Environmental Management General Risks and Opportunities, Business Impact, and Strategic Analysis Outline

We have prepared this section under the assumption that it will be used as a reference together with "holistic environmental management information disclosure based on the TCFD framework and draft TNFD framework, etc." →P.15~P.39
We expect, however, that this section alone will often be used as an independent reference, and therefore, when we have deemed it necessary, we have included the same tables, graphs, figures, etc., in both sections.

Physical risks

Physical risks	Risk assessment	Strategy
Chronic risks (biological resources)	Declining yields of agricultural products and increasing procurement costs [medium to long term] ●Significant decline in yields of major agricultural products, including barley, hops, tea leaves, and coffee ●The financial impact from lower agricultural yields caused by climate change is approximately 0.9 billion yen to 2.5 billion yen in 2050 under the 2℃ scenario, and approximately 2.5 billion yen to 9.7 billion yen under the 4℃ scenario (mid 50 percentile range in the price fluctuation) ●The risk is small for corn if the increase is 2℃ or less, but there is research with different results so close attention is required. The risk of decline in yields for agricultural raw materials related to high-fructose corn syrup is low.	●Brewing technology that does not rely on barley (adaptation measures/risk reduction) ●Mass plant propagation technologies (adaptation measures/risk reduction) ●Support for farms to acquire certification for sustainable agriculture (adaptation measures/risk reduction) ●GHG emissions reduction (mitigation measures/risk reduction)
Acute risks (water resources)	Disruption of operations owing to floods [short to long term] ●Plants facing an elevated water risk: two in Australia, four in Japan, one in US and China respectively ●Historical examples of actual flood damage: Approximately 1.0 to 5.0 billion yen ●Exposure to 200-year disasters (total of 20 locations in Japan): Approximately 1.0 billion yen	●Sharing of knowledge concerning responses to floods (adaptation measures/risk reduction) ●Insurance for flooding (adaptation measures/risk transfer) ●Capital investment for flooding at facilities (adaptation measures/risk reduction or acceptance)
	Impact on shipping & delibery owing to floods [short to long term] ●There is a risk of flooding at shipping ports but planned responses exist	●Sharing of knowledge on responses to floods (adaptation measures/risk reduction) ●Diversification of suppliers (adaptation measures/risk reduction)
	Disruption of operations owing to droughts [short to long term] ●High water stress plants: 2 in Australia (all 5 in the future), 1 in the USA and 1 in Thailand. ●Impact from decline in production owing to droughts: estimated to be between approximately 30 million yen and 600 million yen	●Advanced technologies for water use reduction (adaptation measures/risk reduction) ●Sharing of knowledge concerning responses to droughts (adaptation measures/risk reduction)
	Impact on agricultural products owing to floods and droughts [short to long term] ●We forecast that water stress will become higher in many producing areas ●Natural disasters are materializing in many countries and regions	●Responses to water stress in areas producing agricultural raw materials (adaptation measures/risk reduction or acceptance) ●Utilization of bag-type culture vessel technology that enables the recirculation of water (adaptation measures/risk reduction) ●GHG emissions reduction (mitigation measures)

* Recalculated with 2022 data

Chronic risks

Details of physical risks

Declining yields of agricultural products and increasing procurement costs [medium to long term]

Yields of agricultural raw materials may decline significantly owing to global warming and reductions in daily temperature ranges.

When we assessed the financial impact of lower agricultural yields using the 25-75 percentile range of the distribution of forecast data for change in prices, the impact was approximately 0.9 billion yen to 2.5 billion yen in 2050 under the 2℃ scenario, and approximately 2.5 billion yen to 9.7 billion yen under the 4℃ scenario (Graph 2). The range of the 25-75 percentile was 4.5 times larger for the 4℃ scenario than the 2℃ scenario, from which we can interpret that uncertainty is higher and the risk is more significant.

Since 2018, we have continued surveys and analysis of the impact of climate change on agricultural raw materials, with reference to numerous academic papers. Although the impact differs between countries and regions, we have found that there are some agricultural raw materials for which yields will decline significantly. In 2022, we added surveys related to high-fructose corn syrup and protein sources, which are raw materials for low-malt beer products, etc. Every year, we refer to the latest academic papers and revise our information related to other agricultural products (Table 1).

In surveys related to water risk and water stress in areas producing agricultural raw materials, we identified severe levels of drought risk and flood risk, which may impact agricultural products (Table 10).

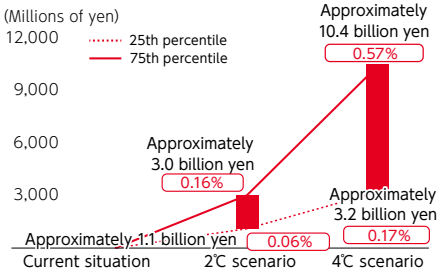
In 2022, we estimated the financial impact of declines in agricultural yields for Kirin Brewery, Kirin Beverage, Mercian, Lion (Oceania region only), Kyowa Kirin, and Kyowa Hakko Bio, referring to numerous academic papers. Our estimates covered the following agricultural products: barley, hops, tea leaves, grape juice, starch, lactose, corn, and cassava.

1 Impact of climate change on yields of key agricultural products (forecast for 2050 unless otherwise specified)

Kirin Group Scenario3: 4℃, unwanted world, 2050

Agricultural products	America (North and South)	Asia	Europe and Africa	Oceania
Barley	Canada -12% (2100) U.S. +9%(2100)	West Asia -5% to +10% Korea +0.5%	Finland -5.9% (spring barley) France -10% or more(Winter barley) -20% or more(Spring barley) Mediterranean coast (West)-0.3%(Portugal, Spain, France, Italy) (East)+4.4% Germany -14% to +18%	Western Australia -10 to -30%
Hops	U.S. (Washington) -16% (2100)		Czech Republic -8.5%	
Tea leaves		Sri Lanka Decline in yields in lowlands, low impact in highlands India (Assam region) 3.8% decline in yields per 1°C increase above average temperature of 28°C India (Darjeeling region) -40% to -80%	Kenya Change in suitable land from 1500 to 2100 meters above sea level to 2000 to 2300 meters above sea level. Drastic reduction in suitable land in the western part of Kenya, with land remaining suitable in the mountainous area of Kenya Malawi Chitipa 80% reduction in suitable land Nkhata Bay 60% reduction in suitable land Mulanje 70% increase in suitable land Thyolo 20% increase in suitable land	
Wine grapes	U.S. (California) 60% reduction in suitable land U.S. (Northwest) 231% increase in suitable land Chile 25% reduction in suitable land	Japan(Hokkaido) Increase in suitable land, Pinot Noir cultivation possible Japan (Central) Increase in suitable land while also anticipating obstacles from high temperatures	Northern Europe 99% increase in suitable land Mediterranean 68% reduction in suitable land Spain Change in overall wine production for each 1°C rise -2.1% (Spain as a whole) -4.6% (Andalusia) -4.8% (Duero River Valley) -34.6.% (northern Mediterranean)	New Zealand 168% increase in suitable land Australia (southern coast) 73% reduction in suitable land Australia (ex. southern coast) 22% reduction in suitable land
Coffee beans	Brazil 55% reduction in land suitable for arabica 60% reduction in land suitable for robusta	Southeast Asia 60% reduction in land suitable for arabica 52% reduction in land suitable for robusta	East Africa 13% reduction in land suitable for arabica 16% reduction in land suitable for robusta	
Corn	U.S. (Southwest) -27% U.S. (Midwestern Iowa) -5% to -12% U.S. -46/5% (2100) Brazil -19/4% (2100) Argentine -28.5% (2100)	China -27.4%	Ukraine -40.6% (2100)	
Soybeans	U.S. -10% (2080) Brazil -20% (2080) Argentine +40% or more	China +16% to +50% (2100) India -80%		

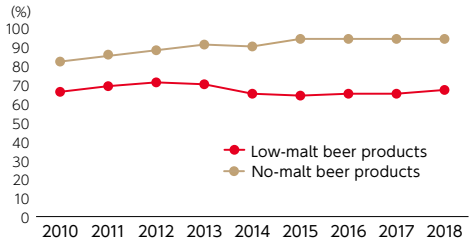
2 Impact of lower yields on procurement costs for agricultural products in 2050



Estimated for the main agricultural raw materials at Kirin Brewery, Kirin Beverage, Mercian, Lion (excluding the non-alcoholic beverages business), Kyowa Kirin, and Kyowa Hakko Bio. Figures in ▭ show the percentage of revenue

*1 Recalculated with 2022 data

3 Change in Kirin Brewery domestic share of low-malt beer products and no-malt beer products market



●Brewing technology that does not rely on barley (adaptation measures)

In response to declining barley yields as a result of climate change, we will maintain earnings by leveraging the brewing technology for the products that limit the amount of barley used.
Kirin Brewery has an extremely high share in low-malt and no-malt beer categories and maintains a competitive advantage in this area.
We have also conducted surveys and analyses related to high-fructose corn syrup and protein sources, which are required to brew low-malt and no-malt beer products, while referring to numerous academic papers, and as a result (Table 5), we have judged that there are no major issues at present.
As for corn, we studied the impact of climate change on four major exporting countries of corn (approximately 87% of global exports). Although there is a fairly significant probability (Table 4) that yields in each producing area will fall by 10% or 20%, we found that the probability that average yields will fall at the same time across the four major exporting countries was approximately 7% under the 2℃ scenario. Under the 4℃ scenario, this probability was approximately 86%, so we would be unable to avoid a significant impact. But if we can limit the increase within the 2℃ scenario, we think we may be able to reduce the impact by changing the countries we procure from.
In 2021, an international research team consisting of 20 research institutions from eight countries, including Japan's National Institute for Environmental Studies and the National Agriculture and Food Research Organization (NARO) reported average global corn yields will fall by approximately 24% by the end of this century compared with the present (1983 to 2013) if climate change progresses. We will continue to monitor the development in research and assess new studies.
We expect that yields of sugar cane, which can act as a substitute for high-fructose corn syrup besides corn, will fall in Brazil, the leading producer, but will rise in China and parts of India.
Yields of potatoes will either rise or fall in India and America, depending on the variety, but overall, we do not expect yields to fall, partly because we expect an increase in yields in China.
As for soybeans, which are a raw material for no-malt beer products, we forecast that yields will either rise or fall depending on the region, and we have judged that it is highly likely we will be able to avoid significant impact.

