Practical guide for Scenario Analysis in line with the TCFD recommendations 2nd edition

Ministry of the Environment, Government of Japan
Climate Change Policy Division
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[Structure and Use of this Practical Guide]
Composed of “The TCFD recommendations,” “Key points for scenario analysis,” “Practical examples,” and “Appendix”

Corporate Needs	Chapters and the Practical Guide and Their Summaries
Companies want to know what the TCFD recommendations are and what scenario analysis is in terms of the TCFD recommendations in the first place.	**CHARTER 1. Introduction** This chapter explains the purpose of this practice guide, outlines the TCFD recommendations in the background, and positions of scenario analysis.
Companies want to know the specific promotion means and practical points for scenario analysis.	**CHAPTER 2. Scenario Analysis - Key Points of Practice** This chapter explains how to practically undertake scenario analysis and describes key points of its practice, based on use cases performed by companies under the support program of the Ministry of Environment.
Companies want to know the actual scenario analysis conducted by Japanese companies for each step in the analysis.	**CHAPTER 3. Scenario Analysis - Practice Examples** This chapter explains how scenario analysis is carried out based on the support cases of the Ministry of the Environment (18 companies).
Companies want to know the reference tools and literature for scenario analysis.	**Appendix.** Provide useful materials for scenario analysis based on supporting case studies

- TCFD's approach for scenario analysis in this Practical Guide has been developed based on a technical supplement to scenario analysis ("TCFD Technical Supplement: The Use of Scenario Analysis in Disclosure of Climate-related Risks and Opportunities" (2017.6)) as well as its own methodology and interpretations.
- Figures for each case are based on information at the time of acquisition.
- Examples of projects supported by the Ministry of the Environment are examples of projects supported by the "Project to Analyze Scenarios of Climate Risks and Opportunities in Accordance with TCFD" implemented in FY2018 and FY2019.

1. Introduction

1-1. Purpose of this Practical Guide

1-2. Positioning of scenario analysis on the TCFD recommendations

Chapter 1. Introduction

This chapter explains the purpose of Practical Guide, concept of TCFD, and positioning of scenario analysis

[Challenges for companies in implementing scenario analysis] Respond to the challenges of scenario analysis with “Practical Points” and “Practical Examples by Sector”

■ There are roughly 4 difficulties that companies face in implementing scenario analysis

① Scenario analysis is roughly understood, but **no specific implementation process is known.**

② **The processes and departments** involved in scenario analysis differ for each company and product, and the level of implementation of scenario analysis cannot be determined uniformly.

③ **Efforts are required to ensure that internal management understands** the purpose and the results of scenario analysis.

④ **Utilizable external data for scenario analysis is lacking.**

■ The above issues can be resolved in this Practical Guide.

- ✓ ①②: Understanding of “**Practical Points**” and “**Practical Examples by Sector**” in this Practical Guide.
- ✓ ③: First, scenario analysis is conducted using parameters within a known range. Start dialogue with the management team based on the result.
- ✓ ④: Describe the external data and parameter in Appendix.

■ The key is to begin scenario analysis with what you understand, and progress and deepen your knowledge and experience.

- ✓ Example: First, conduct qualitative scenario analysis. Then, try quantitative scenario analysis.
- ✓ Example: First, apply scenario analysis to a certain segment. Then, apply to a greater part of your company.

■ The goal of scenario analysis is to “respond to climate-related issues” and to “increase corporate value” at the same time.

- ✓ It is important not only to conduct scenario analysis, but also to continue the “cycle” which is to disclose information and hold dialogues with management.
- ✓ Seize opportunities by continuing the cycle and incorporate it into business plans.

1. Introduction

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Chapter 1. Introduction

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【Background of the TCFD】
Climate change risks could destabilize the financial system and become a possible threat to financial institutions

- **"The financial risks that could result from the process of adjustment towards a lower carbon economy could prompt a reassessment of the value of a large range of assets with a large volume of greenhouse gas emissions and destabilize the financial system." Speech made by Mark Carney, Chair of the Financial Stability Board (FSB), Then Governor of the Bank of England**
- **Dr. Carney also refers to the possibility that a sudden reassessment could destabilize markets like the subprime loan crises.**

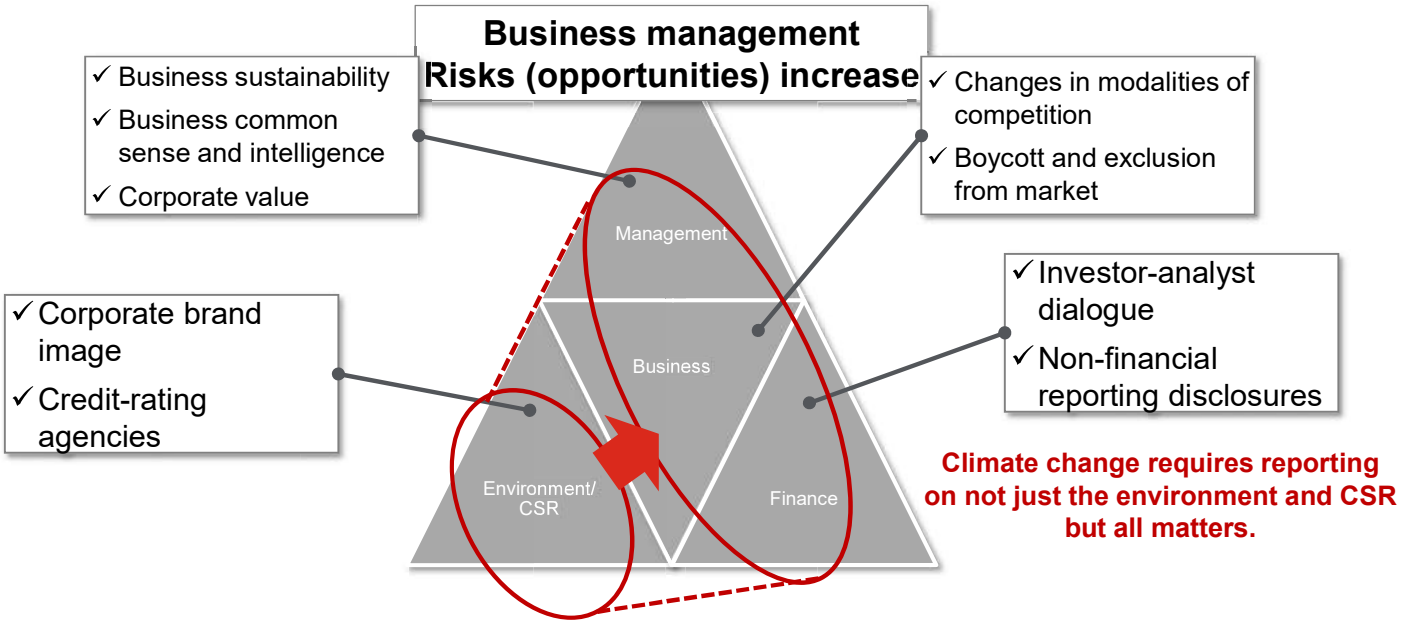
Speech by Mark Carney, Chair of the Financial Stability Board (FSB), Then Governor of the Bank of England (September 2015)

There are three broad channels through which climate change **can affect financial stability:**

- **Physical risks** : The direct impacts on property from climate related events, such as floods and storms and indirect impacts on blocked global supply chain or depletion of resources;
- **Liability risks** : The impacts that could arise if parties who have suffered loss or damage from the effects of climate change seek compensation from those they hold responsible;
- **Transition risks** : The risks which could result from **reassessment of the value of a large range of assets with a large volume of greenhouse gas emissions during the process of adjustment towards a lower carbon economy.**

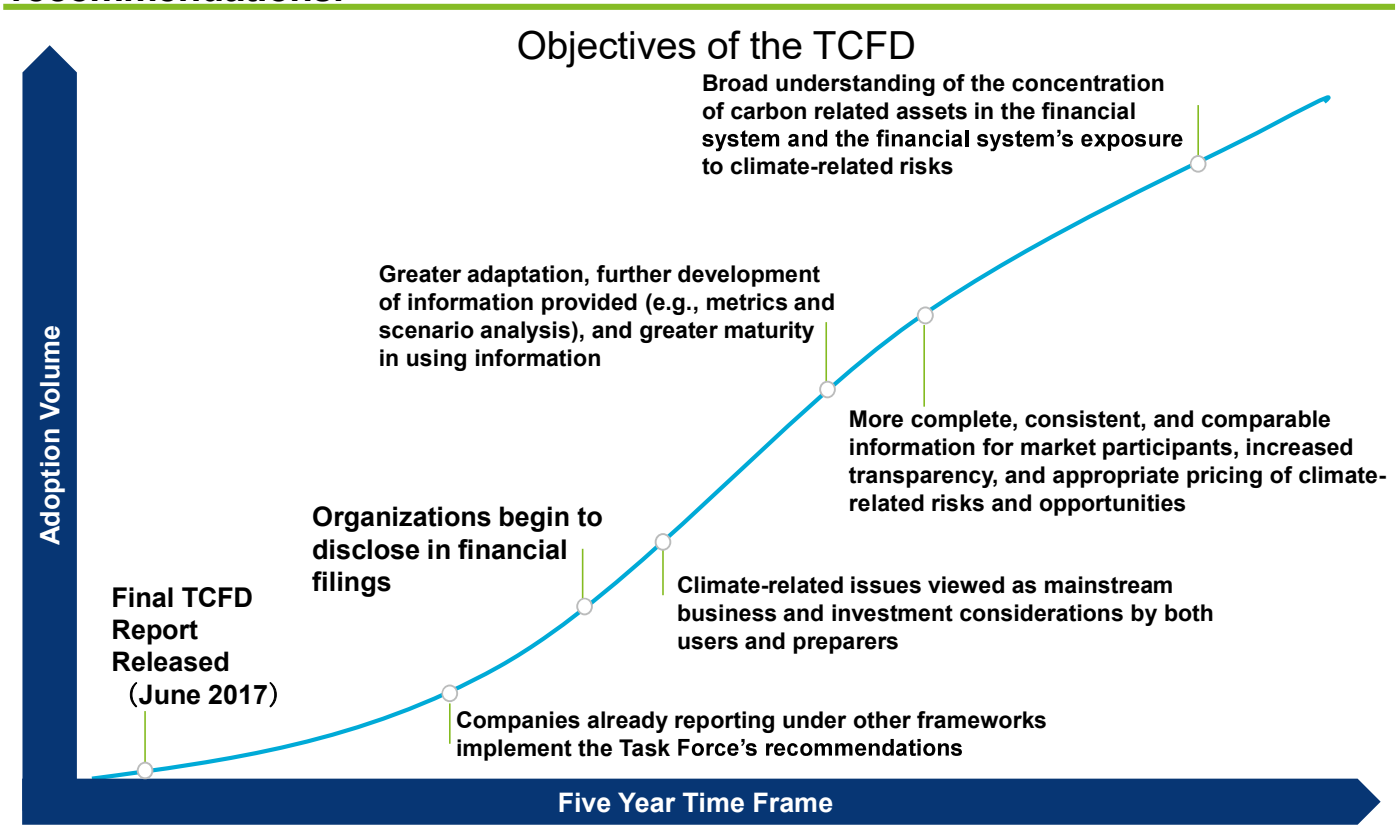
Source: Financial Times Online, September 30, 2015

【Climate Change and Corporate Management】
Climate change can present clear risks and opportunities for business management



The environment and CSR department has responded to the climate change, however, there is a growing need for a company to respond to the issues as a whole, as climate-related issues can be risks and opportunities in the field of “corporate value”, “business sales”, and “fund raising.”

【Objectives of the TCFD】
The TCFD recommendations expect companies to gradually adopt the recommendations.



Resources: Task Force on Climate-related Financial Disclosures, 2017

Status of the TCFD recommendations in Each Country
Institutionalization of TCFD in Europe and China. Working on TCFD recommendations can be global standard

Recent Trends in Each Country Based on TCFD

Developments toward institutionalization

EU — **EU revised its directive to comply with the TCFD recommendations**
- Published a draft revision in March 2019 toward the "revision of guidelines for non-financial reporting directive"
- On June 20, 2019, the draft revision of the guidelines and supplementary materials was announced. TCFD compliant (June 2019)

United Kingdom — **UK requests its regulators to support the TCFD recommendations**
- The UK Green Finance Taskforce, established by the government to transition to a low-carbon society
- Aiming to disclose information in line with TCFD of all listed companies and large asset owners by 2022.

Canada — **Compiled recommendations on sustainable financing, including TCFD**
- Expert Panel established by the Ministry of the Environment and Climate Change and the Ministry of Finance
- Publication of the Final Report on the Issues and Recommendations on Institutionalization of Sustainable Finance, etc. (June 2019)
- In addition, banks and other financial institutions and CSA (Canada Standard Authority) are taking the lead in discussing a unique Canadian taxonomy (October 2019).

France — **Started standardizing and developing frameworks for non-financial data as a whole to disclose TCFD**
- Economic and Finance Minister consulted the Accounting Standards Authority to develop extra-financial information disclosure frameworks to disclose information based on TCFD.
- Introduced a system to establish the Advisory Committee on Climate Change and Sustainable Finance composed of financial institutions, companies, and experts (July 2019)

China — **Scheduled revision of Environmental Reporting Guidelines**
- A pilot project was launched in collaboration with the British government. Exploring the incorporation of a TCFD framework into the Chinese Environmental Reporting Guidelines, and announcing its intention to make such mandatory for all listed companies by 2020 (January 2018). In addition, ESG has been incorporated into the Governance Disclosure Guidelines (September 2018).

United States — **New York State department of Financial Services (DFS) has joined the Network for Greeting the Financial System (NGFS)**
- New York State Department of Financial Services (DFS) participates in NGFS. NGFS considers an appropriate response to the climate-related risks on financial supervision, by publishing nonbinding recommendations in the integrated report in April 2019, including promotion of disclosure based on the TCFD recommendations (September 2019).
- However, the United States officially notified the United Nations of its decision to withdraw from the Paris Agreement, and the future outlook is uncertain (October 2019).

Japan — **Released guidance on TCFD disclosures**
- METI released TCFD Guidance*1 by adding explanation to TCFD final report in order to promote disclosure by companies based on TCFD (December 2018).
- The Ministry of the Environment announced a practical guide describing examples and methodologies to be used as a reference when companies conduct scenario analysis (March 2019, March 2020).
- Led by five founders including Professor Kunio Ito of Hitotsubashi University, the TCFD Consortium was established (May 2019). The consortium formulated the Green Investment Guidance*2 which provides commentaries on perspectives needed by investors and other stakeholders when understanding the information disclosed based on the TCFD recommendations, and released it at the TCFD Summit (October 2019).

*1 Guidance for Climate-related Financial Disclosures *2 Guidance for Utilizing Climate-related Information to Promote Green Investment

Source: TCFD, "2019 Status Report": Ministry of the Environment; European Union Commission website, etc.

[Status of approval for TCFD]
This is an initiative centered on the U.S. and Europe, and Japan ranks first in the world in terms of the number of people in favor of it

- As of February 25, 2020, 46 countries, 1,056 companies, governments, multilateral institutions, private organizations, etc., expressed their support for TCFD. The Ministry of Environment on July 27, 2018, the Ministry of Economy, Trade and Industries on December 25, 2018, and Financial Agencies Services Agency on December, 2017 announced that it agreed to adopt the TCFD recommendations.
- As of June 2019, the total assets of financial institutions that have pledged their approval exceeded US$118 trillion, and thereafter increased (from the 2019 Status Report)

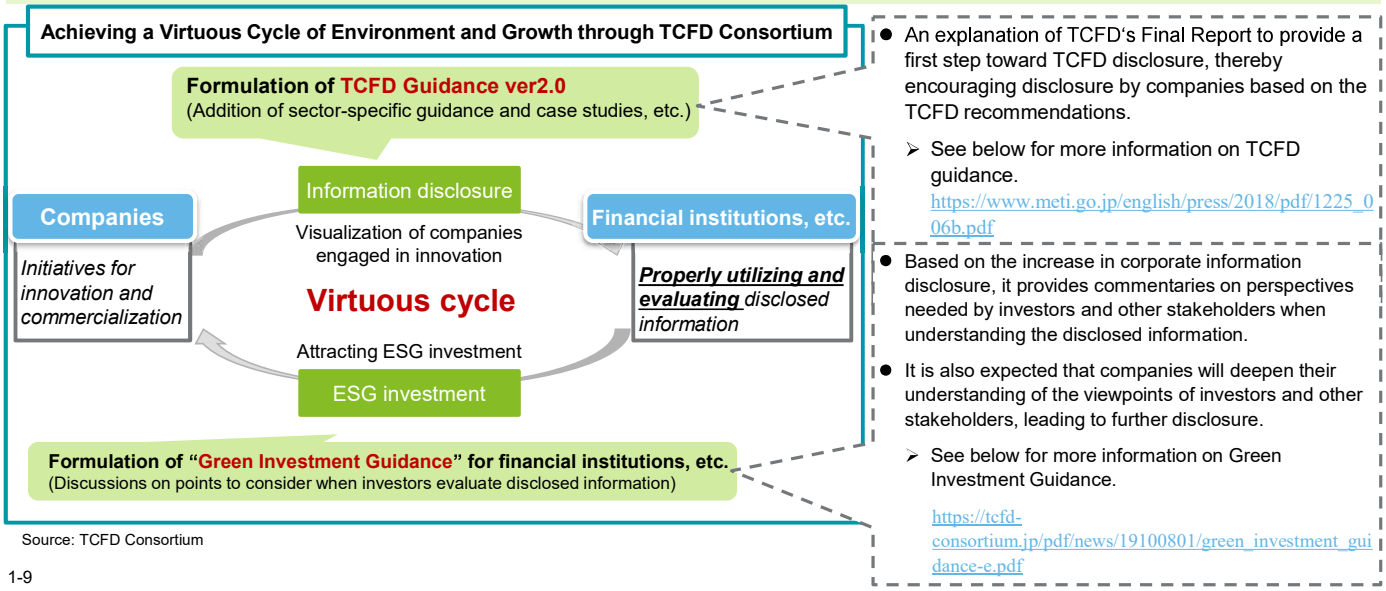
Number of Japanese Companies Presenting Support (as of February 25, 2020)

Industries and Groups		Number of companies
Financial (61)		**61**
Non-Financial(161)	**Energy**	**17**
	Transportation	**10**
	Materials and Buildings	**38**
	Agriculture, Food, and Forest Products	**9**
	Trading, Retail	**13**
	Electronics, Machinery, Telecommunications	**45**
	Consumer Goods, Pharmaceutical	**10**
	Services	**19**

Source: TCFD Consortium-provided materials

Outline of TCFD Consortium

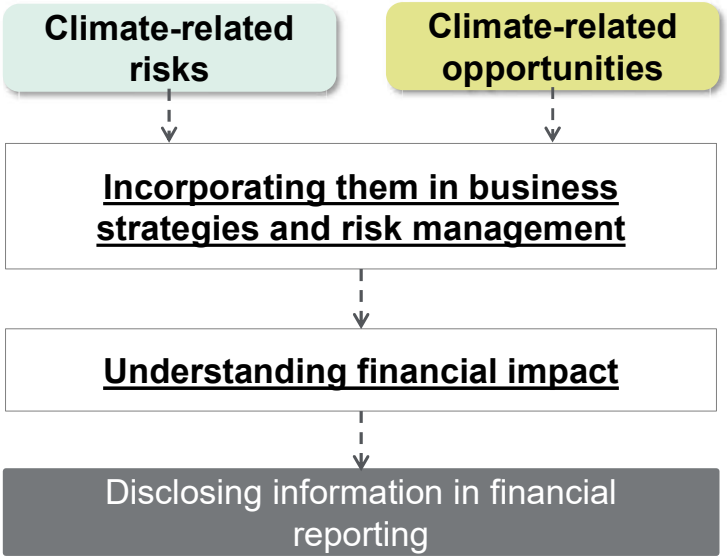
- In view of the increased awareness on corporate disclosure and use of climate-related information highlighted by the Task Force on Climate-related Financial Disclosures (TCFD) in Japan, **the private-led TCFD Consortium was established on May 27, 2019** by five founders.
  * Founders of the consortium: Professor Kunio Ito of Hitotsubashi University; Chairman Hiroaki Nakanishi of Keidanren (Japan Business Federation); Chair Makoto Takashima of the Japan Bankers Association; President and Chief Executive Officer Takehiko Kakiuchi of Mitsubishi Corporation; and Chairman of the Board Shuzo Sumi of Tokyo Marine Holdings.
- the Consortium aims to further discussion on **effective corporate disclosure of climate-related information and their use by financial institutions for appropriate investment decision**.
- **"Green Investment Guidance"** was formulated to provide commentaries on **perspectives needed by investors and other stakeholders when understanding the information disclosed based on the TCFD recommendations and released globally at the "TCFD Summit"** held on October 8, 2019.
- In the future, TCFD Consortium will **consider formulating TCFD Guidance ver2.0** which was originally formulated by the Ministry of Economy, Trade and Industry in December 2018.



- An explanation of TCFD's Final Report to provide a first step toward TCFD disclosure, thereby encouraging disclosure by companies based on the TCFD recommendations.
  - ➢ See below for more information on TCFD guidance. https://www.meti.go.jp/english/press/2018/pdf/1225_006b.pdf
- Based on the increase in corporate information disclosure, it provides commentaries on perspectives needed by investors and other stakeholders when understanding the disclosed information.
- It is also expected that companies will deepen their understanding of the viewpoints of investors and other stakeholders, leading to further disclosure.
  - ➢ See below for more information on Green Investment Guidance. https://tcfd-consortium.jp/pdf/news/19100801/green_investment_guidance-e.pdf

Source: TCFD Consortium

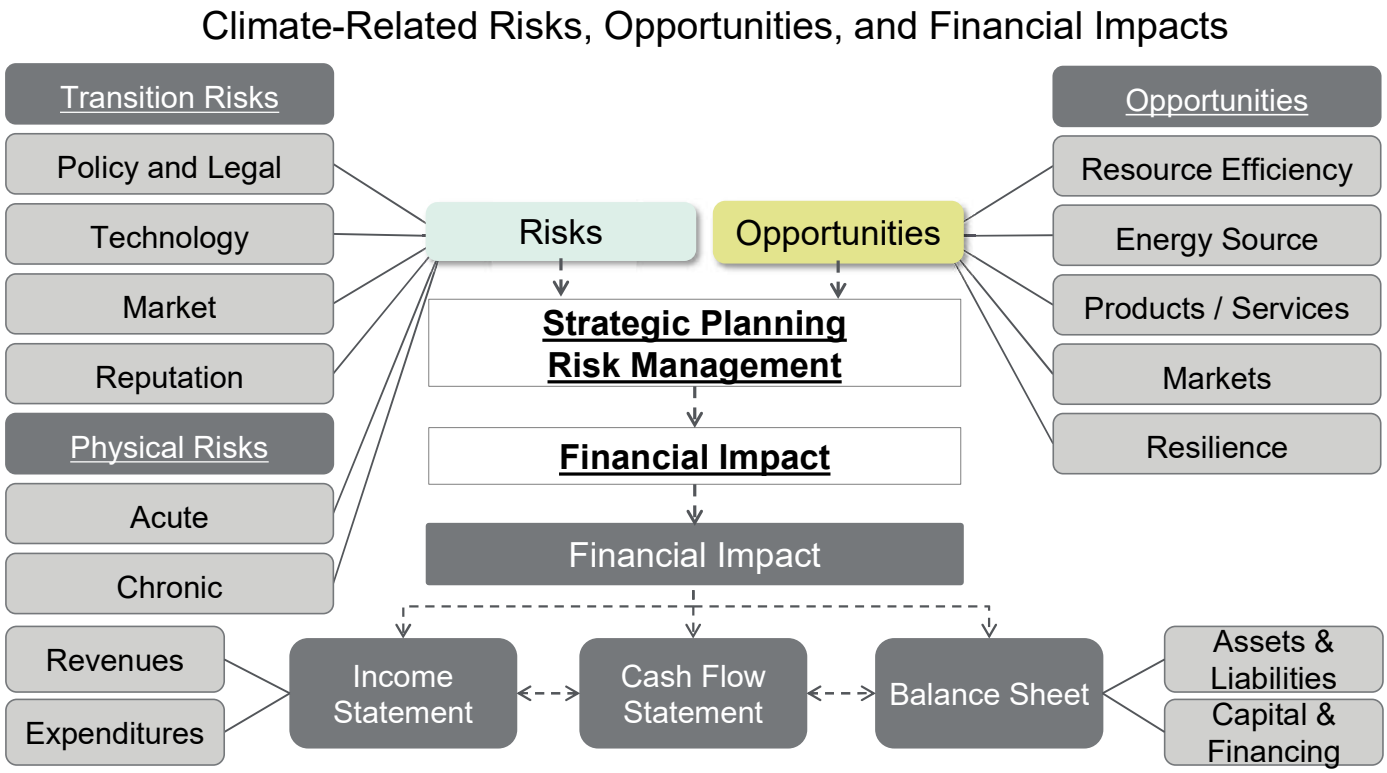
【Requirement of the TCFD Recommendations】
The TCFD recommendations disclosure of information related to climate change that poses financial risks and opportunities



The TCFD recommendations request all companies to (i) use different climate-related scenarios, including a 2°C or lower scenario to (ii) assess their climate-related risks and opportunities, (iii) incorporate such risks and opportunities in their business strategies and risk management, and (iv) understand and disclose their financial impacts.

Sources: prepared by the Ministry of Environment based on the page 9 of Financial Services Agency's document, "On Reports of the Task Force on Climate related Financial Disclosures (TCFD)" for briefings on "Final Report

[Financial Impact]
The TCFD recommendations present the scope of climate-related risks and opportunities, and financial impacts to be disclosed



Source: prepared by the Ministry of Environment based on the Task Force on Climate-related Financial Disclosures, "Final Report - Recommendations of the Task Force on Climate-related Financial Disclosures", 2017. p.8

[Climate-related Risks]
The TCFD Recommendations divided climate-related risks into two major categories: (1) risks related to the transition to a lower-carbon economy and (2) risks related to the physical impacts of climate change

Category	Definition	Type	Major aspects and policy actions
Transition Risks	Risks related to the transition to a lower-carbon economy	Policy and Legal	Enhancing regulations on GHG emissions, imposing greater obligations on information disclosure
		Technology	Replacing existing products with those based on low-carbon technologies, investing in new technologies that eventually turn out to be a failure
		Market	Changes in consumer behaviors, market signals with greater uncertainty, a rise in materials and costs
		Reputation	Changes in customer or community perceptions, criticism against certain industries, increased concern among stakeholders
Physical Risks	Risks related to the physical impacts of climate change	Acute	Event-driven risks, including severity of extreme events such as cyclones or floods
		Chronic	Longer-term shifts in climate patterns, including sustained higher temperatures, which may cause sea level rise or chronic heat waves

Source: prepared by the Ministry of Environment based on the Task Force on Climate-related Financial Disclosures, "Final Report - Recommendations of the Task Force on Climate-related Financial Disclosures", 2017. p.10

[Climate-related Opportunities]
The TCFD recommendations identified the following five areas of climate-related opportunities that organizations can produce in the course of their efforts to mitigate and adapt to climate change

	Area	Policy actions	Financial impact
Opportunities	Resource Efficiency	■ Use of more efficient models of transport ■ Use of more efficient production and distribution processes ■ Use of Recycling ■ Move to more efficient buildings ■ Reduced water usage and consumption	■ Reduced operating costs (e.g., through efficiency gains and cost reductions) ■ Increased production capacity, resulting in increased revenues ■ Increased value of fixed assets (e.g., highly rated energy-efficient buildings) ■ Benefits to workforce management and planning (e.g., improved health and safety, employee satisfaction) resulting in lower costs
	Energy Source	■ Use of lower-emission sources of energy ■ Use of supportive policy incentives ■ Use of new technologies ■ Participation in carbon market ■ Shift toward decentralized energy generation	■ Reduced operational costs (e.g., through use of lowest cost abatement) ■ Reduced exposure to future fossil fuel price increases ■ Reduced exposure to GHG emissions and therefore less sensitivity to changes in cost of carbon ■ Returns on investment in low-emissions technology ■ Increased capital availability (e.g., as more investors favor lower-emissions producers) ■ Reputational benefits resulting in increased demand for goods/services
	Products and Services	■ Development and/or expansion of low emission goods and services ■ Development of climate adaptation and insurance risk solutions ■ Development of new products or services through R&D and innovation ■ Ability to diversify business activities	■ Increased revenue through demand for lower emissions products and services ■ Increased revenue through new solutions to adaptation needs (e.g., insurance risk transfer products and services) ■ Better competitive position to reflect shifting consumer preferences, resulting in increased revenues
	Markets	■ Access to new markets ■ Use of public-sector incentives ■ Access to new assets and locations needing insurance coverage	■ Increased revenues through access to new and emerging markets (e.g., partnerships with governments, development banks) ■ Increased diversification of financial assets (e.g., green bonds and infrastructure)
	Resilience	■ Participation in renewable energy programs and adaptation of energy-efficiency measures ■ Resource substitutes/diversification	■ Increased market valuation through resilience planning ■ Increased reliability of supply chain and ability to operate under various conditions ■ Increased revenue through new products and services

Source: prepared by the Ministry of Environment based on the Task Force on Climate-related Financial Disclosures, "Final Report - Recommendations of the Task Force on Climate-related Financial Disclosures", 2017. p.11

[Guidance for Specific Sectors]
The TCFD supplemental guidance provides additional context and suggestions for implementing the recommended disclosures for four non-financial sectors (Energy; Materials and Buildings; Transportation; and Agriculture, Food, and Forest Products) potentially most affected by climate change

Sector	Industry	Recommended disclosure
Energy	■ Oil and Gas ■ Coal ■ Electric Utilities	Assessment and potential impacts of legal compliance, operating costs, changes in risks and opportunities; changes in regulations and shift in consumer and investor preferences; and changes in investment strategy
Transportation	■ Air Transport, Maritime Transportation ■ Land Transportation (Rail Transportation, Tracking Services) ■ Automobiles	Assessment and potential impacts of financial risks of enhanced regulations and new technology on existing factories and equipment; R&D investment in new technologies; opportunities for use of new technologies to lower emissions standards and regulations on higher fuel efficiency
Materials and Buildings	■ Metals and Mining ■ Chemicals ■ Construction Materials, Capital Goods ■ Real Estate Management and Development	Assessment and potential impacts of enhanced regulations on GHG emissions and carbon pricing; risk assessment of increased severity of extreme weather events on construction materials and property; and opportunities for products to improve energy efficiency or reduce energy consumption
Agriculture, Food, and Forest Products	■ Beverages, Foods ■ Agriculture ■ Paper and Forest Products	Assessment and potential impacts of GHG emissions reductions; recycling and waste management; business of food and textile products with lower GHG emissions, and shifts in consumer preferences

Source: prepared by the Ministry of Environment based on the Task Force on Climate-related Financial Disclosures, "Final Report - Recommendations of the Task Force on Climate-related Financial Disclosures", 2017. p.52-65

[The TCFD recommendations]
The TCFD recommendations are structured around four thematic areas: Governance, strategy, risk management, and metrics and targets

Recommended disclosures	Governance	Strategy	Risk Management	Metrics and Targets
Areas in detail	Disclose the organization's governance around climate-related risks and opportunities	Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material	Disclose how the organization identifies, assesses, and manages climate-related risks	Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material
Recommended Disclosures	a) Describe the board's oversight of climate-related risks and opportunities	a) Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term	a) Describe the organization's processes for identifying and assessing climate-related risks	a) Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process
	b) Describe management's role in assessing and managing climate-related risks and opportunities	b) Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning	b) Describe the organization's processes for managing climate-related risks	b) Disclose Scope 1, Scope 2, and if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks
		c) Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario	c) Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management	c) Describe the targets used by the organization to manage climate-related risks and opportunities, and performance against targets

Source: prepared by the Ministry of Environment based on the Task Force on Climate-related Financial Disclosures, "Final Report - Recommendations of the Task Force on Climate-related Financial Disclosures", 2017. p.14

[Governance = Involvement of Management]
To incorporate climate-related risks and opportunities in business strategy, an organization should establish a system involving management. The TCFD recommendations require an organization to describe the board's oversight of climate-related risks and opportunities, and management's role in assessing and managing such risks and opportunities

The organization's governance around climate-related risks and opportunities

The board's oversight of climate-related risks and opportunities

- Processes and frequency by which the board and/or board committees are informed about climate-related issues
- Whether the board and/or board committees consider climate-related issues when reviewing and guiding strategy, major plans of action, risk management policies, annual budgets, and business plans as setting the organization's performance objectives, monitoring implementation and performance, and overseeing major capital expenditures, acquisitions, and divestitures
- How the board monitors and oversees progress against goals and targets for addressing climate-related issues

Management role in assessing and managing climate-related risks and opportunities

- Whether the organization has assigned climate-related responsibilities to management-level positions or committees; and, if so, whether such management positions or committees report to the board or a committee of the board and whether those responsibilities include assessing and/or managing climate-related issues
- A description of the associated organizational structure(s)
- How management (through specific positions and/or management committees) monitors climate-related issues

Source: prepared by the Ministry of Environment based on the Task Force on Climate-related Financial Disclosures, "Final Report - Recommendations of the Task Force on Climate-related Financial Disclosures", 2017. p.19

[Strategy]

The TCFD recommendations require an organization to describe the climate-related risks and opportunities over the short, medium, and long term; their impacts on the organization's businesses, strategy, and financial planning; and the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario

Impact on the organization's businesses, strategy, and financial planning (where relevant information is critical)

The climate-related risks and opportunities the organization has identified over the short, medium, and long term

- A description of what they consider to be the relevant short, medium, and long-term time horizons
- The specific climate-related issues for each time horizon that could have a material financial impact on the organization
- The process(es) used to determine which risks and opportunities could have a material financial impact on the organization

The impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning

- How identified climate-related issues have affected their businesses, strategy, and financial planning
- The impact on their businesses and strategy in the areas of products and services; supply chain and/or value chain; adaptation and mitigation activities; investment in research and development; and operations
- The impact of climate-related issues on operating costs and revenues; capital expenditures and capital allocation; acquisitions or divestments; and access to capital

The resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario

- How resilient their strategies are to climate-related risks and opportunities
- Where they believe their strategies may be affected by climate-related risks and opportunities; how their strategies might change to address such potential risks and opportunities; and the climate-related scenarios and associated time horizon(s)

Source: prepared by the Ministry of Environment based on the Task Force on Climate-related Financial Disclosures, "Final Report - Recommendations of the Task Force on Climate-related Financial Disclosures", 2017. p.20-21

[Risk Management]

The TCFD recommendations require an organization to describe the organization's processes for identifying, assessing, and managing climate-related risks, as well as how these processes are integrated into the organization's overall risk management

How the organization identifies, assesses, and manages climate-related risks

The Organization's processes for identifying and assessing climate-related risks

- Their risk management processes for identifying and assessing climate-related risks (An important aspect is how the organization determines the relative materiality of climate-related risks in relation to other risks)
- Whether they consider existing and emerging regulatory requirements related to climate change
- Their processes for assessing the potential size and scope of identified climate-related risks; and definitions of risk terminology used or references to existing risk classification frameworks used

The organization's processes for managing climate-related risks

- Their processes for managing climate-related risks, (including how they make decisions to mitigate, transfer, accept, or control those risks)
- Their processes for prioritizing climate-related risks, (including how materiality determinations are made)

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

- How their processes for identifying, assessing, and managing climate-related risks are integrated into their overall risk management

Source: prepared by the Ministry of Environment based on the Task Force on Climate-related Financial Disclosures, "Final Report - Recommendations of the Task Force on Climate-related Financial Disclosures", 2017. p.21-22

[Metrics and Targets]
The TCFD recommendations require an organization to describe the metrics used to assess climate-related risks and opportunities in line with its strategy and risk management process; GHG emissions; the targets to manage climate-related risks and opportunities, and performance against targets

The metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material

<u>The metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process</u>

- The key metrics used to measure and manage climate-related risks and opportunities (organizations should consider including metrics associated with water, energy, land use, and waste management)
- Whether and how related performance metrics are incorporated into remuneration policies (where climate-related issues are material)
- Their internal carbon prices as well as climate-related opportunity metrics such as revenue from products and services designed for a lower-carbon economy
- Metrics should be provided for historical periods to allow for trend analysis. The methodologies used to calculate or estimate metrics should also be included.

<u>Scope 1, Scope 2, and if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks</u>

- GHG emissions calculated in line with the GHG Protocol methodology to allow for aggregation and comparability across organizations and jurisdictions
- Related, generally accepted industry-specific GHG efficiency ratios (as appropriate)
- GHG emissions and associated metrics should be provided for historical periods. The methodologies used to calculate or estimate the metrics should also be included.

<u>The targets used by the organization to manage climate-related risks and opportunities and performance against targets</u>

- Their key climate-related targets (such as those related to GHG emissions, water usage, energy usage)
- Other goals including efficiency or financial goals through the entire life cycle of products and services
- Whether the target is absolute or intensity; time frames over which the target applies; key performance indicators, etc.

Source: prepared by the Ministry of Environment based on the Task Force on Climate-related Financial Disclosures, “Final Report - Recommendations of the Task Force on Climate-related Financial Disclosures”, 2017. p.22-23

Materiality of Scenario Analysis ①
Disclosure through scenario analysis is recommended to assess the impacts of climate-related risks and opportunities. Developed technical supplement for scenario analysis

Usefulness of scenario analysis

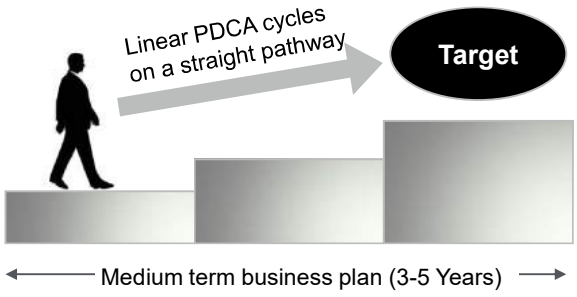
- Scenario analysis can be useful as a tool for an organization to strategically tackle challenges in the long run that are highly uncertain
- **<u>Disclosure should also include assumptions for critical scenarios for sectors where climate-related risks are a concern.</u>** Scenario analysis requires skill and effort, but it also benefits the organization.

Target	Applicable range of scenarios
Transition risk	■ IEA WEO SDS/ETP 2DS/IEA WEO STEPS/IEA WEO NPS (2°C Target Achievement Scenario versus No Scenario) ■ Deep decarbonizaion Pathways Project (2°C target achieved) ■ IRENA REmap (doubling the renewable energy ratio by 2030) ■ Greenpeace Advanced Energy [R] evolution (2°C Target Achieved)
Physical risk	■ RCPs (Representative Concentration Pathway) Scenarios adopted by IPCC: RCP8. 5, RCP6. 0, RCP4. 5, RCP2. 6

Source: Climate-Related Financial Disclosure Task Force, Recommendations by the Climate-Related Financial Disclosure Task Force (Final), 2017, pp. 25-29.
Prepared by the Ministry of the Environment based on the Task Force on Climate-Related Financial Information Disclosure, “Utilization of Scenario Analysis in Climate-Related Risks and Opportunities Disclosure,” Auxiliary Guidance on Pages 2017, 21 & 25.
Scenarios listed on IEA WEO are updated based on the most recent publicly available report.

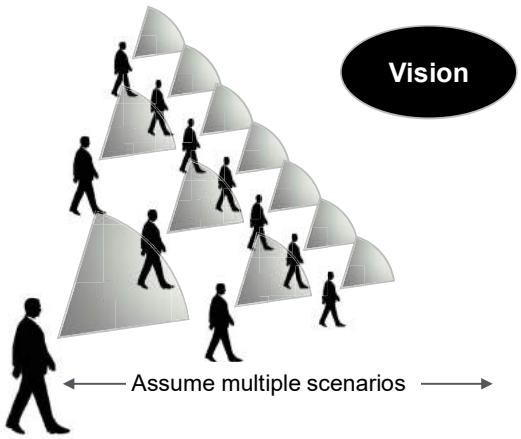
Materiality of Scenario Analysis ②
Scenario analysis enables strategic planning and internal/external dialogue in response to future uncertainties

In a reasonable foreseeable term…



- Business strategy cannot respond to changes in the future
- The discussion never reaches a consensus on future perspectives
- Suspected of lacking business resilience

In a longer term, where outcomes are highly uncertain, and possibly promising…



- Business management can flexibly respond to future change
- The discussion takes places without any subjective viewpoints on future
- Management can demonstrate business resilience

2. Scenario Analysis - Key Points of Practice

2-1. For beginning scenario analysis

2-2. STEP2. Assess materiality of climate-related risks

2-3. STEP3. Identify and define range of scenarios

2-4. STEP4. Evaluate business impacts

2-5. STEP5. Identify potential responses

Chapter 2 Scenario Analysis - Key Points of Practice

This chapter explains how to practically undertake scenario analysis and describes key points of its practice, based on use cases performed by companies under the support program of the Ministry of Environment.

Points to consider when implementing scenario analysis in line with the TCFD recommendations were mapped out for 18 companies, forming the basis for the trial

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

(Notes in red: Points to consider in each step were added after the support program.)

1 **Ensure governance Is in place**

Integrate scenario analysis into strategic planning and/or enterprise risk management processes.
Assign oversight to relevant board committees/subcommittees.
Identify which internal (and external) stakeholders to involve and how.

Get management and operation divisions involved!

2 **Assess materiality of climate-related risks**

Market and Technology Shifts | Reputation | Policy and Legal | Physical Risks

What are the current and anticipated organizational exposures to climate-related risks and opportunities?
Do these have the potential to be material in the future? Are stakeholders concerned?

Pick and choose from your industry and company viewpoint!

3 **Identify and define range of scenarios**

Scenarios inclusive of a range of transition and physical risks relevant to the organization

What scenarios (and narratives) are appropriate, given the exposures?
Consider input parameters, assumptions, and analytical choices. What reference scenario(s) should be used?

Clearly imagine a future world under certain assumptions!

4 **Evaluate business impacts**

Impact on:
•Input costs
•Operating costs
•Revenues
•Supply chain
•Business interruption
•Timing

Evaluate the potential effects on the organization's strategic and financial position under each of the defined scenarios.
Identify key sensitivities.

Try not to seek too much accuracy!

5 **Identify potential responses**

Responses might include
•Changes to business model
•Changes to portfolio mix
•Investments in capabilities and technologies

Use the results to identify applicable, realistic decisions to manage the identified risks and opportunities.
What adjustments to strategic/financial plans would be needed?

Do not narrow down! Take multiple scenarios into account.

6 **Documentation and disclose**

Document the process; communicate to relevant parties: Be prepared to disclose key inputs, assumptions, analytical methods, outputs, and potential management responses

Disclose information from readers' viewpoint!

Sources: The Task Force on Climate related Financial Disclosures, "Technical Supplement The Use of Scenario Analysis in Disclosure of Climate Related Risks and Opportunities", June 2017.

