CSR Activity Report (CSR Guideline Activity Reports)

Contributing Solutions to Social Issues through Business Activities

Leverage innovation to provide solutions to various social issues such as climate change, resource and energy use, water resource and natural environment conservation, improvement of medical care, and promotion of public health, thereby contributing to sustainable development for society.

Basic Approach

Global environmental issues continue to become increasingly severe, marked by global warming, water scarcity, marine pollution, resource depletion, and loss of biodiversity. 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.

In 2018 and 2020 respectively, the Group established and announced the Toray Group Sustainability Vision followed by the Long-Term Corporate Vision, TORAY VISION 2030 to clearly outline the world as envisioned by the Toray Group in 2050. The Group also set KPIs to be achieved by 2030 as long-term milestone targets. Under the Medium-Term Management Program, Project AP-G 2025, announced in March 2023, Toray integrated the Green Innovation and Life Innovation businesses, creating a Sustainability Innovation (SI) Business[1] to better meet diversifying sustainability needs. This is being promoted under the Sustainability Innovation (SI) Business Expansion Project.

With its SI business, Toray Group aims to help 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,” “a world with a restored natural environment, with clean water and air for everyone,” and “a world where everyone enjoys good health and hygiene” as outlined in the Toray Group Sustainability Vision. Here are some specific examples of Toray initiatives in this business area. To accelerate efforts to combat climate change, the Group is expanding aircraft and automobile applications for its advanced materials and helping to reduce CO_2 emissions by improving fuel efficiency through vehicle weight reduction. It is also working to help society transition to renewable energy by supplying materials for wind and hydrogen power applications. For the sustainable, circular use of resources, the Group is also promoting initiatives for resource recycling and bio-technology. To help ensure safe water and air, it is proceeding with initiatives in areas such as water treatment membranes and air filters. Finally, the Group is expanding its products that support health, longevity, improved quality of medical care, and human safety, as well as help the elderly and home-care recipients to live more independent lives.

1 Sustainability Innovation (SI) business: Businesses or material lines that can help realize the Toray Group Sustainability Vision.

Structure

To promote activities designed to achieve the Toray Group Sustainability Vision, the Group formulates and promotes medium- and long-term roadmaps and action plans under the SI Business Expansion Project and the Climate Change Project, addressing climate change and the need for circular economy creation. The Group is also managing progress toward achieving relevant numerical targets set for 2030.
Through these projects, Toray Group is contributing to the reduction of greenhouse gas emissions to help achieve a carbon neutral world, as well as promoting the reduction of Toray Group greenhouse gas emissions to become carbon neutral itself. The Group is also accelerating its resource recycling efforts, including recycling and the conversion of key polymers to biomass-based polymers, by developing and promoting group-wide strategies for the implementation of sustainable, circular use of resources.
Furthermore, the Group is examining and promoting an overall strategy to reduce its impact on biodiversity and natural capital.
The Board of Directors is supported by the Executive Committee, which serves as a council for deliberating key group-wide matters. The committee discusses project details, key policies, and important agenda items related to sustainability. Moreover, it collaborates with functional departments responsible for CSR, risk management, safety, health, and the environment, as well as research and technological development, to address sustainability challenges faced by the entire Toray Group.
The Board of Directors receives reports on these discussions from each functional department at least once a year and provides oversight and makes key decisions. When it comes to formulating business strategy and making management decisions, sustainability issues are a key consideration in the overall deliberations and decision-making.
For more information on the Toray Group governance structure related to the issue of climate change, please refer to the Toray Group TCFD Report Ver. 2.1.

CSR Roadmap 2025 Targets

CSR Roadmap goals

Leverage Sustainability Innovation Business to address social issues by growing businesses based on the provision of innovative technologies and advanced materials, and by creating new technologies

Main Initiatives and Key Performance Indicators

	KPI
(1) Expand revenues from Sustainability Innovation Business	7-❶
(2) Expand contribution to CO_2 reduction in the value chain[2]	7-❷
(3) Expand water filtration throughput contribution by Toray's water treatment membranes[3]	7-❸
(4) Conduct a wide variety of product research and technology development to help build a low-carbon, circular economy	-
(5) 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	-
(6) Contribute to countermeasures to public health risks, including infectious diseases, by developing and upgrading materials and products for personal protective equipment, as well as materials to protect environmental hygiene including of air and water	-

Key Performance Indicator (KPI)	Target			Fiscal 2023 Result
	Fiscal 2023	Fiscal 2024	Fiscal 2025	
7-❶ Revenues from Sustainability Innovation Business	1,600 billion yen (Fiscal 2025)			1,311.5 billion yen
7-❷ Contribution to CO_2 reduction in value chain	15 times compared to fiscal 2013 (Fiscal 2025)			10.3 times compared to fiscal 2013
7-❸ Contribution of Toray water treatment products	2.9 times compared to fiscal 2013 (Fiscal 2025)			2.7 times compared to fiscal 2013

Reporting scope: Toray Group

2 Toray calculates the value chain CO_2 emissions reduced throughout the entire product lifecycle in accordance with the chemical sector guidelines of the Japan Chemical Industry Association, and the International Council of Chemical Associations (ICCA).

3 Water treated annually with Toray water treatment membranes. It is calculated by multiplying the amount of fresh water that the Toray 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

- Accelerating Climate Change Mitigation
- Promoting a Circular Economy
- Taking a Nature-Positive Approach
- Committed to Healthier Lives
- Developing in Collaboration with Stakeholders

* Click here for CSR Roadmap 2025 from the perspective of materiality (PDF:392.4KB). PDF

Looking to the Future

The consolidated revenue generated by the Sustainability Innovation (SI) Business in fiscal 2022 was 1.2828 trillion yen. For fiscal 2023, revenue increased by 2.2% year-on-year to 1.3115 trillion yen. In the carbon fiber composite materials business, while the wind turbine blade segment was affected by inventory adjustments, recovery in the aviation segment had a significant impact. The fiscal 2025 revenue target for this business is 1.6 trillion yen, with the aim of achieving an average annual growth rate of 7.6% compared to fiscal 2022. Along with business expansion, the contribution to CO_2 reduction in the value chain and the environmental contribution of Toray water treatment products have steadily increased.

Worldwide, a range of issues are becoming increasingly interconnected and serious. These include population growth and aging in many countries, as well as climate change, water shortages, and resource depletion. This is 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.

In order to better respond to diversifying sustainability needs, the Group is promoting more vigorous expansion of products that can help achieve the aims outlined in the Toray Group Sustainability Vision. These include aims 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) [CN domain[4]], “a world where resources are sustainably managed” [CE domain[5]]. and “a world with a restored natural environment, with clean water and air for everyone” [NP domain[6]], and “a world where everyone enjoys good health and hygiene” [LI domain[7]].

4 CN domain: Defined as products that support energy conservation by reducing the weight of mobility and decreasing electrical loads; new energy source adoption, with a focus on renewable energy, mobility electrification, and hydrogen-related products; and the absorption and recycling of CO_2. Initiatives in this domain are mainly focused on energy conservation that utilizes lightweight materials and heat-blocking/insulating materials, as well as electrification and hydrogen-related materials.

5 CE domain: Defined as products to support recycling, biomass utilization, and valuable material separation and recovery. In this domain, the focus is primarily on promoting the recycling of key polymers such as PET and nylon, as well as the use of biomass-derived raw materials.

6 NP domain: Products for water treatment, air purification, and reducing environmental impact. The primary efforts are in water treatment membranes, as well as materials and alternative technologies for reducing pollution.

7 LI domain: Products for improving the quality of medical care, health, longevity, and human safety. The focus is on expanding businesses related to pharmaceuticals, medical devices, hygiene products, safety, and health.

Click here for the main initiatives and KPIs for CSR Guideline No. 7 “Contributing Solutions to Social Issues through Business Activities” during the CSR Roadmap 2025 period (fiscal 2023–2025).

