

Initiatives Supporting the Growth Strategy

Research and Development

Message from the CTO

With an eye on society beyond 2030, we will accelerate development in response to advances in CASE and decarbonization to contribute to society and achieve corporate growth.

Development Efforts toward the 2030 Business Plan

We are developing products that will help make future lifestyles more sustainable and affluent based on our understanding of social issues that will continue into the future.

As our broad development policy for the 2030 Business Plan, we are working on the following three policies to contribute not only to the automotive field but also to a wider range of fields.

- 1. Develop system and module products that lead the mobility of the CASE society**
- 2. Develop technologies and create new businesses that achieve carbon neutrality and lead the way in the circular economy**
- 3. Develop solutions with a focus on Energy, Healthcare, and Smart Homes**

The technologies required for these developments will be identified as core technologies to be developed from both backcasting and forecasting perspectives based on our polymer material technology and other fundamental technologies. We will aim for quick business development by implementing measures that include external collaboration.

Mobility Development

In order to respond to the rapid shift to BEVs in the automotive industry, we must accelerate product development from the perspective of changing vehicles and user needs.

For vehicles, not only are the power units being replaced, but automobile manufacturers are also considering a fundamental review of their production processes. As automotive parts manufacturers, we



Mitsuhiro Nawashiro
Director, Corporate Officer
CTO

need to conduct development not on a component basis as in the past, but on a module and system basis. To this end, we have started projects that cross over business domains, enabling us to break down conventional internal norms and barriers and quickly realize ideas from planning to developing of manufacturing methods.

We need a product planning strategy that anticipates the world's trends and changes in people's values toward CASE for the future, and that captures technological trends from a global perspective. We envision the value required for mobility that will support people's lives in the future, and we are working to imagine and propose products that embody the huge concepts of space and mobility to our customers.

We always aim to create vehicles that are friendly to the earth and people, and to incorporate safety and security (zero fatalities for all traffic participants), comfort (providing value based on how the vehicle is used), and decarbonization into our product planning.

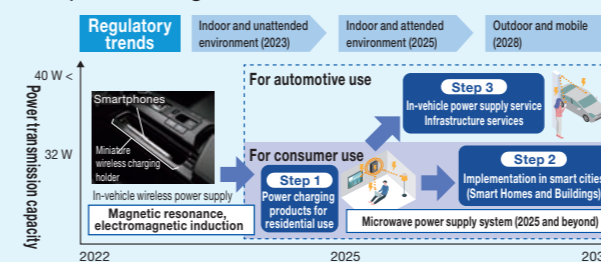
Carbon Neutrality/Circular Economy

Carbon neutrality (CN) has become a commonplace responsibility, and the idea of creating value and running an economy with a circular economy (CE), which is based on a recycling-oriented society, has become a widely-held vision of how businesses should be. In the automotive industry, in addition to the need for new functionality for plastic materials due to the conversion to electrification, the ELV Directive has set a target value for the use of recycled materials, and social demands are greatly accelerating. We will not only utilize recycled materials, but also consider the lifecycle of plastic/rubber, and implement design proposals that facilitate vehicle disassembly, aiming for complete recycling. In addition, we will contribute to the global environment by developing uses for bio-based materials.

New Business/Solution Development

In the 2030 Business Plan, we have set targets for "creating new businesses and products to serve as new mainstays in the coming era" and are working on development themes by identifying social issues and targeting Energy, Healthcare, and Smart Homes as fields with high affinity by combining our core competence and growth markets.

- (1) In the Energy field, as a part of our efforts to expand renewable energy sources, we are developing next-generation solar cells, hydrogen production technology, and power devices for recharging batteries, aiming for mass production by 2030.
- (2) In the Healthcare field, we are developing materials for the rapidly growing global market of the health industry and are working to develop smart insoles for the early detection of diseases by measuring foot pressure.
- (3) In the Smart Homes field, as the use of IoT sensors, AI, and other technologies becomes more widespread, we are developing products with wireless power sources for seamless power supply for more comfortable living, and plan to bring them to market in the near future.



Initiatives Supporting These Activities

In order to speed up the development of solid technology for future business expansion, we are strategically working on securing intellectual property rights, strengthening our R&D system outside Japan, and building stronger external partnerships.

