

Development Strategy

Message from the CTO

Anticipating social challenges beyond 2030, we are accelerating technological development for our global users, contributing to the realization of prosperity in the future.

Mitsuhiro Nawashiro
Director and Corporate Officer, CTO



《 Expanding Plastic-based Products in Line with the Shift to Plastic Structural Components 》

As the trend for vehicle electrification progresses, lightweighting to extend driving range and modularization to simplify manufacturing have become key development themes. Although replacing metal components with plastic is only one approach to lightweighting, plastic structural components are particularly well-suited for modularization when installing in vehicles. They offer freedom of shape that enables integration of complex parts, along with properties that enhance strength and rigidity through reinforced fibers, ribs, and variable thicknesses, and ease of functional integration with surrounding parts. These components also offer enhanced freedom of design, with the potential to transform vehicle architecture.

By combining our unique expertise in design, materials, and manufacturing, we aim to develop one-of-a-kind products. We

are advancing the use of plastic in structural components across both interior and exterior parts, meeting core vehicle performance standards while creating new designs and architectures. This effort contributes to the future of all types of vehicles, including not only BEVs but also internal combustion engine (ICE) vehicles.



Achieving seamless design through plastic-based structures and modularization

《 Providing Comfortable Spaces for Autonomous Driving 》

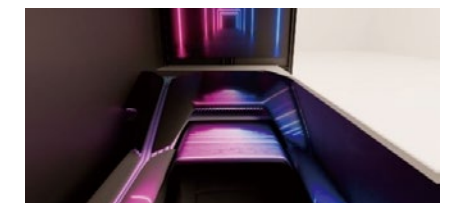
Autonomous driving technology is advancing rapidly, with research and development ongoing in regions such as Japan, China, and Western countries. Practical trials are being conducted with autonomous taxis and buses, and regulatory frameworks are under consideration to support these efforts, paving the way for future implementation.

As autonomous driving technology becomes more widespread, in-vehicle spaces and ways of spending time within the vehicle are diversifying. To respond to these changes, we are developing elemental technologies that enable the creation of personalized spaces.

We believe it is essential to approach the rapid changes brought by CASE from a realistic and technical perspective, making accurate future predictions and planning products from a global perspective that anticipates shifts in people's values. Toyoda Gosei is one of the few manufacturers that handle both safety systems, such as steering wheels, and interior and exterior components. Leveraging this strength, we aim to create uniquely functional spaces by combining modular technologies for components like the steering wheel, instrument panel, and center

console. By integrating sensory elements—such as light, fragrance, and sound—that appeal to all five senses and interact with each other, we believe we can generate new value in in-vehicle spaces.

Furthermore, as BEVs lack engine noise, external sounds are more easily heard. To enhance the quietness of the cabin, we are pursuing new developments in weatherstrip products. Anticipating the value expected in mobility solutions that support future lifestyles, we aim to conceptualize and bring to life large ideas, such as spaces and mobility as a whole, while envisioning products that exceed user expectations and contribute to the future of mobility.



Toyoda Gosei's vision of the cockpit beyond 2030

Safety System Development

《 Providing Safety to Various Vehicle Occupants 》

With increasingly stringent regulations and assessments, collision safety technology continues to evolve each year, leading to a reduction in fatalities from traffic accidents. However, approximately 1.2 million lives worldwide remain lost each year due to traffic incidents. To address this, we are committed to our ultimate goal of zero fatalities and injuries from traffic accidents. One aspect of this commitment is addressing the social challenge of protecting a variety of occupants, including vulnerable occupants such as elderly passengers and children. We are advancing our airbags with variable technology and enhancing development collaboration with seat belt manufacturers to enhance seat belt functionality. Together, we are developing an optimized occupant protection system that combines these features.

We are also developing technology for safety devices aimed at protecting vulnerable road users, such as pedestrians and cyclists.

In addition to conventional pedestrian protection airbags, we are working on product development incorporating advancements in external vehicle detection technology, continuing our mission to deliver safety to society.



Pedestrian protection airbag

Development Efforts toward the 2030 Business Plan

We are developing products to expand our car-centered technologies into diverse fields, aiming to contribute to the overall progress of future society.