CSR Activity Report (CSR Guideline Activity Reports) - Contributing Solutions to Social Issues through Business Activities

Sustainability Innovation Business Expansion Project

CSR Roadmap 2025
Main Initiatives (1)(2)(3)(4)(5)(6)

Revenues from Sustainability Innovation Business

■Reporting scope
Toray Group

■Target
1,600 billion yen (Fiscal 2025)

Fiscal 2023 Result

1,311.5

billion yen

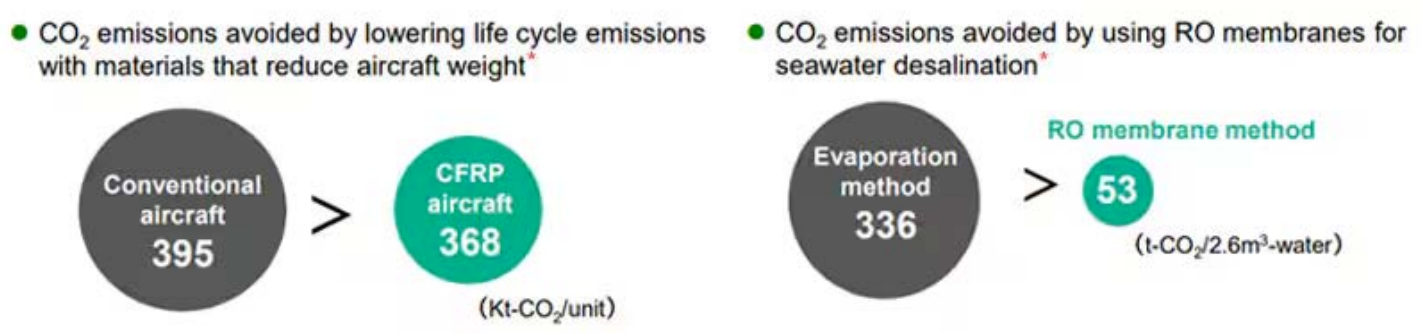
The Toray Group mission is to deliver innovative technologies and advanced materials that provide real solutions to the challenges the world faces with balancing development and sustainability.

Under the Medium-Term Management Program, Project AP-G 2025, which began in fiscal 2023, the Group has combined its Green and Life Innovation businesses to create the Sustainability Innovation (SI) business, which it aims to further expand. In fiscal 2023, the SI business accounted for 53% of Toray Group's consolidated revenue. In fiscal 2023, Toray Group products helped to reduce CO_2 emissions[1] in the value chain by 395.29 million tons (10.3 times higher than in fiscal 2013) and added 73.00 million tons of water filtration[2] (2.7 times higher than in fiscal 2013).

Contribution to CO_2 reduction in value chain in fiscal 2023

395.29 million tons-CO_2
(10.3 times compared to fiscal 2013)

Volume of CO_2 emissions avoided through use of Toray products



* Figures in the circles above represent CO_2 emissions for the entire product life cycle.
Source: *Innovations for Greenhouse Gas Reductions*, Japan Chemical Industry Association (JCIA)

Contribution of Toray water treatment products in fiscal 2023

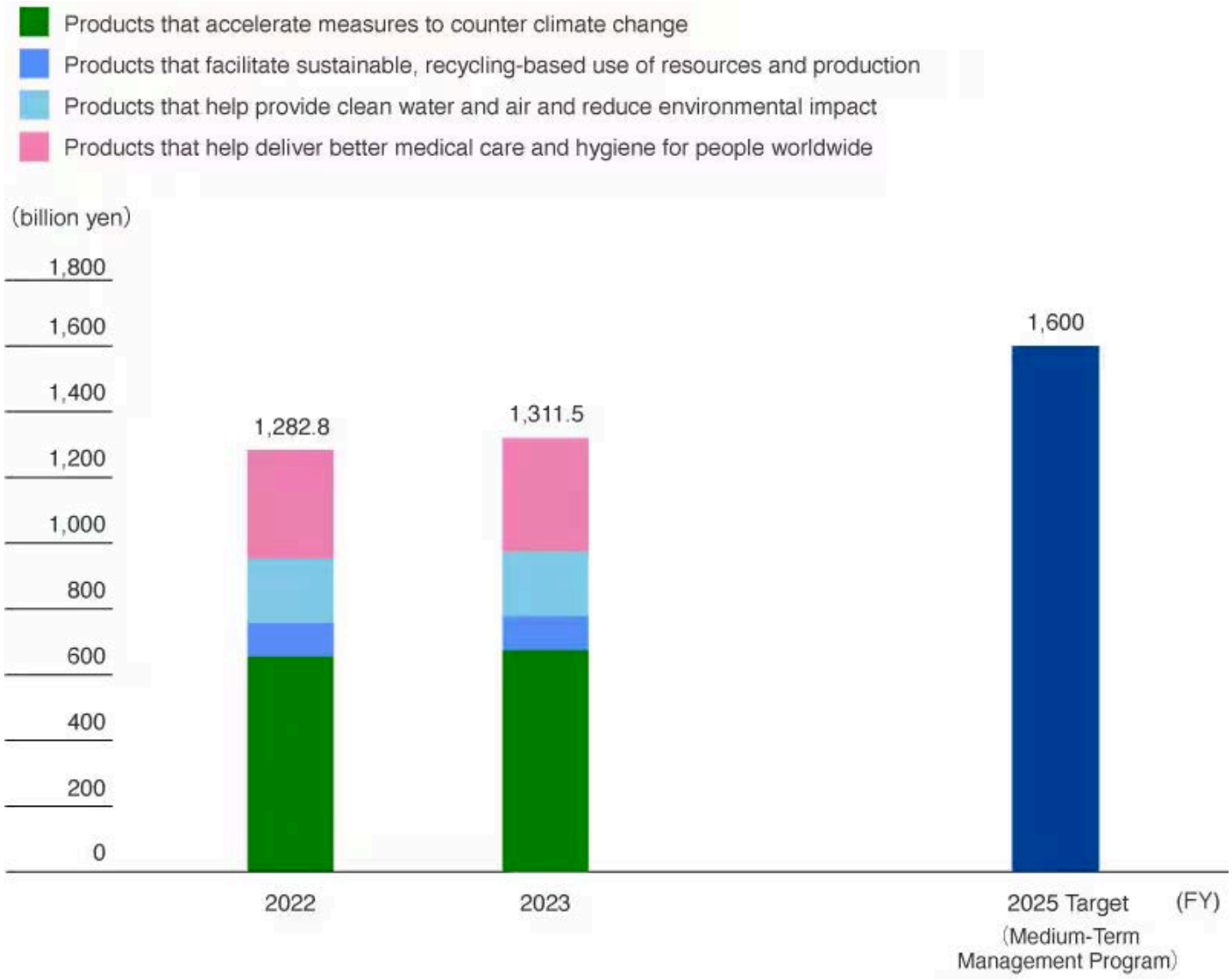
73.00 million tons
(2.7 times compared to fiscal 2013)

To achieve global carbon neutrality, greenhouse gas emissions must be reduced across entire supply chains. Accordingly, there is a growing demand for product carbon footprint data to be made available and for carbon levels to be reduced. The Group is undertaking a succession of product footprint calculations and has begun providing data to some business partners.

As part of efforts to address global environmental issues, it is important for companies to consider the entire life cycle of their products and services when deciding how to reduce environmental impact, while enhancing economic and social value at the same time.
Toray Group has long promoted product life cycle management (LCM). The Group's aim is not only to achieve its own carbon neutrality, but to also help realize a carbon-neutral society through the reduction of greenhouse gas emissions across the entire supply chain.

1 Toray calculates the value chain CO_2 emissions reduced throughout the entire product lifecycle in accordance with the chemical sector guidelines of the Japan Chemical Industry Association, and the International Council of Chemical Associations (ICCA).
In recent years, new calculation guidelines have been released by various organizations, and the Group is considering revision of its calculation method based on the updated standards.
2 Water treated annually with Toray water treatment membranes. It is calculated by multiplying the amount of fresh water that the Toray 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 Sustainability Innovation Businesses (Toray Group)



Fiscal 2023 Initiatives for the Sustainability Innovation Business

Toray's SUMMER SHIELD™ Fabric Protects Participants at 5th All Japan Beach Volleyball U-23 Men's and Women's Select Championship

Beach Volleyball NEXT 2023, the 5th All Japan Beach Volleyball U-23 Men's and Women's Select Championship was held under the scorching sun at the Okura Coast beach park in Akashi City, Hyogo Prefecture. To help protect participating athletes and staff from the risk of heatstroke, shade canopies made from SUMMER SHIELD™ fabric were set up. On the day of the event, a trial was carried out to compare traditional canopies made of coated fabric and those made using SUMMER SHIELD™. The participants were able to experience the cooling effect of each canopy type, and surface temperatures were compared using a thermal camera.

Players taking a break under a SUMMER SHIELD™ canopy during a match

Toray Participates in the Net Zero Forum Shiga

Net Zero Forum Shiga was launched with the involvement of various stakeholders in Shiga prefecture. Its aim is to help achieve net zero emissions in the prefecture and enhance the quality of life for residents, while promoting sustainable development for the region and its economy. Toray Senior Director Toshiyuki Nonaka spoke at the forum. The event was attended by a diverse group, including business representatives, experts, and government officials. In his presentation, Mr. Nonaka highlighted Toray's net-zero activities. He also discussed global trends, changes in the industry, energy and CO_2 reduction initiatives, as well as movements in the plastics and food sectors aimed at circular economy creation. He emphasized the importance of inter-company collaboration across regions and diverse initiatives involving industry, government, and academia.