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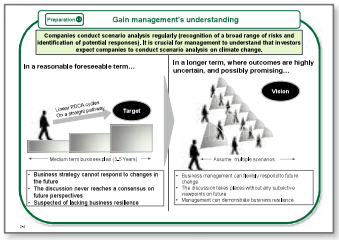
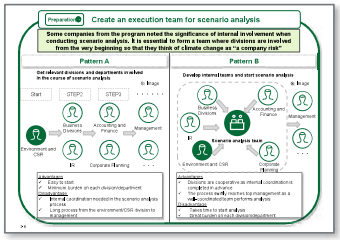
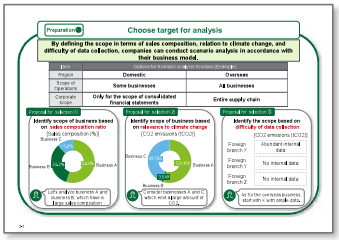
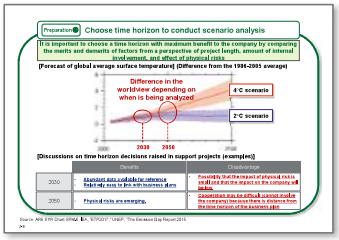
[When starting a Scenario Analysis ①]
Gaining understanding from management on the materiality of scenario analysis is important.
Establishing a team, scope and time horizon is necessary when starting scenario analysis.

Preparation①	Preparation ②	Preparation ③	Preparation ④
Gain management's understanding	**Establish execution team**	**Choose target for analysis**	**Setting the analysis time axis**
Make sure management understands the materiality of TCFD (Recognizes the recommendations and instructs that they be complied with)	Create an execution team for scenario analysis	Set a target scope for the scenario analysis	Choose time horizon to conduct scenario analysis that looks beyond X years in the future
			

Point

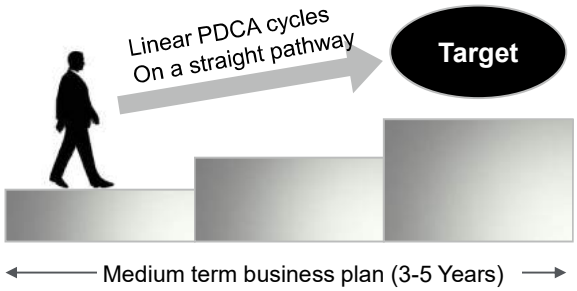
How to provide input to management in terms of climate change

Preparation ①

Gain management's understanding

Companies conduct scenario analysis regularly (recognition of a broad range of risks and identification of potential responses). It is crucial for management to understand that investors expect companies to conduct scenario analysis on climate change.

In a reasonable foreseeable term…



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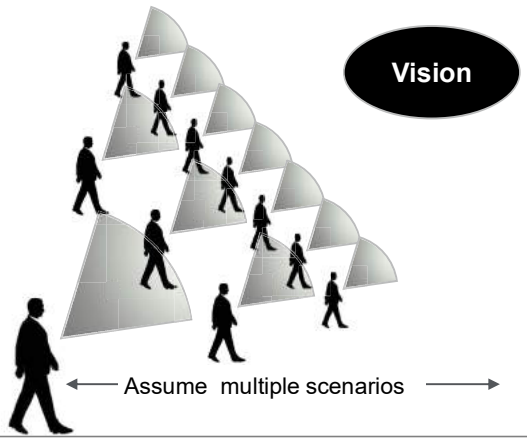
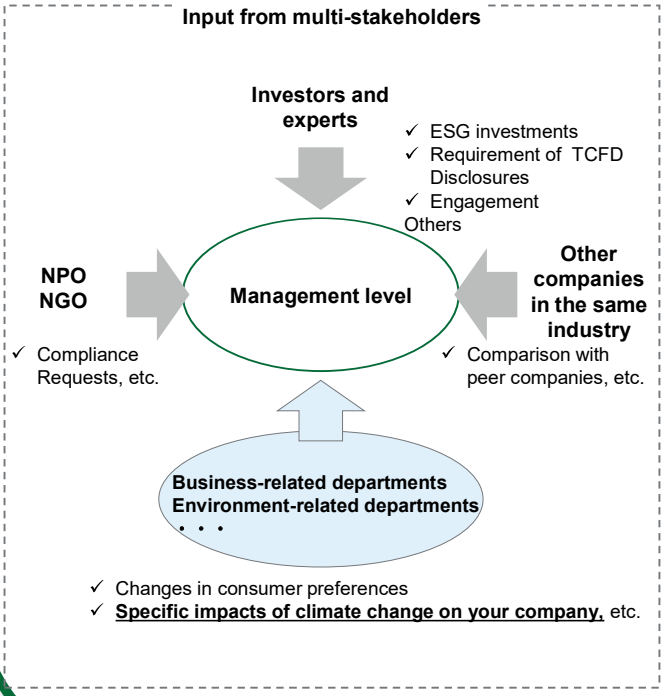


- Business management can flexibly respond to future change
- The discussion takes places without any subjective viewpoints on future
- Management can demonstrate business resilience

How to provide input to management in terms of climate change

It is effective to convey the effect that climate change solutions have on the value of businesses through workshops with experts. As part of the Ministry of the Environment's support programs, selected companies held scenario analysis report meetings for management. These meetings are effective in gaining and deepening management's understanding.



- Requests from multi-stakeholders for climate change response accelerated
- There are some cases in which top management hears directly, but there are also cases in which there is still significant distance.
- In such a case, it is important to compile **the status of requests from multi-stakeholders**, and input to management **through study groups with experts and other means that responding to climate change can affect corporate value**.
- As an input source for support projects by the Ministry of the Environment
  It is essential **to hold briefings of impact of climate change (results of scenario analysis) for management, and** these briefings have been proven to be highly effective.

[Results of the FY2018 Ministry of the Environment Scenario Analysis Support Project]

Company A: Established a new department specializing in the integration of IR/Sustainability as the understanding of management progressed. Periodic discussions with executives on TCFD held at the Sustainability Committee

Company B: Improved understanding of management and **launched a team for climate change management. Executive Vice President assumes chairmanship**

Preparation②

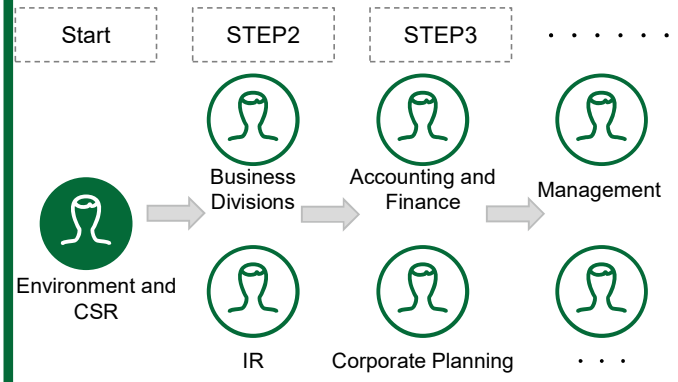
Create an execution team for scenario analysis

Some companies from the program noted the significance of internal involvement when conducting scenario analysis. It is essential to form a team where divisions are involved from the very beginning so that they think of climate change as “a company risk"

Pattern A

Get relevant divisions and departments involved in the course of scenario analysis

※ Image



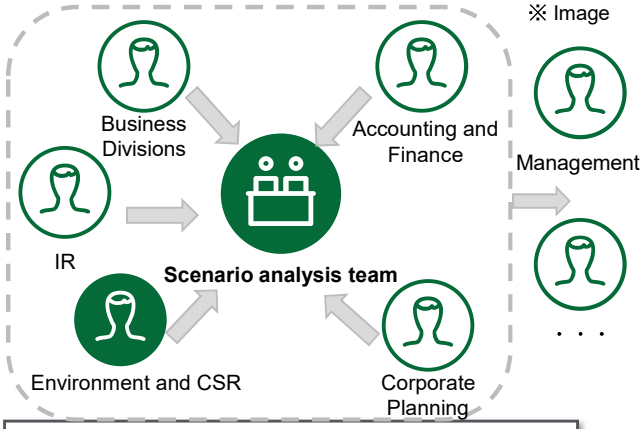
Advantages
- ✓ Easy to start
- ✓ Minimum burden on each division/department

Disadvantage
- ✓ Internal coordination needed in the scenario analysis process
- ✓ Long process from the environment/CSR division to management

Pattern B

Develop internal teams and start scenario analysis

※ Image



Advantages
- ✓ Divisions are cooperative as internal coordination is completed in advance
- ✓ The process swiftly reaches top management as a well-coordinated team performs analysis

Disadvantage
- ✓ Takes time to start analysis
- ✓ Great burden on each division/department

Preparation ③

Choose target for analysis

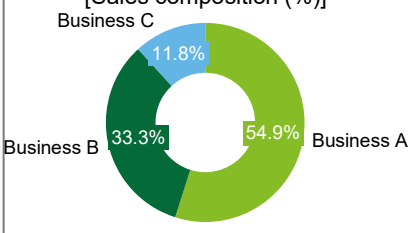
By defining the scope in terms of sales composition, relation to climate change, and difficulty of data collection, companies can conduct scenario analysis in accordance with their business model.

Item	Options for Scenario Analysis Scenario (Example)	
Region	**Domestic**	**Overseas**
Scope of Operations	**Some businesses**	**All businesses**
Corporate scope	**Only for the scope of consolidated financial statements**	**Entire supply chain**

Proposal for selection ①

Identify scope of business based on sales composition ratio

[Sales composition (%)]

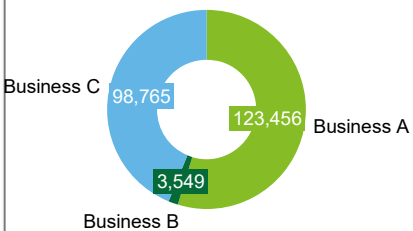


Let's analyze business A and business B, which have a large sales composition

Proposal for selection ②

Identify scope of business based on relevance to climate change

[CO2 emissions (tCO2)]



Consider businesses A and C, which emit a large amount of CO2.

Proposal for selection ③

Identify the scope based on difficulty of data collection

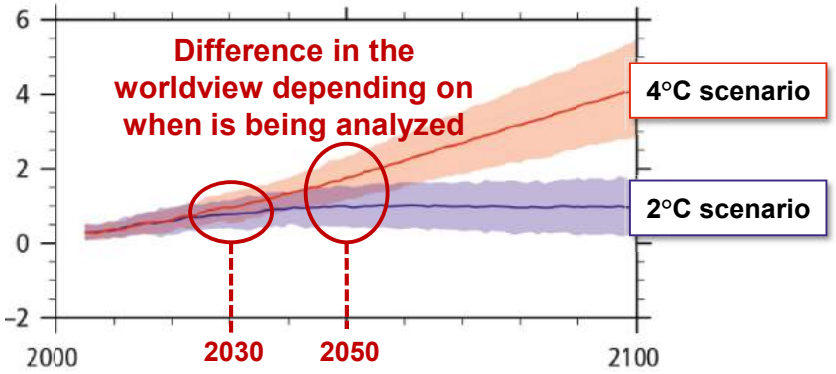
	[CO2 emissions (tCO2)]
Foreign branch X	Abundant internal data
Foreign branch Y	No internal data
Foreign branch Z	No internal data

As for the overseas business, start with X with ample data.

Preparation ④ Choose time horizon to conduct scenario analysis

It is important to choose a time horizon with maximum benefit to the company by comparing the merits and demerits of factors from a perspective of project length, amount of internal involvement, and effect of physical risks

[Forecast of global average surface temperature] (Difference from the 1986-2005 average)



[Discussions on time horizon decisions raised in support projects (examples)]

	Benefits	Disadvantage
2030	• Abundant data available for reference • Relatively easy to link with business plans	• Possibility that the impact of physical risk is small and that the impact on the company will be low
2050	• Physical risks are emerging.	• Cooperation may be difficult (cannot involve the company) because there is distance from the time horizon of the business plan

Source: AR5 SYR Chart SPM.6, IEA, "ETP2017," UNEP, "The Emission Gap Report 2015

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Assess materiality of climate-related risks: What are the current and anticipated organizational exposures to climate-related risks and opportunities?

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

(Notes in red: Points to consider in each step were added after the support program.)

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Responses might include
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Document the process; communicate to relevant parties: Be prepared to disclose key inputs, assumptions, analytical methods, outputs, and potential management responses

Disclose information from readers' viewpoint!

Sources: The Task Force on Climate related Financial Disclosures, "Technical Supplement The Use of Scenario Analysis in Disclosure of Climate Related Risks and Opportunities", June 2017.

[Overview] List risk items, identify the potential impacts on business, and assess materiality of climate-related risks

Stage1 List risk items
List the risks and opportunities related to targeted business areas

Stage2 Identify potential impacts on business
From the list of risk and opportunities, qualitatively describe the potential impact on business

Stage3 Assess the materiality of climate-related risks
Conduct risk assessment based on scale of impact (large to small) and determine how important it is

Image

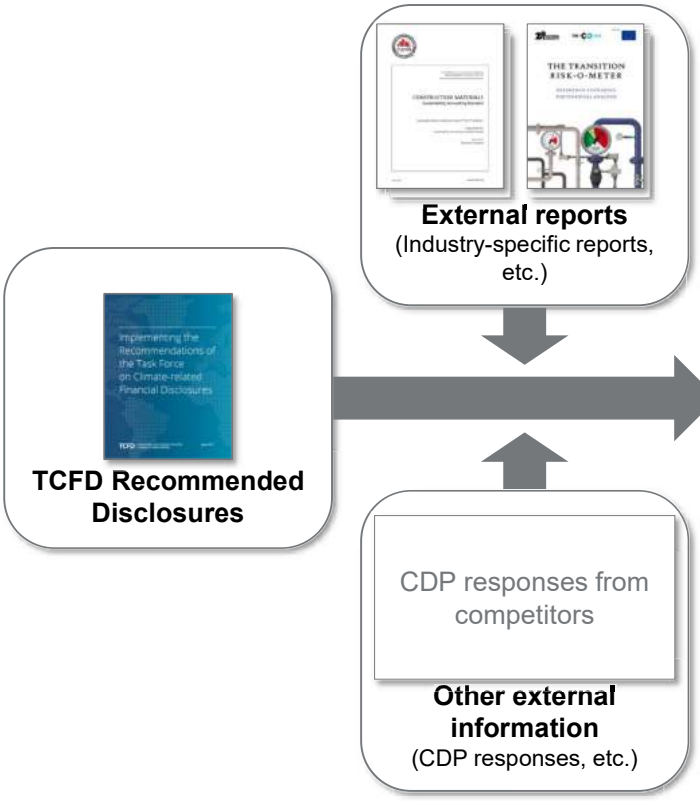
Risks and Opportunities		Business Impact			
Main classification	Small classification	Index	Discussion: Risks	Discussion: Opportunities	Assessment
Transition Risk	Carbon price	Revenue	The introduction of carbon prices is expected to reduce the demand for fossil fuels (to reduce the demand for petroleum plants), which will have a medium-scale impact on PL	Developments in carbon tax markets could create new opportunities in low-carbon energy markets, such as hydrogen, CCU and bio-based chemical industries and decentralized utilities	Large
	Carbon emission targets/policies of each country (including subsidies)	Revenue	Regulatory tightening affects orders for fossil-fuel-derived plants, affecting PL	The market for green energy, hydrogen, etc. is expected to expand with the advancement of policy support, and the demand for plant and energy transportation, etc. is expected to increase, creating business opportunities.	
	In the energy mix Change	Revenue	Large impact on PL due to changes in fossil fuel-derived power generation rate, which affects plant orders	Alternatives to coal such as LNG and natural gas may increase demand for plant production, which can be an opportunity as well as a risk Increased demand for green energy creates new business opportunities	
	Energy Demand	Revenue	Significant impact on PL due to decrease in demand for gasoline and decrease in orders for petroleum refineries Smaller plant size and diversification of customers and regions reduced business opportunities.	Promoting LNG and natural gas as low-carbon fuels creates business opportunities in new markets (increased exports and imports in North America and Asia) New opportunities could emerge in low-carbon energy markets, such as hydrogen, CCU and bio-based chemical industries and decentralized utilities	
	Spread of low-carbon technologies	Revenue	Influence on PL due to the spread of electric vehicles, reduced demand for gasoline, etc., affecting the volume of orders received for petroleum plants.	Promoting LNG and natural gas as low-carbon fuels creates business opportunities in new markets (increased exports and imports in North America and Asia) New opportunities could emerge in low-carbon energy markets, such as hydrogen, CCU and bio-based chemical industries and decentralized utilities	
	Developing next-generation technologies	Revenue Spending	Popularization of decarbonizing materials (bio-plastics, etc.) reduces the market size of petroleum products and has a large impact on orders for petroleum refineries	New opportunities could emerge in low-carbon energy markets, such as hydrogen, CCU and bio-based chemical industries and decentralized utilities	
Other	Changes in customer reputation, changes in investor reputation, rising mean temperatures, rising sea levels, and extreme weather conditions	Revenue Spending	De investment accelerated for oil and LNG, and plant orders declined or were suspended. In addition, the postponement and cancellation of projects have an impact on PL Construction delays caused by extreme weather conditions have an impact on PL due to increased construction costs, etc.	Investors' evaluation improves due to orders received for projects aimed at realizing a low-carbon society such as renewable energy Expected increase in demand for plant resilient to natural disasters, etc.	Small to medium

Note

To what extent should the risk assessment be conducted?

Source: This Practical Guide (example of Chiyoda Corporation: 3-31)

[Stage1: List risk items]
List risk and opportunity categories for targeted business areas

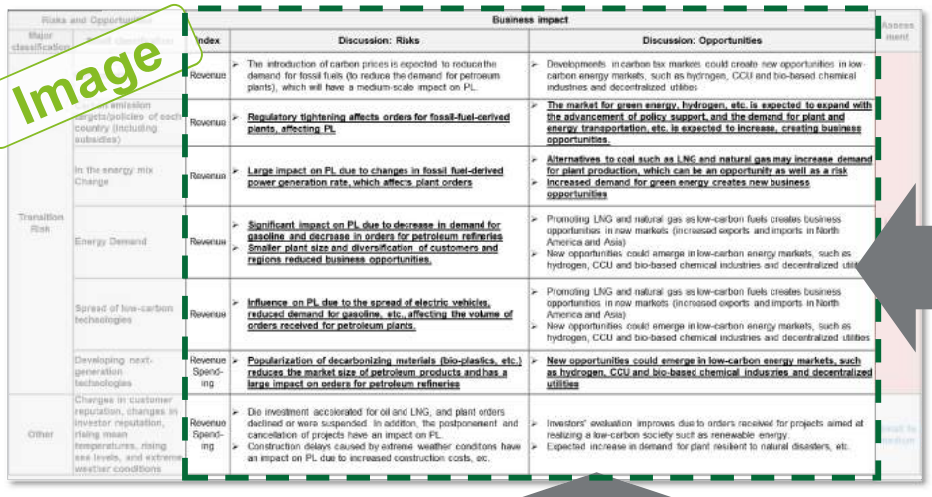


Image

Classification		Risks and Opportunities Related to Climate Change (Examples)
Transition Risk	Policy Regulation	Carbon price
		Carbon emissions targets/policies in each country
		Energy-saving policy
		Fossil fuel subsidies
		Subsidies for renewable energy, etc.
	Market	Changes in the energy mix
		Changes in energy demand
		Changes in important products/prices
	Technologies	Diffusion of renewable energy and energy-saving technologies
	Reputation	Changes in customer reputation
		Changes in investor's reputation
Physical Risk	Chronic	Increase in average temperature
		Changes in rainfall and weather patterns
		Rising sea level
	Acute	Increasing severity of extreme weather conditions

[Stage 2: Identify potential impacts on business]
From the list of risk and opportunity items, qualitatively describe the potential impact on business

Image



It is important to consider not only the company's risks but also its opportunities.

Separate and examine risks and opportunities

CDP responses from competitors

External reports and other external information

Describe the possible impact in a narrative manner through discussions with related parties within the company, based on the company's business model, etc.

Materiality of risks is reviewed throughout each step (not a final decision at this time, but will be reviewed in terms of business impact).

Discussions with internal stakeholders

Source: This Practical Guide (example of Chiyoda Corporation: 3-31)

[Stage3: Materiality assessment of climate-related risks]
Conduct risk assessment based on scale of impact (large to small)

Business impact

Risks and opportunities tied to business impact

Image

Large

- Carbon price
- Changes in important products/prices
- Policies and regulations of each country
- Changes in rainfall and weather conditions

Medium

- Changes in the energy mix
- Changes in the reputation of customers and investors

Small

- Energy-saving policy
- Fossil fuel subsidies
- Subsidies for renewable energy, etc.
- Energy demand
- Improving efficiency
- Diffusion of renewable/energy-saving technologies
- Rising sea levels
- Increasing in severity of extreme weather conditions

Comparison of each risk and opportunity item from the perspective of **the size of the business impact** for the company

Example: **Describe risks and opportunities that impact in a wide range, and those that relate to important goods as "Large." Describe those that have no impact on one's business as "Small"** and **"Medium" for others**.

Examples of Analysis (Changes in Important Products)

Since raw materials account for a large proportion of the cost of sales, the business impact may be "large."

To what extent should the risk assessment be conducted?

Assessing materiality of risks after categorizing them by differences in products (by sector) and affected supply chains (by supply chain) enables an analysis that is convincing to management

Example ①

Materiality assessment of risks by sector

Image

Risk Item	Materiality assessment of risks by sector		
	X	Y	Z
Risk A	Large	Medium	Small
Risk B	Small	Small	Large
Opportunity C	Large	Medium	Medium
Opportunity D	Medium	Large	Large

Example ②

Materiality assessment of risks by supply chain

Image

Risk Item	Materiality assessment of risks by supply Chain			
	Procurement	Transportation	Sales	・・・
Risk A	Large	Large	Small	Medium
Risk B	Small	Small	Large	Large
Opportunity C	Large	Medium	Medium	Small
Opportunity D	Medium	Large	Large	Large

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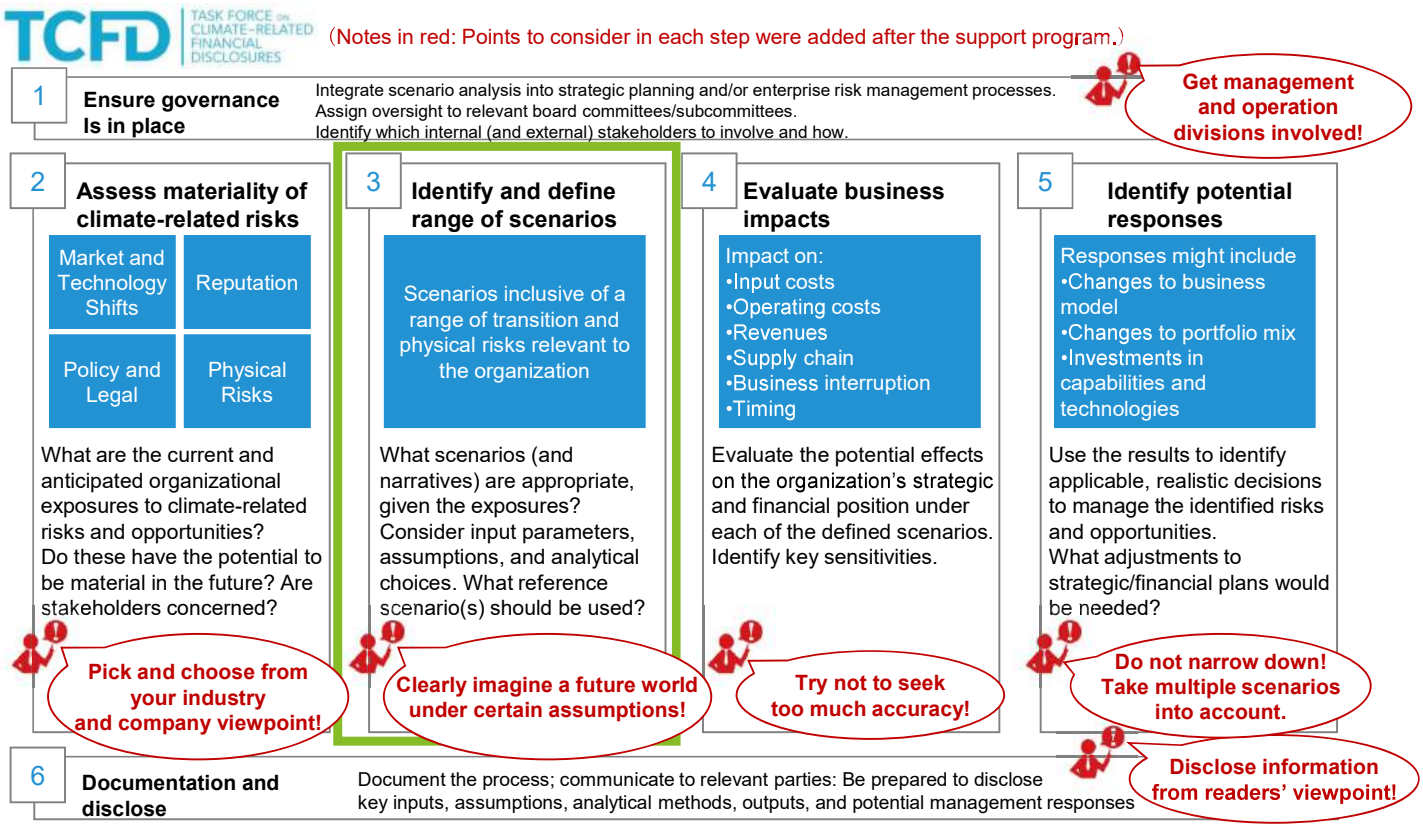
Identify and define range of scenarios: What scenarios (and narratives) are appropriate, given the exposures?



Sources: The Task Force on Climate related Financial Disclosures, "Technical Supplement The Use of Scenario Analysis in Disclosure of Climate Related Risks and Opportunities", June 2017.

[Overview]

Choose scenarios, obtain forecast information on parameters, and shape the worldview

Stage1

Choose scenarios

Choose a number of scenarios with different temperature targets, including “lower than 2°C”.

Stage 2

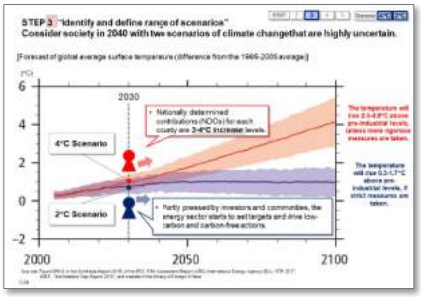
Obtain forecast information on relevant parameters (variables)

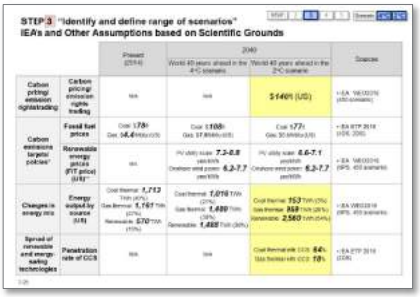
Obtain objective forecast information of relevant parameters on each risk and opportunity items, and identify the effects to the company in further detail.

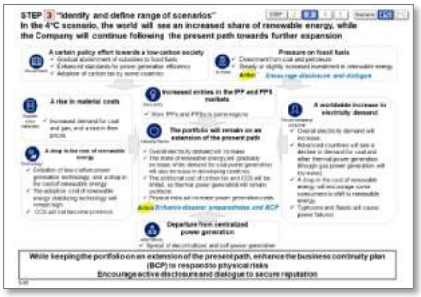
Stage 3

Shape the worldview in consideration of stakeholders

Based on forecast information, shape the company’s worldview such as future stakeholders’ performance, and work towards achieving internal and external consensus by incorporating the perspectives from outside of company (If needed).







Note

What kind of scenarios should be chosen?

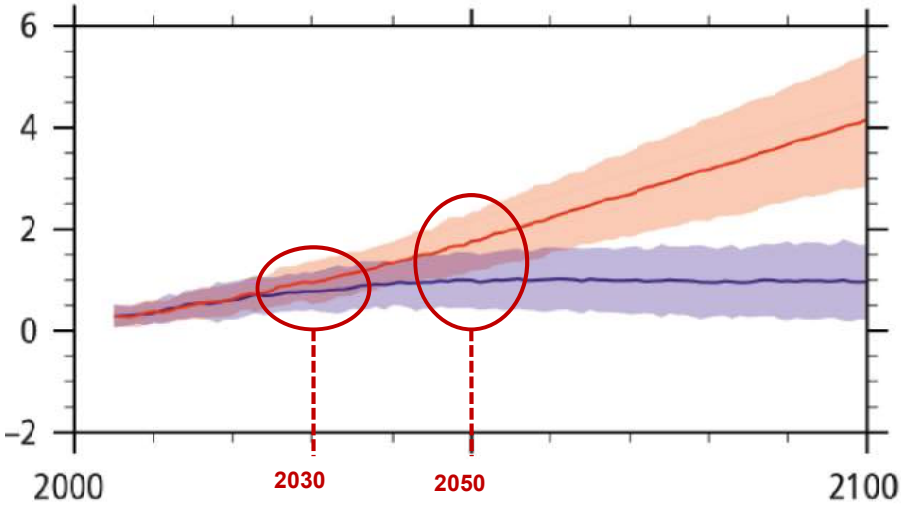
Note

How to coordinate the worldview with each business division?

Source: This Practical Guide (example of ITOCHU Corporation: 3-24, 3-25, 3-26)

[Stage1: Choose scenarios]
Choose a number of scenarios with different temperature targets, including “lower than 2°C”

[Forecast of global averages surface temperature]
(Difference from the 1986-2005 average)



4°C scenario:
The temperature will rise 3.2-5.4°C above pre-industrial levels, unless more rigorous measures are taken.

2°C scenario:
The temperature will rise 0.9-2.3°C above pre-industrial levels, if strict measures are taken.

(Reference) 1.5°C scenario:
The temperature will rise less than 1.5°C above pre-industrial levels with high probability, if fundamental system migration is achieved

Almost the same temperature changes would occur in the 2°C and 4°C scenarios by 2030.
Differences between scenarios widen in the years after 2030.

Scenario analysis in the TCFD recommendations indicates applying multiple temperature scenarios including under 2°C scenario

Sources: AR5 SYR Chart SPM.6, "ETP2017," UNEP, "The Emission Gap Report 2015, Global Warming of 1.5°C (IPCC).

What kinds of scenarios should be chosen?

Scenario analyses in line with the TCFD recommendations advise that several scenarios, including "below 2°C", should be chosen. It is desirable to choose scenarios with different temperature targets and worldviews in order to minimize the possibility of unexpected "surprises." It is essential to choose scenarios that fit the sector and situation of the company, with consideration of the characteristics and parameters of each scenario.

Name・Features	IEA WEO (World Energy Outlook)	SSP (Shared Socioeconomic Pathways)	PRI IPR (Inevitable Policy Response)
	• Describes forecasts of the energy market for middle to long term ✓ Describes forecast information (qualitative and quantitative) on energy	• Describes socioeconomic scenario considering the current policy response and context ✓Describes macroeconomic information for each scenario	• Describes scenario of near-term policy response to climate change ✓Describes qualitative and quantitative forecasts related to policy response to climate change

Temperature zone

		SSP1	SSP2	SSP3	SSP4	SSP5	
RCP 8.5	CPS(Current Policies Scenario)	—	—	—	—	○	—
RCP 6.0	STEPS(Stated Policies Scenario)	○	○	○	○	○	FPS(Forecast Policy Scenario)
RCP 4.5	—	○	○	○	○	○	—
RCP 3.4	—	○	○	○	○	○	—
RCP 2.6	SDS(Sustainable Development Scenario)	○	○	○	○	○	—
RCP 1.9	—	○	○	○	—	△ Partly not achieved	—

※RCP (Representative Concentration Pathways) is a representative pathway that has radiative forcing characteristics. Below figures are radiative forcing values (If RCP is 2.6, radiative forcing will rise to 2.6W/m2 by the end of 21st century, comparing to the value before industrialization.)

○ : With climate models for RCPs
△: No model

⇒See Appendix for an outline of the various scenarios and examples of parameters.

Source: IEA Website, Riahi et al. (2017), PRI Home Paper

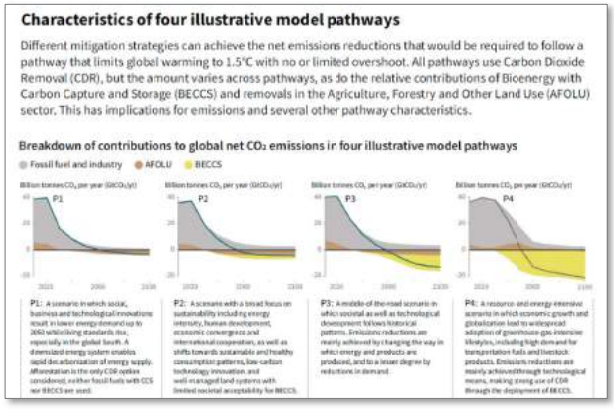
Column: 1.5°C Scenario

The Paris Agreement indicated that efforts will be pursued to keep the global average temperature increase well below 2°C and to keep it at 1.5°C compared to pre-industrial levels. In October 2018, the Intergovernmental Panel on Climate Change (IPCC) prepared a special report on the effects of a 1.5°C global warming and the pathways through which it can emit greenhouse gases.

Impact difference between 2℃ and 1.5℃ scenario（Examples）

	1.5℃ scenario	2℃ scenario
Sea level rise by 2100	Rise of 26~77cm	Rise of 30~93cm
Biological species loss	Insects：6% decrease Plants：8% decrease Vertebrates：4% decrease	Insects:18% decrease Plants:16% decrease Vertebrates:8% decrease
Disappearance frequency of sea ice in the Arctic Ocean during summer	Once in 100 years	Once in 10 years
Decrease ratio of catches	1.5 million tons	3.0 million tons
Impacts on coral reef	Approximately 70%~90% dies	Mostly annihilated

Greenhouse gas emissions pathways to 1.5°C

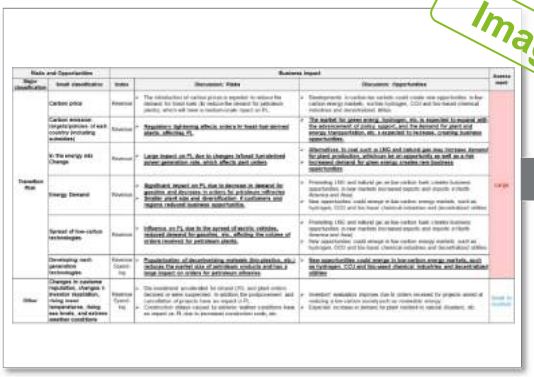


- Examples of 4 representative pathways (P1 to P4) are listed.
  - **P1: Low energy demand. No use of CCS**
  - **P2: Wide focus on sustainability**
  - **P3: Middle of the road scenario (business as usual)**
  - **P4: Expected use of CCS**

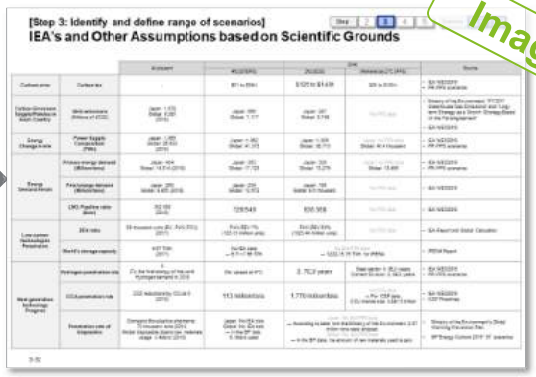
Source: Global Warming of 1.5°C (IPCC)

[Step 2: Obtain forecast information on parameters (variables)]
Obtain forecast information on parameters and identify the effects to the company in further detail

List of Risks and Opportunities



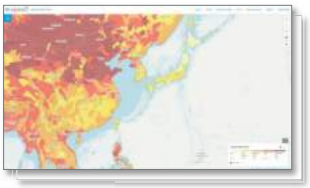
Parameters list



It is important to obtain objective forecast information on parameters from external sources

Scenario Report
(IEA WEO, IEA ETP (Energy Technology Perspectives) etc.)

External reports
(Industry-specific reports, academic papers, etc.)

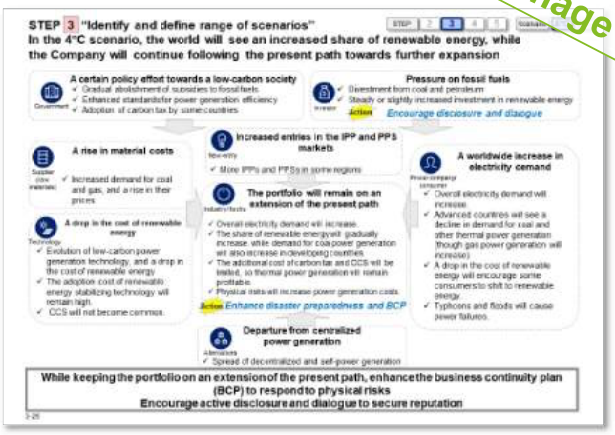


Climate Change Impact Assessment Tools
(Physical Risk Map, Hazard Map, etc.)

⇒See Appendix for examples of parameters.

Source: This Practical Guide (example of Chiyoda Corporation: 3-31, 3-32)

[Stage 3: Shape the worldview in consideration of stakeholders]
Based on forecast information, shape the company's worldview such as future stakeholders' performance and work towards achieving internal and external consensus by incorporating the perspectives from outside of company (if needed)



It would be useful to aim for building internal consensus after incorporating the perspectives from outside of company in order to understand comprehensive worldview.

Components of the worldview surrounding the company (e.g.)

Government	✓ Legal systems and regulations related to risks ✓ Policies to promote opportunities
Industry	✓ Trends, technologies and tendencies related to climate change that are mainstream in the industry
Buyer (Customers)	✓ Customer trends and tendencies affecting products, businesses, and services we provide
Seller (Suppliers)	✓ Trends affecting raw materials and costs required for business
New comer	✓ Businesses themselves and new entrants who can change supply chains
Substitute product	✓ Substitutes, etc., that could affect the market for the products, businesses, and services provided

Source: This Practical Guide (example of ITOCHU Corporation: 3-26)

How to coordinate worldview with each business division?

It is important to create a worldview that can convince relevant departments including business division through dialogue. In order to encourage relevant department members to think of climate change as their own problem, and to share the scenario's meaning and perspective, it is important to have a written narrative or some type of visualization to facilitate discussion.

Worldview (draft) developed by the Scenario Analysis Team

Points in the discussion with each department to coordinate the worldview (Example)

Business Divisions

- ✓ Are there any discrepancies in the worldview, technology, products, etc., related to each business?
- ✓ Is it a worldview that is likely to occur in the future relative to the behavior of the sellers and buyers who interact with us in our day-to-day operations?

Corporate Planning

- ✓ Are there any discrepancies compared with the company's management strategy?
- ✓ Are there any prospects for the future compared to the industry outlook mentioned in our daily operations?

Source: This Practical Guide (example of ITOCHU Corporation: 3-26)

2. Scenario Analysis - Key Points of Practice

2-1. For beginning scenario analysis

2-2. STEP2. Assess materiality of climate-related risks

2-3. STEP3. Identify and define range of scenarios

2-4. STEP4. Evaluate business impacts

2-5. STEP5. Identify potential responses

Chapter 2 Scenario Analysis - Key Points of Practice

This chapter explains how to practically undertake scenario analysis and describes key points of its practice, based on use cases performed by companies under the support program of the Ministry of Environment.

Evaluate business impacts:
Evaluate the potential effects on the organization's strategic and financial position under each of the defined scenarios.

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

(Notes in red: Points to consider in each step were added after the support program.)

1 Ensure governance Is in place

Integrate scenario analysis into strategic planning and/or enterprise risk management processes.
Assign oversight to relevant board committees/subcommittees.
Identify which internal (and external) stakeholders to involve and how.

Get management and operation divisions involved!

2 Assess materiality of climate-related risks

- Market and Technology Shifts
- Reputation
- Policy and Legal
- Physical Risks

What are the current and anticipated organizational exposures to climate-related risks and opportunities?
Do these have the potential to be material in the future? Are stakeholders concerned?

Pick and choose from your industry and company viewpoint!

3 Identify and define range of scenarios

Scenarios inclusive of a range of transition and physical risks relevant to the organization

What scenarios (and narratives) are appropriate, given the exposures?
Consider input parameters, assumptions, and analytical choices. What reference scenario(s) should be used?

Clearly imagine a future world under certain assumptions!

4 Evaluate business impacts

Impact on:
- Input costs
- Operating costs
- Revenues
- Supply chain
- Business interruption
- Timing

Evaluate the potential effects on the organization's strategic and financial position under each of the defined scenarios.
Identify key sensitivities.

Try not to seek too much accuracy!

5 Identify potential responses

Responses might include
- Changes to business model
- Changes to portfolio mix
- Investments in capabilities and technologies

Use the results to identify applicable, realistic decisions to manage the identified risks and opportunities.
What adjustments to strategic/financial plans would be needed?

Do not narrow down! Take multiple scenarios into account.

6 Documentation and disclose

Document the process; communicate to relevant parties: Be prepared to disclose key inputs, assumptions, analytical methods, outputs, and potential management responses

Disclose information from readers' viewpoint!

Sources: The Task Force on Climate related Financial Disclosures, "Technical Supplement The Use of Scenario Analysis in Disclosure of Climate Related Risks and Opportunities", June 2017.

