CSR Activity Report (CSR Guideline Activity Reports)

Contributing Solutions to Social Issues through Business Activities

Leverage innovation to address global-scale environmental issues such as climate change and provide solutions for various social issues such as the need to improve the quality of medical care, the need to reduce the burden on medical staff, health maintenance and longevity, and personal safety, thereby helping to build a more sustainable world.

Basic Approach

Global environmental issues continue to escalate, marked by climate change, rising CO₂ concentrations, and population growth-induced water scarcity and resource depletion. The world population is approximately eight billion, a number that is expected to surpass 10 billion by 2050. Meanwhile, developed countries as well as many emerging countries are expected to face rapid population aging, as average lifespans increase and birthrates decline.

In the world of the 21st century, the most critical shared challenges are to resolve global-scale environmental issues and to provide healthcare that helps people lead healthy, independent lives, which involves delivering high-quality medical care that reduces the burden on both patients and medical staff.

As basic strategies of the Medium-Term Management Program, Project AP-G 2019, Toray Group has implemented the Green Innovation Business Expansion Project (Green Innovation Project) and the Life Innovation Business Expansion Project (Life Innovation Project) to expand business in growth sectors. These efforts are directed by the Global Environment Business Strategic Planning Department and the Life Innovation Business Strategic Planning Department, respectively. The progress on the projects has been followed up by company-wide management committees and other bodies. To strengthen the initiatives, in 2018, the Group established and announced the Toray Group Sustainability Vision to clearly outline the world as envisioned by the Toray Group in 2050, and also set KPIs to be achieved by 2030 as long-term targets. To help ensure the achievement of the Sustainability Vision, the Group is strongly promoting the Green Innovation Project and Life Innovation Project group-wide. These projects are led by the president of Toray Industries, under the Long-Term Corporate Vision, TORAY VISION 2030, and the Medium-Term Management Program, Project AP-G 2022, which were announced in May 2020.
In the Green Innovation Project, Toray Group works to achieve “a net-zero-emissions world, where greenhouse gas emissions are completely offset by absorption” (in other words, a net zero emissions, carbon-neutral world), “a world where resources are sustainably managed,” and “a world with a restored natural environment, with clean water and air for everyone,” as outlined in the Toray Group Sustainability Vision. Here are some specific examples of Toray initiatives under this vision. To accelerate efforts to fight climate change, the Group will expand aircraft and automobile applications for its advanced materials and help reduce CO₂ emissions by improving fuel efficiency through vehicle weight reduction. It will also work to help society transition to renewable energy by supplying materials for wind and hydrogen power applications. To enhance sustainable, recycling-oriented use of resources, the Group will promote initiatives for resource recycling and bio-technology. To help ensure safe water and air, it will proceed with initiatives in areas such as water treatment membranes and air filters.

With its Life Innovation Project, Toray Group seeks to build “a world with a restored natural environment, with clean water and air for everyone,” as well as “a world where everyone enjoys good health and hygiene,” as set out in the Toray Group Sustainability Vision.

In working toward “a world where everyone enjoys good health and hygiene”, the Group is focused on “contributing to better medical care and hygiene for people worldwide.” In order to accelerate this initiative, the Group has broadened Life Innovation beyond its conventional definition of products that support people’s health maintenance and longevity and improve the quality of medical care, to include products that support personal safety and help the elderly and home-care recipients to live more independent lives (improving activities of daily living [ADLs]).

Structure

In April 2021, the Group established the Sustainability Committee to serve as a group-wide committee. Headed by the president, the committee is tasked with promoting efforts to achieve the Toray Group Sustainability Vision. Toward this end, the committee draws up the overall medium- and long-term roadmaps and action plans for achieving the Vision and deliberates on the yearly action plans for the three group-wide projects—the Green Innovation Project, the Life Innovation Project, and the Challenge 30 Project¹—and manages the progress on KPIs for fiscal 2030. In addition, the committee further promotes these efforts by overseeing and managing implementation issues and the status of activities. The Sustainability Committee also collaborates with the CSR Committee, Risk Management Committee, Safety, Health and Environment Committee, and Technology Committee to address climate change-related issues for the entire Toray Group. Along with the creation of the Sustainability Committee in April 2021, a Climate Change Subcommittee was also set up to promote initiatives to combat climate change. In addition to Scopes 1 and 2 greenhouse gas emissions, it is also working to reduce emissions from raw materials, which account for the majority of Scope 3 emissions. The subcommittee discusses important policies and agenda items related to climate change, such as reducing the carbon footprint² of Toray products. Furthermore, with the function of developing and promoting group-wide strategies for the implementation of sustainable, recycling-oriented use of resources, a Circular Economy Subcommittee was created in April 2022 under the Sustainability Committee. As a result, the Group is accelerating its resource recycling efforts, including recycling and the conversion of key polymers to biomass-based polymers.

For more information on the Toray Group governance structure related to the issue of climate change, please refer to the Toray Group TCFD Report 2021.

