NIPPON SHOKUBAI

TCFD Report

March 2023

Data updated in September 2023

Contents

1. Introduction

NIPPON SHOKUBAI CO., LTD. published the TCFD Report in April 2022 and posted it on our corporate website. We are pleased to announce the issuance of the second edition of the TCFD Report, updating its contents.

In addition to presenting the progress we have made on various climate change issues, we introduce new efforts that we have launched in the past year, including a third-party verification of GHG emissions, acquisition of international sustainability carbon certification, and adoption of internal carbon pricing.

We have also added a new transition plan for achieving carbon neutrality. We believe our company's efforts against climate change issues will change significantly before and after 2030. Therefore, we have presented our plans up to 2030 and our thinking beyond 2030 and toward 2050.

With awareness that addressing the issues of climate change will significantly change our company's business model, we will continue to consider and implement new efforts in the future.

2. Aiming to Achieve Carbon Neutrality in 2050

In April 2021, our company announced Nippon Shokubai Group's Long-term vision "**TechnoAmenity** for the Future," which outlines our goals for the next 10 years by 2030.

In this vision, we specified the following three goals for 2030, and set three transformations in order to achieve these goals.

<FY 2030 Goals>

* Provide materials and solutions required by people and society
* Become a chemical company that keeps evolving by identifying social trends
* Develop with various stakeholders inside and outside the company

<Three transformations to achieve FY 2030 Goals>

[1] Business Transformation	Transform portfolio from existing to growth fields
[2] Strategic Transformation for Environmental Initiatives	Promote sustainability to realize carbon neutrality by FY 2050
[3] Organizational Transformation	Transform into an organization with sustainable growth and a company where diverse human resources are motivated to work

Of these, we believe that the activities aiming for achievement of carbon neutrality by reduction in greenhouse gas (GHGs, especially CO_2) emissions are most important for [2] Strategic Transformation for Environmental Initiatives. As a concrete method of approach, we will first work to reduce CO_2 emissions from our own production (Scope 1, Scope 2) through conversion of raw materials into biomass, promotion of energy conservation, improvement in processes, adoption of green energy, etc. In addition, in order to reduce CO_2 emissions in the supply chain (Scope 3), we will actively promote the spread of Environmental Contribution Products, develop technologies to promote the use of hydrogen and ammonia, and recycle resources, including superabsorbent polymer (SAP).

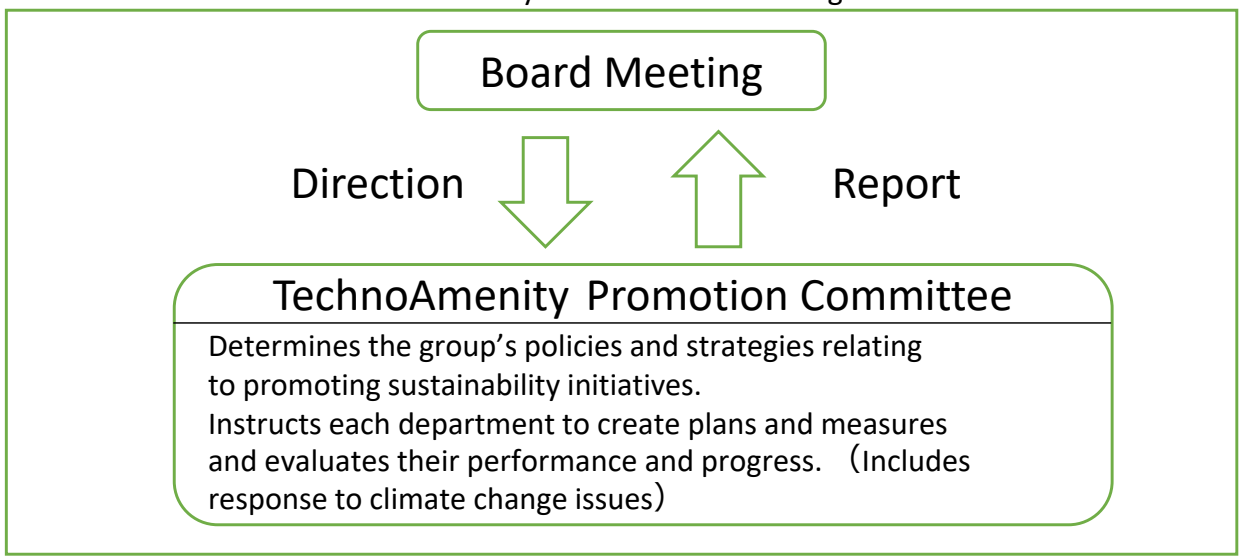
Goals in 2030, 2050

3. Governance System for Climate Change Issues

Of all the environmental issues, climate change is a company-wide issue that extends beyond the manufacturing and research stages. Therefore, it has been decided that the TechnoAmenity Promotion Committee (Chair: President), which determines the core policies and strategies for our company management with regard to sustainability, should examine the issue intensively so that our activities can be accelerated.

The Board Meeting receives reports on policies, strategies, plans, and results related to climate change issues that are discussed in this Committee and provides necessary instructions.

Governance System for Climate Change Issues



4. Risk Management in Relation to Climate Change Issues

In the overall risk management of our company group, we work by classifying the risks into serious Group-wide risks and department risks.

For serious Group-wide risks, potential serious risks underlying execution of the Group's management strategies, sustainable improvement of corporate value, and acquisition of trust from stakeholders are subject to risk management, and we have established a system in which the Board Meeting identifies and assesses the risks, decides whether they should be addressed, and supervises the status of risk management by the executive section.

For department risks, on the other hand, potential risks underlying execution of business strategies or business operations by each department or affiliated company are subject to management, and we have established a system in which responses to the risks are taken promptly.

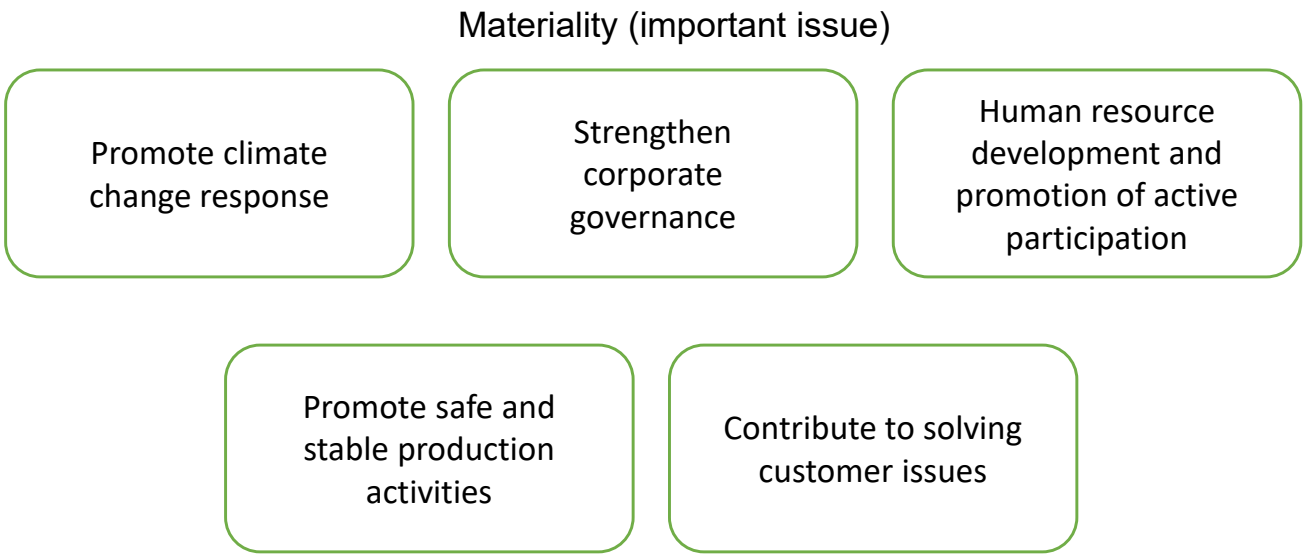
Of these, any issues with insufficient sustainability response are considered serious Group-wide risks, and management is implemented by the TechnoAmenity Promotion Committee. Regarding climate change issues in particular, we recognize it as an important social issue to be solved, and we respond flexibly, including establishment of subcommittees as necessary.