1) Intellectual property strategy

To boost the competitiveness of our technologies, we are utilizing IP landscapes that lead to the creation of new development themes in order to create patents with the aim of acquiring intellectual property rights from a long-term perspective. In order to win against new competition, it is necessary to know where we stand compared to other companies, build a strategy to gain an advantageous position, and obtain patents in line with that strategy.

Through these operations, we will combine market and patent information to come up with a strategy that will enable our company to win against the competition.

2) R&D system outside Japan

With the accelerating adoption of BEVs, it is necessary to enhance local development in order to better investigate market trends and respond quickly to customer demands. To expand sales to local OEMs, we will also bolster our overseas R&D system by increasing the number of local staff to enhance our ability to make decisions locally.

3) Building stronger external partnerships

In order to acquire customers and the technologies needed to develop mobility and solutions, we will systematically strengthen alliances, corporate venture capital (CVC), and other external partnerships that cross over industry boundaries to achieve technological development. Also, we will accelerate human resource training and business development by actively sending employees to companies where we have CVC investments.

To Our Stakeholders

To achieve the targets in the 2030 Business Plan, we will draw up a technology strategy that responds to changes in the market so that we can become the company of choice. All employees will work together to take on challenges, develop and grow our technology, and strive to create value that will contribute to future society.

Initiatives Supporting the Growth Strategy

Research and Development

Mobility

For mobility in 2030 and beyond, we will assess the future of CASE, which is constantly evolving, and implement technological development as an initiative to anticipate social changes and solve future social issues in order to provide new value through the entire vehicle, from value-added improvements of existing parts to modules/systemization, and beyond.

Toward resolution of social issues

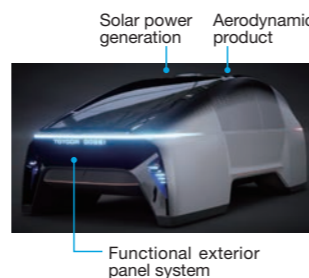
Based on future projections of society, the environment, the economy, technology, and people's values in 2035, we see the key social issues as contributing to a decarbonized society, responding to diversifying values, and mobility optimized for each region, and we are working on technology

development under the theme of creating value based on the three concepts of cars that are friendly to the earth and users, free space created together with the car, and freedom of movement for all.

Cars that are friendly to the earth and users

In order to achieve carbon neutrality by 2050, OEMs have announced their goals for electrification, and we are also working on the development of products responding to electrification as a priority theme. In particular, we are pursuing three development approaches to decarbonization, with an eye beyond the 2030 target. The first is the use of perovskite and other photovoltaic materials in automobiles, the second is aerodynamic products that are not bound by conventional structures,

and the third is a functional exterior panel system that does not use energy from the vehicle side. By integrating new elements using outside technology based on our materials, surface treatment, and design technologies, these developments will enable the creation of new value.



Free space created together with the car

With the advances in automated driving, the ways in which the vehicle interior space is used will continue to diversify. In particular, after 2030, Generation Z and Generation Alpha will also own cars, and the aging of the population will lead to a wide range of users using cars. In anticipation of the diversification of user values, we aim to create safer and more comfortable interior spaces that can switch between sharing and personalization according to the user.

Also, one factor for why the number of traffic accidents among seniors has not been reduced is the lack of means of transportation in rural areas where public transportation is scarce. There is a growing need for micromobility that allows people to get around even after they have surrendered their driver's license, and we are committed to developing safe, secure, and easy-to-operate micromobility vehicles that will contribute to the happiness in people's lives.



Cabin space that appeals to the five senses through communication between people and the car (HMI, vitals sensing, etc.)

For example, we believe that the combination of retractable steering wheel technology and instrument panel/console technology can create an overwhelmingly expansive space, and by adding elements that appeal to the five senses, such as light, scent, and sound, we can create new spatial value.

Freedom of movement for all

As urban populations become increasingly concentrated and rural populations age, the future transportation society is expected to develop automated transportation networks connecting urban and rural areas, as well as mobility systems that are optimized for each region. For mobility that allows people to easily move around in their daily lives, we are developing driving modules that are easy and enjoyable for anyone to operate. We are working on

the development of a steering wheel incorporating a gas pedal and brake levers and with HMI functions so that the steering wheel becomes an "agent."