¹ The Challenge 30 Project aims to achieve a 30% reduction in greenhouse gas emissions and water usage per unit of revenue in production activities by fiscal 2030 (compared with fiscal 2013) by undertaking the following activities.
- Implement regular energy-conservation activities with stronger cooperation between sites in and outside Japan, and adopt successful case studies across the Group
- Shift to purchasing electricity instead of generating with coal-fired boilers, and increase the usage of biomass fuels
- Promote wastewater reuse, etc. with Toray Group’s water treatment technologies
**CSR Roadmap 2022 Targets**

**CSR Roadmap goals**

Help address social issues by developing innovative materials and new technologies, focusing on the fields of Green Innovation and Life Innovation

<table>
<thead>
<tr>
<th>Main Initiatives and Key Performance Indicators</th>
<th>KPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Increase revenue from Green Innovation products</td>
<td>7-1</td>
</tr>
<tr>
<td>2. Increase revenue from Life Innovation products</td>
<td>7-2</td>
</tr>
<tr>
<td>3. Expand contribution to CO₂ reduction in the value chain</td>
<td>7-3</td>
</tr>
<tr>
<td>4. Expand water filtration throughput contribution by Toray’s water treatment membranes</td>
<td>7-4</td>
</tr>
<tr>
<td>5. Conduct a wide variety of product research and technology development to help build a low-carbon, circular economy</td>
<td>-</td>
</tr>
<tr>
<td>6. Contribute to the utilization of biomass in and recycling of plastic products, the spread of renewable energy and hydrogen, and the reuse of water resources</td>
<td>-</td>
</tr>
<tr>
<td>7. Contribute to countermeasures to public health risks, including infectious diseases, by developing and upgrading materials and products for protective clothing and personal protective equipment, as well as materials to protect environmental hygiene including of air and water</td>
<td>-</td>
</tr>
</tbody>
</table>
### Key Performance Indicator (KPI) Table

<table>
<thead>
<tr>
<th>KPI Description</th>
<th>Target</th>
<th>Fiscal 2021 Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-1 Revenue of Green Innovation products (IFRS)</td>
<td>1,000 billion yen (Fiscal 2022)</td>
<td>832.2 billion yen</td>
</tr>
<tr>
<td>7-2 Revenue of Life Innovation products (IFRS)</td>
<td>300.0 billion yen (Fiscal 2022)</td>
<td>308.4 billion yen</td>
</tr>
<tr>
<td>7-3 Contribution to CO₂ reduction in value chain</td>
<td>5.3 times compared to fiscal 2013 (Fiscal 2022)</td>
<td>8.0 times compared to fiscal 2013</td>
</tr>
<tr>
<td>7-4 Contribution of Toray water treatment products</td>
<td>2.4 times compared to fiscal 2013 (Fiscal 2022)</td>
<td>2.2 times compared to fiscal 2013</td>
</tr>
</tbody>
</table>

**Reporting scope:** Toray Group

3 Toray calculates the CO₂ emissions reduced throughout the value chain of products in accordance with the chemical sector guidelines of the Japan Chemical Industry Association, the International Council of Chemical Associations (ICCA), and the World Business Council For Sustainable Development (WBCSD).

4 Toray calculates water treated with Toray’s water treatment membranes by multiplying the amount of fresh water that its ultrafiltration water treatment membranes can produce per day, including reverse osmosis (RO), ultrafiltration (UF) and membrane separation bioreactors (MBR), by the number of membrane elements sold.

### Related Materiality for CSR

- Contributing to the solution of environmental issues through business activities
- Contributing to health maintenance and longevity through business activities
- Initiatives for managing water resources

Click here for a PDF summary of materiality-related CSR Roadmap 2022 main initiatives, KPIs and progress (PDF: 1.6MB).

### Looking to the Future

In fiscal 2021, the Green Innovation Project generated revenue of 832.2 billion yen on a consolidated basis. This was a year-on-year increase of 120.4 billion yen, attributed to business recovery from the impact of COVID-19 pandemic. Although sales of carbon fiber for aircraft remained sluggish due to the continued impact of COVID-19, sales of carbon fiber for wind turbine blades and water treatment membranes were strong. On the other hand, the contribution to the reduction of CO₂ emissions from the use of Toray Group products throughout the value chain increased due to business expansion. The Group will continue to help address resource, energy, and global environmental issues through its businesses.