●Support for farms to acquire certification for sustainable agriculture (adaptation measures)

In order to ensure that areas producing agricultural products are resilient to climate change, we will continue to support the acquisition of sustainable farming certification.

More information→P.44～P.45、P.48

●Mass plant propagation technologies (adaptation measures)

We will continue efforts to enhance the range of applications of "mass plant propagation technologies" developed by the Kirin Central Research Institute, to ensure that they can be used for heat-tolerant agricultural breeds developed in response to falling yields of agricultural products as a result of climate change.
While it is difficult to conceive of a business model for the Kirin Group that is completely independent of barely and hops, we anticipate that "mass plant propagation technologies" will have a positive impact on the stability of agriculture through cultivation if agricultural breeds suited to global warming are developed.
We will be able to use plastic film "bag-type culture vessel technology," which the Kirin Group has developed proprietarily, to significantly increase growth rates of healthy seedlings with no diseases and seedlings that are genetically identical to their parents (clones) by multiples of tens or hundreds of thousands depending on the plant species. We aerate a solution containing nutrients necessary for plant growth inside a small bag, making it easier to use water more effectively than in soil cultivation and enabling cultivation in areas with high levels of water stress. In this way, we expect that we can reduce our dependence on water specific to certain countries and regions.

More information→P.49

●GHG emissions reduction (mitigation measures)

In order to minimize the risk of falling agricultural yields, we aim to achieve net zero emissions by 2050, our science-based 1.5℃ target by 2030, and renewable energy targets under RE100 by 2040, in accordance with our roadmap.

4 Probability of simultaneous 10% or 20% decline in average yield compared to the current level due to climate change in the four largest corn exporters

	2℃ scenario		4℃ scenario	
Country	>10%	>20%	>10%	>20%
United States	68.6	29.5	100.0	96.9
China	46.2	16.8	98.8	89.2
Argentina	50.0	9.9	96.9	86.9
Ukraine	51.8	19.2	98.2	85.0

5 Impact of climate change on high-fructose corn syrup and soybeans(4° C scenario, 2050, unless otherwise noted)

	Regional Harvest Forecasts		
Agricultural Products	North America	South America	Asia
Sugarcane	–	Brazil ▲9.6%～+1.4%	Pakistan +1.6%～+4.1% China +22～+40%(2060)
Potatoes	United States No fertilizer effect Atlantic ▲20%～▲27% Russet Burbank +0～+5% Fertilizer effective Atlantic 0～▲5% Russet Burbank +18%	–	India +5.7%～+6.2% China Rainfed agriculture - Dabaihua +21.8% (2060) Irrigated agriculture, Kexin-1 +20.9% (2060)
Soybeans	United States (Central) No effect of fertilizer application ▲33.3% (2080) Fertilizer application +4.4% (2080)	Brazil ▲20%(2080)	China +50%(2080) India ▲8.24%

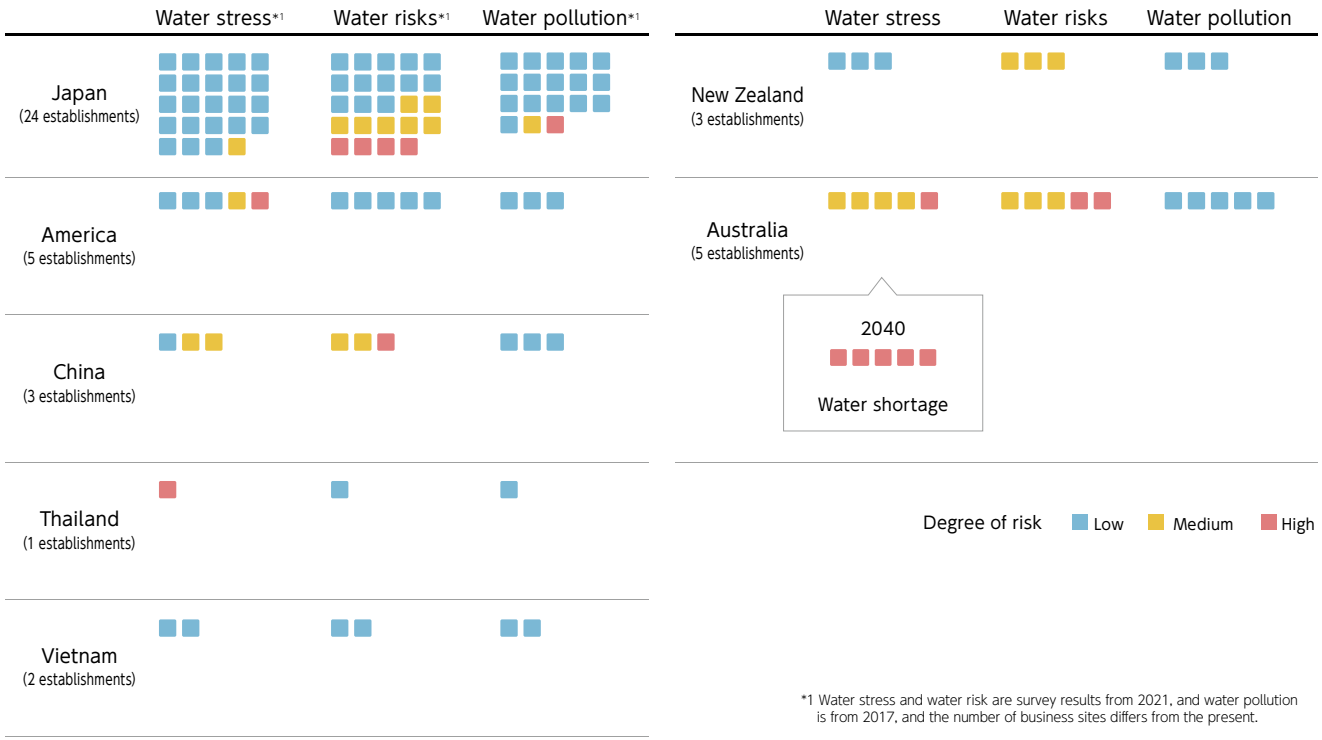
Acute risk

Details of physical risks

Disruption of operations owing to floods [short to long term]

Disruptions to brewing and manufacturing, or a significant impact, may occur as a result of damage from typhoons, heavy rainfall, and other disasters caused by climate change.
The Kirin Group has operated businesses in Japan and Australia, two countries where the level of water stress differs significantly. As such, we have developed an understanding rooted in experience of the fact that problems related to water differ between countries and regions, and that they largely depend on basins and specific locations. Since 2014, we have been conducting regular scientific surveys, and in 2021, we conducted additional surveys and assessments based on Aqueduct for main brewing sites at New Belgium Brewing in the United States in accordance with the expansion of our businesses.
In 2020, we conducted surveys and analyses of water risk at brewing and production sites using Aqueduct 3.0, hazard maps created by local governments, and other resources. As a result, we identified plants with a high level of water risk from flooding, etc., as follows: two in Australia, and four in Japan, one in U.S., and one in China.. (figure on the right: Business site water risk assessment). Flooding occurred at Lion's Castlemaine Perkins Brewery in Australia, which we assessed as having a high level of water risk, as a result of large-scale floods in Brisbane caused by very heavy rainfall over a wide area in the eastern part of Australia in March 2022. Flooding also occurred as a result of heavy rainfall in 2011. Going forward, we will continue using tools to assess risk, while considering factors based on our experience.
Our management benchmark for the financial impact of flooding on breweries and plants is approximately 1.0 billion yen to 5.0 billion yen, in line with the actual amounts of flood damage in the past (Table 7).
We are also using wind and water damage simulation systems to forecast losses from the risk of flooding. Our exposure to general 200-year disasters (the total of 20 business sites in Japan) is approximately 1.0 billion yen. There is a possibility of flood damage at our business sites from a rise in sea levels caused by global warming, but although there are forecasts for a rise in sea levels of 0.46 to 0.97 meters with a 4℃ increase in temperature in Japan, we think it is still difficult to form a quantitative assessment. Going forward, we will continue paying close attention to the results of research.

6 Manufacturing Site Water Risk/Stress



*1 Water stress and water risk are survey results from 2021, and water pollution is from 2017, and the number of business sites differs from the present.

7 Cost of damages in past factory flooding events

Country	Operating companies	Plant	Cost of damage*2	Sales ratio
Australia	Lion	Castlemain Perkins Brewery	Approx. 1 billion yen	0.05%
Japan	Kirin Brewery	Sendai Plant	Approx. 5 billion yen	0.27%

*2 The amount for the Sendai Brewery is from tsunami and earthquake damage in the 2011 Great East Japan Earthquake

8 Results of wind damage simulation

Recurrence period (years)	Flood AEP(JPY)*3
1000	21,768,643,347
500	16,373,304,101
200	1,030,581,609
100	2,590,244
50	52,859

*3 Aggregate Exceedance Probability

*4 Brisbane is an area of high water stress and severe drought, but at the same time it has a history of repeatedly experiencing major flooding every few decades.
*5 Japan Meteorological Agency: Observed facts and future projections of sea level, storm surge and high waves - from "Climate Change in Japan 2020".
https://www.mlit.go.jp/kowan/content/06.pdf

Kirin Brewery Nagoya Plant

Castlemaine Perkins Brewery

Response strategy

●Sharing of knowledge on responses to floods (adaptation measures)

At breweries and plants in areas where, comparatively, there is leeway in terms of time until flooding occurs, we will minimize damage in ways such as shutting down power sources in advance.
When flooding occurred at Castlemaine Perkins Brewery in 2011, we shut down power sources in the brewery in advance, partly because there was some time between the flood alert and the actual flooding. As a result, we prevented harm from short-circuiting to electrical equipment in the brewery, and were able to reduce the amount of damage and quickly restart operations. Similar countermeasures were effective against partial flooding at the Kirin Brewery Nagoya Brewery in 2000.