Our 2030 Business Plan focuses on delivering value through three key initiatives: “Safety” based on our safety systems, “Comfort” grounded in interior and exterior

components, and “Decarbonization” through new businesses in high-performance polymer materials. To support the 2030 Business Plan, we are driving forward four core development policies aimed at addressing social challenges:

1. Expanding plastic-based products in line with the shift to plastic structural components and developing comfort-oriented products with a focus on autonomous driving
2. Developing technologies and creating new businesses to lead carbon neutrality and the circular economy, as part of our response to a decarbonized society
3. Focusing on solutions in the key areas of Energy, Healthcare, and Smart Homes
4. Enhancing our global R&D framework to better serve regional and customer needs

Mobility Development

For mobility in 2030 and beyond, we will assess the future of CASE (Connected, Autonomous, Shared, Electric), which is constantly evolving, and we are working to enhance the added value of existing components, develop modular and systemized solutions, and ultimately deliver new, vehicle-wide value. By staying ahead of societal changes, we aim to develop technologies that enable mobility spaces that adapt to diverse needs, connectivity between mobility and daily life, and safety for all occupants.

In the automotive industry, while the adoption rate of BEVs has slowed, we anticipate that the share of BEVs will increase in the long term, particularly beyond 2030. For Toyoda Gosei, vehicle electrification, including BEVs, presents an opportunity to enhance the added value of our products.

As vehicle electrification progresses, there will be a need to support extended range through lightweighting with plastic materials, provide spacious and comfortable interiors, and adapt occupant protection to new vehicle structures.

In the area of lightweighting, the use of plastic materials plays an essential role by offering design flexibility, enhanced strength and rigidity, and ease of functional integration. Through our unique technologies, we are advancing the use of plastic in structural components to create new designs and architectures, contributing to the future of mobility.

On the other hand, as autonomous driving technology becomes more widespread, in-vehicle spaces and how they are used will diversify. We are advancing the development of technologies to create personal spaces and planning products that anticipate changes in values alongside CASE advancements. Also, in line with the widespread adoption of BEVs and autonomous driving, we are working to optimize airbags and seat belts to enhance safety performance. To provide safety for diverse occupants, we contribute to reducing traffic fatalities through innovations such as illuminated steering wheels that connect people with vehicles, adjustable-capacity airbags for various postures, and lap airbags.

Development Strategy

《 Expanding into New Markets with CAE Analysis Technology Developed for Automotive Safety 》

The CAE (Computer-Aided Engineering) analysis technology we have developed in our automotive safety technology enables the simulation and evaluation of not only crash test dummies but also realistic human models. In collaboration with medical institutions and universities, we have enhanced our CAE analysis technology to achieve world-class accuracy in simulating human tolerance, including internal organs.

Using this technology, we can recreate various vehicles and human bodies on a computer, simulate accidents, predict injury mechanisms, and provide feedback to inform new product development.

Looking ahead, we plan to leverage our CAE analysis technology—originally developed for automotive safety—to address life-saving challenges in new markets beyond automobiles, including motorcycles, drones, and electric

scooters. By identifying safety issues and injury mechanisms, we aim to develop safety devices that contribute to solving societal challenges.

Our commitment is to expand the reach of safety technology beyond automobiles to other forms of mobility, ensuring safety for all people on the move, and contributing to the realization of a safe future mobility society.



Airbag for drones

《 Development of Recycled Plastics from ELV-Sourced Materials 》

We are focusing on the development of recycled plastic materials to enhance circularity and reduce CO₂ emissions throughout the entire vehicle lifecycle. Recycled raw materials used in recycled plastics often contain various foreign substances and mixed materials due to the collection process from the market, making them unsuitable for direct use in automotive parts.

Through collaboration with recycled material manufacturers, we are working on the development of recycled polypropylene (PP) materials suitable for automotive parts by utilizing technologies for effective removal of foreign substances and modification of polymer materials. In FY2024, we used recycled PP derived from ELV-sourced materials collected from domestic end-of-life vehicles in automotive parts and launched these products in the market.

