TOKUYAMA

April 1, 2023 ～ March 31, 2024

Tokuyama TCFD Report 2024

Disclosures Based on TCFD Recommendations

Governance

- ⓐ Board's oversight of climate-related risks and opportunities
- ⓑ Management's role in assessing and managing climate-related risks and opportunities

Strategy

- ⓐ Climate-related risks and opportunities the company has identified over the short, medium, and long term; and ⓒ the resilience of the company's strategy, taking into consideration different climate-related scenarios, including a 2˚C or lower scenario
- ⓑ Impact of climate-related risks and opportunities on the company's businesses, strategy, and financial planning

Risk Management

- ⓐ Company's processes for identifying and assessing climate-related risks
- ⓑ Company's processes for managing climate-related risks
- ⓒ How processes for identifying, assessing, and managing climate-related risks are integrated into the company's overall risk management

Metrics and Targets

- ⓐ Metrics used by the company to assess climate-related risks and opportunities in line with its strategy and risk management process
- ⓑ Scope 1, Scope 2, and, Scope 3 greenhouse gas (GHG) emissions, and the related risks
- ⓒ Targets used by the company to manage climate-related risks and opportunities and performance against targets

Issued by Carbon Neutral Strategy Div. and Corporate Social Responsibility Div. Tokuyama Corporation on June 28, 2024

Fiscal year 2023
April 1, 2023 ～ March 31, 2024

The Tokuyama Group announced its support for the TCFD recommendations in February 2021 and has been studying climate change measures based on the TCFD framework. In FY2023, the Group issued its second TCFD report. It reveals that we have enhanced our analysis of climate change risks and opportunities, set new reduction targets for Scope 3 emissions, and shared stakeholder evaluations of our emissions reduction efforts. Tokuyama discloses its climate change efforts in line with the TCFD's four thematic areas that represent core elements of how companies operate: Governance, Strategy, Risk Management, and Metrics and Targets.

Governance

Tokuyama Group has identified climate change as one of its most significant management risks. Accordingly, contributing to global warming mitigation is one of the key objectives under its current Medium-Term Management Plan, which began in FY 2021.

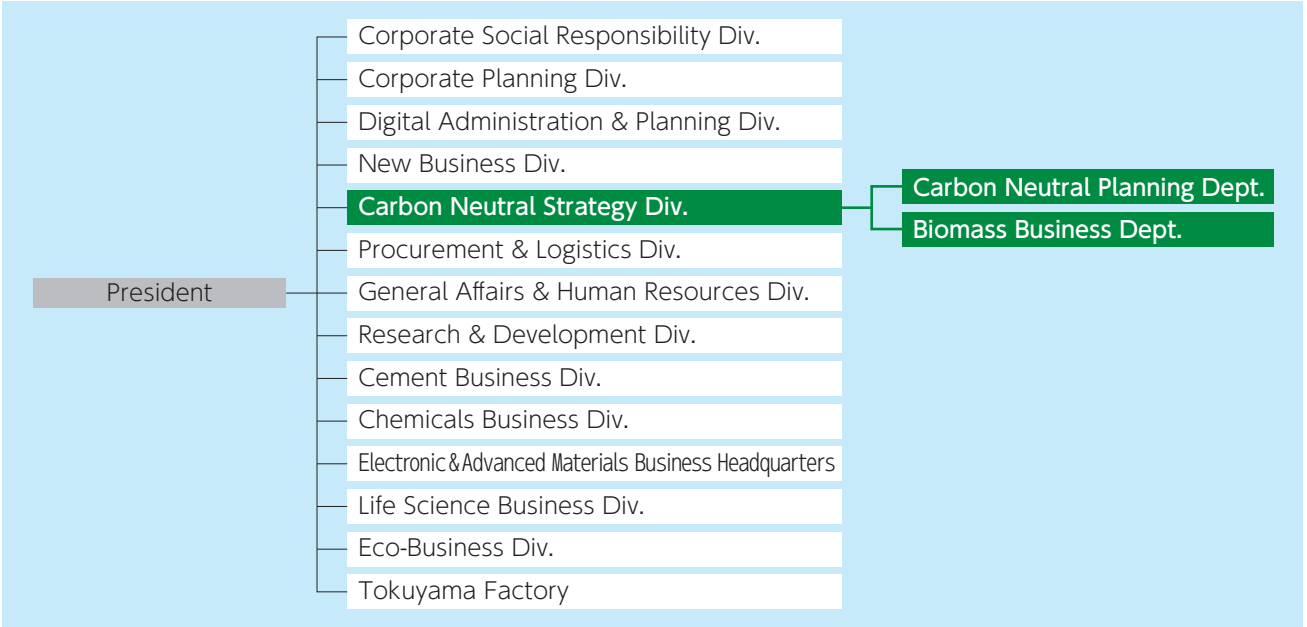
Figure 1: Medium-Term Management Plan [FY2021 to FY2025]

❶ Transform business portfolio	Increase growth businesses' share of consolidated net sales to over 50%
❷ Contribute to mitigation of global warming	Expedite development/commercialization of next-gen energy technologies; reduce GHG* emissions 30%** by FY2030
❸ Practice socially responsible management	Step up high-priority CSR initiatives to lay groundwork for further growth and realize our vision

* GHG : Greenhouse Gas
** Base year FY2019

Two months after announcing our support for the TCFD recommendations in February 2021, we established Carbon Neutral Strategy Dept. directly under the president . With the transition from the concept stage to the implementation phase, Tokuyama has now accelerated its efforts by establishing Carbon Neutral Strategy Div., which has the status of an independent division.

Figure 2: Organizational Position of the Carbon Neutral Strategy Div.



ⓐ Board's oversight of climate-related risks and opportunities

In order to determine the Group's sustainability policies and goals and efficiently proceed with the relevant activities, the Group has established a CSR Promotion Council, which meets once a year in principle. Chaired by the President, it includes all executive officers, and the meetings are attended by the Audit and Supervisory Committee members, including outside directors. At meetings, the council members discuss important matters, including the implementation of appropriate corporate governance and risks and opportunities related to sustainability issues. The decisions made by the council are reported to the Board of Directors, which provides oversight of the body, and then reflected in the Group's strategy.

Matters related to climate change are discussed by the Executive Committee, which then adopts resolutions as necessary. Such matters include corporate policies for addressing climate change, the formulation of medium and long-term strategies to achieve those policies, and the selection of investment projects, etc. The resolutions are then reported to the Board of Directors. Additionally, decisions on matters of particularly high importance are taken by the Board of Directors after deliberation by the Executive Committee.

Figure 3: Corporate Governance Structure

As of April 1, 2024

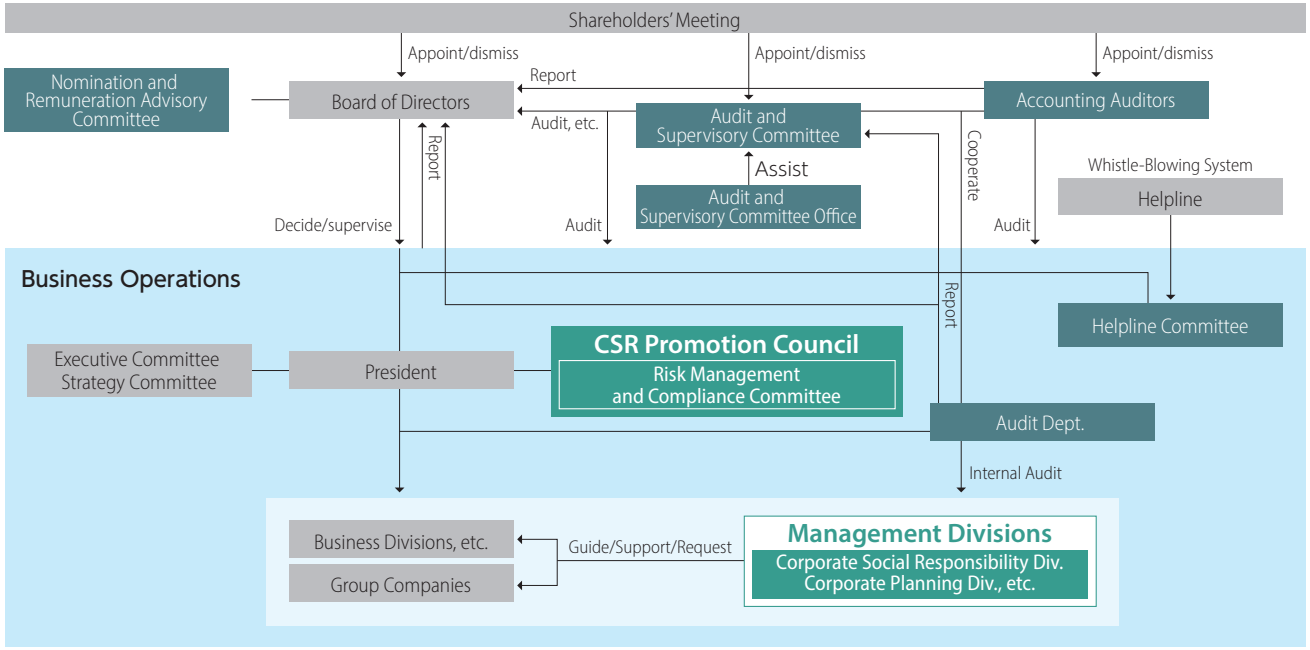


Table 1: Process and Frequency for Reporting and Approval of Climate-Related Matters

Approval Process	FY2023 Results	Notes
Board of Directors	19 *	● Receives reports on and oversees CSR matters, including climate change activities ● Receives reports on and oversees matters that can help achieve key measures under the Medium-Term Management Plan
CSR Promotion Council	1	● The president chairs the council, which reports to the Board of Directors on its meetings and the activities of the council's eight subcommittees
Sustainability Committee	2	● Established in FY2022, the Sustainability Committee permits Group directors to attend its meetings as observers ● Summary reports are provided to the Board of Directors
Environment Committee	1	● This committee oversees onsite environmental audits conducted across the Group, and monitors the energy-saving activities of individual Group sites
Executive briefing of Carbon Neutral Strategy Dept.	4	● Reporting on and investigating measures

* Regarding the Board of Directors, in addition to the above, there were five written resolutions that were deemed to have been a Board of Directors resolutions.

ⓑ Management's role in assessing and managing climate-related risks and opportunities

Tokuyama has established an approval process for governance related to climate change. The president bears ultimate responsibility for the Group's efforts to help combat climate change.

Under the CSR Promotion Council, the Group has established a Sustainability Committee, which meets twice a year in principle. Its role is to lead the Group's CSR efforts, including climate change response measures. Under the same council, the Group has also created an Environment Committee, which meets once a year in principle. Its role is to oversee group-wide environmental audits and compile energy conservation activity reports, etc., with the aim of accelerating the Group' s climate change initiatives. After analyzing the risks and opportunities posed by climate change with respect to the Group's business activities, we have incorporated the results into our measures for fulfilling the Medium-Term Management Plan 2025.

All the executive officers and outside directors participate in seminars to learn more about global warming and attended three such activities in FY2023. These seminars monitor the latest trends and regulatory systems related to climate change and is making preparations to enable rapid response as necessary.

Figure 4: System to Promote Carbon Neutrality Achievement

Table 2: Process and Frequency for Receiving Reports, and Monitoring Mechanism

Reporting Process	Meeting Frequency (Number of meetings in FY2022)	Monitoring Mechanism
Executive Committee	Twice a month in principle (29) *	With "contribution to global warming mitigation" set as a priority issue under the Medium-Term Management Plan 2025, the committee deliberates on the strategic planning and capital investment needed to mitigate climate change risks.
CSR Promotion Council	Annually (1)	Chaired by the president, the council manages progress on addressing material issues, while receiving activity reports from the Risk Management and Compliance Committee and its eight expert subcommittees.
Sustainability Committee	Semiannually (2)	Chaired by the director responsible for CSR, the committee directs the Group's CSR initiatives including climate change.
TCFD Task Force	As necessary (6)	Positioned under the Sustainability Committee, the task force assembles its members from across the Group to investigate and promote practical initiatives that meet the TCFD recommendations.
Environment Committee	Annually (1)	The committee provides general oversight of the environmental audits conducted at each production facility, receives energy conservation activity reports, and sets environmental targets for the next fiscal year.
Top executives' interview with Carbon Neutral Strategy Dept.	Monthly (12)	Responsible for investigating and implementing measures.
Officer Seminars	Annually in principal (3)	Seminars on management strategies including carbon neutrality for all executive officers.

*Regarding the Executive Committee, in addition to the above, there was one written resolution that was deemed to have been an Executive Committee resolution.

Strategy

The Group's Medium-Term Management Plan 2025 addresses both the risks related to climate change, and the potential new business opportunities in the environmental field. The risk mitigation measures include making visible the carbon costs arising from the introduction of carbon pricing, addressing the impact of potential changes in customer procurement policies, and identifying the impact on financing arising from potential policy changes at financial and investment companies. Moreover, by referring to the International Energy Agency's (IEA) transition risk scenarios (such as the Net Zero Emissions by 2050 Scenario [NZE]), and the Intergovernmental Panel on Climate Change's (IPCC) physical risk scenarios (such as RCP8.5 and SSP3-7.0), we conducted risk and opportunity analysis using 1.5°C and 4°C warming scenarios covering a period from the present to 2050. Our aim is to monetize promising business opportunities while reducing climate change risks by shifting our portfolio from energy-intensive to value-creating companies.

ⓐ Climate-related risks and opportunities the company has identified over the short, medium, and long term; and ⓒ the resilience of the company's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario

In FY2021, we began analyzing the risks and opportunities that the Group faces due to climate change. In FY2022, we evaluated the potential financial impacts on the Group of those risks and opportunities, the potential timing of their occurrence, the impact on business, and the priorities for addressing these risks and opportunities.

Based on the results, we proceeded with the consideration of specific measures in FY2023.