Worldwide issues such as climate change, water scarcity, and resource depletion will become more serious, inducing a transition to more sustainable modes of production and consumption. Initiatives will be implemented for moving to a circular economy where used products are recovered and regenerated to make new ones. This will enable a further transition from a mass production/mass consumption linear business scheme to business models such as PaaS (products as a service), sharing, product life extension, resource collection and recycling, and circulated supply chains. The Green Innovation Project will take advantage of this transition to create new business opportunities and development.
In fiscal 2021, the Life Innovation Project generated revenue of 308.4 billion yen on a consolidated basis, due to increased shipments of sports-related materials and non-woven fabrics for hygiene products. Moving forward, Toray Group will continue to leverage its strengths in advanced materials in Life Innovation fields, while accelerating activities in the Pharmaceuticals & Medical Products Business.
CSR Activity Report (CSR Guideline Activity Reports) - Contributing Solutions to Social Issues through Business Activities

Green Innovation Business Expansion Project

Revenue of Green Innovation products (IFRS)

<table>
<thead>
<tr>
<th>Reporting scope</th>
<th>Target</th>
<th>Fiscal 2021 Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toray Group</td>
<td>1,000 billion yen (Fiscal 2022)</td>
<td>832.2 billion yen</td>
</tr>
</tbody>
</table>

Toray Group embraces the thinking that all business strategies must prioritize responsibility for the global environment in an effort to help build a more sustainable world with a small carbon footprint. The Group is endeavoring to realize this vision by addressing global environmental, resource, and energy issues through the continued implementation of the Green Innovation Business Expansion Project.

Green Innovation businesses have steadily grown since the start in 2011, reaching consolidated revenue of 832.2 billion yen in fiscal 2021. In the Medium-Term Management Program, Project AP-G 2022, which started in fiscal 2020, Toray Group set a challenging target of 1,000 billion yen in revenue from Green Innovation businesses on a consolidated and International Financial Reporting Standards (IFRS) basis and aims to expand its environment-related businesses. The contribution to CO$_2$ emission reduction$^1$ and water filtration$^2$ from the use of Toray Group products has steadily increased as the business has expanded. In fiscal 2021, Toray Group products helped to reduce CO$_2$ emissions in the value chain by 306.22 million tons (8.0 times higher than in fiscal 2013) and added 61.00 million tons of water filtration (2.2 times higher than in fiscal 2013).

<table>
<thead>
<tr>
<th>Contribution to CO$_2$ reduction$^1$ in value chain in fiscal 2021</th>
<th>306.22 million tons-CO$_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(8.0 times compared to fiscal 2013)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contribution of Toray water treatment products$^2$ in fiscal 2021</th>
<th>61.00 million tons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2.2 times compared to fiscal 2013)</td>
</tr>
</tbody>
</table>

$^1$ Toray calculates the CO$_2$ emissions reduced throughout the value chain of products in accordance with the chemical sector guidelines of the Japan Chemical Industry Association, the International Council of Chemical Associations (ICCA), and the World Business Council For Sustainable Development (WBCSD).
Toray calculates water treated with Toray’s water treatment membranes by multiplying the amount of fresh water that its ultrafiltration water treatment membranes can produce per day, including reverse osmosis (RO), ultrafiltration (UF) and membrane separation bioreactors (MBR), by the number of membrane elements sold.

Net Sales (Revenue) from Green Innovation Businesses (Toray Group)

<table>
<thead>
<tr>
<th>Year</th>
<th>Greenhouse gas reduction</th>
<th>Water treatment</th>
<th>Air purification</th>
<th>Low environmental impact</th>
<th>Recycling</th>
<th>Other (Biomass-based products, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>712.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>786.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2019 (J-GAAP)</td>
<td>820.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020 (IFRS)</td>
<td>711.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2021 (IFRS)</td>
<td>832.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2022 (Target) (IFRS)</td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: FY2020-21 performance and FY2022 target are revenue based on International Financial Reporting Standards (IFRS).

Related Information

› Toray Group’s Green Innovation

Click here for the main initiatives for CSR Guideline 7, “Contributing Solutions to Social Issues through Business Activities” in CSR Roadmap 2022.
CSR Activity Report (CSR Guideline Activity Reports) - Contributing Solutions to Social Issues through Business Activities

Promoting Life Cycle Management

In addressing global environmental issues, it is vital to consider the entire life cycle of products and services in order to reduce environmental impact while also delivering improved economic and social value. In this respect, Toray Group has been promoting life cycle management for some time. Life cycle management is the basis for Green Innovation products, and the Group has adopted life cycle assessment and the Toray Eco-Efficiency Analysis (T-E2A) tool and is working to ensure these are employed thoroughly in all of its businesses. Toray Group also recognizes the importance of product life cycle assessment when it comes to addressing global issues such as reducing greenhouse gas emissions and achieving zero emissions. In an effort to become carbon neutral, the Group will further enhance its assessment implementation and the corresponding promotion system. Moreover, it will actively utilize and promote life cycle assessment in order to help realize a carbon neutral society.

1 Life cycle assessment is a method for quantitatively assessing the resources that have gone into a product and the impact the product will have on the environment and ecosystems over its life cycle.

2 T-E2A is an environmental analysis tool developed by Toray Industries, Inc. It produces a map of multiple products plotted along the axes of environmental impact and economic performance, enabling users to select the most environmentally friendly and economical products.