Toray Senior Director Toshiyuki Nonaka delivering his presentation

Click here for the main initiatives for CSR Guideline 7, “Contributing Solutions to Social Issues through Business Activities” in CSR Roadmap 2025.

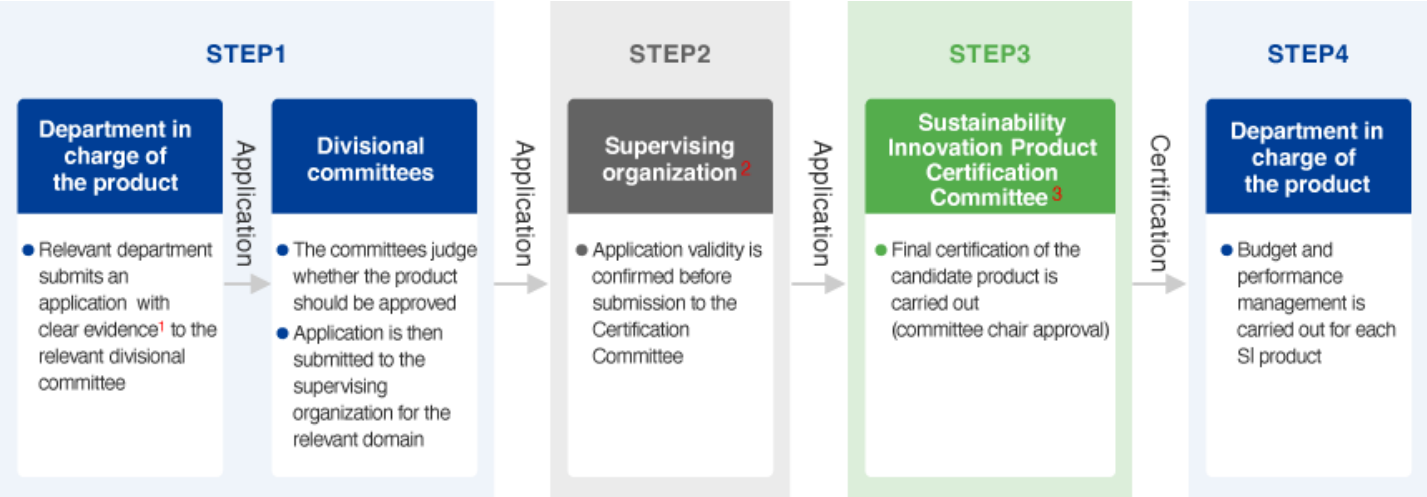
CSR Activity Report (CSR Guideline Activity Reports) - Contributing Solutions to Social Issues through Business Activities

Approach to Sustainability Innovation Products

CSR Roadmap 2025
Main Initiatives (1)(2)(3)(4)(5)(6)

Toray Group is contributing to society and reducing its own environmental impact through business activities, aiming to realize the four objectives outlined in the Toray Group Sustainability Vision. The Group defines its Sustainability Innovation (SI) Products as products and technologies that can help achieve the four priorities outlined in the Toray Group Sustainability Vision, namely, 1) products that accelerate measures to counter climate change, 2) products that facilitate sustainable, recycling-based use of resources and production, 3) products that help provide clean water and air and reduce environmental impact, and 4) products that help deliver better medical care and hygiene for people worldwide. To certify its SI products, the Group has established an SI Product Certification Committee, and products are certified according to the procedures shown in the diagram below. Based on a three-stage review process involving the relevant divisional committee, supervising organization, and the SI Product Certification Committee, SI products are certified based on objective assessment of their contribution to sustainability.

Sustainability Innovation Product Certification Process



1 In addition to estimates of CO_2 emissions reduction attributable to the product, and details concerning the intended applications and materials used, analysis results data based on 1) a product life cycle assessment (a method for quantitatively evaluating environmental impacts throughout the entire life cycle of a product, from resource extraction and material and component manufacturing, to distribution, use, and disposal), as well as 2) a life cycle inventory (a list of environmental impact items and the relevant resource inputs and emission outputs over the life cycle of the product or service)

2 Supervising organizations (domains of responsibility):
■SI Strategy Group, Corporate Strategic Planning Division (Carbon Neutral and Nature Positive)
■Environmental Solutions Department (Circular Economy)
■Sustainable Technology Department (Life Innovation)

3 Sustainability Innovation Product Certification Committee: The SI Business Expansion Project leader (committee chair: executive vice president for Corporate Sales & Marketing), senior vice president in charge of the Corporate Strategic Planning Division, executive officer in charge of the SI Strategy Group, general manager of the Corporate Marketing Planning Division, general manager of the Technology Center Planning Division, as well as external experts when necessary

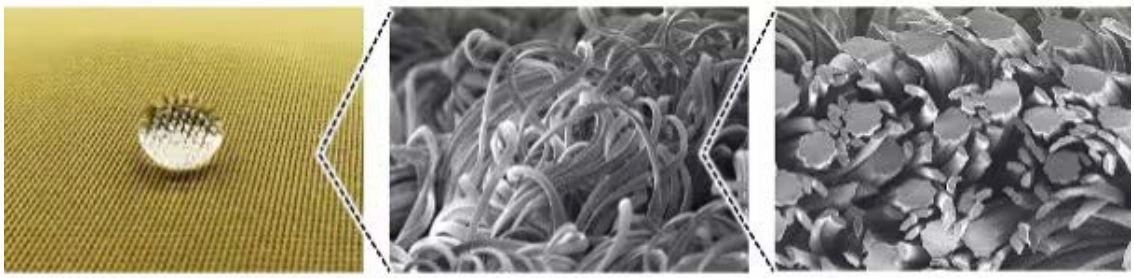
Sustainability Innovation-Related Products and R&D Announced in Fiscal 2023

CSR Roadmap 2025
Main Initiatives (1)(2)(3)(4)(5)(6)

Toray Launches DEWEIGHT™ – A PFAS-free Stretch Textile with Outstanding Water Repellency

Brand logo

Toray Industries, Inc. has recently developed DEWEIGHT™ a stretch textile offering excellent water repellent performance without any PFAS (organic fluorine compounds, frequently called “forever chemicals”).
This newly developed material mimics the structure of highly water-repellent surfaces found in nature, such as lotus leaves and butterfly wings. By looking at the multiscale roughness of these natural surfaces, which feature micro- and nanoscale structures, Toray developed a fabric that allows water droplets to easily roll off the surface while providing a smooth, dry, and comfortable feel against the skin.
The new textile structure was achieved through the precise control of fiber cross-sections using new proprietary yarn and Toray’s special advanced processing technology (NANODESIG™)[4] that creates two different types of spiral structures. This innovation delivers superior water repellency without using fluorine-based water repellents, which are coming under increasing regulation due to potential health hazards when they accumulate in the human body.
DEWEIGHT™ was developed to better meet customer desires, such as wanting to look stylish and feel comfortable even on rainy days. Going forward, there are plans to expand its application to everyday fashion, including everything from outerwear for both men and women, to pants and dresses.



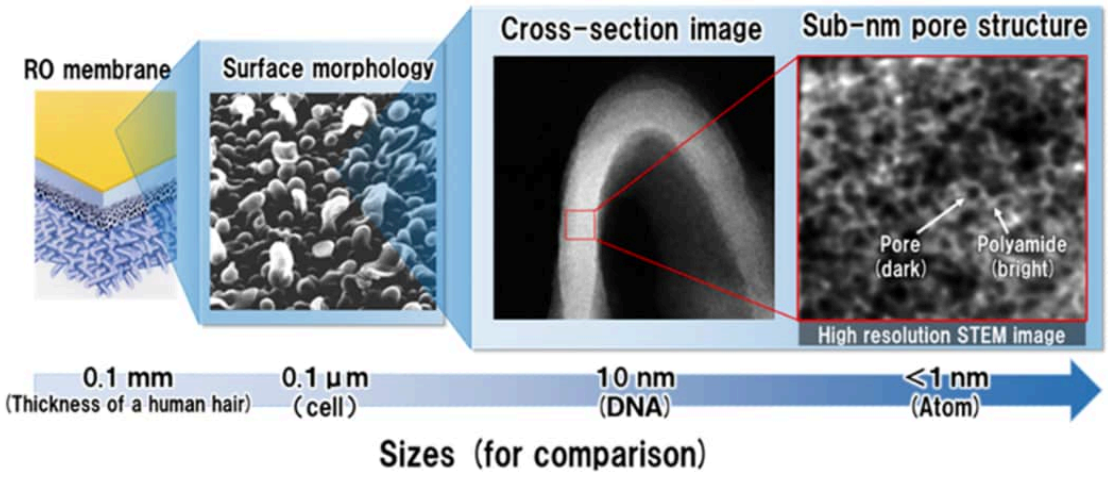
4 Website for conjugate spinning technology NANODESIGN™: https://www.nanodesign.toray/en/