Table 3: Risks Posed by Climate Change (scenario analysis)

Scenario	Risk category	Target of risk assessment	Potential impacts on the Group (financial) (identified risks)	Financial impact	Timing of risk materialization	Impact on business	Priority evel	Response measures
1.5°C	Government policy and regulations	① Carbon pricing and energy procurement costs	● Increase in operating costs due to expanded carbon pricing	Large	Medium to long term	Large	High	● Initiatives to reduce GHG emissions through fuel conversion (biomass and ammonia) ● Promoting GHG emission reduction measures by adopting internal carbon pricing ● Enhancing initiatives to help promote green transformation by participating in the GX League
			● Increase in mitigation measure costs due to tightening of GHG emission regulations	Large	Medium to long term	Large	High	
	Technology	② Green process adoption measures	● Increased green energy production and procurement costs	Large	Medium term	Large	High	● Studying ammonia supply chain establishment at the Shunan petrochemical complex ● Ensuring stable procurement of certified biomass fuel by building relationships with suppliers ● Development of black pellets ● Calculation of product carbon footprints (CFP)
			● Increased costs for green material procurement and green process conversion due to lack of technology and market maturity	Large	Medium to long term	Large	High	
	Evaluation	③ Evaluation by stakeholders	● Decline in market value and increase in financing costs due to a poor evaluation of carbon neutrality initiatives ● Risk of litigation by local residents to shut down or decommission coal-fired power plants owned by Tokuyama ● Sustainability risks for biomass fuel	Large	Medium to long term	Large	High	● Improving information disclosure and steadily working to reduce GHG emissions ● Dialogue with the local community ● Business portfolio transformation ● Certified biomass fuel procurement
	Market	④ Penetration of green procurement by customers	● Rejection of products by the market based on large carbon-footprint evaluation ● Decrease in profitability due to the inability to pass on the price fully cover costs for green process adoption	Large	Medium to long term	Large	High	● Steadily reducing GHG emissions through energy conservation and fuel conversion, etc. ● Studying mass balance certification ● Enhancing supply chain cooperation to form a suitable green market ● CFP evaluation system creation
		⑤ Lost opportunities due to a failure to keep up with green market expansion	● Lost opportunities due to the delay in establishing a green supply chain ● Lost opportunities due to insufficient efforts for entering the circular economy and the carbon recycling field	Large	Medium to long term	Large	High	● Prompt implementation of measures
4°C	Physical risks (acute)	⑥ More frequent extreme weather events and sea level rise	● Wind and flood damage to production facilities; production plans delay and increased costs due to supply chain disruptions, etc.	Moderate	Long term	Moderate	Moderate	● Enhancing business continuity planning
	Physical risks (chronic)	⑦ Long-term intensification of extreme weather events and rising sea levels	● Decrease in production capacity due to insufficient factory cooling capacity caused by rising average temperatures ● Production halts due to storm surges caused by rising sea levels	Minimal	Long term	Minimal	Low	● Maintaining capacity through equipment modifications, etc.

Short term: by FY2025; medium term: by FY2030; long term: by FY2050

Government policy and regulations

① Carbon pricing and energy procurement costs

Impact on Tokuyama Group

Increase in operating costs due to expanded carbon pricing (medium to long term)

Tokuyama uses coal mainly for onsite power plants. We paid approximately 1.6 billion yen in environmental taxes (Japan's petroleum and coal tax, and carbon tax) in FY2023, which is equivalent to approximately 6.3% of operating income.

Moreover, under the Japanese government's "growth-oriented" carbon pricing plan, Phase 1 of emissions trading will begin in FY2023, with full-scale emissions trading starting in FY2026. Then a carbon levy will be introduced in FY2028, which will gradually increase thereafter.

Japanese carbon pricing will be introduced in stages. Since the details of these programs have not been fully determined yet, it is difficult to estimate the financial impact on the Group at this time. However, assuming a tax of 10,000 yen per ton of CO_2 emissions from fuels-derived, if our CO_2 emissions remain at the same level as in FY2022, the annual cost will be approximately 48 billion yen.

Increase in mitigation measure costs due to tightening of GHG emission regulations (medium to long term)

In April 2023, Japan implemented the Revised Act on Rationalizing Energy Use. Under this law, in addition to conventional promotion of energy conservation, requirements for conversion to non-fossil energy have been established. Guidelines for quantitative targets to be achieved by FY2030 have also been implemented for industries with substantial emissions.

Tokuyama has set the following targets based on established objectives.

- **Cement** production: Achieve a non-fossil fuel ratio of 50% in co-firing processes (179% compared to the guideline)
- **Chemical** industry (soda industry): Reduce coal consumption by 45% compared to FY2013 (150% compared to the guideline)

Tokuyama will set targets based on established guidelines and work on conversion to greener fuels.

While there are no penalties for failure to achieve targets, if the performance of an organization is found to be significantly inadequate, recommendations and/or announcements will be made after considering the level of the relevant technology and the situation for non-fossil energy supply.

Tokuyama is working to achieve a 50% reduction in fuel-derived GHG emissions from onsite power plants by FY2030 compared to FY2019 and aims to switch to non-fossil fuels (biomass and ammonia) to meet this goal. To achieve a 30% reduction in GHG emissions through co-firing with biomass and a 20% reduction through co-firing with ammonia, we estimate that approximately 11 billion yen will need to be invested in biomass technology along with about 15 billion yen in ammonia.

Government policy and regulations

① Carbon pricing and energy procurement costs

Response measures

Initiatives to reduce GHG emissions through fuel conversion (biomass and ammonia)

The Group needs to steadily reduce its GHG emissions to mitigate the risk of increased manufacturing costs due to carbon pricing.

Tokuyama is aiming to achieve a 50% reduction in GHG emissions from onsite power plants compared to FY2019 by 2030, and it plans to switch to non-fossil fuels (biomass and ammonia) for onsite power plants. The rate of co-firing with biomass will gradually increase starting in FY2023. Co-firing with ammonia is scheduled to begin starting in FY2028 and beyond. A basic plan for biomass and ammonia adoption is currently being implemented, as part of a project sponsored by Japan's Agency for Natural Resources and Energy (FY2023 Oil Supply Structure Advancement Project Cost Subsidy: Project to Promote Transition to a Stable Supply of Next-Generation Fuels).

To cover the cost of this emissions reduction project, we will utilize government subsidies, and pass on the remaining costs through higher product prices.

Promoting GHG emission reduction measures by adopting internal carbon pricing

In order to promote GHG emission reduction measures, Tokuyama has added internal carbon pricing (ICP) to its evaluation criteria for investment projects (10,000 yen/t-CO2). This will promote energy conservation activities in the short and medium term, and we are working to reduce coal use by co-firing with biomass or ammonia at power plants. In FY2023, the investment effect taking ICP into account was used as a reference value when deciding on biomass co-firing investments.

Enhancing initiatives to help promote green transformation by participating in the GX League

As a member of Japan's GX League since FY2023, the Tokuyama Group has been sharing data relating to its emissions reduction and green transformation (GX) efforts, while also conducting emissions trading. While actively working toward GX and disclosing our progress, we are learning from the initiatives of other companies in the GX League and striving to carry out even more effective emissions reduction activities.

Technology

② Green process adoption measures

Impact on Tokuyama Group

Increased green energy production and procurement costs (medium term)

Tokuyama has four coal-fired power plants, one of which is a circulating fluidized bed boiler that can also operate on biomass exclusively. In FY2023, we began to increase the biomass co-firing ratio for that plant, and as a result we reduced the amount of coal used for onsite power generation by 170,000 tons compared to FY2019. On the other hand, the remaining three boilers are pulverized coal-fired boilers, and capital investment will be required to convert them to biomass or ammonia use. If we reduce our GHG emissions by 30% through biomass co-firing and by 20% through ammonia co-firing, approximately 11 billion yen will need to be invested in biomass technology along with about 15 billion yen in ammonia equipment. At the same time, operating costs are expected to increase due to the procurement of biomass and ammonia.

Increased costs for green material procurement and green process conversion costs due to the lack of technology and market maturity (medium to long term)

In order to achieve carbon neutrality, not only does energy input need to be green, but also raw materials and production processes. Many of these processes are still being developed, as relevant markets and technologies are yet to be established. Since many green technologies and markets are still immature, there is a risk of increased costs.

Technology

② Green process adoption measures

Response measures

Investigation of ammonia supply chain establishment at the Shunan petrochemical complex

Building a large-scale supply chain is essential for reducing the cost of green energy. To procure biomass fuel, the Group installed equipment for handling wood pellets at the Port of Tokuyama. We are making efforts to efficiently unload biomass fuel, which we will need more of going forward.

To obtain ammonia, we are working with relevant companies to build an ammonia supply chain in the Shunan Industrial Complex.

Ensuring stable procurement of certified biomass fuel by building relationships with suppliers Development of black pellets

Due to the global transition to decarbonization, there will likely be a tight supply situation for internationally certified biomass fuels, going forward. Until now, we have used palm kernel shells (PKS) as fuel in our power plants. Thanks to the good relationships we have built with our suppliers over the years, we have been able to secure certified products from an early date and have increased our biomass fuel usage.

Through the development of black pellets by semi-carbonizing biomass from FY2023, the Group aims to increase the types of biomass fuel it can use and thereby ensure an affordable and stable supply.

Calculation of product carbon footprints

The first step towards making greener products is being able to accurately calculate the GHG emissions related to each one. As part of efforts to better meet customer needs, in FY2023, we calculated the cradle-to-gate carbon footprint for each of our products (from the extraction of raw materials to the point where the product leaves the manufacturing facility) based on accepted and proposed standards and guidelines. Going forward, we will update our calculation method based on anticipated changes in the guidelines and customer needs, in order to provide even more accurate carbon footprint data.

Evaluation

③ Evaluation by stakeholders

Impact on Tokuyama Group

Decline in market value and increase in financing costs due to a poor evaluation of carbon neutrality initiatives (medium to long term)

Our stock price could suffer if investors see the ownership of coal-fired power plants as a high risk. Moreover, we could be charged higher interest rates on our borrowing if we are evaluated as a high-risk company, and our financing costs would then increase.

Risk of litigation by local residents to shut down or decommission coal-fired power plants owned by Tokuyama (medium to long term)

In Japan, lawsuits have been filed against constructions of coal-fired power plants by local residents, and there have been cases where such construction plans have been cancelled. As Tokuyama owns four coal-fired power plants, we could be sued to shut down or decommission these facilities if our efforts to reduce coal consumption are seen as insufficient.

Sustainability risks of biomass fuels (medium to long term)

While the Group uses palm kernel shells (PKS) as fuel, they have been tied to issues such as deforestation and labor conditions in the palm oil industry. Moreover, falsification of wood pellet certification has been discovered in Vietnam, and so expanding the procurement of biomass fuels comes with certain risks.

Response measures

Improving information disclosure and steadily working to reduce GHG emissions

With the ultimate goal of achieving carbon neutrality by FY2050, Tokuyama Corporation and its consolidated manufacturing subsidiaries are working to reduce Scope 1 and 2 GHG emissions by 30% by the end of FY2030, compared to FY2019. We are also calculating and disclosing these emissions in accordance with the GHG Protocol. For Scope 3 emissions, Tokuyama and its consolidated manufacturing subsidiaries have set a goal of reducing GHG emissions by 10% by FY2030, compared to FY2022.

We also follow the TCFD recommendations and proactively disclose information that stakeholders are seeking.

Evaluation

③ Evaluation by stakeholders

Response measures

Dialogue with the local community

In FY2023, we supported the implementation of a Shunan regional dialogue, environmental class visits provided to technical high schools in Shunan City, and a symposium entitled "A carbon-neutral society of the future made possible by Shunan."

As part of the Shunan regional dialogue, Tokuyama gave a presentation on the company' s environmental conservation efforts under the banner of "Building a safer and more livable city as part of the green transition," followed by a factory tour and a social gathering. In the environmental class visits, we explained Tokuyama' s carbon neutrality and CSR initiatives, giving specific examples, to third-year students who were studying industrial chemistry in the Environmental Systems Department at Yamaguchi Prefectural Tokuyama Commercial Technical High School. The students also participated in experiments and a study tour of the Tokuyama Factory.

The symposium was hosted by the Shunan Industrial Complex Decarbonization Promotion Council and supported by Tokuyama. In addition to the lectures, we held panel discussions with high school students to spread information to Shunan residents about Tokuyama' s initiatives to achieve carbon neutrality.

The Group will continue building good stakeholder relationships by including local residents in its environmental initiatives and by actively participating in community activities.

Business portfolio transformation

As a key issue under the Medium-Term Management Plan 2025, we are promoting efforts to transform our business portfolio.

In FY2023, we conducted an evaluation of our legacy businesses, assuming future carbon pricing. By identifying potential changes in our competitiveness due to the transition to a low-carbon society, we began devising an appropriate business strategy.

Moreover, the Group plans to make large-scale investments to achieve carbon neutrality, which will total approximately 18 billion yen over the three-year period from FY2024 to FY2026.

Procurement of certified biomass fuel

As the Group is increasing its use of biomass co-firing to reduce GHG emissions, it is important that we ensure sustainability by procuring biomass fuel that meets the level of certification required by the Japanese government's renewable energy feed-in tariff system. Starting in FY2024, we have adopted Green Gold Label certified palm kernel shells (PKS) for our internal power production. We are also promoting CSR procurement, which is one of our key CSR issues (materialities), while working to minimize risks by trying to source from regions with low sustainability risks.

Market

④ Penetration of green procurement by customers

Impact on Tokuyama Group

Rejection of products by the market based on large carbon-footprint evaluation (medium to long term)

In recent years, the rules for calculating the carbon footprint (CFP) of products over their life cycle continue to be refined. Since Tokuyama emits a large amount of greenhouse gases, customers may require us to disclose our CFP and set reduction targets for each product. If we fail to achieve these targets, sales of our products could be affected. In particular, sales to customers who are actively working to combat global warming could very well decrease.

Deterioration of profits due to an inability to recover green initiative costs by raising prices (medium to long term)

Tokuyama is investigating fuel conversion and green power procurement to reduce GHG emissions from fuels-derived, but we also assume that energy costs will rise going forward. Therefore, we need to assume an appropriate green market energy price that takes into account the rising costs associated with fuel conversion. However, there is a risk of lower profit margins if the costs related to green process adoption cannot be passed on through higher product prices.

Market

④ Penetration of green procurement by customers

Response measures

Steadily reducing GHG emissions through energy conservation and fuel conversion, etc.

To ensure that our products remain the choice of our customers and survive in the marketplace, we must meet our GHG emission reduction targets for FY2030.

First, we will further promote ramp up energy-saving activities to fully eliminate any energy loss. Tokuyama will steadily reduce GHG emissions from fuels-derived by steadily adopting co-firing with biomass and ammonia.

Over the short term, we have promoted energy conservation activities in each manufacturing department as shown below, and reduced coal consumption by co-firing with biomass and hydrogen at the Group' s onsite power plants.

- Polycrystalline silicon: Improved production process
- Cement: Installation of high-efficiency equipment

In FY2023, we were able to reduce GHG emissions by 80,000 t-CO_2e through energy-saving activities.

