

Message from the Executive Vice President



Cultivating Future Core Businesses through Green Innovation

Representative Director of the Board
and Executive Vice President of
Oji Holdings

Fumio Shindo

Promotion of Green Innovation

With forests serving as the core of the Oji Group's businesses, it is our enduring mission to bring the world a brighter future filled with hope by creating products from these forest resources.

By fully leveraging the abundant forest resources owned by the Oji Group and the core technologies we have accumulated over the past 150 years, I believe we can predict future prospects and realize a circular society in a way that enhances corporate value and helps advance business.

Based on our forest resources, the Group engages in the development and manufacture of products that connect to commercialization using wood components. Yet our efforts go beyond the framework of our existing businesses and extend to the three fields of Environmentally Friendly Products, New Materials Derived from Wood, and Medical and Healthcare.

Environmentally Friendly Products

In particular, the Oji Group is aiming to expand the environmentally friendly packaging business at the earliest possible stage. As part of the field of packaging materials, one of our mainstay businesses, we are engaged in initiatives that help reduce plastic use throughout society by switching from fossil resource-derived plastic products to environmentally friendly paper products. In addition, we are helping to realize a circular society by constructing a material recycling system that produces new paper products from used polyethylene laminated paper cartons and cups designed for chilled foods, as well as from paper cartons containing a layer of aluminum. [\(P.59\)](#)

New Materials Derived from Wood

The Oji Group is developing new materials other than paper that will form future core businesses. Specifically, we are researching and developing sugar solutions, bioethanol, biomass plastics, and other new materials derived from wood taken from inedible timber.

Sugar solutions derived from wood are considered an important basic substance in the effort to transition from existing

petrochemical products (rubber, fibers, pharmaceuticals, etc.) to biomass products. The Group will therefore strengthen collaboration on the greater use of these biomass products in response to the many inquiries we have received regarding these solutions from manufacturers and research institutes.

In regard to bioethanol derived from wood, Oji Holdings is currently constructing a pilot plant with an annual production capacity of 1,000 kL at the Yonago Mill. Slated to be commissioned by the end of FY2024, this pilot plant will be able to produce sugar solutions, allowing us to verify production efficiency and quality, as well as estimate costs and CO₂ emissions, for each product. We also plan to identify problems and achieve higher efficiency with the goal of scaling up the facility to an annual commercial production capacity of 100,000 kL of bioethanol by FY2030.

One of the potential applications for this bioethanol is sustainable aviation fuel (SAF). In fact, the Japanese government has raised the target to substitute 10% of all aviation fuel with SAF by FY2030. By developing this pilot plant, we intend to first establish cost-competitive processes before evolving them into profitable businesses. Moreover, producing 100,000 kL of bioethanol will require the entire volume of pulp produced by a medium-sized paper mill. In other words, this effort will require a dedicated biorefinery* plant. Against the backdrop of manufacturing site consolidation coinciding with the declining demand for paper, the Group is working to optimize the production and supply system from a medium- to long-term perspective covering 2030 to 2040. In regard to bioethanol, this effort will also rely in part on switching from existing paper mills to biorefinery manufacturing plants while factoring in locations suited to biorefinery manufacturing and utility conditions, for example.

* Plants and technologies for manufacturing biofuels, resins, and other products from renewable biomass as the raw material

Message from the
Executive Vice President

Green Innovation

Examples of Recycling Materials
and Reducing Plastic Use

In addition to bioethanol, we are advancing initiatives involving wood-derived biomass plastic. The demand for biomass plastic in Japan is anticipated to reach approximately 2 million tons in 2030, which is why we are working to transition to these from conventional fossil resource-derived plastic products. In this regard, we intend to develop sugar solutions as a basic substance, bioethanol, and biomass plastics derived from wood into a business that, overall, will achieve sales of ¥10 billion by FY2030.

Medical and Healthcare

In the Medical and Healthcare field, the Oji Group is working to develop (drug discovery) arthritis drugs and anti-coagulant drugs based on hemicellulose, a component that can be extracted from wood. Heparin, which is used in anti-coagulant drugs for humans, is primarily made from animals, meaning infectious disease epidemics among animals present the risk of supply disruptions. Moreover, there are those who wish to avoid medications made from animals, which is another problem that switching to wood-derived medications will help solve. The global market for human-use pharmaceutical products (heparin) is estimated at roughly ¥1 trillion–¥2 trillion, while the global market for arthritis drugs for animal use is estimated at roughly ¥50 billion. We therefore aim to achieve sales on the scale of ¥10 billion by FY2030 through this approach to drug discovery.

Our approach to material development is more than just a means of improving profitability against declines in the amount of pulp used, however. Indeed, it is a sustainable initiative in terms of effectively using wood components other than cellulose (pulp).

In regard to cellulose nanofibers (CNF), we are currently advancing various trials from the stance of technology, which have already led to their use in cosmetics, paint applications, and table tennis rackets, for example. In addition, we are exploring new applications and advancing toward commercialization of CNF through the development of natural rubber and polycarbonate CNF composite materials, as well as the development of fuel cell components. We are well aware

of issues with CO₂ emissions and the costs involved in the manufacture of CNF, however, so we are advancing research and development that encompasses efficiency through demonstration manufacturing at the CNF R&D Center.