●Insurance for flooding (adaptation measures)

We will consider insurance at business sites as an effective measure against natural disasters, including floods.
In 2020, we used the natural disaster model AIR to simulate wind and water damage for our main 20 business sites in Japan, thereby estimating loss percentages and amounts of damage for each recurrence period. For 200-year disasters (a disaster occurring once every 200 years), the total exposure across the Kirin Group was approximately 1.0 billion yen. At KYOWA PHARMA CHEMICAL, however, we calculated that the annual amount of damage from a wind and water disaster of a scale occurring once every 500 years would be equivalent to 42% of the value of its property. Accordingly, we will consider covering an insurance, etc., after on-site surveys.

●Addressing flooding at facilities (adaptation measures)

We assume that flooding would have a serious impact on the continuity of our businesses, and we will therefore promote physical countermeasures as necessary at business sites where we must fulfill our responsibility to supply customers without interruption.
At Kyowa Kirin, we have judged that the amount of damages from recovery, production disruption, and business opportunity losses would be considerable in the event that water damage, etc., caused long-term disruptions to operations at Kyowa Kirin's own pharmaceutical plants, commissioned manufacturers of drug substances, and packaging material suppliers.
At Kyowa Kirin's own sites, we have formulated policies on countermeasures against water damage, and have taken measures to prevent flooding (geographically distributed storage of important assets related to production, waterproofing of buildings, moving important facilities to high floors and locations, the installation of flood walls, etc.). In the future, we intend to continue to address these issues through investment in our facilities. We will assess and address the impact across the supply chain as a whole, and take steps to avoid production disruptions and minimize damages. At the same time, there will be a significant impact on companies commissioned to manufacture drug substances, packaging material suppliers, etc., so we will gather information about water damage countermeasures at each partner company, identify issues, and consider measures such the formulation of BCPs and disaster response drills.

*1 We have assessed risk related to flooding in a multifaceted manner, using multiple systems. Aqueduct can be used to assess risks, not just at the present but also including future forecasts. Aqueduct is the most widely used water risk assessment tool today, so one of its advantages is that it has a high potential for comparisons, but it is a black box, and in some aspects it does not fully reflect Japan's complex water systems. Hazard maps provide an assessment of the worst expected damage by local governments with a deep understanding of the area. We believe that when hazard maps and Aqueduct are used together, it enables more accurate risk assessments. With simulation systems, it is possible to estimate loss percentages and amounts of damage for each recurrence period, so we use them to identify our exposure and make judgments concerning insurance.

Details of physical risks

Impact on transportation from floods [short to long term]

There may be an impact on product distribution and the transportation of raw materials from typhoons, heavy rainfall, and other disasters caused by climate change. In 2018, the West Japan Torrential Rain Disaster resulted in long-term disruptions to railroads and roads in the Chugoku region, and there were major obstacles to the transportation of products from breweries and plants to customers.
In 2022, we conducted a survey concerning flooding risk and countermeasures in major barley shipping ports overseas. As a result of this survey, we found that flooding risk was low in Canada, Australia, and the United Kingdom, and that while there was a risk of future floods of between 0.5 and 5 meters in the Netherlands and Germany, planned countermeasures have been formulated and implemented. We also found that, even when flooding risk is not high in the bays themselves, disasters affecting railroads and roads linked to the bays, as well as adjacent cities, would cause obstacles to the functioning of the ports.

Response strategy

●Sharing of knowledge on responses to floods (adaptation measures)

We are developing a manual for responding when we anticipate disruptions to logistics over a wide area from natural disasters, etc. Immediately after we recovered from major damage to logistics networks from the 2018 West Japan Torrential Rain Disaster, we created a manual for responding to similar events. As a result, we were able to avoid any significant impact from subsequent typhoon damage on product distribution, including Typhoon Faxai, which caused significant damage, particularly in Chiba Prefecture, and Typhoon Hagibis, the first typhoon to receive the designation of a Disaster of Extreme Severity and a Specified Anomalous Disaster (both occurred in 2019).

●Diversification of suppliers (adaptation measures)

We reduce risk by having multiple suppliers.
We work with our suppliers as part of endeavors to sustain our supply chain, to ensure that we can stably deliver safe and secure products to customers, at the optimal price. We have diversified our procurement of malt, the main ingredient in beer, across three continents: North America, Europe, and Australia. We combine procurement measures for hops, such as adopting long-term contracts with producers, as part of efforts to secure the necessary amounts, and minimize the impact of market prices.

9 Assessment of water risk at main barley exporting ports

Country	Coast name	Flood risk	Recent disaster information	Flood control measures
Canada	Vancouver Bay	Risk of floods between 0.5 and 1m in 2100	Full-scale disruptions occurred to rail freight transportation and highways connected to the bay as a result of flooding and landslides caused by heavy rainfall in 2021	In cooperation with local NPOs, flood management strategies have been formulated and coastal lines have been repaired
Australia	Fremantle Perth Bay	Risk of floods between 0.7 and 2m between 2010 and 2080, and risk of floods between 0.5 and 5m from 2080 onward	No information about coastal disasters	On-site analysis is being conducted concerning the risk of climate change. Separately to climate change, there have been repairs to piers, bulkheads, and important facilities
United Kingdom	Southampton Bay	Low risk of flooding prior to 2050. Risk of floods between 0.5 and 5m in 2080	No information about coastal disasters. Damage from heavy rainfall occurred in the city in 2021	Coastal development is being promoted, including flooding countermeasures, and there are plans to complete the construction of bulkheads in rivers with a particularly high level of risk
The Netherlands	Rotterdam Bay	Risk of floods between 0.5 and 5m between 2010 and 2080	No information about coastal disasters	The government and companies collaborated to launch a program for managing flood risk in 2015. They are strengthening protective barriers and embankments, as it is urgently required
Germany	Bremerhaven Bay	Risk of floods between 0.5 and 5m between 2010 and 2080	No information about coastal disasters. Damage from heavy rainfall occurred in the city in 2021	Measures such as building and strengthening sea embankments and protective barriers are being implemented in accordance with plans. Repairs to 1.3km of quay walls were completed in January 2022

Details of physical risks

Disruption of operations owing to droughts [short to long term]

Water is essential in brewing and manufacturing processes for alcoholic beverages, soft drinks, pharmaceutical products, and biochemical products. Accordingly, there may be disruption or obstacles to brewing and manufacturing in the event of severe droughts caused by climate change.
In our assessment of water stress at manufacturing and brewing sites based on Aqueduct 3.0, other resources, water stress such as drought is elevated at two plants in Australia, one in the US, and one in Thailand, and we have determined that risks facing Lion's five Australian plants will increase in the future.
We have identified the estimated financial impact of droughts on breweries and manufacturing business sites based on the volume decline in brewing and manufacturing under certain assumptions at business sites with a "high" level of water stress. We estimated that the financial impact was between approximately 30 to 600 million yen, but in past examples, we have been able to minimize the impact of droughts, so we have judged that the risk is negligible.

More information on business site water risk assessments→P.80

More information on water usage at breweries and manufacturing sites in areas with water stress→P.22

Impact on agricultural products from floods and droughts [short to long term]

There is a possibility that water risk and water stress from climate change, as well as disasters, may result in a decline in agricultural yields and an increasing financial impact related to procurement.
In 2017, we used Aqueduct 2.1 to conduct detailed surveys of water risk in areas that produce agricultural raw materials, and we found that water stress would increase in many production areas (Table 10).

Response strategy

●Advanced technologies for water use reduction (adaptation measures)

We will appropriately reduce our use of water, taking into consideration the amount of water stress. The Kirin Group has operated businesses in Australia, where there is extremely high water stress, and Japan, where water is relatively abundant. As such, we have known from our experiences that water risk and water stress differs between countries and regions. Since as early as 2014, we have been conducting regular surveys of water risk and water stress, and we have continued these surveys as part of our scenario analysis since 2017. We conserve water in ways suited to the differing levels of water stress in each country and region, based on our understanding of the scientific evidence.
At Lion, in response to severe long-term droughts in Queensland, we collaborated with the state government to establish a reverse osmosis (RO) plant to collect and reuse water that has been used in brewing processes at Castlemaine Perkins Brewery in 2011. In 2019, we achieved world class level of water efficiency at 2.5 liters of water for every liter of beer produced.

More information→P.55

●Sharing of knowledge on responses to droughts (adaptation measures)

The scope to which we are able to utilize such insights differs depending on the details of the business, but we will enhance the resilience of each business while sharing insights on droughts.
Thai Kyowa Biotechnologies, which faced water intake restrictions due to drought in 2020, has been able to limit water intake and avoid negative impacts by holding enough inventories and switching temporarily to products that use less water. There are limits to the situations in which we can utilize this knowledge, but by sharing it within the Kirin Group, we are reinforcing our ability to respond.

●Responses to water stress in areas producing agricultural raw materials (adaptation measures)

We will accumulate knowledge as we continue initiatives such as water source conservation activities at tea farms in Sri Lanka. At tea farms in Sri Lanka, we began water source conservation activities on the farms in 2018, and as a result, by the end of 2022, we have conserved water sources in 15 locations. In 2020, we began similar support for the acquisition of certification at coffee farms in Vietnam. As part of training for the acquisition of certifications, we teach subjects such as mulching and planting shade trees to ensure that the ground does not dry out in the event of droughts, as well as methods to store water to prepare for droughts.

More information→P.54

●Prevention of soil runoff in areas producing agricultural raw materials (adaptation measures)

At tea farms in Sri Lanka, we teach methods of preventing soil runoff from heavy rainfall by planting undergrowth with deep roots, as part of training in activities to support the acquisition of certification for sustainable agriculture. Our teaching is based on simple methods with a scientific core, such as working with local universities to develop methods that enable farm laborers to distinguish the correct type of plants, because they must choose plants that do not harm the cultivation of tea trees.
At present, we have not taken any specific measures in relation to major agricultural products in Europe and Australia, where we anticipate significant water risk and water stress, but we hope to utilize the knowledge we have accumulated through our initiatives in Sri Lanka and elsewhere.