5. Strategy on Climate Change Issues

5-1. Materiality (important issue)

The TechnoAmenity Promotion Committee specified five materiality items that are important in order for our company to fulfill its social responsibility and conduct business sustainably.

Of these, we are intensively examining how to respond to climate change issues, which is of particular urgency and importance.



5-2. Implementation of scenario analysis related to climate change issues

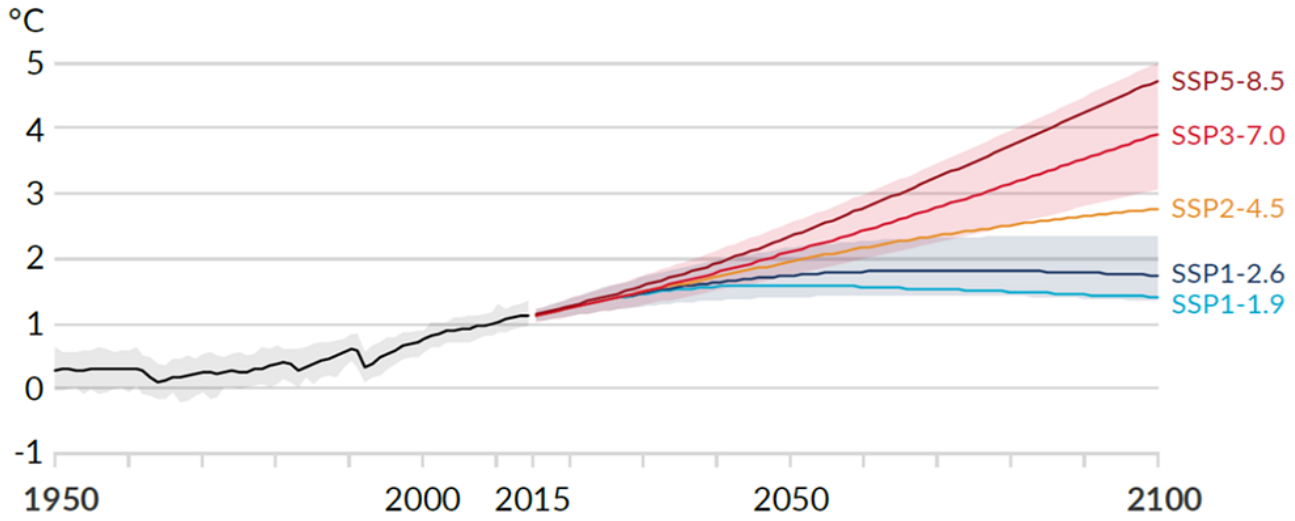
In March 2021, our company endorsed the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD). Taking this opportunity, we conducted a scenario analysis of opportunities and risks related to climate change issues, which had been conducted before, again in line with the TCFD recommendations.

5. Strategy on Climate Change Issues

5-2-1. Assumptions for scenario analysis

In the scenario analysis, we focused on the 1.5˚C scenario (SSP1-1.9), which is the scenario for a rapid transition to low-carbon, and the 4˚C scenario (SPP5-8.5), which predicts higher global warming results and more serious physical impacts, based on the Paris Agreement goal to “pursuing efforts to limit the global temperature increase to 1.5˚C above pre-industrial levels” and the Sixth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC).

Since our Group deals with chemical products at the upstream of the value chain to the products at the downstream, we can assume many scenarios. By identifying the scope as shown below, we believed that we would be able to respond to the climate change issue more efficiently by focusing our analysis on more important scenarios.



Global surface temperature change relative to 1850–1900

Source: Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR6) Figure SPM. 8

5-2-2. Identification of the scope of scenario analysis

In conducting scenario analysis, we specified 2030 as the subject year for analysis while aiming to achieve carbon neutrality in 2050.

We also specified

[1] the key growth areas for our company business,

[2] the risks and opportunities associated with climate change that are likely to impact the business, and

[3] the potential impacts of climate change across the value chain

as the scope of analysis.

We evaluated the opportunities and risks for 2030 based on the above time frame and business scope.

5. Strategy on Climate Change Issues

5-2-3. Scientific evidence, etc. used as a reference

We used the scenarios as shown in the following table in order to analyze the business environment for our company based on various published scenarios, as well as forecast materials derived from these scenarios, and organize the worldview of the industry centering on new entrants, sellers, buyers, and our own company.

		Present	1.5℃ scenario	4℃ scenario	Source
Physical Climate Scenario		—	SSP1-1.9	SSP5-8.5	IPCC AR6
Carbon emission goals and policies	CO_2 emissions (global)	36064 Million tonnes (Mt)	16834 Mt (2040)	-	IEA ETP2020
	Price of carbon (advanced countries)	63 $/t (2025)	140 $/t (2030)	-	IEA WEM2020
	CO_2 emission coefficient for electric power companies (Japan)	0.444 kg-CO_2/kWh (2019)	0.37 Kg-CO_2/kWh (2030)	-	Action Plan for the Electricity Industry for Achieving a Low-Carbon Society by the Federation of Electric Power Companies of Japan
	Electric power generation (global) Wind power Solar power (% indicates the proportion)	1423 TWh (5%) 665 TWh (2%)	4770 TWh (15%) 4315 TWh (14%)	3361 TWh (10%) 2764 TWh (8%)	IEA WEO2020
	Hydrogen production using renewable electricity (global)	-	833 TWh (2030)	-	IRENA GET2050
	Hydrogen power generation (Japan)	-	100 GW (2030)	-	Agency for Natural Resources and Energy Basic hydrogen strategy
	Solar power generation (global)	17 GW/y (2010)	300 GW/y (2030)	-	IRENA GET2050
Technology market	Fuel cells (ENE-FARM)	350,000 units	5,300,000 units (2030)	-	The 5th Strategic Energy Plan
	Storage batteries (global)	4.67TWh (2017)	11.89–15.27 TWh (2030)	6.62–7.82 TWh	IRENA ERCM2030
	Electric vehicles (global)	500,000 units or less (2010)	1,570,000 units (2030)	-	IRENA GET2050
Recycling	CO_2 capture	160 Mt (2020)	650 Mt (2030)	-	IEA ETP2020 CCU
	Waste recycling (EU)	46% (2017)	60% (2030)		Directive (EU) 2018/851
Natural disasters	Frequency of flood occurrence	-	Twofold (2˚C)	Fourfold (2˚C)	the Ministry of Land, Infrastructure, Transport and Tourism
	High tide (Tokyo Bay)	-	5% increase	13% increase	the Ministry of the Environment

ETP: Energy Technology Perspectives WEM: World Energy Model
WEO: World Energy Outlook GET: Global Energy Transformation A Roadmap To 2050
ERCM: ELECTRICITY STORAGE AND RENEWABLES:COSTS AND MARKETS TO 2030
CCU: Special Report on Carbon Capture Utilisation and Storage CCUS in clean energy transitions