Elements Supporting Green Innovation

Green Innovation Promotion Structure

In July 2023, the Innovation Promotion Division, which plays a central role in promoting green innovation, underwent a significant organizational restructuring, with its research department divided into two units. Specifically, we broke this department up into the “Biorefinery Unit,” which helps convert new value from wood components into bio-businesses, and the “Sheet and Converting Unit,” which is centered on the environmentally friendly packaging business. By establishing a framework that more seamlessly shares information and verifies the direction of R&D, this move strengthened our capacity to create new products and materials that directly connect to profits. (P.54 )

Abundant Forest Resources and a Global Network

Perhaps the greatest strength for the Oji Group in advancing green innovation is our abundant forest resources. We own approximately 180,000 ha of production forests in Japan and approximately 290,000 ha overseas, which together produce some 7 million tons of wood per year. We have also raised the target of expanding our overseas production forests to 400,000 ha by FY2030.

If biomass comes to replace petroleum, the forests that we own can be considered oil fields that will never run dry. As our policy for acquiring forest plantations, we absolutely require that all potential locations have acquired FSC™, PEFC, or other certifications. We also remove any forest plantations from the candidate sites where problems have occurred with indigenous peoples, ethnic minorities, or local residents.

Another one of our strengths is our global network. The Oji Group has built a network that incorporates the latest technologies through efforts to expand overseas businesses

ahead of the rest of the industry, and through tie-ups with overseas research institutes and partner companies. I expect this network to afford us major advantages as we work to drive the green innovation that leverages our forest resources.

Optimizing Manufacturing Sites

The Group has had little choice but to consolidate manufacturing sites as the demand for paper has declined. Each of the plants operated by the Oji Group has unique characteristics, however, including the pulp and paper machines that they use. Against this backdrop, our challenge has been to optimize our manufacturing sites while maintaining the same level of paper quality and production efficiency. From the perspective of manufacturing biorefinery products, as I discussed earlier, we must also consider many other factors in addition to ways of pursuing paper quality and production efficiency. As we raise our antenna to capture trends in Japan and abroad to illustrate a picture of the Group from a medium- to long-term perspective, we must engage in careful, yet fast-past studies of this area.



**Message from the
Executive Vice President**

Green Innovation

Examples of Recycling Materials
and Reducing Plastic Use

Human Resource Development

Against the backdrop of growing difficulties in securing human resources in step with the decline of the working-age population, the Oji Group now faces challenges with developing human resources at its production sites. Moreover, as the veteran operators who have supported production at our plants for many years retire, their expertise and deep knowledge of operations are becoming lost. As they also trained younger employees, it has become difficult to pass on, in the same manner as before, those skills and expertise acquired over the years. Although we have addressed this issue in the short term by using e-learning programs, for example, as part of Group-wide courses, from a medium- to long-term perspective, we must work to automate and optimize production using AI and other tools.

The reason the Oji Group has survived for the past 150 years is because, in addition to our abundant forest resources and infrastructure, those who came before us responded flexibly to each era, passed on their skills and knowledge, and made improvements. But I feel another major reason is that we have passed down our philosophy, symbolized by our Purpose, as part of our DNA. Regardless of the times, it is people that generate value in line with the needs of their respective eras. Human resource development will therefore remain, as always, the core for supporting the management foundation.

Promoting Sustainability

Another area that the Oji Group is focused on promoting in parallel with green innovation is sustainability. We have raised carbon neutral and nature positive as the vision for which we aim over the long term. In part through the activities of the International Sustainable Forestry Coalition (ISFC), established by 10 global forest-related companies, including the Group, we share the common challenge of helping to solve climate change, biodiversity, deforestation, and other global-scale problems. In February 2024, we revised part of the Environmental Action Program 2030 to clarify our stance of contributing to

nature positive on a global basis through sustainable forest management, as well as through initiatives targeting ecosystem conservation and restoration.

Carbon Neutrality Initiatives

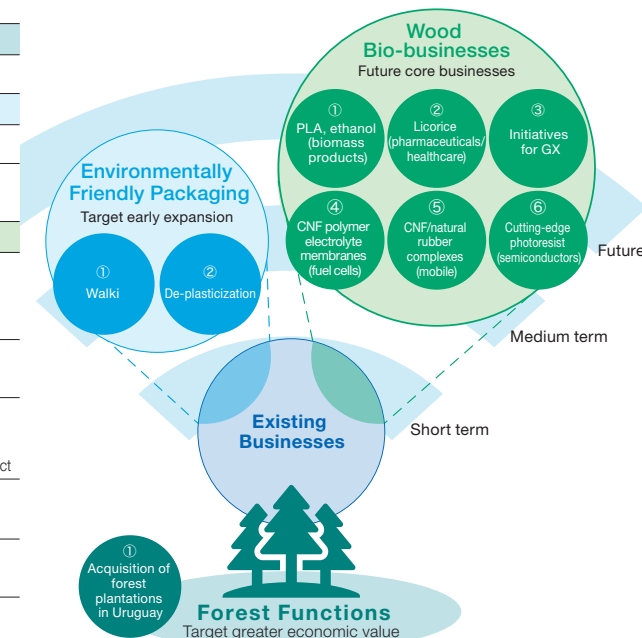
Having laid out a long-term vision for decarbonization that presents the goal of achieving net-zero carbon by FY2050, the Oji Group is targeting the milestone of 70% fewer greenhouse gas (GHG) emissions by FY2030 compared with FY2018. Of this 70%, we achieve our reduction target by eliminating 20% in terms of actual emissions and by expanding the net increment of carbon stocks accounted for by forests to manage the remaining 50%.