More information→P.44, P.54

A picture drawn by children in Sri Lanka who learned that we must treasure water

A micro watershed in a tea farm in Sri Lanka that was fenced off with Kirin's support

Landslide prevention implemented as part of training in support for the acquisition of certification (the slope with undergrowth on with deep roots)

10 Water stress in major agricultural product production areas (around 2050)

Agricultural products	America (North and South)	Asia	Europe/Africa	Oceania
Barley	Canada High~Extreamly high	Japan Medium to high	Ukraine High~Extreamly high United Kingdom Low in the North, high in the South Germany medium~High Czech Republic Medium to high in Moravia, low to medium in Bohemia Belgium High France High	Australia Extremely high in the East and Southeast Medium in the Southwest
Hops	United States Medium to high in Oregon, medium to high in Idaho (partially Extremely high)	Japan Medium to high in Tono, Yokote, Yamagata Low to medium in Odate	Germany Medium~High Czech Republic Medium to high in Moravia, low to medium in Bohemia	Australia Extreamly high New Zealand Low
Tea leaves		Sri Lanka Extremely high in the North, and medium to high in the South and central highlands India Low in Darjeeling and Assam, low to Medium in Nilgiri Indonesia Extremely high in Java, low in Sumatra Low in Sumatra	Kenya Low Malawi Low	
Wine grapes	Chile Extreamly high Argentine Extreamly high		Spain High in the North, extremely high in other areas	
Coffee beans	Brazil Low to medium in the Northeast, low in other regions		Tanzania Medium to high in the North, low in other areas	

11 Major natural disasters and their impact on crops in 2021 and 2022

United States	Record droughts in California resulted in a 19% reduction in crop acreage for agricultural products and a loss of approximately 8,750 agricultural jobs. Fertilizer prices doubled
Canada	Drought reduced wheat production by 45% in Alberta. Wildfires spread to the western part of the province in September 2022, and hurricanes caused extensive damage in the east
Germany	$40 billion in economic losses due to heavy rains, six times the average rainfall. Most of the vineyards in the Arl Gorge region were flooded. 22 years of record temperatures led the European Commission to declare "We are facing the worst drought in the last 500 years," said the European Commission
Brazil	Droughts, frost, and freezing caused corn production to fall 9% and many products did not meet the standard quality for sale, resulting in price increases. There was a bad harvest of sugar cane owing to droughts for two years in a row. This contributed to an increase in sugar price indices of 9.6% in just one month
Kenya	The government declared a national state of emergency as a result of droughts among the worst recorded in the past 40 years. The impact on agricultural products was devastating, and an estimated 2.8 million people faced starvation
Malaysia	Palm oil production fell 11% as a result of flooding from heavy rainfall and the prolonging of the COVID-19 pandemic. Palm oil prices remain at record high levels

Physical risks

Type of transitional risk		Transitional risk and strategy		
Policy	Risk	Carbon pricing and energy procurement costs [medium to long term] ●Tax savings in 2030 of approximately 0.6 billion yen under the 4℃ scenario, 3.8 billion yen under the 2℃ scenario, and at least 5.2 billion yen under the 1.5℃ scenario	Financial impact on the procurement of agricultural products from carbon pricing [medium to long term] ●Approximately 0.7 billion yen to 3.0 billion yen in 2050 under the 2℃ scenario, and approximately 1.6 billion yen to 5.7 billion yen under the 4℃ scenario	Impact on currently held assets [medium to long term] ●The possibility that we may be unable to recover investments owing to facility renewals earlier than expected as a result of legal regulations, etc., affecting through-flow boilers, etc.
	Strategy	●Profit and loss neutral reduction of GHG emissions in brewing and manufacturing ●GHG emission reductions through logistics optimization	●Mass plant propagation technologies and support for farms to acquire certification for sustainable agriculture	●Identification of trends in technology and renewal of our road map
Technology	Risk	Research and development capabilities [short to long term] ●Possibility that research contributing to decarbonization will not be put to practical use at the expected timing	Engineering capabilities [short to long term] ●Possibility that engineering capabilities required for decarbonization will not be transferred and cannot be utilized	Introduction of appropriate technology and facilities [short to long term] ●Possibility that we cannot install energy-saving facilities and switch to renewable energy at an appropriate time or price
	Strategy	●In-house packaging development technology (mitigation measures/reduction)	●Strengthen engineering functions	●Identification of trends in technology and renewal of our road map
Markets	Risk	Avoidance of fossil-derived raw materials [medium to long term] ●Possibility that people's impression of containers and packaging using raw materials derived from fossils may be negative	Concerns surrounding the destruction of forests [medium to long term] ●Possibility that awareness of forests as a sink of GHG will become stronger, and there will be a stronger negative impression of forestry and agriculture	Fluctuations in natural gas prices [medium to long term] ●Possibility that natural gas prices will not fall significantly
	Strategy	●Plastic resource recycling	●Promotion of sustainable forestry and agriculture	●Steady implementation of our roadmap to achieve our science-based 1.5℃ target
Reputation	Risk	Assessment of consumers [short to long term] ●Decline in the assessment of our brand owing to inferior initiatives and insufficient appropriate communication	Social responsibility toward renewable energy [short to long term] ●Criticism from the inconsiderate introduction of renewable energy power generation	Trust from long-term investors [short to long term] ●Possibility of loss of opportunities to secure stable investment owing to a lack of appropriate disclosure
	Strategy	●Engagement with young generation	●Formulation and operation of basic policies concerning the introduction of environmental value	●Appropriate disclosure in line with the TCFD recommendations

*1 Recalculated with 2022 data

Type of transitional risk **Policy**

Details of transitional risks

Carbon pricing and energy procurement costs [medium to long term]

Energy procurement and logistics costs may spike if governments introduce carbon taxes and carbon border adjustment mechanisms.

Table 12 shows the results of our estimation of the financial impact of carbon pricing on energy procurement. We estimated tax savings in 2030 of approximately 0.6 billion yen under the 4℃ scenario, 3.8 billion yen under the 2℃ scenario, and at least 5.2 billion yen under the 1.5℃ scenario, in the event that we achieve our science-based 1.5℃ target. Under the 1.5℃ scenario, the expected range of carbon pricing is extremely large, and there is a risk that it will be a large value. In order to reduce risk and lower our procurement costs, an effective way is to achieve or bring forward our GHG emissions reduction targets.

When assessing the impact of carbon pricing on energy procurement, we estimated the impact at Kirin Brewery, Kirin Beverage, Mercian, Lion, Kyowa Kirin, and Kyowa Hakko Bio in 2022. For power emissions factors and carbon taxes, we applied the 2℃ scenario and 4℃ scenario from the IEA scenarios, and set the IPCC "Special Report on Global Warming of 1.5℃" as the 1.5℃ scenario and the basis of forecast carbon prices for all three scenarios.

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Response strategy

●Profit and loss neutral reduction of GHG emissions in brewing and manufacturing

In order to minimize the financial impact of carbon pricing, we will achieve our targets of net zero emissions by 2050, our science-based 1.5℃ target by 2030, and renewable energy targets under RE100 by 2040, in accordance with our roadmap, under the basic principle of profit and loss neutrality. Specifically, the merit from saving energy will offset depreciation and amortization from the investment and the procurement costs increase of renewable energy.

Lion has already achieved carbon neutrality in both Australia and New Zealand.

For information on our approach to environmental investment to reduce GHG emissions, financing, investment amounts, and ICP, please refer to "Our Holistic Approach to Solving Environmental Issues" (→P.24 and P.35).

●GHG emissions reduction through logistics optimization

In order to reduce GHG emissions in logistics departments, we will develop the various initiatives such as modal shifts, joint deliveries with industry peers, and higher loading ratios.

GHG emissions from upstream transportation (category 4), including the transportation of products, account for approximately 12% of total Scope 3 emissions, and are a major target for the reduction of emissions. In recent years, reducing the impact of transportation has also been an important initiative from the perspective of reducing the risk that we will not be able to transport products owing to the shortage of truck drivers. More information→P.72

12 Assessment of impact of carbon pricing

	Scenario	Group Scenario 3(4℃ Scenario)		Group Scenario 1(2℃ Scenario)		1.5℃ Scenario	
	Year	2030	2050	2030	2050	2030	2050
If GHG emissions are not reduced	Carbon taxes(Billions of yen)	12	14	77	114	104~4,703	155~9,044
	Percentage of revenue	0.06%	0.07%	0.38%	0.57%	0.53%~23.46%	0.78%~45.46%
If we reduce GHG emissions in line with targets	Carbon taxes(Billions of yen)	6	0	38	0	52~2,352	0
	Percentage of revenue	0.03%	0.00%	0.19%	0.00%	0.26%~11.82%	0.00%
Carbon taxes	Tax savings(Billions of yen)	6	14	38	114	52~2,352	155~9,044
	Percentage of revenue	0.03%	0.07%	0.19%	0.57%	0.26%~11.82%	0.78%~45.46%

*1 Recalculated with 2022 data

13 Main Initiatives

Initiatives	Description and effects (2020~)
Introduction of large-scale solar power generation facilities with the PPA method	Already introduced at eight Kirin Brewery plants nationwide, excluding the Yokohama Brewery. When all facilities begin operating, we expect to reduce GHG emissions by approximately 5,800 tons per year, increasing the proportion of renewable energy in electric power used by Kirin Brewery as a whole from approximately 18% as of 2020 to approximately 34% More information→P.69
Achieved a proportion of 100% renewable energy in purchased electric power	Already implemented at the Kirin Brewery Nagoya Plant, Sendai Plant, all Mercian wineries (three locations), the Kyowa Kirin Fuji Plant, and Shanghai Kyowa Amino Acid More information→P.68
Joint deliveries	Reduced GHG emissions by approximately 330 tons per year through joint deliveries using railroad containers in the east Hokkaido area. More information→P.72
Joint collection of beer pallets	Reduced GHG emissions by a total of 5,158 tons of CO_2 per year (approximately 37% compared with previous levels) across four brewing companiesbeer companies

*2 Calculation procedures for joint delivery and joint collection of beer pallets are described in "Contribution to Reduction through Global Value Chain, 5th Edition" by Nippon Keidanren (Japan Business Federation)
http://www.keidanren.or.jp/policy/2018/102.html

Details of transitional risks

Financial impact on the procurement of agricultural products from carbon pricing [medium to long term]

The prices of agricultural products may spike if governments introduce carbon taxes and carbon border adjustment mechanisms.
The Graph on the right shows the results of our estimation of the financial impact of carbon pricing on agricultural product prices. In 2022, we estimated the impact for Kirin Brewery, Kirin Beverage, Mercian, Lion (excluding the non-alcoholic beverages business), Kyowa Kirin, and Kyowa Hakko Bio. Our estimates covered the following agricultural products: barley, hops, tea leaves, grape juice, starch, lactose, corn, and cassava.
In our estimates, we calculated that the impact would be approximately 0.7 billion yen to approximately 3.0 billion yen under the RCP2.6/SSP scenario and approximately 1.6 billion yen to 5.7 billion yen under the RCP8.5/SSP3 scenario in 2050. The range of the 25-75 percentile was twice as larger for the RCP8.5/SSP3 scenario than the RCP2.6/SSP1 scenario, from which we can conclude that uncertainty is higher and the risk is more significant.