Toray Industries’ Life Cycle Management Approach

Click here for the main initiatives for CSR Guideline 7, “Contributing Solutions to Social Issues through Business Activities” in CSR Roadmap 2022.
Approach to Green Innovation Products

The following diagram outlines Toray Group's process and procedures for certifying Green Innovation products. Products are subjected to a two-stage screening process conducted by the divisional committees and by the group-wide Green Innovation Certification Committee. Those able to demonstrate objective evidence of providing an effective solution for global environmental issues are certified as Green Innovation products.

Green Innovation Product Certification Process

1 This includes LCA data, T-E2A data, and estimates of CO₂ emissions reduction attributable to the product.
2 Comprised of members of Toray Industries’ Global Environment Business Strategic Planning Department, Corporate Marketing Planning Department, and Technology Center Planning Department, as well as experts when necessary.
Launch of New Nylon Fiber Made From Plants

100% Plant-based Nylon Fiber Ecodear™ N510

Toray Industries has developed a new fiber, Nylon 510 (N510), made entirely with polymer raw material obtained from plants. It has been released as Ecodear™ N510\(^3\) and is the newest in the lineup of biomass-based polymer materials and products under the Ecodear™ brand. The Company has created diverse potential applications for Ecodear™ N510 as a sustainable offering for high-end markets worldwide. While primarily for sports and outdoor fabrics they extend to lightweights, cut-and-sew fabrics through innerwear lace materials.

Toray Industries already offers partially plant-based polyester, nylon, and other polymers. However, this is the first 100% plant-based\(^4\) nylon fiber to be put on the market. Unlike other wholly plant-based nylons, Ecodear™ N510 has practical features like a high melting point and outstanding dimensional stability. Moreover, because it is as strong and heat-resistant as Nylon 6, companies can use it to create products that are sustainable and offer the same performance as products made from conventional petroleum-based nylon.

Going forward, Toray is focused on combining various proprietary technologies to drive further fiber advances. These would include making fibers thinner and lighter or adding functionality by changing cross-sectional shapes. In this way, the Company will develop an array of apparel and other materials applications. By providing innovative technologies and advanced materials, Toray will keep serving increasingly diverse lifestyles while contributing to affluent living and sustainability.

\(^3\) 100% plant-based nylon fiber made using Sebacic acid from castor-oil plants, and Pentamethylenediamine from corn.

\(^4\) ISO16620-1 3.1.5 bio-based synthetic polymer content (percentage of content derived from plants) is 100%.

SPORTS FABRICS (product site)
TORAY Commercializes “IMPRIMA™ FR” as New Waterless Offset Printing Plate for Flexible Packaging

Gravure and flexographic processes predominate in the printing of flexible packaging materials. A drawback is that these setups consume a lot of printing ink containing organic solvents. This results in energy consumption and CO₂ emissions when thermally drying these solvents and treating waste gas. There has therefore been a shift toward the adoption of offset printing, which is free of organic solvents and employs printing inks that are cured with electron beam or ultraviolet processes, which consume less energy.

IMPRIMA™ is the brand name for the Toray Waterless Plate™, which does not use water containing volatile organic solvents for dampening during the printing process and does not discharge alkaline processing liquid waste during plate making. More than 1,500 printing companies in 50 countries have adopted this Toray product in recognition of its eco-friendly performance. Released in October 2021, the IMPRIMA™ FR waterless printing plate for flexible packaging materials delivers high resolution and beautiful gradations in printing by leveraging Toray’s proprietary nano-structure and interface control technologies.

It also lowers printing costs because this printing plate costs less than those for conventional flexible packaging printing processes.

To assess the environmental impact, Toray produced estimates based on Product Category Rule PA-BC-02, the Japan Federation of Printing Industries’ calculation standard for plastic containers and packaging. The estimates confirmed that using the IMPRIMA™ FR waterless printing plate with electron beam offset printing for flexible packaging printing can reduce CO₂ emissions by up to one fifth compared to gravure printing and by up to one third compared to flexographic printing.

This product should significantly reduce CO₂ emissions and contribute to carbon neutrality in the growing flexible packaging materials market, while helping to improve printing quality and lower printing costs.

▶ Waterless printing plates (product site)
Toray's Hydrocarbon Electrolyte Membrane Contributes to Reducing Green Hydrogen Cost

As part of its efforts to help realize a carbon-neutral society, Toray Industries has been developing and demonstrating Japan's first megawatt-class, polymer electrolyte membrane (PEM) type water electrolysis technology. Since 2016, in collaboration with Yamanashi Prefecture and Tokyo Electric Power Company Holdings, Inc., Toray has been demonstrating a P2G (power-to-gas) system that produces hydrogen from photovoltaic power in Komekurayama, Kofu City, Yamanashi Prefecture. The project has shown that by using the hydrocarbon-based electrolyte membrane developed by Toray, it is possible to produce twice as much hydrogen per unit of membrane area as with conventional fluorine membranes, at the same voltage. It is expected that this drastic improvement in the efficiency of water electrolysis will greatly reduce green hydrogen costs in the future.