[Overview]
Estimate the financial impact on P/L and B/S, then compare the gap between future perspectives and financial indicators in the business as usual

Stage 1 — Identify potential financial indicators affected by risks and opportunities

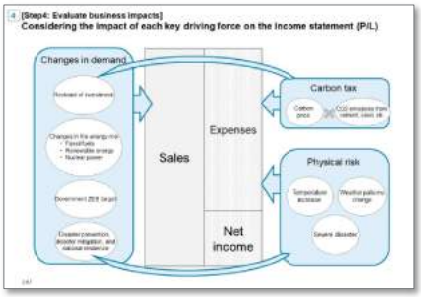
Identify which financial indicators are possibly affected by business impact of climate change

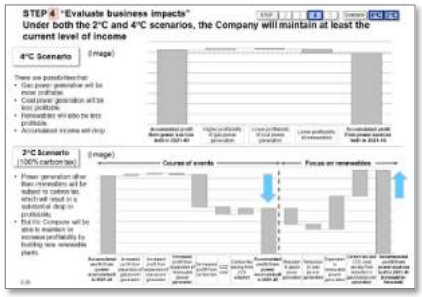
Stage 2 — Consider calculation formula and estimate financial impact

Consider calculation formula for risks that can be estimated, then estimate the financial impact based on internal information

Stage 3 — Be aware of the gap between future outlook and financial indicators in the business as usual

Based on the estimated results, be aware of the scale of impact on the future outlook





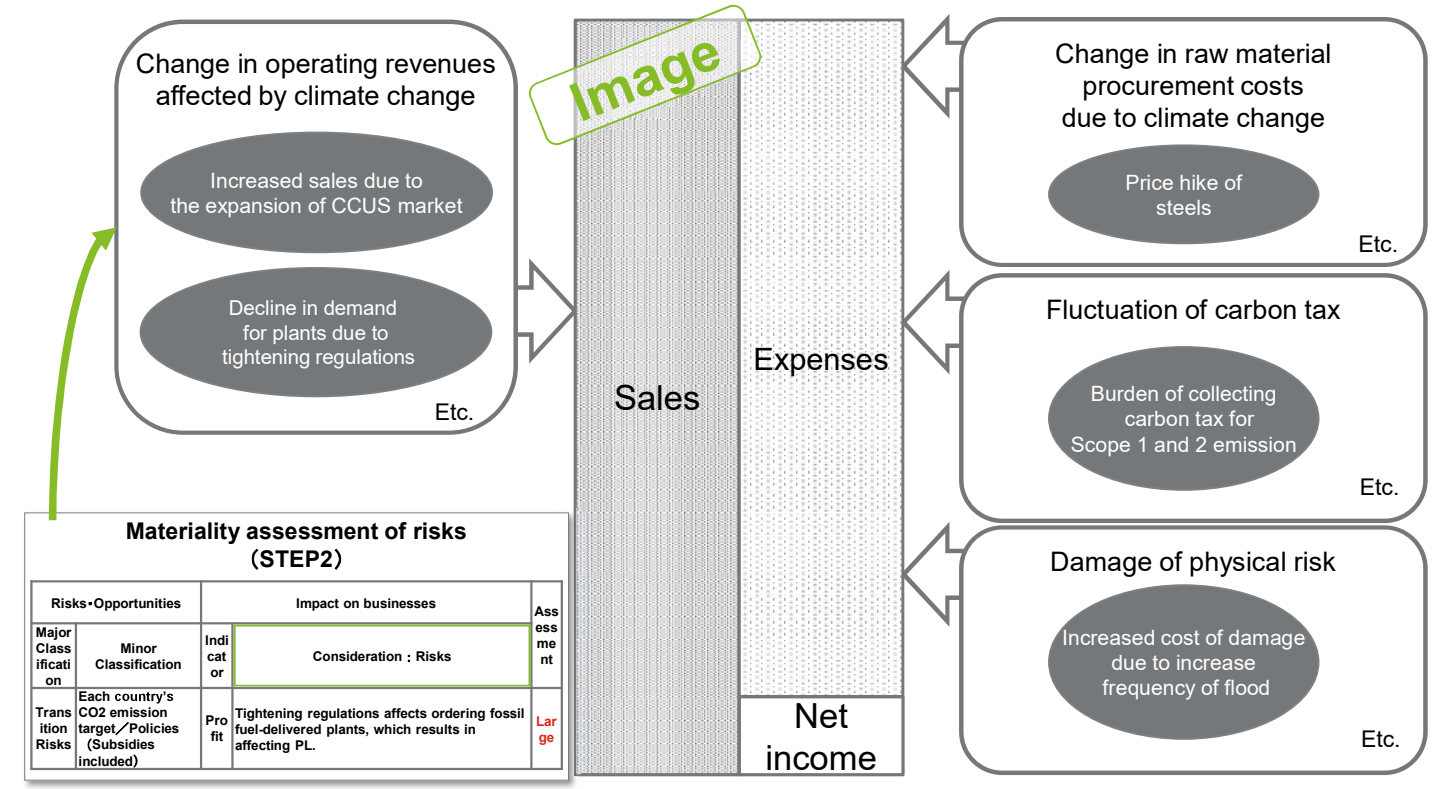
Note
What kind of internal data can be used for estimation?

Note
How do we treat data that cannot be quantitatively estimated?

Source: This Practical Guide (examples of Kajima Corporation: 3-67, Mitsui O.S.K. Lines, Ltd.: 3-46, ITOCHU Corporation: 3-28)

[Stage1: Identify potential financial indicators affected by risks and opportunities]

Identify which financial indicators of P/L and B/S are affected by risks and opportunities



Materiality assessment of risks (STEP2)

Risks・Opportunities		Impact on businesses		Assessment
Major Classification	Minor Classification	Indicator	Consideration : Risks	
Transition Risks	Each country's CO2 emission target／Policies (Subsidies included)	Profit	Tightening regulations affects ordering fossil fuel-delivered plants, which results in affecting PL.	Large

It is crucial to differentiate "Profit" and "Cost" at first (as Fluctuation of profit × Profit ratio = Fluctuation of profit, which also indicates that the impact can be largely different.)

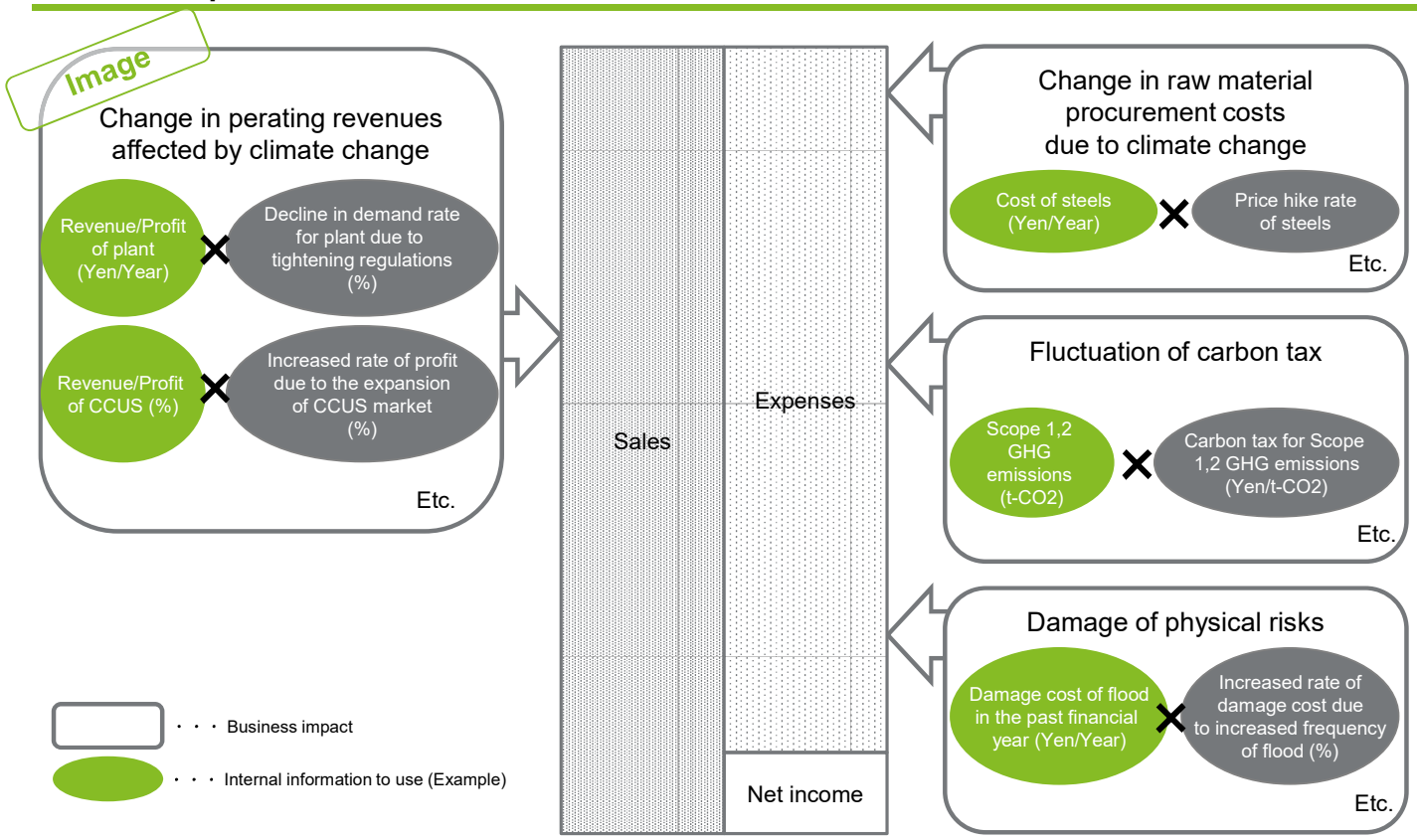
□ ・・・ Business impact

What kind of internal data can be used for estimation?

By using data that is commonly used by business divisions (e.g. sales information by business/products, operational costs, cost structure, greenhouse gas emissions), it is possible to create estimations close to actual company conditions

	Information available for consideration	Methods for collecting information
Sales Structure	**Current and future sales and operating income by business segment** (Targets for net sales and operating income)	✓ Refer to the company's long-term management targets, etc. ✓ In the absence of relevant information, it is possible to calculate the current value using CAGR (annual growth rate), etc.
	Sales forecasts and targets for related products in the future (By product)	✓ Hearings from business divisions, corporate planning, etc. ✓ If owned, also collect information on future market conditions normally used by relevant departments.
Cost Structure	**Current operating costs** (Electricity and fuel prices, electricity and fuel consumption, etc.)	✓ Hearings from business divisions, corporate planning, etc.
	Information on the cost structure of raw materials (Amount of raw materials used, procurement cost, etc.)	✓ Hearings from business divisions, corporate planning, etc. ✓ If owned, also collect information on future market conditions normally used by relevant departments.
	Current and future GHG emissions (Scope 1 and 2, Scope3 if needed)	✓ Refer to the company's environment-related targets, etc.

[Stage2: Consider calculation formula and estimate financial impact]
Consider calculation formula for financial indicator that can be estimated, then estimate the financial impact based on internal information



How do we treat data that cannot be quantitatively estimated?

Regarding qualitative information or information with little scientific basis, measures such as continuous monitoring and interviews with external experts could be methods for evaluation. It is important to identify evaluated/unevaluated risks and clarify the next action

Image

Risk Item	Validity of quantitative estimation of business impact	Review status
Risk A	**Possible**	**Considered**
Risk B	**Possible**	**Considered**
Risk C	**Not possible** (Qualitative Information Only)	Considered (Qualitative)
Risk D	**Not possible** (no scientific data)	Not considered
Risk E	**Possible**	**Considered**

[Examples of actions for risks that cannot be quantified]

Interviews with outside experts

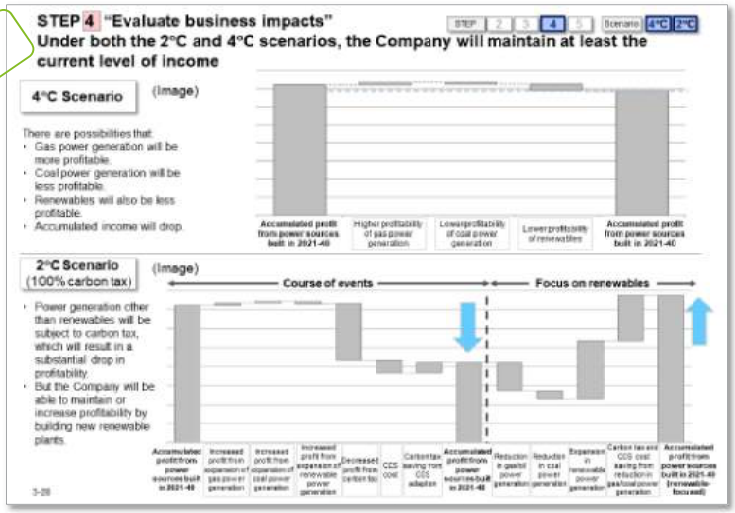
- ✓ Hearings with external experts such as research institutes and experts regarding risks that could not be calculated
- ✓ The results of the hearings are stored as qualitative information.

Continuous internal monitoring

- ✓ Continuously monitor to obtain up-to-date information on risks.

[Stage 3: Be aware of the gap between future outlook and financial indicators in the business as usual]
Based on the estimated results, be aware of the scale of impact on the future outlook

Image



Understand the impact of climate change on business prospects (future management targets and plans)

- ✓ What risks and opportunities have a greater impact?
- ✓ It is possible to understand the extent to which climate change threatens the business prospects for future management and targets. In some sectors and industries, the impact may be smaller than anticipated.

Source: This Practical Guide (example of ITOCHU Corporation: 3-28)

2. Scenario Analysis - Key Points of Practice

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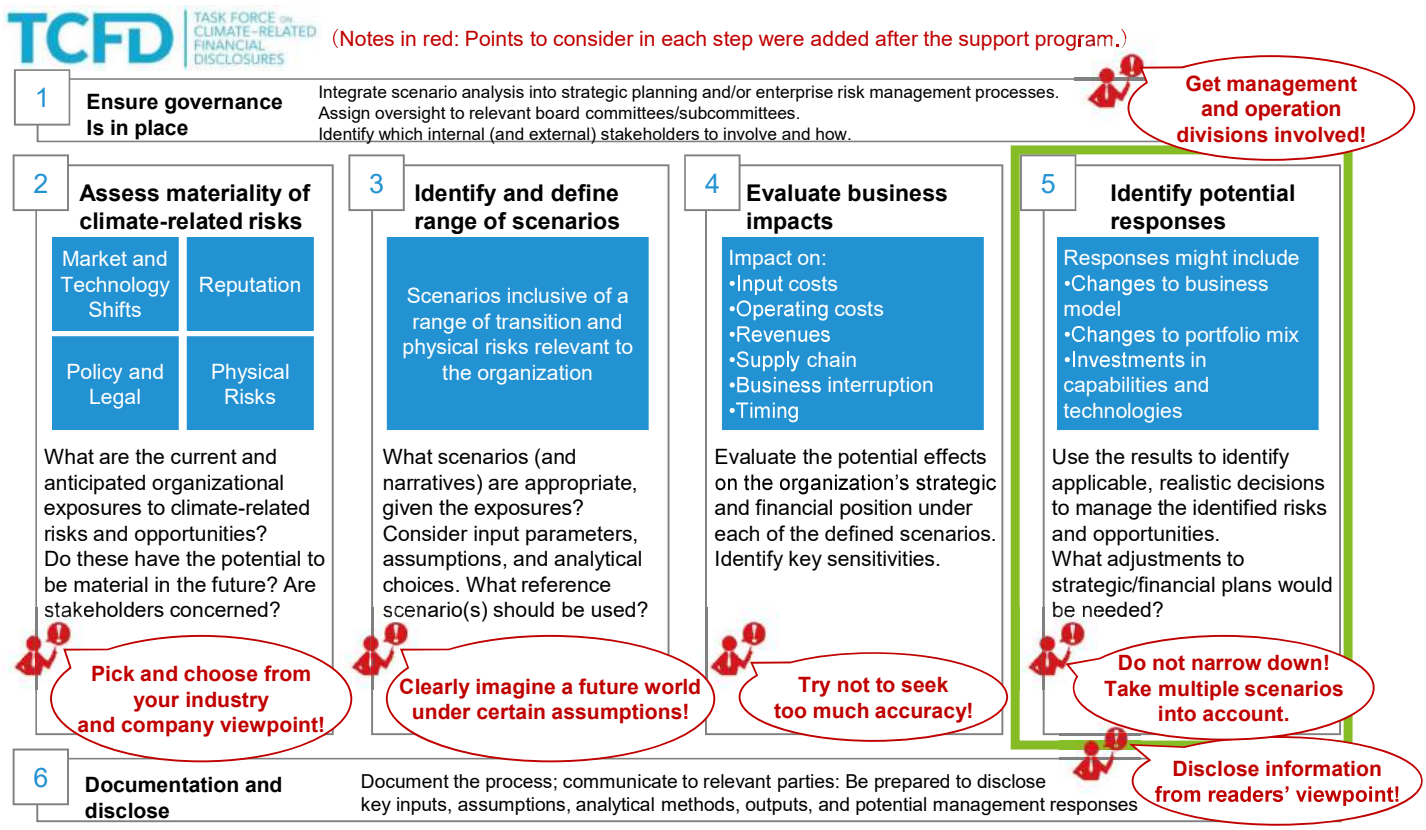
Chapter 2 Scenario Analysis - Key Points of Practice

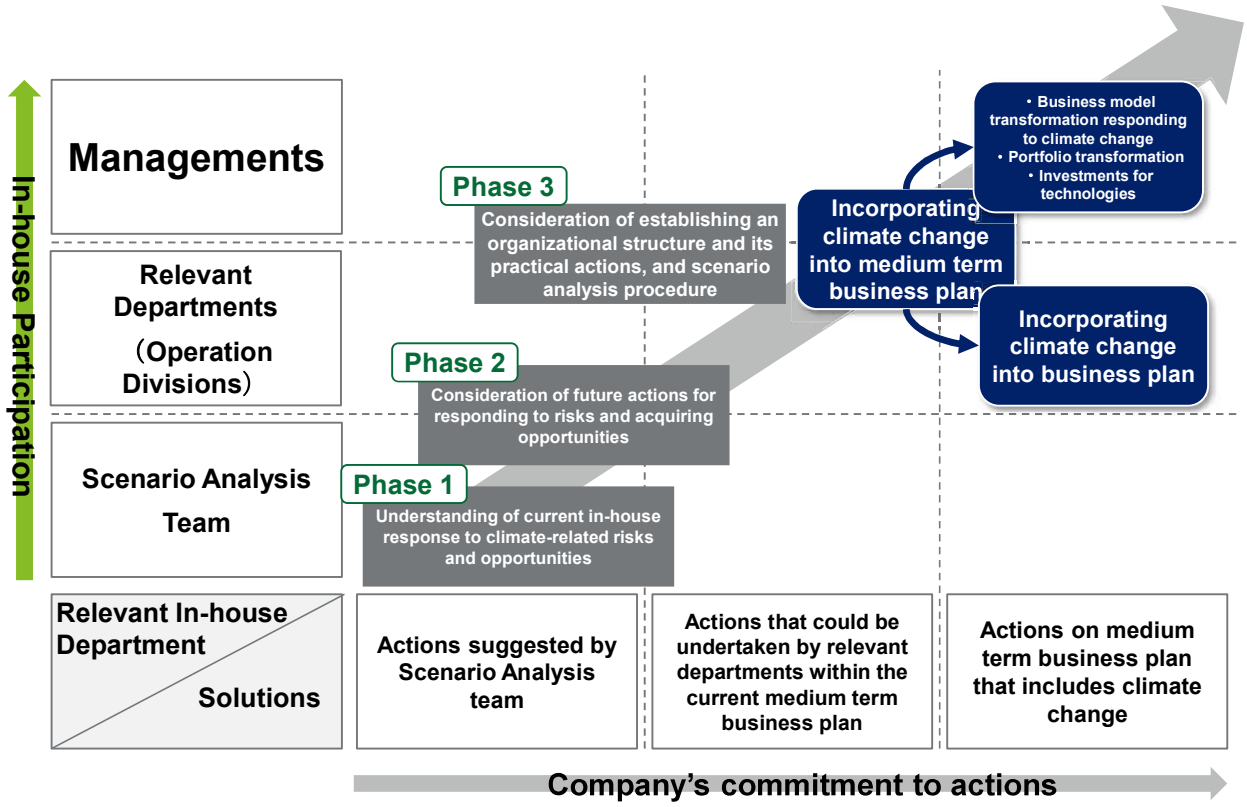
This chapter explains how to practically undertake scenario analysis and describes key points of its practice, based on use cases performed by companies under the support program of the Ministry of Environment.

Identify potential responses:
Use the results to identify applicable, realistic decisions to manage the identified risks and opportunities.



Sources: The Task Force on Climate related Financial Disclosures, "Technical Supplement The Use of Scenario Analysis in Disclosure of Climate Related Risks and Opportunities", June 2017.

【STEP5　Definitions of Actions/ Target of Practical Guide】
Practical Guide demonstrates flows for "integration of climate change into business management (inclusion of climate change into medium term business plan)" as it is crucial for countermeasures involving business model transformation.



[Overview]

Understand company's current status on risk management, consider countermeasures, and establish practical action plans and an organizational structure

Stage1

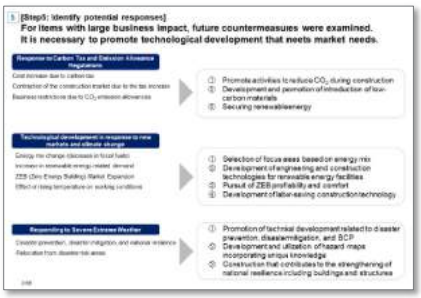
Understand company's current status on risk management

Regarding climate-related risks with great financial impact, it is important to understand the company's current status for risk management. If necessary, confirm the current status of rival companies

Stage2

Consider future countermeasures for climate-related risk management and seizing opportunities

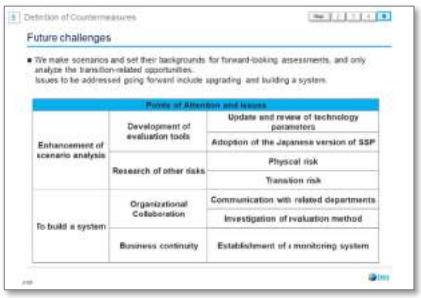
Consider practical countermeasures for risks and opportunities with great financial impact



Staeg3

Establish an organizational structure and consider practical countermeasures and how to proceed scenario analysis

Establish an organizational structure in order to promote countermeasures, and take practical actions cooperating with relevant department. And also consider how to proceed with scenario analysis



Note

How will scenario analysis results be used in management?

Note

What kind of organizational structures are suitable after conducting scenario analysis?

Note

What steps should be taken in the future?

Source: This Practical Guide (examples of FUJIFILM Holdings Corporation: 3-116, Kajima Corporation: 3-69, Development Bank of Japan Inc.: 3-20)

[Stage1: Understand company's current status on risks management and seizing opportunities]

Regarding climate-related risks and opportunities with great financial impact, it is important to understand the company's current status for risk management. If necessary, confirm the current status of rival companies

	Risks and Opportunities	Status of the company's own response	Status of responses by competitors		
			Company X	Company Y	Company Z
Policies/ Target	Risk A	Organizing the status of the company's own responses	Benchmark Survey of Competitors' Responses		
	Risk B				
	Opportunity C				
Market	Risk D				
	Opportunity E				
	Opportunity F				
. . . .	. . .	. . .	. . .	. . .	. . .

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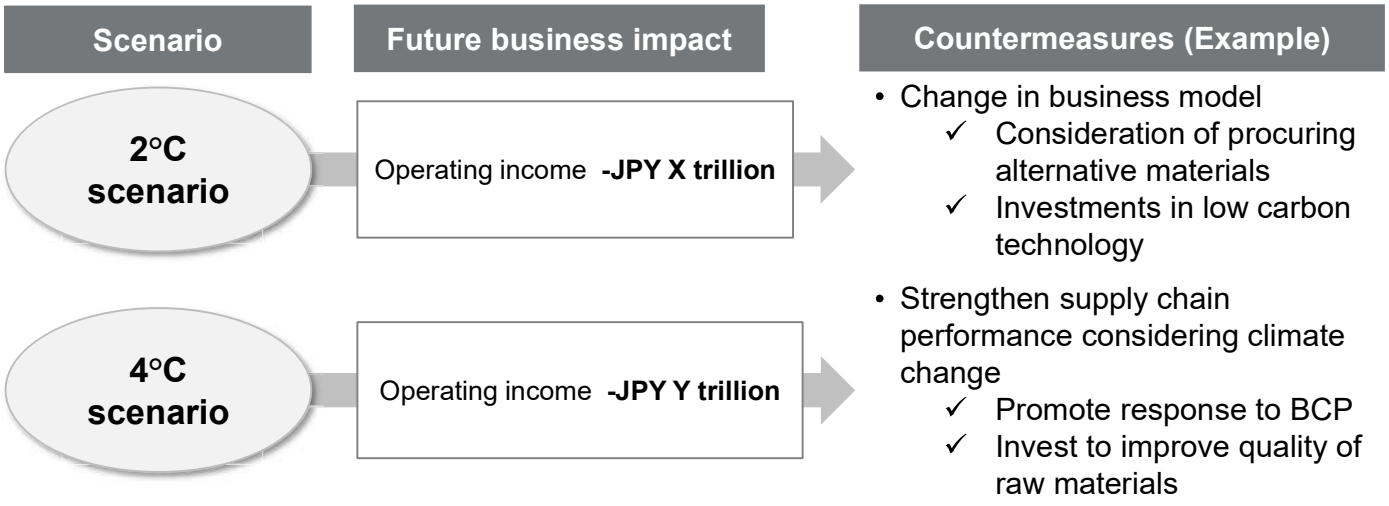
It is a suggestion to conduct comparative analysis on the company and competitors regarding risk management

[Stage 2: Consider countermeasures for climate-related risk management and seizing opportunities]
Consider practical countermeasures for risks and opportunities with great financial impact



It will become important to plan resilient countermeasures that can be used in any situation

[Phase 3: Establish practical action plans and an organizational structure]
Establish an organizational structure in order to implement countermeasures and take practical actions cooperating with relevant department. And also consider how to proceed with scenario analysis

Image

Response implementation period (Example)	Future Actions (Example)		
	Establish an organizational structure	Taking practical actions cooperating with relevant department	How to proceed with scenario analysis
Currently or for a few months	✓ Dissemination of the results of scenario analysis within the company (including managements) ✓ Gaining an agreement from managements on the needs for establishing an organizational structure in order to promote countermeasures	-	✓ Interviews with experts on important risks and opportunities for which there is little information
～1 year	✓ Establishing an organizational structure in order to promote countermeasures through explaining to relevant department	✓ Cooperating with relevant department and take practical actions aligned with existing business plans that is relatively easy to implement ✓ Beginning practical consideration with relevant department for new actions	✓ **Establishment of a monitoring system for scenario analysis** ✓ Monitoring
As needed (timings may differ for each company)	✓ **Incorporating climate change into medium term business plan** ✓ Encourage dialogue with stakeholders on climate change to create markets ✓ Introduction of internal carbon pricing as a mechanism to promote low-carbon investment		

Consider scenario analysis procedure, establishing an organizational structure , and getting relevant department involved in the course of scenario analysis, alongside with proceeding the incorporation of climate change into medium term business plan

How will scenario analysis results be used in management?

It is important that climate change be included in the process of business strategy planning.
One tip is to include climate change into the nearest midterm management plan

Report the results of scenario analysis to managements

Establish an organizational structure and take practical actions cooperating with relevant department

Incorporate climate change into medium term business plan

Climate Change

Management Policy

Responding to Risks and Opportunities

- **Report the results of scenario analysis to managements**

※Under the Ministry's support program, **it is required to conduct "A debrief session on climate change impacts on one's company" (the results of the scenario analysis) for managements**

[Results of the FY2018 Ministry of the Environment Scenario Analysis Support Project]

Company A: Established a new department specializing in the integration of IR/Sustainability as the understanding of management progressed. **Periodic discussions with executives on TCFD held at the Sustainability Committee**

Company B: Improved understanding of management and launched a team for climate change management. **Executive Vice President assumes chairmanship**

- Company-wide deployment of scenario analysis
- Materialization of countermeasures for risk management and seizing opportunities
- Establishment of a system to promote the above

Alignment of target level and practical measures for achieving the targets in the medium term business plan

- **Creation of medium term business plan**

Input of external environment

Promoting Scenario Analysis

- Monitoring of risks and opportunities
- Establishment of a system to promote the above

- **Consider indicators and targets linked to medium term business plan**
- Continuation of monitoring

What kind of organizational structures are suitable after conducting scenario analysis?

It may be suggested to create a cross-sectional organization directly under the corporate planning department that deals with climate change to give effectiveness to the result of scenario analysis

As a cross-sectional organization with climate change as a company-wide theme

Philosophy

Vision

Management Strategy

Input scenario analysis results

Climate Change Measures Division

Business Divisions

XX Division

CSR Division

Collaborate under common goals

Collaborate under common goals

Remain as limited initiatives by some divisions

Philosophy

Vision

Management Strategy

Climate Change Measures

Business Divisions

XX Division

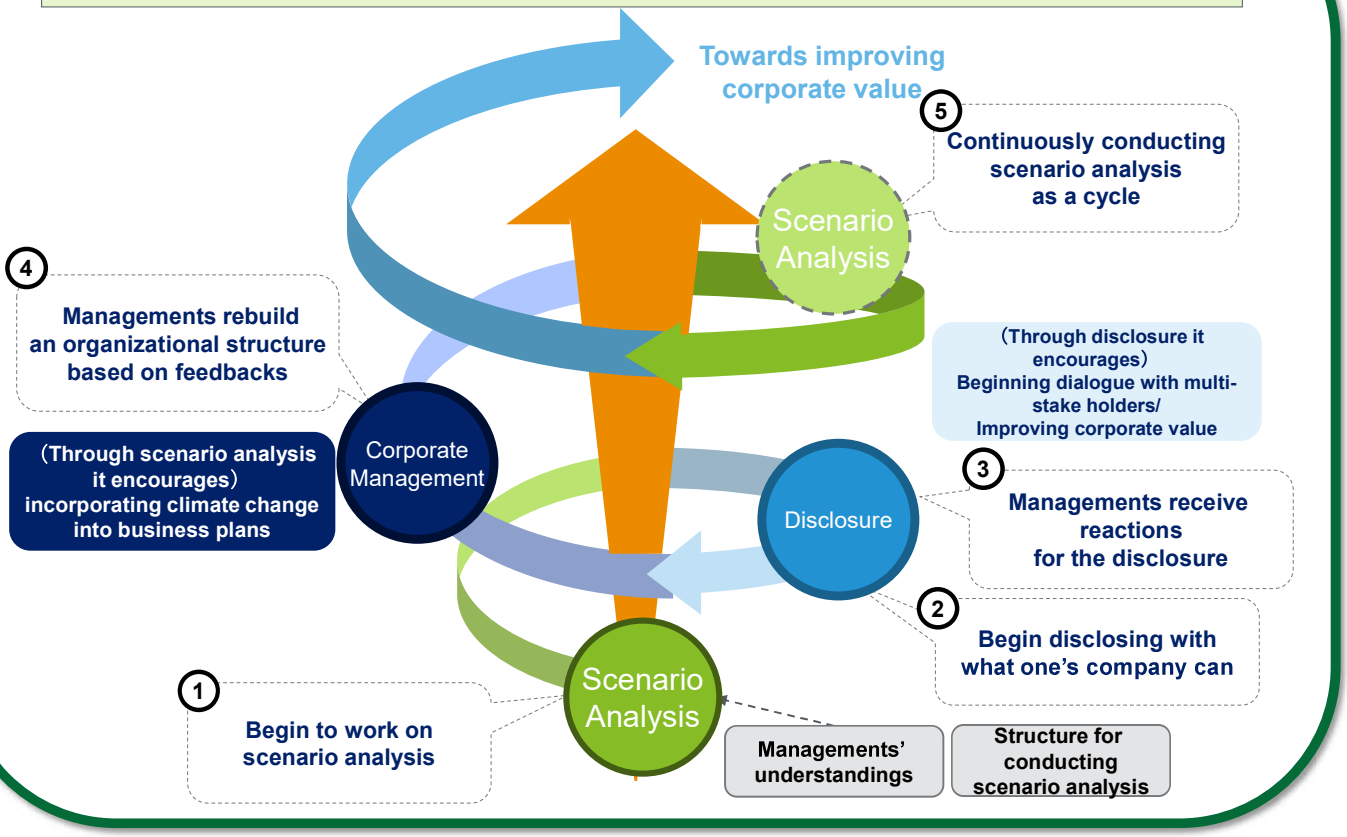
CSR Division

Cooperation on climate change is limited

Cooperation on climate change is limited

Actions to be taken for the next step?

The goal of scenario analysis is to integrate climate change with business management, and to enhance corporate value. With scenario analysis, it aims to continue the cycle of disclosing information and rebuilding an organizational structure (integration with business management).



3. Scenario Analysis - Practice Examples

Chapter 3. Scenario Analysis - Practice Example
This chapter explains how scenario analysis is carried out based on the support cases of the Ministry of the Environment (18 companies).

【Examples of scenario analysis by sector】
For beginning scenario analysis

Sector		Company	For beginning scenario analysis			
			Preparation① Gaining understandings from managements	Preparation② Establishing an organizational structure for scenario analysis	Preparation③ Setting target analysis	Preparation④ Setting timeline for analysis
Financial	Banks	Development Bank of Japan Inc.	—	—	3-7, 3-8	3-7
Non-Financial	Energy	ITOCHU Corporation	—	—	3-22	3-24
		Chiyoda Corporation	—	—	—	3-30
	Transportation	Mitsui O.S.K. Lines, Ltd.	—	—	—	3-39
		Japan Airlines Co., Ltd.	—	—	—	3-50
		Mitsubishi Motors Corporation	—	—	—	3-55, 3-58
	Buildings/ Forest Products	Kajima CORPORATION	—	—	3-61	3-63
		Sumitomo Forestry Co., Ltd.	—	—	—	3-74
		Tokyu Fudosan Holdings Corporation	—	—	3-86	3-86
	Construction Materials	LIXIL Group Corporation	—	—	3-93, 3-94	3-94
	Materials	FUJIFILM Holdings Corporation	—	—	3-106	3-108
		Furukawa Electric Co., Ltd.	—	—	3-118,3-119	3-122
	Food	Kagome CO.,LTD.	—	—	3-131	3-133
		Calbee, Inc.	—	—	3-148	3-150
		Meiji Holdings Co., Ltd.	—	—	3-157	3-157
	Electronic Equipment	KYOCERA Corporation	—	—	—	3-175
	Retailing	Seven & i Holdings Co., Ltd.	—	—	3-186	3-189
	Consumer Products	Lion Corporation	—	3-199	3-199	3-202

【Examples of scenario analysis by sector】
STEP2. Assess materiality of climate-related risks

Sector		Company	STEP2. Assess materiality of climate-related risks		
			Stage 1 Listing risk items	Stage 2 Identifying potential impact on business	Stage 3 Assessing materiality of risks
Financial	Banks	Development Bank of Japan Inc.	3-10	3-10	3-10
Non-Financial	Energy	ITOCHU Corporation	3-23	3-23	3-23
		Chiyoda Corporation	3-31	3-31	3-31
	Transportation	Mitsui O.S.K. Lines, Ltd.	3-38	3-38	3-38
		Japan Airlines Co., Ltd.	3-49	3-49	3-49
		Mitsubishi Motors Corporation	3-56, 3-59	3-56, 3-59	—
	Buildings/ Forest Products	Kajima CORPORATION	3-62	3-62	3-62
		Sumitomo Forestry Co., Ltd.	3-72, 3-73	3-72, 3-73	3-72, 3-73
		Tokyu Fudosan Holdings Corporation	3-87	3-87	3-87
	Construction Materials	LIXIL Group Corporation	3-95	3-95	3-95
	Materials	FUJIFILM Holdings Corporation	3-107	3-107	3-107
		Furukawa Electric Co., Ltd.	3-121	3-121	3-121
	Food	Kagome CO.,LTD.	3-132	3-132	3-132
		Calbee, Inc.	3-148, 3-149	3-149	3-149
		Meiji Holdings Co., Ltd.	3-157 ~ 3-159	3-157 ~ 3-159	3-157 ~ 3-159
	Electronic Equipment	KYOCERA Corporation	3-174	3-174	3-174
	Retailing	Seven & i Holdings Co., Ltd.	3-187, 3-188	—	3-187, 3-188
	Consumer Products	Lion Corporation	3-200, 3-201	3-200, 3-201	3-200, 3-201

【Examples of scenario analysis by sector】
STEP3. Identify and define range of scenarios

Sector		Company	STEP3. Identify and define range of scenarios		
			Stage 1 Choosing scenarios	Stage 2 Obtaining forecast information on relevant parameters (viable)	Stage 3 Shaping worldview in consideration of stakeholders
Financial	Banks	Development Bank of Japan Inc.	3-10 ~ 3-12	3-10 ~ 3-12	3-13 ~ 3-16
Non-Financial	Energy	ITOCHU Corporation	3-24	3-25	3-26, 3-27
		Chiyoda Corporation	3-30	3-32	3-33, 3-34
	Transportation	Mitsui O.S.K. Lines, Ltd.	3-39	3-40, 3-41	3-42 ~ 3-45
		Japan Airlines Co., Ltd.	3-50	—	3-51, 3-52
		Mitsubishi Motors Corporation	—	3-56, 3-59	3-55, 3-58
	Buildings/ Forest Products	Kajima CORPORATION	3-63	3-64	3-65, 3-66
		Sumitomo Forestry Co., Ltd.	3-74	3-81	3-75 ~ 3-80
		Tokyu Fudosan Holdings Corporation	—	—	3-88, 3-90
	Construction Materials	LIXIL Group Corporation	3-94	3-100	3-96 ~ 3-99
	Materials	FUJIFILM Holdings Corporation	3-108	3-108	3-109 ~ 3-112
		Furukawa Electric Co., Ltd.	3-120	3-122	3-123 ~ 3-125
	Food	Kagome CO.,LTD.	3-133	3-134	3-135 ~ 3-137
		Calbee, Inc.	3-150	3-151	3-152, 3-153
		Meiji Holdings Co., Ltd.	3-157	3-160	3-161, 3-162
	Electronic Equipment	KYOCERA Corporation	3-175	3-176	3-177 ~ 3-180
	Retailing	Seven & i Holdings Co., Ltd.	3-189	3-190	3-191, 3-192
	Consumer Products	Lion Corporation	3-202	3-203	3-204 ~ 3-207

【Examples of scenario analysis by sector】
STEP4. Evaluate business impacts

Sector		Company	STEP4. Evaluate business impacts		
			Stage 1 Identifying potential financial indicators affected by risks and opportunities	Stage 2 Considering calculation formula and estimating financial impact	Stage 3 Being aware of the gap between future outlook and financial indicators in the business as usual
Financial	Banks	Development Bank of Japan Inc.	—	3-17 ~ 3-19	—
Non-Financial	Energy	ITOCHU Corporation	—	—	3-28
		Chiyoda Corporation	3-35	3-35	—
	Transportation	Mitsui O.S.K. Lines, Ltd.	3-46, 3-47	—	3-46,47
		Japan Airlines Co., Ltd.	3-53	—	—
		Mitsubishi Motors Corporation	—	—	3-56, 3-59
	Buildings/ Forest Products	Kajima CORPORATION	3-67	—	3-68
		Sumitomo Forestry Co., Ltd.	—	—	3-83, 3-84
		Tokyu Fudosan Holdings Corporation	—	—	3-89, 3-91
	Construction Materials	LIXIL Group Corporation	3-101	—	3-102, 3-103
	Materials	FUJIFILM Holdings Corporation	—	—	3-113
		Furukawa Electric Co., Ltd.	—	—	3-126, 3-127
	Food	Kagome CO.,LTD.	3-138	3-138	3-139, 3-140
		Calbee, Inc.	—	3-154	3-154
		Meiji Holdings Co., Ltd.	3-163	—	3-163, 3-164, 3-170, 3-171
	Electronic Equipment	KYOCERA Corporation	—	—	3-181
	Retailing	Seven & i Holdings Co., Ltd.	—	—	3-193, 3-194
	Consumer Products	Lion Corporation	3-208	—	3-209, 3-210

【Examples of scenario analysis by sector】
STEP5. Identify potential responses

Sector		Company	STEP5. Identify potential responses		
			Stage 1 Understanding company's current status on risk management	Stage 2 Considering future countermeasures for climate-related risk management and seizing opportunities	Stage 3 Establish an organizational structure and consider practical countermeasures and how to proceed scenario analysis
Financial	Banks	Development Bank of Japan Inc.	—	3-20	3-20
Non-Financial	Energy	ITOCHU Corporation	—	—	—
		Chiyoda Corporation	—	3-36	—
	Transportation	Mitsui O.S.K. Lines, Ltd.	—	—	—
		Japan Airlines Co., Ltd.	—	—	—
		Mitsubishi Motors Corporation	—	—	—
	Buildings/ Forest Products	Kajima CORPORATION	—	3-69, 3-70	—
		Sumitomo Forestry Co., Ltd.	—	—	—
		Tokyu Fudosan Holdings Corporation	—	—	—
	Construction Materials	LIXIL Group Corporation	—	3-104	—
	Materials	FUJIFILM Holdings Corporation	3-116	3-116	—
		Furukawa Electric Co., Ltd.	—	3-128	—
	Food	Kagome CO.,LTD.	—	3-141 ~3-144	—
		Calbee, Inc.	3-155	3-155	—
		Meiji Holdings Co., Ltd.	3-165, 3-172	3-165, 3-172	—
	Electronic Equipment	KYOCERA Corporation	—	3-182 ~ 3-184	—
	Retailing	Seven & i Holdings Co., Ltd.	—	3-197	—
	Consumer Products	Lion Corporation	3-211	3-211	—

Financial Sector (Banks)

✓ Practice Example：Development Bank of Japan Inc.

1 [Overview]

Overview of our scenario analysis

- Scenario analysis of transition risks and analysis of expected impact on loans and investments by 2050 (Principle)

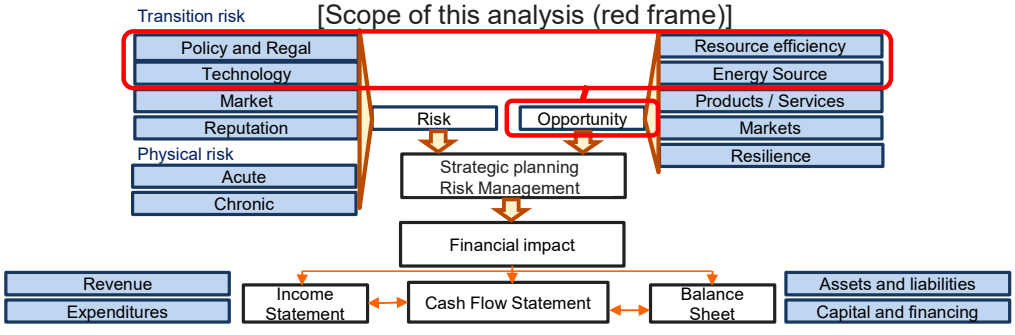
⇒ Focus on technological innovations and risks and opportunities due to policies and regulations aimed at realizing a low-carbon society and a decarbonized society.

- It is necessary for us to envision various economic and social scenarios in the future, including climate-related risks and opportunities, and to consider the optimal portfolios accordingly.

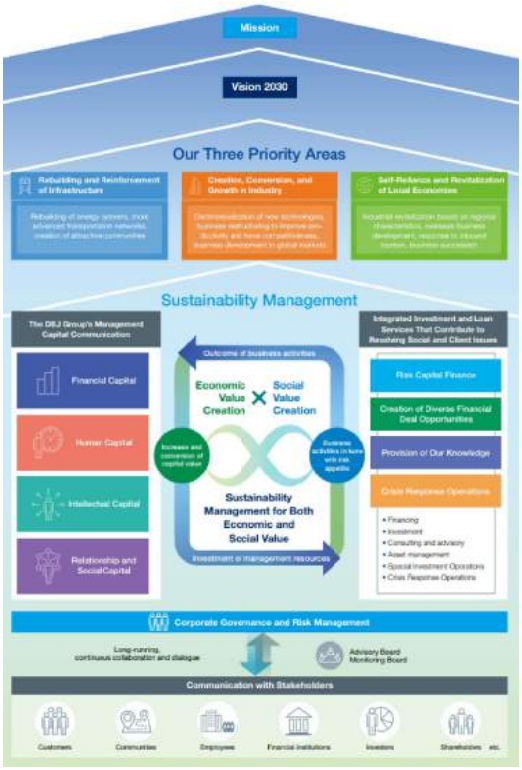
⇒To take into account socio-economic trends associated with climate change, utilizing the "Shared Socioeconomic Pathways: SSP" scenarios

- 5 technologies (CCS, EV, biomass, hydrogen, renewable energy) are focused as a trial basis from among technologies closely related to climate change.

⇒Each technology is regarded as an investment opportunity, and the business impact is analyzed and evaluated by scenario from the viewpoint of technological development and dissemination.



Sectors to be analyzed



- We select 3 sectors (A, B, and C) from our “Three Priority Areas” (Materiality), taking into account the balance of money loans and other factors.
- Opinions from departments in the relevant sector are also reflected in the analysis.

Steps to implement scenario analysis

2 Assess materiality of climate-related risks	3 Identify and define range of scenarios	4 Evaluate business impacts	5 Definition of countermeasures
Risk materiality assessment • Selection of risk items • Assessment of the importance of risk	**Selection of scenarios** • SSP	**Cross-sectoral comparisons**	**Cross-sectoral assessment**
Selection of timeframe • 2050		**Impact on its portfolio**	**Concentrated and diversified investment** etc・・・
Coverage of our trial		Future Challenges	

For this analysis, we select assessment of the importance of risk(technologies/policies), timeframe (2050), and SSP Scenarios.