Creation of green products based on mass balance approach certification

Since Scope 1 emissions from electricity and steam generation cannot be reduced using carbon offset credits, and since the Tokuyama Factory generates all its own power, we need to ensure that all the electricity produced by the factory is green in order for it to make green products. Therefore, we are currently considering obtaining certification for biomass electricity and steam under the mass balance method.

Enhancing supply chain cooperation for proper green market formation

Businesses that directly emit GHG emissions are responsible for reducing those emissions. However, the prevailing view is that the relevant costs will likely not be borne entirely by those businesses, but by society as a whole. Therefore, we will strengthen cooperation with other stakeholders so that the entire supply chain can work to help create a sound green market.

In FY2023, we surveyed our major suppliers about their GHG emissions initiatives to get a picture the actual situation.

Construction of a carbon footprint evaluation system

In order to make greener products, GHG emissions data needs to be made available for the entire product life cycle, including the calculation method. In FY2023, we established a system for calculating product carbon footprints based on accepted and proposed standards and guidelines for determining cradle-to-gate GHG emissions, including the upstream supply chain. Going forward, we will continue to improve the reliability of our data, through measures such as system-based calculation and third-party verification.

Market

⑤ Lost opportunities due to a failure to keep up with green market expansion

Impact on Tokuyama Group

Lost opportunities due to the delay in establishing a green supply chain (medium to long term)

We are currently working to bolster the competitiveness by creating a large-scale green supply chain that includes ammonia in the Shunan petrochemical complex. We recognize that any delay in this effort to enter the green market could result in lost business opportunities.

Lost opportunities due to insufficient efforts for entering the circular economy and the carbon recycling field (medium to long term)

Carbon recycling involves the capture of carbon from CO_2 emissions for use as a raw material, while the creation of a circular economy promotes waste recycling to mitigate resource procurement risks. Tokuyama is investigating initiatives for these two efforts, as they are expected to be implemented worldwide. We recognize that any delay in this effort could result in lost business opportunities.

Response measures

Prompt implementation of measures

Tokuyama will ensure that it seizes business opportunities by steadily implementing the response measures outlined on pages 17 to 21. Moreover, in 2023, we joined Japan' s Circular Partners initiative. It was established to promote organic collaboration among ambitious and pioneering companies, as well as government agencies and academic institutions. The aim is to build a circular economy that maximizes added value while promoting efficient and circular use of resources. We are promoting collaboration with other companies to help build a circular economy.

Physical risks (acute)

⑥ More frequent extreme weather events and sea level rise

Impact on Tokuyama Group

Wind and flood damage to production facilities; production plans delay and increased costs due to supply chain disruptions, etc. (long term)

Since the Tokuyama Factory is situated in a coastal industrial complex, if extreme weather events (such as heavy rains, lightning strikes, and major typhoons) increase due to the effects of climate change, production could be interrupted due to facility flooding. In the past, large typhoons have not caused sufficient damage to affect operations, but they have caused water and other damage to some equipment. In 2018, when torrential rains caused landslides that damaged the JR Sanyo Main Line, we were forced to shift some transport from rail to truck, which increased transportation costs by 52 million yen.

Since Tokuyama transports most of its raw materials and products by sea, more frequent storms could significantly reduce profitability whenever marine transport is delayed or halted as a result.

Response measures

Enhanced Business Continuity Plan measures

To mitigate the risk of plant shutdown due to natural disasters, the Tokuyama Factory is strengthening its infrastructure. As a measure to protect against storm surges during typhoons, which are deemed to be the greatest threat in terms of natural disasters, the factory constructed a seawall during the period from FY2000 to 2016. Considering the greatest potential wave height estimates for the next 15 and 30 years, the height of the seawall was raised from C.D.L* 4.7 to 5.5 meters. This cost about 300 million yen in total, including materials, transportation, labor, administrative work, and other expenses.

In 2019, the high waves generated by Typhoon No.15 (Hagibis) caused flooding beyond designated storm surge zones, so Japan's national standards were revised. Based on that, Yamaguchi Prefecture also updated its standards in 2022. In the same year, we used the prefecture's revised standards and sensitivity analysis to predict potential flood damage to the Tokuyama Factory due to high waves from a typhoon, using various potential typhoon courses and magnitudes. Going forward, we will set typhoon protection standards for the Tokuyama Factory, compare the required seawall height with its existing height, and plan improvements such as raising the seawall height to meet the requirement. Our analysis also revealed that storm surges could cause flooding damage to the factory through backflow and overflow in the plant' s discharge channel, so we will consider measures to rectify this as well.

* C.D.L: The chart datum level indicates the baseline from which water depths are calculated for each port.

Physical risks (chronic)

⑦ Long-term intensification of extreme weather events and rising sea levels

Impact on Tokuyama Group

Decrease in production capacity due to insufficient factory cooling capacity caused by rising average temperatures (long term)

Situated in a coastal industrial complex in Shunan City, Yamaguchi Prefecture, the Tokuyama Factory contains many manufacturing facilities and produces a wide variety of products. Recirculating water is used to cool the manufacturing equipment. Once this water has captured heat from the manufacturing process, it is cooled by the effects of evaporation in cooling towers, and then recirculated. If equipment cooling capacity decreases due to an increase in average air or water temperatures, there is a risk of a corresponding decrease in production capacity.

Production halts due to storm surges caused by rising sea levels (long term)

As it is located in a coastal industrial complex, the Tokuyama Factory is susceptible to flooding caused by storm surges. If one manufacturing facility within the Tokuyama Factory were to be shut down for 10 days, the estimated losses would be approximately 300 million yen.

Response measures

Maintaining capacity through equipment modifications, etc.

To maintain cooling capacity, current cooling tower capacity will be increased by expanding the evaporation area, increasing the capacity of circulation pumps, and improving the piping design. This will require an investment of at least several hundred million yen.

ⓐ Climate-related risks and opportunities the company has identified over the short, medium, and long term; and ⓒ the resilience of the company's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario

Table 4: Climate Change Opportunities (scenario analysis)

Scenario	Opportunity Type	Opportunity Assessment Target	Impact on Tokuyama Group	Impact Level	Term	Priority Level	Response Measures
1.5°C	Market	① Expanding demand in the environmental market	● Expansion of businesses offering waste disposal, effective utilization of resources, and measures to combat global warming	Large	Medium to long term	High	● Commercialization of renewable resources and energy
		② Shift to carbon neutrality by regions and industrial complexes	● Enhancing site competitiveness by promoting large-scale green supply chains for energy materials	Large	Medium to long term	High	● Green supply chain construction conducted and promoting green technology development through the Shunan Industrial Complex Decarbonization Promotion Council
	Resource use efficiency	③ Demand for products and services to promote carbon utilization	● Entering new business fields by establishing a carbon recycling system	Large	Medium term	High	● Accelerating research and development, feasibility studies, and demonstration experiments, along with implementation in actual operations

Market

① Expanding demand in the environmental market

Impact on Tokuyama Group

Expansion of businesses offering waste disposal, effective utilization of resources, and measures to combat global warming

Waste recycling is expected to further expand in response to rising environmental awareness and the need to mitigate resource procurement risks heightened by geopolitical factors. While renewable energy use is growing, there is also demand for carbon-neutral thermal power generation in the manufacturing industry, which requires heat for production.

Response measures

Commercialization of renewable resources and energy

While using co-firing with PKS biomass as a measure to reduce coal consumption, the Group is continuing to study the development and commercialization of alternative biomass fuels in order to ensure stable fuel procurement. In December 2023, we decided to build a pilot plant for the development of black pellets, which has the potential to be a new biomass fuel that eliminates various issues with existing biomass fuels.

In September 2023, group company Tokuyama Chiyoda Gypsum Co., Ltd. (TCG) opened a new recycling plant in Muroran City, Hokkaido, its third such site in Japan. Established in 2011 as a joint venture between Tokuyama and Chiyoda Ute Co., Ltd., TCG operates a waste gypsum board recycling business. It uses the world's first technology for continuous large recrystallization of waste gypsum, a process developed by Tokuyama. In 2013, TCG began operations at the Mie Headquarters Factory, and in 2016, it started operations at the Kanto Plant in Sodegaura City, Chiba Prefecture. Currently, both plants recycles approximately 100,000 tons of waste gypsum board in total annually. Gypsum board is widely used as a fireproof material for walls and ceilings in residential construction, but the amount of waste from renovations and demolition is increasing each year. There are also growing needs for recycling due to factors such as a shortage of managed landfill sites and a decrease in waste gypsum raw materials due to decarbonization efforts.

The Nanporo Industrial Park is located in Nanporo Town, Sorachi District, Hokkaido. In 2019, the Group built an experimental facility there for the development of catalyst-based technology for recycling photovoltaic cell modules. With the aim of helping to make solar power a mainstay electricity source, this project has been adopted by Japan' s New Energy and Industrial Technology Development Organization (NEDO) as a project for "technology development relating to solar cell module separation and material recycling." With this technology development, the Group aims to commercialize solar equipment recycling and be ready for the huge expected increase in solar panel disposal in the 2030s. In March 2024, we supplied glass sheets separated from solar panels using this technology to AGC Inc. The company conducted demonstration testing for the recycling float sheet glass, and this became the first successful demonstration of its kind in Japan.

Market

② Shift to carbon neutrality by regions and industrial complexes

Impact on Tokuyama Group

Enhancing site competitiveness by promoting large-scale green supply chains for energy materials

For the Group, the challenge of achieving carbon neutrality all on its own presents a number of difficult problems, such as the need to procure new energy materials on an individual-company basis.

However, if this is viewed as a regional issue and, for example, the entire industrial complex strives to achieve carbon neutrality, it becomes possible to examine and address energy materials issues on a regional basis. Although it will still require high levels of technology development and innovation, if this can be achieved, the region can gain new added value as a "carbon-neutral industrial complex" and become highly competitive.

Response measures

Green supply chain construction conducted and promoting green technology development through the Shunan Industrial Complex Decarbonization Promotion Council

The Shunan Industrial Complex Decarbonization Promotion Council was established in February 2022 with the aim of achieving carbon neutral of the site while maintaining and strengthening its industrial competitiveness. The Council comprises companies with operations at the Shunan Complex, the city of Shunan, and the Society of Chemical Engineers, Japan. In May 2023, the Council released a grand design and a roadmap for the complex, with targets established through backcasting.

Currently, various themes are being investigated by subcommittees established under this council. Tokuyama and four other companies in the complex requested consultation with the Japan Fair Trade Commission regarding planned joint activities to promote carbon neutrality at the Shunan Complex. In February 2024, the Commission responded that these activities should pose no issues under Japan' s Antimonopoly Act, except in cases where they ended up restricting competition, such as cartel behavior when setting product prices. As a result, the Group will accelerate its efforts to help achieve a carbon-neutral industrial park, including discussions on how to create a carbon-free ammonia fuel hub within the Shunan Complex.

Resource use Efficiency

③ Requests for CCU-related products

Impact on Tokuyama Group

Entering new business fields by establishing a carbon recycling system

While carbon pricing is making CO_2 emissions more costly, it also means increasing the value of carbon in other words. Carbon is indispensable for human life, and the supply of carbon will become ever more restricted due to limitations imposed on the use of fossil resources. Therefore, in the near future, carbon recycling could become an important technology. In other words, any company that emits a lot of CO_2 will also have a source of carbon. Tokuyama has a long history of using soda ash by-products as a raw-material for cement. Applying the power of chemistry to make efficient use of materials that were once considered useless is a challenge that we, as a chemical company, must take on.

Response measures

Accelerating R&D, demonstration projects, and actual green technology adoption in business operations

As part of efforts to establish a carbon recycling system, the Group is conducting demonstration testing for CO_2 capture, as well as feasibility studies concerning the manufacture of valuable materials using the captured CO_2.

For the demonstration testing, CO_2 capture equipment manufactured by Mitsubishi Heavy Industries Engineering, Ltd. (currently Mitsubishi Heavy Industries, Ltd.) was installed at a Group cement plant in 2022 and 2023. It captured CO_2 from the plant's exhaust gases, and the reliability of long-term continuous operation was evaluated. We also analyzed data obtained concerning impurities in the captured CO_2 gas, and verified the feasible application of optimal CO_2 capture technology in cement plants.

For the Group's feasibility studies, we are continuing to research the commercial feasibility of methanol production, utilization, and sale. Methanol is expected to become a useful product for building a carbon-neutral society. By leveraging manufacturing technology developed by Mitsubishi Gas Chemical Company, Inc., we could produce methanol using CO_2 captured from the emissions of the Tokuyama Factory. In this process, hydrogen would first be produced using green electricity generated from biomass at the same factory, and then reacted with the captured CO_2 to produce methanol.

In March 2024, Tokuyama and eight other members of the Shunan Industrial Complex Decarbonization Council submitted a proposal to NEDO entitled, "Study for the Implementation of a Carbon Recycling Project through Industrial Collaboration at the Shunan Complex." It was subsequently adopted by NEDO as the "Project for the Development of Carbon Recycling Technologies and the Development and Promotion of Next-Generation Thermal Power Generation Technologies / Project for the Implementation of Carbon Recycling Technologies through Industrial Collaboration." With the aim of helping to build a carbon-neutral society through inter-industry collaboration, the Council will conduct a feasibility study on a carbon recycling project to lower CO_2 emissions, while taking into account the characteristics of the petrochemical complex.

ⓑ Impact of climate-related risks and opportunities on the company's businesses, strategy, and financial planning

Using our analysis of opportunities arising from climate change, and after examining business opportunities in the environmental field, we determined more specific details and evaluated the relevant time scope, financial impacts and priorities.

Table 5: Investigation of Business Opportunities Arising from Climate Change

	Future Events	Business Opportunities	Products and Technology	Term	Financial Impact	Priority Level
Business Opportunities in the 1.5°C Scenario	Widespread adoption of low-carbon hydrogen	● Sudden increase in demand for water electrolysis equipment ● Expansion of hydrogen demand and distribution	● Water electrolysis equipment ● Expansion of sodium chloride electrolysis equipment ● Hydrogen carrier (magnesium hydride)	Medium to long term	Moderate	High
	Expansion of electrification of mobility	● Expansion of demand for lithium batteries ● Expansion of demand for thermal management materials	● Ion exchange membranes ● Thermal management materials	Short to long term	Moderate	High
	Rapid digitalization	● Expansion of semiconductor demand	● Polycrystalline silicon ● Photoresist developer ● Silica for CMP ● High-purity IPA ● Thermal management materials, etc.	Short term	Large	High
	Spread of energy-saving housing	● Increase in demand for functional insulation material	● Super-insulated, highly-airtight plastic window sashes ● Plaster sheets	Short term	Minimal	Low
	Formation of a closed-loop society	● Increase in demand for recycling of waste material and industrial waste	● Waste gypsum board recycling technology ● Ion exchange membranes ● Effective use of biomass combustion ash (CCUS) ● Development of carbon negative concrete	Short term	Minimal	Moderate
		● Response to large quantities of waste from photovoltaics panels	● Recycling technology for photovoltaics modules	Medium term	Minimal to Moderate	Moderate

FY2023 Initiatives and Specific Progress **Business opportunities** See pages P.38 / P.39 / P.40

Risk Management

For Tokuyama Group, corporate management risks include any events or factors that could damage its corporate value, affect the sustainability of its businesses, or hinder the achievement its organizational goals. These risks also include any such events or factors that would require cross-organizational response. We have a management system in place to ensure that we can appropriately mitigate these enterprise risks.