5. Strategy on Climate Change Issues

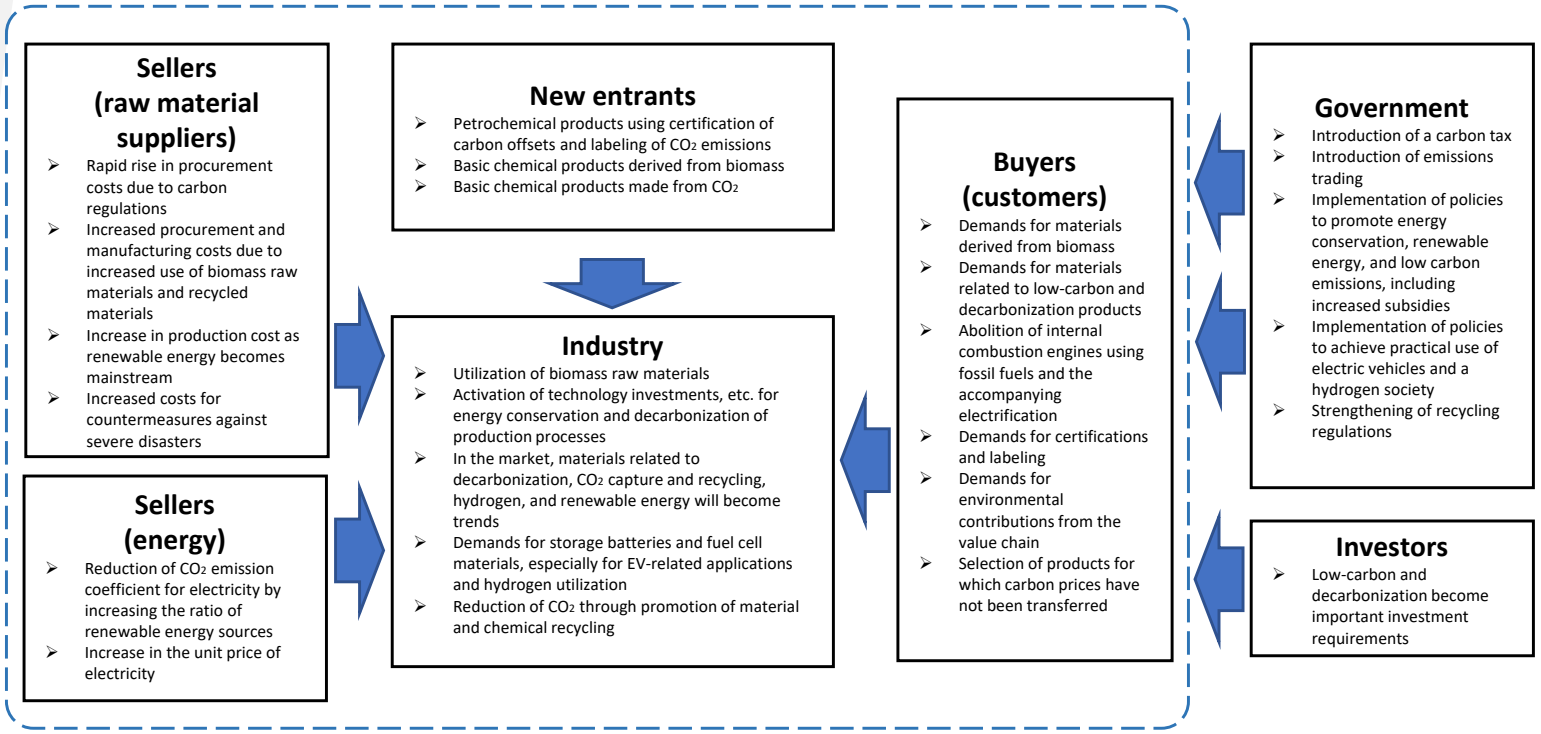
5-2-4. Analysis results based on the 1.5˚C scenario

The 1.5˚C scenario calls for a strong response to the transition to a decarbonized society in order to significantly mitigate the effects of climate change.

As a result of this transition, the market is expected to shift to social infrastructure centered on the use of renewable energy, as well as products that support it. Specific measures include electrification of automobiles, provision of materials related to energy storage, promotion of recycling, and utilization of biomass raw materials.

In addition, the introduction of decarbonization laws and regulations, and increased demands from customers and investors are expected.

Analysis results based on the 1.5˚C scenario (low carbon transition scenario)



5. Strategy on Climate Change Issues

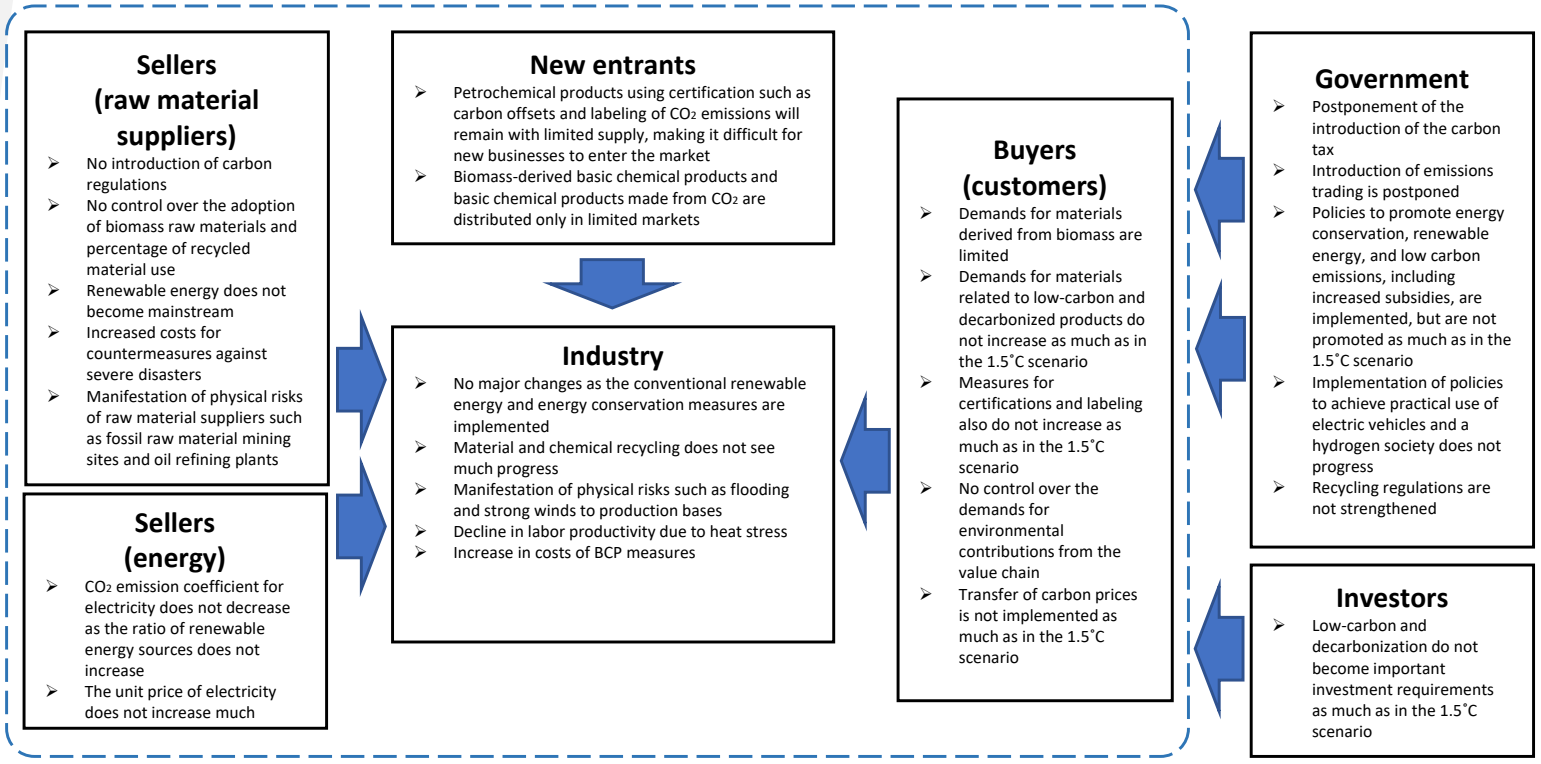
5-2-5. Analysis results based on the 4˚C scenario

According to the IPCC Assessment Report, the change in climate is expected to be similar between the 1.5˚C and 4˚C scenarios as of 2030, but the differences between the scenarios will increase after 2030.

The 4˚C scenario is an extension of the current one, and low carbon and decarbonization will not progress as much as in the 1.5˚C scenario. In 2030 and later, we will not be able to avoid the various physical risks associated with intensifying severity of natural disasters caused by rising temperatures and the chronic temperature increase.

Specifically, it is expected that business operation costs will inevitably increase due to the increasing difficulty in obtaining biomass raw materials, physical damages to manufacturing facilities caused by abnormal weather, supply chain disruptions, and increased utility costs.

Analysis results based on the 4˚C scenario (physical climate scenario)



5. Strategy on Climate Change Issues

5-3. Assessment of business impact based on the scenario analysis

We summarized the degree of financial impact as shown in the table below, based on a scenario analysis that took into consideration market changes, changes in corporate activities, policies, laws and regulations that promote the transition to a low-carbon society and a recycling-oriented society, stakeholder evaluations, and so on. Our company views any positive financial impact as an opportunity and any negative financial impact as a risk, and assessed the degrees of financial impact on a scale of large, medium, and small based on the impact on the related financial indicators.

Business opportunities include increasing demands for materials that contribute to low-carbon and decarbonization. In particular, automobiles are expected to reduce energy consumption due to the acceleration of the switch from gasoline engines to electric motors and further reductions in vehicle weights. We believe that our company's supply of materials related to lithium-ion batteries and automobile-related materials that help reduce vehicle weight will contribute to this.