Toray Develops High-Durability Reverse Osmosis Membrane that is Expected to Improve Wastewater Reuse Efficiency, and Halve CO_2 Emissions

Toray Industries, Inc. has recently developed a high-durability reverse osmosis (RO) membrane that can produce high-quality water for extended periods while maintaining treatment performance, which makes it suitable for reusing industrial wastewater and treating sewage. The new membrane offers double the resistance to cleaning chemicals compared to conventional products. This is expected to reduce performance degradation due to membrane deterioration and simplify operational management, thereby halving replacement frequencies and shrinking the product’s carbon footprint.
The broad applications of RO membranes include desalinating seawater and river water, reusing wastewater, and producing drinking water as a technology to ensure sustainable water sources.
In the field of wastewater reuse, cleaning chemicals are being used more frequently to maintain filtration

performance, leading to membrane pore deformation, which in turn lowers contaminant removal performance. This has spurred demand for more durable RO membranes.
The company combined scanning transmission electron microscope (STEM)[5] technology developed by the Toray Research Center with a digital data analysis technique to quantitatively analyze the pore structure of the separation layer of RO membranes. These pores are smaller than one nanometer (a billionth of a meter) in diameter. Toray drew on the analysis to identify a substructure that helps enhance pore structure stability when in contact with cleaning chemicals. It then designed a new polymer structure to create an RO membrane that delivers a stable pore structure.

Results of RO membrane structural analysis



Toray tested its new RO membrane at a wastewater reuse plant to simulate harsh chemical cleaning conditions. The membrane proved effective in reducing deterioration by half in the quality of obtained water.
By offering an extended lifespan, the new RO membrane can halve associated CO_2 emissions based on less frequent membrane replacement and disposal. This is particularly beneficial in applications such as wastewater reuse in facilities that require frequent chemical cleaning, like sewage treatment plants, as well as chemical, steel, and dyeing factories. It is also useful when implementing a Zero Liquid Discharge (ZLD)[6] environmental management strategy.

5 Scanning Transmission Electron Microscope (STEM): A device that scans a sample using an electron beam while detecting transmitted electrons to obtain high-resolution images. It enables the analysis of the sample's elemental composition and atomic-level structural information.
6 Zero Liquid Discharge (ZLD): A framework for water reuse by ultimately discharging only solid waste with concentrators and crystallizers after RO membrane and other treatment, eliminating environmental or sewage releases of wastewater from factories and other facilities.

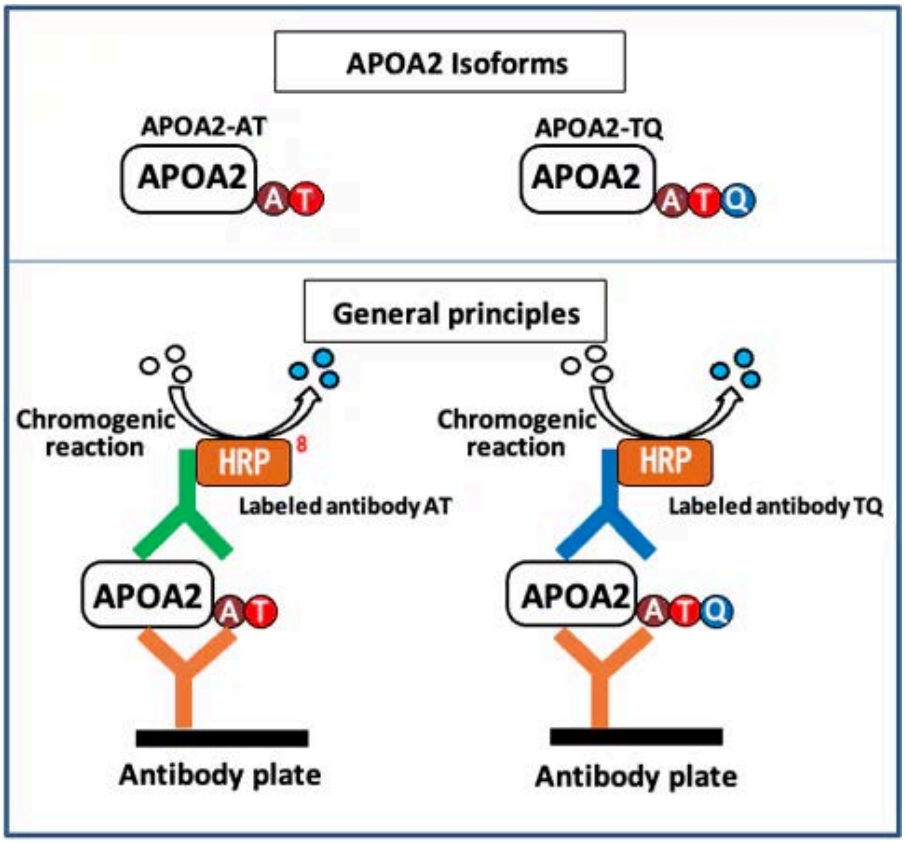
Toray Launched Toray APOA2-iTQ- Insurance-Covered *In Vitro* Diagnostics Kit for Aiding the Diagnosis of Pancreatic Cancer

Toray Industries, Inc. launched Toray APOA2-iTQ in Japan on February 22, 2024. This *in vitro* kit aids with pancreatic cancer diagnosis. Insurance coverage for the kit in Japan began on February 1.
As it uses blood-based diagnostics, the kit is more easily accessible to a greater number of people. It measures substances other than conventional tumor markers and is expected to promote early detection of pancreatic cancer, which had gone undetected in the past.

Toray APOA2-iTQ diagnostics kit

Professor Kazufumi Honda of the Graduate School of Medicine of Nippon Medical School discovered that the quantitative ratios of APOA2-AT and APOA2-TQ[7] change in the blood of people with pancreatic cancer.
Using these research results, Toray Industries independently developed an assay reagent using antibodies that recognize each of the terminal structures of the two APOA2 isoforms. It collaborated with the National Cancer Center and the Graduate School of Medicine of Nippon Medical School, leveraging research findings from the Japan Agency for Medical Research and Development. In June 2023, Toray obtained marketing approval for an *in vitro* diagnostic kit using that antibody that it has decided to launch.

The principle of this kit is to detect structural changes in APOA2 isoforms resulting from pancreatic exocrine function abnormalities from tumors and other causes. Since this principle differs from that of existing methods that detect tumor markers in the patient's blood such as CA19-9, the new kit is considered complementary to methods based on CA19-9. The kit could thus offer early detection of pancreatic cancer patients that eludes identification with conventional techniques.



7 APOA2 Isoforms (APOA2-AT and APOA2-TQ): Apolipoprotein A2 is a major component of high-density lipoprotein (HDL), and is a protein composed of 77 amino acids. APOA2-TQ has a terminal sequence of "alanine (A) - threonine (T) - glutamine (Q)," and truncation of the terminal glutamine results in APOA2-AT, with a final sequence of "alanine (A) - threonine (T)." In healthy individuals, APOA2-AT and APOA2-TQ are present at constant concentrations. In many pancreatic cancer patients however, one or both types of APOA2- isoforms decrease, leading to changes in their relative proportions. With the new diagnostic kit, the concentrations of the two types of APOA2 isoforms (APOA2-AT and APOA2-TQ) in blood plasma are measured separately.

8 Horseradish Peroxidase (HRP): An enzyme found in horseradish. Antibodies tagged with this enzyme are used to detect the target protein indirectly through a colorimetric reaction.

Click here for the main initiatives for CSR Guideline 7, "Contributing Solutions to Social Issues through Business Activities" in CSR Roadmap 2025.

CSR Activity Report (CSR Guideline Activity Reports) - Contributing Solutions to Social Issues through Business Activities

Realizing a Circular Economy

CSR Roadmap 2025
Main Initiatives (1)(2)(4)(5)

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 CO_2 emissions. In order to solve these problems and realize a sustainable, circular economy that makes effective use of resources, the Group facilitates recycling of discarded plastic products and process remnants, 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 identified helping to build a circular economy as a key issue. An initiative example in this area is material recycling[1], which enables the reuse of discarded products and process remnants, such as fibers/textiles, resins, and films. In addition, chemical recycling[2], which converts products that are difficult to mechanically recycle 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, with an eye to the future, the Group is promoting research and development into carbon recycling, including ways to utilize CO_2 as a resource. 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.
Under the Medium-Term Management Program, Project AP-G 2025, launched in fiscal 2023, Toray Group has set out helping to build a circular economy as an important objective. Accordingly, the Group aims to improve the value of its products and businesses by promoting further R&D. Additionally, Toray has identified the opportunities and risks associated with the transition to a circular economy as follows.