ⓐ Company's processes for identifying and assessing climate-related risks

To direct our group-wide enterprise risk management system, we have established a Risk Management and Compliance Committee chaired by the director responsible for CSR, which is positioned under the CSR Promotion Council chaired by the president. All executive officers who supervise each division are members of this committee, which is open to attendance by Audit and Supervisory Committee members, including outside directors, and regularly prioritizes risk responses for Group-wide enterprise risk management.

Specifically, by monitoring international trends and working with its expert committees, the Risk Management and Compliance Committee examines events and factors that have just emerged or that have changed in terms of the potential level of impact. These are then visualized and mapped using risk levels from both the quantitative and corrective aspects, taking into consideration impact levels (such as monetary losses, reduced market share, and scale of impact, etc.), frequency of occurrence, probability, and vulnerability. The relevant expert committees then identify the Group' s new risks and determine the appropriate mitigation measures.

Figure 5: Expert Committees and Meeting Bodies in Charge of Risks

ⓑ Company's processes for managing climate-related risks

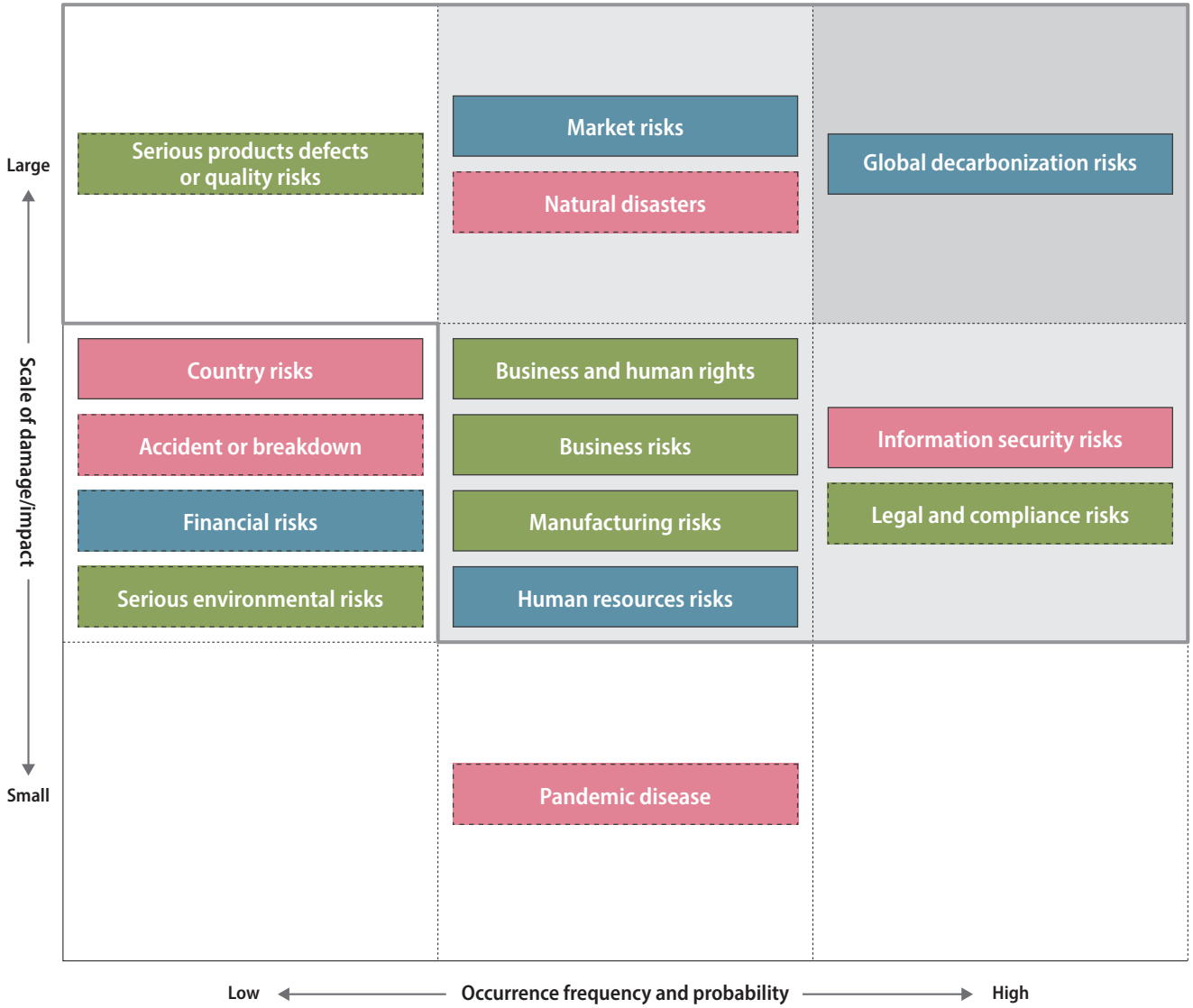
In FY2023, the Risk Management and Compliance Committee redefined the subcategories under its Risks from Adapting to a Carbon-Free Society, which are significant risks that require urgent measures by the Group. In response to recent global trends and issues, the Committee added new subcategory risks such as water risks and biodiversity, etc., which the Group needs to mitigate.

Table 6: List of Enterprise Risks (FY2024)

*The chairperson of each committee is a director who has responsible for the relevant risks

Large category	Moderate category	Minimal category	Relevant committee *
Hazard risk	Natural disasters	Earthquake, tsunami, weather-related disaster, abnormal weather event (typhoon, storm surge, or heavy rains, etc.)	Risk Management and Compliance Committee
	Accident or breakdown	Fire, explosion, chemical leak, equipment or device damage or failure, utility supply interruption, transport (aircraft, ship or railway) accident	Safety Committee
	Pandemic disease	Widespread outbreak of COVID-19 or another infectious disease	Risk Management and Compliance Committee
	Country risks	War, conflict, terrorism incident, riot, unlawful political change, or economic crisis	Risk Management and Compliance Committee
	Information security risks	Cyber-attack, virus infection, information leakage, failure of system facilities/equipment, system failure	Information Security Committee
Business risk	Global decarbonization risks	Carbon pricing and energy costs, green process adoption measures, stakeholder evaluation, penetration of green procurement by customers, lost opportunities from not being ready for expansion of the green market, and more frequent severe weather events over the short and long term	Sustainability Committee
	Market risks	Changes in market needs, marketing failures or deficiencies, emergence of new competitors, product development failures or obsolescence, delays in responding to rapid technological innovations, and delays or barriers to overseas expansion	(Executive Committee)
	Human resource risks	Mass retirement, difficulty in securing human resources, workforce aging, distorted human resource pyramid, failure to adopt new work styles such as human resource development and technology transfer (including foreign workers), and human resource mismatch due to business conversion	(Executive Committee)
	Financial risks	Funding plan or financing failure, paid capital increase, suspension of financial support, interest rate or foreign exchange rate fluctuation risk, and stock price decline	(Executive Committee)
Operational risk	Manufacturing risks	Equipment or machine stoppages or accidents due to operational errors, industrial accidents, and aging equipment or machinery	Safety Committee
	Business risks	Soaring raw material or fuels prices, failed pricing policies, declining price competitiveness, dependence on a small number of suppliers, and dependence on a small number of customers	(Executive Committee)
	Serious product defects or quality risks	Quality defects, voluntary recalls, product liability accidents, deficiencies in chemical safety management at the time of export, management of chemical substances contained in products, and mislabeling or counterfeit labeling	Product Safety and Quality Assurance Committee
	Serious environmental risks	Release of hazardous pollutants, contamination of soil and groundwater, complaints from local residents regarding noise and odors, illegal dumping and improper disposal of waste, water risks, and biodiversity.	Environment Committee
	Business and human rights	Human rights violations in supply chains, boycotts, and consumer movements	Sustainability Committee
	Legal and compliance risks	Non-performing loans/bad debts, intellectual property rights infringement, invention compensation disputes, antimonopoly law violation, Unfair Competition Prevention Act violation (bribery), improper contract signing, insider trading, inadequate management of licenses and permits, misconduct involving executives or employees, ties to antisocial forces, and intimidation	Antitrust and Competition Law Compliance Committee Risk Management and Compliance Committee

Figure 6: Mapping of Significant Enterprise Risks (FY2024)



Definitions of major risk categories

■···Hazard risk (External environment risk)
Risks posed by the external environment and potential events

■···Business risk (Strategic risk)
Risks posed by the quality and accuracy of corporate strategies that affect performance and corporate value

■···Operational risk (Business process risk)
Risks arising from deficiencies in internal processes related to business execution, or from inadequate functions

Definition of scale of damage and impact

Large Damage that threatens the survival of the company, as well as substantial damage such as loss of assets

Moderate Significant decrease of profits, or minor loss of assets

Small Little impact on corporate profits and assets

Definition of occurrence frequency and probability

High Occurs more than once a year
Will almost certainly occur in the near future

Moderate Occurs several times a decade

Low Occurs once every decade or more

Definition of vulnerability

High Mitigation measures have not been implemented or are completely inadequate

Moderate Some measures have been implemented, but they are still insufficient

Low Effective measures have been implemented and a management cycle is in place

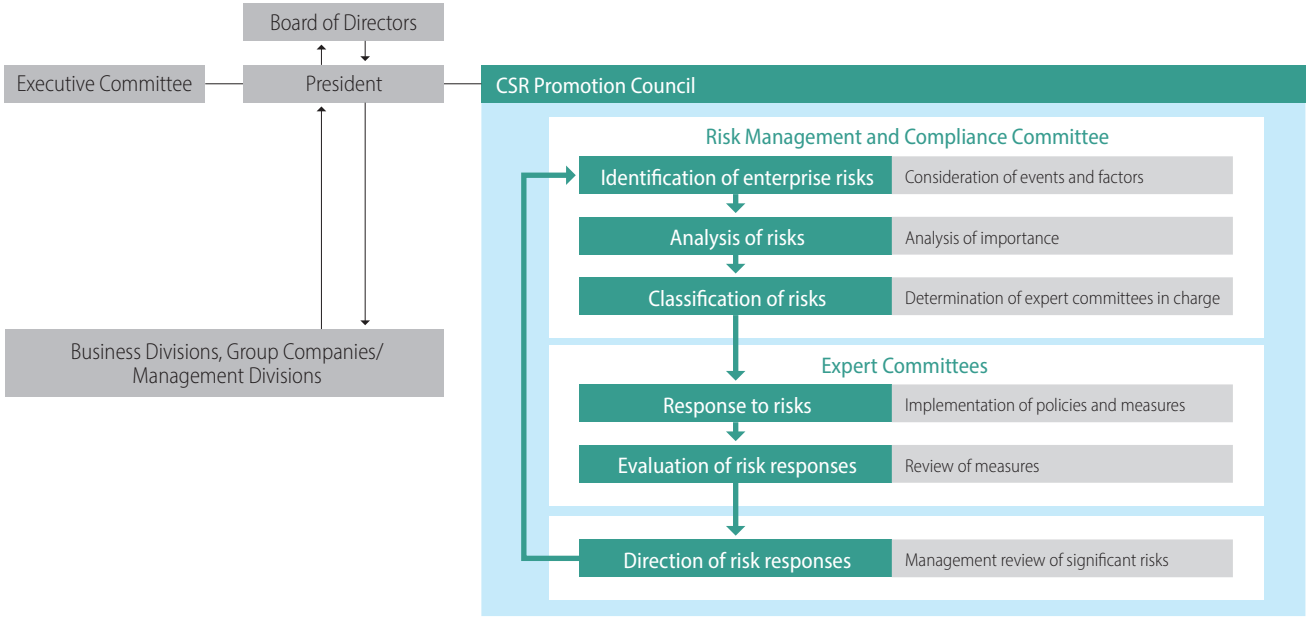
The expert committees, chaired by the relevant directors, examine and determine mitigation policies for the risks they are responsible for (including risk reduction, avoidance, transfer, and retention). Based on the determined policies, the Group plans and implement measures to manage risks. It also conducts periodic reviews to ensure performance based on the risk management system.

Having identified Risks from Adapting to a Carbon-Free Society as the Group's most significant risk category, the Risk Management and Compliance Committee has established several expert committees to address it. The Environmental Committee is responsible for risks related to non-compliance with environmental laws and regulations, the Safety Committee is responsible for physical risks such as storm surges at manufacturing sites, and the Sustainability Committee is responsible for risks stemming from a failure to follow non-binding environmental guidelines and principles relating to public information disclosure and initiatives to help combat climate change. These expert committees are working together to address these issues.

The Sustainability Committee is actively addressing sustainability issues and disclosing the Group' s initiatives. In terms of disclosure of corporate information related to climate change, we have expanded the content of our TCFD report and set Scope 3 emission targets for the entire Group.

Regarding individual activities to address climate change, for example, the Tokuyama Factory regularly holds energy management committee meetings chaired by the factory general manager. The members discuss and check the progress made on planned activities for energy-saving, including improvement of energy intensity. Moreover, important matters related to risk management are reported as necessary to the Executive Committee and the Board of Directors.

Figure 7: Process of Identifying Enterprise Risks



ⓒ How processes for identifying, assessing, and managing climate-related risks are integrated into the company's overall risk management

The Group's competitiveness is based on highly efficient integrated production processes at Tokuyama Factory, while its earnings have been driven by energy-intensive businesses that rely on coal-fired power plants. Now however, with the acceleration of industrial structure transformation, along with increased public environmental awareness and stricter regulations to promote a recycling-oriented society, we believe profitability and competitiveness can only be ensured by creating and expanding businesses that represent a departure from past models.

Therefore, under the Medium-Term Management Plan 2025, we have updated our mission, which is now "To create a bright future in harmony with the environment, in collaboration with our customers, based on chemistry." One of the priority issues of the plan is "Contribute to mitigation of global warming," and we are pursuing group-wide initiatives to achieve this.