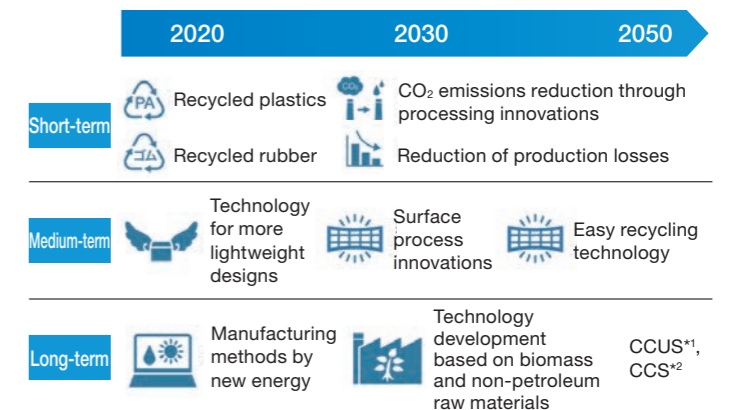
Carbon Neutrality/Circular Economy

As a polymer manufacturer of rubber and plastics, we aim for carbon neutrality and circular economy by combining our various technological capabilities in material development, weight reduction, process innovation, 100% recycling, and more, throughout the entire LCA* from the stage of raw materials and purchased parts to disposal in the manufacturing process.

* Life Cycle Assessment

Research on materials and devices to achieve carbon neutrality

In the recent trend toward carbon neutrality, a wide range of technologies must be developed to reduce CO₂ emissions from a short- to medium- and long-term perspective. In the short term, we are working on material modification technology to restore the physical properties of materials to the same state as new ones by utilizing our strengths in polymer technology, aiming to improve the recycling rate of used automotive plastics and rubber. We are also engaged in material research to make it easier for customers to accept recycled materials by reducing odors and reproducing colors and designs more easily.



*1 Carbon dioxide recovery, effective utilization and storage *2 Carbon dioxide recovery and storage

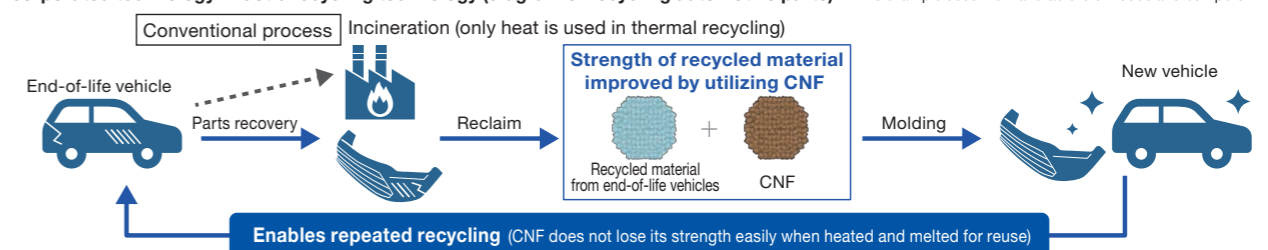
Initiatives for recycled plastics

In our work, we give priority to polypropylene (PP) materials, which are the most widely used polymer material (excluding tires) in the entire vehicle. In using recycled materials in automotive parts, which have high quality standards, we use bio-based materials (cellulose nanofiber: CNF, which is five times stronger than steel), to increase the strength of the recycled materials, thereby enabling repeated recycling. In our latest initiative, Toyota Gosei's plastic recycling technology has been adopted for use in the Lexus ROV¹, Lexus' environmentally friendly off-road vehicle.



¹Abbreviation for Recreational Off-highway Vehicle. A concept vehicle that aims to realize a lifestyle of enjoying driving while living in harmony with nature by stepping into places where even off-road vehicles cannot go and coming into contact with nature while enjoying excellent responsiveness and sounds that stimulate the five senses.

Incorporated technology: Plastic recycling technology (diagram of recycling automotive parts) * This example uses the manufacture of hoods and bumpers.