Impact on currently held assets [medium to long term]

There is a possibility that various policies and regulations, as well as demands from society for decarbonization will mean it becomes difficult to use existing facilities that use fossil fuels, etc., and it may be difficult to continue using them for the period that we initially expected.
Under the Kirin Group roadmap, we plan transition in the future to hydrogen and other forms of GHG-free energy to replace natural gas that we use in heating processes such as boiling in brewing and manufacturing. We may be unable to recover our investments if it becomes necessary to renew through-flow boilers and other facilities earlier than expected. In the same way, we may be unable to recover investments related to trucks that we hold if we are required to transition the trucks we use for transportation to electric vehicles sooner than initially expected.

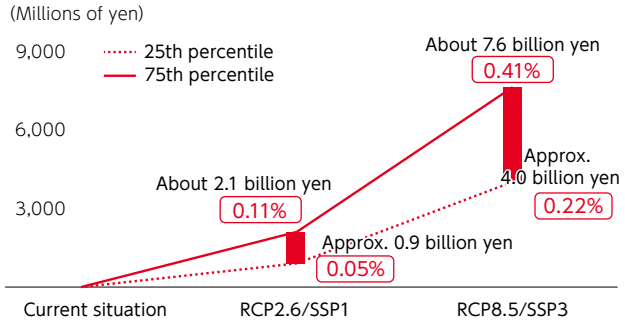
Response strategy

●Mass plant propagation technologies and support for farms to acquire certification for sustainable agriculture

We have judged that mass plant propagation technologies and support for farms to acquire certification for sustainable agriculture are effective as countermeasures.
Mass plant propagation technologies may be able to contribute to an increase in crop acreage in response to the issue of competition between alcoholic/non-alcoholic beverages and biofuels for raw materials as carbon pricing causes renewable energy to expand and the use of corn, soybeans, etc., as biofuels increases.
In response to the possibility of an impact on fertilizer prices from soaring prices of natural gas, which is a raw material in nitrogen fertilizer, we think that training for farmers on appropriate fertilizer management as part of support for the acquisition of sustainable farming certification will act as a countermeasure.

More information on mass plant propagation technologies→P.49
More information on support for the acquisition of certification→P.44~P.45、P.48

14 Impact on agricultural product procurement costs from carbon pricing in 2050 (percentage of revenue)



*1 The socioeconomic systems in the papers we used for our estimates differ from the Kirin Group scenarios, so we have created and disclosed our estimates under the RCP2.6/SSP1 and RCP8.5/SSP3 scenarios in these papers.
*2 Recalculated with 2022 data

●Identification of trends in technology and renewal of our road map

The use of hydrogen, etc., will require technological innovation and infrastructure development, and we expect that full-fledged transition will not take place until 2030 or later. Until then, we think the probability is low that regulation, etc., will require us to renew our existing boilers and other brewery and plant equipment, and trucks, before they are depreciated.

If we misjudge the introduction of new technology, our technology and facilities may become obsolete as a result of regulatory and social trends. Accordingly, we will address this issue by formulating roadmaps for long-term facility renewal and introduction, and constantly update the roadmaps.

More information→P.22

Type of transitional risk **Technology**

Details of transitional risks

Research and development capabilities [short to long term]

There is a possibility that research contributing to a decarbonized society will not be put to practical use at the expected timing.
Category 1, which represents GHG emissions from container packaging and raw materials production, accounts for about 51% of the Kirin Group's Scope 3, and reducing GHG emissions related to containers and packaging is a key theme for achieving Net Zero.

Engineering capabilities [short to long term]

There is a possibility that our engineering systems aimed at achieving decarbonization will not be sufficient, or that we will not be able to appropriately apply them because the technical expertise is not well succeeded.
Waste heat from brewing and manufacturing processes in the alcoholic and non-alcoholic beverages businesses is at a low temperature. As such, it is difficult to achieve the efficient cascading use of heat based solely on introducing the latest facilities, and engineering and technical expertise with a deep understanding of brewing and manufacturing processes is required.

Introduction of appropriate technology and facilities [short to long term]

Alongside rapid technological progress, in recent years, there have also been major delays to deliveries of facilities and equipment as a result of the tight supply and demand for semiconductors and other facility components, etc. As such, if we are unable to identify the timing of the introduction of technology and quickly make investment decisions, there is a possibility that we will not be able to reduce GHG emissions in line with plans. While momentum for the decarbonized society is rapidly increasing, there is a possibility that we will be unable to introduce renewable energy at an appropriate time and appropriate price in Japan, where the places for installing renewable energy facilities are particularly limited.

Response strategy

●In-house packaging development technology

We think we will be able to develop advanced containers and packaging with lower GHG emissions across the value chain, utilizing our strength – the fact that we have the Institute for Packaging Innovation, where we develop packaging and containers in-house, as one of the few research laboratories of its scale owned by a global alcoholic beverage company.
Based on the technologies it has developed over many years in areas such as glass bottles, cans, PET bottles, cardboard cartons, and other paper packaging, the Institute for Packaging Innovation utilizes AI technology, kansei (sensibility) engineering, and other technologies and takes advantage of its strength in possessing research facilities equivalent to a small plant to enable the technical support required to create products based on these technologies, as well as the development of new containers.
In terms of recycling PET bottles, we have created practical uses for R100 bottle technology, in which we recycle used PET bottles into new PET bottles, and we are focusing on the development of chemical recycling. We have estimated that external diseconomies related to PET bottles in the domestic alcoholic beverages and non-alcoholic beverages businesses amount to approximately 1.1 billion yen (results of estimation in 2019). We aim to use recycled resin for 50% of domestic PET bottles by 2027, and we will thereby contribute to reducing social costs by transitioning to a circular economy.

More information→P.12

●Strengthen engineering functions

We have established engineering teams in each group company and ensure that we are supporting brewing and manufacturing facilities, while training engineers and transferring technical expertise on an ongoing basis.
In the Kirin Group, engineers with a deep knowledge of brewing and manufacturing processes, production technologies, and safety technologies reliably support brewing and manufacturing facilities. Furthermore, the Kirin Group owns Kirin Engineering, a general engineering company engaged in the construction of plants producing beer, non-alcoholic beverages, pharmaceuticals, and other products. Having Kirin Engineering within the group, we have been conducting large-scale new expansion and remodeling of manufacturing facilities not only for domestic and overseas group companies but also for companies outside the group for many years. By performing engineering in various businesses in-house, we make it possible for engineers to transfer expertise and technical capabilities related to building facilities. These technical capabilities that we have developed and our engineers will support the growth and development of our business domains, ranging from food and beverages to pharmaceuticals.

More information→P.12

●Identification of trends in technology and renewal of our road map

The Kirin Group will intensively watch technological trends and social conditions in the engineering department of Kirin Brewery, reflect them in the roadmap based on these developments, determine where and what kind of equipment introduction will be effective for the Group, and respond flexibly based on close communication with each Group company.
When introducing renewable energy, we will also prioritize "additionality," which indicates the actual increase in renewable energy.

More information→P.68~P.69

Markets

Details of transitional risks

Avoidance of fossil-derived raw materials [medium to long term]

There is a possibility that people may have a more negative impression than before of containers and packaging using raw materials derived from fossils as interest in problems related to plastic spreads to issues related to all aspects of climate change, not just ocean pollution.
Problems related to plastics have attracted significant attention around the world, including the enactment of the "Act on Promotion of Resource Circulation for Plastics" on April 1, 2022, in Japan.
Plastics are a raw material derived from oil, and we expect that as interest in problems related to climate change increases, people will focus on global warming caused by GHG emissions when they are burned, as well as problems related to the depletion of resources from raw materials derived from oil.

Concerns about deforestation [medium to long term]

As awareness of the importance of forests as GHG sinks grows, concerns about business activities that lead to deforestation are more prevalent than ever before and may have a negative impact on forestry and agriculture. the worst forest fires in Australian history, which occurred between 2019 and 2020, and the annual wildfires in California and other cases have brought more attention than ever before to the relationship between climate change impacts and forests.
The United Nations Food System Summit was held in 2021, the EU's "FarmtoFork" strategy and Japan's "Green Food System Strategy" have been formulated and announced, and there is a stronger focus on sustainable agricultural production than ever before. The spread of COVID-19 and geopolitical issues have also increased people's interest in food security. It is assumed that interest in sustainable agriculture will lead to interest in forest issues.