In addition, there are power plants and steelworks where it is difficult to significantly reduce or eliminate CO_2 emissions for the time being. Efforts are being made to capture the CO_2 emitted and use the captured CO_2 effectively as a resource. In such fields, we believe that our company's development of CO_2 absorbers and methane production catalysts can help solve these problems.

Moreover, looking ahead to a hydrogen society, our company is also expected to contribute to a series of processes including electrolysis of water using renewable energy, cracking of ammonia—a hydrogen carrier—into hydrogen, and removal of harmful substances during ammonia combustion, though provision of our catalysts and materials.

In fields that utilize renewable energy to eliminate fossil fuels, expectations for the materials industry are high, and the financial impact on business opportunities is also considered to be significant.

Risks include the loss of business opportunities as we fail to be selected by customers due to delays in the development of technologies related to climate change and the greening of energy and raw materials. With regard to these risks, we will flexibly focus on low-carbon and decarbonization-related development themes to meet market demands and promote adoption of non-fossil raw materials and fuels.

We are also examining measures to deal with possible risks with the assumption that it is possible to shift from the 1.5˚C scenario to the 4˚C scenario in the future. As for manufacturing facilities, we will continue to promote resilience measures for manufacturing facilities and strengthen BCP in preparation for supply chain disruptions in the future. We have already taken some measures against natural disasters.

In addition, it is expected that long-term climate change will make it difficult to procure plant materials, so we have begun to consider the procurement of diverse materials as well as alternative materials.

5. Strategy on Climate Change Issues

5-3-1. Evaluation results on opportunities related to climate change

1.5˚C scenario		Major opportunities	Evaluation results	Response by Nippon Shokubai
Technology market	Increase in demands for products related to low-carbon and decarbonization Promotion of recycling	Increase in demands for battery materials, etc. due to electrification of automobiles	Large	Materials related to lithium-ion batteries Materials for electric vehicle-related components
		Increase in demands for products related to CO_2 absorption, capture, and recycling technologies, and fixation technologies	Medium	CO_2 absorbents Methane production catalysts
		Utilization of hydrogen/ammonia synthesis/decomposition catalysts - Promotion of hydrogen-related technology development - Increase in adoption of exhaust gas catalysts in conjunction with fuel conversion to ammonia	Large	Separator for alkaline water electrolysis Fuel cell materials Ammonia synthesis/decomposition catalysts Denitrification catalysts
		Increase in demands for Environmental Contribution Products that contribute to energy conservation during use	Large	Materials for automobile weight reduction, materials related to energy conservation, etc.
		Increase in demands for recyclable products	Large	Promotion of disposable diaper (superabsorbent polymer) recycling
Policy Laws and regulations	Rise in carbon price Laws, regulations, and policies related to carbon	Dissemination of energy conservation and GHG reduction facilities	Large	Catalysts for wet oxidation wastewater treatment Development of unique energy conservation processes
Customer requests and reputation	Requirement for utilization of biomass raw materials and introduction of energy and fuel with low CO_2 emissions	Expansion in business opportunities by responding to climate change Increase in demands for Environmental Contribution Products	Large	Use of biomass raw materials Greening of energy
	Requirements for products that help reduce CO_2 emissions during use		Large	Promotion of development and enhancement of certification of Environmental Contribution Products
	External evaluation of efforts against climate change	Improvement in corporate value through environmental ratings	Medium	Active disclosure of information related to climate change

5. Strategy on Climate Change Issues

5-3-2. Evaluation results on risks related to climate change

1.5˚C scenario		Major risks	Evaluation results	Response by Nippon Shokubai
Technology market	Increase in demands for products related to low-carbon and decarbonization Promotion of recycling	Decrease in market share due to delays in decarbonization research and development Decrease in sales of products using petroleum-derived raw materials Technical difficulties of recycling technology	Large	Focus on development themes related to low-carbon and decarbonization Development of manufacturing processes and products that generate less waste Development of SAP recycling technology
Policy Laws and regulations	Rise in carbon price Laws, regulations, and policies related to carbon	Increase in raw material and energy procurement costs Increase in costs due to installation of energy conservation and GHG reduction facilities	Large	Utilization of energy certificates Greening of energy and use of biomass raw materials Process efficiency improvement
Customer requests and reputation	Requirement for utilization of biomass raw materials and introduction of energy/fuel with low CO_2 emissions	Replacement with other companies' products Poor reputation among customers and investors due to failure to advance decarbonization	Large	Utilization of biomass raw materials Greening of energy
	Requirements for products that help reduce CO_2 emissions during use		Large	Promotion of development of Environmental Contribution Products
	External evaluation of efforts against climate change	Decrease in corporate value through environmental ratings	Medium	Active disclosure of information related to climate change

4˚C scenario		Major risks	Evaluation results	Response by Nippon Shokubai
Acute	Intensifying severity of disasters	Flooding and destruction of manufacturing facilities due to high tides and strong winds	Medium	Strengthening of measures against wind and flood damages Resilience measures
		Production stoppages and increased loss of sales opportunities due to supply chain disruptions caused by floods	Large	Strengthening of BCP
Chronic	Rise in average air temperature	Difficulty in procuring biomass raw materials	Large	Promotion of diversification in raw material procurement Securing of alternative raw materials
		Increase in the costs of heat stroke countermeasures	Small	Further improvement of work environments Promotion of digital transformation use

6. Metrics and Targets in Relation to Climate Change Issues

In March 2020, our company announced a target to reduce GHG emissions by 10% by 2030, with 2014 as the base year, in order to reduce GHG emissions from our business activities (Scope 1, Scope 2).

However, in April 2021, the Japanese government announced a major revision to its GHG emission reduction target for 2030, which is based on 2013, from 26% to 46%.

Furthermore, the Sixth Assessment Report by IPCC, released in 2021, found that the timing when the mean global temperature will increase by 1.5˚C or more compared to pre-industrial levels has been accelerated by 10 years, compared to the Fifth Assessment Report (2014 version).

In response to this, our company reviewed and revised its GHG emission reduction target with 2014 as the base year for the entire country including our Group companies from 10% to 30% for 2030, and announced it in November 2021.

In addition, in order to promote the development and popularization of Environmental Contribution Products, our company has set new targets for the total sales revenue (our company only and Group companies) of Environmental Contribution Products among the overall sales revenue as 55 billion yen in FY 2024 and 135 billion yen in FY 2030, compared with 29 billion yen in FY 2020. The table below shows the results from FY 2020 to FY 2022 along with the FY 2030 target.

Metrics and targets related to the climate change issue for 2030

	FY 2014 result	FY 2020 result	FY 2021 result	FY 2022 result	FY 2030 target
GHG emissions: Scope 1 + 2 (1,000 t-CO_2, in Japan)	840	810	820	720[*1]	590
Base reduction rate for FY 2014 (%, Scope 1 + 2)	-	4	2	14[*1]	30
Sales revenue from Environmental Contribution Products (billion yen, including Group companies)	-	29	39	44	135

Note: The calculation method of GHG emissions has been partially revised.
*1 Includes offsetting 61 thousand tons of carbon credits (7.3% of the total in FY2014) by purchasing Carbon-Neutral City Gas.

GHG emissions (Scope 1 + 2) decreased in FY 2022 compared to FY 2021, partly due to the use of Carbon-Neutral City Gas[*2], although the CO_2 emission intensity increased due to a decrease in the production volume.

In addition, some of the Environmental Contribution Products are introduced individually in detail on page 21 and later.

*2 Carbon-Neutral City Gas utilizes liquefied natural gas, which is considered to produce no CO_2 on a global scale when burned, by offsetting (carbon offsetting) the greenhouse gases produced in the entire processes from extraction to combustion of the natural gas with CO_2 credits.