In June 2021, the project began supplying green hydrogen made using renewable energy to semiconductor factories and supermarkets in Yamanashi Prefecture, ahead of the rest of Japan. In addition, based on a Green Innovation Fund Project, supported by Japan's New Energy and Industrial Technology Development Organization (NEDO) and jointly adopted by eight parties concerned in August 2021, Toray plans to help build one of the largest PEM-type water electrolyzers in Japan to produce green hydrogen that could decarbonize factory heating demand. With its proprietary hydrocarbon-based electrolyte membrane technology, Toray will continue to improve the performance of water electrolyzers. Its aim is to help build a carbon-neutral world by lowering the cost of hydrogen to the current fossil fuel level, and to help build a global green-hydrogen supply chain.

In recognition of these efforts, Toray Industries received the Japan Business Federation Chairman's Award at the 30th Global Environment Awards sponsored by the Fujisankei Communications Group.

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5 Hydrogen produced by electrolyzing water using electricity generated from renewable energy sources. Because it is produced this way without emitting CO\(_2\), it is classified as green hydrogen.

6 The Global Environment Awards were established in 1992 with the aim of "industry coexisting with the global environment." As a way to recognize environmental excellence that brings together companies, government, and citizens, the program has involved special participation by the World Wide Fund for Nature Japan (WWF Japan; Honorary President, Crown Prince Akishino).

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Click [here](#) for the main initiatives for CSR Guideline 7, "Contributing Solutions to Social Issues through Business Activities" in CSR Roadmap 2022.
Realizing a Circular Economy

As a manufacturer of a wide range of materials, Toray Group has been promoting various recycling initiatives to ensure that the earth's resources are efficiently utilized.

In the Toray Group Sustainability Vision, the Group outlines "a world where resources are sustainably managed," as one of the perspectives of the world as envisioned in 2050. Conventional societies face a variety of problems, including the depletion of resources, marine pollution caused by large amounts of waste, and CO₂ emissions. In order to solve these problems and realize a sustainable, circular economy that makes effective use of resources, the Group facilitates recycling of plastic products, switching to biomass for raw material, adopting renewable energy and hydrogen, and reusing water, across its various technologies.

In its Medium-Term Management Program, Project AP-G 2022, Toray Group has identified realizing a circular economy as a key issue. An initiative example in this area is material recycling, which enables the reuse of products such as fibers/textiles, resins, and films. In addition, chemical recycling, which converts unrecyclable products back into basic chemicals such as monomers and gases, is already implemented for nylon fiber/textile products.

Toray Group is also working to develop materials that use bio-based instead of fossil resources, and membrane-integrated bioprocess technology, which efficiently produces these raw materials. Moreover, the Group is promoting carbon recycling, the use of CO₂ as a resource with our gas separation membranes. Toray technology is also used in the materials for the wind turbine blades and hydrogen production equipment that utilize renewable energy sources to generate electricity and hydrogen used in manufacturing processes, as well as in the water treatment membranes for the reuse of wastewater.
1 Material recycling is a recycling process that uses heat to convert used plastic bottles and remnants produced during manufacturing processes into yarn, staple fiber, and other materials.

2 Chemical recycling is a recycling process that breaks down through depolymerization used products and remnants produced during manufacturing processes into monomers that are manufactured back into chips and then recycled into yarn, staple fiber and other materials.

**Related Information**
For more information on Toray Group waste reduction, chemical substance management, energy conservation, and climate change measures, please visit the website below.

> Safety, Accident Prevention, and Environmental Preservation

**Recycling Activity Principles** Established in March 2004

1. We shall design, produce, and sell products that reduce our impact on the environment.
2. We shall purchase and use materials and products which will help reduce our impact on the environment.
3. We shall disclose information related to recycling programs and recycled goods.
4. We shall voluntarily cooperate with customers to recycle or otherwise appropriately dispose of our products.
Biomaterials Business

Toray Group is developing biomass-based materials made from plant-based raw materials instead of fossil raw materials. For example, Toray Group mass produces partially bio-based polyethylene terephthalate (PET) fibers that are made from plant-based ethylene glycol, which is also used to make Ultrasuede™ PX ultra-microfiber non-woven fabric with suede texture. Toray Group is also prototyping a 100% bio-based PET fiber and developing membrane-integrated bioprocesses. The Group has recently developed and launched Ecodear™ N510, a nylon fiber made from 100% plant-based raw materials.

100% Bio-Based PET Fiber, Membrane-Integrated Bioprocesses

Toray Group is promoting a 100% bio-based PET material made from plant-based ethylene glycol and bio-para-xylene produced at its pilot plant, as its flagship environmentally conscious products. Toray Group seeks to launch mass production of these materials for sportswear and automotive interior applications in the early 2020s.