Initiatives for sustainable growth

Forest Functions	
①	▶ Acquire forest plantations in Uruguay
Environmentally Friendly Packaging	
①	▶ Acquire a leading environmentally friendly packaging company in Europe
②	▶ Transition 5,000 tons of plastic to paper products every year ▶ Recycle 100% of waste plastic
Wood Bio-businesses	
①	▶ Successfully polymerize polylactic acid at a bench plant scale facility for the first time in the world ▶ Operate a sugar solution and ethanol pilot facility (proceeding as planned)
②	▶ Perfect large-scale licorice cultivation technology ▶ Study further expansion of cultivation areas using idle land
③	▶ Enter alliances in the e-methane production business ▶ Shut down all coal-only-fired boilers by FY2030 (currently under way) ▶ Participate in the GX Acceleration Agency as a government-industry jointly-funded project
④	▶ Successfully develop high-performance, fluorine-free fuel cell materials (joint research with Yamagata University)
⑤	▶ Introduce mass-production and prototyping facilities for composite materials with excellent size stability, high strength, and heat stability
⑥	▶ Successfully develop fluorine-free semiconductor materials suited to cutting-edge micro-lithography

Shuttering All Coal-fired Boilers by 2030 to Reduce Actual Emissions

The Oji Group's core approach to reducing actual emissions is to shift away from using coal-only-fired boilers in Japan. We will therefore invest roughly ¥100 billion to shut down all coal-only-fired boilers in Japan by FY2030 in an effort that will reduce GHG emissions by about 1,000 kt-CO₂e. In fact, we have already shut down two coal-fired boilers, one at the Oji Materia Nayoro Mill in FY2021 and one at the Oji F-Tex Ebetsu Mill in FY2023. Moreover, we are currently preparing to shut down two more coal-fired boilers and expect to complete this work by FY2027. We are also accelerating plans to shut down other coal-fired boilers in an attempt to complete the process as soon as possible ahead of the 2030 target year.



▶ [Summary of Financial Business Results](#)

**Message from the
Executive Vice President**

Green Innovation

Examples of Recycling Materials
and Reducing Plastic Use

As a substitute fuel for coal-fired boiler shut-down during the transition stage, we plan to switch from coal to LNG and other gases in light of their practical nature and lower CO₂ emission intensity. We will also expand the use of renewable energy, including black liquor, a biomass fuel by-product from pulp production, and hydroelectric power, which we have used for many years. We will expand solar power generation facilities as an effective way to use the land and buildings that we own, and are studying the use of wind power. Similarly, we are advancing efforts to switch to hydrogen, ammonia, e-methane, and other fuels to achieve net-zero carbon while identifying their respective advantages and disadvantages along with global trends. Moreover, we are not simply waiting for someone else to begin supplying green fuels, but are working with TOKYO GAS CO., LTD., on a joint study regarding e-methane production in Japan.

In addition, the Group is making energy-saving investments that will be essential for achieving carbon neutrality and has made steady progress on reducing energy consumption intensity per unit of net sales. In fact, we have already achieved an average

5.0% reduction over the most recent five-year period, exceeding our target of 1% for year.

Expanding the Net Increment of Carbon Stocks Accounted for by Forests

To increase the net increment of carbon stocks accounted for by forests, the Oji Group had acquired approximately 280,000 ha of production forests overseas by the end of FY2023 compared to the target of 400,000 ha for FY2030. This move reduced net GHG emissions for FY2023 by 28.1% compared with FY2018. Humanity is highly dependent on water, forests, and other forms of natural capital, which is why I believe we have a role to play in a sustainable society, primarily through efforts to grow healthy forests and use them appropriately for the purpose of conserving and restoring natural capital.

Nature Positive Initiatives

Forest resources play a wide range of roles, from water resource cultivation to preventing landslide disasters and absorbing CO₂, and therefore function as an extremely important public service in terms of the environment and society. For this reason, the Group engages in business activities that factor in ecosystems and works to protect and nurture rare plants and animals in the approximately 640,000 ha of forests that we own and manage in Japan and abroad. Our efforts also serve to conserve and restore the biodiversity of life that exists within our forest resources. In addition to planting and growing trees in production forests for the purpose of producing forest products, as well as re-planting and maintaining forests after felling, we have set aside 25% of the total land area, or approximately 160,000 ha, as conservation forests for the purpose of conserving biodiversity and basins.

With 43% of its land accounted for by conservation forests, CENIBRA in Brazil monitors the plant and animal life that live there. Moreover, we scored the abundance of biodiversity in roughly 650 company-owned forests in Japan during FY2023 and surveyed the amount of cultivated water. In FY2024, we

will select several forests that received particularly high scores during the biodiversity survey and conduct field surveys using drones, AI analysis, and other cutting-edge technologies. In a leading initiative for Japan's paper-making industry, in FY2024 we will begin gradually disclosing information in line with the TNFD recommendations as an early adopter. At the same time, we will continue to engage in initiatives that help maximize the value of forests in a way that goes beyond simply producing forestry products. As part of these efforts, we will work with local communities to protect rare species, restore nature, protect aquatic environments, and promote carbon fixation.

To Our Stakeholders

The Oji Group will appropriately administer the forests we own and manage in Japan and abroad, and will contribute to achieving a sustainable society by enhancing their multifunctional role. At the same time, we will reflect biodiversity, climate change, human rights, and other sustainability-related risks and opportunities in our management strategies in an effort to enhance corporate value.

And through green innovation, we will accelerate the shift toward developing wood-derived materials and solutions on a global basis in the fields of sugar solutions, bioethanol, biomass plastics, films, CNF, and pharmaceutical products. As indicated by the Purpose, forests are the core of the Oji Group's businesses, and it is our mission to bring this world a brighter future filled with hope by creating products from these forest resources.

