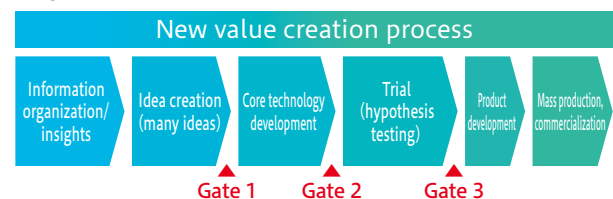
For the more effective use of internal capabilities, we established a new organization called the New Value Creation Division in January 2022. It was formed to promote activities that create new value from within the company, rather than simply depending on external organizations through CVC.

First, new business plans and ideas that different departments had been working on independently were brought together in the New Value Creation Division, which then centralized all the information. Next, the processes for creating new business were clearly defined, and the items to be checked for each process were clarified. At the same time, stage gates were set up to check each milestone. In this way, a system was started that enables timely decisions on whether the necessary recovery and business development is possible and on efficient management.

In the design generation stage, a large number of ideas are proposed without trying to winnow

them down (high production). Hypotheses are then formulated on customer value and market size, and verified step by step. Technical development target levels and how close we are to those levels are assessed from multiple perspectives. Development themes are then prioritized, resources are allocated to key activities, and missing pieces are examined (external use). By following this process carefully and managing the gates, we will eliminate rework, arrive at carefully-selected and high-quality themes, and accelerate new business creation.

### Stage Gate Review Steps in New Value Creation Process



## Business Idea Contest

In trying to create new businesses, we started the Business Idea Contest in the hope of soliciting ideas from a wider range of employees. This system encourages boldness in stepping forward with attempts to actively propose interesting ideas that come to mind. These contests were launched in FY2021, and the first one received 125 applications, far exceeding expectations. Two excellent ideas were selected and research activities were begun.

We see that an attitude and culture of “new value

creation for the future” has been cultivated and is taking root within the company.

We will continue to advance these various measures and actively promote activities that support sustainable growth.



During Business Idea Contest