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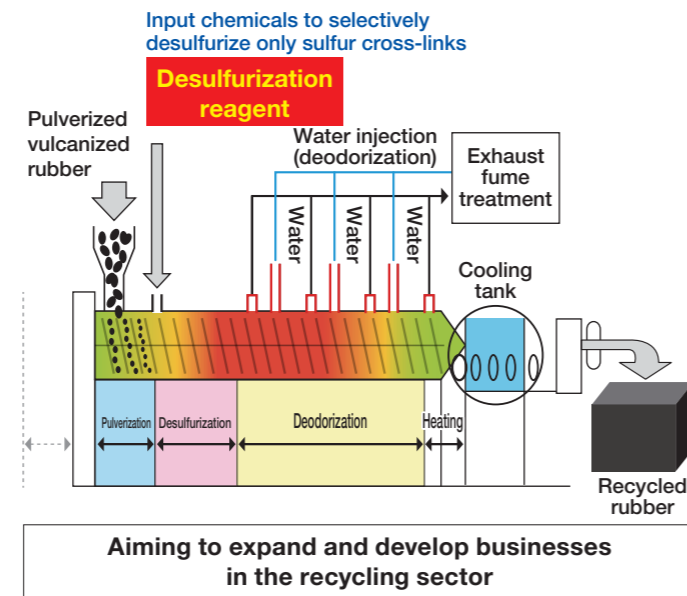
Research and Development

Initiatives for recycled rubber

We have been mass-producing desulfurized recycled materials^{*1} for weatherstrips for more than 20 years. To further expand the scope of our recycling, we are working on the development of new chemical desulfurization technology^{*2} for improving the quality of desulfurized recycled materials. This initiative aims to selectively cut 100% of sulfur cross-links by combining the conventional desulfurization technology with a newly developed reagent to dramatically improve the quality of the recycled material. This will greatly expand the scope of recycling, not only for in-house use but also as a viable business through sales of recycled materials to other companies, thereby contributing to industry-wide efforts to reduce environmental burdens.

*1 A new technology that can selectively desulfurize only the sulfur cross-links by using chemicals in the desulfurization process of vulcanized rubber after pulverization.
 *2 Recycled materials using technology to return rubber to raw material by breaking molecular bonds in the recycling process in order to make rubber elastic.

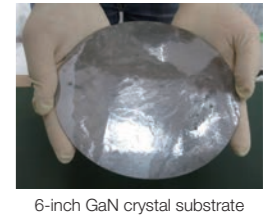
Recycling process using Toyoda Gosei's chemical desulfurization technology



GaN crystal substrate materials

Many of the electronic devices that we use everyday have switching devices to convert DC/AC power, and there is a need to reduce CO₂ emissions by improving switching efficiency. Based on the GaN crystal growth technology that we have developed in the LED sector, we are researching large GaN crystal substrate materials and GaN on GaN power devices, which are next-generation semiconductors. We have been collaborating with Osaka University for more than 10 years on substrate material research, and the joint research on our proprietary crystal growth technology

(MPS + FFC method) has produced world-leading results on large-diameter, low-crystal-defect GaN substrates. Through collaboration with industry-leading companies and industry-academia partners in the national project, we will study the entire process from materials to devices and application demonstrations, aiming for early implementation in society.

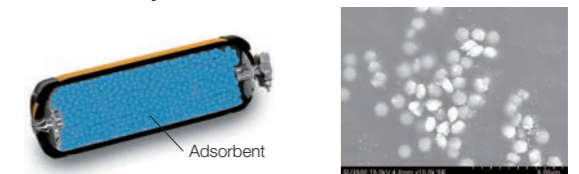


6-inch GaN crystal substrate

R&D for achieving a hydrogen society

At Toyoda Gosei, we have been accelerating our research and development for achieving a hydrogen society, starting with the market launch of high-pressure hydrogen tanks for FCEVs in 2020. In the future hydrogen society, needs for hydrogen supply will emerge not only in mobility-related fields but also in various other fields, such as construction sites and home use, and we will contribute to achieving a hydrogen society by expanding the scope of our technological development from simply storing and using hydrogen in the hydrogen value chain to even transporting and producing hydrogen. In the area of transporting technology, we are researching and developing organic/inorganic materials that selectively adsorb hydrogen to increase the storage efficiency per volume of hydrogen tanks, leading to the development of tanks that are more compact and portable than conventional ones. This R&D is being conducted as part of a NEDO-subsidized project, and aims for early social implementation

through integrated development from materials research to hydrogen tank implementation in collaboration with participating companies. In the area of producing technology, research is being conducted on photocatalytic materials that generate green hydrogen by utilizing the natural energy of sunlight, and on wavelength conversion materials for the efficient use of sunlight. For the wavelength conversion research, we are conducting joint research with universities using LED wavelength conversion material technology as our core technology, and are challenging basic research on the synthesis of new fluorescent dyes.



Left: Cross-sectional image of a hydrogen tank with hydrogen storage material inside
 Right: Prototype of wavelength conversion material (SEM photograph)

New Business/Solution Development

We are strengthening our R&D operations to create innovative technologies, products, and services that will lead to solutions to future social issues.