6. Metrics and Targets in Relation to Climate Change Issues

6-1. Efforts to reduce CO_2 emissions from the production stage (Scope 1, Scope 2) by 2050

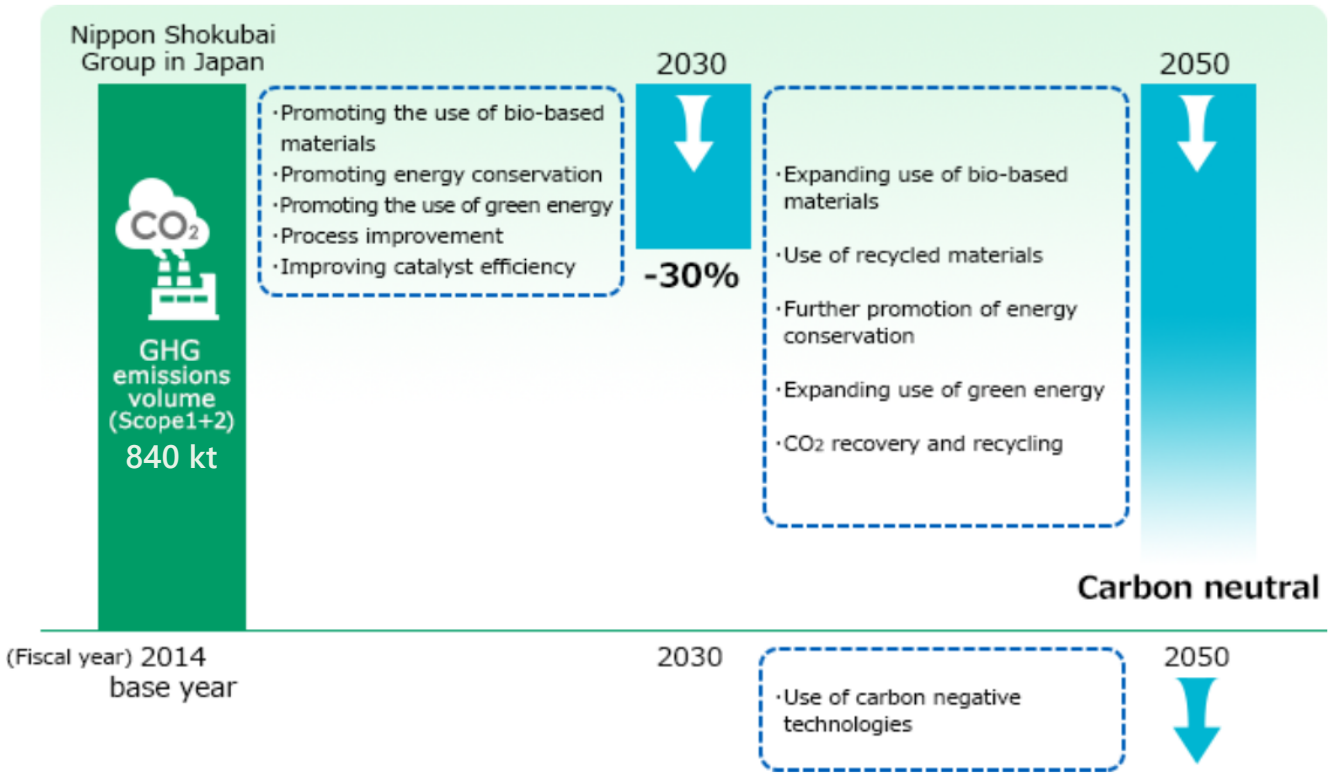
CO_2 accounts for the majority of GHG emissions from our Group's business activities. CO_2 emissions from business activities include CO_2 from energy use in product production activities, CO_2 from oxidation reaction processes, and CO_2 from the treatment of wastes generated in production activities.

By 2030, we will promote the conversion of raw materials into biomass to the extent possible, and reduce CO_2 emissions through measures centering on promoting energy conservation, promoting the use of green energy, process improvements, catalyst efficiency improvements, and so on.

While we will promote the above measures in 2030 to 2050, we also plan to promote the expanded use of biomass raw materials, use of recycled raw materials, use of green fuels (hydrogen, ammonia), and demonstrate carbon recycling technology (CO_2 capture and recycling).

We aim to achieve carbon neutrality by achieving the goals for the above measures, while also capturing and recycling biomass-derived CO_2.

GHG Emissions Reduction Roadmap for 2050



Note: Partially revised the calculation method

6. Metrics and Targets in Relation to Climate Change Issues

6-2. New Efforts started in FY 2022

(1) Third-party verification of GHG emissions

Our company sets a target to reduce GHG emissions (Scope 1 + 2), including Group companies in Japan. Calculation of this reduction amount must be conducted by accurately measuring the GHG emissions and following the calculation standard consistent with national and international guidelines.

For this reason, our company has newly developed its Greenhouse Gas (GHG) Emissions Calculation Manual and prepared a Calculation Report based on measurements and calculations made in accordance with this manual. The FY 2022 Calculation Report has been subjected to a third-party verification by the Japan Quality Assurance Organization (JQA), and received in September 2023 verification that our GHG emissions in Japan were 784 thousand t-CO_2e. We plan to continue receiving third-party verification every year.

(2) Acquisition of International Sustainability Carbon & Certification Plus (ISCC PLUS)

In the future, we plan to gradually introduce biomass raw materials at our plants. Since we will be using biomass raw materials by mixing them with petrochemical raw materials for the time being, it is necessary to use the mass balance method in identifying biomass products.

As a result, we have acquired the International Sustainability Carbon & Certification Plus (ISCC PLUS), an international certification system, for acrylic acid, superabsorbent polymer, ethylene oxide, etc. that are produced at the Himeji and Kawasaki Plants in February 2023. With this, our company has established a system to manufacture and sell certified products that use biomass-derived raw materials allocated by the mass balance method based on the certification system, and become capable of proposing a wider range of products with low environmental impact. A Group company in Belgium has obtained this certification in May 2021.

(3) Implementation of Internal Carbon Pricing (ICP)

To achieve carbon neutrality, the use of carbon pricing is becoming more active worldwide, and an increasing number of companies are adopting the Internal Carbon Pricing (ICP) to promote the reduction of CO_2 emissions.

Our company has implemented the ICP system in February 2023 to promote the low-carbon and decarbonized management of the Nippon Shokubai Group. Based on the current status of credit costs for offsetting CO_2 emissions, etc., we have set an internal carbon price of 10,000 yen/t-CO_2, and will operate by considering the cost conversion of the increase or decrease in CO_2 emissions through application of the internal carbon price as a criterion of capital investment.

By implementing the ICP system, we will raise the awareness of the Group toward decarbonization, promote energy conservation, actively examine the business opportunities and risks related to the reduction of CO_2 emissions, and accelerate our “Strategic Transformation for Environmental Initiatives.”

6. Metrics and Targets in Relation to Climate Change Issues

6-3. Efforts to reduce CO_2 emissions through the supply chain (Scope 3)

In order to solve the issue of climate change, it is important to reduce CO_2 emissions not only from the manufacturing stage of our products but also throughout the entire supply chain, including the stages of use and disposal. Our company offers products (Environmental Contribution Products) that reduce CO_2 emissions during the stage of product use compared to conventional products, and is developing more new Environmental Contribution Products.

We also promote developments of new technologies (such as CO_2 conversion catalysts) that will help reduce CO_2 emissions throughout the supply chain.

We are also working on the development of a new recycling technology for superabsorbent polymer (SAP) contained in used diapers to reduce CO_2 emissions by recycling carbon.

Contribution to reduction of CO_2 emissions from the supply chain

* Development and increased popularization of Environmental Contribution Products
  - Contribution to reductions in CO_2 emissions through energy conservation during use
  - Contribution to reductions in CO_2 emissions by being incorporated into products that contribute to energy conservation
  - Contribution to reduction in CO_2 emissions through the adoption of biomass raw materials
* Promotion of utilization of hydrogen and ammonia
  - Catalysts for cracking of ammonia into hydrogen, etc.
* CO_2 absorption and recycling
  - CO_2 absorption materials, CO_2 conversion catalysts, etc.
* Development and social implementation of material recycling and chemical recycling
  - Promotion of recycling of disposable diapers containing superabsorbent polymer (SAP)

6. Metrics and Targets in Relation to Climate Change Issues

6-4. Certification of Environmental Contribution Products

Chemical industrial products use global resources from the Earth during production and emit GHGs and waste, thereby affecting the environment. However, when we view the entire life cycle from the procurement of raw materials to the disposal of final products, the presence of these chemical industrial products may contribute to the reduction of environmental loads.