Response strategy

●Plastic resource recycling

In accordance with the "Kirin Group Plastic Policy," which we formulated in 2019 in order to resolve problems related to plastics, we will promote PET bottles that use recycled PET resin.
In the "Kirin Group Plastic Policy," we have set forth our target of increasing the percentage of recycled resin to 50% of PET bottles in our operations in Japan by 2027. We have previously promoted the utilization of recycled PET resin through mechanical recycling.
As of June 2023, R100 PET bottles made of 100% recycled PET resin are used in the 600ml and 525ml bottles (available only at convenience stores) of *Kirin Namacha* and *Namacha Houjisencha*, as well as in *Kirin Namacha Immunocare* and *Kirin Namacha Caffeine Zero* bottles.
We will promote technical development related to practical uses for chemical recycling to create highly pure recycled PET resin, even from dirty used PET bottles and other PET products. In addition, we will create systems to recover used PET bottles and other PET products.

More information→P.60

●Promotion of sustainable forestry and agriculture

We are continuing initiatives to expand sustainable forestry and agriculture, and will increase the proportion of certified paper and raw materials from certified farms that we use.
As one initiative targeting sustainable forestry, we are expanding the use of FSC-certified paper in paper containers.
In 2020, we adopted FSC-certified paper for 100% of paper containers at Kirin Brewery, Kirin Beverage, and Mercian. In 2021, we revised our Action Plan for the Sustainable Use of Biological Resources, and we intend to expand our use of sustainable paper to other group companies in Japan, as well as our overseas businesses.
As one initiative targeting sustainable agriculture, we support the acquisition of Rainforest Alliance certification, which is a certification for more sustainable farming, at tea farms in Sri Lanka and coffee farms in Vietnam. In August 2021, we began selling a year-round product in *the Kirin Gogo-no-Kocha* line that uses tea leaves from farms with Rainforest Alliance certification.

More information→P.44~P.45、P.48、P.50、P.55、P.61

Details of transitional risks

Fluctuations in natural gas prices [medium to long term]

As initiatives targeting decarbonization accelerate around the world, it is possible that the balance of supply and demand for natural gas may become tight and prices may spike in the short term, owing to such factors as the transition toward sources of energy with low GHG emissions and divestment from coal.
For our future scenarios concerning natural gas prices, we have referred to "Net Zero by2050: A Roadmap for the Global Energy Sector" and "World Energy Outlook 2021 (WEO 2021)" by the IEA, and have conducted our survey based on three scenarios (Table 15): NZE (Net Zero Emissions by 2050 Scenario: an ambitious scenario in which the 1.5℃ target is achieved), APS (Announced Pledges Scenario: a scenario in which all commitments already announced by the governments of each country are executed), and STEPS (Stated Policies Scenario: a scenario that only reflects implemented policies in each country).
In each scenario, we forecast that demand for natural gas will increase through 2025, and we subsequently only expect it to fall significantly in the NZE scenario.
In our analysis, we expect natural gas prices to fall approximately 4% from current levels in the APS scenario, and rise approximately 8% in the STEPS scenario by 2050. In the NZE scenario, we expect prices will fall by around half by 2030, but these price forecasts do not reflect necessary investment and expenses related to Carbon dioxide Capture, Utilization and Storage (CCUS), so there is a possibility that prices may not decline significantly when these costs are taken into consideration.

Response strategy

●Steady implementation of our roadmap to achieve our science-based 1.5℃ target

We believe that we must surely execute our roadmap, which we formulated in order to achieve our science-based 1.5℃ target as we look to reduce our use of natural gas.
In the Kirin Group roadmap, we plan to shift our energy mix to electric power as much as possible, and use renewable energy as the source of that electric power.
We will steadily transition away from natural gas in our energy mix to electric power, and although we will continue to use natural gas for the time being for some heating processes where it is difficult to transition to electric power, we plan to ultimately replace it with hydrogen. We do not just expect technological innovation and infrastructure development, but instead we intend to take on the challenge of using hydrogen in advance if it is possible.

More information→P.34~P.35

15 Forecast fluctuations in natural gas prices

	Current price	Future price	
Scenario	2020 USD/GJ	2030 USD/GJ	2050 USD/GJ
Net Zero Emissions by 2050	8.3	4.6	4.4
Sustainable Development	8.3	5.7	5.6
Announced Pledges	8.3	8.0	7.2
Stated Policies	8.3	9.0	9.4

World Energy Outlook 2021 (WEO 2021)

Type of transitional risk **Reputation**

Details of transitional risks

Assessment of consumers [short to long term]

There is a possibility that consumers' assessment of our brand may decline if our initiatives related to climate change and other aspects of sustainability are inferior, and if we cannot engage in appropriate communication.
Since 2020, the SDGs have been gradually incorporated into Japanese study guidelines. In recent surveys, we have found that consumer awareness of environmental issues has risen, including a significant increase in awareness of various certification systems related to eco-friendly products.

Social responsibility toward renewable energy [short to long term]

In order to achieve our target of net zero emissions, we must introduce renewable energy, but the inconsiderate construction of power plants may harm scenery and nature and cause disasters, possibly resulting in criticism from society. Although the FIT system has contributed to the expansion of solar power facilities in Japan, it has become a significant burden on citizens, with total expenses associated with FIT purchases in Japan of 3.1 trillion yen in 2019, and estimates stating that this figure will hit 4.9 trillion yen by 2030. Even if we are able to achieve our net zero emissions target, it will not contribute to our true aim of preventing global warming if the amount of renewable energy on earth does not actually increase.

Trust from long-term investors [short to long term]

We may lose opportunities for securing stable investment if we lack appropriate disclosure on climate change, natural capital, the circular economy, and other environmental issues. The Kirin Group has declared our aim to be "a global leader in CSV, creating value across our world of Food & Beverages to Pharmaceuticals," and we aim to expand our business in the Health Science domain. We believe that the support of long-term investors is necessary for long-term initiatives and investment.

Response strategy

●Engagement with young generations

As we promote our initiatives, we will prioritize engagement with the young people who will take responsibility for the next generation. Since 2014, we have held Kirin School Challenge workshops for junior and senior high school students, based on the themes of our support for the acquisition of Rainforest Alliance certification at tea farms in Sri Lanka and the use of FSC-certified paper in paper containers. In these workshops, we do not just introduce certification systems, but we prioritize mutual communication with junior and senior high school students, as well as spontaneous discussion, thinking, and sharing information among junior and senior high school students about what they should communicate to members of their own generation, and how they should do it.
We are also teaming up with multiple companies on the free distribution of the SDGs Start Book (300,000 copies per year), which teaches elementary school students and junior high school students about the SDGs in a way that is easy to understand.
For young children in elementary school, we are collaborating with organizations such as after-school care clubs, Girl Scouts, and Boy Scouts on the "Environmental Mark Discovery Notebook" initiative, which starts from children learning to recognize environmental marks and finding out their meanings.

●Formulation and operation of basic policies concerning the introduction of environmental value

In July 2021, the Kirin Group established our policy on the introduction of environmental value, with the basic policies of the "responsible introduction of renewable energy" and "additionality" when introducing renewable energy.
With regard to the "responsible introduction of renewable energy," we select that which "causes no harm to the environment and does not violate human rights when power plants are constructed and fuel is procured," and we also set forth examples of expected risks in relation to each source of power, including solar power, wind power, and biogas, and we check these risks in advance.
With regard to "additionality," our policy is to "replace thermal power by creating new renewable energy power generation facilities in society, and thereby contribute to the creation of a decarbonized society." Renewable energy that has "additionality" and does not rely on the FIT system will contribute to reducing the burden on citizens.

More information→P33、P.68、P.69

●Appropriate disclosure in line with the TCFD recommendations

We will win the trust of long-term investors and secure stable investment by appropriately disclosing information related to climate change.
The Kirin Group has disclosed detailed information related to climate change and other environmental factors in our Integrated Report and Environmental Report. We have also continued to disclose information in line with the final recommendations of the TCFD since our 2018 Environmental Report. Going forward, we intend to comply with the requirements of the TNFD and ISSB.
The "Kirin Group Environmental Report 2020" won the Climate Change Reporting Grand Prize (Minister of the Environment Award) in the 24th Environmental Communication Award.
We have won a "Gold Award" for two years in a row in the environmentally sustainable company category of the "ESG Finance Awards Japan," and for the second consecutive year, we received the highest number of votes from investment management institutions (10 institutions in 2023 and 8 institutions in 2022) in the selection of "superior TCFD disclosure" requested of investment management institutions to which the GPIF outsources domestic equity management.

Business opportunities

Type of transitional risk	Business opportunity	Strategy
Markets	Increasing interest in infectious diseases caused by global warming [short to long term] ●Concerns related to increases in the number of infections and regions affected ●Northward movement of the habitat of the Aedes albopictus Increase in heatstroke caused by global warming [short to long term] ●The National Institute for Environmental Studies expects the number of excess deaths related to heat to increase between 4 and 10 times under the 4℃ scenario	Contribution in Health Science domain ●Long-term research related to immunity ●Wide range of products in the Health Science domain Contribution with products to address heatstroke ●Provision of non-alcoholic beverages that prevent heatstroke
Products and services	Products that contribute to decarbonization [medium to long term] ●Possibility that products will be required that contribute to decarbonization or the shift to a low-carbon society	Decarbonization products ●Provision of zero-carbon certified products
Resource efficiency	Social issues related to logistics [short to long term] ●Shortage of drivers and increase in GHG emissions from truck transportation Social demands for the shift to lightweight containers and the 3Rs [short to long term] ●Demands for the 3Rs and reduction in costs from the move to lightweight containers	Reduction in costs from more efficient transportation ●Modal shift, joint deliveries, and higher loading efficiency Shift to lightweight containers ●Promoting the shift to lightweight materials utilizing the strengths of the Institute for Packaging Innovation
Energy sources	Reduction in reliance on fossil fuels [short to long term] ●Demand gap and spike in prices of fossil fuels Securing of energy that can be controlled [short to long term] ●Increase in demand and tight supply and demand for renewable energy	Achievement of our energy mix ●Promotion to electric power in heating processes and introduction of renewable energy for electric power Use of renewable energy with a focus on additionality ●Introduction of solar power generation at our own breweries and plants utilizing PPAs
Resilience	Strengthening the supply chain [short to long term] ●Ensuring the stability of the procurement of agricultural raw materials ●Reduction of Scope 3 emissions	Enhancement of engagement ●Engagement and appropriate responses based on visits to areas producing raw materials ●Conducting surveys of suppliers and engagement

Details of business opportunities

Increasing interest in infectious diseases caused by global warming [short to long term]

WHO forecasts

A report from the WHO forecasts that approximately 250,000 additional people will die each year compared with a world where there is no climate change between 2030 and 2050, as a result of factors such as the spread of infectious diseases from expansions in the distribution of disease vectors. In Japan, the habitat of the Aedes albopictus, which carries dengue fever, was confirmed to have spread as far north as Aomori in 2015, and if global warming continues, it appears to be a matter of time before the northernmost limit of its habitat expands to Hokkaido.