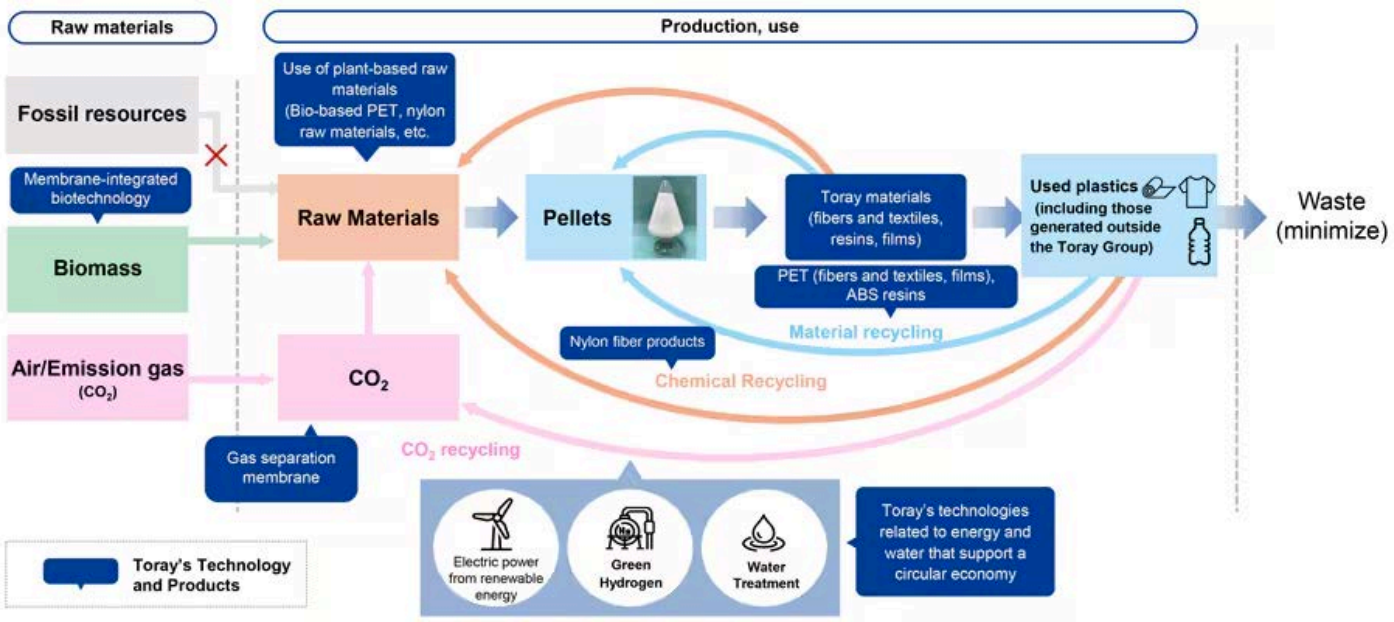
Opportunities

- Growth of biomaterials business
- Growth of recycled materials business
- Growth of businesses that help reduce waste (waste reduction, and product durability)

Risks

- Increased cost of waste processing
- Contraction of the materials market due to a shift away from mass production and consumption
- Lost opportunities due to any delay in adapting to the circular economy

In order to reduce the risks and maximize the opportunities, the Group intends to promote the use of biomaterials and recycling as outlined below. In promoting these, Toray is also helping to create systems that can lay the foundation of a circular economy. These efforts include not only Toray Group's own activities, but also collaboration with recyclers (e.g. PET bottle recycling with Kyoei Industry Co., Ltd., and discarded fishing net recycling with Refineverse Group, Inc.), and collaboration with customers (e.g. fishing net-to-net recycling with Nitto Seimo Co., Ltd. and Maruha Nichiro Corporation, as well as technical demonstration of subcritical depolymerization of automobile parts with Honda Motor Co., Ltd.).



1 Material recycling is a recycling process that uses heat to convert discarded plastic (PET) bottles and products as well as remnants produced during manufacturing processes into chips, which are then used to make yarn, staple fiber, film, resin, 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.

Toray Group's target percentage of raw materials sourced from biomass and other recycled is 20% to be achieved by fiscal 2030 for core polymers (polyester and nylon). The actual rate in fiscal 2022 was only a few percent, and to achieve the 2030 target the Group will continue to promote recycling and the switch to biomass for raw materials.

As part of its efforts to promote recycling and the use of bio-based materials, Toray Group has adopted the mass balance approach[3]. The following Toray companies and sites have obtained ISCC PLUS certification, an internationally recognized system to verify proper use of the mass balance approach by companies.

Gunsan Plant, a production site for PPS resin (Toray Advanced Materials Korea Inc.)

- Toray Industries, Inc. (Ehime Plant, Okazaki Plant, Tokai Plant, Nagoya Plant, Chiba Plant)
- Toray Advanced Materials Korea Inc.
- Toray Plastics (America), Inc.
- Toray Plastics (Malaysia) Sdn. Berhad
- Toray Films Europe S.A.S.
- Toray Carbon Fibers Europe S.A.
- Delta-Preg S.p.A.
- Toray Celanese Co., Ltd.

- Toray International, Inc.

The ISCC PLUS certification system ensures appropriate management and traceability for production using biomass or recycled materials, based on the mass balance approach, as part of a global supply chain. Certified sites are able to allocate and use bio-based or recycled materials according to the mass balance approach and produce and supply products with verifiable levels of sustainability.
Toray Industries is committed to following the latest ISCC regulations and declares its conformity to the ISCC PLUS requirements.

3 Mass Balance Approach: During the processing and distribution stages from raw material procurement to finished product delivery, materials with specific characteristics (e.g., biomass-derived raw materials) are often mixed with materials without those characteristics (e.g., petroleum-derived raw materials). The mass balance approach is a method for reliably allocating the characteristics of specific raw materials to a portion of the finished product based on the input amount of those raw materials.

Related Information

For more information on Toray Group waste reduction, chemical 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.