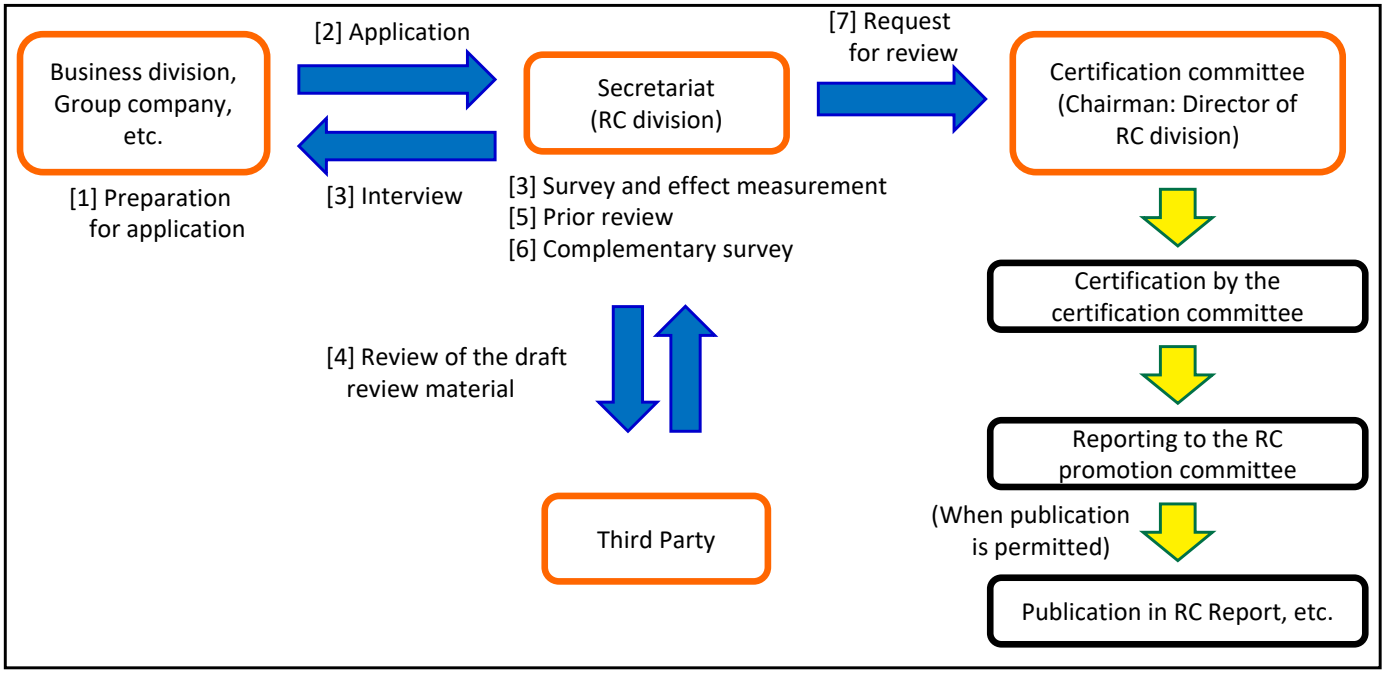
We evaluate how our products contribute to reducing environmental loads, including GHG emissions, based on how they are used throughout the supply chain, in the facilities that produce the products familiar to us and in the social infrastructure.

Starting in FY 2019, our company established and started operating a system to review and certify products as Environmental Contribution Products by comparing the check items, numerical data, etc. with the internal standards.

Third-party reviews are also included in the review process, and the content of the review is being enhanced through their input on the appropriateness of the concept, lacking data, etc.

Products that have been certified by the certification committee are reported to the Responsible Care (RC) Promotion Committee and published on our website and in RC Reports.

Certification Process for Environmental Contribution Products



6. Metrics and Targets in Relation to Climate Change Issues

Environmental Contribution Products (Only carbon-neutral related)

As of March 31, 2023

Product life stage	Applications	Accredited products
Manufacturing	Aquaculture feed binders	AQUALIC™ H (for feed)
	Concrete admixtures	AQUALOC™
	Multifunctional hydrophilic treatment agent for synthetic fibers	PET-4G (product using recycled PET) (SINO-JAPAN CHEMICAL CO., LTD.)*
	UV-curable reactive diluents	VEEA™
Use	Lithium-ion battery materials	IONEL™
	Solid-state battery materials	ICPDAP™, ICPSEB™
	CO_2 absorbent	Aminoalcohol (for absorbent) (NIPPON NYUKAZAI CO., LTD.)*
	Solid oxide fuel cell materials	Electrolyte sheets for solid oxide fuel cells
	Automotive damping materials	ACRYSET™ (for damping materials)
	Optical and electronic materials	ZIRCOSTAR™
	FO (Forward Osmosis) system components for seawater desalination	Draw solute
Disposal	Paint and adhesive raw materials, Reactive diluents	Isobornyl acrylate
	Paint and adhesive raw materials	Ethyl acrylate
	Concrete admixtures	AQUAGUARD™

＊ A product of our Group company

6-5. Estimate of avoided emissions in the supply chain by Environmental Contribution Products

We conducted an estimation of avoided emissions by Environmental Contribution Products that were expected to contribute to the reduction in CO_2 emissions in the supply chain (14 products in the table above).

As a result, the amount of avoided emissions in FY 2022 was approximately 1.14 million ton-CO_2/year.

We will try to improve the accuracy of estimation, further promote their spread, and develop new Environmental Contribution Products to contribute to the reduction in CO_2 emissions throughout the supply chain in the future.

7. Transition Plans toward Carbon Neutrality

As mentioned above, our Group has set a 2030 target of reducing GHG emissions by 30% (Group companies in Japan, Scope 1 + 2, compared to 2014), with the aim of achieving carbon neutrality by 2050. We expect that our efforts to reduce GHG emissions in Scope 1 and 2 will change significantly by 2030 and beyond.

For this reason, we have designated the period up to 2030 as a transition period for achieving carbon neutrality to work on reducing various GHG emissions, while also promoting developments to realize new efforts that are expected to be utilized after 2030.

7-1. Efforts During the Transition Period Until 2030

We will continue to develop energy conservation processes and introduce energy conservation equipment as we have done for some time, and promote energy conservation through precision control using DX. We also aim to improve efficiency by developing new catalysts. In FY 2022, we began introducing Carbon-Neutral City Gas, which is offset by carbon credits, and we will further examine and work toward greening of our electricity supply.

In addition, as CO_2 is emitted by our company due to chemical reaction processes, the use of biomass materials is essential in order to reduce CO_2 emissions. Specifically, we will promote the production of ethylene oxide, acrylic acid, superabsorbent polymer (SAP), etc., with partial utilization of ethylene and propylene derived from biomass.

Meanwhile, we will also pursue various developments with the aim of fully utilizing biomass raw materials after 2030. Specifically, we are developing processes to produce acrylic acid, which is one of our core products, from biomass raw materials. We plan to launch a pilot demonstration by 2025 with the aim of commercializing the system by 2030. Acrylic acid is used on the scale of several million tons per year as a raw material for the superabsorbent polymer (SAP), which is used in disposable diapers, and is expected to have a major ripple effect in reducing GHG emissions from the supply chain.

In addition, as there have been indications that society will make full use of hydrogen and ammonia after 2030, and our company will continue to promote the use of such technologies as catalysts to decompose ammonia into hydrogen. In addition, we will continue to take on the challenge of developing innovative technologies that will open the way for a decarbonized society, such as alkaline water electrolysis separators, CO_2 absorption materials and CO_2 conversion catalysts, electrolytes for Li-ion batteries, separators for zinc batteries, wastewater treatment catalysts, environmentally friendly materials, osmotic pressure generators (Draw solutes), and heat storage devices, while focusing on the expansion of hydrogen use, CO_2 separation, recovery and reuse, progress in electrification, and the realization of energy conservation as market opportunities in a decarbonized society.

7. Transition Plans toward Carbon Neutrality

We will also work to develop and achieve social implementation of the recycling technologies for SAP, which is a core product of our company, as we consider promotion of recycling as another important method.

7-2. Our Desired State in 2030 and Beyond

It is expected that various sectors and industries will develop innovative technologies and systems in order to achieve carbon neutrality by 2050, and that they will have progressed to the social implementation stage after 2030. Therefore, we will position the period after 2030 as our full-fledged transition period to achieve carbon neutrality and implement more innovative efforts.

Our company's manufacturing processes are expected to change dramatically after 2030. First, the shift from petroleum-derived raw materials to biomass raw materials will be expanded, and systems to absorb and reuse the CO_2 generated will be introduced if some petroleum raw materials remain. In addition, the development of recycling technology will greatly advance the circular economy and resource circulation. In other words, the raw materials for chemical products are expected to diversify, coming from petroleum, biomass, CO_2, and recycled raw materials. Our company aims to acquire the technologies to utilize such diverse raw materials more efficiently.