Graph 16 shows the results of analysis that we conducted in relation to the impact of the spread of the dengue virus, based on the WHO scenario concerning climate change and the impact on people's health. The number of cases of dengue fever increased by more than 10 times in just under 20 years, from approximately 500,000 in 2000 to over 2.4 million in 2010, and approximately 5.2 million in 2019. We forecast that the total global population at risk of exposure to infection with the dengue virus will increase to a maximum of 4.4 billion by 2030.

Growth in immunity-related product market

In consumer surveys that we conducted, people's health awareness was most heightened in relation to their "interest in immunity." In response to this issue, we think we can contribute through Foods with Function Claims (FFCs) that "help maintain the immune system in consumer people." Sales in the global market for immunity and health supplements amounted to 19,040.3 million US$ in 2020, and we forecast that the market will grow by 50% or more, to 28,961.4 million US$ by the end of 2030 (Graph 17).

Increase in heatstroke caused by global warming [short to long term]

Heatstroke cases are expected to increase as a result of global warming. Based on observational and forecast data on climate change from the National Institute for Environmental Studies, under the RCP8.5 scenario (equivalent to the 4℃ scenario in Kirin Group Scenario 3), the number of heat-related excess deaths in Japan between 2080 and 2100 will be between almost four times and over 10 times the number between 1981 and 2000. In Kirin Group Scenario 3 (the 4℃ scenario), we have estimated that the Japanese market for beverages that prevent heatstroke will grow by between 94 billion yen and 188 billion yen, assuming that it correlates with the number of persons requiring emergency services as a result of heatstroke caused by global warming.

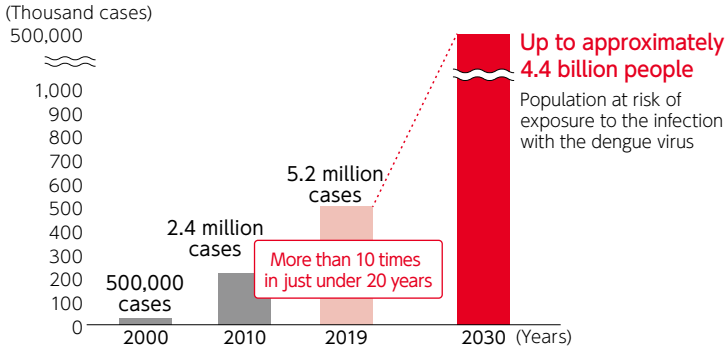
Response strategy

●Contribution to Health Science domain

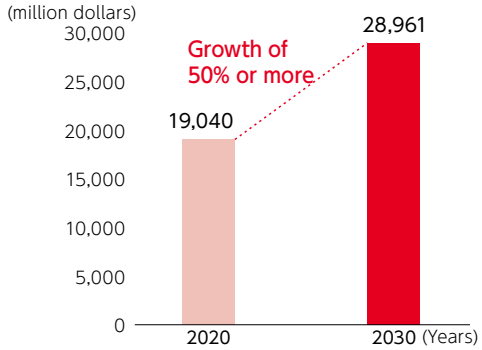
In 2021, we expanded our lineup of FFC products that "help maintain the immune system in healthy people, as we began selling such products under the Nama-cha and Gogo-no-Kocha brands, which have a high level of brand awareness among consumers, in addition to yoghurt and supplement products. In our BtoB business, annual sales in 2021 were at least four times larger than the previous year while markets struggled in the COVID-19 pandemic, thanks to our licensing and provision of materials to external partner companies in Japan and overseas, as well as the launch of sales of a wide range of products, including snacks, protein, etc.

In order to offer products to more consumers, we began selling immune-related beverages in 100ml PET bottles at general merchandise stores, drugstores, and convenience stores nationwide from the end of March 2022. In anticipation of the future expansion of the market for immunity-related products, we will invest approximately 10 billion yen in enhancing manufacturing facilities* for small PET bottles at the Kirin Beverage Shonan Plant, thus developing a supply system for immune-related beverages in small PET bottles, including 100ml PET bottles.

16 Number of dengue fever cases reported to the WHO



17 Sales in the global market for immunity and health supplements



Estimated based on the WHO's "Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s" report.

●Contribution with products to counter heatstroke

We think we will be able to contribute by selling products with high brand recognition as beverages that prevent heatstroke.

At present, the market for beverages that prevent heatstroke is not expanding significantly, but the SALTY LITCHI brand is becoming more popular as a beverage that prevents heatstroke, and we have judged that it may contribute when necessary. At Kirin Beverage, "heatstroke countermeasure advisors," who have received certification for completing training courses held by the Heat Illness Prevention - Communication Project, hold seminars on heat stroke countermeasures, etc., at schools and other institutions.

Type of business opportunity

Products and services

Details of business opportunities

Products that contribute to decarbonization [medium to long term]

As the momentum of decarbonization grows, there is a possibility that products will be required that contribute to decarbonization or the shift to a low-carbon society.
In Australia and New Zealand, there is a high level of interest in climate change, and carbon-neutral products have become popular with consumers to some extent. Although we cannot say that interest in carbon-neutral products is high in Japan at present, awareness of the SDGs has grown significantly, including progress on their incorporation into study guidelines. As such, we have judged that there is a strong possibility that interest in ethical products will increase in the future.

Response strategy

●Decarbonization products

Lion's *Steinlager* in New Zealand is a carbon zero product certified by the Toitu program. In 2021, we focused on the Toitu carbon zero mark in a marketing campaign, and used *Steinlager's* efforts toward reducing carbon to appeal to consumers.
In Japan, we have judged that consumers do not yet require decarbonized alcoholic or non-alcoholic beverages, but we have established standards for calculating the carbon footprint for each category of product (Product Category Rule: PCR) for beer and soft drinks, and we think it will be possible to address this need.

More information→P.73

Type of business opportunity

Resource efficiency

Details of business opportunities

Social issues related to logistics [short to long term]

By increasing transportation efficiency to reduce GHG emissions, we can also expect to solve chronic driver shortages.
Transportation distances from breweries and plants to areas of consumption are tending to become longer owing to factors such as a decline in the number of breweries and plants and the concentration of breweries and manufacturing plants for small-lot product varieties. Amid these conditions, a trend has become apparent among truck drivers to avoid long-distance journeys in recent years, and it has become difficult to secure drivers for such journeys. We must solve these logistics issues because it is inefficient to transport products for long distances using trucks, and it increases GHG emissions.

Response strategy

●Reduction in costs from more efficient transportation

We are implementing various initiatives to make deliveries more efficient and contribute to reducing logistics costs, such as a modal shift, joint deliveries, and more efficient loading.
We actively promote joint deliveries with other companies by positioning the logistics functions as non-competitive fields. For example, in our joint delivery initiative using railroad containers to transport products from breweries and plants in the Kansai area to the Hokuriku region, we have avoided long-distance truck transportation by completing a modal shift away from long-distance truck transportation equivalent to 10,000 vehicles a year, and we have estimated that this will contribute to reducing annual GHG emissions by approximately 2,700 tons.

More information→P.71~P.72

Social demands for the shift to lightweight containers and the 3Rs [short to long term]

Society continues to demand that companies address the issue of the 3Rs for containers and packaging. At the same time, this will contribute to reducing GHG emissions, make resource use more efficient, and reduce costs.
We can describe beer and soft drinks as products that represent mass production and mass consumption, and they thus use a fairly large amount of containers and packaging, which accounts for a large proportion of costs.
The domestic beverage business uses 125,000 tons of paper containers and 66,000 tons of PET bottles.

●Shift to lightweight containers

We are promoting the shift to lightweight containers and packaging, utilizing our strength – the fact that we have the Institute for Packaging Innovation, where we develop packaging and containers in-house, etc., as one of the few research laboratories of its scale owned by a global alcoholic beverage company. Our "204-diameter can ends" for aluminum beer cans have reduced weight by approximately 29% for 350ml cans compared with when we used "209-diameter can ends."
We also use beer bottles that reduce weight by 21% for large bottles and 19% for medium-size bottles compared with conventional bottles.
"R100 PET bottles," which use 100% recycled PET resin, make it possible to reduce the use of resin derived from oil by 90% in manufacturing, and reduce GHG emissions from manufacturing by 50-60%.
The introduction of smart-cut cartons has contributed to cost savings of 0.17 billion yen per year, while lighter 2.0-liter PET bottles have contributed to cost savings of 0.16 billion yen per year.

More information→P.60~P.62

Type of business opportunity

Energy sources

Details of business opportunities

Reduction in reliance on fossil fuels [short to long term]

It will be possible to use stable energy by reducing our use of fossil fuels and transitioning to renewable energy.
With demand expected to fall in the future, a demand gap has occurred as producing countries have avoided investment in fossil fuels, resulting in a spike in prices of fossil fuels. Producing countries are concentrated in places with high geopolitical risk, so reducing our reliance on fossil fuels will contribute to reducing risk.

Securing of energy that can be controlled [short to long term]

There are various methods for introducing environmental value, each of which have their own merits and demerits, including in-house power generation, purchasing from electricity retailers, purchase of certificates that power is derived from renewable energy, and corporate PPAs. We will acquire environmental value that satisfies the criteria set forth in RE100 by introducing renewable energy, but in Japan, we expect the balance of supply and demand to grow tight in the future as demand for renewable energy increases.