As mentioned above, sustainability opportunities and risks are addressed using a corporate structure headed by the CSR Promotion Council, but matters involving important management decisions such as investments are reported to the Executive Committee and the Board of Directors as necessary.

Metrics and Targets

For the purpose of setting management indicators and targets, Tokuyama Group considers the period up through FY2025 (the final fiscal year for the Medium-Term Management Plan 2025) as the short term, with the medium term extending through FY2030, and the long term through FY2050.

ⓐ Metrics used by the company to assess climate-related risks and opportunities in line with its strategy and risk management process

Reduction targets for Scope1and 2 emissions

In the past, the Group has measured its GHG emissions, GHG intensity and energy intensity. Under the new Medium-Term Management Plan 2025, however, we aim to help mitigate global warming by measuring total group-wide GHG emissions and achieving certain management targets. These are a 30% reduction in GHG emissions (Scope 1 and 2) compared to FY2019 by FY2030, and the attainment of carbon neutrality by FY2050.

Moreover, when calculating compensation for all executive officers, we look at performance with respect to relevant material issues determined by the Group as indicators and evaluate each officer accordingly. As a result, specific roles and responsibilities are taken into account as relevant factors.

Reduction targets for Scope 3 emissions

Tokuyama has also set new emission reduction targets for Scope 3 emissions, with the challenging to carbon neutrality across its entire supply chain.

As Categories 1, 3 and 4 account for more than 90% of Tokuyama Group's total Scope 3 emissions, we aim to reduce total emissions for these three categories by 10% before the end of FY2030 (compared to FY2022). To achieve this goal, we will further enhance our supply chain engagement activities.

Figure 8: GHG Emissions (Scope 1 and 2) Reduction Targets

*The fuel-derived GHG include emissions from coal as a thermal energy source

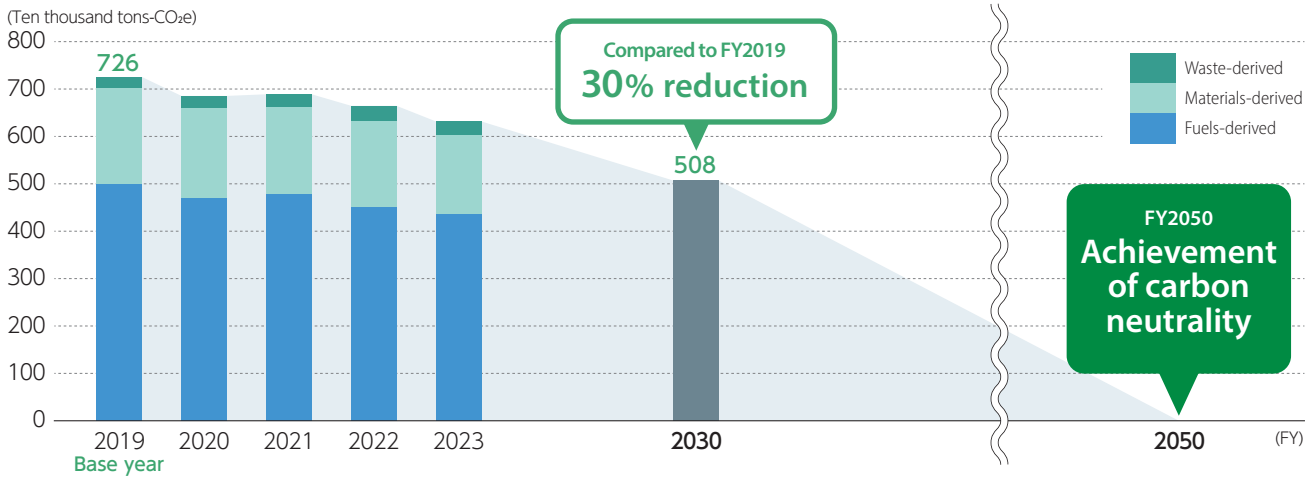
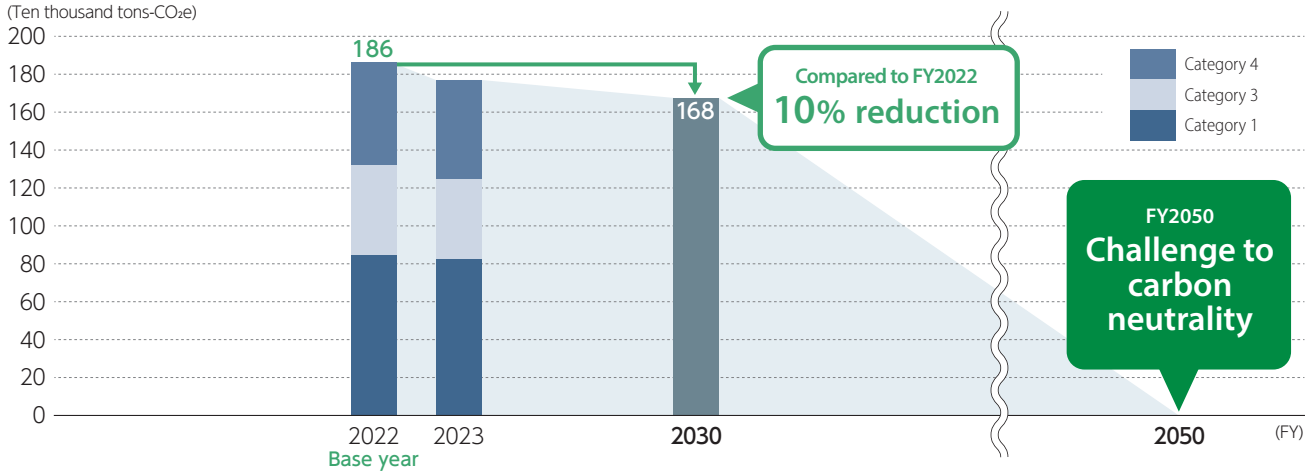


Figure 9: Supply chain emissions (Scope 3) medium- to long-term reduction targets (Categories 1, 3 and 4)



Other important metrics and targets related to climate change are listed here.

SBTs: Start investigation for SBT Certification

After submitting a letter of commitment to the SBT initiative in March 2023, and while drafting the next Medium-Term Management Plan to be implemented two years from now, we are now considering updating our targets in line with the Science Based Targets (SBT) initiative.

Water Use Metrics and Targets

During the analysis of the Group's climate-related risks and opportunities, it became clear that climate change and water use issues are also highly relevant.

To manage the industrial water the Group uses for facility cooling and processes, we check the dam reservoir level every day, and adjust water conservation rate according to the reservoir accumulation rate.

Along with recirculating cooling water, we use condensation water from steam generated at our power plants as effectively as possible to conserve water. For our recirculated cooling water, we use just 100,000 cubic meters of industrial water or less per day, compared to our total required water usage of 1.5 million cubic meters per day.

With our condensation water, we effectively utilize approximately 25,000 cubic meters per day.

With respect to water consumption, we are committed to conserving water, and our goal is to keep water consumption no higher than the FY2019 level.

Energy consumption targets

Tokuyama Group is aiming to achieve a 50% reduction in GHG emissions from fuels-derived compared to FY2019 by FY2030, and it plans to switch to non-fossil fuels (biomass and ammonia) for onsite power plants. The rate of co-firing with biomass will gradually increase starting in FY2023. Co-firing with ammonia is scheduled to begin in FY2028 and beyond. A basic plan for biomass and ammonia adoption is currently being implemented, as part of a project sponsored by Japan' s Agency for Natural Resources and Energy (FY2023 Oil Supply Structure Advancement Project Cost Subsidy: Project to Promote Transition to a Stable Supply of Next-generation Fuels).

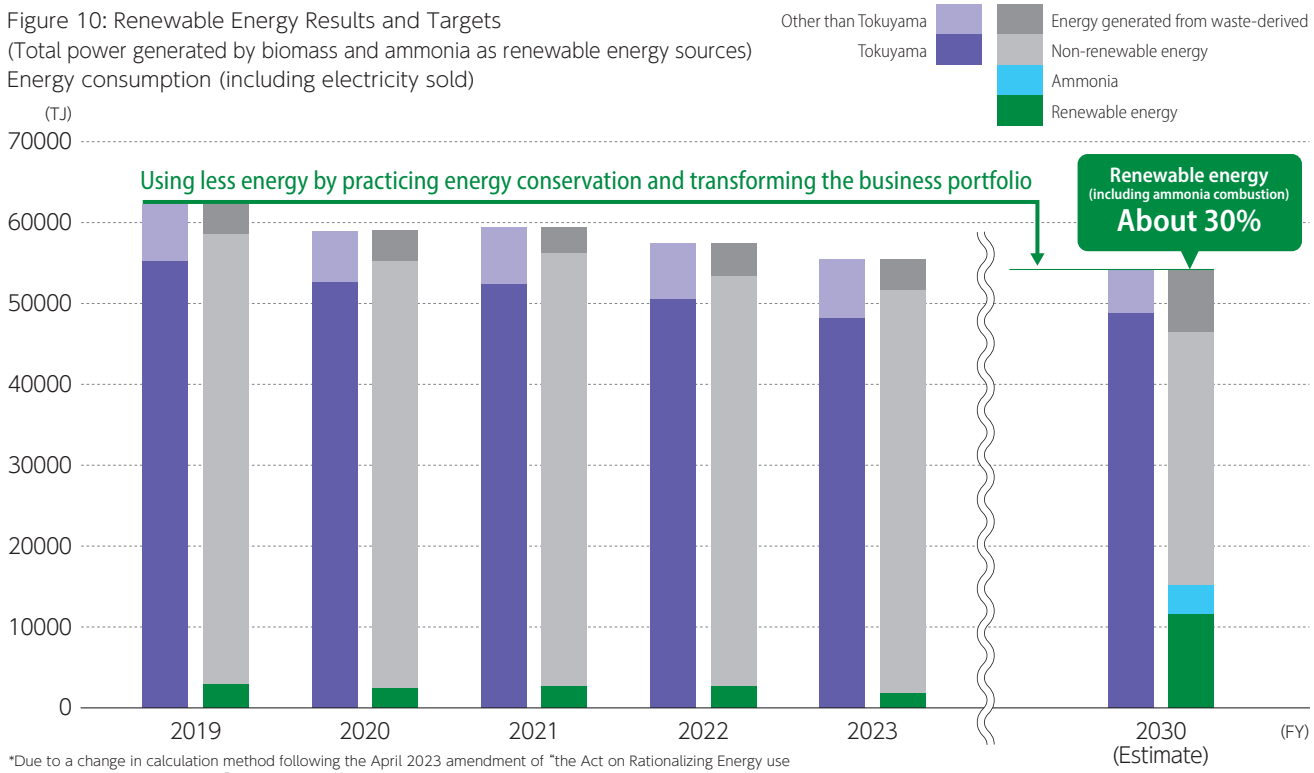
Through this initiative, the Group aims to achieve a renewable energy ratio of 30% by FY2030.

The ratio of renewable energy use for the entire Group in FY2023 was about 3.3%.

Metrics (initiatives) related to internal carbon pricing

In FY2019, Tokuyama adopted internal carbon pricing (ICP) as a criterion for evaluating investment projects to promote GHG emissions reduction. Initially, the price of carbon was set at 3,700 yen per ton of CO_2, based on the European Union Emissions Trading System (EU-ETS) price. In order to further enhance our efforts to reduce GHG emissions, in FY2022 we raised our internal price of carbon to 10,000 yen per ton of CO_2. Using ICP, we will promote activities aimed at decarbonization over the short and medium term.

Figure 10: Renewable Energy Results and Targets
(Total power generated by biomass and ammonia as renewable energy sources)
Energy consumption (including electricity sold)



*Due to a change in calculation method following the April 2023 amendment of "the Act on Rationalizing Energy use and Shifting to Non-fossil Energy", renewable energy usage has decreased in FY2023.

ⓑ Scope 1, Scope 2, and, Scope 3 greenhouse gas (GHG) emissions, and the related risks

The Table 7 shows the changes in GHG emissions (Scope 1, 2, and 3). In FY2023, we were able to reduce GHG emissions (Scope 1 and 2) by 13% from the base year of FY2019 by carrying out the co-firing with biomass and vigorously pursuing energy-saving activities.

Table 7: Scope 1, 2 and 3 GHG Emissions *Third-party verification

(Ten Thousand tons-CO_2e)

			FY2019	FY2020	FY2021	FY2022	FY2023
Scope 1	Tokuyama	GHG emissions from fuels-derived	487.6	460.5	467.7	438.5*	**419.2***
		GHG emissions from raw materials-derived	203.2	188.6	185.7	180.2*	**166.6***
		Waste-derived	25.3	26.5	27.0	32.1*	**29.6***
	Consolidated manufacturing subsidiaries in Japan		0.4	0.4	0.5	0.5*	**0.7***
	Consolidated manufacturing subsidiaries outside Japan		0.0	0.0	0.0	0.2*	**0.7***
Scope 2	Tokuyama		3.1	3.7	1.5	3.9*	**3.7***
	Consolidated manufacturing subsidiaries in Japan		1.4	0.9	1.0	1.0*	**0.7***
	Consolidated manufacturing subsidiaries outside Japan		5.3	5.9	6.8	8.3*	**10.7***
Scope 3	Tokuyama		178.7	173.7	176.8	176.0	**166.2**
	Tokuyama (Category 1,3,4)		169.7	166.7	168.5	167.8*	**157.5***
	Consolidated manufacturing subsidiaries in Japan (Category 1,3,4)		—	—	—	3.3	**3.1***
	Consolidated manufacturing subsidiaries outside Japan (Category 1,3,4)		—	—	—	15.1	**16.3***

* GHG emissions from biomass combustion in FY2023 results were 350,000 tons-CO_2e

The Table 8 shows the breakdown in GHG emissions (Scope 3). In FY2023, we were able to reduce GHG emissions (Scope 3) by 5% from the base year of FY2022.