At the same time, with regard to energy used in the manufacturing process, we will consider further promoting the use of renewable energy, using hydrogen and ammonia as cogeneration materials, and using methane produced through the CO_2 methanation technology as cogeneration materials. We expect that the technologies our company owns and develops will also make significant contributions to the construction of these systems, and that innovative efforts will be realized through collaboration among different industries.

Through the above efforts, we aim to contribute to a society that achieves carbon neutrality not only in our company but also in Japan and the world at large.

8. Development of Products that Help Address Climate Change Issues

Electrolyte for lithium-ion batteries: IONEL™

Lithium-ion batteries are expected to be applied to various applications such as electric vehicles, mobile phones, stationary power supplies, and drones. In 2013, Nippon Shokubai developed the world's first industrial production process for LiFSI (trade name IONEL™) using a proprietary synthesis and purification method, and has obtained numerous patents worldwide.

IONEL™ is high in purity and quality, and exhibits stable electrochemical properties. It has been found that use of IONEL™ as an electrolyte for lithium-ion batteries delivers effects such as extension of battery life over a wide temperature range, improvement of input/output characteristics, improvement in storage characteristics, and suppression of swelling. It has already been adopted and certified as an electrolyte for many lithium-ion batteries in Japan and outside Japan, and its applications range widely including automotive, consumer, and stationary. It is expected to be adopted more widely and further contribute as a low-carbon, recycling-oriented clean energy technology in the future, and we plan to further increase our production capacity.

Appearance of IONEL™

Separator for alkaline water electrolysis, contributing to the spread of green hydrogen and the reduction of CO_2 emissions

The separator for alkaline water electrolysis is used for alkaline water electrolysis*1, a technique attracting attention as the production method for green hydrogen*2. Hydrogen energy does not emit CO_2 when used and therefore its applications have been expanding as fuel cells for automobiles and houses.

The separator has a significant impact on the hydrogen production efficiency and therefore is required to have two characteristics: high electrolysis efficiency (low ionic resistance) and not cross leaking the generated hydrogen and oxygen (high gas barrier property). Under the severe conditions of high-temperature, high-concentration alkaline water, the number of both practical and durable separators is limited. However, Nippon Shokubai has succeeded in the development of a product that ensures both of these characteristics by applying our unique organic/inorganic hybrid technology and sheet manufacturing technology.

This separator is expected to show several advantages, including reduction of power consumption and improvement of the purity of the hydrogen produced, thereby contributing to the spread of green hydrogen and a reduction in CO_2 emissions.

*1 Method of water electrolysis using strong alkaline solution, such as potassium hydroxide

*2 Hydrogen produced using renewable energy with reduced CO_2 emissions

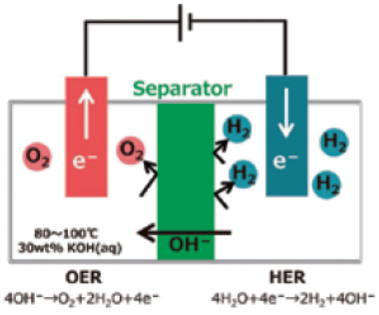


Image of alkaline water electrolysis

Separator for alkaline water electrolysis

8. Development of Products that Help Address Climate Change Issues

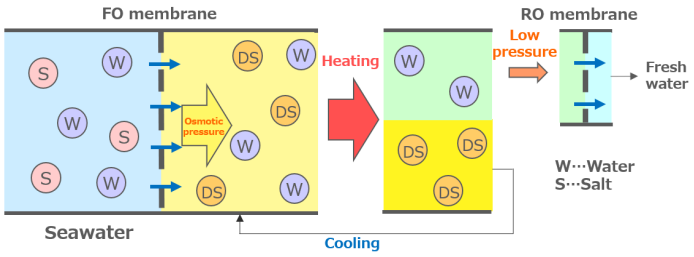
Materials for seawater desalination and wastewater treatment: Osmotic pressure generating agents

Osmotic pressure generating agent (Draw Solute or DS) is a key component of the Forward Osmosis (FO) system, a next-generation seawater desalination technology.

The DS our company developed only extracts water from seawater with its high osmotic pressure within the FO system, and then separates it from water by heating, enabling efficient freshwater extraction.

By using factory waste heat and solar heat for the heat source used in this separation process, it is possible to conserve energy, reduce CO_2 emissions, and reduce costs when compared to existing seawater desalination technologies such as reverse osmosis (RO) systems. In addition, our company's DS can be used repeatedly for water extraction process after separation, and has a reduced environmental impact.

Moreover, the FO system can be applied to industrial wastewater treatment applications (Zero Liquid Discharge or ZLD). It is therefore attracting attention as a technology that can meet increasingly stringent global wastewater regulations.



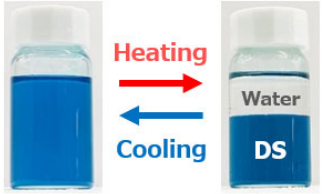


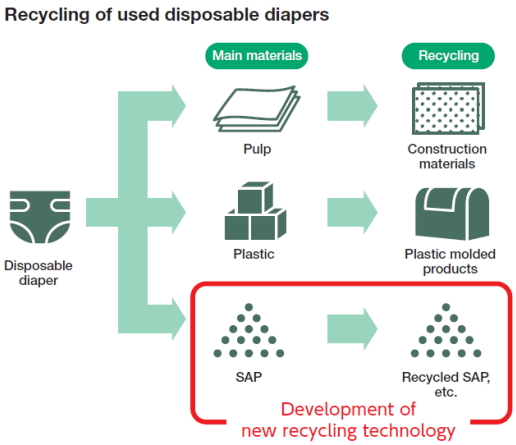
Image of a forward osmosis system

A new value: reduction of waste by switching from disposable to recycled use

Disposable diapers are mainly composed of pulp, plastic, and SAP. Recycling of used diapers has been put into practice by Total Care System for a part of their raw materials. The recycled pulp has been effectively used as raw materials for building materials (e.g., exterior and interior wall materials) and plastic has been thermally recovered as solid fuel.

Nippon Shokubai began to examine the recycling technology for SAPs, which has not been in practice, and succeeded in the development of new recycling technologies jointly with Livedo Corporation, a major manufacturer of diapers for adults, and Total Care System. This technology consists of two techniques: 1. a technique to increase the recovery rate of paper pulp through processing SAP that had been swollen from absorbing urine, to improve the separation from paper pulp, and 2. a technique to collect SAP while minimizing the performance degradation of SAP and also paying attention to energy saving and water quality conservation of rivers and other bodies of water.

These technologies are applicable to all SAPs produced by Nippon Shokubai, as well as to various SAPs of other companies. We will improve these technologies to a practical level, advance the development of easy-to-recycle materials and treatment technology, and work with the two partner companies to build a recycling system.



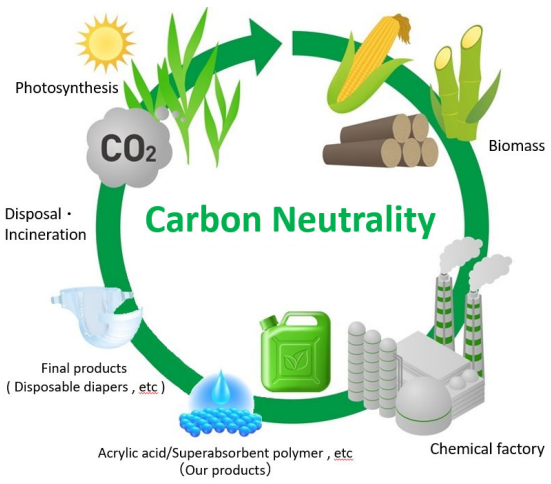
8. Development of Products that Help Address Climate Change Issues

Acrylic acid/superabsorbent polymer made from biomass raw materials

Acrylic acid is widely used as a raw material for various products, including superabsorbent polymers (the water-absorbing component of disposable diapers) and acrylic esters (the main ingredients and additives in paints and adhesives). However, the final products—disposable diapers and so on—become a source of CO_2 emissions when disposed of and incinerated after use.