Based on our core technologies cultivated in automobiles and LEDs, we will accelerate innovation through co-creation activities with promising start-ups and industry-academia partnerships to provide new customer value and create new businesses.

Efforts to create new businesses

One of the priority issues in the 2030 Business Plan is "creating new businesses and products to serve as new mainstays in the coming era," and we have drawn up a medium- to long-term growth strategy based on providing solutions to social issues. We are building a portfolio of medium- to long-term R&D themes based on a backcasting approach, breaking down social issues into factors in three priority areas that we have newly identified as targets and envisioning a future society in which these issues have been resolved. In order to create new value for our customers, we need to take on a wide range of challenges that

transcend the conventional framework of research and development, from upstream materials in the supply chain to midstream devices and downstream data services. We will work to create new value by providing solutions that combine these elements. In order to deliver this value to the market as quickly as possible, in addition to advancing our own core technologies, we are actively pursuing alliances with industry leaders, industry-academia partnerships, and promising start-ups as efforts to compensate for shortcomings and accelerate development through co-creation with other companies.

Priority Area	Energy	Smart Homes	Healthcare
	Expansion of renewable energy	Achieving of seamless electric power society	Improvement of quality of life in the era of 100-year life expectancy
New delivered value to customer			
Research area (example)	Next-generation solar cells Green hydrogen	Wireless power supply GaN crystal substrate materials	Health condition sensing Non-invasive POCT technology*

* POCT: Point of Care Testing. Technology for immediate examination at clinical sites with minimal injury to the patient's body (including assisted examination technology).

Challenges of digital healthcare services

Japan, a society with the world's longest healthy life expectancy, is entering the era of 100-year life expectancy, and there is a need to develop digital healthcare technologies for pre-disease, prevention, and prognosis in order to extend people's healthy life spans. In particular, early detection of frailty and mild dementia, which are signs that an elderly person may require nursing care, is of great significance in extending healthy life expectancy, and there is academic data showing that this is accurately indicated through the gait of elderly people. Our eRubber insoles have a built-in pressure sensor that can measure the center of gravity sway data of elderly people when they walk, and in this way, we are taking on the challenge of detecting pre-disease states by processing this data through AI.

In this research, we are participating in the Moonshot R&D project of the Cabinet Office, and are implementing efforts to improve the accuracy of data collection and analysis through medical-engineering collaboration with the university medical school, which is a partner in the project. We are also conducting demonstration tests with the general public in tie-ups with large-scale commercial facilities and local governments to accelerate development for social implementation.



Left: e-Rubber insole and measurement application
 Right: Demonstration test at a commercial facility

Initiatives Supporting the Growth Strategy

Research and Development

Initiatives Supporting Activities

1. Intellectual Property Strategy

Toyoda Gosei's intellectual property efforts and enhancing of strategic initiatives through IP landscape (IPL)

Based on the premise of compliance with laws and contracts, Toyoda Gosei has traditionally conducted its intellectual property efforts based on the following guidelines: (1) Acquisition, effective use, and management of intellectual property rights based on a long-term perspective; (2) Prevention of infringement of intellectual property rights by other companies and respect for the intellectual property rights of other companies; and (3) Continuous improvement of intellectual property skills of our engineers and stimulation of innovation.

In addition to these efforts, we contribute to management and business through IPL initiatives, and for this purpose, we established the IPL Project within the Development Division. By discussing and implementing strategic IP initiatives, we are strengthening our intellectual capital, which is the source of sustainable business growth.

Strategic IPL initiatives

In our IPL initiatives, we first select key technologies in line with our technology strategy, then set IP investment KPIs (number of applications/patents held, etc.) and submit applications for differentiation technologies and contribute to the launching of new businesses.

IPL initiatives for achieving the 2030 Business Plan

Among the delivered values cited in the 2030 Business Plan, forecast IPL initiatives are directed toward safety and comfort based on existing businesses, while backcast IPL initiatives are directed toward decarbonization with the goal of creating new businesses.

In the forecast IPL, as one example, we conduct a thorough investigation of the current status of our company and other companies within the scope of our business, determine the target areas for patent applications to improve our business, and then conduct a multifaceted and intensive application process through invention discovery meetings and brainstorming sessions.