Risk materiality assessment and analytical perspectives after step 3

① Selection and assessment of risk items (example)

Risk item	Business impact/Uncertainty	
Small classification	**Discussion**	**Assessment**
Carbon price	➢ Introduction of carbon prices to electricity generates additional costs for the company's power generation and increases the company's expenditure. Consumer burdens increase when costs are reflected in electricity sales prices, but consumers are more likely to choose renewable energy that gives them a competitive advantage in terms of carbon prices.	Large ～ Medium ～ Small
Dissemination of renewable energy and energy-saving technologies	Classify each risk item, and consider and assess the business impact and uncertainty associated with each item.	
Developing next-generation technologies		
Carbon Emissions Targets/Policies in Each Country		
Changes in the energy mix		

- In the many of scenario analyses, company classifies each risk item specifically and assess the importance risk according to temperature targets: 1.5℃, 2℃, and 4℃.

② Viewpoints of the analysis after step 3

[Target technologies]

Evaluate the degree of importance based on the degree of dissemination and development of technologies, etc.

CCS / EV / Renewable energy / Biomass / Hydrogen

NOTE: In order to facilitate data collection,limited to the above-mentioned technologies on a trial basis

×

[SSP Scenarios]

SSP offers a variety of possibilities for socioeconomic development, difficulty of mitigation and adaptation divided into 5 categories

- Afterwards, we will focus on "technology" as an investment opportunity, which is included in risk items. In order to consider the economic and social factors behind climate change, analysis was conducted using the SSP Scenarios.

Selection of SSP scenarios

	Scenario name	IPCC temperature zone	Overview of the worldview	Focusing on achieving a decarbonized society	International cooperation
Sustain-able	**SSP1**	1.5℃	**Decarbonized society worldwide**	✓ Policies for sustainability have been adopted, and a decarbonized society is highly likely to be realized. Optimization methods are applied to renewable energy.	✓ Assuming a world in which international cooperation is advancing and the Paris Agreement is respected
	SSP3	4℃	**Nationalism/Regionalism caused by economic disparities**	✓ Policies on environmental issues are of low priority, and it is difficult to achieve a decarbonizing society.	✓ Assuming a world that prioritizes domestic interests and values rather than international cooperation such as the Paris Agreement
	SSP5-1	2℃	**Fossil-fueled Low-carbon society**	✓ The society depended on fossil fuels, but low carbon will progress to some extent with the use of CCS and other technologies.	✓ Assuming a worldview based on cooperation aimed at by the Paris Agreement
Conventional development	**SSP5-2**	4℃	**Fossil-fueled conventional development society**	✓ Expecting growth depended on fossil fuels, it is difficult to achieve a decarbonizing society.	✓ Assuming a worldview that does not presuppose cooperation aimed at by the Paris Agreement

(Reference) Economic and policy background data on SSP1-5 scenarios

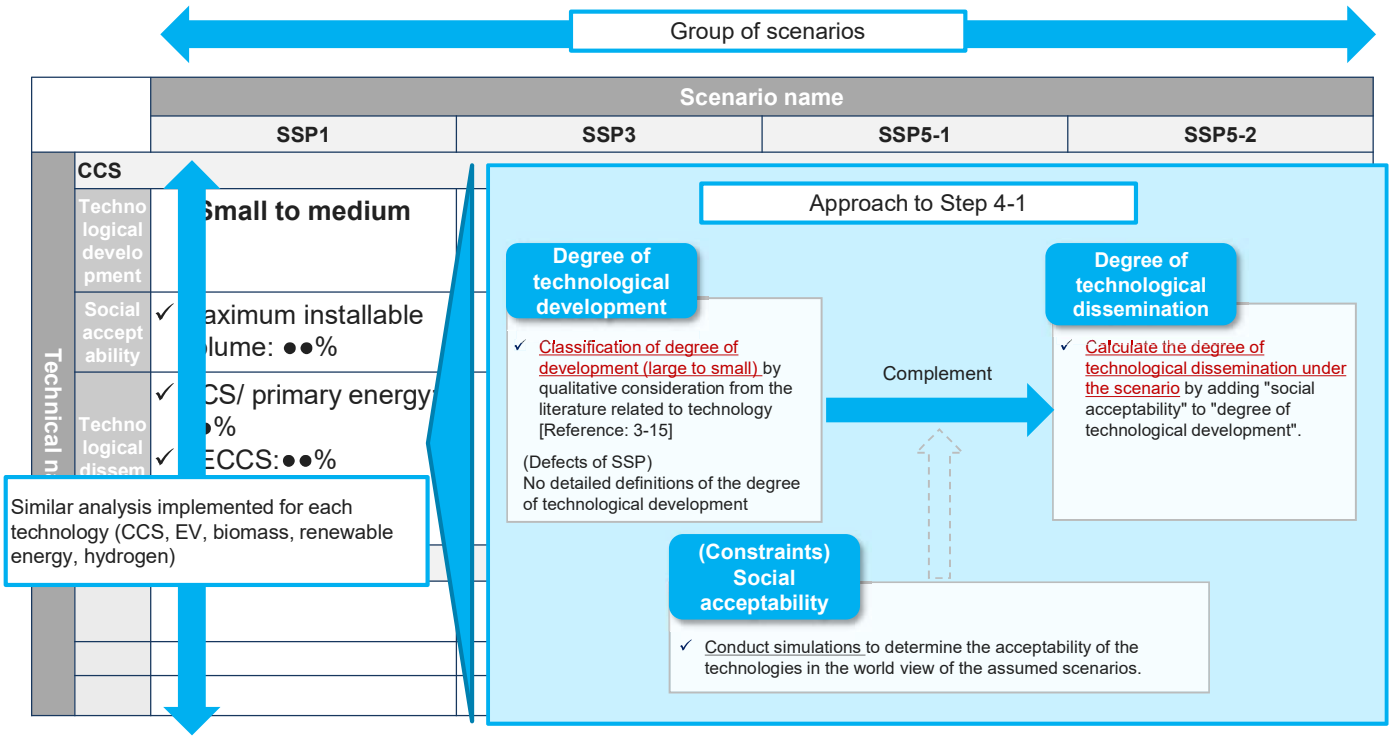
		SSP1	SSP2	SSP3	SSP4	SSP5
Economic and lifestyle	Economic growth	Growth rates are high in low-and middle-income countries, and moderate in high-income countries.	Medium, heterogeneous	Slow (low)	Low-income countries have low growth rates. Others are medium	High
	Disparity	Disparity narrows in Japan and overseas	Different conditions for the elimination of disparities in Japan and overseas	There is a large gap between Japan and overseas.	Expansion especially in Japan	Disparity narrows sharply in Japan and overseas
	International trade	Medium	Medium	Enforcement of strong restrictions	Medium	Trade is active. Production with comparative advantage of each country
	Globalization	Markets are unified and production is carried out in each region.	Some degree of freedom in globalization	Reverse from globalization. Active regional security policies	Elite employees have global connections	Globalization advances and markets move toward unification.
	Consumption trend	Physical consumption decreases in high-income countries. Expand meat-free meals	Consumption centeres on physical consumption, moderate meat consumption	Mainly physical consumption	Consumption levels are high among elites, but low among others.	Material consumption, tourism and mobility consumption Meat-centric life
Policies and Related Organizations	International cooperation	Have the effect	Relatively weak	Weak	Globally unified markets outside of vulnerable people	Targets for development are achieved, but targets for the environment are not achieved.
	Environmental policy	Improved management at regional and global volume levels. Strengthening pollution regulation	Although there are concerns about pollution at the local level, putting into practice is successful	Priority on environmental issues is low.	Middle-and high-income countries focus on environmental issues, without measures for vulnerable people	Focus on domestic policies, but lack of interest in global initiatives
	Policy direction	Sustainability policy	Focus less on sustainability	Concentration of security-related policies	Policies that benefit the business elite	Implementation of policies related to free markets, human resources development, and development
	Relevant agencies	The state and international organizations have influence	Have a moderate influence	Weak influence of international organizations	Effective measures for politics and business elites	To foster a competitive market, relevant agencies will cooperate more closely

Source: Brian C. O'Neill et al. (2017) "The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century"

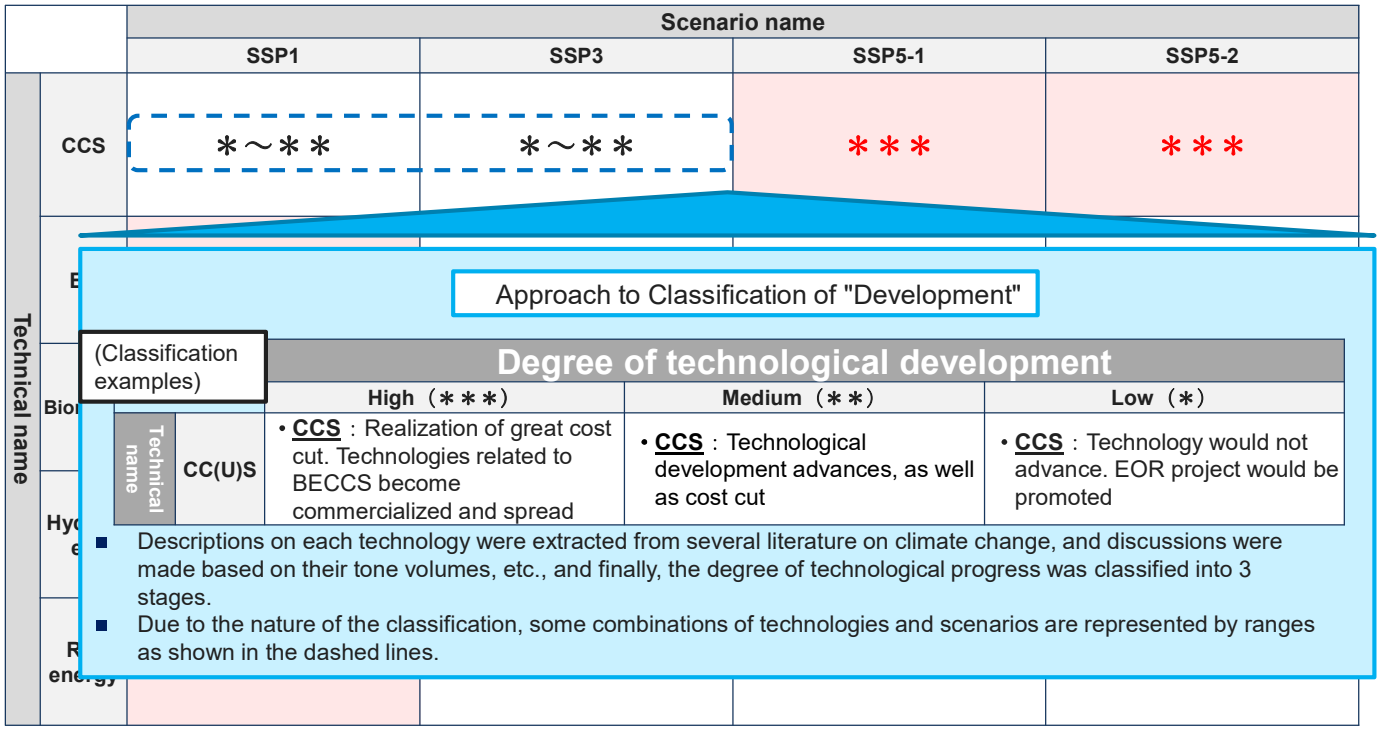
Steps to evaluate business impact

	Step 4-1	Step 4-2	Step 4-3
Overview of Evaluation	Evaluation of 5 technologies (Qualitative & Quantitative) ✓ Classify of the technological development and acceptance by scenarios.	Business impact evaluation (Qualitative) ✓ Evaluate sector impact based on scenario worldview and technology evaluation	Business impact evaluation (Quantitative) ✓ Quantify the degree of impact of technology in the scenario and Japan's strengths in technology, and consolidate them into sectoral units to evaluate "business impact."
Analytical methods	✓ Extract technology-related descriptions from multiple literature on climate change and classify "technological progress" into 3 stages ✓ We conduct simulations for each SSP scenario and calculate "degree of technological dissemination" by taking into account the results.	✓ Qualitatively evaluate the external impact of 3 sectors×4 scenarios using 5Force analyses	✓ Select recommended technologies for investment by sector and scenario, and construct our investment portfolio ✓ Scored "degree of impact of technology" (up to 6 points) from the viewpoint of necessity of government support and coverage of technology ✓ Evaluation of Japan's technological strengths on a 3-stage scale based on comparison with other countries' policies and budget requests in Japan

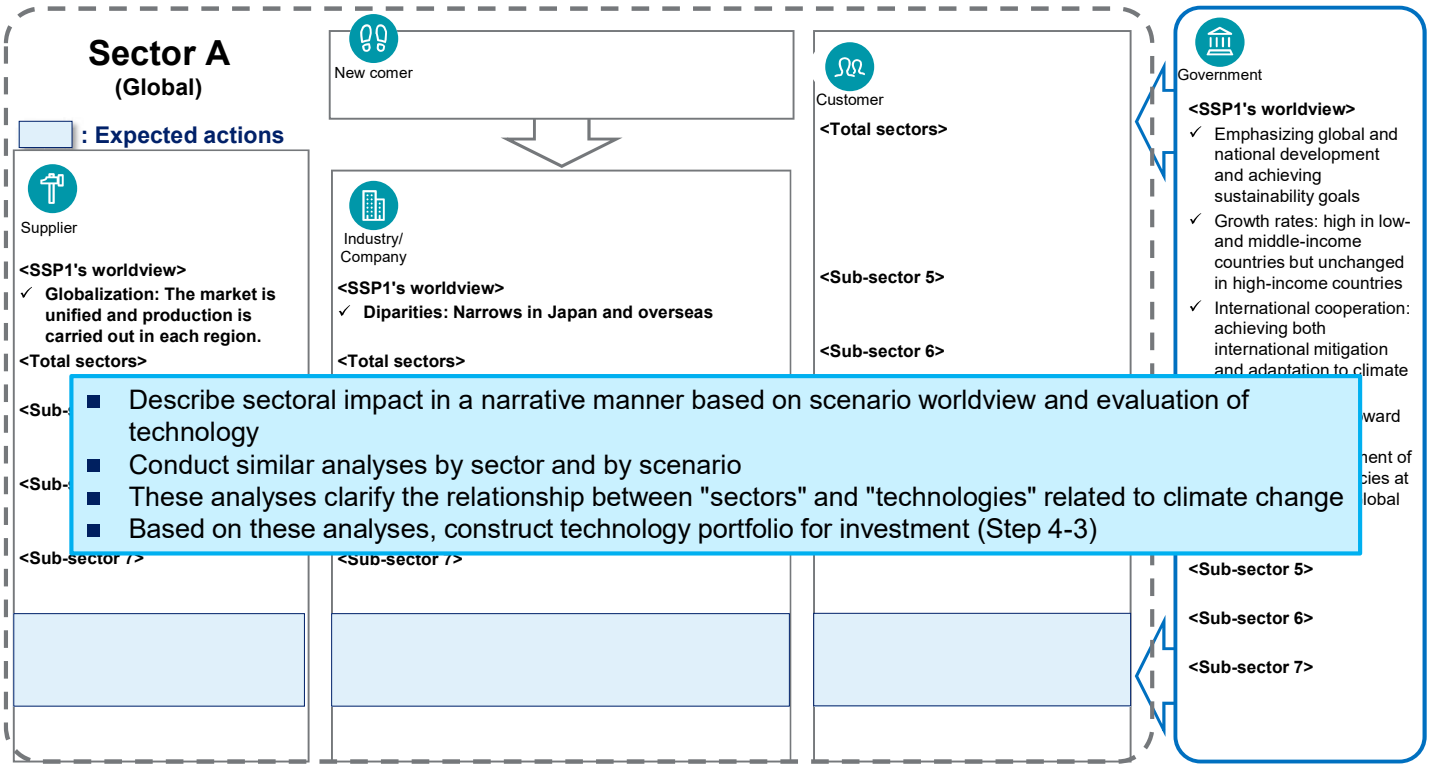
Step 4-1 Diagram



(Reference) “Degree of technological development” by scenarios



Step 4-2 Diagram: Qualitative evaluation and 5Force analyses



Approach to evaluate business impact

■ Quantify "degree of impact of technology" and "Japan's strengths" for relative evaluation. Based on these results, construct technology portfolio to conduct business impact evaluation

Evaluation Summary

✓ Based on 5Force analyses, select recommended technologies for investment by sector and scenario, and construct our investment portfolio in each sector

✓ Scored as "degree of technological impact" (up to 6 points) by adding consistency with global data to "degree of technological dissemination" selected in STEP1.

✓ Evaluation of Japan's technological strengths on a scale of small to large

"Strengths" in this analysis: Defined as an evaluation ratio whether Japan has the uniqueness of its technology and has the potential to promote it worldwide in the future. [Reference: 3-18]

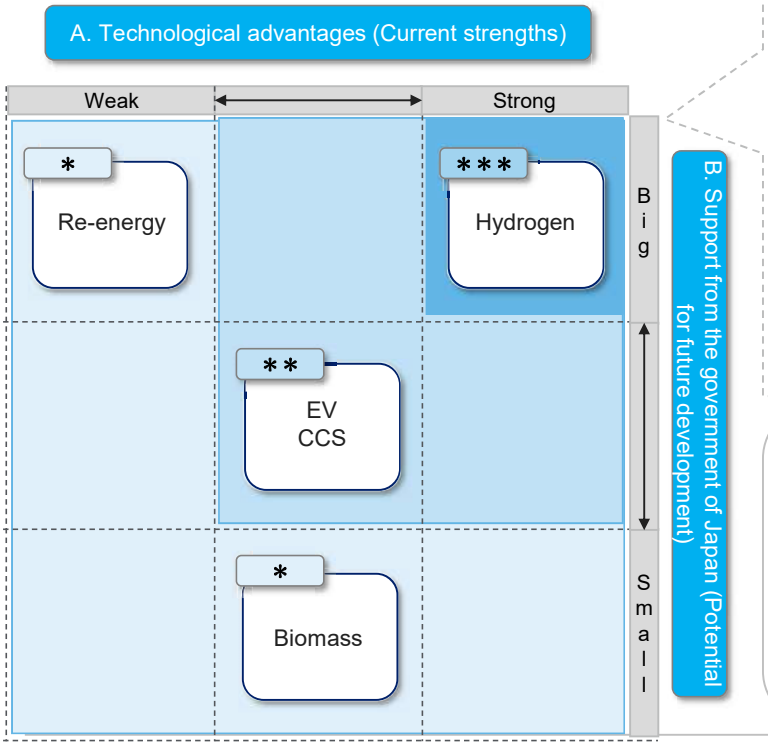
Technology portfolio = Evaluation points (0 to 6) × Evaluation ratio (0.5 to 1.5)

- Technology portfolio: Sector × Scenario
- Evaluation points (0 to 6): Technologies × Degree of impact × Scenario
- Evaluation ratio (0.5 to 1.5): Technological advantage × Assistance of the Japanese government

Business impact | Total points (4 grade evaluation: ++ to − −)

(Reference) Approach to evaluate Japan's technology strengths

■ Setting technologies in which Japanese companies have relative advantages



Evaluation	Points	Significance of Evaluation
***	1.5	✓ Japan has a high degree of uniqueness regarding technology, and the size of the government's budget is also large.
**	1	✓ Medium both in terms of technical uniqueness and budget size in Japan
*	0.5	✓ Other countries are ahead of the other countries in terms of technology, and the budget is low.

Evaluation Standards

A. Current strengths

- Comparing the content of reports published by the government and related organizations, if the technology strategy is unique, it is evaluated as strong, and if the technology is implemented in Europe, Central America, it is evaluated as weak, depending on the strategy's expansion.

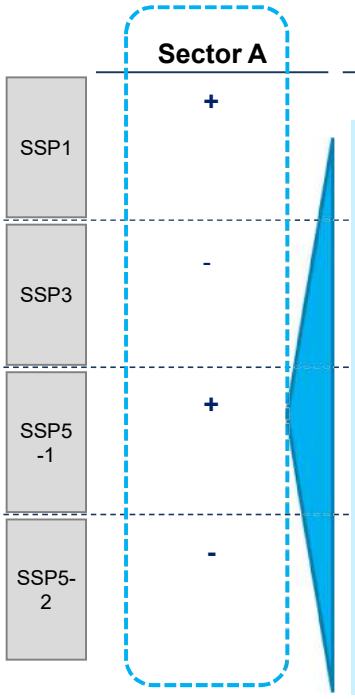
B. Assistance of the Japanese government

- Referring to METI's "Outline of Resource and Energy Related Budget" for FY2020, evaluation is made on a big scale when the budget is JPY50 billion or more, on a medium scale when the budget is JPY10 billion or more, and on a small scale when the budget is less than JPY10 billion.

Note: Created based on information as of February 2019

Step 4-3 Diagram: Business impact evaluation

■ Consider the priority of investment based on the evaluation of business impact



Approach to Business Impact Assessment

■ For each scenario, the total points are calculated based on “the impact and strength assessments” of the evaluated 5 technologies. Based on this evaluation, we set a threshold value and evaluate it on a scale from ++ to - - 4.

■ They are allocated to each sector, and the average was used as the ultimate business impact assessment.

Rank	Significance of Evaluation
++	✓ High impact of target technologies in the sector and high growth potential
+	✓ Influence of target technologies in sectors and expected to grow
—	✓ Limited impact and growth of target technologies in the sector
— —	✓ Low impact of target technologies in the sector and no growth expected

Future challenges

- During the scenario analysis, we only focused on scenario building on “future world view” and analyzing opportunities this time.
  ⇒ Consider utilizing the scenario analysis as one of the tools for strategic investment in the future. Issues to be addressed are developing the scenario analysis and establishing organizational structure.

Points of Attention and Issues		
Enhancement of scenario analysis	Development of evaluation tools	Update and review of technology parameters
		Adoption of the Japanese version of SSP
	Research of other risks	Physical risk
		Transition risk
To build a system	Organizational Collaboration	Communication with related departments
		Investigation of evaluation method
	Business continuity	Establishment of a monitoring system

Energy

✓ Practice Example①：ITOCHU Corporation

✓ Practice Example②：Chiyoda Corporation

ITOCHU Corporation

- Textile Company
  - Apparel Division
  - Brand Marketing Division 1
  - Brand Marketing Division 2
- Machinery Company
  - Plant Project, Marine & Aerospace Division
  - Automobile, Construction, Realty & Logistics, Machinery & Industrial Machinery Division
- Metals & Minerals Company
  - Metal & Mineral Resources Division
- Energy & Chemicals Company
  - Energy Division
  - Chemicals Division
- Food Company
  - Provisions Division
  - Fresh Food Division
  - Food Products Marketing & Distribution Division
- General Products & Reality Company
  - Forest Products & General Merchandise Division
  - Construction & Logistics Division
- ICT & Financial Business Company
  - ICT Division
  - Financial & Insurance Business Division

Department in charge of scenario analysis

Power Project Department

● As of 2018

STEP 2 3 4 5

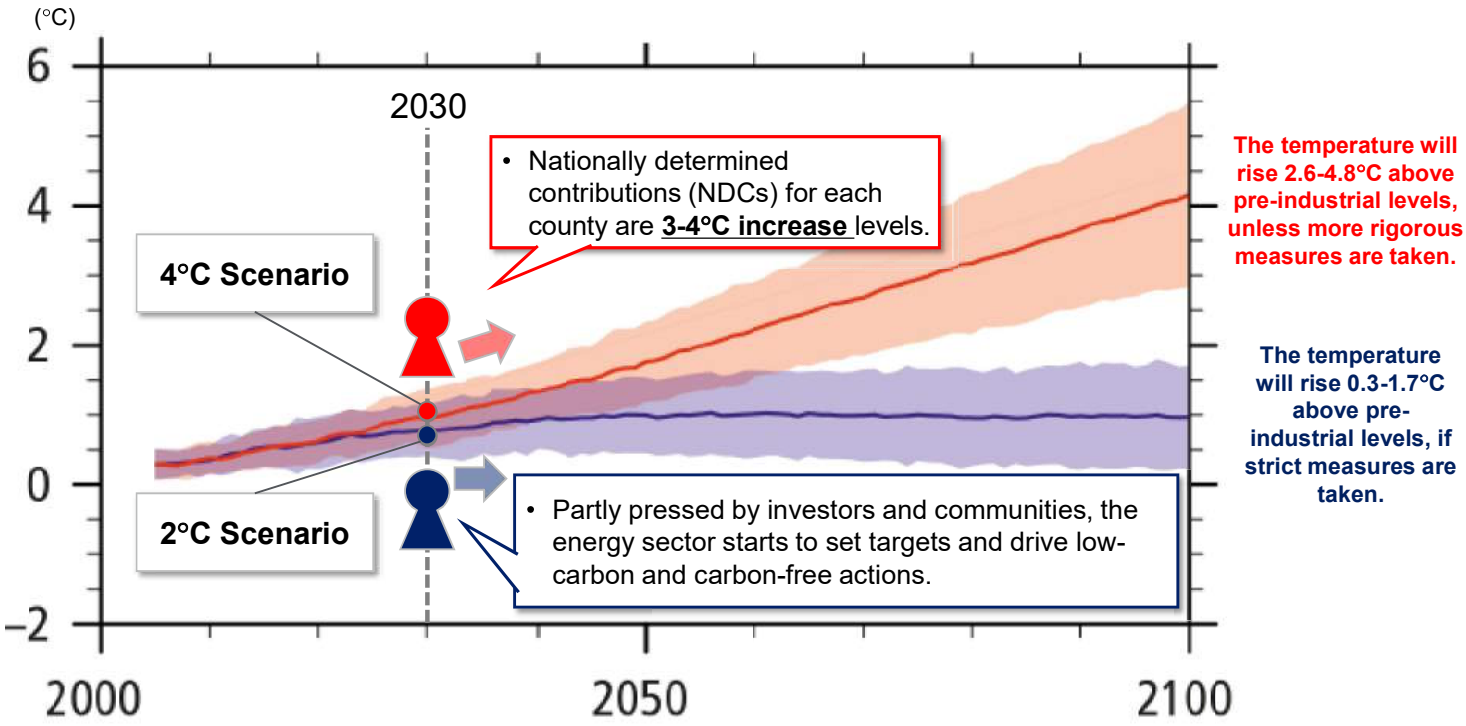
STEP 2 “Assess materiality of climate-related risks”
Climate-change risks and opportunities for the power generation segment

Risk item	Business impact (examples of considerations)	
Carbon pricing/emission rights trading	• Introduction of carbon pricing and emission rights trading will **increase the cost of thermal power generation.** (It is highly likely that the cost will not be able to be passed on in the sales price.) • **Competitive advantages for renewable energy will increase.**	**Large**
Carbon dioxide emission targets/policies of countries	• Strict regulations will **require the company to consider selling assets or making additional capital investment**.	**Large**
Change in energy mix	• Electricity from particular resources will **become unsaleable**, **opportunity loss** will occur, or **sales will decrease**. • The Company will **have to consider selling assets, or making capital investment in alternative energy resources**.	**Large**
Spread of recycling and energy-saving technologies (CCS, storage batteries, resource-saving design, etc.)	• If carbon capture and storage (CCS) is made mandatory for thermal power generation, **extra costs will be incurred**. • A drastic shift to renewable energy will **require huge investment in storage batteries and grid systems**. • If a new, low-cost and high-efficiency renewable or energy-saving technology emerges, the **demand for thermal power generation will decrease**.	**Large**
Renewable energy prices (FIT price)	• **Sales prices of new renewable energy projects will decline.** • **Competitive advantages for renewable energy will increase**.	**Large**
Changes in the reputations among investors	• Divestment will accelerate, and continuation of the thermal power generation business will **increase fund-raising costs.**	**Large**

Introduction of carbon pricing will lead to a rise in power generation costs and changes in energy mix, which will have great financial impacts.

STEP 3 "Identify and define range of scenarios"
Consider society in 2040 with two scenarios of climate change that are highly uncertain.

[Forecast of global average surface temperature (difference from the 1986-2005 average)]



Sources: Figure SPM.6 in the Synthesis Report (SYR) of the IPCC Fifth Assessment Report (AR5); International Energy Agency (IEA), "ETP 2017"; UNEP, "the Emission Gap Report 2015"; and website of the Ministry of Foreign Affairs

STEP 3 "Identify and define range of scenarios"
IEA's and Other Assumptions based on Scientific Grounds

		Present (2014)	2040		Sources
			World 40 years ahead in the 4°C scenario	World 40 years ahead in the 2°C scenario	
Carbon pricing/ emission rights trading	**Carbon pricing/ emission rights trading**	N/A	N/A	$***140***/t (US)	• IEA WEO2016 (450 scenario)
Carbon emissions targets/ policies*	**Fossil fuel prices**	Coal: $***78***/t Gas: $***4.4***/Mbtu (US)	Coal: $***108***/t Gas: $***7.5***/Mbtu (US)	Coal: $***77***/t Gas: $5.9/Mbtu (US)	• IEA ETP 2016 (4DS, 2DS)
	Renewable energy prices (FIT price) (US)**	N/A	PV utility scale: ***7.2-8.8*** yen/kWh Onshore wind power: ***6.2-7.7*** yen/kWh	PV utility scale: ***6.6-7.1*** yen/kWh Onshore wind power: ***6.2-7.7*** yen/kWh	• IEA WEO2016 (NPS, 450 scenario)
Changes in energy mix	**Energy output by source (US)**	Coal thermal: ***1,713*** TWh (40%) Gas thermal: ***1,161*** TWh (27%) Renewable: ***570*** TWh (13%)	Coal thermal: ***1,016*** TWh (21%) Gas thermal: ***1,480*** TWh (30%) Renewable: ***1,488*** TWh (30%)	Coal thermal: ***153*** TWh (3%) Gas thermal: ***959*** TWh (20%) Renewable: ***2,560*** TWh (54%)	• IEA WEO2016 (NPS, 450 scenario)
Spread of renewable and energy-saving technologies	**Penetration rate of CCS**	N/A	N/A	Coal thermal with CCS: ***64***% Gas thermal with CCS: ***18***%	• IEA ETP 2016 (2DS)

STEP 3 “Identify and define range of scenarios”

STEP 2 | **3** | 4 | 5 — Scenario **4°C** | 2°C

In the 4°C scenario, the world will see an increased share of renewable energy, while the Company will continue following the present path towards further expansion

A certain policy effort towards a low-carbon society (Government)
- ✓ Gradual abolishment of subsidies to fossil fuels
- ✓ Enhanced standards for power generation efficiency
- ✓ Adoption of carbon tax by some countries

Pressure on fossil fuels (Investor)
- ✓ Divestment from coal and petroleum
- ✓ Steady or slightly increased investment in renewable energy

Action: *Encourage disclosure and dialogue*

Increased entries in the IPP and PPS markets (New entry)
- ✓ More IPPs and PPSs in some regions

A rise in material costs (Supplier (raw materials))
- ✓ Increased demand for coal and gas, and a rise in their prices

A drop in the cost of renewable energy (Technology)
- ✓ Evolution of low-carbon power generation technology, and a drop in the cost of renewable energy
- ✓ The adoption cost of renewable energy stabilizing technology will remain high.
- ✓ CCS will not become common.

The portfolio will remain on an extension of the present path (Industry/ Itochu)
- ✓ Overall electricity demand will increase.
- ✓ The share of renewable energy will gradually increase, while demand for coal power generation will also increase in developing countries.
- ✓ The additional cost of carbon tax and CCS will be limited, so thermal power generation will remain profitable.
- ✓ Physical risks will increase power generation costs.

Action: *Enhance disaster preparedness and BCP*

A worldwide increase in electricity demand (Power company/ consumer)
- ✓ Overall electricity demand will increase.
- ✓ Advanced countries will see a decline in demand for coal and other thermal power generation (though gas power generation will increase).
- ✓ A drop in the cost of renewable energy will encourage some consumers to shift to renewable energy.
- ✓ Typhoons and floods will cause power failures.

Departure from centralized power generation (Alternatives)
- ✓ Spread of decentralized and self-power generation

While keeping the portfolio on an extension of the present path, enhance the business continuity plan (BCP) to respond to physical risks
Encourage active disclosure and dialogue to secure reputation

STEP 3 “Identify and define range of scenarios”

STEP 2 | **3** | 4 | 5 — Scenario 4°C | **2°C**

In the 2°C scenario, the world will reduce the use of thermal power generation, and substantially increase the share of renewable energy

Enhanced efforts towards a low-carbon society (Government)
- ✓ Abolishment of subsidies to fossil fuels
- ✓ Enhanced standards for power generation efficiency
- ✓ Adoption of carbon tax by many countries
- ✓ Subsidies to CCS will be granted/increased.
- ✓ More countries will adopt “Capacity Market”.

Pressure on fossil fuels (Investor)
- ✓ Divestment from coal and petroleum
- ✓ Increased investment in renewable energy

Changes in material costs (Supplier (raw materials))
- ✓ Gas prices will increase.
- ✓ Coal prices will gently decrease.
- ✓ Land prices for renewable energy will increase, and the land market will be more competitive.

More entries in the IPP and PPS markets (New entry)
- ✓ More IPPs and PPSs in some regions

A drop in the cost of renewable energy (Technology)
- ✓ Evolution of low-carbon power generation technology, and a drop in the cost of renewable energy
- ✓ Further development of renewable energy and electric vehicles, and inflated prices of storage battery and scares resources
- ✓ CCS will become common.

Action: *Increase investment related to renewable energy*

The share of renewable energy will considerably increase. (Industry/Itochu)
- ✓ Overall electricity demand will increase.
- ✓ Most electricity will be generated with renewable energy.
- ✓ Gas will replace coal as a backup source for renewable energy stabilization. (A drop in coal demand)
- ✓ Because of the additional cost of carbon tax and CCS, thermal power generation will become less profitable.

Action: *Increase the share of renewable power generation*

A worldwide increase in electricity demand (Power company/consumer)
- ✓ Overall electricity demand will increase.
- ✓ Carbon pricing will be adopted, dampening demand for thermal power generation.
- ✓ A drop in the cost of renewable energy will encourage consumers to shift to renewable energy.

Action: *Review the portfolio, and supply highly competitive energy*

Departure from centralized power generation (Alternatives)
- ✓ Spread of decentralized and self-power generation

Action: *Go into decentralized and self-power generation businesses*

While constructing a business portfolio focusing on renewable energy in line with the world trend of departure from carbon, pursue new electricity business opportunities

STEP 4 “Evaluate business impacts”

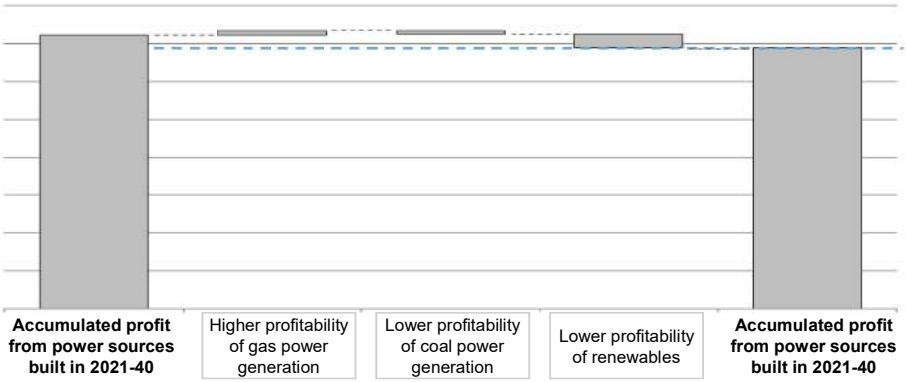
STEP 2 3 **4** 5 Scenario **4°C** **2°C**

Under both the 2°C and 4°C scenarios, the Company will maintain at least the current level of income

4°C Scenario

There are possibilities that:
- Gas power generation will be more profitable.
- Coal power generation will be less profitable.
- Renewables will also be less profitable.
- Accumulated income will drop.

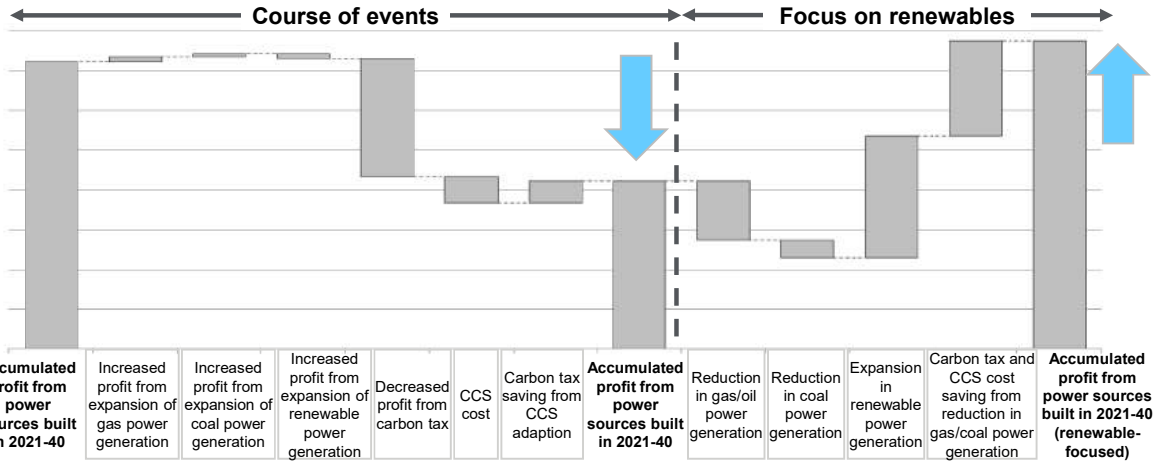
(Image)



2°C Scenario (100% carbon tax)

- Power generation other than renewables will be subject to carbon tax, which will result in a substantial drop in profitability.
- But the Company will be able to maintain or increase profitability by building new renewable plants.

(Image)



Energy

✓ Practice Example①：ITOCHU Corporation

✓ **Practice Example②：Chiyoda Corporation**

Define range of scenarios

Analytical Assumptions	Target
Target	2040
Scenarios	4℃ → Without any countermeasures (ex: no carbon tax, etc.) 2℃ → Promote countermeasures against climate change (ex: introduction of carbon tax, etc.)
Reference data	Sources: IEA WEO 2019 (Unless it doesn't cover necessary data)
Sectors	LNG/ Green Energy EPC/ Non-EPC such as hydrogen, CCU, and distributed composite utilities * EPC = Engineering, Procurement, Construction * CCU = CO2 Capture and Utilization
Financial Data	Extending the data to 2040 based on business plan until 2023 disclosed in recovery plan.

CHIYODA CORPORATION

[Step 2: Assess materiality of climate-related risks]

Step 2 | Scenario 4℃ 2℃

Future climate change poses significant risks and opportunities for Chiyoda Corporation

Risks and Opportunities		Business impact			Assessment
Major classification	Small classification	Index	Discussion: Risks	Discussion: Opportunities	
Transition Risk	Carbon price	Revenue	➢ The introduction of carbon prices is expected to reduce the demand for fossil fuels (to reduce the demand for petroleum plants), which will have a medium-scale impact on PL.	➢ Developments in carbon tax markets could create new opportunities in low-carbon energy markets, such as hydrogen, CCU and bio-based chemical industries and decentralized utilities	Large
	Carbon emission targets/policies of each country (including subsidies)	Revenue	➢ **Regulatory tightening affects orders for fossil-fuel-derived plants, affecting PL**	➢ **The market for green energy, hydrogen, etc. is expected to expand with the advancement of policy support, and the demand for plant and energy transportation, etc. is expected to increase, creating business opportunities.**	
	In the energy mix Change	Revenue	➢ **Large impact on PL due to changes in fossil fuel-derived power generation rate, which affects plant orders**	➢ **Alternatives to coal such as LNG and natural gas may increase demand for plant production, which can be an opportunity as well as a risk** ➢ **Increased demand for green energy creates new business opportunities**	
	Energy Demand	Revenue	➢ **Significant impact on PL due to decrease in demand for gasoline and decrease in orders for petroleum refineries** ➢ **Smaller plant size and diversification of customers and regions reduced business opportunities.**	➢ Promoting LNG and natural gas as low-carbon fuels creates business opportunities in new markets (increased exports and imports in North America and Asia) ➢ New opportunities could emerge in low-carbon energy markets, such as hydrogen, CCU and bio-based chemical industries and decentralized utilities	
	Spread of low-carbon technologies	Revenue	➢ **Influence on PL due to the spread of electric vehicles, reduced demand for gasoline, etc., affecting the volume of orders received for petroleum plants.**	➢ Promoting LNG and natural gas as low-carbon fuels creates business opportunities in new markets (increased exports and imports in North America and Asia) ➢ New opportunities could emerge in low-carbon energy markets, such as hydrogen, CCU and bio-based chemical industries and decentralized utilities	
	Developing next-generation technologies	Revenue Spend-ing	➢ **Popularization of decarbonizing materials (bio-plastics, etc.) reduces the market size of petroleum products and has a large impact on orders for petroleum refineries**	➢ **New opportunities could emerge in low-carbon energy markets, such as hydrogen, CCU and bio-based chemical industries and decentralized utilities**	
Other	Changes in customer reputation, changes in investor reputation, rising mean temperatures, rising sea levels, and extreme weather conditions	Revenue Spend-ing	➢ Die investment accelerated for oil and LNG, and plant orders declined or were suspended. In addition, the postponement and cancellation of projects have an impact on PL. ➢ Construction delays caused by extreme weather conditions have an impact on PL due to increased construction costs, etc.	➢ Investors' evaluation improves due to orders received for projects aimed at realizing a low-carbon society such as renewable energy. ➢ Expected increase in demand for plant resilient to natural disasters, etc.	Small to medium

The effects of "Carbon price","policy","change in energy consumption","demand transition" and "new technology",which have an influence on orders, are significant. It is also assumed that the development of next-generation technologies linked to market opportunities will have a great financial impact.