I therefore humbly ask for your continued support as we seek out, from among the various possibilities and directions, the types of forests that we can grow in the future, as well as the types of value that we can deliver to society from materials conceived from these forests, with the intention of connecting these efforts to future generations.

Green Innovation

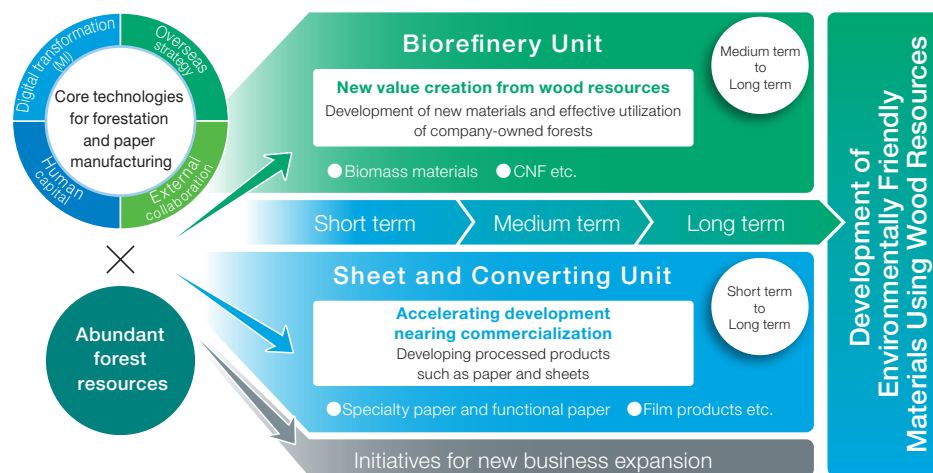
Our Vision for the Innovation Promotion Division

Our role is to fully utilize wood resources effectively to solve social challenges

The Oji Group is committed to green innovation, leveraging its abundant renewable forest resources to address global environmental challenges such as reducing CO₂ emissions and plastic usage. The Innovation Promotion Division focuses on creating unique new materials that are specific to the Oji Group, contributing to the creation of innovative value and expanding business domains.

Research and Development Policy to Achieve the Oji Group's Growth and Deepening

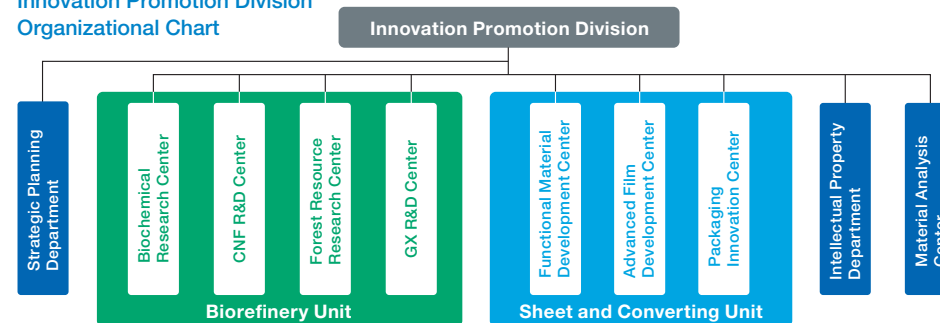
Based on the core technologies cultivated through more than 150 years of “forestation” and “papermaking,” the Innovation Promotion Division accumulates expertise from newly acquired overseas companies and deepens research and development. In addition, we are accelerating material development by introducing “Materials Informatics (MI)” as part of our DX promotion. Furthermore, we, with two units, are enhancing our research and development system through collaboration with universities, external research institutions, and start-ups. With such a robust system, we aim to develop environmentally friendly materials utilizing wood resources.



Research and Development Structure

To respond to the ever-changing needs of society, the Innovation Promotion Division has divided its research and development department into two units, and has established a system that facilitates the smooth information exchange and confirmation of research and development direction. In the “Biorefinery Unit,” research and development activities are conducted to cultivate the core of medium- to long-term businesses, which is the woody biomass business, and create new value related to woody components. In addition, in the “Sheet and Converting Unit,” development related to de-plasticization and environmentally friendly materials that are directly linked to business is being pursued as short- to medium-term initiatives closer to the market. Furthermore, turning to projects with greater urgency and development with significant future potential, the Strategic Planning Department takes the lead in driving new commercialization efforts and has even split off companies to deploy new businesses in some cases. The Intellectual Property Department and the Material Analysis Center support research and development across the entire the Oji Group while contributing to the business.

Innovation Promotion Division Organizational Chart



Launch of New Departments

In the organizational changes carried out in 2023, in addition to the existing organization, the GX R&D Center and Forest Resource Research Center were established. The GX R&D Center focuses on technological innovation utilizing wood components and reducing CO₂ emissions. The Forest Resource Research Center conducts research on the effective utilization of forest resources and the utilization of forest functions such as CO₂ absorption, water source cultivation, and biodiversity conservation.