The backcast IPL, on the other hand, combines general information from specialized industry

Achievements in our past intellectual property initiatives and number of patents held

In FY2022, we registered 255 new patents in Japan and 143 new patents outside Japan, bringing the total number of our patents held to 2,567 in Japan and 2,268 outside Japan at the end of the fiscal year. The number of patents held is comprised of 60% in automotive fields and 40% in non-automotive fields. As a necessary input to realize the 2030 Business Plan, we will properly manage these patents held and effectively utilize them in a wide range of fields.

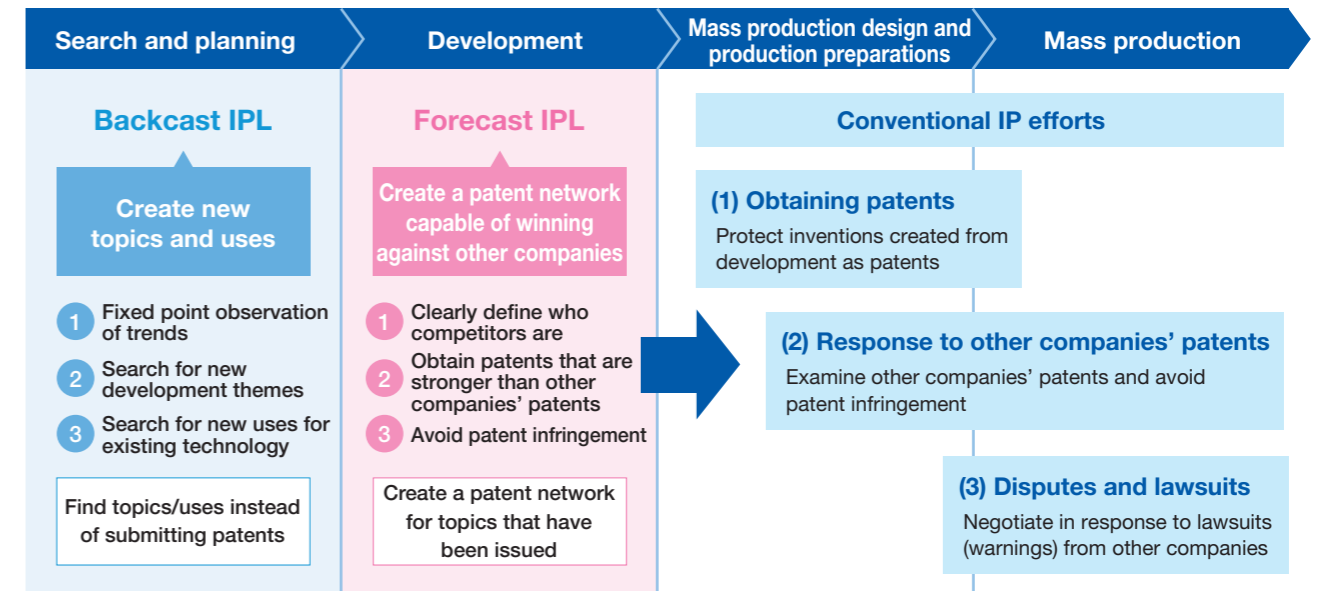
Number of patents held as of the end of FY2022

Japan	2,567
Outside Japan	2,268

In addition, we classify IPL initiatives into a forecast IPL, which creates a patent network that can win against competitors, and a backcast IPL, which creates new topics and uses.

magazines, motor show exhibits, and information on the Web with intellectual property information, such as patent information, to analyze patent information to anticipate customer problems and make development proposals, explore potential applications for our technologies and propose ideas for new uses, and search for and select alliance partners that possess important technologies, and in this way, we contribute to new business development through a variety of activities.

We will continue our efforts to acquire and effectively utilize necessary intellectual property rights and intellectual property information in order to increase corporate value in a sustainable way.



2. Building Stronger External Partnerships

Co-creation with venture companies to create new value and develop human resources

Collaboration with innovative start-ups is indispensable for creating new businesses based on solutions to social issues. We launched our corporate venture capital in 2019 with the aim of maximizing strategic and financial returns, and have invested in and co-developed 18 companies to date. For example, we are collaborating with Ossia, a company with microwave-based long-distance wireless power transmission technology, with the aim of achieving a seamless power supply society free from electrical outlets in living spaces. This technology uses radio waves to wirelessly charge various electronic devices from a distance of several meters, and we are developing high-frequency antennas, rectifying elements, and control software for this technology.