Table 8: Scope 3 GHG emissions by category (Ten Thousand tons-CO_2e)

		FY2022	FY2023
Category 1	Tokuyama	71.2*	**68.8***
	Consolidated manufacturing subsidiaries in Japan	1.6	**1.3***
	Consolidated manufacturing subsidiaries outside Japan	11.7	**12.0***
	Total	84.4	**82.2***
Category 3	Tokuyama	45.0*	**39.0***
	Consolidated manufacturing subsidiaries in Japan	0.4	**0.4***
	Consolidated manufacturing subsidiaries outside Japan	2.1	**2.9***
	Total	47.5	**42.4***
Category 4	Tokuyama	51.6*	**49.7***
	Consolidated manufacturing subsidiaries in Japan	1.3	**1.4***
	Consolidated manufacturing subsidiaries outside Japan	1.3	**1.3***
	Total	54.2	**52.4***
Total (Category1, 3, 4)	Tokuyama	167.8*	**157.5***
	Consolidated manufacturing subsidiaries in Japan	3.3	**3.1***
	Consolidated manufacturing subsidiaries outside Japan	15.1	**16.3***
	Total	186.1	**176.9***

*Obtained third-party verification
* Due to rounding, the total value may not always be accurate

Methodology explanation Scope 1, 2

● Greenhouse Gas Emissions Calculation and Reporting Manual (Ver. 5.0) February 2024, Ministry of the Environment and Ministry of Economy, Trade and Industry

● Emission Coefficients by Electric Utility (for calculating greenhouse gas emissions of specified emitters) – FY2022 Results – Released December 22, 2023 by the Ministry of the Environment and the Ministry of Economy, Trade and Industry

Scope 3

● Basic Guidelines on Accounting for Greenhouse Gas Emissions throughout the Supply Chain (Ver. 2.5) March 2023, Ministry of the Environment and Ministry of Economy, Trade and Industry

● Emission Intensity Database for Calculating Greenhouse Gas Emissions of Organizations Across Supply Chains (Ver. 3.4), March 2024, Ministry of the Environment and Ministry of Economy, Trade and Industry

● LCI Database IDEAv2 (for supply chain greenhouse gas emissions calculation), Sustainable Management Promotion Organization (SuMPO), December 2019

GX League

In FY2022, we endorsed the GX League Basic Concept announced by Japan' s Ministry of Economy, Trade and Industry, and then joined the League when it began full-scale activities in FY2023.

As a member of the GX League, Tokuyama has established emission reduction targets based on the requirement set by this coalition. Specifically, we have set targets for Tokuyama and consolidated manufacturing subsidiaries Scope 1 and 2 emissions in Japan, along with GHG emission reduction targets set based on the GHG Protocol.

Even though the emissions data and base years submitted to the GX League is different from those calculated based on the GHG Protocol, because of different calculation protocols, the original emissions data is the same and the reduction targets are consistent.

In FY2023, we were able to reduce emissions by 11% from the base year of FY2021.

Figure 11: GX League emission reduction targets (Scope 1 and 2)

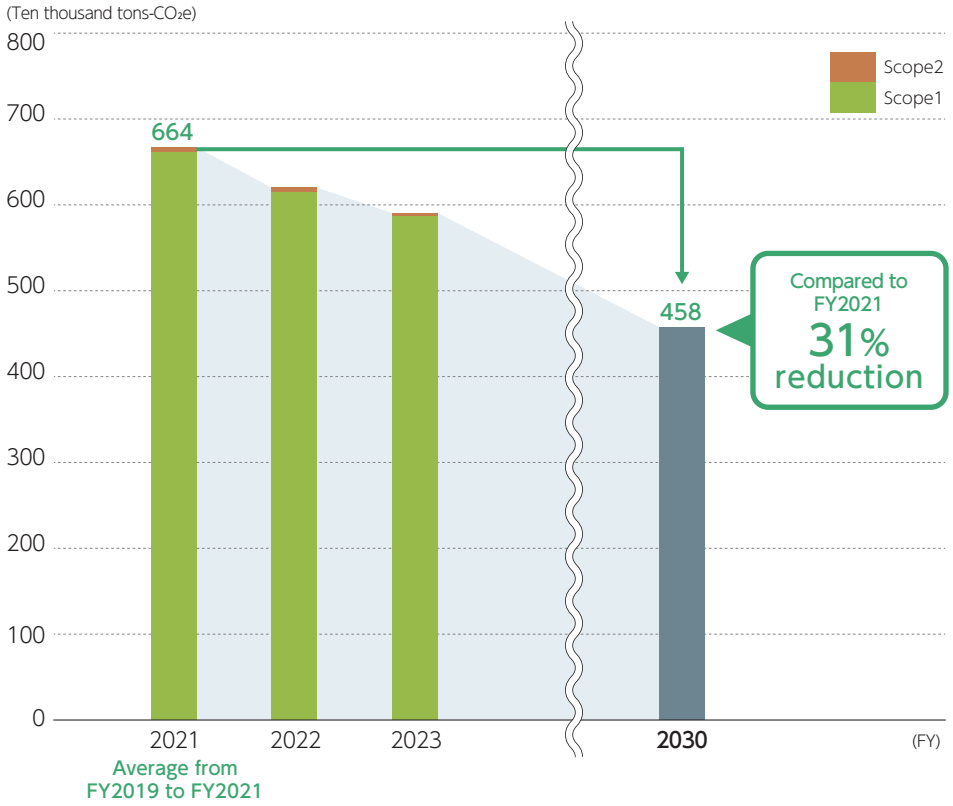


Table 9: Tokuyama Group GHG Emissions (GX League)

*Obtained third-party verification to meet the GX League requirement
*Obtained third-party verification to meet the GHG Protocol standard

(Ten thousand tons-CO₂e)

			FY2021 Base year	FY2022	FY2023
Scope 1	Tokuyama (non-consolidated)	Fuels-derived (GHG Protocol)	471.9*	438.5*	**419.2***
		Materials-derived (SHK standard)	188.1*	175.8	**166.6***
	Consolidated manufacturing subsidiaries in Japan		0.4*	0.5*	**0.7***
	Total Scope 1 (GX League)		660.4*	614.8	**586.5***
Scope 2	Tokuyama (non-consolidated)		2.8*	3.9*	**3.7***
	Consolidated manufacturing subsidiaries in Japan		1.1*	1.0*	**0.7***
	Total Scope 2 (GX League)		3.9*	4.9*	**4.4***
Total Scope 1, 2 (GX League)			664.3*	619.7	**590.9***

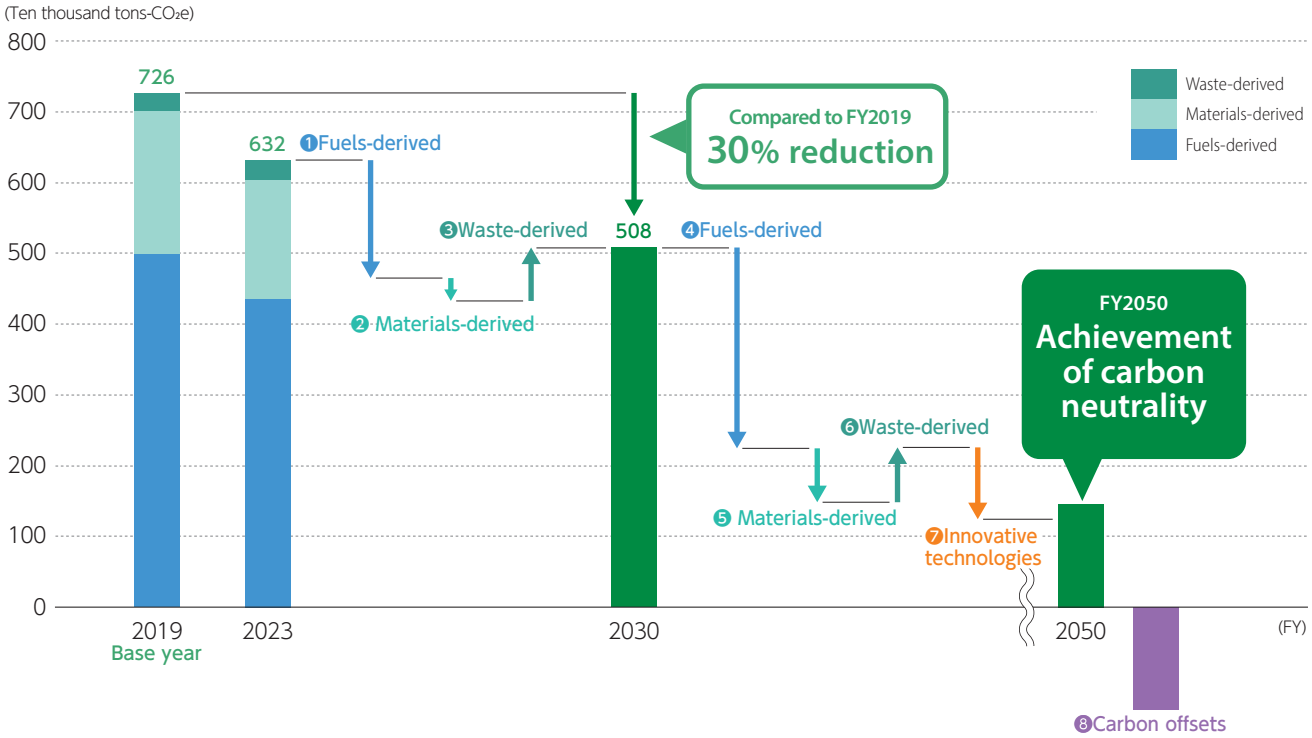
* Average from FY2019 to FY2021

ⓒ Targets used by the company to manage climate-related risks and opportunities and performance against targets

We have set a long-term goal of becoming carbon neutral by FY2050. We will accomplish this primarily by reducing GHG emissions from fuel consumption and raw materials, and by developing innovative technologies. We will reduce CO_2 emissions from energy generation, which accounts for about 70% of our total emissions, by further promoting energy-saving measures. These include measures that have already been implemented while also switching to carbon-neutral fuels such as biomass and ammonia.

The Group will reduce GHG emissions from raw materials-derived by reducing the amount of limestone used in its cement, and by increasing other cement mixture materials and recycling calcium. We will proceed with development and introduction of these measures while evaluating the economic efficiency. At present, however, it appears that reducing these emissions to zero will be difficult, and CO_2 capture, utilization, and storage (CCUS) will likely be necessary. The Group will proceed with the development and introduction of such measures.

Figure 12: Medium- to long-term GHG emission reduction targets (Scopes 1, 2)



❶ ▶Co-firing with biomass / ammonia ▶Energy conservation, process improvement, and equipment renewal ▶Utilization of locally sourced energy ▶Business portfolio transformation

❷ ▶Suspended operation of a cement kiln, and increase from small amounts of mixed ingredients

❸ ▶Thermal recycling

❹ ▶Increase biomass / ammonia co-firing rate → Non-fossil combustion ▶Further utilization of locally sourced energy ▶Energy conservation, process improvement, equipment renewal ▶Use of renewable energy ▶Improvement of energy efficiency at the petrochemical complex ▶Business portfolio transformation

❺ ▶Calcium recycling ▶Development of low GHG-emission cement/concrete ▶Business portfolio transformation

❻ ▶Thermal recycling

❼ ▶Transition to innovative manufacturing methods

❽ ▶Adoption of negative emission technology (CCUS) ▶Carbon offset (J Credits, etc.)

FY2023 Initiatives and Specific Progress

❶❹Reduction of fuels-derived
See pages P.34 / P.35

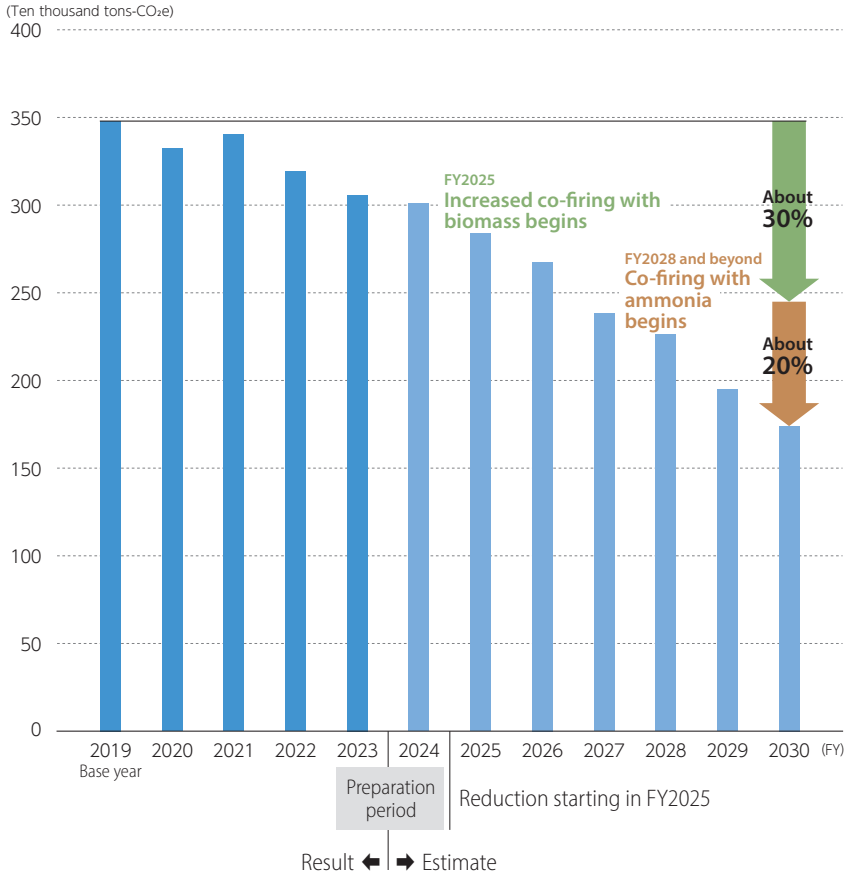
❽Carbon offsets
See pages P.34 / P.36 / P.37 / P.38

The major sources of the Group's GHG emissions are onsite coal-fired power plants (GHG emissions from fuels-derived) and cement production (GHG emissions from raw materials-derived and waste-derived).

Reduction for fuel-derived GHG emissions from onsite power plants

The Group is aiming for a 50% reduction in GHG emissions from fuels-derived (not related to cement) compared to FY2019 by FY2030, and we are currently drafting and implementing plans to achieve this goal. For co-firing with biomass, we will still use palm kernel shells, construction waste and wood chips as fuel. However, we are planning to procure biomass fuel and invest in co-firing equipment in order to further increase the level of co-firing starting in FY2025. The Group estimates that the total investment required to reduce GHG emissions by 30% through co-firing with biomass will be 11 billion yen by FY2030. With regard to co-firing with ammonia, we are currently investigating the installation of relevant equipment. The Group estimates that the total investment required to reduce GHG emissions by 20% using ammonia co-firing will be 15 billion yen by FY2030. As both biomass and ammonia co-firing require large amounts of investment, we plan to make steady progress while assessing economic feasibility and seeking government support.