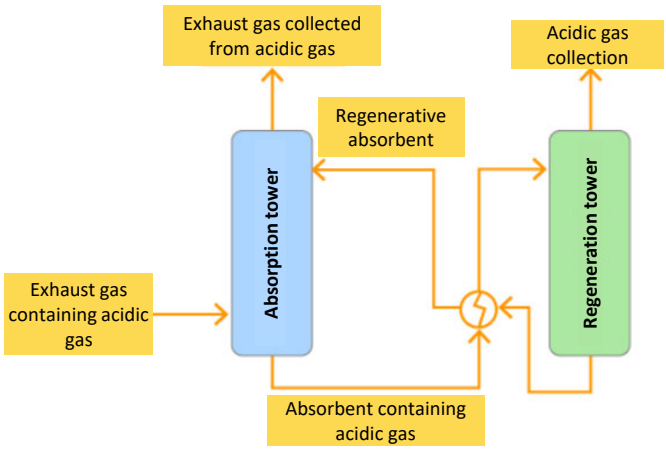
Therefore, Nippon Shokubai is investigating the use of biomass-derived propylene instead of petroleum-derived propylene, and is developing a new manufacturing method for acrylic acid from biomass. Since biomass absorbs and fixes CO_2 in the air through photosynthesis, the CO_2 emitted during incineration can be regarded as carbon neutral, leading to a reduction in CO_2 emissions.

We aim to start the commercial production of biomass-derived acrylic acid as early as possible by 2030, by working to develop the mass production technology during our medium-term management plan from FY 2022 to FY 2024. We will also expand its use to the production of superabsorbent polymer and acrylic esters, and aim to reduce CO_2 emissions throughout the lifecycles of our customers' final products.



Carbon dioxide absorption liquid: Amino alcohol (Product of Nippon Nyukazai Co., Ltd.)

Amino alcohol is a gas absorbent that absorbs acidic gases such as CO_2 and H_2S. It absorbs CO_2 and H_2S and releases them easily when heated, requires little heat to absorb and dissipate, and offers fast absorption speeds. It is used for decarboxylation and desulfurization in thermal power plants, steelworks, and petroleum refineries that generate large amounts of CO_2, and gas refining in the chemical industry. It contributes to the capture and storage of CO_2, which is essential as a climate change countermeasure, and can be expected to significantly reduce emissions.



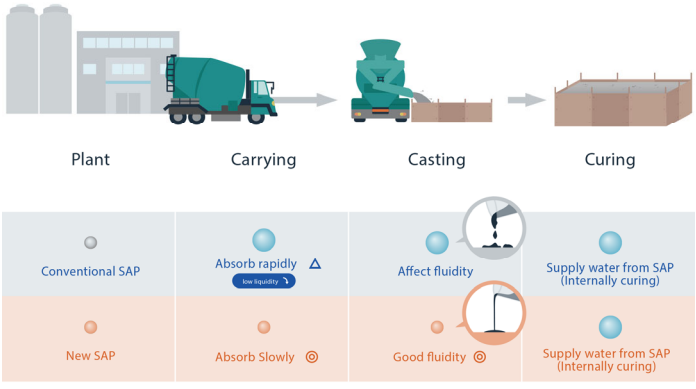
Acidic gas absorption process flow (example)

8. Development of Products that Help Address Climate Change Issues

Superabsorbent polymer (SAP) that contributes to the life extension for concrete structures

Concrete has been an important civil engineering and building material since ancient Roman times, supporting social infrastructure to the present day. On the other hand, there are demands for measures to reduce CO_2 emissions related to the construction and maintenance of structures and realize a recycling-oriented society, as cement—the main raw material for concrete—emits a large amount of greenhouse gases (CO_2) during its manufacture. To date, studies have been conducted on extending the life of concrete (durability improvement) using SAP, but they had never reached the stage of its application or adoption, as SAP, which is used in disposable diapers and industrial applications, rapidly absorbs water and causes a decrease in the fluidity of concrete.

Leveraging its core technology of polymer synthesis and its knowledge of cement additives, our company has developed SAP for concrete that controls the rate of water absorption during concrete construction. This SAP can contribute to the reduction of CO_2 emissions as it is expected to allow a reduction in the amount of cement used and extend the life of concrete structures by improving strength, preventing carbonation, reducing shrinkage, etc. through the sustained release of water inside the concrete.

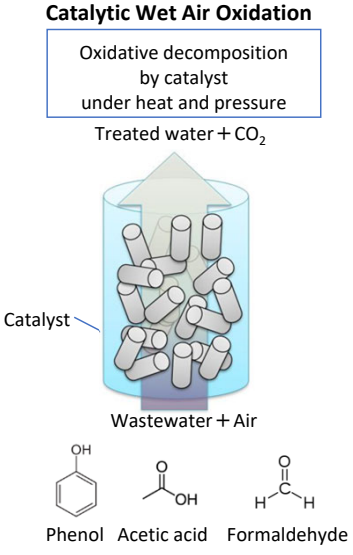


An alternative wastewater treatment to incineration

High-efficiency, low-cost processing capacity achieved in a maintenance-free facility

Catalytic Wet Air Oxidation (CWAO) wastewater treatment is a technology that can treat harmful substances such as organic matters in wastewater with high efficiency and low running costs. Using the solid catalysts developed by our company, it is possible to detoxify highly toxic organic matters, organic nitrogen compounds, ammonia, sulfur compounds, etc. into carbon dioxide, water, nitrogen and sulfates through a liquid-phase oxidation reaction using air as the oxidizing agent. CWAO emits no exhaust gases, including SO_x, NO_x and dioxin, and no secondary pollutants such as combustion ash. In addition, compared to the incineration method, which requires fuel as a combustion improver, this process can be autonomously operated in terms of heat by reusing the energy generated from the oxidation reaction, eliminating the need for auxiliary fuel and reducing CO_2 emissions.

In addition, by combining biological treatment in the latter stage, even more advanced treatment can be easily achieved. It is suitable for treating wastewater discharged from chemical and semiconductor plants, especially wastewater that is difficult to clean through biological treatment.



8. Development of Products that Help Address Climate Change Issues

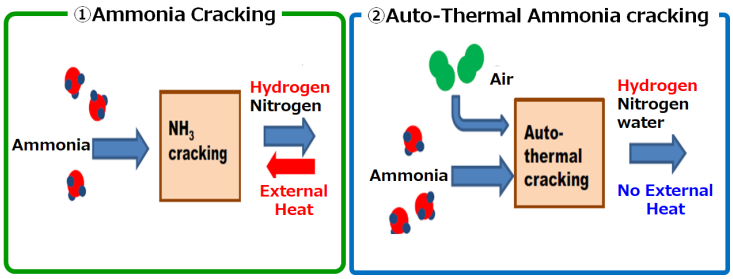
Ammonia cracking catalyst to contribute to the hydrogen and ammonia-based society

As hydrogen and ammonia do not generate carbon dioxide (CO_2) through combustion, they are attracting attention in the fields of power generation, transportation, and industry as a next-generation energy as society looks to carbon neutrality. Ammonia is also promising as a hydrogen transport medium (hydrogen carrier) because of its high hydrogen density per volume and its properties that allow the use of existing infrastructure.

Ammonia, on the other hand, is less flammable than fossil fuels, and its combustibility can be improved if some of it is decomposed into hydrogen. Ammonia cracking technology, which decomposes ammonia to extract hydrogen, is also extremely important for the use of hydrogen in large hydrogen power plants and hydrogen stations.

Nippon Shokubai has developed two types of ammonia cracking catalysts (direct decomposition and auto-thermal) to accommodate various applications. The ammonia cracking type can extract hydrogen without waste through external heating below 600 degrees Celsius. The auto-thermal cracking can build a simple system that does not require external heating because the catalyst oxidizes a part of ammonia with oxygen and the generated heat can decompose ammonia.

Our company aims to develop mass production technology for these ammonia cracking catalysts by around 2025, and put them into practical use by around 2030 with the goal of contributing to carbon neutrality.



9. Conclusion

Our Group has been working under the group mission "**TechnoAmenity**: Providing prosperity and comfort to people and society, with our unique technology," and we believe that this mission is also consistent with the Sustainable Development Goals (SDGs).

In our response to the changes in the environment, including climate change issues, we will contribute to the realization of a carbon-neutral and sustainable society by minimizing risks, maximizing opportunities, and providing innovative technologies and products.