In 2024, a prototype of a power transmitter designed by Ossia and a prototype of a power receiver designed

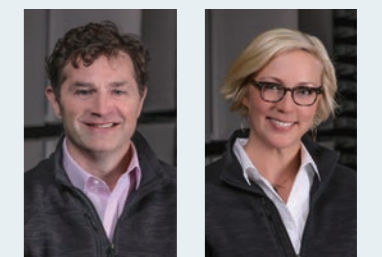
by Toyoda Gosei will be built, and a PoC (Proof of Concept) demonstration of wireless power transmission is planned in about 10 industries in the North American market. Furthermore, as one measure to develop innovative human resources, we have established a system for sending staff to venture companies, and are working to foster a culture that encourages the challenge of creating new businesses.



Left: Power transmitter jointly developed with Ossia
 Middle: Prototype IoT surveillance camera with a built-in power receiver
 Right: AA battery wireless power receiver

Message from Co-Creation Partner/Ossia Inc.

"Ossia's mission is to create a world where the full potential of Cota Real Wireless Power is ubiquitous," said Doug Stovall, CEO of Ossia. "We are honored to work with the industry leader, Toyoda Gosei, to deliver smart wireless power and connectivity to devices across the world. Cota® is the future."



Doug Stovall, CEO Jennifer Grenz, CRO

Initiatives Supporting the Growth Strategy

Manufacturing Innovations

TG Advanced Factory Concept

Even in the manufacturing field, where certainty is required, dreams are necessary for evolution. In order to evolve together as one in these turbulent times, we have established the TG Advanced Factory Concept, which is also in line with our management philosophy. We have drawn up a backcast vision (= dream) in line with three concepts centered on "Smart." Furthermore, by setting KPIs that serve as a common metric and clarifying our own capabilities and gaps, we will formulate and steadily implement more concrete strategies while keeping our eyes on the distant dream. We will contribute to the realization of the 2030 Business Plan by continuing to evolve globally in a single, straight-line direction that includes new plants such as the new plant in South China and the Seto plant expansion, as well as existing plants.

Concept	What we want to be		KPI
	What we aspire to be	End goal	
Lively	Free people from heavy-duty and mentally and physically exhausting work	People and machines grow together	Engagement
Clean	Energy minimization	Carbon neutrality	CO ₂ emissions
Integrity	Bringing the near future within reach	Elimination of human error	Disasters, complaints Legal compliance
Smart	Sequential production, sequential delivery	Ultimate one-piece flow manufacturing process	Production lead time

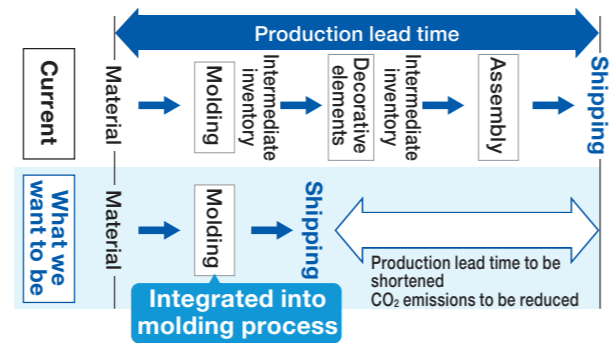
Strategies and Implementation in Line with Each Concept

Commitment to shortening production lead time: Smart

Even though products may change, we will not change our mission to deliver good products to our customers when they are needed and in the quantity they need. We have designated production lead time as our main KPI, and we will pursue the ultimate one-piece flow manufacturing process to thoroughly eliminate waste and double productivity.

Major examples

Process integration can reduce intermediate inventory, which is a bottleneck. Based on the concept of integration into the molding process, which is our core technology, we have begun development of production technology for applying decorative elements and assembly at the same time or in the same cycle as the molding process.