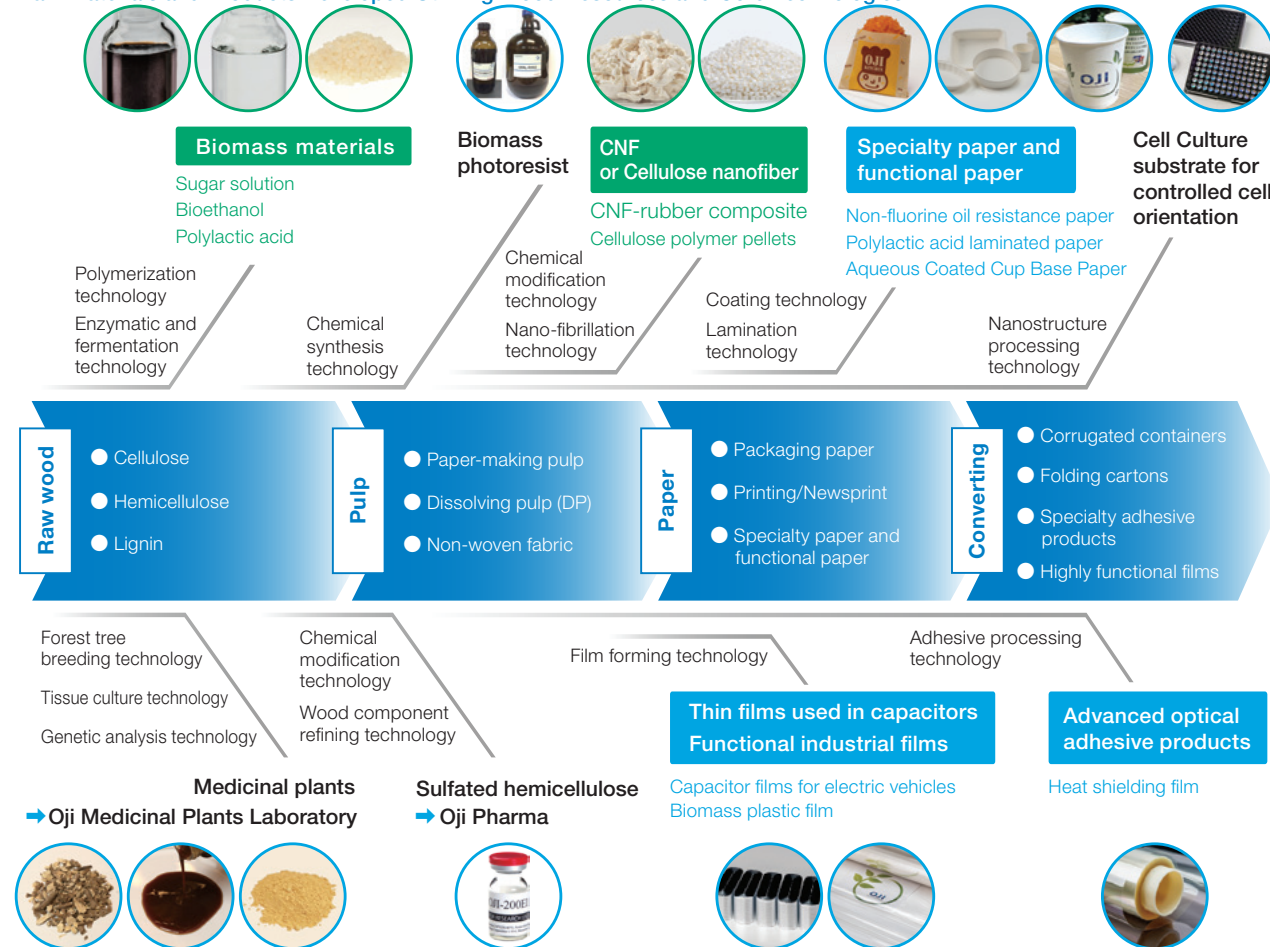
► [Innovation Promotion Division Website \(in Japanese Only\)](#)

Introducing in detail the activities and developed products of the Innovation Promotion Division.

Green Innovation That Utilizes Forest Resources Fully to Address Social Issues

The Oji Group combines forest resources with various technologies to develop unique products that meet the needs of customers and society.

Main Materials and Products Developed Utilizing Wood Resources and Core Technologies



Innovation and Intellectual Property

The Oji Group Innovation and Intellectual Property Management

Intellectual property is the culmination of the various innovations the Oji Group has developed over the years. By proposing strategies for effectively leveraging intellectual property in executing innovation-driven management strategies that drive innovation, and by properly managing the resulting outcomes and know-how, the Group aims to commercialize and create products from the generated corporate value, thereby solving various challenges faced by customers and society.

● Basic Policy

The Oji Group considers patents, utility models, designs, trademarks, know-how, and other forms of intellectual property as important management resources and aims to actively utilize these as a source of business competitiveness. Moreover, we will actively employ these resources in the formation of new businesses.

● Intellectual Property Management

The intellectual property rights owned by the Oji Group are centrally managed and held by Oji Holdings, which acquires and exercises these rights based on the Group's policy. In addition, Oji Holdings strives to effectively utilize these rights throughout the Group by granting licenses to companies within the Oji Group.

● Intellectual Property Strategies

The Oji Group engages in intellectual property-related activities in alignment with the management policies, and strengthens the acquisition and use of green innovation-related intellectual property rights to achieve a decarbonized society, thereby promoting the creation of corporate value and sustainable growth.