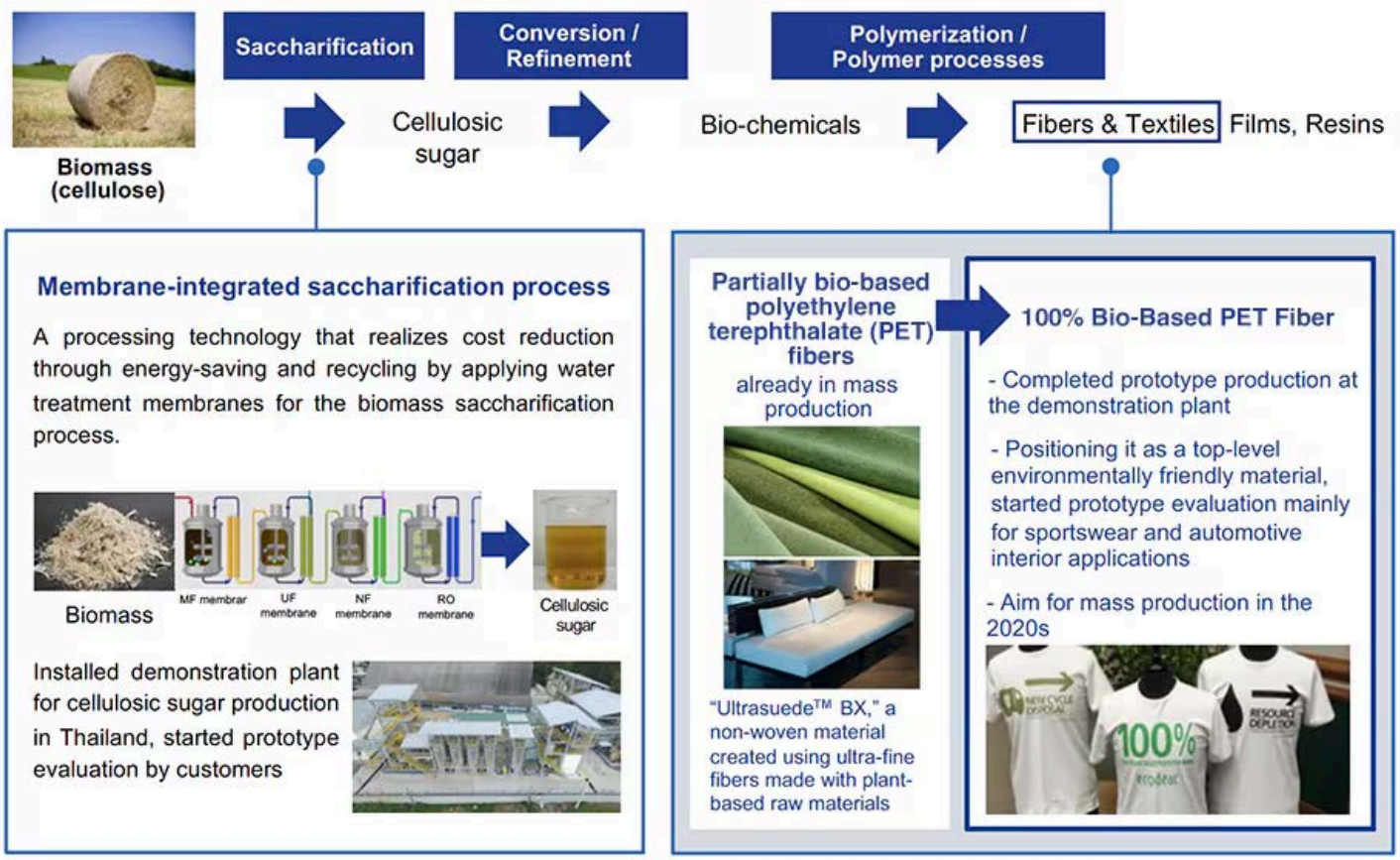
Biomaterials Business

CSR Roadmap 2025 Main Initiatives (1)(2)(4)(5)

Toray Group is promoting initiatives related to biomaterials under a unified brand, Ecodear™. It is developing these products using raw materials derived from biomass-based resources rather than fossil resources. For example, Toray Group mass produces partially bio-based polyethylene terephthalate (PET) fibers that are made from plant-based ethylene glycol, derived from molasses byproducts. These fibers are also used to make Ultrasuede™ PX and Ultrasuede™ BX synthetic suede texture fabrics. Toray Group is also proceeding with prototype sales of bio-based PET fiber, in which both of the main raw materials, ethylene glycol and terephthalic acid, are derived from biomass resources. At the same time, it is developing membrane-integrated bioprocesses for the in-house production of biomass-based raw materials. In the field of nylon fibers, the Group has recently developed and launched Ecodear™ N510, a nylon fiber made from 100% plant-based raw materials. In collaboration with Yoshida Co., Ltd. and ISSEY MIYAKE Inc., this fiber has been utilized for bags and clothing in the TANKER series and in the STRINGS lineup, respectively.

PET Fiber Made Using Bio-based Main Ingredients, Membrane-Integrated Bioprocesses

Toray Group produces a bio-based PET material using ethylene glycol made from waste molasses and terephthalic acid obtained from bio-para-xylene produced at its pilot plant. It is positioning this material as one of its top environmentally conscious products. Toray Group seeks to launch mass production of these materials for sportswear and automotive interior applications as early in the 2020s as possible.
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 biomaterials made from biomass-based raw materials. 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

CSR Roadmap 2025
Main Initiatives (1)(2)(4)(5)

Toray Group is promoting recycling initiatives across a wide range of business segments including fibers & textiles, plastics, and films. The Group works with fibers derived from recycled plastic (PET) bottles and production scrap ends, recycled resin made from scrap ends and used plastics, as well as films made by recovering and recycling films that have been used in customer processes.
In the fiber/textile segment, Toray Group uses discarded PET bottles as raw materials, along with filtering and cleaning technologies to remove foreign matter, making it possible to develop a wide variety of recycled products. In 2019, Toray Group introduced the &+™ (“And plus”) brand of recycled fibers that include Toray’s original traceability function. After rebranding in April 2023, the Group added recycled fiber products made using nylon recovered from discarded fishing nets to the &+™ brand. As a recycled material brand, &+™ advocates consumer and organizational participation from the very beginning of the recycling process, the collection of recyclable items, encouraging them to support and take part in Toray's recycling efforts.
By utilizing waste fibers, resin, and film, the Group is promoting initiatives to create systems that recycle materials for various uses.

Fiber and Textile Recycling

CSR Roadmap 2025
Main Initiatives (1)(2)(4)(5)

&+™ Recycled Fiber Brand

Previously, fibers derived from recycled PET bottles were limited in variety due to contaminants mixed into raw materials, which made it difficult to produce special cross-sections and fine fibers. In response, Toray Industries together with Kyoei Industry Co., Ltd. developed contaminant filtering technology and advanced plastic bottle cleaning techniques to stabilize the supply of high-quality raw materials. Combining these technologies with Toray’s fiber production technology, it is possible to achieve the same level of diversity in fabric applications as with fiber 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. The Group is also creating a unique recovery scheme for discarded fishing nets in collaboration with a recycling company and a fishing net manufacturer. The nylon in the recovered nets will be used for a newly released recycled nylon fiber material sold under the &+™ brand. Through the production and sale of high-value-added recycled nylon fiber based on Toray’s chemical recycling technology, the Group aims to raise awareness of the need to help recover discarded fishing nets and is working to further promote the activity. The Group also intends to expand its recycled fiber material lineup to enable product planning that will further satisfy the needs of consumers.

> &+™ (product site)

Promoting Recycling with UNIQLO Co., Ltd.

Together with UNIQLO Co., Ltd., Toray Industries is promoting new initiatives for sustainable products, with Toray supplying fibers derived from PET bottles for some of 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 Industries 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.

Resin Recycling

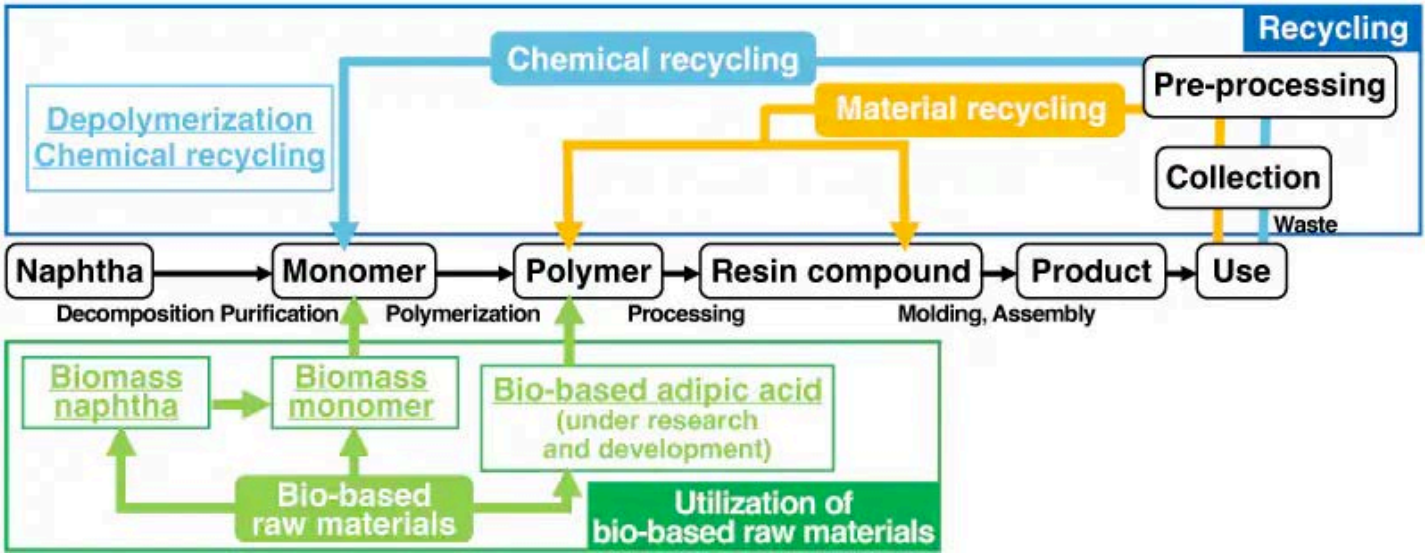
CSR Roadmap 2025
Main Initiatives (1)(2)(4)(5)

Toray Group is developing sustainable resin materials through recycling and the use of bio-based raw materials. In the area of resin recycling, the Group is developing and distributing recycled resins based on a proprietary formulation design using material and chemical recycling (depolymerization chemical recycling), which breaks down polymers into monomer raw materials before re-polymerizing them.
Going forward, Toray will actively work to recycle resin using post-consumer material for recycling, thereby promoting sustainable resource utilization.
Furthermore, Ecouse™, a group-wide unified brand for recycled materials and products, will be expanded to include resins, and the development of the Ecouse™ series of environmentally friendly resin materials will be accelerated.