[Step 3: Identify and define a range of scenarios]

Step 2 **3** 4 5 | Scenario **4℃** **2℃**

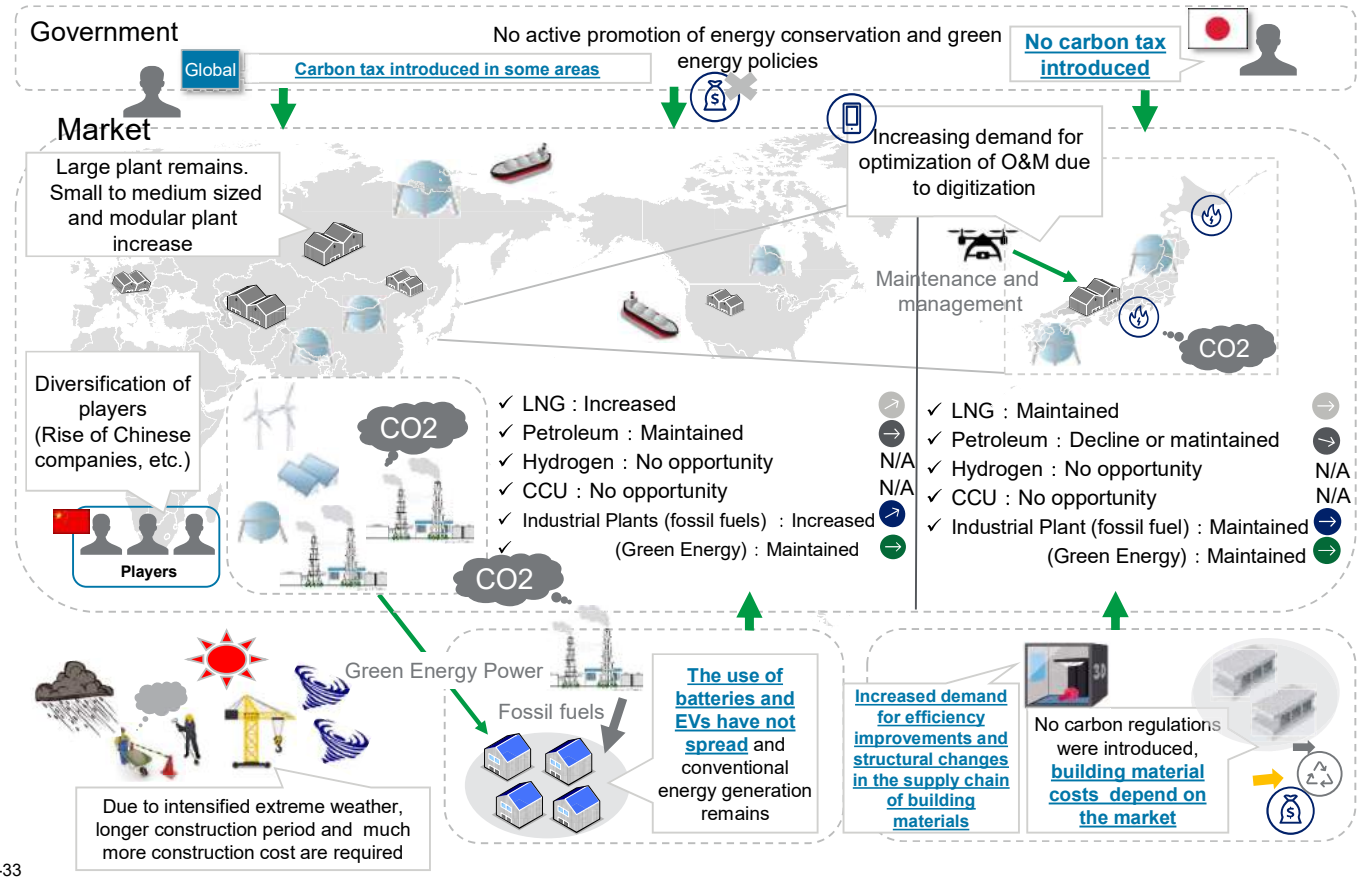
Defining worldview for each scenario based on scientific evidence from IEA and others.

		At present	2040			Source
			4℃(STEPS)	2℃(SDS)	(Reference) 2℃ (FPS)	
Carbon price	**Carbon tax**	-	$31 to $39/t	$125 to $140/t	$25 to $100/t	• IEA WEO2019 • PRI FPS scenarios
Carbon Emissions Targets/Policies in Each Country	**GHG emissions** (Millions of tCO2)	Japan :1,078 Global: 6,087 (2018)	Japan :666 Global: 7,117	Japan :287 Global: 3,748	No FPS data	• Ministry of the Environment, "FY2017 Greenhouse Gas Emissions" and "Long-term Strategy as a Growth Strategy Based on the Paris Agreement" • IEA WEO2019
Energy Change in mix	**Power Supply Composition (TWh)**	Japan :1,069 Global: 26,603 (2018)	Japan :1,062 Global: 41,373	Japan :1,005 Global: 38,713	Japan: no FPS data Global: 40.4 thousand	• IEA WEO2019 • PRI FPS scenarios
Energy Demand trends	**Primary energy demand (Million tons)**	Japan :434 Global: 14,314 (2018)	Japan :353 Global: 17,723	Japan :300 Global: 13,279	Japan: no FPS data Global: 13,469	• IEA WEO2019 • PRI FPS scenarios
	Final energy demand (Million tons)	Japan :293 Global: 9,955 (2018)	Japan :234 Global: 12,672	Japan :185 Global: 9.5 thousand	No FPS data	• IEA WEO2019
	LNG: Pipeline ratio (bcm)	352:436 (2018)	729:549	636:358	No FPS data	• IEA WEO2019
Low-carbon technologies Penetration	**ZEV ratio**	58 thousand units (EV, PHV, FCV) (2017)	PHV/ZEV:7% (123.81 million units)	PHV/ZEV:63% (1023.44 million units)	No FPS data	• IEA Report and Global Calculator
	World's storage capacity	4.67 TWh (2017)	No IEA data → 6.71~7.96 TWh	No IEA/FPS data → 12.22-15.75 TWh for IRENA		• IRENA Report
Next generation technology Progress	**Hydrogen penetration rate**	0 (To the final energy of the world Hydrogen demand in 2018	(No spread at 4°C)	2. 7EJ/ years	Steel sector: 4. 0EJ/ years Cement Division: 2. 0EJ/ years	• IEA WEO2019 • PRI FPS scenarios
	CCU penetration rate	CO2 reductions by CCUs: 0 (2018)	113 million tons	1,770 million tons	No FPS data → For ICEF data, CCU market size: US$1.5 trillion	• IEA WEO2019 • ICEF Roadmap
	Penetration rate of bioplastics	Domestic Bio-plastics shipments: 70 thousand tons (2013) Global disposable plastic raw materials usage: 3.4Mb/d (2015)	Japan: No IEA data Global: No IEA data → In the BP data, 6.1Mb/d used	Japan: No IEA/FPS data → According to data from the Ministry of the Environment, 3.07 million tons were shipped. Global: No IEA/FPS data → In the BP data, the amount of raw materials used is zero.		• Ministry of the Environment's Global Warming Prevention Plan • BP"Energy Outlook 2019" ET scenarios

[Step 3: Identify and define range of scenarios]

Step 2 **3** 4 5 | Scenario **4℃** 2℃

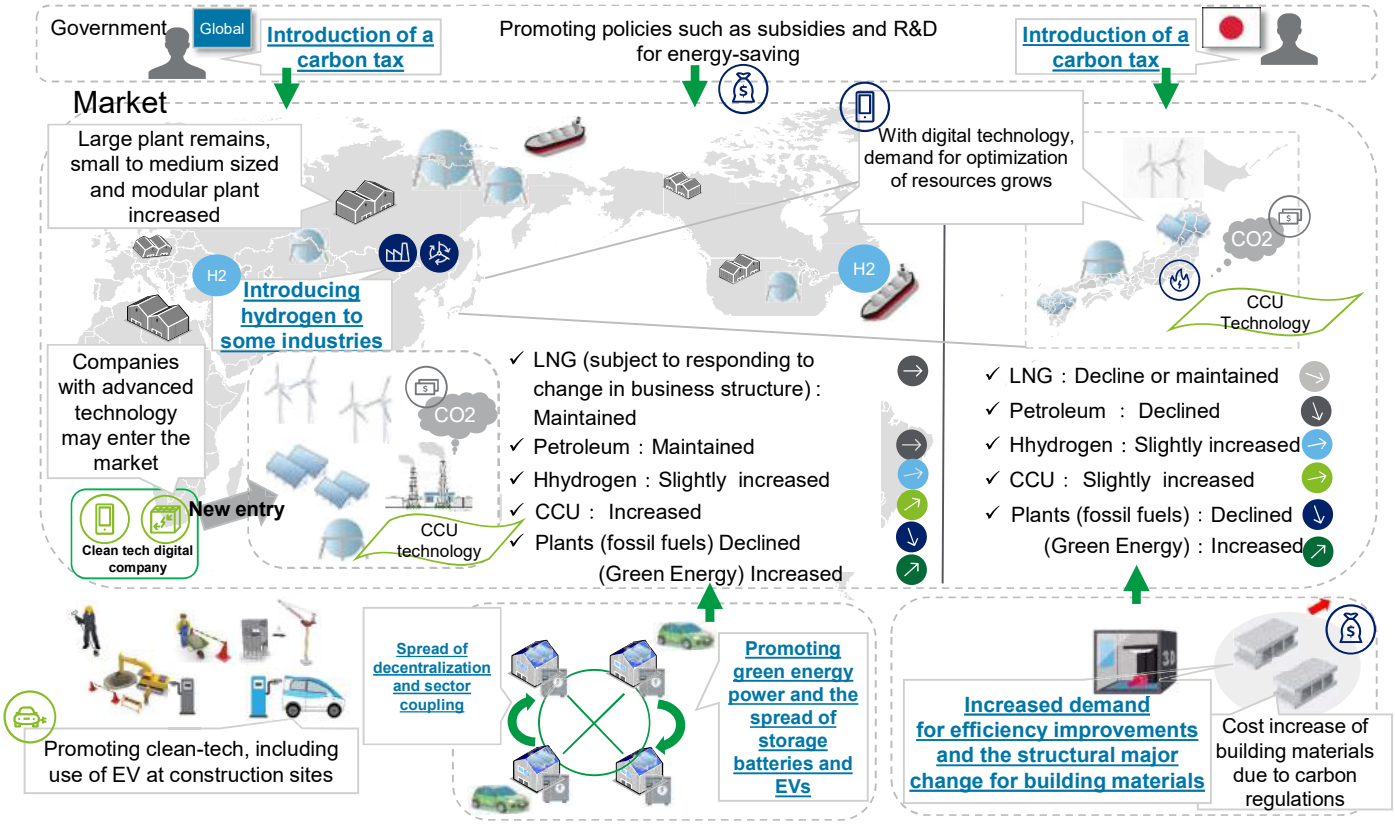
In the 4°C world, low carbon and carbon cycles are not promoted, and dependence on fossil fuels continues.



[Step 3: Identify and define range of scenarios]

Step 2 **3** 4 5 | Scenario 4℃ **2℃**

In the 2°C world, low carbon and carbon cycles are promoted, and demand for green energy facilities expands. The introduction of hydrogen and CCU is accelerated



3-34

[Step 4: Evaluate business impacts]

Step 2 3 **4** 5 | Scenario **4℃** **2℃**

Considering the direction of the calculation (business as usual/our potential) from "market growth" and "market share"

	Market growth	×	Share	=	Direction of Estimation: Business as usual	Direction of Estimation: Our Potential
LNG	Market expansion		In response to structural changes in business promotion The present market share maintained		No increase in profit beyond the business plan	No "counting" of potential
Green Energy (PV/Biomass)					Due to the small market expansion Profit declined	Not counted
Green Energy (Offshore wind power)			Assume 10% *1 acquisition of Japanese market		Not counted	Market expansion is counted as an opportunity
Oil-related	Market Shrink or expand		The present market share maintained		Profit declined due to the shrinking market	Market expansion is counted as an opportunity*2
Utility	Market expansion (Creation of new markets)		Assume 1% acquisition*3 of the market		Not counted	Market expansion is counted as an opportunity
Hydrogen			Assume 2% acquisition*4 of hydrogen supply		Profit increased due to the market expansion	Not counted
CCU			Assume 5%*3 acquisition of CCU market		Not counted	Market expansion is counted as an opportunity

*1: Assuming an internal share ratio of 10%, *2: At 4°C, the oil-related market will expand, so there will be no decrease in sales at the time of completion. *3: Since entry into a new market and major players have already been established, it is temporarily set at 1%. *4: Assuming that 2% of hydrogen supply will be obtained from our efforts to date, *5: Entering into a new market, it is temporarily set at 5%.

3-35

[Step 5: Identify potential responses]

Step 2 3 4 **5** Scenario **4℃** **2℃**

Considering the direction of countermeasures for responding to risks and securing opportunities

Summary of impact calculations and policy for countermeasures

Items (Impact on our company)	2℃	4℃	Policy for countermeasures
LNG	→	↗	Provide services that respond to changes in the business structure
Petroleum Fossil fuel plant	↘	→	Respond to optimization of customer assets by utilizing digital technology
Hydrogen	↗	-	Early entry into the market and securing market share is required due to increasing demand for low-carbon and carbon cycle
CCU	↗	-	
Green Energy Plant	↗	→	Develop utility business based on future trends

Transportation

- ✓ **Practice Example①：Mitsui O.S.K. Lines, Ltd.**
- ✓ **Practice Example②：Japan Airlines Co., Ltd.**
- ✓ **Practice Example③：Mitsubishi Motors Corporation**

Climate-related Impact on Mitsui O.S.K. Lines

STEP 2 3 4 5

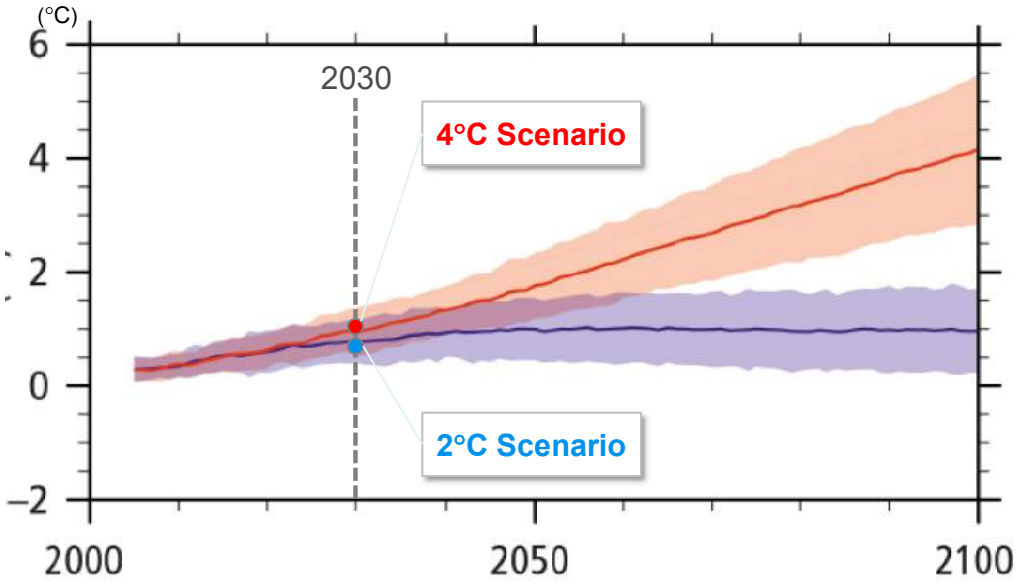
	Risk item	Business impact	
Transition risk	Increase/decrease in Key products and prices	• Changes in energy mix will impact the **demand for key cargo transport (crude oil, petroleum products, petrochemicals, coal, LNG)**, leading to fluctuations in profit of ocean shipping business • Transition to a low-carbon society will **decrease the demand for coal and petroleum**, which **will reduce** the cargo volume **and profit in the ocean shipping business**. • However, the **spread of CCS and CCU** can revive the **demand for coal transport**, enabling the shipping business to maintain profit. • **Spread of EVs and other next-generation** vehicles will **substantially change the ways of completed vehicle transport and supply chains.** This will **reduce the vehicle transport volume** and lower profit in the ocean shipping business. • **Spread of renewable energy will increase the demand for hydrogen transport**, which can help maintain profit in the ocean shipping business. • **Increased demand for onshore wind power generation will increase profit from development of onshore facilities (costs of transport and installation)**, which will increase profit in the ocean shipping business. • Climate change will adversely impact cereal crop harvests, which will lower the **demand for bulk cargo transport and reduce** profit in the ocean shipping business.	Large
	Promotion of next-generation vessels	• **Shippers will expect environmental considerations in transport,** calling on the ocean shipping **business to shift to next-generation vessels**. This will **increase R&D costs, capital investments**, and overall expenditures. • **Adaption of next-generation vessels will save fuel costs and payments of carbon tax**, reducing overall expenditures.	
	National regulations on SOx/NOx	• The 2020 IMO **fuel sulphur regulations will require the ocean shipping business to purchase appropriate fuel**. This will **increase operating costs** and overall expenditures. • **Installation of SOx scrubber systems will increase capital costs** and overall expenditures. Promotion of alternative fuels, though not directly related to climate change or global warming, can indirectly contribute to CO2 emissions reduction.	
	Energy-saving policy (EEDI/Energy efficiency laws)	• The **EEDI for new ships will tighten the regulations** (Phase 2 from 2020 and Phase 3 from 2025), which will inflate ship prices, **and increase maintenance costs** and overall expenditures.	
	Energy-saving subsidies	• **Access to energy-saving subsidies will save capital investment**, and reduce overall expenditures. • **FIT and other policies to promote renewable energy will reduce the demand for crude oil, coal and LNG transport**, the transport volume, and income in the ocean shipping business. • **An increase in the demand for biomass fuel transport** will increase the transport volume and income in the ocean shipping business.	
	Trend in energy demand	• **Stricter regulations on the use of cleaner fuels or those with less environmental impact will increase the costs of technology development, capital, fuel and vessels (including crew training costs)**, and overall expenditures.	
	Carbon pricing	• If **market-based measures (MBMs)** for GHG from ships are **made obligatory** by IMO, **fuel will be charged**, and ship operators **will have to purchase emission rights** for emissions exceeding their allocated volumes. This will increase overall expenditures.	Medium to large
Others	Change in reputation among customers (shippers) and investors; melting of permafrost and glaciers; extremely abnormal weather; etc.	• General preference to transport means with environmental considerations will increase the demand for vessels. • Development of the North Sea Route will reduce traveling time, and the capital and travel costs. This will lead to more new contracts and increase freight revenue. • Abnormal whether and typhoons require ship operators to change navigation routes to longer routes. This can damage reputation from shippers.	Small to medium

Adoption of carbon pricing and emission rights trading will increase vessel fuel costs and overall expenditures. In addition, investment in development of next-generation vessels will have considerable financial impacts.

Consider society in 2030 with two scenarios

STEP 2 3 4 5 Scenario 4°C 2°C

[Global average surface temperature (difference from the 1986-2005 average)]



The temperature will rise 3.2-5.4°C above pre-industrial levels, unless more rigorous measures are taken.

The temperature will rise 0.9-2.3°C above pre-industrial levels, if strict measures are taken.

Source: Figure SPM.6 in the Synthesis Report (SYR) of the IPCC Fifth Assessment Report (AR5)

Assumptions in the Scenarios

STEP 2 3 4 5 Scenario 4°C 2°C

		Present	2030		Sources
			World in the 4°C scenario	World in the 2°C scenario	
Increase/ decrease in Key products and prices	Total traffic volume	66,000 G tonne-km/year (2015)	113,588 G tonne-km/year	101,178 G tonne-km/year	• 2ii (ACT, LCT scenarios)
	Coal traffic volume	7,300 G tonne-km/year (2015)	7,665 G tonne-km/year	5,256 G tonne-km/year	• IEA WEO2017/2ii (ACT, LCT scenarios)
	Petroleum traffic volume	19,000 G tonne-km/year (2015)	25,039 G tonne-km/year	15,987 G tonne-km/year	• IEA WEO2017/2ii (ACT, LCT scenarios)
	Automobile traffic volume	36.2 million vehicles/year (2017)	53.02 million vehicles/year	43.27 million vehicles/year	• The Global Calculator V23 (IEA 2DS/4DS scenarios)
	Steel demand	1,670Mt (2014)	1,855Mt	1,855Mt	• IEA ETP 2017 (RTS, 2°C scenario)
	LNG demand	3,635bcm (2014)	4,269bcm	4,545bcm	• IEA ETP 2017 (RTS, 2°C scenario)
	Demand for offshore wind power generation	350GW (2014)	1,255GW	1,840GW	• Agency for Natural Resources and Energy, Renewable Energy Institute, Japan Maritime Center, etc.
Spread of next-generation vessels	Spread of next-generation fuels	FAME: 1,040USD/Mt, 38MJ/kg MDO: 482USD/Mt, 43MJ/kg (2016)	n.a.	n.a.	• IEA Bioenergy report "Biofuels for the marine shipping sector"
	EEDI regulations	Phase 1 = 10%	Phase 3 = 30% (in and after 2025)	Phase 3 = 30% (in and after 2025)	• IMO
Regulations	CO2 emissions of global marine transport	810 million tonnes (Emissions from ships worldwide, 2010)	924 million tonnes (Emissions from ships worldwide)	823 million tonnes (Emissions from ships worldwide)	• 2ii (UMAS Scenarios 8, 10)
Carbon pricing	Carbon tax	* Average bidding price: Approx. $8/t at the EU-ETS	Europe: $37/t China: $23/t	Japan, North America, Europe: $100/t China: $75/t	• IEA WEO 2016 (450, NPS scenario) • "Implementation and Considerations of Emissions Trading in Selected Countries", a Ministry of Environment report, 2016
	Fuel price	Petroleum: $97/bbl	Petroleum: $113/bbl	Petroleum: $97/bbl	• IEA ETP 2016/2ii

MOL

CO2 Emissions from the Global Maritime Transport Sector

STEP 2 3 4 5 Scenario 4°C 2°C

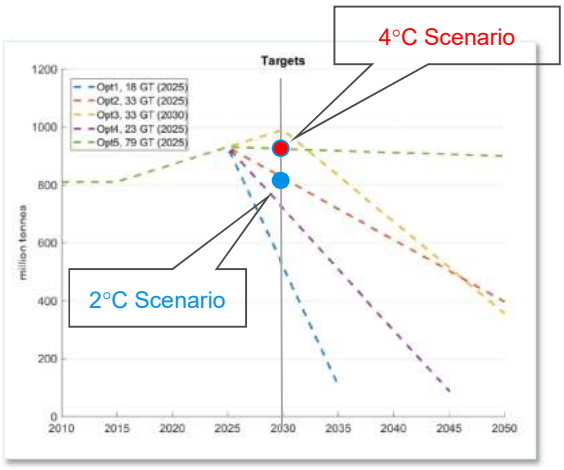


Figure 16: CO_2 targets quantified

Table 14: Absolute CO_2 emissions targets for international shipping under five different target derivations (million tonnes)

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Opt.1 - Responsibility principle, 1.5 degrees, 18 Gt (2025)	810	810	870	930	518	106			
Opt.2 - Responsibility principle, 2 degrees, 33 Gt (2025)	810	810	870	930	823	716	610	503	396
Opt.3 - Responsibility principle, 2 degrees, 33 Gt (2030)	810	810	870	930	990	831	673	514	356
Opt.4 - Egalitarian principle, developed country based, 23 Gt (2025)	810	810	870	930	719	508	297	86	
Opt.5 - Egalitarian principle, developing country based 79 Gt (2025)	810	810	870	930	924	917	911	905	898

Opt 2 = Scenario 8:

- The scenario sets CO2 emissions targets at 33Gt during the period 2010 to 2100 on the assumption that MBM starts in 2025 and 20% of the total revenue derived from a carbon pricing can be used to purchase CO2 offsets. It is used as an ACT scenario (2°C) in the 2ii report.

Opt 5 = Scenario 10:

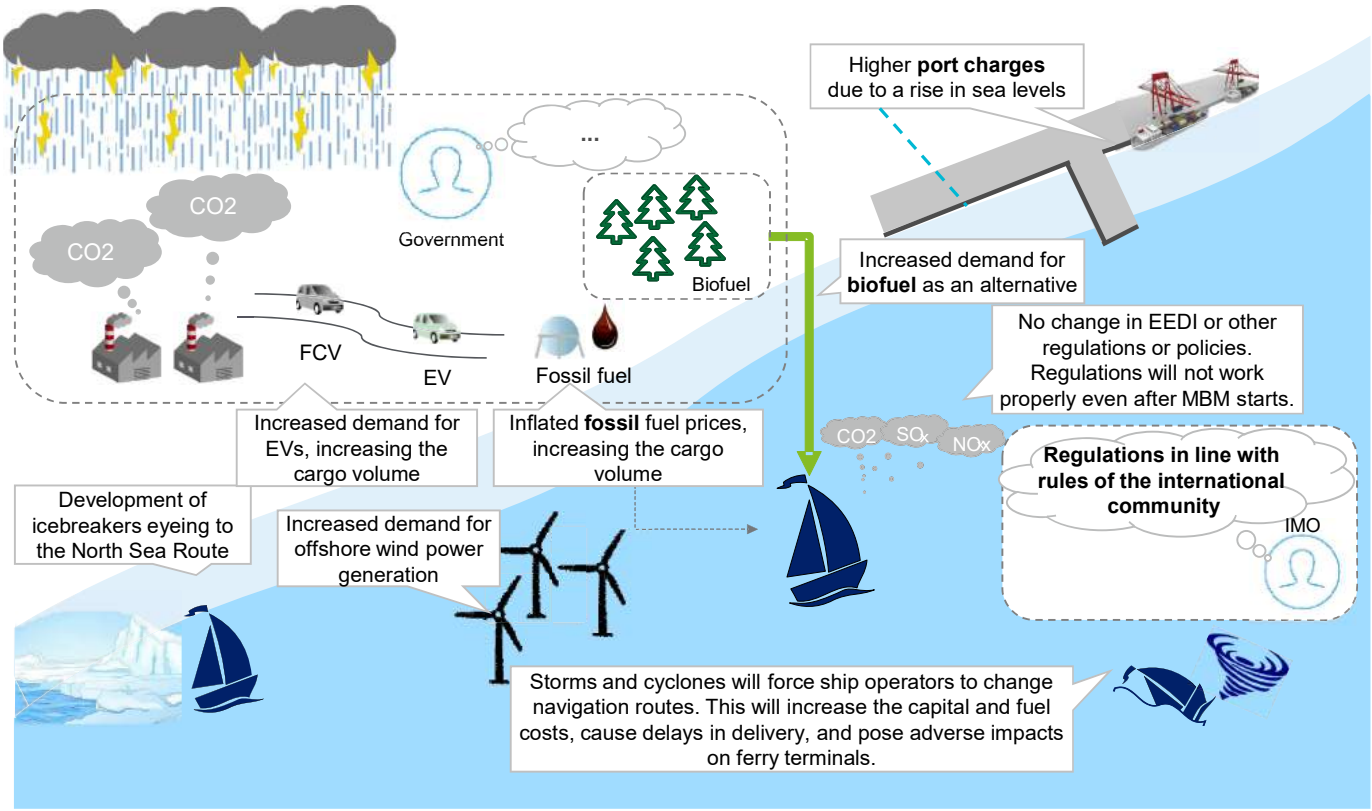
- The scenario sets CO2 emissions targets at 79Gt during the period 2010 to 2100 on the assumption that MBM starts in 2025 and 80% of the total revenue derived from a carbon pricing can be used to purchase CO2 offsets. It is used as an LCT scenario (4°C) in the 2ii report.

Source: UMAS, "CO2 Emissions from International Shipping - Possible reduction targets and their associated pathways", 2016. P.45

MOL

World in the 4°C Scenario: More Natural Disasters and Inflated Fuel Costs

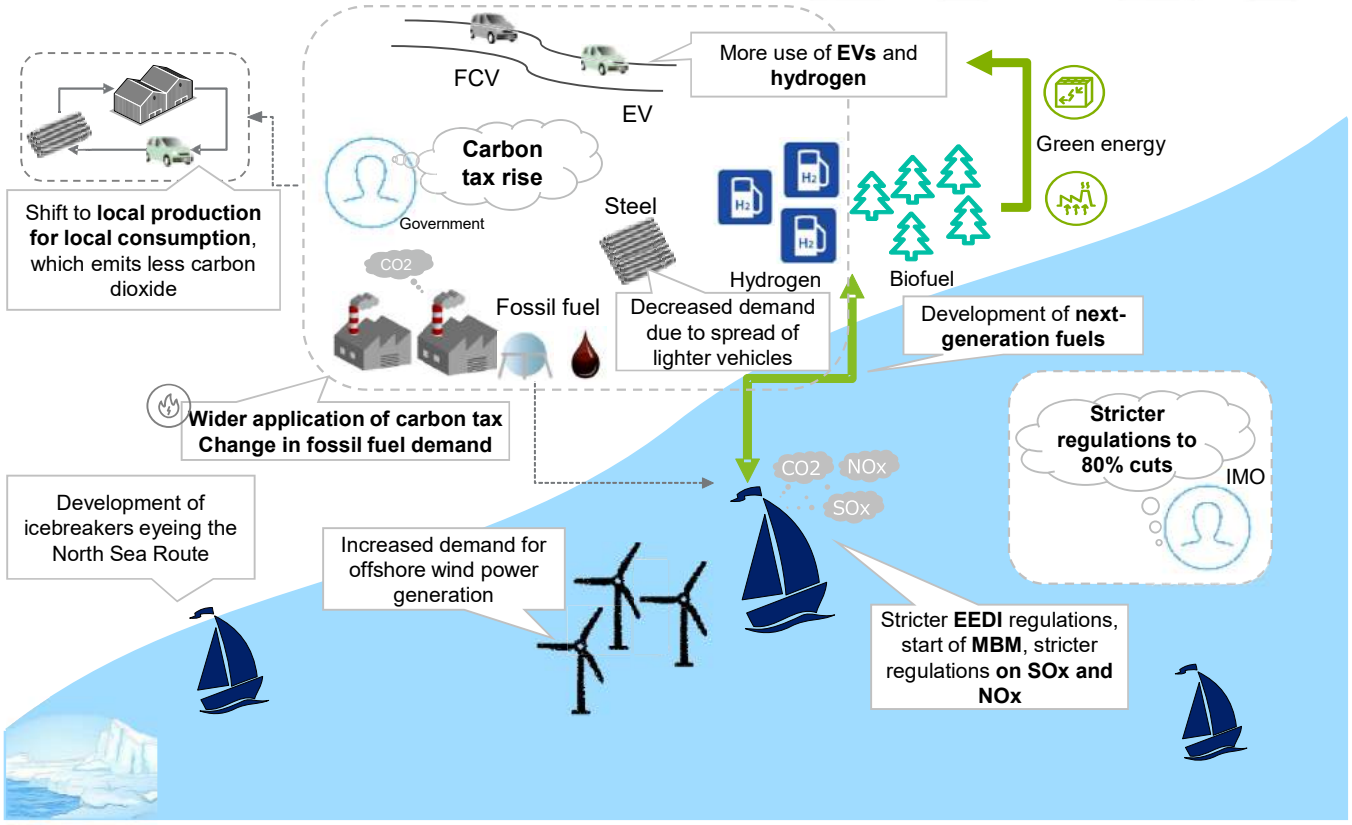
STEP 2 3 4 5 Scenario 4°C 2°C



MOL

World in the 2°C Scenario: Cleaner Society, Shift to Renewables, and Dampened Demand for Fossil Fuel

STEP 2 3 4 5 Scenario 4°C 2°C



MOL

World in the 4°C scenario, the Company will continue following the present path towards further expansion.

STEP 2 3 4 5 Scenario 4°C 2°C

World in the 2030s in the 4°C scenario

Supplier — Accelerating technology innovation

- ✓ Suppliers will develop EEDI-compatible, high-fuel efficiency technologies, and see increased development costs of next-generation vessels. Subsidy schemes will help them save capital investment.

Action: **Request incentives/ subsidies**

Energy business — Higher demand for fossil fuel

- ✓ Adoption of carbon tax and MBM will increase petroleum and coal fuel prices.
- ✓ More use of LNG as alternative
- ✓ Increased demand for biofuel as alternative, but increase will be limited due to prices and supply volume

Action: **Consider prices of alternative fuels and suppliers**

New entry — No impact on new entry

- ✓ New entries will have no impact from climate change.

(No particular action needed)

Shipping industry

Industry/MOL — Rainstorm, typhoon, rise in sea levels

- ✓ Physical risks will emerge, which will increase insurance costs.
- ✓ Traffic volume will increase as a result of population growth.
- ✓ A rise in sea levels will result in higher port charges.

Action: **Comply with EEDI regulations and develop technology to reduce environmental burden**

Alternatives — Entry in related businesses

- ✓ Development of the North Sea Route and related businesses

(No particular action needed)

Customer — Change in transport demand

- ✓ Changes in navigation routes will increase the capital and fuel costs, and cause delays in delivery.
- ✓ Promotion of renewable energy will slightly decrease coal transport, increase oil and biomass fuel transport, and substantially increase natural gas transport.
- ✓ Increased demand for offshore wind power generation
- ✓ Poor harvests will reduce transport demand.
- ✓ Substantial increase in demand for EVs will change transport supply chains.
- ✓ Adverse impacts on ferry and terminal businesses

Action: **Develop navigation routes and vessels compatible with climate change**
Call for understanding of an increase in capital investment

Government — More subsidies

- ✓ No change in EEDI or other regulations or policies
- ✓ IMO targets of 50% cuts by 2050 will continue.
- ✓ Adoption of carbon tax and MBM (charges on vessel fuel, and obligation to purchase emission rights)
- ✓ Harbors and ports will be developed to meet the new regulations
- ✓ Enhanced SOx/NOx regulations will accelerate the use of alternative fuels.

Action: **Enhance and maintain liaison with the government to swiftly gain information about any revisions to regulations**

World in the 2°C scenario: More Action Needed towards a Low-Carbon Society

STEP 2 3 4 5 Scenario 4°C 2°C

World in the 2030s in the 2°C scenario

Supplier — Accelerating technology innovation

- ✓ Suppliers will develop EEDI-compatible, high-fuel efficiency technologies, and see increased development costs of next-generation vessels. Subsidy schemes will help them save capital investment.
- ✓ Low-carbon technology will help increase vessel prices and lease charges.

Action: **Investment in next-generation technology (joint investment)**

Energy business — Increased fossil fuel costs

- ✓ Adoption of carbon tax and MBM will increase fossil fuel prices.
- ✓ Rapid spread of LNG fuel as alternative
- ✓ Hydrogen supply chain will be put into practice.
- ✓ Increased demand for biofuel as an alternative, but the increase will be limited due to prices and supply volume

Action: **Shift from fossil fuel to alternative fuels**

New entry — No impact on new entry

- ✓ New entries will have no impact from climate change.

(No particular action needed)

Shipping industry

Industry/MOL — Predict moves towards a low-carbon society based on climate change external factors.

- ✓ Vessels will consume less fuel. (LNG ships, higher engine efficiency, higher propeller efficiency, reduced ship resistance)
- ✓ The industry will promote technology development of next-generation fuels.

Action: **Develop technology towards a low-carbon society**

Alternatives — Consider impacts of land transport on marine transport

- ✓ Accelerated modal shift
- ✓ Development of the North Sea Route and related businesses

Customer — Decline in fossil fuel transport

Increase in renewable/EV transport

- ✓ Promotion of renewable energy will decrease coal and oil transport, and increase biomass fuel transport.
- ✓ Increased demand for offshore wind power generation
- ✓ Consumers will opt for low-carbon-oriented, local production for local consumption. Traffic volume will not increase in proportion to population growth.
- ✓ Substantial increase in demand for EVs will change transport supply chains.
- ✓ Spread of lighter vehicles will decrease steel demand. Increase in electric furnaces will decrease iron ore demand. Impacts of population growth will be minimal.
- ✓ Poor harvest will reduce transport demand.
- ✓ Adverse impacts on ferry and terminal businesses

Action: **Change in portfolio (gradual shift from fossil fuel transport)**

Government — Intensified actions for climate change

(Stricter MBMs and carbon tax)

- ✓ Many countries will raise carbon tax rates, which will impact office and onshore businesses.
- ✓ IMO targets of 50% cuts of GHG by 2050 will continue.
- ✓ EEDI regulations will continue, and more effective MBMs will be adopted. (charges on vessel fuel, and obligation to purchase emission rights)
- ✓ Enhanced SOx/NOx regulations will accelerate the use of alternative fuels.
- ✓ Harbors and ports will be developed to respond to short-term abnormal weather.

Action: **Adopt next-generation ships under partnership with government, and build a supply chain**

World in the 4°C scenario, population growth and other factors will increase traffic volume. The Company will use high-efficiency and LNG vessels to deal with inflated fuel costs.

STEP 2 3 **4** 5 Scenario **4°C** 2°C

	Risk item		Financial impact indicator	Summary of impact	Background of the impact	Magnitude of impact (¥100 million)
Transition risks	Increase/ decrease in key cargoes	Coal traffic volume	Sales (profit of ocean shipping business)	Increase in traffic volume will increase profit (freight revenue) of ocean shipping business.	The continued upward trend of coal demand, and population growth and vital economy will boost coal demand further.	
		Petroleum traffic volume	Sales (profit of ocean shipping business)	Increase in traffic volume will increase profit (freight revenue) of ocean shipping business.	The continued upward trend of petroleum demand, and population growth and vital economy will boost coal demand further.	
		Automobile traffic volume	Sales (profit of ocean shipping business)	Increase in traffic volume will increase profit (freight revenue) of ocean shipping business.	Consumers will not have enough incentives to purchase next-generation vehicles because of unsolved infrastructure problems, poor availability of related products, and high prices. So, the vehicle market will remain focused on vehicles with an internal combustion engine (ICE).	
		Steel traffic volume	Sales (profit of ocean shipping business)	Increase in traffic volume will increase profit (freight revenue) of ocean shipping business.	Currently, steel is used the most for construction and automobiles. It is hardly possible to consider any alternative to steel for construction, so impacts of transition risks will be minimal. (Increase in climate disasters will result in an increase in demand for stronger and more durable materials.)	
		LNG traffic volume	Sales (profit of ocean shipping business)	Increase in traffic volume will increase profit (freight revenue) of ocean shipping business.	The continued upward trend of LNG demand, and population growth and vital economy will boost LNG demand further.	
		Traffic volume related to offshore wind power generation	Sales (cost of ocean shipping business)	Increase in related projects will increase cost (freight revenue) of ocean shipping business.	Further spread of renewable energy and particularly an increase in demand for offshore wind power generation using Japan's outstanding technology will increase revenues from facility construction (transport and installation costs).	
		Transport of other products	Sales (profit of ocean shipping business)	Increase in traffic volume will increase profit (freight revenue) of ocean shipping business.	The continued upward trend of demand, and population growth and vital economy will boost demand further.	
	Energy-saving policy/ regulations / carbon pricing	MBM/emission rights trading	Expenditures (cost of ocean shipping business)	Emission trading will increase expenditures.	Emission trading will be adopted to achieve the CO2 reduction target by 2050, but the trading volume will be limited. New technologies will be put in place to achieve the goal.	
		Inflated fuel prices	Expenditures (cost of ocean shipping business)	Adoption of carbon pricing will inflate fuel prices, which will increase cost (fuel costs) of ocean shipping business.	Carbon pricing will slightly increase. This will be passed on to fuel prices in advanced countries, causing financial impacts.	
	Trend in energy demand	Inflated fuel prices	Expenditures (cost of ocean shipping business)	Rise in fuel prices due to supply-demand balance will increase costs (fuel costs) of ocean shipping business.	Considerable rise in fossil fuel costs will have great financial impacts.	
	Energy-saving policy/ regulations /carbon pricing	EEDI and other regulations	Expenditures (cost of ocean shipping business)	Adoption of high-efficiency vessels will reduce cost (fuel costs) of ocean shipping business.	Low-carbon transport modes will be required. Fuel efficiency of vessels will be improved, reducing operation costs.	
			Expenditures (cost of ocean shipping business)	Regulations will increase new shipbuilding costs.	To develop low-carbon transport modes, shipbuilders will seek high-efficiency vessels and install high-efficiency facilities in existing vessels. This will increase shipbuilding and repair costs.	
	Spread of next-generation vessels	Adoption of LNG-fueled vessels	Expenditures (cost of ocean shipping business)	Adoption of LNG-fueled vessels will impact cost (fuel costs) of ocean shipping business.	Adoption of LNG-fueled vessels will reduce vessel fuel costs and costs equivalent to carbon pricing.	
			Expenditures (cost of ocean shipping business)	Adoption of LNG-fueled vessels will increase new shipbuilding costs.	Adoption of LNG-fueled vessels will require additional investment as the difference from conventional vessels, having great financial impacts.	
		Spread of next-generation fuels (biofuels, etc.)	Expenditures (cost of ocean shipping business)	Spread of biofuels will increase cost (fuel costs) of ocean shipping business.	Biofuels will become common and more easily available. Businesses will consider adopting such fuels toward a low-carbon society.	

World in the 2°C scenario, fossil fuel traffic volume will decrease. The Company will face greater burden of emission trading and carbon tax.

STEP 2 3 **4** 5 Scenario 4°C **2°C**

	Risk item		Financial impact indicator	Summary of impact	Background of the impact	Magnitude of impact (¥100 million)
Transition risks	Increase/decrease in key cargoes	Coal traffic volume	Sales (profit of ocean shipping business)	Decrease in traffic volume will reduce profit (freight revenue) of ocean shipping business.	Shift from fossil fuels to renewable energy will reduce the coal traffic demand.	
		Petroleum traffic volume	Sales (profit of ocean shipping business)	Decrease in traffic volume will reduce profit (freight revenue) of ocean shipping business.	Shift from fossil fuels to renewable energy will reduce the petroleum traffic demand.	
		Automobile traffic volume	Sales (profit of ocean shipping business)	Increase in traffic volume will increase profit (freight revenue) of ocean shipping business.	Demand for EVs will considerably increase, affecting transport supply chain. A low-carbon society will draw higher attention, reducing the growth of traffic volume of ICE. But population growth will offset the reduction, and overall traffic volume will increase.	
		Steel traffic volume	Sales (profit of ocean shipping business)	Increase in traffic volume will increase profit (freight revenue) of ocean shipping business.	Currently, steel is used the most for construction and automobiles. It is hardly possible to consider any alternative to steel for construction, but steel can be replaced by lighter materials such as aluminum, plastics, and CFRP for car bodies.	
		LNG traffic volume	Sales (profit of ocean shipping business)	Fluctuations in traffic volume will increase profit (freight revenue) of ocean shipping business.	Increased LNG demand in a low-carbon society will increase LNG traffic volume.	
		Traffic volume related to offshore wind power generation	Sales (cost of ocean shipping business)	Increase in related projects will increase cost (freight revenue) of ocean shipping business.	Further spread of renewable energy and particularly an increase in demand for offshore wind power generation using Japan's outstanding technology will increase revenues from facility construction (transport and installation costs).	
		Transport of other products	Sales (profit of ocean shipping business)	Increase in traffic volume will increase profit (freight revenue) of ocean shipping business.	The continued upward trend of demand, and population growth and vital economy will boost demand further.	
	Energy-saving policy/ regulations / carbon pricing	MBM/emission rights trading	Expenditures (cost of ocean shipping business)	Emission trading will increase expenditures.	Emission trading will be adopted to achieve the CO2 reduction target by 2050, but the tradable volume will be large. The Company will have to purchase emission rights if it fails to meet the targets. This will increase expenditures.	
		Inflated fuel prices	Expenditures (cost of ocean shipping business)	Adoption of carbon pricing will inflate fuel prices, which will increase cost (fuel costs) of ocean shipping business.	Carbon pricing will increase. This will be passed on to fuel prices in advanced countries, causing financial impacts.	
	Trend in energy demand	Inflated fuel prices	Expenditures (cost of ocean shipping business)	Rise in fuel prices due to supply-demand balance will increase cost (fuel costs) of ocean shipping business.	Slight rise in fossil fuel costs will increase fuel costs.	
	Energy-saving policy/ regulations / carbon pricing	EEDI and other regulations	Expenditures (cost of ocean shipping business)	Adoption of high-efficiency vessels will reduce cost (fuel costs) of ocean shipping business.	Low-carbon transport modes will be required. Fuel efficiency of vessels will be improved, reducing operation costs.	
			Expenditures (cost of ocean shipping business)	Regulations will increase new shipbuilding costs.	To develop low-carbon transport modes, shipbuilders will seek high-efficiency vessels and install high-efficiency facilities in existing vessels. This will increase shipbuilding and repair costs.	
	Spread of next-generation vessels	Adoption of LNG-fueled vessels	Expenditures (cost of ocean shipping business)	Adoption of LNG-fueled vessels will impact cost (fuel costs) of ocean shipping business.	Adoption of LNG-fueled vessels will reduce vessel fuel costs by the amount equivalent to carbon pricing.	
			Expenditures (cost of ocean shipping business)	Adoption of LNG-fueled vessels will increase new shipbuilding costs.	Adoption of LNG-fueled vessels will require additional investment as difference from conventional vessels, having great financial impacts.	
		Spread of next-generation fuels (biofuels, etc.)	Expenditures (cost of ocean shipping business)	Spread of biofuels will increase cost (fuel costs) of ocean shipping business.	Biofuels will become common and more easily available. Businesses will consider adopting such fuels toward a low-carbon society.	