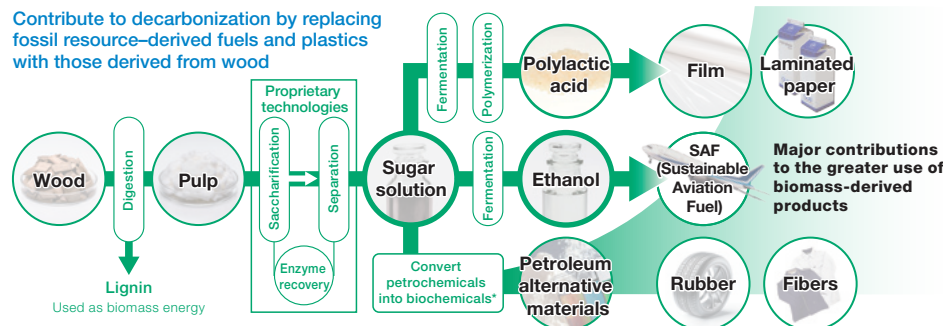
Message from the
Executive Vice President

Green Innovation

Examples of Recycling Materials
and Reducing Plastic Use

Development of Biomanufacturing Technology with Wood Resources as Raw Materials

Contribute to decarbonization by replacing fossil resource-derived fuels and plastics with those derived from wood



* Companies engaged in biochemical manufacturing combine fermentation and other technologies for application in manufacturing petroleum alternative materials. Polymeric acid and ethanol are typical examples of biochemical products made by the Oji Group.

We are pursuing the development of new materials derived from the wood that is obtained from sustainable forest management. In particular, we focus on sugar solutions, which are a key substance for various types of biomanufacturing^{*1}; ethanol, which can be used in the manufacture of SAF^{*2} and other chemicals; and polylactic acid, which is a representative form of biomass plastic. To refine these manufacturing technologies, we will accelerate initiatives targeting social implementation, including the installation of pilot plant for wood-derived sugar solution and ethanol.

^{*1} Production of plastics, rubber, fibers, fuels, and other products using smart cells (micro-organisms that raise the productivity of beneficial substances), with biomass-derived sugars as raw materials

^{*2} Sustainable aviation fuel: Fuel seen as the trump card in the decarbonization of the aviation industry



Polymeric acid bench plant

After being selected for the Ministry of the Environment's Demonstration Project for a Plastic Resource Circulation System toward a Decarbonized Society, we established technology for the manufacture of wood-derived polymeric acid.



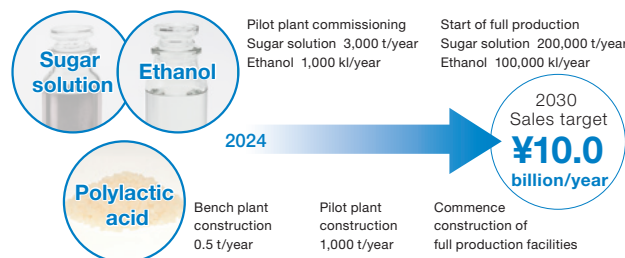
Pilot plant for sugar solution and ethanol

In addition to providing sugar solution and ethanol, we will continue to improve our technologies and accelerate our initiatives for commercialization. (Inside Oji Paper Yonago Mill)

Scheduled for completion during the second half of FY2024

Scale of the Target Markets

- ① Sustainable aviation fuel
Forecast demand (Japan)
2030 1,710,000 kl
2050 23,000,000 kl
- ② Biomass plastics
Forecast demand (Japan)
2030 Approx. 2.0 million t



Use of Cellulose That Accommodates Social Changes

To accommodate changes in society and customers' requirements, we are promoting development for the effective use of cellulose materials in products beyond paper, from CNF (cellulose nanofiber) to pulp.

Development for the Expansion of CNF Market - CNF-Natural Rubber Composite



We are advancing sample work toward commercialization of these composites as a new type of rubber material in which the carbon black, the existing fossil resource-derived reinforcing material, has been replaced with biomass. In anticipation of adoption for various applications, including tires and other rubber products used in automobiles, we will introduce mass-production and prototyping facilities for the composites and accelerate demonstration tests for real-world application.

Introducing ToughCel: Cellulose Resin Composite Materials for Various Applications

With high rigidity and resistance to breaking when molded into various products, we have advanced the development and commercialization of innovative resin composite materials known as ToughCel. These composite materials contain reinforcing fibers made of cellulose (pulp), contributing to the reduction of plastic usage and promoting de-plasticization. We are actively exploring the potential application of ToughCel in various sectors, including automotive components, and enhancing the quality and workability required for these products.

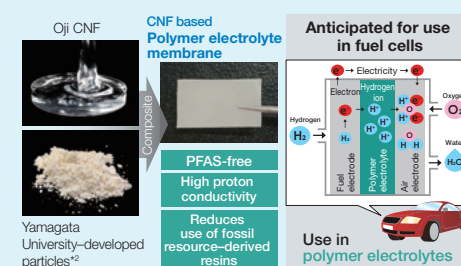


Development of polyelectrolyte membrane using CNF for fuel cells

The polymer electrolyte membranes used in existing fuel cells are derived from fossil resources and contain fluorine, which poses safety and environmental concerns. Our newly developed polymer electrolyte membrane is PFAS-free^{*1} and has high proton conductivity.

^{*1} The general term for organic fluorine compounds. PFAS-free indicates that a material does not contain any organic fluorine compounds.

^{*2} Proton conductive materials under development at Yamagata University (Professor Akito Masuhara)



Environmentally Friendly Paper Products

Non-fluorine Oil-resistant Paper O-hajiki®



As countries around the world increasingly tighten PFAS-related regulations, we developed the PFAS-free oil-resistant paper O-hajiki®. Available in bleached and non-bleached grades, these two types of O-hajiki® have been adopted by foreign fast food and coffee shop chains operating in Japan, while many domestic fast food and convenience store chains have also shown interest. Moreover, we are advancing new developments to expand the available grades in accordance with different applications and quality requirements.