To further expand the use of recycled plastics, we are also participating in the government-supported Circular Economy Social Implementation Project, accelerating partnerships within the recycling industry and advancing the application of various recycled materials in automotive parts.

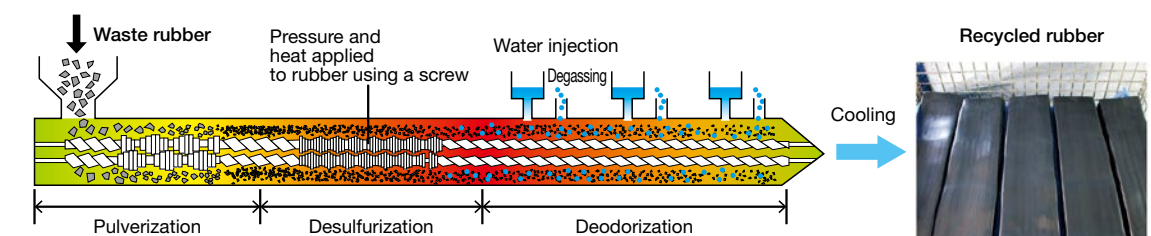


Examples of products using ELV-sourced recycled materials: (From left) glove box, lower grille

《 Advances in Rubber Desulfurization Technology: Increasing Recycled Rubber Blending Ratios 》

Since 1997, our Morimachi Plant has utilized our proprietary rubber desulfurization technology to recycle scrap generated during the manufacturing process, such as opening trim weatherstrips, blending it back into new materials. Through ongoing development of desulfurization technology, we have successfully produced recycled materials with significantly improved physical properties and odor, enabling us to dramatically increase the blending ratio in new materials from

around 5% to as much as 20%. This summer, we installed new equipment that has doubled our recycling capacity. We are also working on developing chemical desulfurization technology using agents that have demonstrated selective sulfur bond cleavage at the laboratory level. Moving forward, we plan to steadily improve the quality of recycled materials, further contributing to the circular economy for automotive rubber.



Carbon Neutrality/Circular Economy

We are bringing together a wide range of technologies—including lightweighting, 100% recyclability, easy disassembly design (monomaterialization), molding process innovation, and the development of bio-materials—to achieve and advance carbon neutrality and a circular economy.

As a specialized manufacturer of polymer materials, such as rubber and plastic, we are intensifying our efforts to support a decarbonized society through developments in carbon neutrality and circular economy initiatives. We are also committed to proactively addressing future ELV (End-of-Life Vehicle) regulations and advancing our carbon neutrality timeline. Our efforts to maximize the use of recycled materials, in both upstream and downstream processes, include securing recycled

resources and ensuring the quality of recycled materials through technological development.

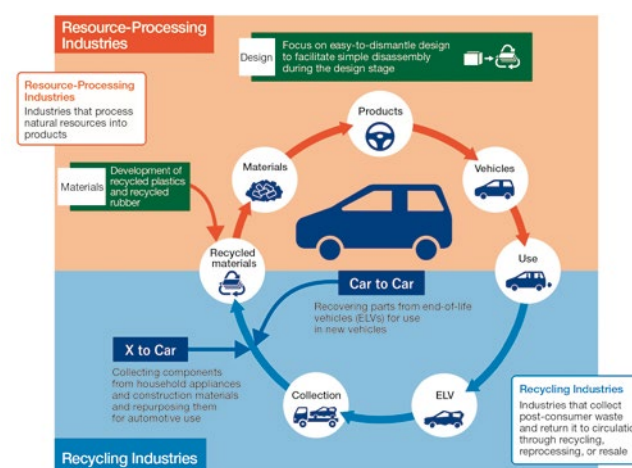
In recycled plastics developed from ELV-sourced materials, we are moving forward with product development and market entry, with plans to expand this to other products in the future.

For rubber recycling, we are advancing our proprietary desulfurization technology to improve the quality of recycled materials, allowing for higher blending ratios and enabling commercialization as a viable material.

Also, we are taking on new challenges in material development, such as creating wood biomass-infused plastics, as part of our commitment to exploring innovative new materials.