Toray Group is also developing a membrane-integrated bioprocess to enable bio-based raw materials to be manufactured with greater efficiency. This membrane-integrated bioprocess combines membrane separation technology and biotechnology to create new applications for water treatment membranes in processes such as saccharification, fermentation, and purification. The technology significantly improves the manufacturing of raw sugar from non-edible biomass and increases fermentation efficiency, thereby contributing to realizing a non-fossil raw material. Toray Group is currently operating a technology demonstration project for a saccharification process that produces sugars from nonedible biomass. Toray Group will work to commercialize the technology, in order to build a supply chain that produces materials and chemicals from non-edible biomass.
Promoting Recycling

At Toray Group, Ecourse™ is the unified brand for its recycled materials and products across a wide range of business segments including fibers & textiles, plastics, and films. These products include fibers made by recovering and recycling discarded PET bottles and scrap ends generated from manufacturing processes, recycled resin made from scrap ends generated during manufacturing and collected used products, as well as films made by recovering and recycling films that have been used in customer processes.

In the fiber/textile segment, Toray Group offers the CYCLEAD™ reclaiming system for the recovery and circulation of used fibers. In 2019, Toray Group introduced the &+™ (“And plus”) brand of recycled fibers that include Toray’s original traceability function. These fibers are made from discarded PET bottles and use filtering and cleaning technologies to remove foreign matter, resulting in a fiber with high whiteness that can be made into a wide variety of products.

Finally, Toray promotes efforts that involve developing unique material recycling systems to, for example, recover and recycle used fibers, resin, and film.

Fiber and Textile Recycling

Recycled Materials ECOUSE™

ECOUSE™ is a textile mainly for corporate uniforms, made from reusing byproducts such as film and thread scraps from internal manufacturing processes.

> ECOUSE™ recycled polyester fiber (product site)
&+™ Fiber Brand Made from Recycled Plastic Bottles

Previously, plastic bottle derived-fibers were limited in variety due to contaminants mixed into raw materials, which made it difficult to produce special cross-sections and fine fibers, as well as issues posed by fiber whiteness being impaired by yellowing from plastic bottle degradation. In response, Toray together with Kyoei Industry Co., Ltd. developed contaminant filtering technology and advanced plastic bottle cleaning techniques to stabilize the supply of raw materials that are impurity-free. Combining these technologies with Toray’s fiber production technology, it is possible to achieve diverse fabric applications with a degree of whiteness equivalent to fibers materials made directly from fossil resources. Moreover, Toray has commercialized its highly reliable polyester fiber under the &+™ brand by incorporating its proprietary traceability technology that can detect special additives premised in with plastic bottle-based raw materials. In January 2020, Toray Industries began full-scale sales of &+™ brand products. Going forward, the goal is to expand the scale of the brand by utilizing a diverse supply chain that includes textiles and sewn products, as well as fibers, and involves production sites around the world.

> &+™ (product site)
3 &+ raw pellets have better whiteness than typical recycled plastic pellets due to Toray’s cleaning and filtering technologies.

4 &+ fiber has a high degree of whiteness and can be made in a wide variety of textiles. It is therefore used in a wide range of clothing including fashion garments and sportswear, by meeting diverse needs for functionality, texture, and color variation. Clean PET bottles that have been properly sorted are transformed using various recycling processes into high-quality &+ PET fiber.

Promoting Recycling with UNIQLO

Together with UNIQLO, Toray is promoting new initiatives for sustainable products, with Toray supplying fibers made from recycled plastic bottles for UNIQLO’s quick-drying wear DRY-EX brand polo shirts starting in 2020. In addition, UNIQLO stores are collecting used down items from customers to recycle the feathers. Conventionally, the stuffing in duvets and other objects incorporating down is manually removed. Such processes are arduous with Ultra Light Down items because of their thin outer fabric and complex construction. By developing special extraction machinery, Toray has fully automated cutting, stirring and separating, and recovery, for 50-fold the process capacity of manual processes, thus greatly alleviating workloads. Toray and UNIQLO are jointly developing new recycling-based down products from recycled feathers.
Expanding Recycled Grade Products by Recycling Pre-Consumer and Post-Consumer Materials

Toray Group is developing recycled grade products based on a proprietary formulation design that actively engages in both pre-consumer recycling, utilizing such byproducts as film and fiber scraps from manufacturing processes, and post-consumer recycling, utilizing used materials collected from users. The Group also produces chemically recycled PBT grades made by depolymerizing scraps and then re-polymerizing them back into PBT. Toray will continue to meet customer needs for recycled resin by sourcing materials from diverse sources in and outside the Group.
Recycling Post-Consumer Materials and Practicing Closed Loop Recycling with Customers: Horizontal Recycling of Air-Conditioner Components

For post-consumer recycling, the Group is working with customers to establish a material recycling system for reusing fans from indoor air conditioners collected under the Home Appliances Recycling Law as new fans. Fans installed in indoor air conditioners use glass fiber-reinforced acrylonitrile-styrene resins, and Toray’s unique collection and foreign substance removal system and materials blending method solve such problems as contamination and glass breakage during recycling as well as realize physical properties nearly equivalent to virgin materials.

The Group is currently looking at ways to work with customers to recycle in other sectors, as well.