Laminated Paper Using Plant-derived Polylactic Acid



The incineration of ordinary laminated paper as combustible waste results in the emission of fossil resource-derived CO₂. Because the plastic layers of the laminated paper that we developed use plant-derived polylactic acid, the combustion of the paper does not increase CO₂ in the atmosphere. In addition, this paper is biodegradable under compost conditions.

Recyclable Aqueous Coated Cup and Tray Base



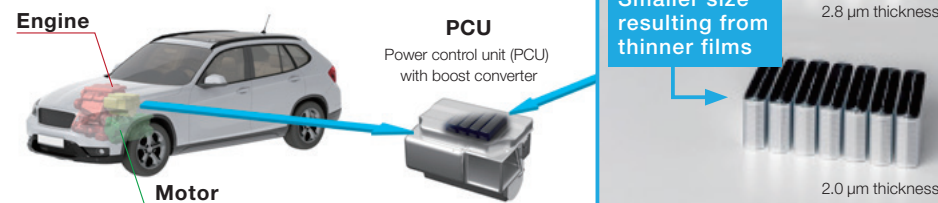
Conventional plastic laminated paper cups and paper trays are generally treated as combustible waste. However, by leveraging our technology to apply special aqueous resin to the cup base in a thin and even manner, we successfully developed a paper cup and tray base that still has the functions required for paper cups and trays, while being recyclable as paper material.

Developing Film Products That Respond to the Needs of Society

Thin Capacitor Films for Electric Vehicles

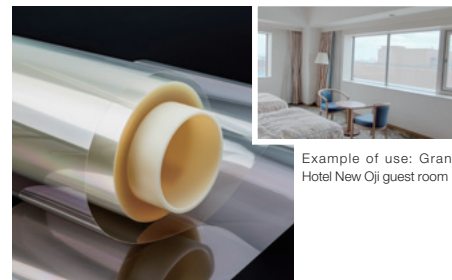
Our ultra-thin films for HEV and EV* capacitors maintain not only the thinnest property but also the highest level of heat and voltage resistance in the world. We are also advancing research and development that involves engineering plastics for next-generation EV models.

* HEV: Hybrid vehicles, EV: Electric vehicles



Heat Shielding Film

Heat shielding film is designed to be applied to the window glass used in automobiles and buildings, and offers both high heat shielding performance and transparency. We have added a new product with a release film made from recycled materials to our lineup. It is currently available as a film for automotive windshields, and we are considering its application for building windows.



Example of use: Grand
Hotel New Oji guest room

Film Made from Biomass Plastics

Amid the growing demand for environmentally friendly materials, we recently developed a film made entirely from biomass plastic (polylactic acid). Based on the technology used to manufacture our ultra-thin films for capacitors, this biomass film is expected to find use in a broad range of fields, including industrial- and food-related applications. In addition, we are working to develop films made from several other types of biomass plastics.



New Businesses That Split Off as New Companies

Oji Medicinal Plants Laboratory Co., Ltd.

Stable Supply of Medicinal Plant “Licorice” Based on Large-scale Cultivation

Medicinal plant licorice is an indispensable plant resource for daily life and is used in pharmaceuticals (primarily Chinese herbal medicine), cosmetics, and food products. The Oji Group has successfully established large-scale cultivation techniques leveraging our forest tree breeding technology. In 2021, we established Oji Medicinal Plants Laboratory.



Large-scale cultivation of licorice (Hokkaido)

Much of the licorice consumed in Japan is dependent on imports, leading to problems with resource depletion and environmental conservation associated with the harvesting of wild plants. In addition, there are risks associated with export restrictions, therefore domestic production is required. By cultivating licorice in Japan, we can guarantee a high level of traceability and support safe and secure “sustainable businesses.”

Going forward, we will process licorice into the arrangements desired by our customers and deploy its use in pharmaceuticals, cosmetics, and food products, thereby enabling us to provide licorice to a wider range of consumers.

Licorice provided in various arrangements tailored to customers' requirements



Cutting

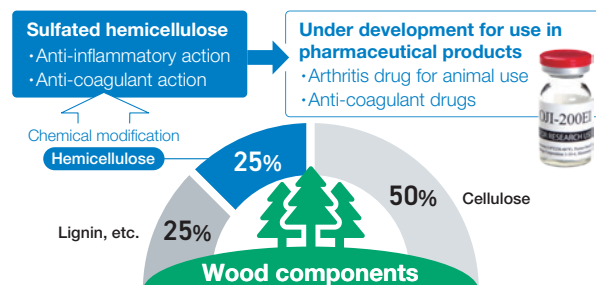
Extraction

Powdering

Oji Pharma Co., Ltd.

Drug Discovery from Wood Resources Leveraging Pulp By-products

Oji Pharma was established to research, develop, and commercialize pharmaceutical products made from sulfated hemicellulose, a substance obtained from the hemicellulose by-product of pulp production.



In addition to its anti-inflammatory and anti-coagulant actions, the Company's sulfated hemicellulose is unique in that it is derived from wood. Possessing the benefits of safety, reliability, and stable supply that are unique to wood-derived products, it offers the potential to replace animal-derived pharmaceutical products such as heparin.

We are currently acquiring approval for an arthritis drug for animal use in parallel with research and development efforts of a drug for human use. Moreover, we are working to market pharmaceutical products that take advantage of these properties in an effort to launch a pharmaceutical products business.