《 Efforts in Upstream and Downstream Processes for Maximizing Recycled Material Use 》

In Europe, the proposed ELV directive has been published, and in Japan and various industries, there is a growing focus on circular economy initiatives aimed at economic security, resource constraints, and carbon neutrality. Our circular economy efforts focus on maximizing the use of recycled and bio-based materials. In particular, for the recycled material use, on the downstream side^{*1}, we are working to secure the quantity and improve the quality of discarded materials by implementing national projects and industry collaborations. To this end, we are considering a broad range of waste sources, including not only ELV^{*2} but also PIR^{*3} and PCR^{*4} materials. On the upstream side^{*5}, we are leveraging our strengths in polymer technology to explore differentiated, cost-effective process development. We have launched products using recycled plastics and recycled rubber into the market. Moving forward, we will continue to ensure the quality and stable supply of recycled materials through ongoing technological development.



*1 Industry for the collection, recycling, reuse, and disposal of waste materials

*2 End of Life Vehicle: A vehicle that has reached the end of its usable life

*3 Post-Industrial Recycled: Waste generated during the product manufacturing stage

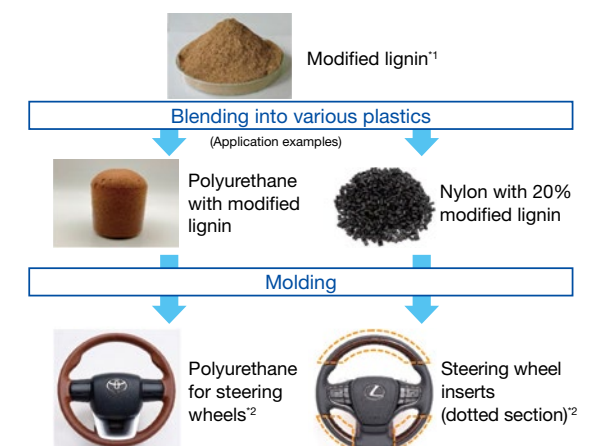
*4 Post-Consumer Recycled: Waste generated by consumers after product use

*5 Industries involved in producing products and services

《 Initiatives for Wood Biomass-Infused Plastics 》

As part of our efforts toward decarbonization, we are developing environmentally friendly plastic materials that incorporate modified lignin extracted from cedar wood into polyurethane and nylon, which are used in components like car steering wheels. Modified lignin, unlike wood fibers, can be incorporated into polyurethane structures. By combining this modified lignin with our material technologies, we have achieved a high bio-content material that maintains physical properties and durability comparable to conventional materials. Using this as a substitute for petroleum-based materials can contribute to CO₂ reduction, with the goal of practical application in the future.

Furthermore, implementing wider use of modified lignin is part of our initiative to add value to the abundant cedar wood resources across Japan. This effort not only enhances effective utilization of cedar but is also expected to help reduce cedar pollen, a known allergen.



*1 This development is a collaborative effort within the High-Performance Lignin Material Development Consortium, led by the Forestry and Forest Products Research Institute, a national research and development agency, to realize a decarbonized society.

*2 Polyurethane for steering wheels is currently under development at Toyota Gosei, and the steering wheel insert is being co-developed with Tendo Co., Ltd.

Development Strategy

New Business/Solution Development

To achieve the vision set forth in our 2030 Business Plan—becoming a company that pursues the possibilities of polymers to contribute to a future of better mobility and living—we are developing solutions aimed at addressing societal challenges, with a focus on the fields of Energy, Healthcare, and Smart Homes.

In the Energy sector, GaN (gallium nitride) power devices, which reduce power loss, are gaining attention as energy usage is expected to increase with the widespread adoption of new technologies. In collaboration with Osaka University, we are developing GaN crystal technology and are working toward the early practical application of GaN substrates larger than 6 inches,

as well as high-performance GaN devices.

In the Healthcare sector, to enable a more and safer lifestyle, we have achieved a world-leading output in UV-C (deep ultraviolet) LED technology, which we aim to expand for disinfection applications in water, air, and other areas.