Film Recycling

Toray Industries is promoting pre-consumer recycling, using byproducts from the PET film LUMIRROR™ manufacturing process in textile and resin applications, as well as for environmentally friendly film. In addition, the Company operates a recycling system for collecting waste PET film from customer manufacturing processes to be recycled and reused as raw material for film.
Reusing waste PET film from customer manufacturing processes

Toray Industries has established a recycling system to collect used films from electronic component applications and recover them for use in producing eco-friendly films, launching the Ecouse™ series, which helps to build a sustainable economy. The company combined mechanical recycling process technology, which removes coating materials and resins from film surfaces, with foreign matter removal techniques for each manufacturing process to enable reuse of the recovered materials in films without impairing mechanical characteristics or reliability. The Ecouse™ series of eco-friendly PET films has reduced the amount of fossil-based resin used as a raw material, and can therefore lower CO₂ emissions by up to 50% compared to conventional films. The Company will continue to make use of this system to help build a circular economy.
Due to its excellent mechanical properties, carbon fiber allows products to be lighter and last longer. Therefore, it is a material that significantly curbs CO₂ emissions over the entire lifecycle of the products, including their operation, contributing to solutions for global environmental issues. In particular, the use of carbon fiber in environmental products such as large wind turbines, aircraft, and hydrogen tanks significantly reduces CO₂ emissions during their operation. As demand grows, market expectations for the development of carbon fiber recycling technologies are also on the rise.

The successful development of recycled carbon fiber and associated applications requires collaboration with a wide range of customers to explore various possibilities for use in specific parts and materials. Toray Industries collaborated with Toyota Tsusho Corporation in a program of the New Energy and Industrial Technology Development Organization (NEDO) for the development of a highly efficient recycled carbon fiber manufacturing technology that uses an innovative and energy-efficient thermal decomposition method, and completed the project in 2017. This new technology uses combustible gas from matrix resin as the energy source for the thermal decomposition process, which is the process that consumes the most energy in this type of carbon fiber recycling. As a result, the companies have significantly reduced the amount of energy consumed in the recycling process. As a result, the companies have significantly reduced energy consumption and CO₂ emissions in the recycling process to less than one-tenth of the energy consumption and CO₂ emissions of virgin carbon fiber production. With an eye towards future commercialization, Toray Industries constructed and began to operate a pilot plant to test energy-efficient recycled carbon fiber manufacturing technologies. In addition, Toray Group will work with its customers to promote the development of new applications for recycled carbon fiber. Through these efforts, the Group aims to establish a circular flow of carbon fiber that will help drive a circular economy. (See chart below.)
Establishing a Circular Economy (CE) That Uses Recycled Carbon Fiber

5 Thermal decomposition method: A recycling method in which carbon fiber is recovered by heating carbon fiber composite materials and thermally decomposing the matrix resins.

Click here for the main initiatives for CSR Guideline 7, “Contributing Solutions to Social Issues through Business Activities” in CSR Roadmap 2022.
In the field of health and medical care, the world has entered a period of historic change. The threats posed by the COVID-19 pandemic have been added to the existing challenges of declining birthrates and aging populations in developed countries, soaring social security costs, and global healthcare disparities. Toray Group’s life science business helps to support health and medical care, especially through polymer material research, which Toray Group has pursued since its establishment.

The Life Innovation Business Expansion Project started in fiscal 2014 with the launch of the Medium-Term Management Program, Project AP-G 2016. Life Innovation is a group-wide project aimed at improving health by making the most of Toray Group’s advanced materials, core and elemental technologies, and business platforms. The project focuses on businesses that can improve the quality of medical care, reduce the burden on medical staff, and support people’s health maintenance and longevity. Under the Medium-Term Management Program, Project AP-G 2022, which was initiated in fiscal 2020, Toray Group has been adding businesses related to personal safety products, including ones that help protect people from infectious diseases, extreme weather (heat waves, etc.), disasters, and accidents, and strengthening group-wide initiatives related to these businesses.

**Product Definitions and Guidelines**

**Improving the quality of medical care and reducing burden on medical staff**
- Products used in medical treatment, products used in medical testing and diagnosis, supplies/products used in medical institutions

**Supporting a society where people everywhere can live long, healthy lives**
- Maintaining wellness, health, and independent living, improving activities of daily living (ADLs) for the elderly and home-care recipients, reducing the burden on care givers (nursing staff and families), and addressing public health issues
FILTRYZER™ HDF

Supporting personal safety
- Leveraging materials to protect people from disasters, extreme weather (heat waves, etc.), and accidents

Net sales (“revenue” from fiscal 2020) in Life Innovation businesses have steadily increased from 142.2 billion yen in fiscal 2014 to 308.4 billion yen in fiscal 2021 due to the addition of personal safety products to this business area in fiscal 2020. Toray Group aims to expand revenue in this area to 300 billion yen in fiscal 2022, based on International Financial Reporting Standards (IFRS).