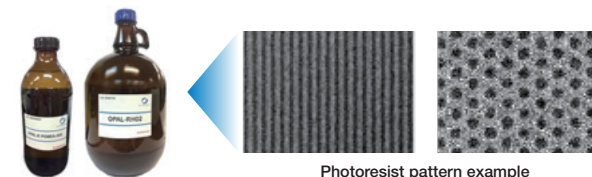
Scale of the Target Markets

- Oji Medicinal Plants Laboratory
Licorice: domestic market approx. ¥15 billion
- Oji Pharma
Arthritis drug for animal use: global market approx. ¥50 billion
Human-use pharmaceutical products (heparin): global market approx. ¥1 trillion–¥2 trillion

Featured Products under Development

Advanced Semiconductor Photoresist Made from Biomass

The United States and Europe are planning to tighten regulations related to PFAS, which is a substance that negatively affects the environment. Because PFAS is used in many types of semiconductors, the semiconductor industry is starting to shift to PFAS-free. Our photoresist is made from biomass, is PFAS-free compliant, and is environmentally friendly. Having already verified its basic performance, we are proceeding with optimization for customers of semiconductor device manufacturers.



Photoresist pattern example

Cell Culture Substrate Made Using Nanostructuring Technology

Cell Culture Substrate for Controlled Cell Orientation, CellArray-Heart™

Given that the cellular functions of human cardiomyocytes fail to develop into those of in vivo cardiomyocytes, there is a growing need for maturation of these cells. Focusing on the condition of in vivo cardiomyocytes, we developed CellArray-Heart™. This product is a cell culture substrate in which the nanodot regions and planar regions are oriented in stripes using a proprietary technology held by the Oji Group.

It has been confirmed that culturing human iPS cell-derived cardiomyocytes using CellArray-Heart™ reproduce the same oriented condition as seen with in vivo cells, thereby facilitating their maturation. Accordingly, it is hoped that this method will help avoid animal testing and have applications in regenerative medicine.



Examples of Recycling Materials and Reducing Plastic Use

Establishing a New Business Model by Proposing Recycling Systems

We are working to build a sustainable material recycling system toward achieving a circular economy.

A Joint Initiative with Nihon Tetra Pak K.K.

In collaboration with Nihon Tetra Pak, we have launched the first domestic recycling system to collect aseptic carton packages and recycle those into corrugated containers.

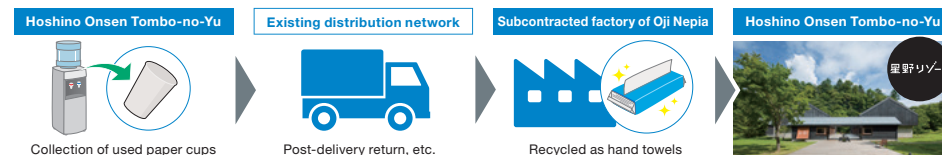
Currently, the majority of aseptic carton packages in Japan are disposed of through incineration (thermal recycling) as combustible waste, with a low level of 3.4% recycled into paper products (material recycling). Building on this first domestic initiative to separate the paper fiber and polyethylene-aluminum layer of used aseptic carton packages, we will expand this system to recycle the paper fiber into corrugated containers through material recycling on a national scale. Aiming for the recycled corrugated containers to be utilized as not only collection boxes for carton packages but also in the food and beverage industry, this initiative will support efforts to achieve zero emissions at food and beverage company factories.



A Joint Initiative with Hoshino Resorts Inc.

We have started an initiative to recycle the paper cups used at Hoshino Onsen Tombo-no-Yu, operated by Hoshino Resorts Inc., into the nepia hand towels produced by Oji Nepia. Paper cups are generally laminated with plastic to enhance their water resistance and are handled as prohibited materials in the current recycling system. As such, paper cups cannot normally be included in the collection of used paper and must be incinerated as combustible waste.

Under this initiative, used paper cups are collected and recycled as fiber (pulp) into hand towels.



Sustainable Packaging Designed to Minimize Plastic Use

We provide environmentally friendly packaging materials to meet the needs of customers with the aim of reducing CO₂ emissions and plastic consumption.

Case Studies

■ Packaging for the replacement wiper rubber used in N-BOX vehicles manufactured by Honda Motor Co., Ltd.

We are working to switch from conventional plastic packaging to paper packaging while continuing to use existing packaging machinery. The goal is to promote environmentally friendly packaging that is pleasant to the touch, easy to open, and fully harnesses the unique features of paper materials.



■ Seasoned seaweed from the Sumapura brand of Shirako Corporation

While seaweed products are typically packed entirely in plastic to prevent moisture, one such product has been switched to paper-based packaging, achieving a 92% reduction in plastic usage. The new package design has also doubled the shelf life compared to the previous plastic bottle version.



■ fufumu Inc.

“Paqupa”

We are adopting environmentally friendly paper materials in new concept baby food packaging.



■ Famidge Co., Ltd.

Rice cracker shop's dog snack

Our paper packaging for “gibier” snacks highlights our contributions to the local economy and environmental conservation.



Topics

Reduction of CO₂ emissions by the introduction of paper packaging

The calculation and comparison of the life-cycle CO₂ emissions of petroleum-based plastic packaging and sustainable paper packaging show that paper packaging emits less CO₂ than plastic packaging. Therefore, the introduction of paper packaging can contribute to CO₂ emission reduction. For more details, please see our website. (in Japanese)

(Sustainable packaging /CO₂ reduction effect (in Japanese Only) [\[PDF\]](#))