Transportation

✓ Practice Example①：Mitsui O.S.K. Lines, Ltd.

✓ **Practice Example②：Japan Airlines Co., Ltd.**

✓ Practice Example③：Mitsubishi Motors Corporation

Scenario Analysis in Practice - STEP 2 Assess materiality of climate-related risks (extract)

JAPAN AIRLINES

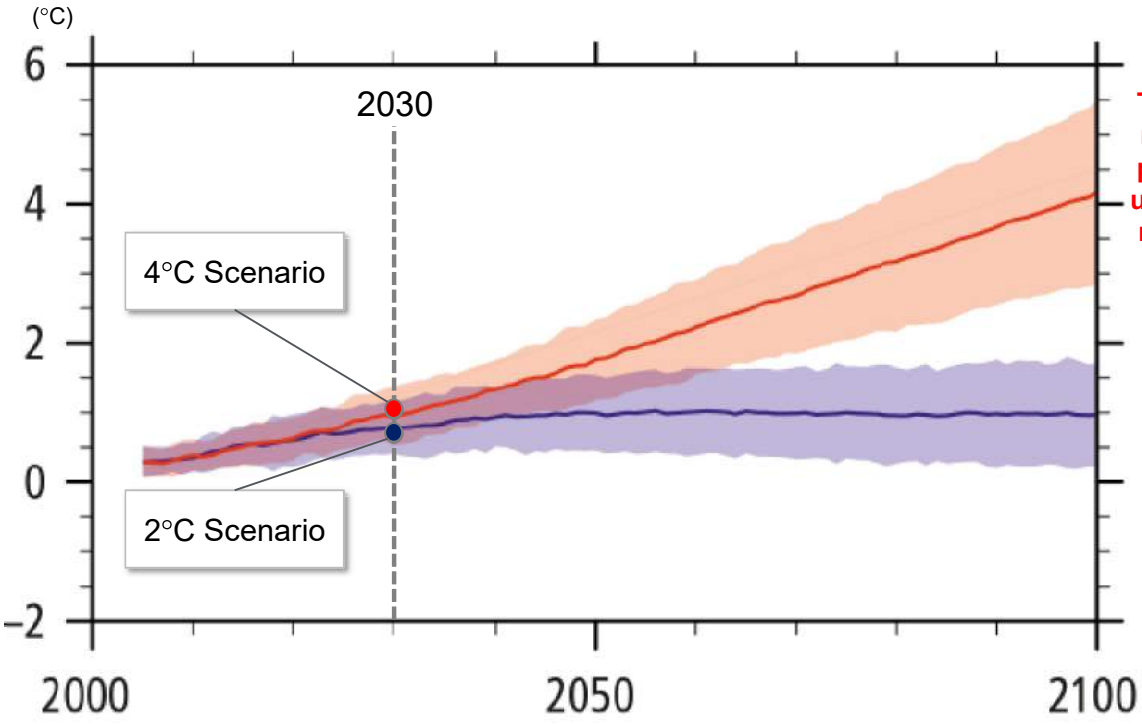
✓ List and categorize risk items into three groups in terms of assumed impacts on the business

Category	Risk item	Assessment
Policy and Legal	Targets and regulations on carbon emissions and fuel efficiency in the airline industry	Large
	Targets and regulations on carbon emissions and fuel efficiency in relevant countries	Medium
	Carbon pricing	Medium
Technology Shifts	Spread of alternative fuels	Large
	Improvement in fuel efficiency	Medium
	Development of next-generation airplanes	Small
Market Shifts	Inflated fuel prices	Large
Physical Risks	Increased severity of extreme weather events	Large
	Changes in rainfall and weather patterns	Large
	Rise in average temperature	Medium to Large

Scenario Analysis in Practice – STEP 3 Identify and define range of scenario

✓ Consider a society with high climate uncertainty in 2030 with two existing scientific scenarios

[Forecast of global average surface temperature (difference from the 1986-2005 average)]



The temperature will rise 2.6-4.8°C above pre-industrial levels, unless more rigorous measures are taken.

The temperature will rise 0.3-1.7°C above pre-industrial levels, if strict measures are taken.

Sources: Figure SPM.6 in the Synthesis Report (SYR) of the IPCC Fifth Assessment Report (AR5); International Energy Agency (IEA), "ETP 2017"; UNEP, "the Emission Gap Report 2015"; and website of the Ministry of Foreign Affairs

Scenario Analysis in Practice - STEP 3 Identify and define range of scenario (extract)

✓ The world in the 4°C scenario will be an extension of the present.

4°C Scenario

Further policy effort towards a low-carbon society

Government

✓ Some countries and regions will adopt carbon tax.
✓ Enhanced fuel efficiency regulations

Continued increase in new entries in the LCC market

New entry

✓ New LCC focusing on low-price oriented customers will enter the airline market at the present pace.

Rise in material costs

Supplier (raw materials)

✓ Gentle spread of biofuels
✓ Inflated conventional jet fuel prices

Increased costs

Industry/JAL

✓ Fuel efficiency will improve, but development of next-generation airplanes and spread of alternative fuels will be limited.
✓ Dependency on conventional jet fuel will remain high and inflated crude oil prices will increase fuel costs.

Considerable increase in demand for international flights

Customer

✓ Demand will particularly increase in developing countries.
✓ Population growth and vital economy will boost demand for logistics.
✓ Interest in low-carbon energy and modal shift to railways, etc., will be limited.
✓ Extreme weather events will be more sever and more frequent, causing concerns over service rates and punctuality.

Fuel efficiency will continue improving.

Supplier (airframe makers)

✓ Airframe fuel efficiency will improve.
✓ Development of supersonic transports will progress.

No particular change

Substitutes

Scenario Analysis in Practice – STEP 3 Identify and define range of scenario

✓ In the 2°C Scenario, alternative fuels will become more available, and modal shifts will take place. Therefore, the Company may have to revise its supply chain and business model. **2°C Scenario**

Considerable policy effort towards a low-carbon society

Government

- ✓ More countries and regions will adopt carbon tax towards a carbon-free/low-carbon society.
- ✓ Enhanced fuel efficiency regulations
- ✓ More countries and regions will promote development and spread of alternative fuels towards a carbon-free/low-carbon society.

Fluctuations in material costs

Supplier (raw materials)

- ✓ Use of biojet fuel will vary among regions, which can raise differences in costs among regions

New entry

Carriers with electric airplanes will enter the airline market.

More efforts towards a low-carbon society

Industry/JAL

- ✓ Enhanced regulations will raise carbon pricing.
- ✓ More airline companies will use biojet fuel.

Increase in demand for international flights

Customer

- ✓ Demand will particularly increase in developing countries.
- ✓ Interest in the environment will heighten, and some customers may shift transport modes to railways, vessels, and other modes with lower environmental burdens.

Fuel efficiency will continue improving.

Supplier (airframe makers)

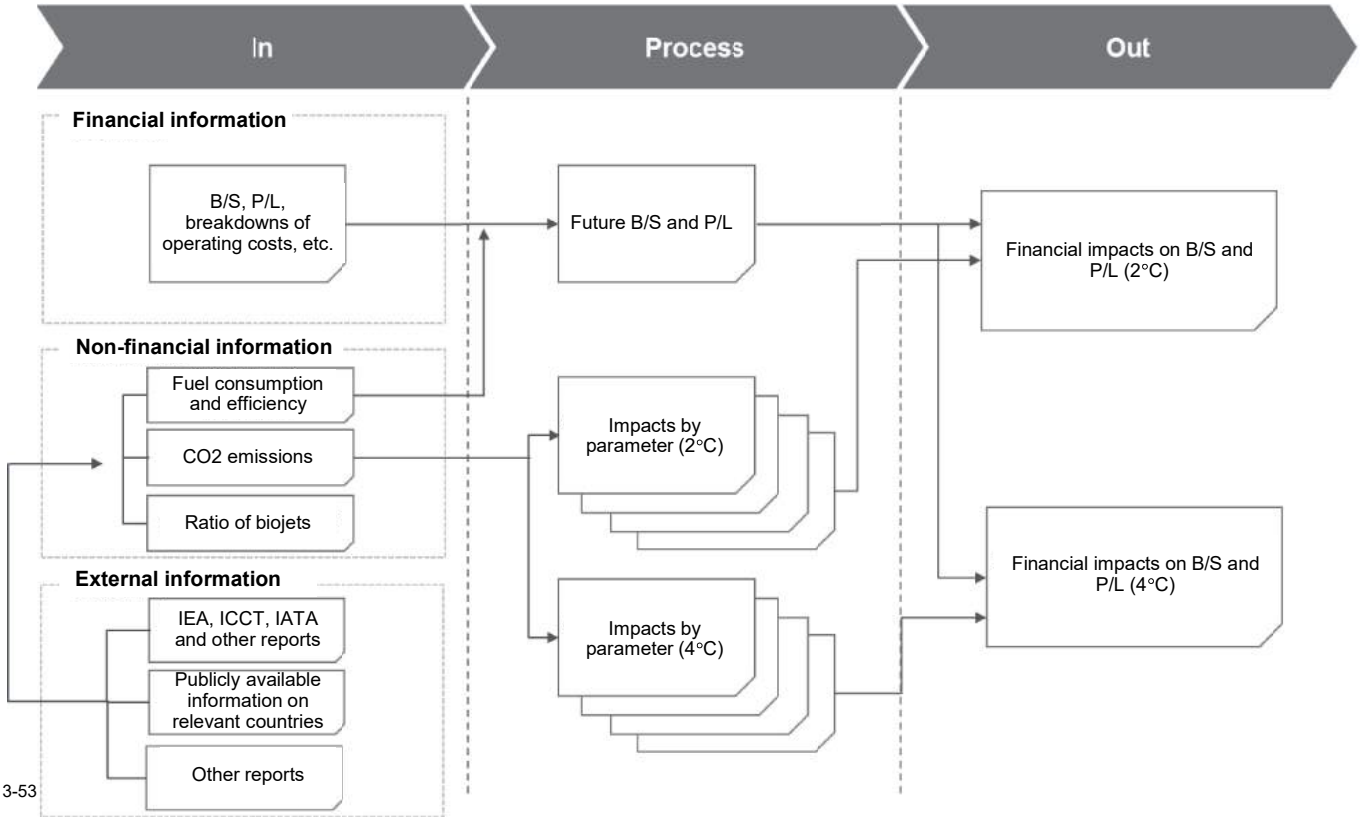
- ✓ Development of next-generation airplanes will progress.
- ✓ Demand for higher fuel-efficiency, next-generation airplanes will increase.

Substitutes

Modal shift to railways and vessels

Scenario Analysis in Practice: STEP 4 Evaluate business impacts

✓ Analyze parameters based on financial and non-financial information, and estimate financial impacts.



Transportation

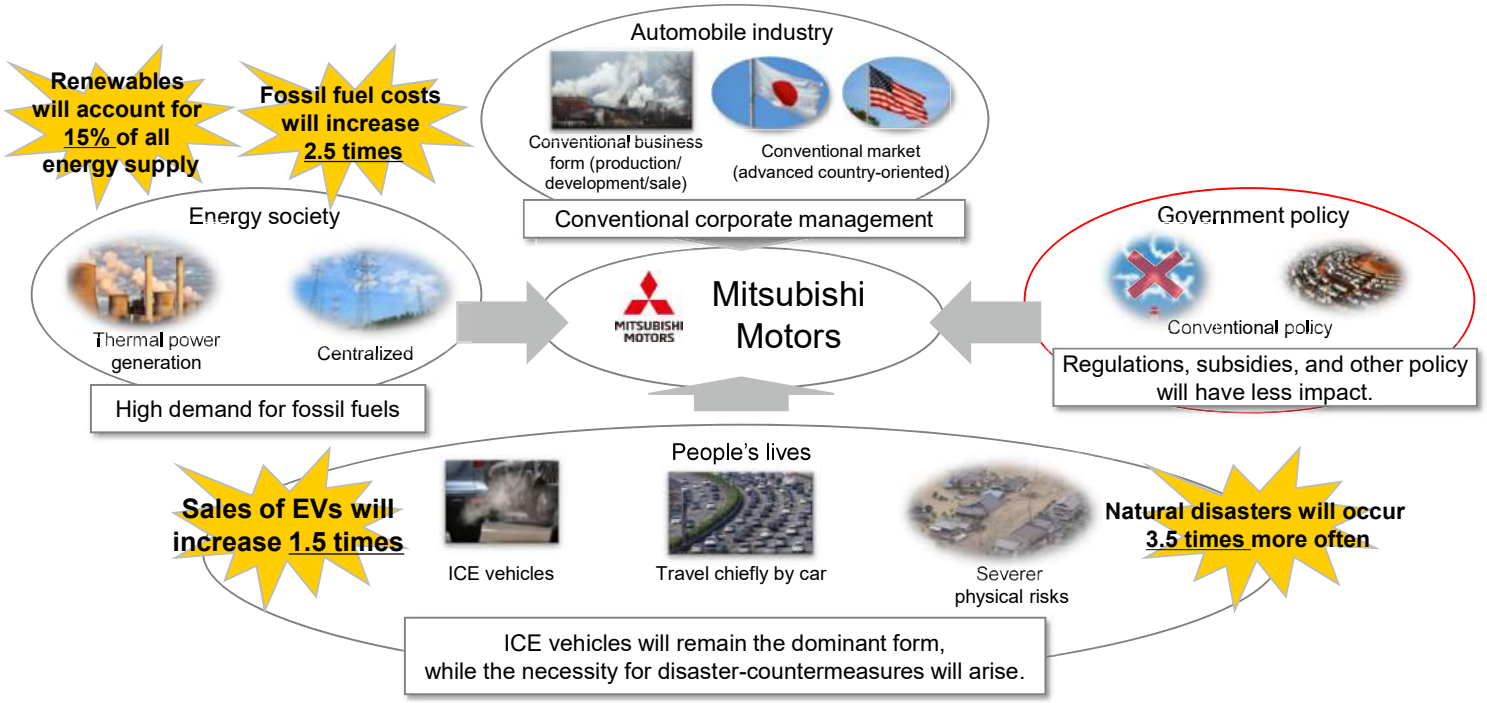
✓ Practice Example①：Mitsui O.S.K. Lines, Ltd.

✓ Practice Example②：Japan Airlines Co., Ltd.

✓ **Practice Example③：Mitsubishi Motors Corporation**

1-3a STEP3：Identify and define range of scenario (4°C)

In 2030 in the 4°C Scenario, the world will see 1.5-2 fold increases in the number of natural disasters and resulting damage. The scenario assumes that the use of electric vehicles will not be widespread.



1-4a STEP4 : Evaluate business impacts (4°C)

Changes in social environment Events that can take place in the future	Future prediction Choice and combinations of information, story-making	Impacts on business Interpretation of actual impacts	Business impacts Impacts on annual profit
• Changes in customer behaviors • Enhanced carbon tax and ZEV regulations • Progress of next-generation vehicle technology • Drop in battery prices	**Further spread of EVs** • Changes in consumer behaviors, government policy, and technology progress will increase car sales to 3 million cars per year. (Global market)	**Expanded share of EVs** • The share of EV sales will grow at a certain rate. • Demand will increase chiefly for PHEV. The average battery capacity will slightly increase. • Battery costs will remain the same because of increased demand for scarce resources and increased battery production. • Capital investment and R&D will slightly increase to meet the increased share of EVs.	
		Government subsidies • Subsidies at the present level will be secured (for capital investment in renewables)	
• Inflated energy prices • Accelerating renewable energy and energy-saving development	**Inflated energy prices** • Increased demand for fossil fuels will raise fuel prices from 2,200 yen to 4,950 yen/barrel. • The share of renewables will increase from 7% to 15% in Japan. Demand for ancillary services will increase, leading to higher electricity rates. • Grid power procurement costs will increase from 14,300 yen to 15,620 yen/Mwh.	**Increased energy procurement costs** • Increased demand for fossil fuels will increase energy prices.	
		Further efforts for energy-saving and renewable energy development • Energy consumption will be reduced to the mandatory annual rate set in the Energy-Saving Act.	
• More frequent and severe natural disasters	**Natural disasters will cause greater damage to the economy.** • Temperature rises will lead to more frequent and severer natural disasters. In particular, Japan will experience more torrential rains, 0.2 to 0.7 more times per year. • Increased natural disasters will increase car accidents and flood damage cars. This will increase payments for insurance companies.	**Increased damage to production facilities and supply chains** • The Company will have overall physical damage to supply chain, suspension of operations, and worsening of working environment.	
		Enhanced efforts to protect supply chain • The Company will enhance countermeasures against natural disasters to minimize damage to supply chains to at least present levels.	
		Development of new technology to avoid physical risks • Development of flood-ready vehicles • Enhancement of V2X function	
		Sale of new-tech vehicles to avoid physical risks • The Company will seek to expand the market share with new value added.	

(Reference) Examples of Actual Physical Risks (Business Impacts)

Mitsubishi Motors CEO Says West Japan Torrential Rains Reduce Production of More than 10,000 Cars

Mitsubishi Motors Co. published consolidated financial results on November 6th. Net profit increased 7% year-on-year to 51.8 billion yen due to strong sales of sports utility vehicles (SUVs) and minivans in emerging economies including Indonesia, Thailand and China. A series of natural disasters including the West Japan Torrential Rains, and typhoons Nos. 21 and 24 caused the company to **reduce production worth 4 billion yen**. The Company, however, achieved profit growth.

At a press conference for the first half of fiscal 2018, held on November 6th, the Chief Executive Officer said: "The West Japan Torrential Rains caused tremendous damage to Okayama prefecture, where our Mizushima Plant is located, and the production declines totaled more than 10,000 vehicles." "Thanks to the efforts of our suppliers and many business partners, however, we managed to minimize the impact on production and shipping", he added.
(Nikkei Shimbun, November 6, 2018)

Impacts of West Japan Torrential Rains and Typhoons

(100 million yen)	Impact of West Japan Torrential Rains	Impacts of Typhoons Nos. 21 and 24
Operating profit	-14	-10
Non-operating and extraordinary losses	-12	-4
Total	-26	-14

* Impacts in the 1st half of FY2018

(Mitsubishi Motors Reports First-Half Financial Results for FY2018, November 6, 2018)

Mazda warns of 28 billion yen loss from Japan floods Production disrupted for months in areas hit by rain

Mazda Motor expects a **roughly 28 billion yen ($248 million) hit to operating profit due to production cuts** at the main factory (Hiroshima pref.) and the Hofu plants (Yamaguchi pref.) from the torrential rains that flooded western Japan in July, the company said.
They operated at reduced capacity in August and September, as paralyzed transportation networks hampered workers' commutes. …
For the year ending March, many factors squeezed earnings, such as the higher costs of materials such as steel and precious metals, as well as spending to bolster the automaker's sales network in the U.S. and comply with tougher environmental regulations. This leaves the company **with little room to absorb the losses from the rains from the reduced production of 28 billion yen**.

(Nikkei Shimbun, September 21, 2018)

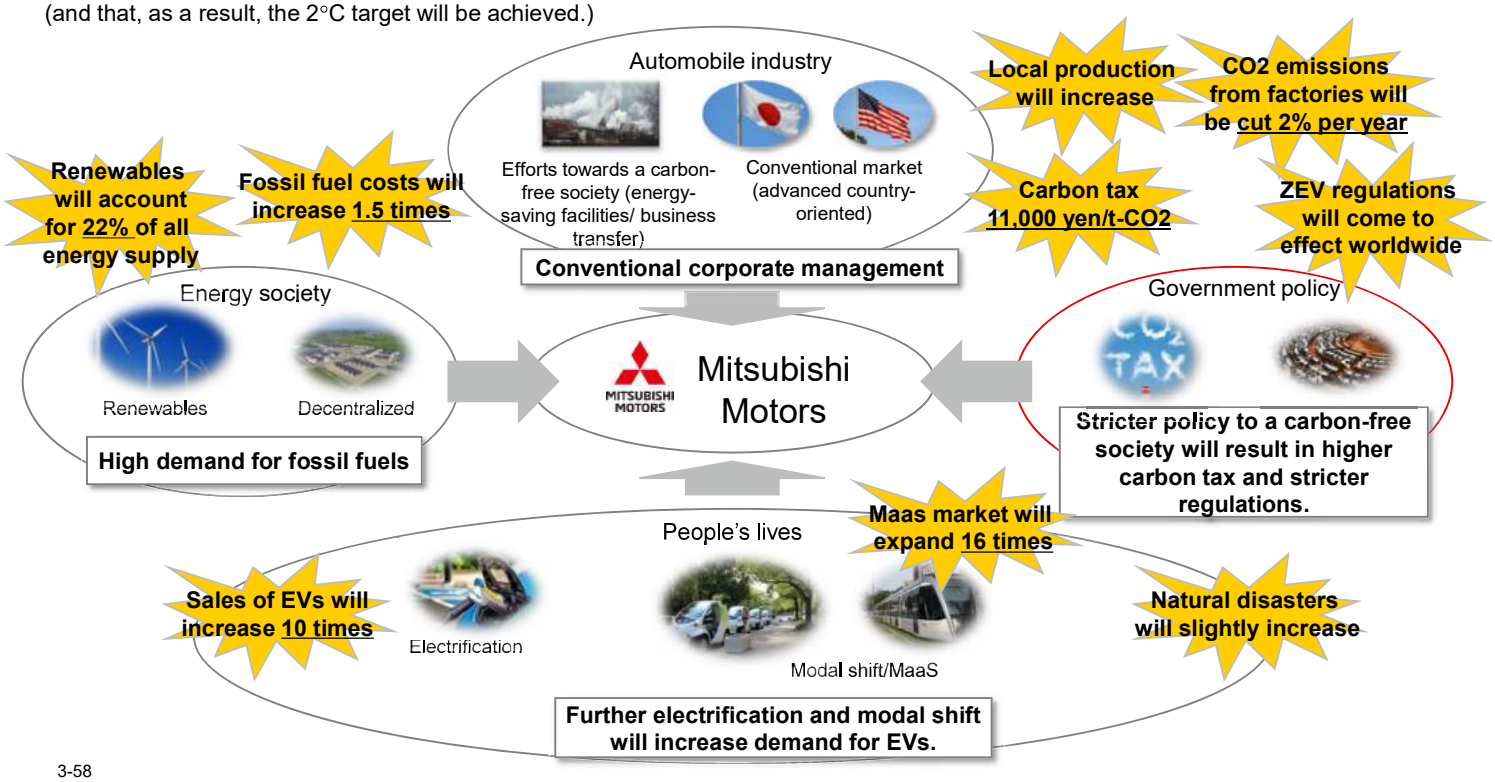
Vehicle Insurance Claims Exceed 20,000 - Nearly 70% in Heavy Rain-hit Okayama and Hiroshima, a GIAJ report reveals

The General Insurance Association of Japan (GIAJ headed by Keiji Nishizawa) compiled the number of car accident claims related to the torrential rains in west Japan. A total of 48,303 insurance claims including vehicles (including commercial vehicles), fire, and new types (including accident insurance) insurance claims were brought to member insurance companies by July 17. **Car insurance claims totaled 23,644**. Member companies set up emergency headquarters at their head offices or local branches in the afflicted prefectures, and started to inspect and collect flood-damaged cars under insurance coverage...
(Daily Automobile (Nikkan Jidosha Shimbun), July 23, 2018)

1-3b STEP3：Identify and define range of scenarios (2°C)

In 2030 in the 2°C Scenario, the number of natural disasters and damage will remain almost present levels.

The scenario assumes that the use of renewables, energy-saving technology, and electric vehicles will steadily progress, (and that, as a result, the 2°C target will be achieved.)



1-4b STEP4：Evaluate business impacts (**2°C**)

Changes in social environment Events that can take place in future	Future prediction Choice and combinations of information, story-making	Impacts on business Interpretation of actual impacts	Business impacts Impacts on annual profit
• Changes in customer behaviors • Enhanced carbon tax and ZEV regulations • Progress of next-generation vehicle technology • Drop in battery prices	**Further and quicker spread of EVs** • Changes in consumer behaviors, government policy, and technology progress will increase car sales to a maximum 17.6 million cars per year. (global market)	**Expanded share of EVs** • The share of EV sales will sharply grow. Sales of new cars will decrease under the 4℃ scenario. • Demand will increase chiefly for EV. The average battery capacity will double. • Adoption of alternative resources and sharp increase in battery production will more than halve battery costs. • Capital investment and R&D will increase to meet the increased share of EVs.	
		Government subsidies • Subsidies will be secured for investment in battery development and renewables. Credit incomes will also be secured.	
• Inflated energy prices • Accelerating renewable energy and energy-saving development	**Inflated energy prices** • Increased demand for fossil fuels will raise fuel prices from 2,200 yen to 3,630 yen/barrel. • The share of renewables will increase from 7% to 22% in Japan. Demand for ancillary services will increase, leading to higher electricity rates. • Grid power procurement costs will increase from 14,300 to 16,610 yen/Mwh.	**Increased energy procurement costs** • For CO2 emissions reduction, inexpensive thermal power generation and oil prices will cost more. • Electricity will cost more because of carbon pricing on thermal power generation.	
		Further efforts for energy-saving and renewable energy development • The Company will seek low-cost electricity through third-party PVs and grid power companies.	
• Inflated energy prices • Accelerating renewable energy and energy-saving development • Spread of EVs	**Development of a renewable energy decentralized society** • Increased use of renewables and inflated fossil fuel prices will make the electricity system less stable. This will lead to a decentralized society. More use of V2X and reuse of batteries.	**Entry in energy management business** • Launch of new businesses including sales of reusable batteries • The Company will build a battery supply chain management scheme to minimize costs of used batteries.	
• Changes in customer behaviors	**Accelerating progress of Maas and urban traffic** • Heightened inclination to the environment and shift in preference from ownership to sharing will facilitate development of MaaS and urban traffic.	**Decrease in new car sales** • Development of Maas and urban traffic will reduce new car sales in the global market.	
		Entry in new businesses • Entry in Maas and CASE businesses will help the Company secure profit.	
• More frequent and severe natural disasters	**Natural disasters will cause greater damage to the economy.** • Temperature rises will lead to more frequent and severer natural disasters. In particular, Japan will experience more torrential rains, 0.2 to 0.5 times more per year. • Increased natural disasters will increase car accidents and flood damage cars. This will increase payments for insurance companies.	**Increased damage to supply chains** • More torrential rains will cause physical damage to supply chains, suspension of operations, and worsening of working environments.	
		Enhanced efforts to protect supply chains • The Company will enhance countermeasures against natural disasters to minimize damage.	
		Creation of new value added • The Company will deal more with V2H functions to increase the market share.	

Building/ Forest Product

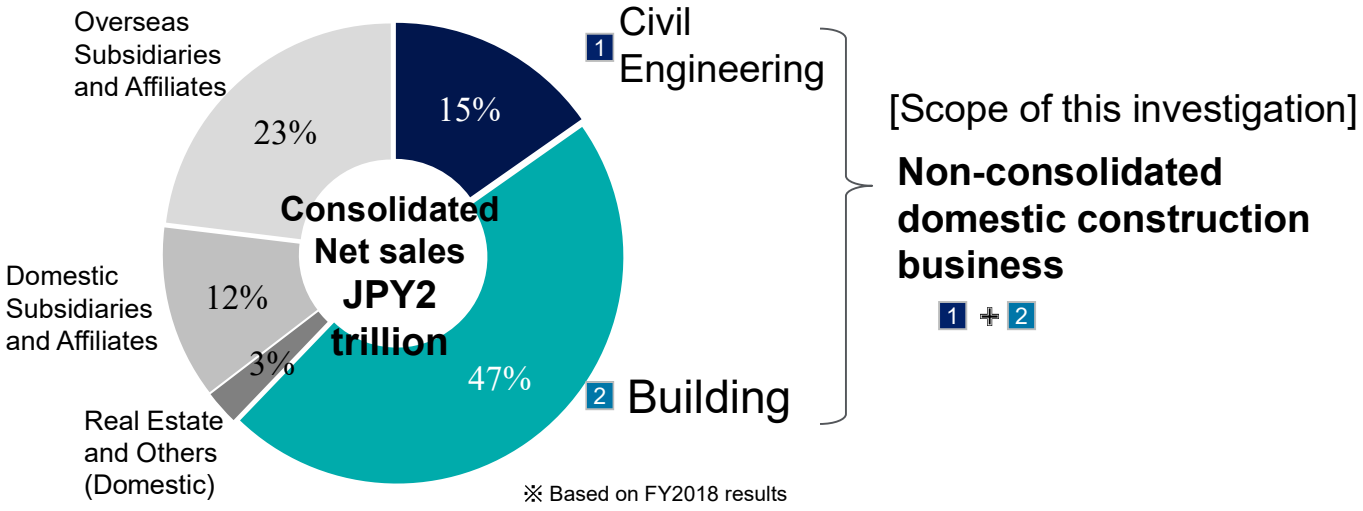
✓ Practice Example①：Kajima Corporation

✓ Practice Example②：Sumitomo Forestry Co., Ltd.

✓ Practice Example③：Tokyu Fudosan Holdings Corporation

[Sales Composition of Kajima Group, Scope of Review]
The scope of consideration is domestic construction (civil engineering + building construction), which accounts for more than 60% of consolidated net sales.

KAJIMA



※ Based on FY2018 results

2 [Step2: Assess materiality of climate-related risks]

From the characteristics of the industry, it was evaluated that the risks related to the market and technology were large in addition to the policy trend.

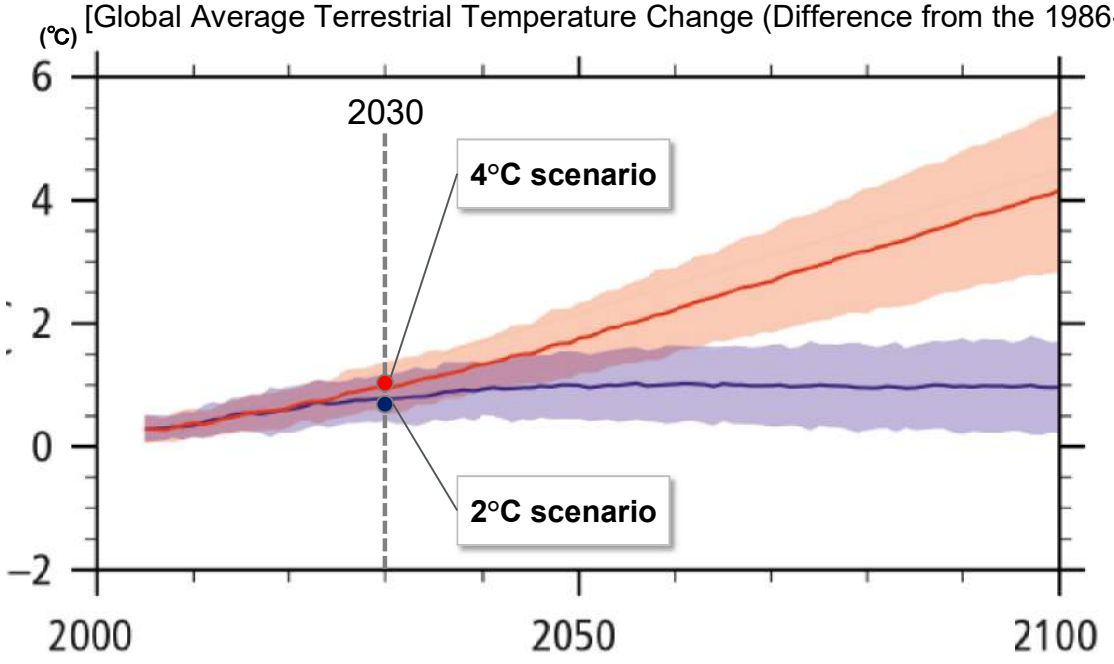
	Classification		Consideration of Risks and Opportunities	Assessment
Transition risk	Policy	Carbon price	Price competitiveness including carbon price and development of low-carbon materials and construction technologies are necessary. A delay in the development of low-carbon is subject to patent royalties from other companies, which reduces competitiveness. The use and development of low-carbon building materials progresses. Construction investment decreases due to an increase in construction costs.	**Large**
	Policy	Carbon Emissions Targets/Policies	Construction investment is restrained by regulations on the total amount of Carbon emissions, our construction revenue is restrained, and sales decline. Additional expenses such as credit purchases are incurred when the upper limit is not achieved. Improvement of design technology on low energy buildings such as ZEB (Zero Energy Building) is required.	**Large**
	Market	Changes in customer behaviours	Carbon emissions are some of the evaluation items in order competition. The global enterprise demands the low carbon construction of the world standard in the domestic. A decrease in fossil fuel-related construction projects affects orders. The energy mix changes and construction related to renewable energy increases.	**Large**
	Technologies	Renewable energy and Energy conservation technologies	Technology development costs related to renewable energy and energy conservation increase at the construction stage and at the facility operation stage. The technology required varies greatly depending on the legislation. Competition arises with advanced companies such as from Europe etc. where renewable energy is spreading.	**Large**
	-	Energy-saving policies, advances in next-generation technologies, recruitment and education to acquire expertise, changes in investor and bank behavior, and increases in energy demand and prices		Medium to Small
Physical risk	Chronic	Deterioration of working and construction conditions	Increased heatstroke risk at construction sites leads to a decrease in productivity and an increase in costs. Changes in construction methods and materials are required to ensure quality. Due to the harsh working conditions, the number of prospective employees decreases.	**Large**
	Policy	(attributable to increased temperature) Changes in labor laws	Sales decline due to legislation prohibiting outdoor work during the summer season. Progress in mechanization and labor-saving in construction is accelerated.	**Large**
	Chronic/ Acute	Changes in rainfall and weather patterns/ Increasing severity of extreme weather conditions	Process delays due to rainfall, strong wind, etc. occur, and costs increase due to countermeasures costs. Delay in delivery of (overseas) procured materials and increase in procurement (transportation) costs occur. Demand for flood control and other measures to strengthen national resilience increases. The disaster prevention and disaster mitigation markets expand.	**Large**
	Market	(Due to an increase in disasters) Lower advantages in location	The domestic construction market shrinks due to the transfer of production facilities in the disaster risk area to overseas.	**Large**
	-	Subsidence, rising sea levels, tightened disaster response regulations and reduced insurance coverage		Medium to Small

3 [Step3: Identify and Define a range of scenarios]

Analyzed impacts on company by drawing the 2℃ and 4℃ scenarios of 2030 regarding highly uncertain climate change

Given the geographical characteristics of Japan, the possibility that natural disasters will become increasingly severe, which cannot be predicted based on past knowledge. We recognize that the construction industry's mission is to respond to that kind of uncertainty.

[Global Average Terrestrial Temperature Change (Difference from the 1986-2005 Average)]



[As is]
The temperature will rise 3.2-5.4°C above pre-industrial levels, unless more rigorous measures are taken.

[Active transition]
The temperature will rise 0.9-2.3°C above pre-industrial levels, if strict measures are taken.

Source: AR5 SYR Diagram SPM.6

3 [Step3: Identify and Define range of scenarios]
Assumptions based on scientific evidence (such as IEA)

Item	Parameter	At present	2030		Source
			4℃	2℃	
Carbon price	**Carbon tax**	※ Average successful bid in the European EU-ETS: Approx. $8 per tonne	-	**88 USD/t**	• IEA WEO 2018 SDS (Developed countries)
Carbon Emissions Targets/Policies	**Target values for emissions**	100% as a benchmark	-3%	-66%	• GoJ Targets • IEA ETP B2DS
Changes in customer behaviors	**Power Supply Composition**	Coal thermal:337 TWh (32%) Oil thermal:97 TWh (9%) Gas-fired thermal: 440 TWh (42%) Nuclear: 12 TWh (2%) Renewable energy: 73TWh (7%)	Coal thermal:264 TWh (25%) Oil thermal:33 TWh (3%) Gas-fired thermal power: 287 TWh (27%) Nuclear: 216 TWh (21%) Renewable energy: 250 TWh (24%)	Coal thermal:83 TWh (9%) Oil thermal:17 TWh (2%) Gas-fired thermal power: 284 TWh (29%) Nuclear: 247 TWh (25%) Renewable energy: 347TWh (36%)	• IEA WEO2018 NPS (Japan)
Renewable energy and Energy Conservation Technologies	**ZEB target**	-	**On average for new buildings** Realize ZEB	**On average for new buildings** Realize ZEB	• Basic Energy Plan
Deterioration of working and construction conditions **→ "Changes in Labor Legislation" as a policy risk is a derivative.**	**Rate of decline in labor productivity due to heat stress**	0.4%	**0.99%**	**0.99%**	• ILO 「Working on a warmer planet」
	Temperature increase	0℃ as a benchmark	Average 2.1℃ (2030-2050)	Average 1.9℃ (2030-2050)	• "Climate Change Adaptation Information Platform" by the Ministry of the Environment, etc.
Changes in rainfall and weather patterns	**Days of heavy rain**	2.5 days/year	**3.0 days/year**	**2.5 days/year**	• Ministry of the Environment and Japan Meteorological Agency Report
Increasing extreme weather conditions (typhoons, heavy rains, sediment, disaster, storm surges, etc.) **→ Derivation of location advantage as market risk**	**Flood damage in urban areas**	$3.3 billion/year	**$7.3 billion/year**	—	• WRI "The Aqueduct Global Flood analyze"

3 [Step3: Identify and Define range of scenarios]

- Increased demand due to increased physical risk
- Possibility of labor restriction during summer due to the harsh heat

4℃ 2℃

Assumption of Future Society (4°C scenario)

Direct impact to the construction industry

- Damage and working stoppages increase due to intensified typhoons, etc
- Lower productivity due to heat stress
- Restrictions on summer work caused by the extreme heat
- Adoption of design and construction methods to cope with climate change (mechanization and labor saving)

Effects of Energy mix changes

- The fossil fuel power plant will continue to exist.
- Increase of renewable energy facilities based on the current policy

Changes in the market

- Fundamental review of flood control plans, etc.
- Relocation from disaster risk areas (Domestic relocation: Increase in demand, Overseas relocation: Decrease in demand)
- Significant expansion of the disaster prevention, disaster mitigation, and BCP markets
- Strengthening building regulations
- ZEB (Zero Energy Building) and energy conservation progress based on the current policy.

3 [Step3: Identify and Define range of scenarios]

Increased demand due to increased physical risk promotion of renewable energy/ZEB (zero energy building) progress while introducing a carbon tax and reducing fossil fuel power generation as a policy

4℃ 2℃

Assumption of Future Society (2°C scenario)

Direct impact to the construction industry

- Introduction of a carbon tax
- Restrictions on business activities due to the introduction of emission allowances
- Technological development for low-carbon construction and materials

Effects of Energy mix changes

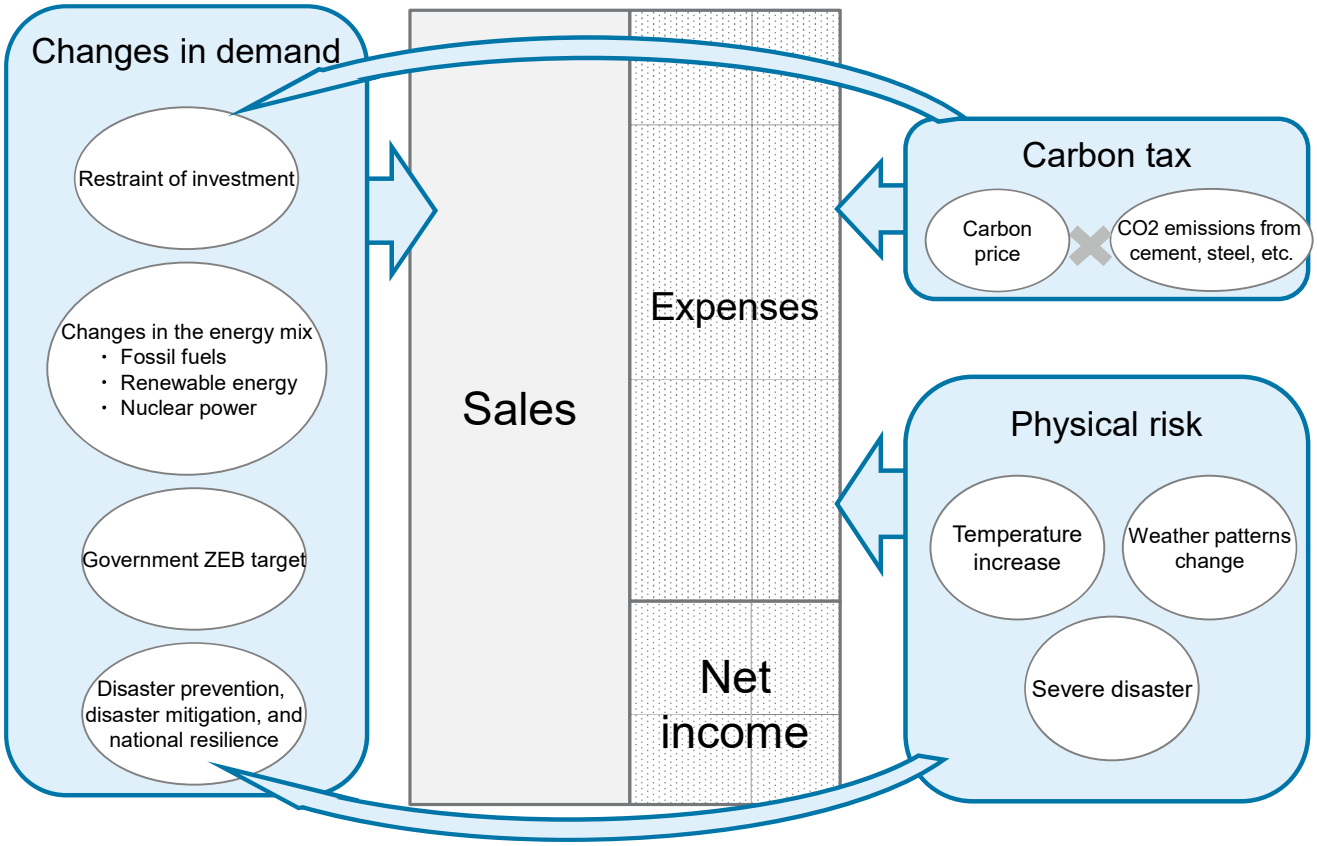
- Substantial increase in renewable energy
- Significant decrease in fossil fuel power generation
- Increase in the introduction of hydrogen and other new energy sources

Changes in the market

- Significant review of flood control plans, etc.
- Review of the location of new buildings
- Expansion of the disaster prevention, disaster mitigation, and BCP Market
- Rapid spread of ZEB (zero energy buildings)
- Increase in energy conservation renewals (decrease in new buildings) / Expansion of energy management services
- Market entry from other industries
- Increased demand for in-house renewable energy facilities

4 [Step4: Evaluate business impacts]

Considering the impact of each key driving force on the income statement (P/L)



4 [Step 4: Evaluate business impacts] Assumptions: around 2030

Reflecting disasters with extreme severity, demand for disaster prevention, disaster mitigation, and national resilience is increased

Additionally,
2°C scenario → Rising cost caused by introduction of carbon tax have an great influence.
On the other hand, demand is expected to increase due to the spread of renewable energy and zero-energy-buildings (ZEB).
4°C scenario → The deterioration of working conditions due to the increase in temperature is significant.