In the Smart Homes sector, as a partner dedicated to creating better living, we are participating in Toyota Home's initiatives to create new value for urban communities. We are co-developing products with Ossia Inc. (U.S.), including demonstrations of next-generation wireless power supply through microwave electricity supply, with plans for market entry in the near future.

《Creating New Social Value through Co-Creation with Venture Companies》

To deliver new social value to a broader audience using the technology developed in our automotive business, we are focused on creating new businesses that aim to solve societal challenges. We have identified Energy, Healthcare, and Smart Homes as key areas and are actively pursuing solutions in these fields. As a core strategy for new business creation, we are committed to co-creation with promising startups that aim to drive social transformation. In 2019, we established a corporate venture capital (CVC) fund, through which we have invested in and co-developed projects with 25 companies to date. For example, in the Healthcare sector—one of our focus areas—we have invested in ThinkCyte, a company working on cell

separation and analysis technology using AI-based cellular image analysis. This technology enables high-speed, high-accuracy early detection of leukemia and is expected to be utilized in drug discovery in the future. As part of our co-creation efforts, we have begun developing plastic microfluidic devices essential for cell separation.

We are also continuing our secondment program for employees to work within invested startups, providing young members with new career opportunities while fostering talent that will drive future business growth and lead the creation of new businesses.



ThinkCyte's AI-driven cell fluorescence analyzer, VisionSort™

"ThinkCyte's mission is to contribute to groundbreaking treatments and diagnostics by utilizing our next-generation image-based high-speed cell sorting technology, developed through the integration of diverse fields such as advanced imaging, machine learning, and microfluidics. Leveraging Toyoda Gosei's expertise in plastic material molding and mold processing, we aim to bring plastic microfluidic devices to practical application."



Waichiro Katsuda
CEO, ThinkCyte Inc.



Yoko Kawamura
Head of Applied Microfluidics
Group, ThinkCyte Inc.

《Microwave Electricity Supply》

Our microwave electricity supply technology strategically combines our established wireless power supply expertise—developed through core technologies such as magnetic resonance-based luminescent resistive knobs—with a framework for generating new business focus areas and our corporate venture capital function for acquiring next-generation technology platforms.

Nagoya University's Toyoda Gosei Industry-Academia Collaboration Research Division joined the initial development phase, utilizing CAE-based rapid prototyping and human protection simulation verification to not only enhance wireless performance but also accelerate the transition to commercialization, including alignment with domestic regulatory standards.

Our partner in this endeavor is Ossia Inc., a pioneering company in microwave electricity supply with the world's largest intellectual property portfolio in this field. In our joint development with Ossia, which began in 2020, we created a 2.4 GHz power transmission and reception system. In FY2023, we were awarded Ossia's "Best Partner of the Year" and received the CES 2024 Innovation Award for our original 5.75 GHz receiver. We have established a comprehensive partnership covering development and manufacturing, aiming for an early market launch and global sales leadership.

To minimize reputation risk and ensure early market entry, we will begin business demonstration in 2024 with the Toyota Home Miyoshigaoka Project and are planning to showcase this technology at the Expo 2025 Osaka, Kansai, Japan.