Figure 13: Reduction plan for fuel-derived GHG emissions from onsite power plants



Estimated biomass-related investment: 11 billion yen
We will increase the level of co-firing using biomass by making further investment to increase co-firing capacity starting in FY2025

Estimated ammonia-related investment: 15 billion yen
Equipment for co-firing with ammonia will be installed

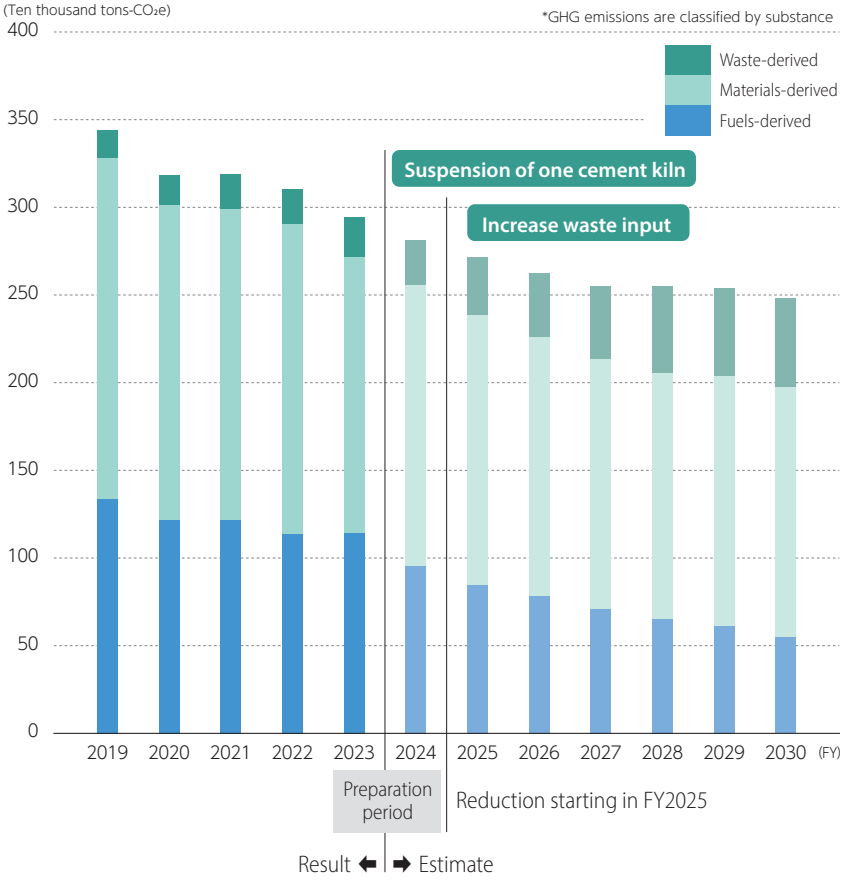
Through these measures, we will gradually replace coal with non-fossil fuels and reduce GHG emissions from onsite power plants.

Reduction for GHG emissions from raw materials-derived, waste-derived, and fuels-derived (cement production)

Over the short and medium terms, we plan to increase the use of waste, especially waste plastic. Using waste plastic as alternative thermal energy increases GHG emissions from waste-derived. Nevertheless, the Group intends to increase its waste use because there are currently no alternative energy that are economically viable, and it wants to reduce its coal use as a priority. Over the long term, the aim is to use hydrogen and ammonia as heat sources, and the necessary investigation is now being carried out. The Group's GHG emissions from raw materials-derived arise mostly from limestone (calcium carbonate) use. Cement production requires large amounts of calcium. However, since there are currently no raw material candidates to replace limestone, dramatic reduction measures are difficult. The Group is now investigating ways to reduce these emissions per unit of production by increasing the use other materials while reducing the amount of clinker (a mix of limestone and minerals) per unit of cement.

While it is our responsibility as a company to steadily reduce GHG emissions, we also recognize that reducing GHG emissions through the use of our products in society is also an important role. In the future, we will contribute to the achievement of carbon neutrality in the world by expanding our environment-friendly products and further developing innovative technologies.

Figure 14: Reduction plan for GHG emissions from raw materials-derived, waste-derived, and fuels-derived (cement production)



The following details the progress of specific measures regarding the Group's initiatives in FY2023.

● Improvement of energy efficiency at the petrochemical complex and adoption of negative emission technology (CCUS)

14 Reduction of fuels-derived
8 Carbon offsets

Participating in Shunan Industrial Complex Decarbonization Promotion Council

The Shunan Industrial Complex Decarbonization Promotion Council was established by Shunan City, the Society for Chemical Engineers Japan, and companies belonging to the Shunan Industrial Complex (Idemitsu Kosan Co., Ltd., Nippon Steel Stainless Steel Corporation, Zeon Corporation, Tosoh Corporation, and Tokuyama). In order to help achieve carbon neutrality, the council's aim is to lay out a vision for decarbonization, and to promote efforts to enable its adoption by society, including relevant technology development, evaluation, and demonstration, as well as making policy recommendations. The members of the council all face the new challenge of balancing decarbonization with the need to maintain and enhance the competitiveness of the Shunan Industrial Complex. Several months after discussions began in February 2022, the council was able to announce at the end of May 2023 a grand design for the Shunan Industrial Complex to achieve by 2050. In FY2023, we set up subcommittees to address each theme and conducted more detailed studies.

● Utilization of locally sourced energy

14 Reduction of fuels-derived

Concluding a partnership agreement for the utilization of woody biomass materials

Tokuyama employees planted fast-growing trees in March 2024, following a similar tree-planting session in December 2022. This activity is based on an agreement for forest maintenance and the utilization of woody biomass material signed with Shunan City, Idemitsu Kosan Co., Ltd., Tosoh Corporation, and Marubeni Corporation. By building a sustainable forest management model through reforestation using fast-growing trees, Tokuyama and its partners will promote the utilization of local forest resources and aim for local production of woody biomass for local consumption.

Response from the Japan Fair Trade Commission to a five-company proposal for joint activities to achieve carbon neutrality at the Shunan petrochemical complex

Currently, various themes are being investigated by subcommittees established under the Council. Tokuyama and four other companies in the complex requested consultation with the Japan Fair Trade Commission regarding planned joint activities to promote carbon neutrality at the Shunan Complex. These activities include: (1) use of a power plant to generate the electricity required for product manufacturing and conversion of that plant for the use of alternative fuels; (2) conversion of product raw materials to bio-based basic chemicals using raw materials with low carbon dioxide emissions (biomass, etc.), and (3) joint capture of carbon dioxide emitted during product manufacturing and its reuse or storage as fuel and a raw material. In February 2024, the Commission responded that the planned joint activities to promote carbon neutrality at the Shunan Complex, including the listed activities and others, should pose no issues under Japan's Antimonopoly Act, except in cases where they ended up restricting competition, such as cartel behavior when setting product prices. As a result, the Group will accelerate its efforts to help achieve a carbon-neutral industrial park, including discussions on how to create a carbon-free ammonia fuel hub within the Shunan Complex.

Organizational structure

Member organizations

- Society for Chemical Engineers, Japan
- Shunan City
- Five companies of the Shunan Industrial Complex
  - ·Idemitsu Kosan Co., Ltd.
  - ·Nippon Steel Stainless Steel Corporation
  - ·Tokuyama Corporation
  - ·Tosoh Corporation
  - ·Zeon Corporation

Observers

- Ministry of Economy, Trade and Industry
- Ministry of the Environment
- Yamaguchi University
- Ministry of Land, Infrastructure, Transport and Tourism
- Yamaguchi Prefecture

Attempts to promote the utilization of biomass materials within the Shunan Industrial Complex

① Demonstration of fast-growing tree planting by Shunan City

A pilot project is underway to utilize land owned by Shunan City to plant fast-growing trees for fuel.

Fast-growing trees: Species that grow faster than Japanese ceda and cypress

② Shunan City, Idemitsu Kosan, Tosoh, Marubeni, and Tokuyama signed a partnership agreement for forest maintenance and the utilization of woody biomass material.

Cooperation areas
① Utilization of locally grown woody biomass and for local consumption
② Forest maintenance and its effective use, etc.

● Co-firing with biomass and ammonia

1 4 Reduction of fuels-derived

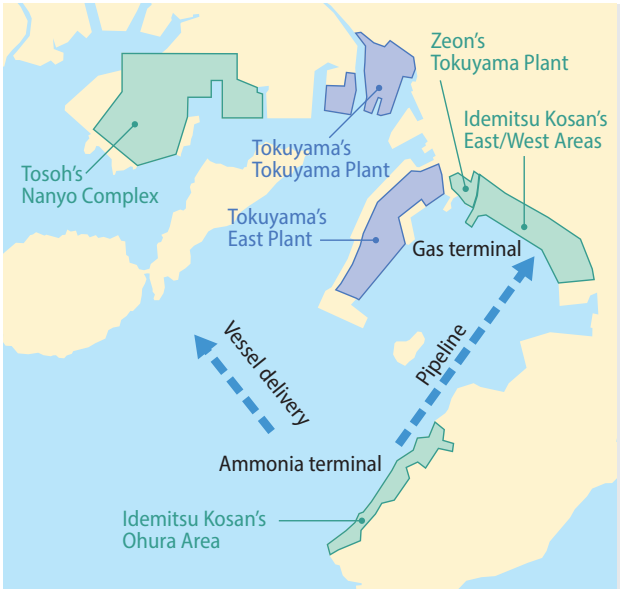
The Transition Promotion Project Based on a Stable Supply of Next-Generation Fuels

Idemitsu Kosan Co., Ltd., Tosoh Corporation, Tokuyama Corporation, and Zeon Corporation jointly applied for and were granted the "FY2023 Oil Supply Structure Advancement Project Cost Subsidy: Project to Promote Transition to a Stable Supply of Next-Generation Fuels)" offered by Japan's Ministry of Economy, Trade and Industry and the Agency for Natural Resources and Energy.

This project aims to investigate the establishment of a zero-carbon system to supply more than one million tons of ammonia per year at the Shunan Industrial Complex by 2030. The investigation covers use of the storage facility at the Tokuyama Factory of Idemitsu Kosan for development as a shared ammonia supply site for the Shunan Industrial Complex, and the construction of an ammonia supply infrastructure for each company in the complex (demand side). Moreover, based on this project, the four participating companies propose constructing in the Shunan region Japan's first ammonia supply chain and are taking various initiatives such as demonstrating ammonia combustion using actual equipment.

In the area of biomass use, construction work to convert one of the Group' s coal-fired power plants to enable co-firing with biomass will begin in FY2024. We plan to operate the plant with a co-firing rate of approximately 25% by calorific value starting around autumn FY2025.

Overview of the Support Project for Turning an Industrial Complex into a Supply Site for Hydrogen, Ammonia, or Similar Fuels [Joint proposal by Idemitsu Kosan, Tosoh, Zeon, and Tokuyama]



Overview of the investigation project

- Investigation into the development of an ammonia terminal using existing infrastructure
- Investigation into the development of a large-scale terminal utilizing existing infrastructure
- Investigation into the development of ammonia supply infrastructure for industrial complex companies
- Aiming to build a district ammonia supply system that can handle more than one million tons


Existing tanks


Existing pier


Existing pipelines

Source: Advisory Committee for Natural Resources and Energy, 5th Meeting; joint meeting of the Hydrogen Policy Subcommittee of the Energy Conservation and New Energy Sectional Committee together with the Ammonia and Other Decarbonized Fuel Policy Subcommittee of the Resources and Fuels Sectional Committee

● Carbon offsets

ⓑ Carbon offsets

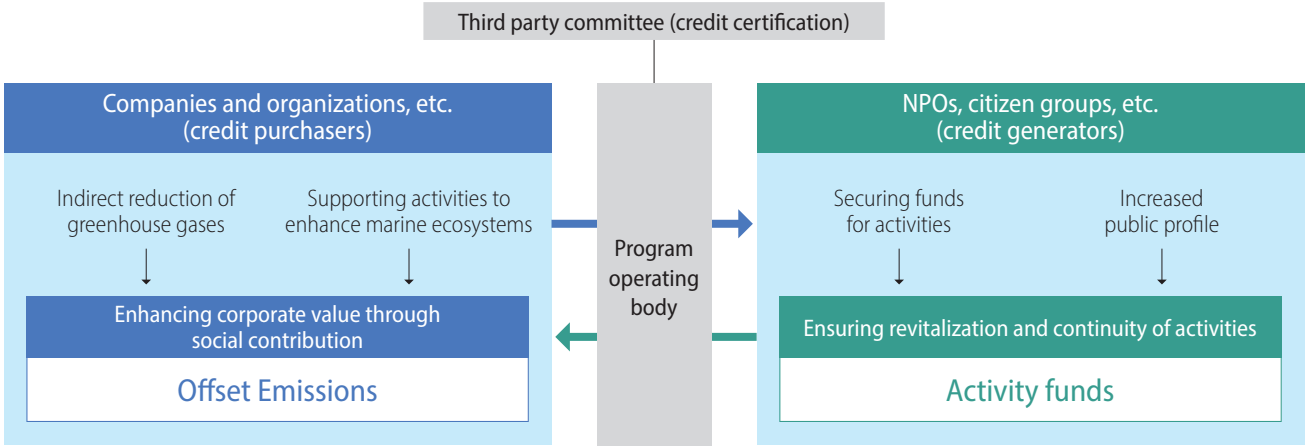
Blue carbon offset

Tokuyama is participating in the Tokuyama Kudamatsu Port and Oshima Tidal Flat Blue Carbon Offset Program, which utilizes "J Blue Credits" issued by the Japan Blue Economy Association (approved by the Minister of Land, Infrastructure, Transport and Tourism).

"Blue carbon" describes the type of carbon that is sequestered when carbon dioxide in the atmosphere is absorbed by marine organisms such as seaweed. It is now attracting attention as a new option for CO_2 capture.

Under the Tokuyama Kudamatsu Port and Oshima Tidal Flat Blue Carbon Offset Program, the amount of CO_2 captured as a result of activities to conserve the seaweed beds near the Oshima tidal flat is certified as J-Blue Credits. Through purchase and utilization of these credits, the Group can offset GHG emissions from its production activities. In FY2023, we purchased credits equivalent to 3.1 tons of CO_2.

By supporting activities to conserve marine ecosystems through this Blue Carbon Offset Program, the Group is helping to build a sustainable world based on beautiful, thriving natural environments from the mountains to the sea.



Blue carbon:
A type of carbon capture where carbon dioxide in the atmosphere is absorbed and sequestered by marine organisms such as seaweed. It is attracting attention as a new option for CO_2 capture.