Response strategy

●Achievement of our energy mix

We will shift our energy mix to "electric power" and utilize electric power generated from renewable energy.
In the Kirin Group roadmap, we plan to make progress on energy conservation by 2030, while also shifting our energy mix toward "electric power" by promoting the shift to electric power for heating processes as much as possible, and utilizing electric power generated from renewable energy.
It will be possible to lower our reliance on fossil fuels directly by reducing our use of natural gas, and also reduce our reliance on the fossil fuels of thermal power plants by increasing the proportion of renewable energy in the electric power that we use.

More information→P.33、P.70

●Use of renewable energy with a focus on additionality

When introducing renewable energy, we prioritize "additionality," which indicates the actual increase in the supply of renewable energy. We will replace thermal power plants and contribute to creating a decarbonized society by increasing renewable energy power plant facilities in society.
Specifically, we have been introducing solar power generation at breweries using the PPA model (excluding the Yokohama Brewery), and we have completed installation at all breweries. PPA stands for Power Purchase Agreement, and it refers to a type of business model where a PPA business operator installs solar power generation facilities at no charge on land, buildings, etc., owned by the party that requires the power, and sells the power-generated by those facilities to the party that requires the power.
Installing solar panels in our own breweries and plants ensures that the renewable energy power plants can reliably add renewable energy, without any negative impact on the local community, while at the same time increasing resilience because it is possible to use it in a stable manner.

More information→P.33、P.69

Type of business opportunity

Resilience

Details of business opportunities

Strengthening the supply chain [short to long term]

We expect that our initiatives targeting the procurement of agricultural raw materials and the reduction of Scope 3 emissions will contribute to strengthening the supply chain.
It is possible that by enhancing our engagement with suppliers and producing areas, identifying various issues, and working to solve them together with the producing areas, it will contribute to improving the resilience of suppliers, producing areas, and the Kirin Group.

Response strategy

●Enhancement of engagement

In addition to producing regions, we will enhance our engagement with suppliers.
Every year, we visit tea farms in Sri Lanka, where we engage with local managers. As part of these initiatives, we have gained an understanding of the severity of heavy rainfall associated with climate change that is affecting tea farms in Sri Lanka, which is contributing to strengthening our training to prevent soil outflow and our water source conservation activities. We are conducting more detailed surveys related to the reduction of Scope 3 emissions, in addition to making requests and performing checks based on the Sustainable Supplier Code. We intend to base our engagement with stakeholders on the results of these surveys, and take steps to jointly solve issues as we target decarbonization.

Systemic risk

Details of systemic risk

The collapse of ecosystems owing to inconsiderate transition plans

The use of edible crops for biofuels as a source of renewable energy may compete with their use for food. The inconsiderate construction of renewable energy power plants may cause the deforestation of precious forests, resulting in landslides and flash floods when there are typhoons and heavy rainfall.

Ecological loss from accumulation

In joint research with National Agriculture and Food Research Organization (NARO) in Japan Wine vineyards, we found examples of a complete loss of ecosystems in vineyards with pergolas where weedkillers have been used continuously for many years. We have found that when we convert such places into hedgerow-style vineyards, ecosystems do not easily recover, even if there are abundant ecosystems in adjacent fields.

The spread of destruction of natural capital

The sudden import ban on chemical fertilizers and agricultural chemicals in Sri Lanka in the first half of 2021 (which was later withdrawn) led to a decline in harvests of many agricultural products, and significantly damaged the economy, which was already vulnerable. The effects have yet to surface, but land use change from tea farms to planted forests for producing timber, rubber farms, etc., and indirect land use change owing to a decline in harvests per unit land area may lead to deforestation. Without sufficient preparation, the transition to organic farming will weaken agriculture itself and result in destruction to nature in the area surrounding agricultural land.

Strategy

●Responsible approach

In transition plans related to climate change, the Kirin Group considers ways to avoid any negative impact related to other environmental issues, such as “biological resources” and “water resources.”
When introducing renewable energy, our basic policy is to “responsibly introduce renewable energy.” When procuring renewable energy, we select that which “causes no harm to the environment and does not violate human rights when power plants are constructed and fuel is procured.” We set forth examples of expected risks in relation to each source of power, including solar power, wind power, and biogas, and we evaluate these risks in advance. At present, for the most part, there are no standards related to competition between renewable energy and foodstuffs, and the EU alone imposes certain restrictions when there is an impact on biomass used for food or indirect land use change (when precious forests are converted into farmland owing to the displacement of the production of crops from land where they were originally cultivated for the production of biofuel crops). Taking into consideration the lack of clear standards for making an assessment, we have lowered the priority of the use of renewable energy from biomass.

●Scientific approach

In ecological surveys with NARO, we found that converting idle farming land into hedgerow-style vineyards for Japan Wine enriches ecosystems. At the Mariko Vineyard (Ueda City, Nagano Prefecture) and Jyonohira Vineyard (Koshu City, Yamanashi Prefecture), we have found endangered species listed in the Red Data Book of the Ministry of the Environment, Japan. Although these vineyards do not use organic farming, we confirmed that there is no negative impact on nature around the vineyards. Going forward, we will continue scientific research and surveys, while cultivating grapes in ways that contribute to nature, including activities to regenerate vegetation. When supporting the acquisition of Rainforest Alliance certification by tea farms in Sri Lanka, we request that tea farms comply with a white list of agricultural chemicals that have been scientifically confirmed as safe for humans and having no negative impact on the natural environment. We also request that tea farms use no more than a certain amount of agricultural chemicals determined in standards, and take records. We provide training concerning the appropriate use of fertilizer. We will provide continuous support toward the acquisition of certification and enhance our engagement with local communities, as part of efforts to enhance the sustainability of producing regions as a whole.

More information→P.46~P.47

●Holistic approach

In Sri Lanka, the quality of organic fertilizers introduced in place of chemical fertilizers was often poor, making them unusable. It could be said that efforts to transition to organic agricultural methods without preparation did not just harm agricultural production and ecosystems, which were interrelated and worked together to ensure stability, but also harmed the economy.
We believe that the study of climate change and natural capital, as well as a holistic approach are necessary to address the risk that one type of damage will spread to other types of damage and result in significant damage to ecosystems in this way. When promoting our initiatives, the Kirin Group has kept in mind the fact that environmental issues are strongly interrelated. We think we have developed a deeper understanding through our scenario analysis based on the TCFD recommendations. It is not easy, however, to understand the relationship between various environmental issues, and in reality, the initiatives we can take are limited. Therefore, at the Kirin Group, we prioritize initiatives based on engagement with various stakeholders, such as consortiums with NGOs and other companies, collaboration with local communities, and participation in global initiatives. By participating in the TNFD and SBTN and contributing to rulemaking, we will further develop our holistic approach.

More information→P.27

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P.79 Impact of climate change on yields of the main agricultural products

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- Climate change adaptation in the Kenyan tea sector Ethical Tea Partnership)
- Diversity buffers winegrowing regions from climate change losses. 2864-2869, PNAS, February 11, 2020. (Morales-Castilla, et.al.)

P.79 Impact of lower yields on procurement costs for agricultural products in 2050 and P88 Estimation of the impact on agricultural product procurement costs from carbon pricing in 2050

- Barley: We calculated the impact by multiplying standard prices of beer per country, as indicated by the results of research using economic models from Xie, et al., by the future rates of change in beer prices (we assumed that beer prices would generally be linked to barley procurement costs)
  Decreases in global beer supply due to extreme drought and heat, Nature Plants, VOL.4, NOVEMBER 2018, 964–973 (Xie, etal.)
- Other than barley: We calculated the impact using rates of change in costs associated with agricultural products from climate change (impact on yields) and mitigation measures (carbon pricing), as indicated in the results of research from Hasegawa et al., and presented in the IPCC "Special Report on Climate Change and Land (SRCCL)"
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- Climate impacts on crop yields in Central Argentina. Adaptation strategies (Rolla et al. 2018)
- Mitigating future climate change effects on wheat and soybean yields in central region of Madhya Pradesh by shifting sowing dates (Balvanshiand Tiwari 2019)
- Changing yields in the Central United States under climate and technological change (Burchfield et al. 2020)

P.88 Assessment of impact of carbon pricing

Estimation of impact of carbon pricing

1) We calculated the rate of decline in future electric power emission factors from the IEA "World Energy Outlook 2019" Annex A (Current Policies Scenario and SD Scenario).
2) We calculated actual electric power emission factors from the actual energy usage and GHG emissions of the Kirin Group in the base year (2019), and estimated future electric power emission factors under the two scenarios (Current Policies Scenario and SD Scenario) by multiplying actual emission factors by the rate of decline in emission factors calculated in Step 1.
3) We used the electric power emission factors that we calculated to forecast GHG emissions in the Kirin Group in 2030 and 2050. We categorized these forecasts depending on whether or not we take measures to reduce emissions.
4) We applied the IEA WEO 2019 Current Policies Scenario to the Kirin Group scenario 3, and the SD Scenario for the Kirin Group scenario 1, while also setting the IPCC "Special Report on Global Warming of 1.5℃" as our new 1.5℃ scenario, and we set the carbon prices indicated in each data source as the basis for the future carbon prices for each scenario (IEA WEO 2019 P758 and IPCC Special Report on Global Warming of 1.5℃ 2.5.2.1 Price of carbon emissions).
5) We calculated the impact by multiplying the forecasts of future GHG emissions that we calculated in Step 3 by the carbon prices that we set in Step 4. We calculated the increase in costs if we did not implement initiatives to reduce GHG emissions from the difference in impact depending on whether or not we take measures to reduce emissions.

P.89 External diseconomies related to Kirin Group PET bottles

We estimated that impairment losses related to marine ecosystem services would be approximately 0.36 to 3.56 million yen (approximately 3,300 US$ to 33,000 US$) per ton of plastic in 2011, based on the estimations of Beaumont et al. We estimated that the median proportion of PET bottles that flowed into the ocean from Japan would be 0.5%, based on the "Annual Report on the Recycling of PET Bottles" by the Ministry of the Environment. We set the total amount of PET materials used by Kirin Group major domestic companies at 66,894 tons in 2018, and multiplied this amount by the above estimates.

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P.94 Increase in heatstroke caused by global warming [short to long term]

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