Risk/Opportunity Items	4°C scenario	2°C scenario
Cost increase due to carbon tax		- - -
Shrinkage in the construction market due to a tax increase		-
Business restrictions due to CO_2 emission allowances		-
Energy mix change (decrease in fossil fuels)		-
Increase in renewable energy-related demand	+ +	+ +
ZEB (Zero Energy Building) market expansion	+	+ +
Effect on working conditions due to temperature rise	- -	-
Disaster prevention, disaster mitigation, and national resilience	+ +	+ +
Relocation from disaster risk areas	+ -	

5 [Step5: Identify potential responses]

For items with large business impact, future countermeasures were examined. It is necessary to promote technological development that meets market needs.

Response to Carbon Tax and Emission Allowance Regulations

Cost increase due to carbon tax
Contraction of the construction market due to the tax increase
Business restrictions due to CO_2 emission allowances

→
① Promote activities to reduce CO_2 during construction
② Development and promotion of introduction of low-carbon materials
③ Securing renewable energy

Technological development in response to new markets and climate change

Energy mix change (decrease in fossil fuels)
Increase in renewable energy-related demand
ZEB (Zero Energy Building) Market Expansion
Effect of rising temperature on working conditions

→
① Selection of focus areas based on energy mix
② Development of engineering and construction technologies for renewable energy facilities
③ Pursuit of ZEB profitability and comfort
④ Development of labor-saving construction technology

Responding to Severe Extreme Weather

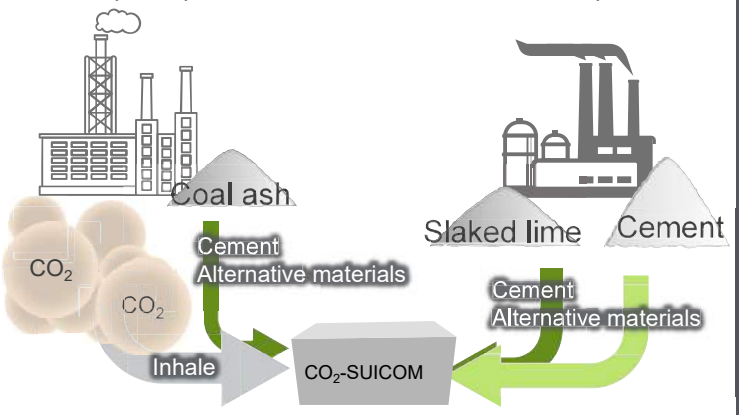
Disaster prevention, disaster mitigation, and national resilience
Relocation from disaster risk areas

→
① Promotion of technical development related to disaster prevention, disaster mitigation, and BCP
② Development and utilization of hazard maps incorporating unique knowledge
③ Construction that contributes to the strengthening of national resilience including buildings and structures

[Development Case of Low-Carbon Building Materials (Concrete)]

CO_2-SUICOM

By "sinking" CO_2 in a way that trees "breath",
Concrete to reduce the amount of CO2 to virtually zero or less

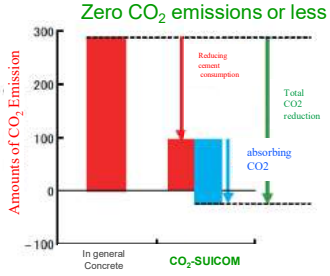


In "CO_2 - SUICOM",

Reducing cement consumption by using coal ash, special admixtures and other materials instead of cement, and absorbing CO_2 into the concrete during manufacturing, we are able to reduce CO_2 emissions to virtually zero or less.

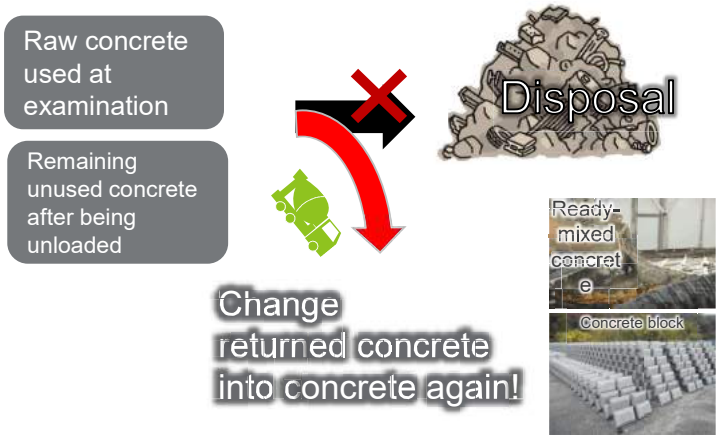
※ Co-developed by Chugoku Electric Power Co., Inc., Kajima Corporation, and Denka Co., Ltd.

Zero CO_2 emissions or less



Eco-cleat R^3

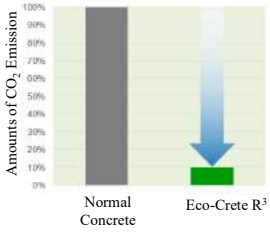
Manufacture by reusing the waste returned concrete
Ultimate Recycling-Oriented Concrete



In "Eco-Crete R^3",

This is an environmentally conscious concrete that reuses the returned concrete which had been inevitably disposed. Eco-Crete contributes to resource recycling and reduce in CO_2 emissions.

Reduce CO_2 emissions by up to 90%



Building/ Forest Product

- ✓ Practice Example①：Kajima Corporation
- ✓ **Practice Example②：Sumitomo Forestry Co., Ltd.**
- ✓ Practice Example③：Tokyu Fudosan Holdings Corporation

STEP2 “Assess materiality of climate-related risks”

STEP 2 3 4 5 | Timber & Building Materials | Housing and Construction

Forest protection policy, and increase in forest fires and pests will have impacts

	Risk item	Business impact on timber and building material business	Assessment
Transition risk	**Carbon emissions targets/policies**	• **Governments’ forest carbon absorption policy will increase timber procurement costs.**	Large
	Forest protection policy	• **Governments’ adoption of logging tax and charges will increase timber procurement costs.**	
	Renewable energy subsidies	• **Promotion of wood biomass power generation will increase sales. If the government stops subsidies, sales will decrease.**	
	Changes in energy mix	• **If relevant countries incorporate biomass in their sustainability standards, sales will increase.** • **But increased demand will increase fuel costs (timber chips) in the biomass power generation business.**	
	Sluggish economic activities due to stricter climate change regulations	• **If construction itself is suppressed, supply and demand of timber and building materials will become sluggish, and sales will decrease.**	
Physical risk	**Rise in average temperatures**	• **Forest fires and pests will increase timber procurement costs.** • **Higher temperature and increased precipitation will facilitate timber growth, possibly improving productivity and reducing timber procurement costs.**	
	Changes in precipitation and weather patterns	• **Changes in forestation and timer procurement areas will increase timber procurement costs.**	
	Increased severity of extreme weather events	• **Suspension of factory operations will reduce sales. Decreased forest resources will increase timber procurement costs.**	
Others	Fluctuations in key product prices, progress of next-generation technology, changes in reputation among investors, dissemination of renewable and energy-saving technologies	• Adoption of AI and IoT will reduce transport and factory operation costs. • Increased trade of energy-saving products and high-efficiency insulating materials will increase sales of timber and building materials for renewable-oriented markets.	Small to Medium

Efforts to comply with governments’ forest protection policy and logging regulations, as well as changes in forest resources caused by physical risks, will have great financial impacts.

STEP2 “Assess materiality of climate-related risks”

STEP 2 3 4 5 | Timber & Building Materials | Housing and Construction

Changes in sales caused by housing policy and delay in construction due to extreme weather events will have impacts

	Risk item	Business impact on housing and construction	Assessment
Transitional risk	**National carbon emissions targets/policies**	• **Governments’ forest carbon absorption policy will increase timber procurement costs.**	Large
	Forest protection policy	• **Governments’ adoption of timber tax and charges will increase timber procurement costs.**	
	Building policy	• **Efforts to meet government’s policy will increase investment and reconstruction costs.** • **If the government continues subsidies, monetary incentives will arise. Some policies can impact market competition and sales.**	
	Changes in reputation customers	• **If customers pay more attention to climate change, they will opt for forest certified timber, which will increase procurement costs.**	
Physical risk	**Increased severity of extreme weather events**	• **Severe natural disasters will cause delays in construction. This, together with recovery of facilities, will increase construction costs.** • **More extremely hot days will lower outdoor work efficiency, and cause delay in construction and require more careful health management of workers. All this will increase costs.**	
Others	Subsidy policies or RE, changes in energy mix, changes in reputation investor, fossil fuel subsidies, average temperature rise, etc.	• Subsidies for PV power systems will increase monetary incentives. • Accelerating divestment will be more unfavorable to companies not practicing environment business. • Changes in subsidies will change demand for renewable and other forms of energy, having impacts on operation costs.	Small to Medium

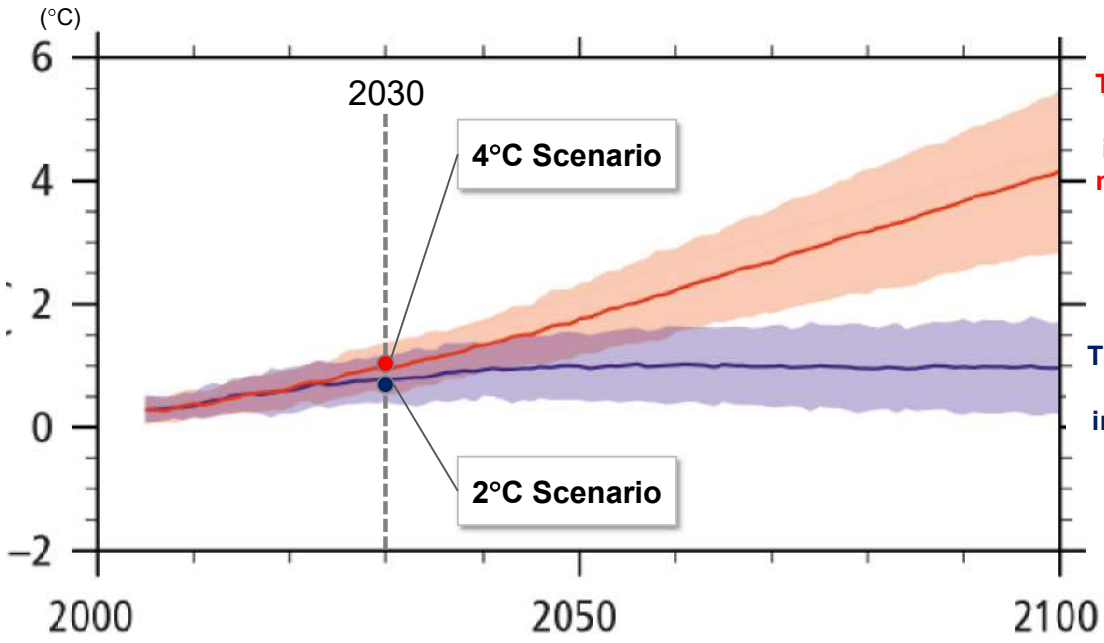
Changes in government policies on forest protection and buildings, as well as severer extreme weather events, will increase costs and have great financial impacts.

STEP3 “Identify and define range of scenario”

STEP 2 **3** 4 5 | Scenario **4°C** **2°C**

Consider society in 2030 with two scenarios of climate change that are highly uncertain. Assess climate change risks and opportunities in the 2°C and 4°C scenarios

[Global average surface temperature (difference from the 1986-2005 average)]



The temperature will rise 3.2-5.4°C above pre-industrial levels, unless more rigorous measures are taken.

The temperature will rise 0.9-2.3°C above pre-industrial levels, if strict measures are taken.

Source: Figure SPM.6 in the Synthesis Report (SYR) of the IPCC Fifth Assessment Report (AR5)

STEP3 “Identify and define range of scenario”

STEP 2 **3** 4 5 | Scenario **4°C** 2°C | **Timber & Building Materials** | Housing and Construction

In the 4°C scenario, increased forest fires and pests by global warming change supply chains

World in the 2030s in the 4°C scenario (example)

Supplier

Increased forest fires and pests will increase costs.

(region: xxx)

✓ **Increased fires and pests will raise timber prices.**

(region: xxx)

✓ Flooding and soil drainage will **reduce timber supply** and raise timber prices. There will be **risk of suspension of factory operations.**

Action

Secure suppliers with an eye to changes in forestation areas

Prepare disaster prevention measures for forest fire and flooding (Collaboration with suppliers)

New entry

✓ No new entry

(No particular action needed)

Timber & building material industry

Industry/Sumitomo Forestry

Further action in light of global warming impacts

✓ **Preparation for possible changes in forestation areas and materials (with an eye to the latter half of the 21st century)**

✓ Governments’ deforestation prevention regulations and policy will change supply change, and raise forest management and logging costs.

Action ***Develop tougher products Review supply chain***

Alternatives

Accelerating shift to alternative materials

✓ Timber will be replaced by metals for building structures (as a result of increased demand for heavy duty materials)

Action ***Change business portfolio***

Customer

Changes in material needs in response to extreme weather events

✓ Frequent extreme weather events will increase demand for heavy duty building materials.

✓ Changes in forestation areas and materials will require the Company to reconsider suppliers and business partners.

Action ***Understand buyers’ needs, and procure materials and develop products to meet the needs***

Other stakeholders

Intensified consumer boycott

✓ NGOs will label logging as unhealthy acts, pushing anti-logging protests and consumer boycotts

Action ***Promote dialogue with NGOs and other environmental groups Participate in initiatives***

Government

Regulations remaining at the present level

(region: xxx)

✓ Government introduce forest protection regulations and policy to achieve NDC target. They may stipulate stricter regulations

(region: xxx)

✓ No regulations on forest absorption in relation to NDC. The government will maintain the present level of operators’ obligations to return emission rights when logging under the emissions trading scheme.

Action ***Gather up-to-date information about government regulations Secure transparency of supply chains***

STEP3 “Identify and define range of scenario”

STEP 2 **3** 4 5 | Scenario 4°C **2°C** | **Timber & Building Materials** | Housing and Construction

In the 2°C scenario, stricter forest regulations and increased forest fires will have impacts

World in the 2030s in the 2°C scenario (example)

Supplier

Stricter regulations will increase timber material costs. Increased forest fires and pests will increase costs

Overall

✓ **Stricter regulations** will lead to higher logging tax rates and reduced material productions. This will **increase sales costs and procurement costs.**

(region: xxx)

✓ **Forestation areas will shift slightly to north, increased forest fires and pests will raise timber prices.**

Action
Secure suppliers with an eye to higher logging tax rates
Prepare measures for disaster prevention arising from forest fires

New entry

Increased demand from biomass power generation

✓ New entries supplying biomass materials and power generation

Action ***Promptly secure promising regions (resilient regions, etc.)***

Timber & building material industry

Industry/Sumitomo Forestry

✓ **Preparation for possible changes in forestation areas and materials**
✓ **Securing of suppliers with an eye to stricter regulations and inflated prices**
✓ Reduction in new housing starts due to ageing society with lower birth rate

Action
Develop a network contributing to transport cost reductions and suitable for the local production for local consumption model

Alternatives

More use of carbon-free materials (including wood)

Use of waste materials and new materials (bioplastics, CNF, etc.) in preparation for reduced supply

Action ***Develop new materials and approaches***

Customer

Higher environment consciousness More use of biomass

✓ Changes in supply volume will encourage development of materials and new approaches.
✓ Increased demand for biomass fuel

Action
Increase the share and secure domestic materials Supply materials to biomass power generation Promote forest certification and forestation

Other stakeholders

Changes in investment and financing

✓ Investors and financial institutions will change their stance in accordance with the quality of forest management (reforestation, etc.).

Action ***Promote forest certificates and plantation forests***

Government

Much stricter government regulations

Overall

✓ **Stricter regulations on natural forest logging**
✓ Spread of the idea of “Net Zero Deforestation”

(Region: xxx)

✓ The government will set stricter forest protection regulations and policy against logging with the target deforestation rate under 350h/year.

Action
Gather up-to-date information about government regulations Secure transparency of supply chain

STEP3 “Identify and define range of scenario”

STEP 2 **3** 4 5 | Scenario **4°C** 2°C | Timber & Building Materials | **Housing and Construction**

In the 4°C scenario, the world will be on an extension of the present path (The landscape of the housing and construction industry will remain unchanged. The focus will be on BCP.)

World in the 2030s in the 4°C scenario (example)

Supplier

Increased forest fires will increase material costs.

✓ **Risks of natural disasters will increase material costs.**
✓ Procurement of heavy duty materials and timber against natural disasters.

Action
Establish supply chain considering physical risk

Energy business

Inflated grid power rates

✓ Grid power rates will increase.
✓ Use of heat as renewable energy

Action
Secure non-utility power sources

New entry

Rise in new entries

✓ IT businesses and mass home appliance retailers are already in the renovation market.
(No particular action needed)

Housing and construction industry

Continued efforts for BCP and spread of ZEH

Industry/ Sumitomo Forestry

✓ Technology development for BCP, energy-saving housing, and HEMS
✓ ZEH will increase, but not among large residential houses
✓ **Longer construction schedules**

Action **Steadily promote energy-saving and ZEH**

Alternatives

✓ No alternatives will emerge.
(No particular action needed)

Customer

More efforts for BCP Continued efforts for ZEH

✓ Possibly more frequent extreme weather events and slope failures will increase demand for tougher, more **resilient housing**.
✓ Global warming will slightly increase air-conditioning demand and costs, and slightly decrease heating demand and costs. If the cooling trend prevails, demand for and costs of heating will increase.
✓ Demand for energy-saving and heat-resistant housing will slightly increase.

Action
Continue promoting ZEH Develop highly resilient housing

Government

Continued efforts for net “zero energy houses” (ZEH) Increased subsidies for BCP

✓ The government will promote energy-saving houses, and visual control of renewable energy and home energy management systems, HEMS, (through subsidies).
✓ The government will encourage the industry to realize ZEH targets (50% of new houses by 2020, and more widespread by 2030).
✓ Efforts for carbon pricing will not bear fruit.

Action
Gather up-to-date information about government policy and secure subsidies

STEP3 “Identify and define range of scenario”

STEP 2 **3** 4 5 | Scenario 4°C **2°C** | Timber & Building Materials | **Housing and Construction**

In the 2°C scenario, the Company will have to find business solutions to increased demand for lower-carbon housing

World in the 2030s in the 2°C scenario (example)

Inflated timber prices
Supplier
- ✓ **Forestry regulations (logging tax, etc.) will raise timber prices.**
- ✓ **Risks of natural disasters will increase material costs.**

Action: **Establish supply chains that can accommodate natural disaster risk. Consider supply chains with an eye to stricter regulations Promptly secure necessary parts for ZEH**

Rise in new entries
New entry
- ✓ Electronics, automobile and IT makers, particularly those with energy-saving and energy storage technology will enter the market.

Action: **Business partnerships and M&A**

Housing and construction industry

Increased demand for high-function housing
Industry/ Sumitomo Forestry
- ✓ Reduction in new housing starts due to ageing society with lower birth rate
- ✓ Longer construction schedules
- ✓ **Development of advanced ZEH, efforts for lower pricing**

Action: **Develop and apply advanced ZEH and low-price ZEH technologies**

More sophisticated (high-function) ZEH at lower costs
Customer
- ✓ **The ZEH market will mature and the demand will be polarized (to inexpensive housing and more sophisticated housing).**
- ✓ Higher interest in lower power rates will increase the demand for housing with higher energy efficiency.
- ✓ Increased demand for certificated housing for “fair forestry” and net zero deforestation.

Action: **More focus on lower-price housing More focus on advantageous field (wooden housing)**

Promotion of lower-carbon policy for households
Government
- ✓ **The government will set stricter targets than current NDC, and adopt stricter building and housing regulations (including ZEH) and subsidies.**
- ✓ Policy to use surplus power for wider use of PV power generation
- ✓ Promotion of electrification for lower carbon in the household sector (depending on the progress of “Power to Gas” technology)

Action: **Work with the government for the spread of advanced ZEH, Adopt renewable energy, and deal with carbon tax to create emission rights**

More use of renewable energy
Energy business
- ✓ Increased share of renewable energy
- ✓ **Creation of FIT-free and aggregated business**

Action: **Secure non-utility power sources and supply from other companies**

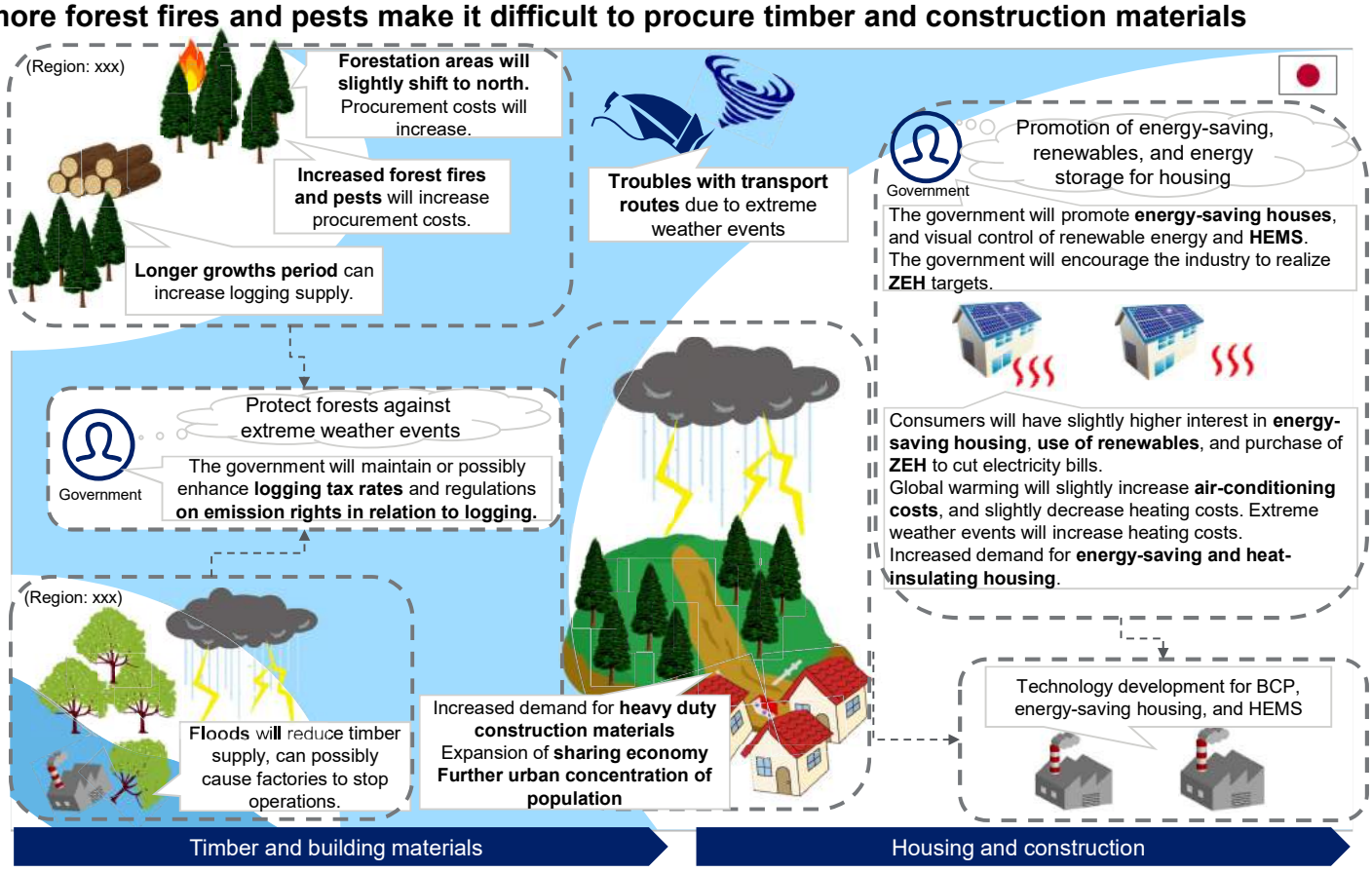
Increased demand for new materials
Alternatives
- ✓ Inflated prices of steel, cement and other materials will increase demand for bioplastics, CNF and other new materials.

Action: **Develop new low-carbon (wooden) materials**

(Reference) Image of a future society in the 4°C scenario

STEP 2 **3** 4 5 | Scenario **4°C** 2°C

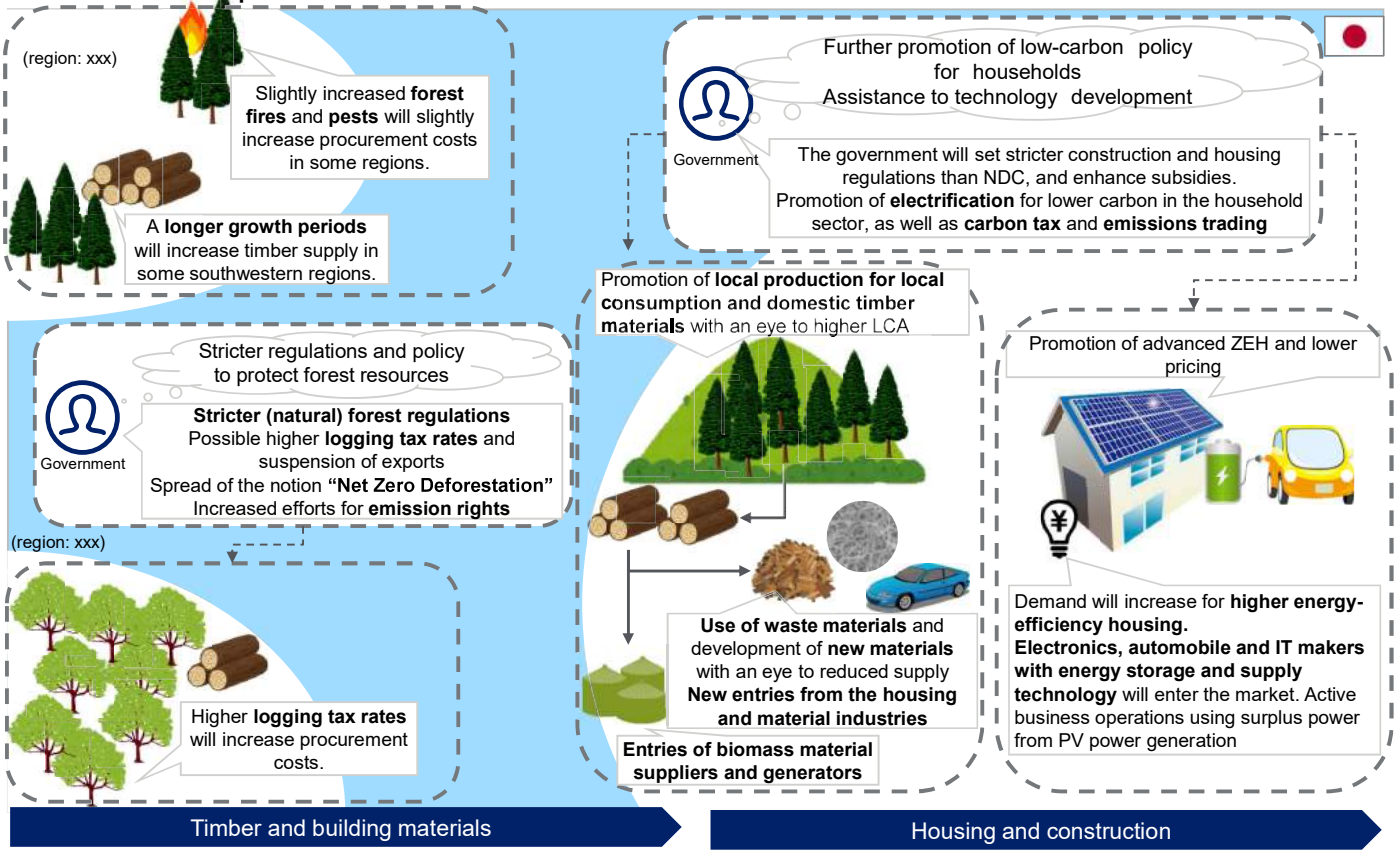
Government initiatives will increase energy-saving housing (ZEH), while there will be risk that more forest fires and pests make it difficult to procure timber and construction materials



(Reference) Image of a future society in the 2°C scenario

STEP 2 **3** 4 5 | Scenario 4°C **2°C**

Government initiatives will lead to the ZEH market maturity. They will also facilitate development of advanced ZEH and lower pricing, and new entries from other industries will increase. There will also be risk that stricter forest regulations and increased fires make it difficult to procure timber and construction materials.



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STEP3 "Identify and define range of scenario"

STEP 2 **3** 4 5 | Scenario **4°C** **2°C**

Define the world in selected scenarios based on IEA and other scientific grounds

		Present	2030		Sources
			4°C	2°C	
National carbon emissions targets/policies	**Government targets**	Indonesia deforestation 325ha (the 2030 target)	450ha (assumed)	**300**ha (assumed)	Indonesia NDC
		Regulations on logging in natural forests	None	**Country targets (20-100%)**	(Assumptions)
Forest protection policy	**Forest protection policy (likely to be logging tax)**	(Malaysia: $12/m3)	(n.a.: unpredictable)	(n.a.: unpredictable)	(to be considered)
Building policy	**ZEH targets**	New housing starts	xxx unit (present level)	xxx unit (opportunity loss of xx%)	(Assumptions)
		Share of ZEH	ZEH: xxx%	xxx%, **Advanced ZEH: xxx%**	(Assumptions)
Subsidies for renewable energies, etc.	**Subsidy amount**	Energy mix in Japan 1.7%	3.7%	4.6%	Agency for Natural Resources and Energy, "Challenges to the 2030 Energy Mix - Overall Picture"
Changes in energy mix	**Share of biomass power generation**				
Rise in average temperatures	**Changes in vegetation and increase in fires**	Forest fire area 0.951%/year (Canada)	**1.594**%/year	**1.690**%/year	Natural Resources Canada Forest Change indicators "Fire regime" (RCP2.6, RCP8.5)
	Increase in forest pests	(n.a.: data unavailable)	(n.a.: unpredictable)	(n.a.: unpredictable)	(to be considered)
Changes in precipitation and weather patterns	**Flooding risk**	$405m/year (Indonesia)	**$875m**/year	$405m/year	WRI "The Aqueduct Global Flood analyzer"
Severer extreme weather event	**Frequency of torrential rains**	Event probability: 0.3 times/year (Japan)	**0.6 times**/year (around 2100)	(n.a.: data unavailable)	Ministry of the Environment, "Synthesis Report on Observations, Projections and Impact Assessments of Climate Change, 2018"

1

1 [Key indicator: Annual area burned]

STEP 2 3 4 5 | Timber & Building Materials | Housing and Construction

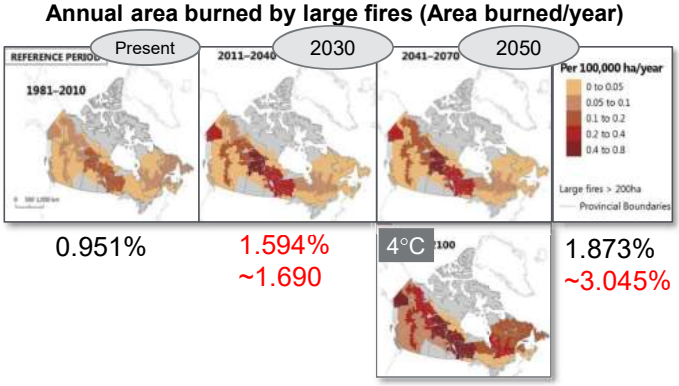
A rise in temperatures will increase the number of large fires, having great impacts both in the 2°C and 4°C scenarios.

Scientific forecasts

Annual area burned by large fires in Canada

	Annual area burned (qualitative)
Present	**Forest fires in the central part of the continent**
2030	**Large scale forest fires central region**
2050	**Forest fires also in the northwest**

Annual area burned by large fires (Area burned/year)



0.951% | 1.594% ~1.690 | 1.873% ~3.045%

Source: Natural Resources Canada, "Forest Change Indicators, Fire Regime RCP 2.6 scenario"

Recognition of forestry companies

CDP response on climate change risks

Companies cited	Comments (extracts)
STORAENSO UPM	**Higher risks of forest fires**: Not yet occurred in northwestern Russia, where the company procures materials, **but possible future risks** (UPM)
Brambles	**Impacts of unforeseeable cyclones, fires, earthquakes and other natural disasters** (Brambles)

Forest fire risk recognition among worldwide companies

- STORAENSO: A forest products company providing products in over 30 countries worldwide. A leading company in the global market
- UPM: A forest industry company having production plants in 13 countries, strong in business fields combining bioenergy and forestry industries
- Brambles: A supply-chain logistics company doing business in over 60 countries worldwide

World leading forest companies recognize that climate change is causing more forest fires.

Source: CDP response

STEP4 "Evaluate business impacts"

STEP 2 3 4 5 | Scenario 4°C 2°C

In the 4°C scenario, the Company must eliminate financial impacts of forest fires

4°C scenario

- Forest protection and building (ZEH) regulations will remain at the present level.
- Annual area burned by large scale fires will be 1.594%. (Area burned/year)
- Increased torrential rains will prolong construction schedules and increase costs.
- The penetration rate of biomass power generation is assumed to be 3.7% in Japan.

	Business impact	Evaluation (100 million yen)
2030 with no action	Higher timber prices due to forest protection regulations	XX
	Opportunity loss due to failure to develop higher-level ZEH	XX
	Higher timber prices due to forest fires	XX
	Higher costs due to heavy rains	XX
	Subtotal	▲ XX
2030 with actions taken	Securing timber suppliers with an eye to forest protection	XX
	Opportunities through development of ZEH and higher-level ZEH	XX
	Increase in demand for biomass power generation	XX
	Efforts to prevent forest fires	XX
	Total	+XX

In the 2°C scenario, the Company must eliminate financial impacts of stricter regulations (forest and ZEH) and forest fires

2°C scenario

- Timber costs will sharply increase on the assumption that the governments of countries enhance forest protection policies and restrict exports of timber from natural forests. (The percentage of restricted imports was calculated based on the share of natural forest in each country. The inflated timber costs will not be passed onto timber prices.)
- Opportunity loss due to failure to develop higher-level ZEH
- Annual area burned by large scale fires will be 1.690%. (Area burned/year)
- The penetration rate of biomass power generation is assumed to be 4.6% in Japan.
- It is also assumed that the Company will complete a change of timber suppliers as a forest fire prevention measure.

	Business impact	Evaluation (100 million yen)
2030 with no action	Higher timber prices due to forest protection regulations	XX
	Opportunity loss due to failure to develop higher-level ZEH	XX
	Higher ZEH costs	XX
	Higher timber prices due to forest fires	XX
	Higher costs due to heavy rains	XX
	Subtotal	▲XX
2030 with actions taken	Securing timber suppliers with an eye to forest protection	XX
	Opportunities through development of ZEH and higher-level ZEH	XX
	Increase in demand for biomass power generation	XX
	Efforts to prevent forest fires	XX
	Total	+XX

Building/ Forest Product

✓ Practice Example①：Kajima Corporation

✓ Practice Example②：Sumitomo Forestry Co., Ltd.

✓ **Practice Example③：Tokyu Fudosan Holdings Corporation**

Target business segments and years of the climate-related risk assessment
Consider urban development and resort (resort hotels, golf courses, and ski areas) business segments

Target business segments and years

Business segment	Target year	Grounds
Urban development	2030	This is one of the Company's leading segments. The purpose is to consider action to be taken in the mid-term timeframe from the scenario analysis perspective.
Resort business (resort hotels, golf courses, and ski areas)	2050	The purpose is to consider physical risk impacts and possible countermeasures to be taken. These impacts will differ in magnitude in the long run.

Assess materiality of climate-related risks

STEP 2 3 4 5 Scenario 4°C 2°C

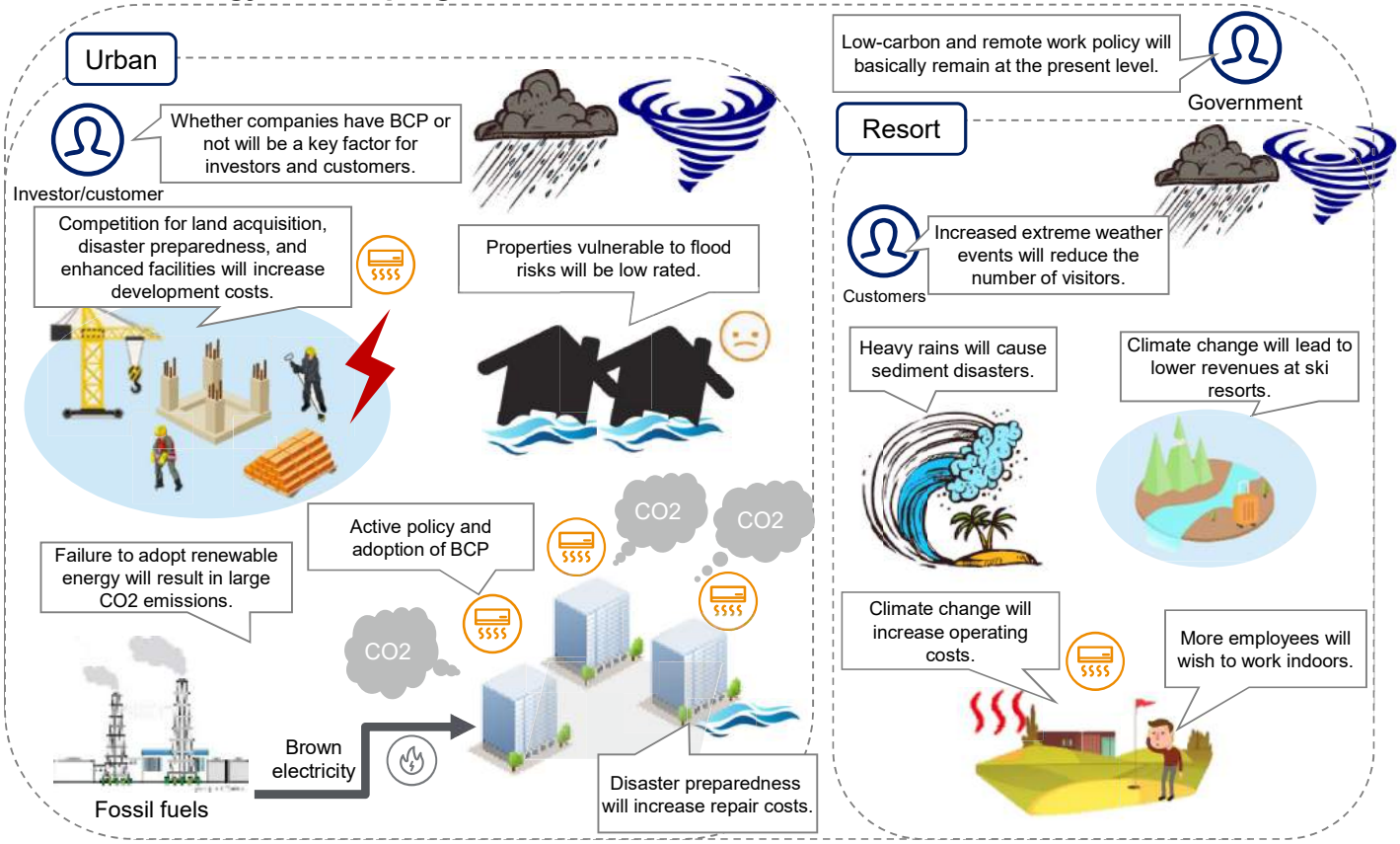
Various factors related to climate change will impact the Company' business

	Politics	Economy	Society	Technology
Transition Risks (Stricter regulations, etc.)	• **Carbon pricing** (Great impact) Adoption of carbon tax will incur costs for CO2 emissions. • **Carbon emissions targets/policies** (Great impact) Expanded coverage of energy-saving laws, enhanced targets of cap and trade programs, and mandatory installation of energy-saving functions will increase technology and facility installation costs. • **ZEB regulations** (Great impact) Application of ZEB regulations to buildings will increase construction and repair costs.	• Energy prices Increased use of renewable energy and inflated fossil fuel prices will lead to less stable grid systems and increase energy prices. • Trends in energy demand Fluctuating demand for energy as a whole will impact energy procurement costs. • Changes in energy mix Changes in the share of renewable energy will change emission reductions companies need to make.	• **Changes in consumer behaviors** (Great impact) Increased needs for (i) disaster-resilient and (ii) "green" buildings • **Changes in reputation among consumers and investors** (Great impact) Any delay to meet the needs for (i) disaster-resilient and (ii) "green" buildings can result in consumer boycott and withdrawal of investors.	• **Progress of ZEB technology** (Great impact) Rise in advanced materials and technologies will reduce ZEB construction and repair costs. • **Spread of energy-saving and renewable technology** (Great impact) Progress towards a low-carbon society will facilitate development of energy-saving and renewable technology, and reduce adoption costs.
Physical Risks (climate change, etc.)	• **Higher average temperatures and sea levels** (Great impact) A rise in average temperatures will cause more heatstroke. It will also lead to more use of air-conditioning, which will increase operation costs. • **Severer extreme weather events (wind and flood damage)** (Great impact) More frequent typhoons and torrential rains will cause more wind and flood damage to buildings, increase repair costs, and reduce customers.			

(Reference) Image of a future society in the 4°C scenario

STEP 2 **3** 4 5 Scenario **4°C** 2°C

Extreme weather events will be more frequent and shifts to a low-carbon society and renewable energy will not progress.