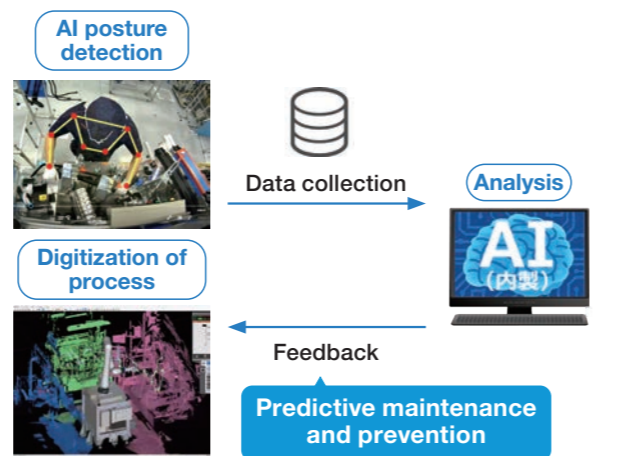


Prevention through digital integration: Integrity x Smart

Real manufacturing sites can be verified digitally. By bringing the near future within reach, human error is eliminated from the factory.

Major examples

By digitizing the entire intuitive process of human work, it is possible to examine the entire process in advance digitally. This makes it possible to eliminate the mistakes caused by human error in advance.

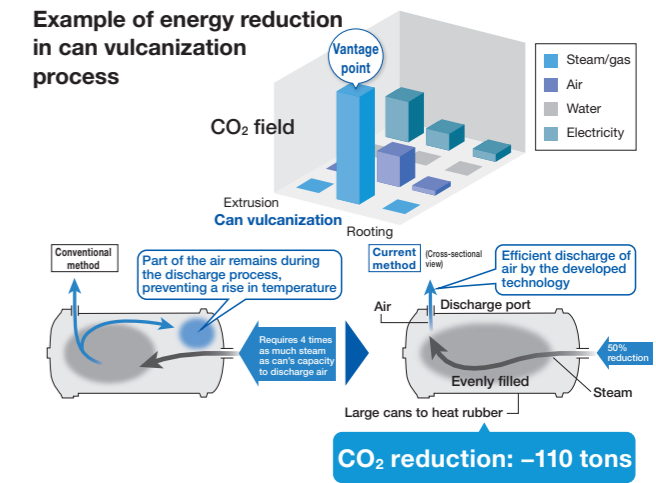


Priority reduction through visualization of CO₂ emissions: Clean x Smart

We provide a "CO₂ field" utilizing our cost visualization expertise. We visualize all CO₂ emitted from factories to strategically achieve carbon neutrality in factories.

Major examples

We have begun process innovation, focusing on processes that handle heat. Based on the results shown in the CO₂ field, we are taking on the challenge of reducing energy consumption in can vulcanization, which has remained unchanged over the past decades. Using simulation technology from Toyota Central R&D Labs., Inc., we have succeeded in halving the amount of steam required for replacement.



Guiding people to value-added work: Lively x Smart

We will install low-investment automated equipment on a global scale to free people from heavy-duty and mentally and physically exhausting work that remains in factories. We will shift the stage for human activity to higher value-added areas, such as accident prevention, maintenance of advanced equipment, and new development. We will create factories where everyone can work with machines with vigor and enthusiasm to achieve self-fulfillment.

Major examples

We are expanding our automation guidelines globally to ensure effective governance of process creation, and strategically expanding the use of AGVs^{*1} and collaborative robots. Based on the concept of CoE^{*2}, Toyoda Gosei (Thailand) Co., Ltd. plays a central role as a global center of automation implementation.

*1 Automatic Guided Vehicle
*2 Center of Excellence

Automation Example from Thailand Plant

Message from President Tani of Toyoda Gosei (Thailand) Co., Ltd.

The Thai region has developed manual labor-intensive processes that take advantage of cheap labor costs, but as labor costs continue to rise year after year, the need for automation has been increasing. In such a changing environment, we are implementing low-cost and energy-saving smart automation that utilizes our special *karakuri* technology.

We design and manufacture everything in-house except for robots, thereby accumulating in-house expertise in low-cost automation, and we are also extracting product designs for automation and providing feedback (applied to product drawings). This automation initiative is linked to improvements in initiatives from the work source and how work is done.

These initiatives are being expanded globally with video, and we are receiving inquiries not only from Japan but also from North America, India, Europe, and other countries, for viewing the initiatives on site and in person. In March 2023, a mini-summit on robot automation in the ASEAN region was held, where not only the top management from companies but also production engineers (actual practitioners) were able to see the results, and operations have been started to have them horizontally deployed.

In order to deploy the developed automation technology, we must standardize the technology (convert to drawings and data) and train human resources to complete the task, both of which will be implemented in parallel. We are planning to issue and deploy these initiatives from Thailand to the rest of the world to create a Toyoda Gosei company that is even stronger in manufacturing.



President Tani instructing local staff