Net Sales (Revenue) of Life Innovation Businesses (Toray Group)

![Net Sales (Revenue) of Life Innovation Businesses (Toray Group)](chart)

Note: FY2020-21 performance and FY2022 target are revenue based on International Financial Reporting Standards (IFRS).

Toray Debuts Japan’s First PMMA Hemodiafiltration Device FILTRYZER™ HDF

Toray Industries has developed FILTRYZER™ HDF, Japan’s first polymethyl methacrylate (PMMA) hollow fiber membrane-based hemodiafiltration device, and has recently launched sales of this product in Japan. Broadly two therapies employ artificial kidneys. The first is hemodialysis with dialyzers. The second is hemodiafiltration with hemodiafilters, which combines hemofiltration and hemodialysis.

More than 80% of hollow fiber membranes in hemodiafilters in Japan are made of polysulfone. Demand has risen for other materials, including because of allergic reactions and other biocompatibility issues and toxin removal performance needs. Toray is the world’s sole
manufacturer of dialyzers incorporating PMMA hollow fiber membranes. They have earned excellent reputations in Japan and numerous other nations for excellent biocompatibility and uremic toxin removal.

By using technology it has developed over many years, the Company pursued hemodiafilter development and now has Japan’s first PMMA hemodiafiltration device, FILTRYZER™ HDF. The product has since received manufacturing and marketing approval in Japan, and is covered by the country’s health insurance system.

Having obtained approval in 2007 to market Japan’s first polysulfone hollow fiber membrane hemodiafilters, the Company has continued to work to improve them. The new PMMA hemodiafiltration device underscores Toray’s ongoing commitment to meeting diversifying dialysis market needs.

**Toray Develops Biochip for High-Performance Multi-Item Allergy Testing**

Food, pollen, and other allergies afflict half of Japan’s population. Incidence rates are rising, particularly among infants and young adults. It is common in medicine to identify such ailments by using in vitro diagnostic products that measure allergen-specific IgE antibody levels in the blood. An issue with simultaneously measuring allergen-specific IgE antibodies from small blood samples (which can alleviate stress for certain patients) has been that proteins, cells, and other contaminants in the blood impede accurate measurements.

Recently, Toray Industries completed development of an allergy testing biochip that can simultaneously measure multiple allergen-specific immunoglobulin E (IgE) antibodies from trace amounts of blood. Toray was able to attain high precision from measurements with small samples by combining the microarray technology of its 3D-Gene™, a highly sensitive DNA chip, and its low-fouling polymer technology to prevent blood component adhesion.

This new biochip should help reduce stress on children and others whose blood is difficult to draw and enhance the accuracy of allergy diagnostics in medical settings. Toray aims to undertake large-scale verifications of the specimens of allergy sufferers and swiftly apply for in vitro diagnostic certification.

**Highly Breathable Model of LIVMOA™ Disposable Personal Protective Clothing Proven to Reduce Heat Stress**

Based on a fusion of fiber and film technologies, the LIVMOA™ lineup of disposable personal protective clothing provides both comfort and barrier properties, making it ideal for dust protection, clean rooms, infection control, and other uses. Toray Industries is promoting business development for this product line.

The Company conducted an evaporative heat resistance test on the fabric of a highly breathable model of LIVMOA™ designed to optimize safety and comfort. Using the Wet Bulb Globe Temperature (WBGT) index, a benchmark for heat stress, the test found that the correction value (value added to the WBGT value according to the clothing combination) showed the same value as for regular clothing. Accordingly, this protective clothing helps keep the wearer from getting sweaty while working, resulting in a high level of comfort. Additionally, the test confirmed that the fabric helps reduce heat stress for the wearer compared to general-purpose protective clothing.
Going forward, Toray will strive to promote safer and more comfortable work environments by marketing its highly breathable model of LIVMOA™ disposable personal protective clothing to the manufacturing and construction sectors, where heat protection is essential in summer.

1 This benchmark used for heat stroke prevention is derived from temperature, humidity, and radiation from light.

Toray Concludes Business Collaboration Agreement with ASKA Concerning Adhesion Barrier TRM-270C

Toray Industries signed a business collaboration agreement with ASKA Pharmaceutical Co., Ltd. to develop and commercialize an adhesion barrier in Japan. Toray has been developing the product in collaboration with Nanotheta Co., Ltd.

The product is used during medical procedures in obstetrics and gynecology, as well as in gastroenterology procedures. It has a laminated structure that comprises anti-adhesive layers, as well as supportive layers that are made of biodegradable polymers and water-soluble polymers respectively. Since it has the properties of being both flexible and providing good adherence to organs, the expected benefits are good operability particularly during laparoscopic surgeries with an excellent anti-adhesive effect.

Through the commercialization of this product, Toray hopes to improve the prognoses of patients who undergo surgery in obstetrics and gynecology as well as gastroenterology interventions.

Click here for the main initiatives for CSR Guideline 7, “Contributing Solutions to Social Issues through Business Activities” in CSR Roadmap 2022.