1. Recycled Nylon 6 Resin “Ecouse” AMILAN™: Toray Industries and Honda R&D Co., Ltd. have begun a joint development project for chemical recycling of automotive nylon 6 resin. This project focuses on a chemical recycling technology that uses subcritical water to depolymerize glass fiber-reinforced nylon 6 resin parts recovered from scrap vehicles, thereby producing the raw monomer caprolactam. Toray and Honda have developed this technology to leverage the high permeability, dissolving power, and hydrolytic capabilities of subcritical water, and have succeeded in using it to depolymerize nylon 6 resin. As a form of high-temperature, high-pressure water, subcritical water can depolymerize nylon 6 without the use of catalysts. There are no additive effects, and it generates a high yield of raw monomer in less than half an hour. After the raw monomer is separated and purified for repolymerization, the resulting recycled nylon 6 has physical properties equivalent to those of virgin material.
2. Recycled nylon 66 “Ecouse” AMILAN™ : Toray has developed a recycled nylon 66 resin compound that is made by removing silicone from airbag fabric scrap cuttings, and then washing the remaining material. With Toray’s proprietary additive compounding technology, residual silicone resin is prevented from migrating to the surface of molded products, and mold adhesion is also significantly reduced. Accordingly, the flowability and mechanical properties of recycled nylon 66 “Ecouse” AMILAN™ are on par with injection molding grades derived from virgin raw materials.
3. Recycled PBT resin (polybutylene terephthalate) “Ecouse” TORAYCON™: Toray has launched a recycled PBT resin, “Ecouse” TORAYCON™, as a chemically recycled resin with physical properties comparable to virgin materials.
4. Recycled PPS (polyphenylene sulfide) resin “Ecouse” TORELINA™: Toray has developed a material recycling technology for glass fiber reinforced PPS resin.

In the area of bio-based raw material use, Toray has established a supply system for biomass-based acrylonitrile butadiene styrene (ABS) resin, bio-based polyphenylene sulfide (PPS) resin, and chemically recycled PPS resin (ISCC PLUS certified) using the mass balance approach.

Resin Resource Recycling Initiatives

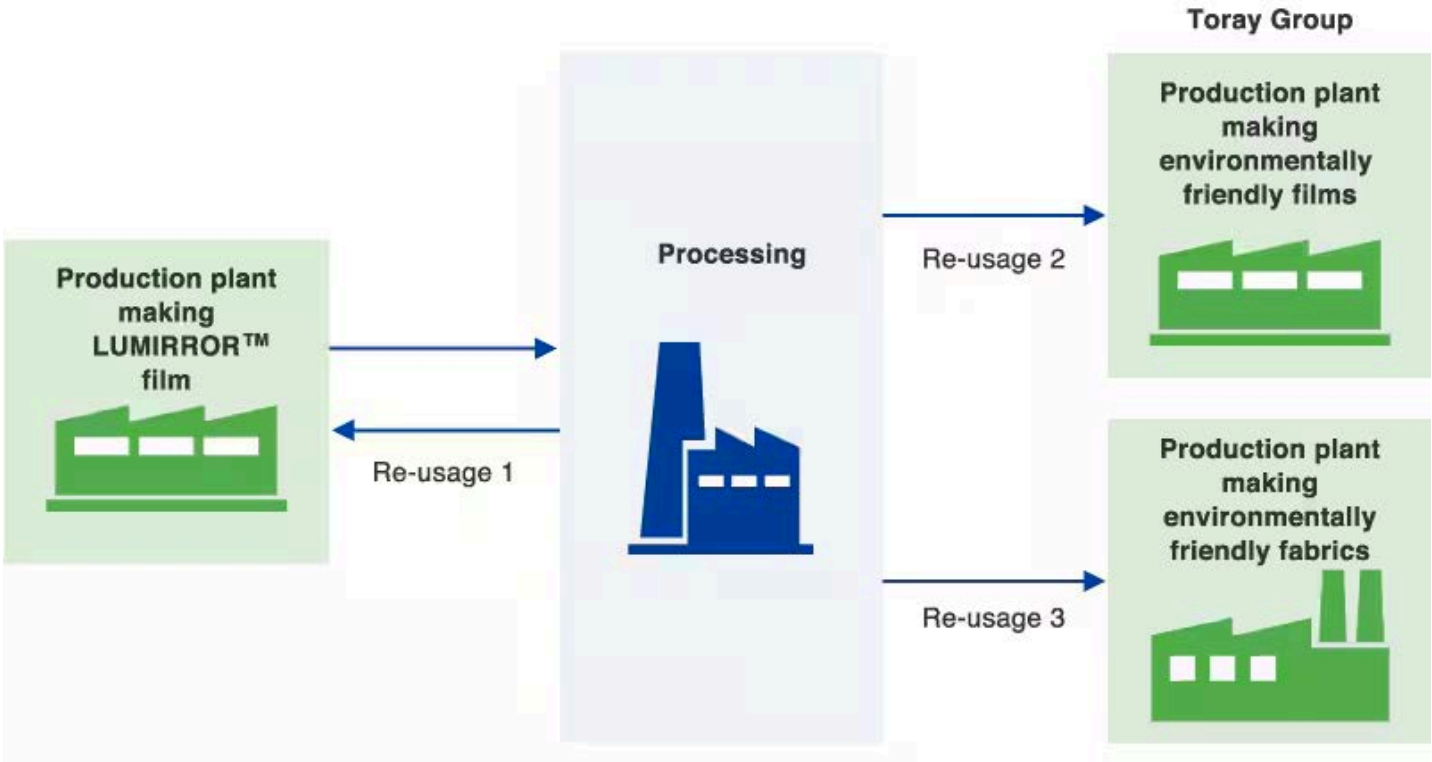


Film Recycling

CSR Roadmap 2025
Main Initiatives (1)(2)(4)(5)

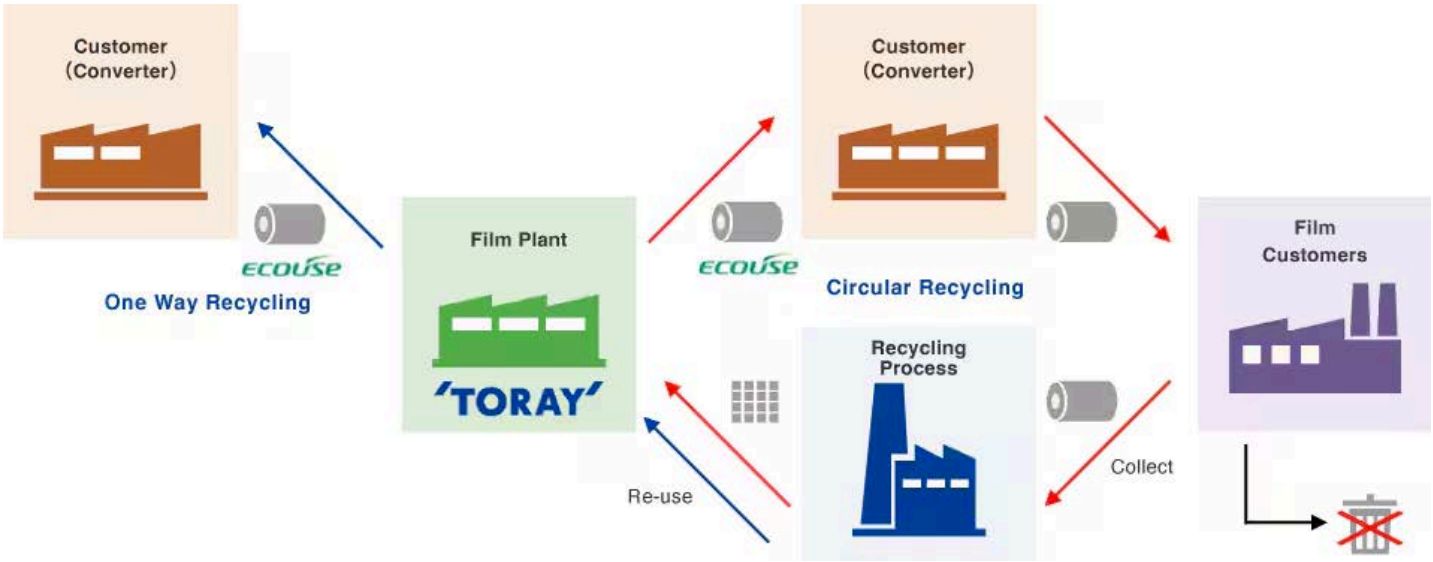
Toray Industries is promoting production activities that use resources carefully. PET plastic generated as waste in PET film LUMIRROR™ manufacturing and other processes is collected and re-pelletized for use in making textiles and resin products and film. In addition, the Company operates a system for collecting used PET film from customer manufacturing processes, and then recycling it as raw material for film.