CES 2024 Award recipient



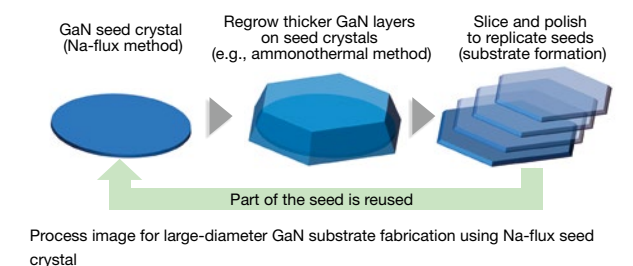
Miyoshigaoka Project Community Opening

《GaN Power Devices》

With the dramatic increase in power usage anticipated due to the widespread adoption of EVs and AI, expectations are rising for next-generation power semiconductors capable of controlling electricity with higher efficiency. Toyoda Gosei has focused on GaN (gallium nitride) power semiconductors, a material used in blue LEDs, and is actively developing technologies for practical application, from crystal growth to device development. The Na-flux method, which we have refined in collaboration with Osaka University, allows for the growth of high-quality GaN crystals over a large area. Using these crystals as seeds, we aim to increase thickness through more productive growth methods, then slice and replicate them to achieve early market entry for GaN substrates of 6 inches or more (see image at right). In a Ministry of the Environment project in which we participate, we collaborate with industry-leading companies and universities to conduct re-growth and substrate fabrication experiments for 4- to 6-inch seed crystals. We have also provided our proprietary vertical power semiconductor devices to Nagoya University, where motor drive tests simulating EV applications have begun. Our goal is to bring GaN power semiconductors to practical application at an early stage, significantly contributing to carbon neutrality by reducing CO₂ emissions globally.



6-inch seed crystal produced from hexagonal Na-flux GaN crystal



Process image for large-diameter GaN substrate fabrication using Na-flux seed crystal

Development Strategy

Intellectual Property Strategy

Intellectual capital is a source of sustainable growth. To enhance our intellectual capital, the Development Division has established

an IP Landscape Project and conducts Backcast IPL and Forecast IPL initiatives.

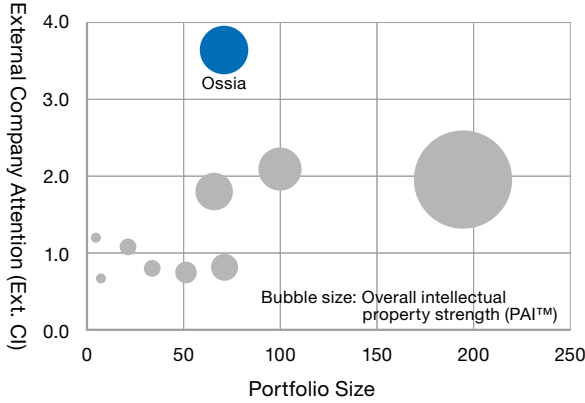
《 Backcast IPL: Creating New Topics and Applications 》

The goal of Backcast IPL is to contribute to early commercialization of new initiatives and support sustainable growth by leveraging intellectual property information in alignment with the growth strategies of our 2030 Business Plan.

Through Backcast IPL, we facilitate the creation and implementation of new businesses, such as microwave electricity supply and GaN-based power semiconductors, as well as the early implementation of environmentally-conscious technologies such as developing recycling techniques for plastic and rubber. Initiatives include an overview and analysis of internal and external technologies, idea brainstorming, and support for enhancing relationships with external partners.

In one of our initiatives, for example, we conducted a value assessment and analysis of patents held by our partner company, Ossia Inc., in the field of microwave electricity supply, using this information to formulate our development strategy.