● Adoption of negative emission technology (CCUS)

8 Carbon offsets

Development of carbon negative concrete

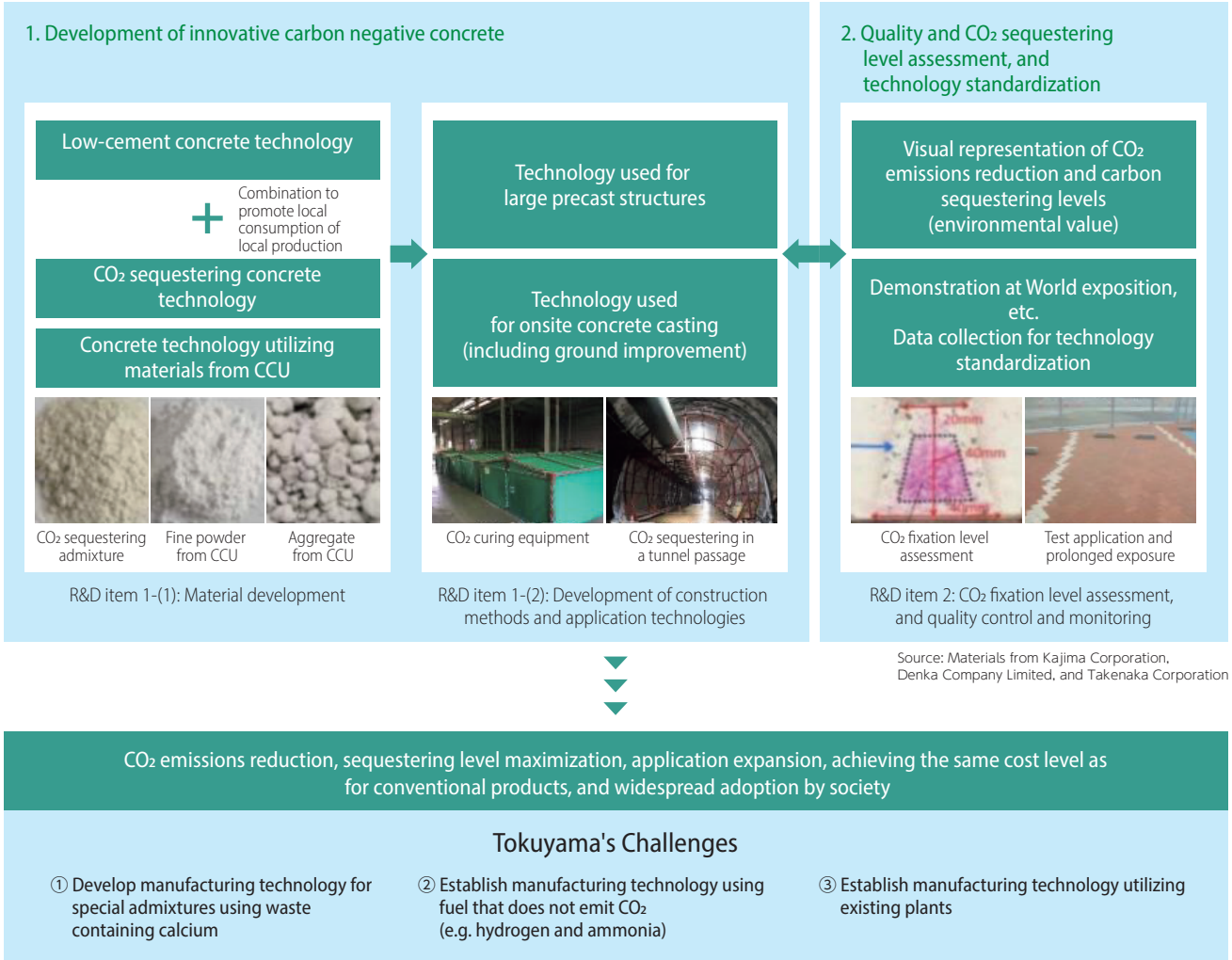
Carbon-negative concrete is a type of concrete that reduces the net amount of CO_2 generated through concrete production by combining technologies to reduce and capture CO_2 emissions. Tokuyama is working with Denka Company Limited to develop CO_2 fixing admixtures to be used in CO_2-absorbing concrete. This is part of a project for the "Development of Materials, Construction Technology, and Quality Evaluation Technology for Innovative Carbon-Negative (CN) Concrete" under the Green Innovation Fund created by the New Energy and Industrial Technology Development Organization (NEDO).

Tokuyama is mainly responsible for developing the CO_2-fixing admixture produced by utilizing calcium-containing industrial waste as a raw material. We are investigating how various components in the waste can affect the mineral composition of the admixture. By taking these effects into consideration in the material design, we have confirmed that the quality of the admixture is good enough, even when waste comprises about 50% of the component raw materials.

The Group will continue to develop technologies for effective waste utilization and for manufacturing carbon-negative concrete products to help decarbonize society.

*Green Innovation Fund Project (GI Fund):
Toward the goal of achieving carbon neutrality by 2050, the Japanese government has established a Green Innovation Fund of two trillion yen to be administered by the New Energy and Industrial Technology Development Organization (NEDO). The fund provides continuous support to companies and other organizations that are committed to taking on, as management issues, the challenge of achieving specific ambitious targets shared by the public and private sectors, from R&D through to demonstration to social implementation over the next 10 years.

Project format:
A consortium of over 40 companies, 10 universities, and 1 research institute



Source: Materials from Kajima Corporation, Denka Company Limited, and Takenaka Corporation

● Adoption of negative emission technology (CCUS)

8 Carbon offsets

Conducting a verification test for CO_2 capture from cement production

Using a CO_2 capture test facility at Mitsubishi Heavy Industries, Ltd., we conducted a verification test of CO_2 capture from cement production exhaust gas.

Based on the knowledge already gained through this initiative, we will calculate the necessary investment, identify issues and take appropriate measures, and then proceed with demonstration and implementation of this technology.

Main GHG emission sources in cement production		
Electricity	Coal (as raw material)	Limestone

- Difficult to replace raw materials (especially limestone)
- Specific issues remain unclear for the installation of equipment to capture CO_2 from cement production exhaust gases

A CO_2 capture facility will be installed in our cement plant to capture CO_2 from exhaust gases.

In addition to evaluating the reliability of long-term continuous operation of the facility, data on impurities in the captured CO_2 gas will be analyzed to verify the application of this facility as an optimal CO_2 recovery technology for cement plants.

Development of alkaline water electrolyzers

Business opportunities

Tokuyama and Nippon Shokubai Co., Ltd. are carrying out the "Project to Develop Large-Scale Alkaline Water Electrolyzers and Separators Suitable for High-Pressure Systems." It is a NEDO-commissioned project as part of "Technology Development for Multi-Purpose Utilization of Fuel Cells" within the framework of the "Joint Problem-Solving Industry Academia Government Collaborative Research and Development Project for Rapidly Expanding the Use of Fuel Cells, etc."

A high-pressure alkaline water electrolyzer (AWE) is a device that produces hydrogen and oxygen by supplying an alkaline aqueous solution to cells divided by separators and electrolyzing the solution. Hydrogen is attracting attention as a next-generation energy source, and expectations are high worldwide concerning green hydrogen produced from renewable electricity.

This project combines Nippon Shokubai's development of a large separator suitable for high-pressure systems with Tokuyama's development of an internal electrolytic cell structure that maximizes separator performance. The aim is to develop a world-class high-pressure AWEs that is very competitive. The separator developed by Nippon Shokubai will be incorporated into the high-pressure AWE prototype developed by Tokuyama, and the project R&D activities will proceed from there.

By utilizing electrolyzer technology developed over many years in Tokuyama's sodium chloride electrolysis business, we will develop and demonstrate high-pressure alkaline water electrolyzers, which should bring prices down even further. In this way, we intend to help promote the supply of next-generation fuels.

Initiative at the Center for Commercialization of Advanced Technology

Business opportunities

With the global drive toward carbon neutrality, Tokuyama has decided to enter the electrolyzer business, leveraging the electrolysis technology and hydrogen handling know-how developed by the Group over the last 70 years. The Center for Commercialization of Advanced Technology in Yanai City (Yamaguchi Prefecture) has become our base of operations for this initiative.

At this site, we will begin manufacturing large sodium chloride electrolyzers that can achieve the world's highest level of energy-saving performance. We will also establish a system to manufacture alkaline water electrolyzers using the same production line.

By incorporating Tokuyama's zero-gap salt electrolysis technology, we have developed a sodium chloride electrolyzer that can achieve the world's highest level of energy-saving performance. Our aim is to make high-efficiency sodium chloride electrolyzers widely available for caustic soda production, enabling energy savings in those operations.

Through this project, Tokuyama seeks to help build a hydrogen supply chain that enables efficient energy use, from hydrogen production to utilization. This will help build a hydrogen-powered society through renewable energy adoption worldwide and local consumption of local energy production.

Efficiently utilize biomass combustion ash and CCS

Business opportunities

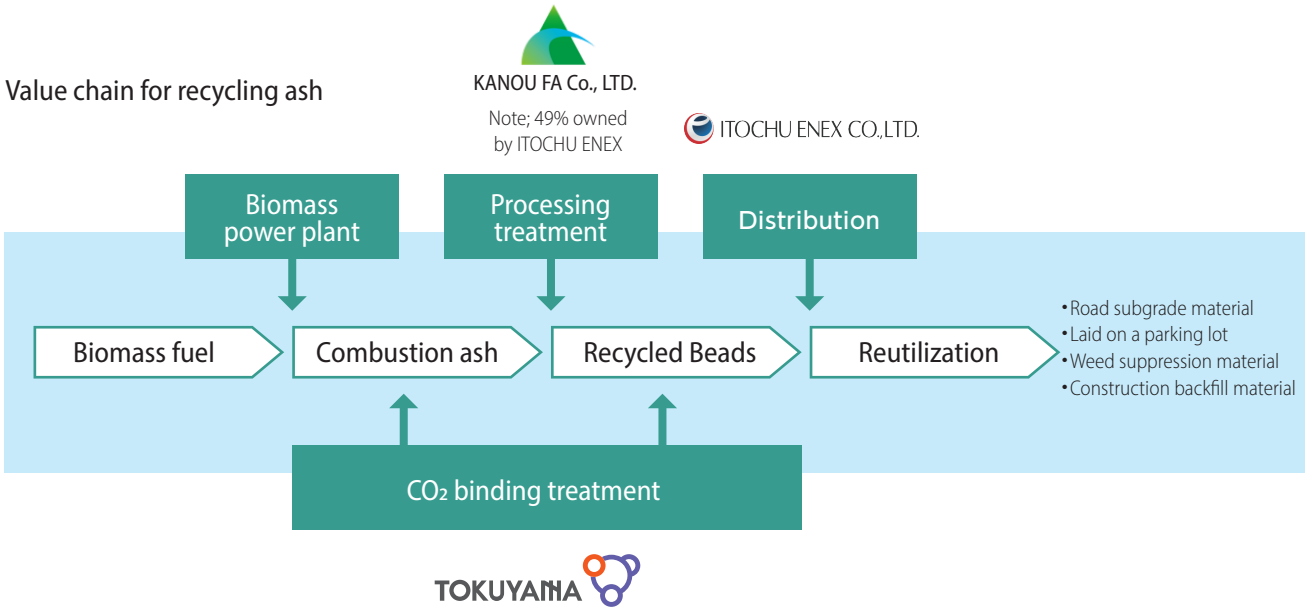
Since combustion ash (fly ash) discharged by biomass power plants contains potassium and other elements, its use in cement production is limited. Therefore, technology needs to be developed for effective utilization of this material.

For this joint research with ITOCHU ENEX Co., Ltd., using Tokuyama technology still under development, we aim to utilize biomass fly ash that has adsorbed CO_2 to make a construction material product (trademark: Recycle Beads). The goal is to create a method for CO_2 capture and storage that can be widely adopted.

In FY2023, the Group developed a process technology whereby CO_2 captured from exhaust gases emitted by Tokuyama's cement plant is fixed to biomass fly ash generated by its power plant. The treated ash was then used as a raw material to manufacture CO_2-fixing Recycle Beads™ by an affiliate of ITOCHU ENEX Co., Ltd. The resulting product was finally utilized at the Tokuyama Factory. We confirmed that the CO_2 emissions attributable to the raw materials and energy used in all the processes required to manufacture the CO_2-fixing Recycle Beads amounted to 34.2 kilograms of CO_2 per ton of recycled beads, while the amount of CO_2 fixed was 61.0 kilograms per ton. Thus, the trial manufacture achieved a net carbon sequestration of 26.8 kilograms of CO_2 per ton of beads.

Through this initiative, both companies aim to help realize a decarbonized, recycling-oriented society.

Value chain for recycling ash



Presented by ITOCHU ENEX

* CCS (Carbon dioxide Capture and Storage)
* Recycle Beads is a roadbed material and weed control product produced by KANOU FA Co., Ltd., a company in which ITOCHU ENEX Co., Ltd. has a 49% stake.

Mass production begins for magnesium hydride, a next-generation hydrogen carrier

Business opportunities

In collaboration with Biocoke Lab Co., Ltd. we have installed a hydrogenation reactor to produce magnesium hydride (MgH_2) at the Tokuyama Factory and have begun mass production with the goal of producing 30 tons per year.

Hydrogen is considered a key energy source for building a decarbonized society. However, since it is a gas with a low density, it generally needs to be transported at low temperature and high pressure. Therefore, the added costs for storage and transportation pose an issue for hydrogen compared to conventional fuels.

Magnesium hydride is a solid material capable of storing hydrogen at high density, and it maintains chemical stability at room temperature and at regular atmospheric pressure. This makes it a substance with the potential to be a next-generation carrier for safely storing and transporting hydrogen.

When Tokuyama manufactures caustic soda, hydrogen is obtained as a byproduct. This is reacted with magnesium to produce magnesium hydride, which is then sold by Biocoke Lab.

The two companies are aiming to develop a market for convenient hydrogen products as part of efforts to build a hydrogen-powered society.

Features of magnesium hydride

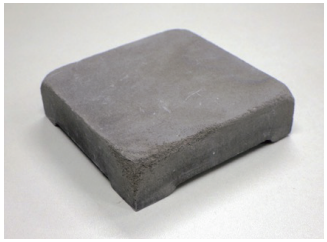
A Enables safe and inexpensive hydrogen transport, as is stable at room temperature and normal atmospheric pressure.

Since it is very lightweight (specific gravity of approx. 1), it can be stored safely and transported inexpensively.

B Enables high-density hydrogen storage, exceeding that of ammonia (NH_3). *Per unit volume

C Easy extraction of hydrogen gas:

Can generate twice the amount of hydrogen per carrier unit compared to hydrolysis.



Magnesium hydride

Magnesium hydride manufacturing and sales process