Processing and Re-using Recovered Raw Materials Generated from Manufacturing Processes



Reusing waste PET film from customer manufacturing processes

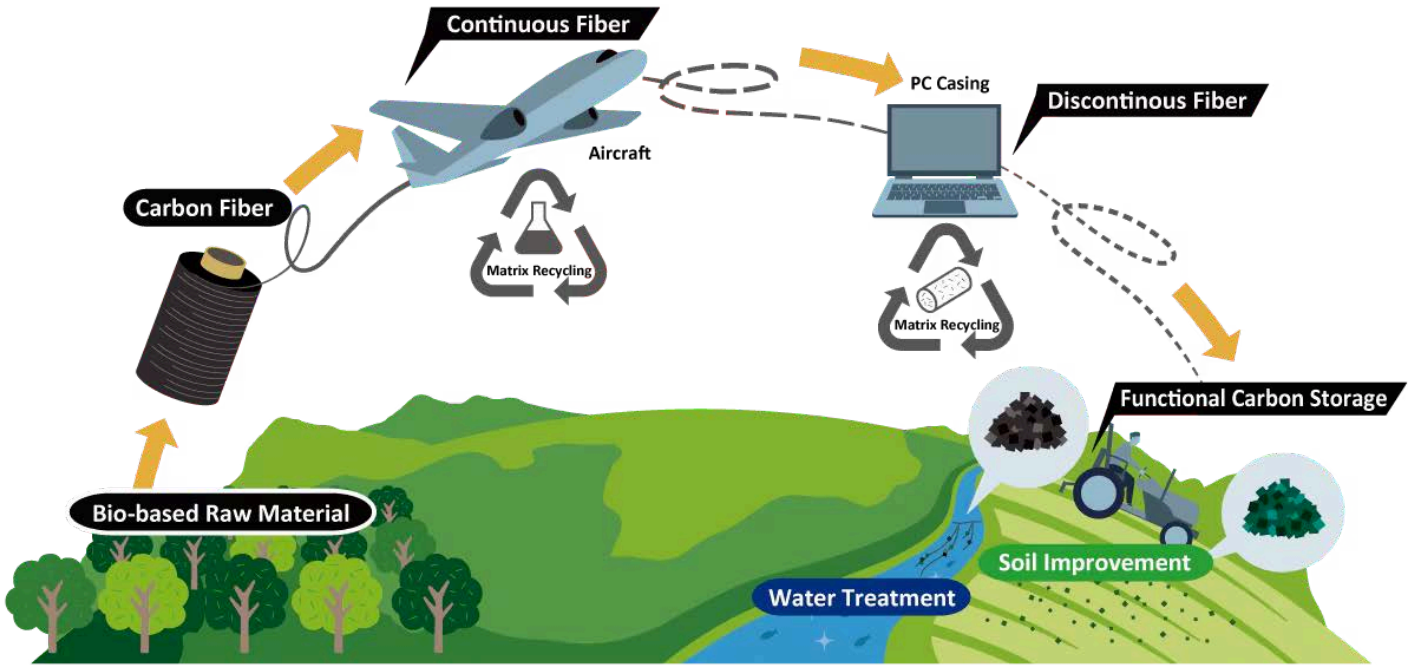
Toray Industries has established a recycling system to collect used films from electronic component applications and recover them for use in producing films, launching the Ecouse™ series, which is helping to create a world where resources are managed sustainably. The company combined mechanical recycling 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. These PET films have reduced the amount of fossil-based resin used as a raw material and can therefore lower CO_2 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.



Carbon Fiber Recycling

CSR Roadmap 2025
Main Initiatives (1)(2)(4)(5)

Carbon fiber, with its excellent mechanical properties, provides products that are lighter in weight and have longer lives. Carbon fiber also contributes to the reduction of CO_2 emissions throughout the product's lifecycle, helping to solve global environmental issues. In particular, the use of carbon fiber in environmental products such as large wind turbines, aircraft, and hydrogen tanks significantly reduces CO_2 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 (rCF) and associated applications requires collaboration with a wide range of customers to explore various possibilities for use in specific parts and materials. Toray carbon fiber is applied in the primary structures of the Boeing 787. Off-cuts generated during this production process are turned into rCF, which Lenovo has utilized to make casings for its computers. rCF based on waste CFRP during the production process of Boeing 787 wings is utilized in Lenovo PC casing. Toray Industries also produces non-woven rCF fabric by recycling scrap material from aircraft manufacturing. This fabric has been applied in components of a solar racing car for the Tokai University Team. In collaboration with partners, Toray is accelerating product development using rCF, with the aim of realizing a circular economy for carbon fiber. Carbon fiber offers higher resistance to heat and ultraviolet light and absorbs less moisture than other organic materials. Moreover, carbon fiber can also be produced from bio-based raw materials. By leveraging these strengths, Toray Industries aims to build a "Material Eco SYSTEM" for carbon fiber.

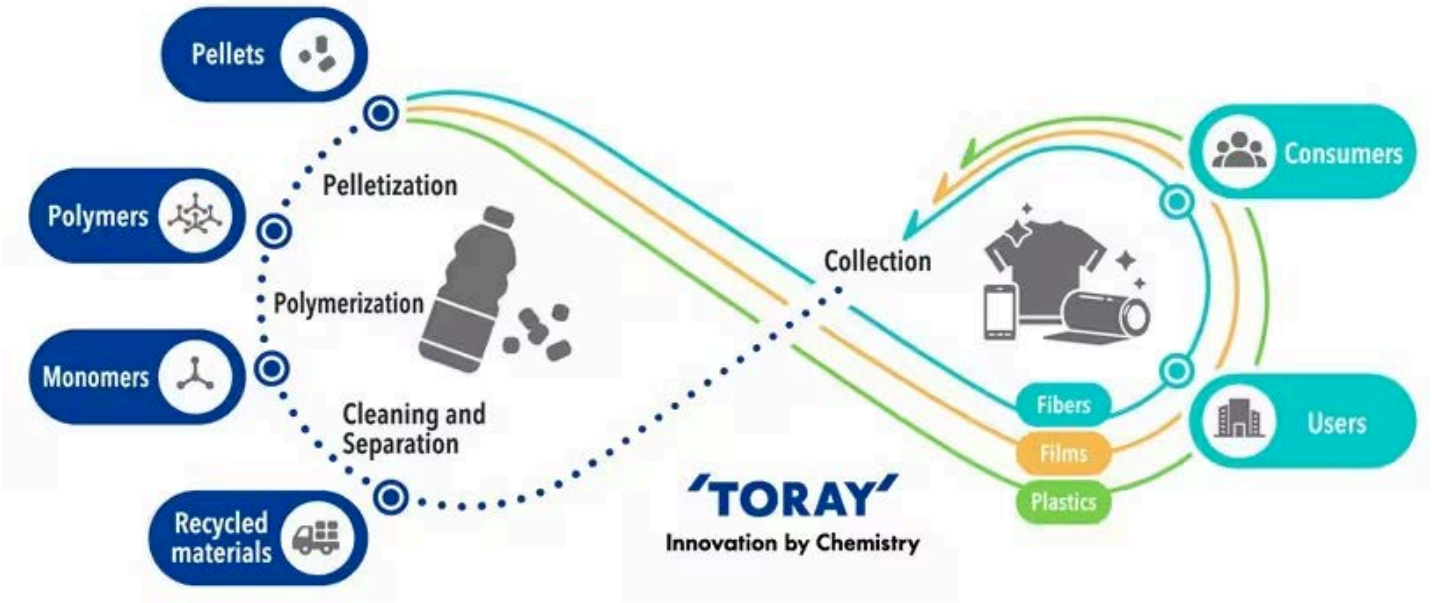


Blockchain-based Traceability

CSR Roadmap 2025
Main Initiatives (1)(2)(4)(5)

Since recycled materials basically have the same physical properties as virgin materials derived from fossil resources, traceability is important for assuring customers that the material has actually been recycled. Therefore, Toray is using blockchain technology to create a traceability system based on manufacturing and transport data from the supply chains of Toray Group products. The technology prevents input data from being tampered with. This system has been set up as a small-scale demonstration.

Blockchain-based Traceability System



Click here for the main initiatives for CSR Guideline 7, “Contributing Solutions to Social Issues through Business Activities” in CSR Roadmap 2025.