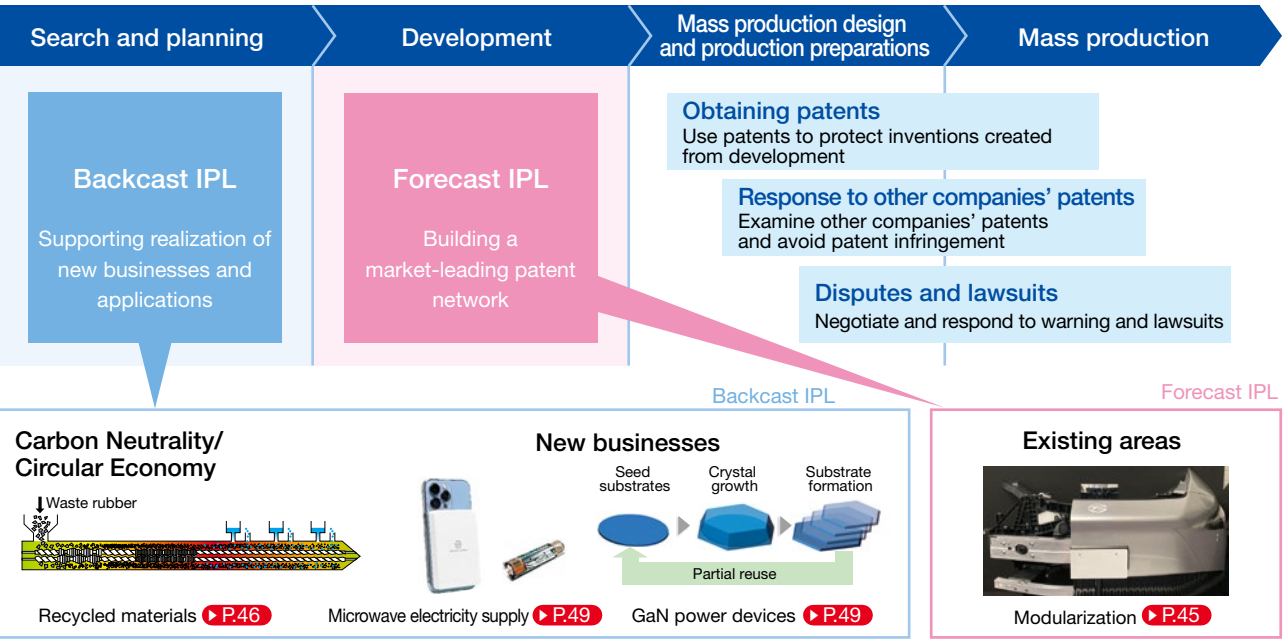
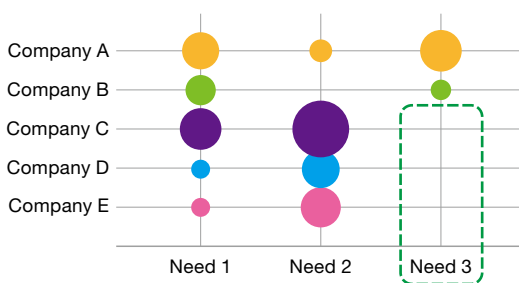
Overview of Each Company Using Intellectual Property Information



《 Forecast IPL: Building a Market-Leading Patent Network 》

Forecast IPL is an initiative to transform our patent network to align with the future market and evolving values and needs, following the 2030 Business Plan. Through this approach, we aim to realize our business strategies and maximize the value of our intellectual property. Furthermore, to enhance modularization technology, we conduct comparative analysis of our patent filing trends with those of other companies, working to build and reinforce our patent network.

Diagram of Priority Areas for Patent Enhancing



Enhanced Global R&D System

Amid rapidly changing global dynamics, it is essential to enhance local development capabilities to respond swiftly to customer demands. In 2023, we hosted a Global Summit to discuss challenges toward achieving our 2030 Business Plan. Also, we held Global Technical Conferences focused on key regions—North America, China, and India—to discuss strategies and enhance local frameworks aimed at expanding sales to local OEMs, resulting in concrete action plans. In North America, which remains a key market, we are enhancing our framework to streamline series order development and reallocate resources toward advanced development.

In China, where the BEV market continues to grow, we are localizing development and design capabilities to meet the needs of OEMs. For the expanding Indian market, we are enhancing our organization by establishing a new development center to support personnel expansion and the localization of design and evaluation, thereby positioning ourselves to expand sales in this growing market and to new customers. In Europe, we are enhancing our capabilities to research and disseminate the latest information on BEVs, laws and regulations, and carbon neutrality, connecting these insights to our global initiatives.

《 Enhancing the “Antenna Function” of Our Central R&D Hubs 》

To effectively respond to global markets, we need agile development tailored to the preferences of each country. We are building local structures and systems responsible for trend research (benchmarking) and acquiring

and disseminating regulatory and assessment information. In particular, we are enhancing our information gathering and dissemination on regulations and assessments, with a focus on Europe.

《 Enhancing Local Development and Design Capabilities 》

We are working to establish a system that enables development and design to be completed locally. Especially, to respond promptly to the demands of local customers, we are increasing the number of national staff members.

To advance vehicle compatibility development efficiently and swiftly, we are enhancing our testing, evaluation, and CAE capabilities, while promoting product development for BEVs and CASE. We are particularly enhancing our framework in North America and India as key regions.