Business impacts in the 4°C scenario

STEP 2 3 **4** 5 Scenario **4°C** 2°C

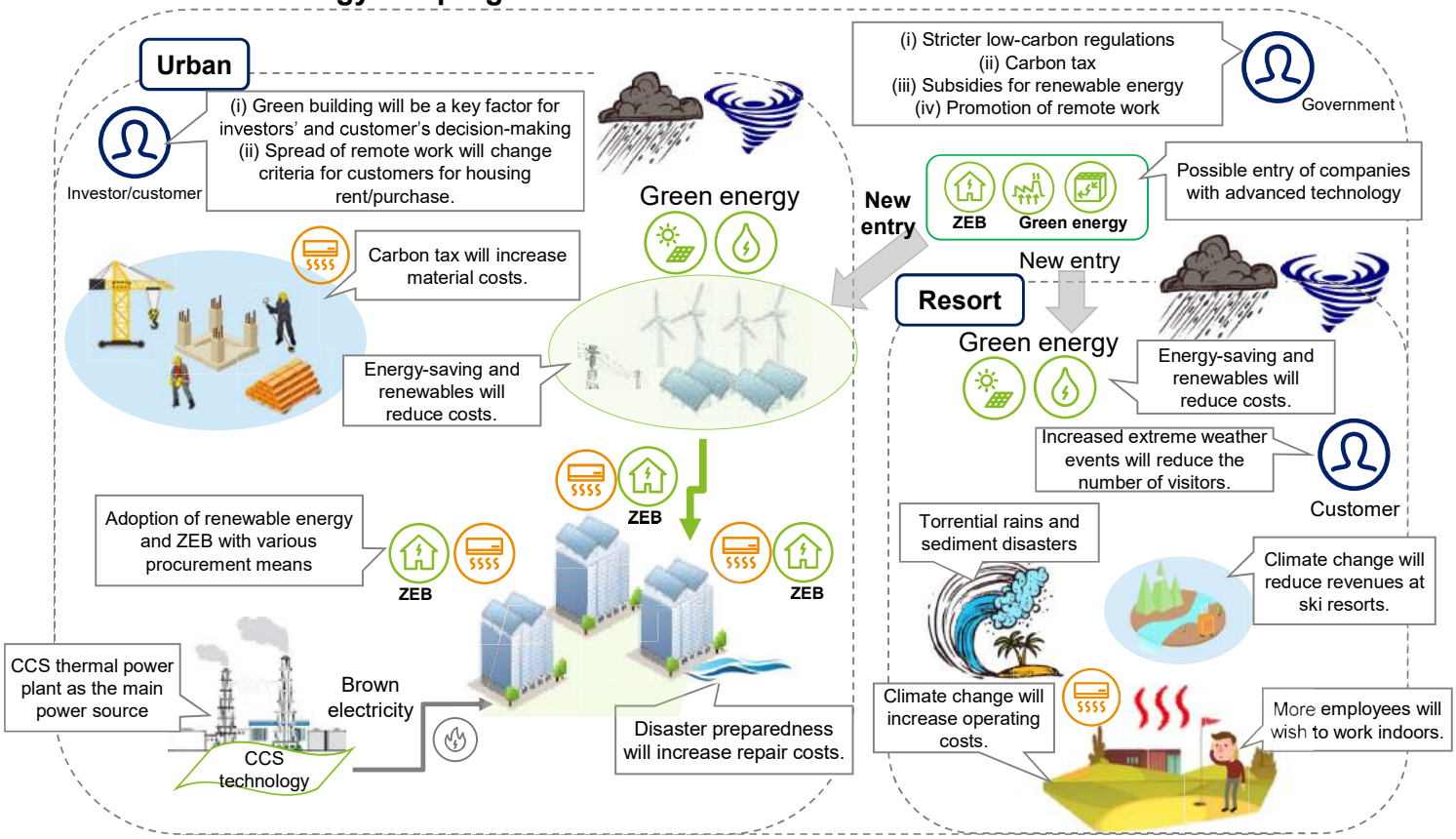
Interpret that changes in the environment in the future will have impacts on business to some extent

	Changes in social environment Events likely to occur in future	Adverse business impacts Interpretation of actual business impacts	Positive business impacts Interpretation of actual business impacts
Development business 2030	**Enhanced environment regulations including ZEB and energy-saving laws**	**Adoption of energy-saving, renewable and ZEB for legal compliance**	**Steady efforts for compliance**
	Increased extreme weather events	**Increased damage to buildings**	**Enhanced resilience of buildings and more active customer promotion**
	BCP-oriented customer preference and transfer of properties	**Loss of customers due to insufficient BCP**	
	Higher vacancy rate due to increased remote work	**Loss of customers due to increased remote work**	**Increase in satellite offices**
Resort business 2050	**Lower revenues at ski resorts due to climate change**	**Shorter business hours at ski resorts**	**Adoption of advanced snow machines**
	Decrease in customers/visitors as they avoid the outdoors due to increased extreme weather events	**Lower revenues due to customers' avoidance of outdoor activities and shift to alternative recreation**	**Creation of new business opportunities leveraging existing assets**
	Torrential rains and sediment disasters **Increased workload due to climate change**	**Increased loss due to sediment disasters**	**Efforts and promotion for heatstroke measures and BCP**
		Increased labor costs for emergency actions	
	Increased procurement and air-conditioning costs due to climate change	**Increased air-conditioning and operating costs due to higher temperatures**	
		Increased food material costs due to higher temperatures	

(Reference) Image of a future society in the 2°C scenario

STEP 2 **3** 4 5 Scenario 4°C **2°C**

Extreme weather events will be less frequent than in the 4°C scenario, and adoption of ZEB and renewable energy will progress



Business impacts in the 2°C scenario

STEP 2 3 **4** 5 Scenario 4°C **2°C**

Interpret that Stricter laws and regulations in the future will have impacts on business to some extent

	Changes in social environment Events likely to occur in future	Adverse business impacts Interpretation of actual business impacts	Positive business impacts Interpretation of actual business impacts
Urban development business 2030	**Adoption of carbon tax**	**Increased construction costs including ZEB adoption costs**	**Steady efforts for compliance**
	Enhanced environment regulations including ZEB and energy-saving laws	**Adoption of energy-saving, renewable and ZEB for legal compliance**	**Reduced costs thanks to ZEB technology development**
	Stricter cap and trade programs	**Increased costs of green electricity certificates**	**Reduced costs thanks to renewable technology development**
	BCP-oriented customer preference and transfer of properties	**Increased damage to buildings** **Loss of customers due to insufficient BCP**	**Improved competitiveness of resilient buildings**
Resort business 2050	**Enhanced environment regulations including energy-saving laws**	**Increased costs of saving-energy adoption**	**Adoption of renewable and other non-utility electricity**
	Lower revenues at ski resorts due to climate change	**Shorter business hours at ski resorts**	**Adoption of advanced snow machines**
	Decrease in customers/visitor as they avoid outdoors due to increased extreme weather events	**Lower revenues due to customers' avoidance of outdoor activities and shift to alternative recreation**	**Creation of new business opportunities leveraging existing assets**
	Increased procurement and air-conditioning costs due to climate change	**Increased air-conditioning and operating costs due to higher temperatures**	**Efforts and promotion for heatstroke measures and BCP**
		Increased food material costs due to higher temperatures	

Construction Material

✓ Practice Example①：LIXIL Group Corporation

1. Target Business

1 - 1 LIXIL Groups and Target Organizations

[LIXIL core philosophy]

The Group's superior products and services contribute to improving people's comfort and lifestyles.

[Company Overview]
(The fiscal year ending in March 2019)

- Sales JPY1,832.6 billion
- Approx. 75 thousand employees
- Sites in 150 or more countries

[LIXIL's business domains]

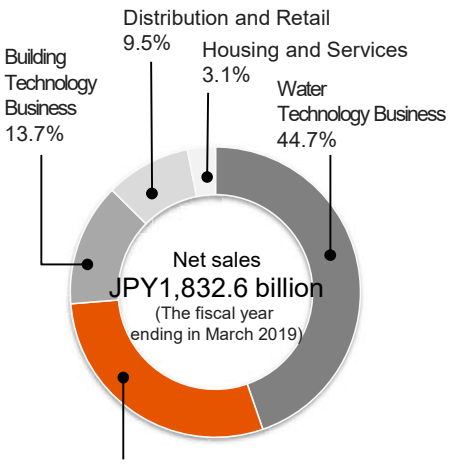
LIXIL Group's products and services support more than **1 billion** people's daily lives worldwide through various partners.

Housing Materials

Housing Equipments

Building materials

[Target organization]



Housing Technology Business
29.5% (Japan 29.0%, Overseas 0.5%)

1. Target Business

1 - 2 Selection of target business divisions

➢ For 2 businesses, estimate financial impacts in 2030 using the 2℃/4℃ scenario.

[Target business]

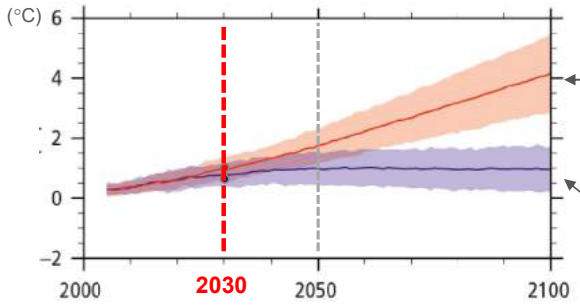
Target business	Reasons for selection
Sash door	Due to the impact of higher costs for raw materials due to tighter regulations and the spread of high-performance products such as energy-saving products
ZEH ※ Net Zero Energy House	Introduction of renewable energy for climate change countermeasures, **As demand for ZEH products is expected to increase**

[Participating departments]

- Sash and door business
- ZEH promotion division
- Technology development
- Environmental division

Cooperation: other related departments at headquarters

[2 future scenarios]



Global Average Terrestrial Temperature Change
(Difference from the 1986-2005 Average)

4℃ Scenario

Scenarios with large physical impacts
- There is no significant tightening of regulations.
- Expansion of damage caused by extreme weather conditions such as typhoons and floods
- Re-energy and ZEH penetration is limited, etc.

2℃ Scenario

Scenarios in which the impact of policy shifts is significant
- Introduction of a carbon tax, drastic tightening of recycling regulations, etc.
- Rising raw material and energy prices
- Increasing use of renewable energy and ZEH, etc.

2. Assessment materiality of climate-related risks

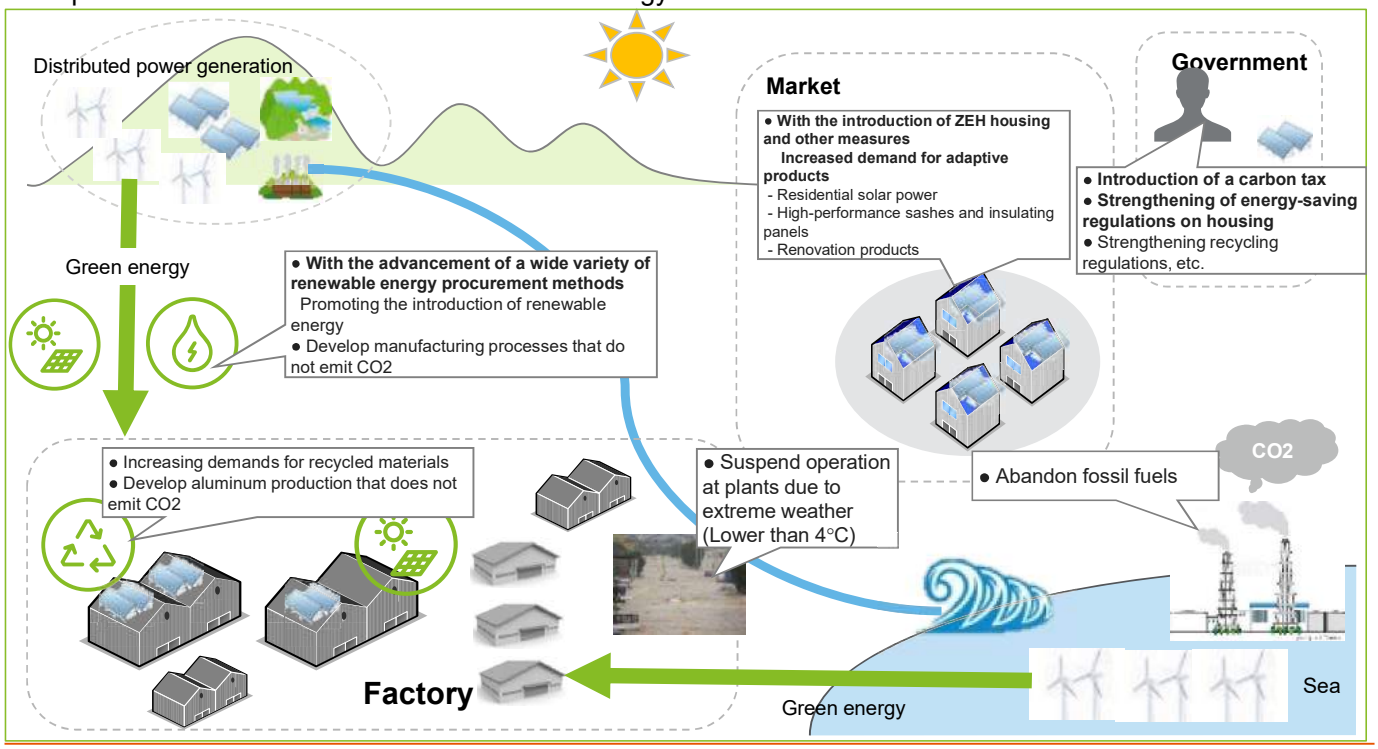
➢ Assumed risks and opportunities were identified, and the impact was assessed from large to small.

Summary of risks and opportunities (only “Large” impact excerpted)

Assumed risks			Anticipated business impact		
Major classification	Medium	Small	Risk	Opportunity	Impact
Transition risk	Policies and regulations	**Carbon tax**	・Fuel taxes and soaring electricity prices	・To boost efficiency ・Increase awareness of energy conservation among customers	**Large**
		Tightening regulations	・Tightening of regulations, such as energy-saving standards ・Mandatory use of alternative materials and recycled materials → Passing on cost increases to raw materials	・Strengthening housing energy conservation standards → Increase in demand for high insulation and renewable energy products ・Sustainable raw material utilization	
		Renewable energy policy	・Convergence of FITs and subsidies → Decline in consumer demand	・Creation of a market for renewable energy-related services ・Promotion of in-house renewable energy improvement measures	
	Market changes / technological change	**Technology investment**	・Increased investment costs in the manufacturing process	・Promoting Innovation in manufacturing processes	
		Changes in the market	・Rising prices of raw materials	・Development of alternative materials	
Physical risk	Acute	**Extreme weather**	・Increase in damage caused by natural disasters ・Supply chain disruptions	・Business opportunities for disaster prevention products ・Increase resilience through BCP measures	
・・・	・・・	・・・	・・・	・・・	Medium to small

3. Identify and define a range of scenarios
3-1 Worldview of the 2°C scenario

- At 2°C, the strengthening of regulations promotes decarbonization and accelerates the spread of ZEH-related products and the introduction of renewable energy.



3. Identify and define a range of scenarios
3-2 5Force analysis of the 2℃ scenario

Housing materials industry

: Required actions

Seller (Raw Material Suppliers)
- Cost increase of raw materials due to carbon regulations
- Shift to recycled materials

Review of low-carbon procurement methods, etc., and response to physical risks

Seller (energy, etc.)
- Increase in renewable energy ratio
- Renewable energy costs decreased

Securing power sources for private consumption Investment in renewable energy Reducing the carbon content of factories

New comer
- Companies in other industries, such as IoT technology and power-related businesses

Strengthening of collaboration (Alliances, M&A)

Industry competition
- Promote the reuse and electrification of energy at factories
- Reducing the carbon content of raw materials and promoting R&D of recycled materials
- Expansion of sales channels through the spread of ZEH and renewable energy

For low-carbon production R&D and development

(Alternative)
- Emergence of disaster response-type products, etc.
- Diversification of re-rnergy-related Systems

Development of high performance and new high-value-added products

Buyer (Customers)
- Promotion of energy-efficient products (including recycling) ⇒Needs for energy-saving products increase
- Customers' energy conservation needs increase due to the promotion of ZEH and energy conservation policies→ Expanding needs to high insulation products for houses
- Increased demand for residential solar power and other renewable energy-related services due to customers' renewable energy needs and rising electricity prices

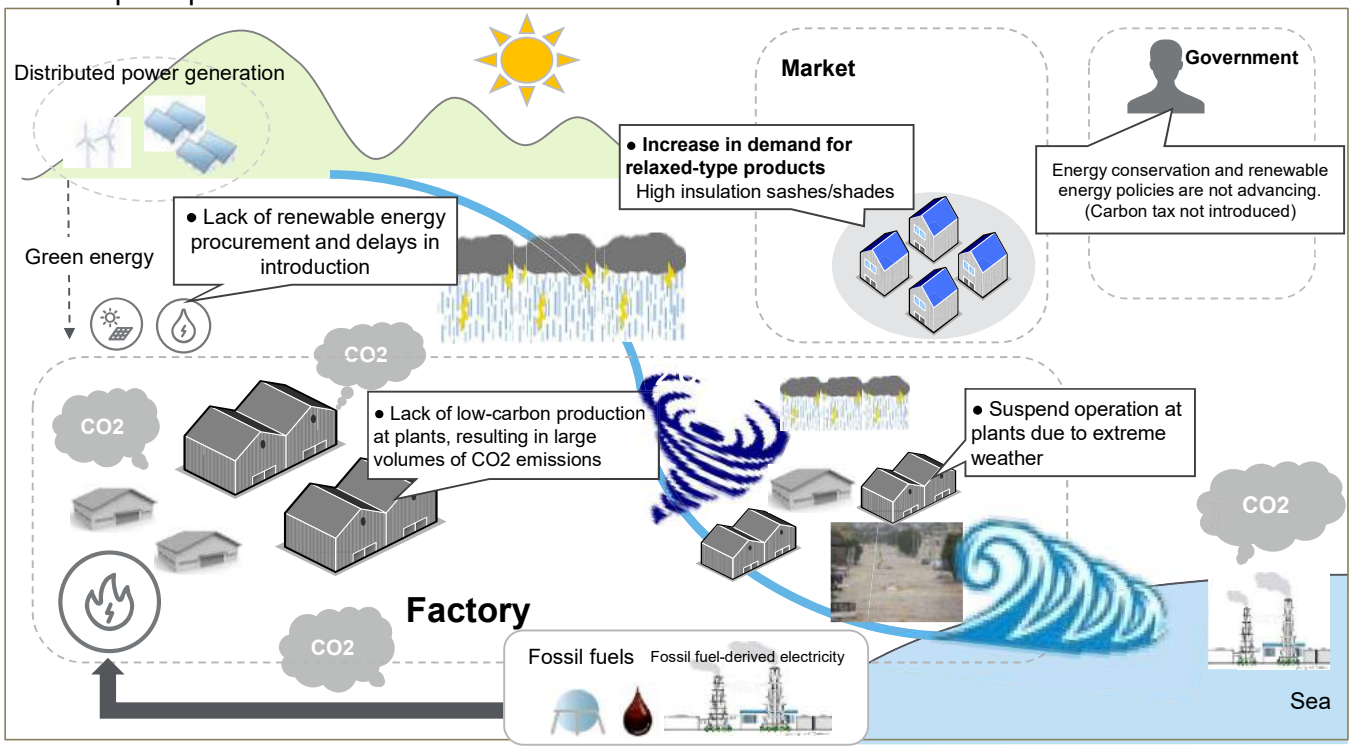
Development of value-added products for reducing the cost and carbon, recycled materials, residential solar power

Government
- Introduction of carbon tax
- Promoting energy conservation, renewable energy, electrification, ZEH, low-carbon policies, and subsidy enhancement to achieve CO2 reduction targets
- Establishment of a system for the widespread use of ZEH
- Subsidies (breakwater, etc.) for increased flood damage have been developed to a certain extent.

In cooperation with the government, make an ecosystem/rule on low-carbon markets

3. Identify and define range of scenarios
3-3 Worldview of the 4°C scenario

➢ At 4°C, policies are not implemented, increasing physical risks and increasing demand for adaptive products.



3. Identify and define range of scenarios
3-4 5Force analysis of the 4°C scenario

Housing materials industry

: Required actions

Seller
(Raw Material Suppliers)

- There is no carbon regulation.
- No shift to recycled materials
- **Physical risks emerge** in some factories and resource suppliers

Consideration of diversified procurement, etc.

Seller
(energy, etc.)

- Renewable energy will spread to a certain extent, but depend on fossil fuels

Optimization of renewable energy-related investment

New comer

- There is no particular entry.

Industry competition

- Re-energy and energy-saving measures implemented as in the past
- Development of adaptive products
- **Physical risks at the company's sites become apparent**

Promotion of measures for renewal and energy conservation, and examination of portfolios of sites with high physical risks, etc.

(Alternative)

- Develop products for market entry with the increasing needs for air conditioners

To consider new high-value-added products

Buyer
(Customers)

- Political support weakened and environmentally conscious products were successful.
- Needs for low-carbon, recycled materials, etc. are low.
  ⇒Stakeholders would not require Response
- **Demand for high insulation and sunlight shielding products increased** due to higher temperature.
- Due to flooding damage, demand in high-rise regions has expanded and demand for rental properties has expanded.
- **Increasing needs for adaptive products**

Providing products that meet new needs

Government

- As the trend of low carbon/decarbonization weakens and external pressure from the international community weakens, regulations such as carbon tax and the use of recycled plastics are not introduced.
- In some countries, CO2 emissions at factories are regulated, and emissions trading is expected to be more active (not to be introduced in Japan).
- ZEH/ZEB penetration has not progressed, and there are no aggressive policies.
- Subsidies (breakwater, etc.) will be provided due to rising sea levels and increased water stress.

Rapid access to policy information and securing of subsidies (mainly in collaboration with the government on physical risks)

3. Identify and define range of scenarios
3 - 5 Assumptions for each scenario

STEP 1 2 3 4 5

		At present	2030		Source
			2°C world	4°C world	
Carbon price	Carbon tax	-	**$100/t**	(Not installed at 4°C)	• IEA WEO 2019
Renewable energy policy	ZEH penetration rate	Newly built houses 54,352 units (2018)	Newly built homes **100**%	(market at 4°C)	• Japan environment co-creation initiative "Net Zero Energy House support project survey presentation 2019 materials"
		Existing houses 159 units (2018)	- %	(market at 4°C)	
Investments in low carbon technology	Regulation of recycled plastics	-	**14%** (Price is assumed to increase by 1.2 times)	(No restriction at 4°C)	• EU "The plastic strategy"
Increase/decrease in prices of heavy-use products	Price of aluminum	$2,108/mt	- (1.25 times higher at 4°C with introduction of carbon tax)	$2.2 thousand/mt	• World Bank "World Bank commodities forecast "
Increasing disasters with extreme severity	Frequency of floods	1 time	**1.7 times**	**3 times**	• Technical review committee on flood control plans based on climate change "Recommendations on water control plans based on climate change"

4. Evaluate business impacts
4 - 1 Estimated items for business impact evaluation

STEP 1 2 3 4 5

➢ Select risk/opportunity items to be prioritized in the current scenario analysis.

Estimated Risks and Opportunities	
Risk	Increase in energy costs due to introduction of carbon tax
	Rising raw material prices and rising costs due to regulations
	Increase in operating costs due to flood damage, etc.
Opportunity	Increase in sales of high-performance products for new homes
	Increase in sales due to expansion of renovation market
	Increase in sales due to market expansion of adaptive products
	Reduction of business activity costs through promotion of energy conservation and renewable energy measures

STEP 1 2 3 4 5

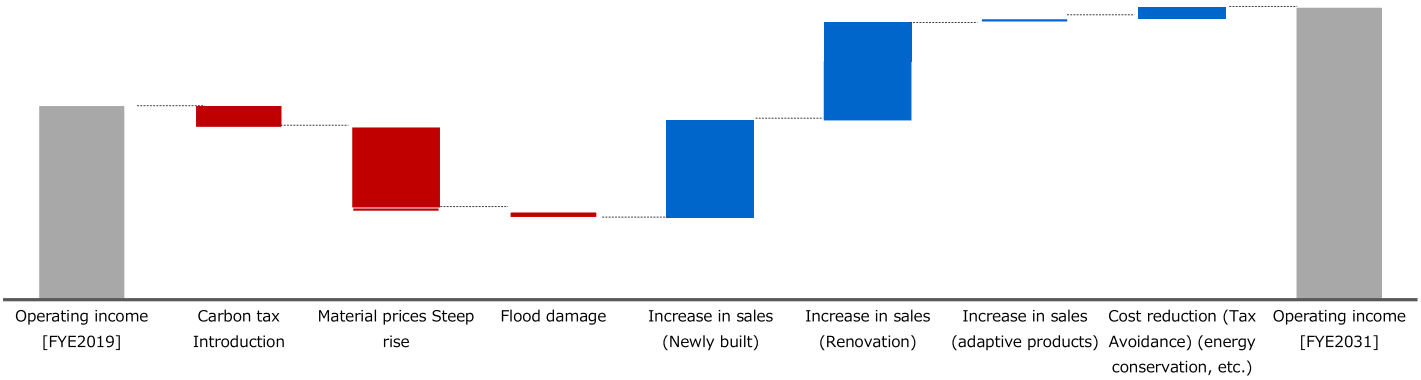
4. Evaluate business impacts
4 - 2 Business impact evaluation (summary of the 2°C Scenario)

2℃ Scenario

- In the 2°C scenario, there is **a large increase or decrease in profit** due to institutional development by the government, tightening of regulations, and changes in consumer preferences.
- Especially, **the renovation of the existing house which occupies the majority of the house is indispensable.**
- In the analysis, we assume that national policy is expanded.

Risk There are risks such as **"introduction of a carbon tax"** and **"soaring material prices"**.

Opportunity There is the possibility of cost reduction **due to sales increase by the renovation market's expansion** and **the introduction of energy saving and creating facilities** to factories, etc.



STEP 1 2 3 4 5

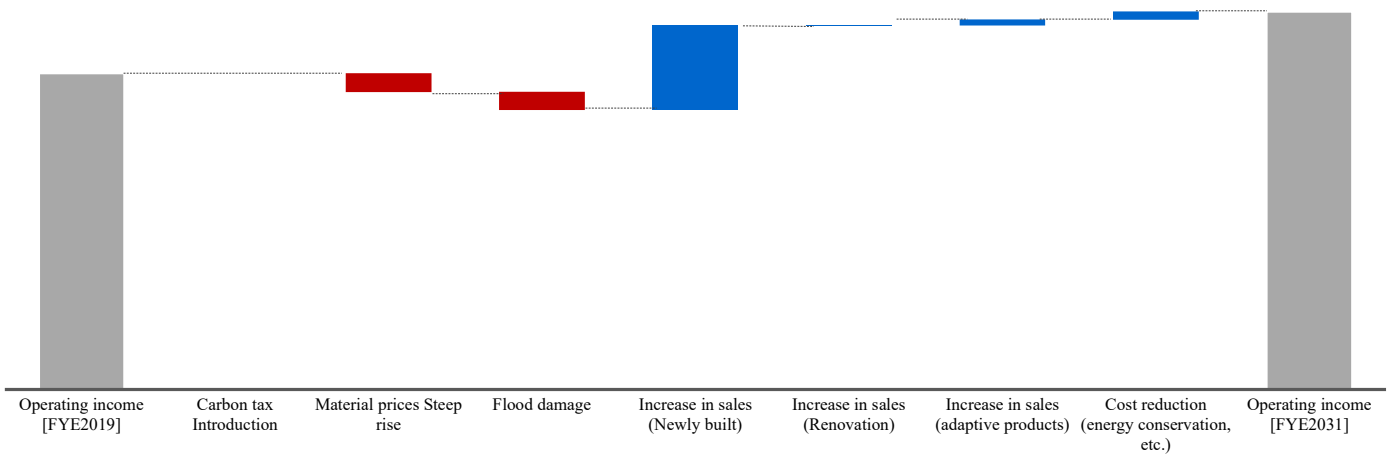
4. Scenario analysis results
4 - 3 Evaluation of Business Impact (Summary of the 4℃ Scenario)

4℃ Scenario

- As the 4°C scenario is an extension of the current scenario, the increase and decrease of profit is **relatively small**.

Risk Risks such as **"steep rise in material prices"** and **"flood damage"** exist.

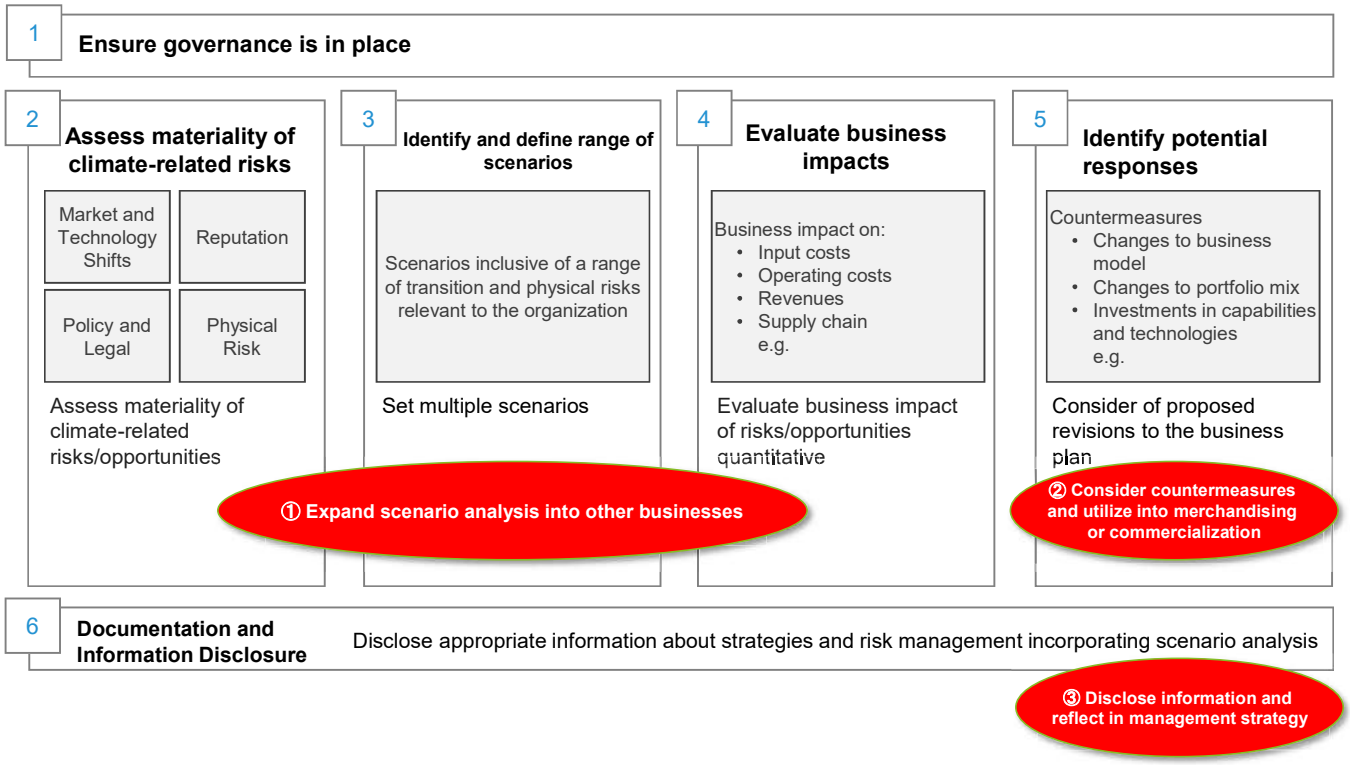
Opportunity Sales increase for high-performance building materials and solar panels due to the dissemination of new ZEH (current pace), in addition to expected increase in profits due to **the expansion of market for adaptive products**.



STEP 1 2 3 4 5

5. Future Challenges and Plans

- For the next fiscal year and beyond, company plans to ① expand scenario analysis into other businesses, ② consider countermeasures deeply, and ③ disclose information

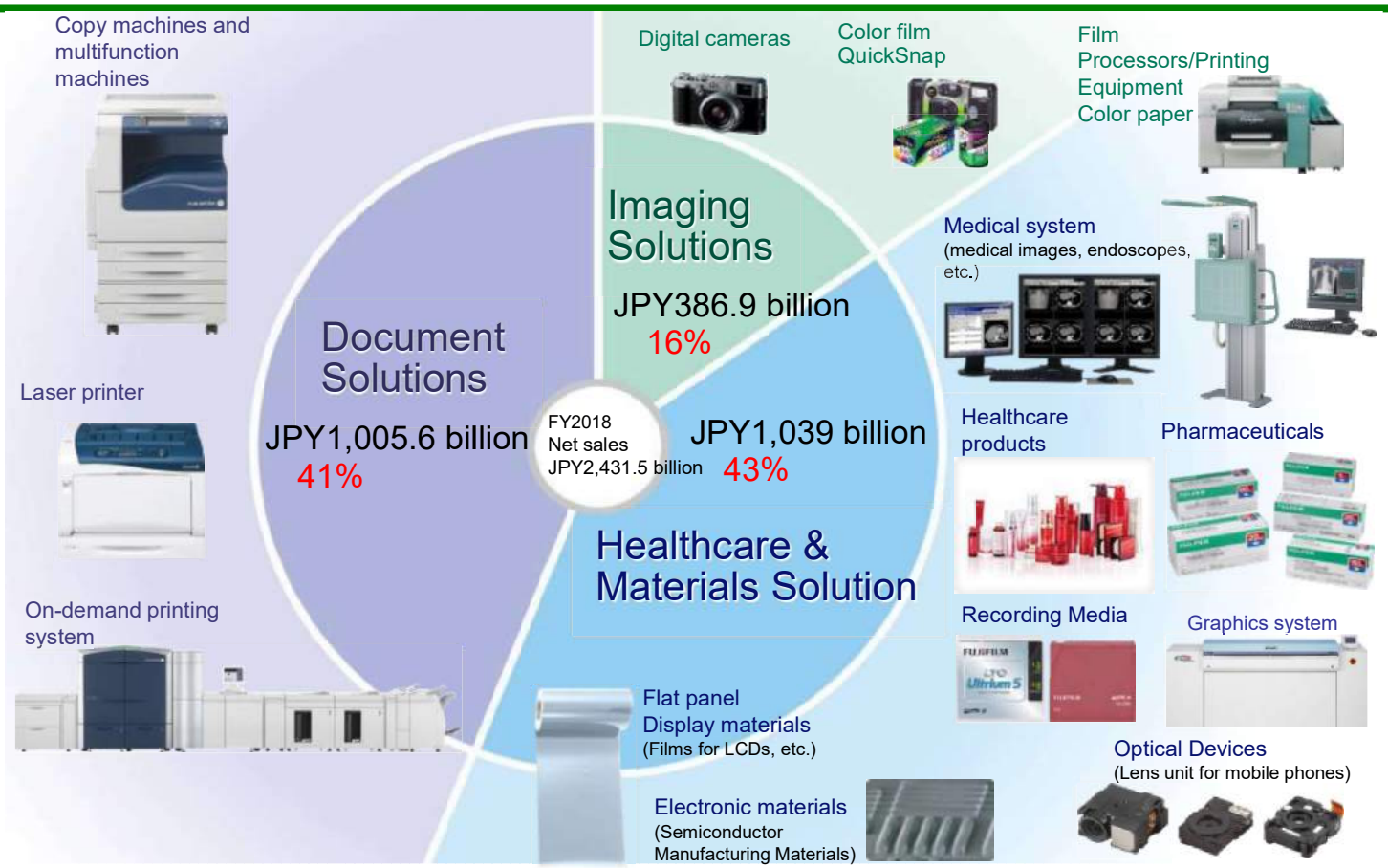


Material

✓ Practice Example①：FUJIFILM Holdings Corporation

✓ Practice Example②：Furukawa Electric Co., Ltd.

Fujifilm Group Basic Information (Business Field)



Risk Items in Display Business and Industrial Equipment Business

Risk Item		Business impact	Assessment
Small classification	Index	Discussion (Example)	
Plastic regulations	Spending	➢ Regulations on plastics are progressing led by Europe, and expenditures for replacement of alternative materials, upgrading of recycling, introduction of tracking systems, etc. are increasing, which has an impact on PL/BS.	Large
Developing next-generation technologies	Revenues, expenditures, and assets	➢ **Strategies for plastics such as material recycling and chemical recycling are required, which affects PL/BS.**	
Carbon price		➢ Introduction of a carbon tax will impose taxes on fuel procurement costs, which will increase production costs in factories in countries with higher carbon taxes and have a medium-scale impact on PL/BS.	
Investments in low carbon technology	Revenues, expenditures, and assets	➢ Environmentally conscious and financing drivers increase demand for low-carbon products such as TACs and require conversion from PETs, affecting	
Increasing severity of extreme weather conditions	Expenditur	nvestment in shutdowns, on high-risk land, which will	
Carbon Emissions Targets/Policies in Each Country	Spending Revenues, expenditures, and assets	➢ Transformation to renewable energy is required in order to achieve CO2 reduction target, and correspondence costs such as the purchase of facilities and green power increase, which has a large impact on PL/BS. ➢ CCUS, BECCUS is assumed in low-carbon societies based on 1.5°C and has a large impact on PL/BS.	
Changes in the energy mix	Expenditures and assets	➢ **Changes in the energy mix will greatly change the emission factor, greatly change the achievement of the carbon emission target, and affect P/L and B/S including changes in the site.**	
Renewable energy subsidy policy	Revenue	➢ **Subsidies for renewable energies such as CCUS, BECCUS will accelerate the introduction of renewable energies in the world and affect product liability.**	Medium
Energy-saving policy	Spending	➢ Rigorous regulations governing GHGs emitted from factories could increase the cost of investments and affect PL/BS.	
Customer reputation change	Revenues and expenditures	Impact on PL/BS due to increased CO2 emissions from in-house manufacturing facilities, increased consumer interest in SDGs (including selection of	
Increase in the average temperature	Expenditures and assets	osts for TACs, PETs, etc., and thereby affecting PL/BS.	
Renewable energy subsidy policy	Revenues, expenditures, and assets	➢ Subsidies for renewable energies such as CCUS, BECCUS will accelerate the introduction of renewable energies and affect product liability.	
Changes in Important Products/Prices	Revenues, expenditures, and assets	➢ Changes in prices of raw materials such as PETs and TACs increase procurement costs and affect PL/BS	
Policies on forest protection	Expenditures and assets	➢ Increased production and sourcing costs due to tighter regulations related to decarbonization have an impact on PL/BS	
Changes in the investor's reputation	Revenues, expenditures and capital	➢ The trend of die vestment accelerates, and the winds of enterprises that do not practice environmental management become stronger. As a result, financing costs increase and affect PL/BS.	
Changes in rainfall and weather patterns	Expenditures and assets	➢ The water level of the dam declines due to changes in rainfall, and power transmission from hydroelectric power plants is disrupted, and the plant stops operation and affects PL.	Small
Energy Demand	Expenditures and assets	➢ Changes in energy costs for transporting materials and operating factories, increased operating costs, and medium-sized impacts on PL/BS	
Rising sea level	Expenditures and assets	➢ Water stress increases supply costs, effectively rendering production virtually impossible, and increases in production costs due to tighter regulations on water withdrawals for production, thereby affecting PL/BS.	

- Risks associated with plastics regulations and their response
- Financial risk of introducing carbon tax

- Business opportunities by promoting the introduction of CCUS, BECCUS

Definition of each worldview based on scientific grounds such as the IEA

FUJIFILM Value from Innovation

		At present	2030		Source
			4°C world	2°C world	
Carbon Emissions Targets/Policies in Each Country		13 Million tCO2 (2017)	401 Million tCO2	401 Million tCO2	• Ministry of the Environment, "Japan's draft promise" and "Toward a drastic reduction of greenhouse gases in anticipation of 2050"
Carbon price	Carbon tax (Japan)	Not introduced	(Not installed at 4°C)	$88/t	• Estimated from IEA WEO 2018
Changes in the energy mix	Power Source Composition (Japan)	Coal: 360 TWh Nuclear: 33 TWh Renewable energy: 186 TWh (2017)	Coal: 264 TWh Nuclear: 216 TWh Renewable energy: 250 TWh	Coal: 83 TWh Nuclear: 247 TWh Renewable energy: 347 TWh	• IEA WEO2018 (New Policies Scenario, Sustainable Development Scenario)
			1.6Mt	31.7 Mt	• Estimated from IEA WEO 2018
	Rate of recycled aluminum Production of alu	37% 80	51%	42% 138Mt	• Estimated from IEA WEO 2018
Plastic regulations	Recycled plastics Utilization ratio	1 t		1.7 Times	• Estimated from IEA WEO 2018
Developing next-generation technologies	CO2 recovery by CCSs (Global)	0	(market movement at 4°C)	Industrial sector 0.54 Gt Power generation 0.30 Gt	• Estimated from IEA WEO 2018
In extreme weather conditions Increasing severity	Days of heavy rainfall per year (Japan)	2.5 days	3.0 days	2.5 days	• "Japan's Weather at the End of the 21st Century" (2015) by the Ministry of the Environment and the Japan Meteorological Agency

Introduction of carbon tax

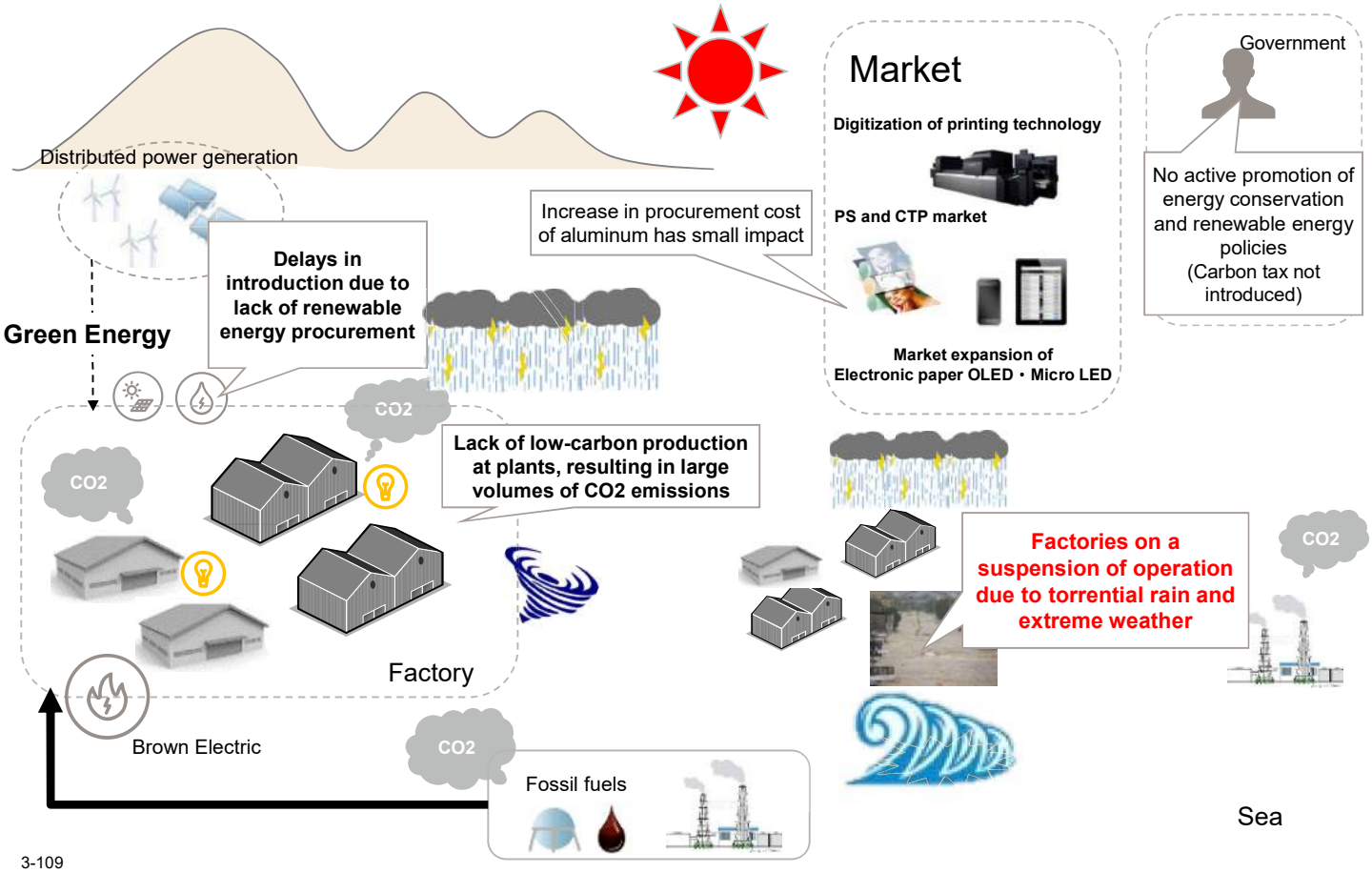
Regulations on the use of recycled plastics

Promotion of CCS

Increasing severity of extreme weather conditions

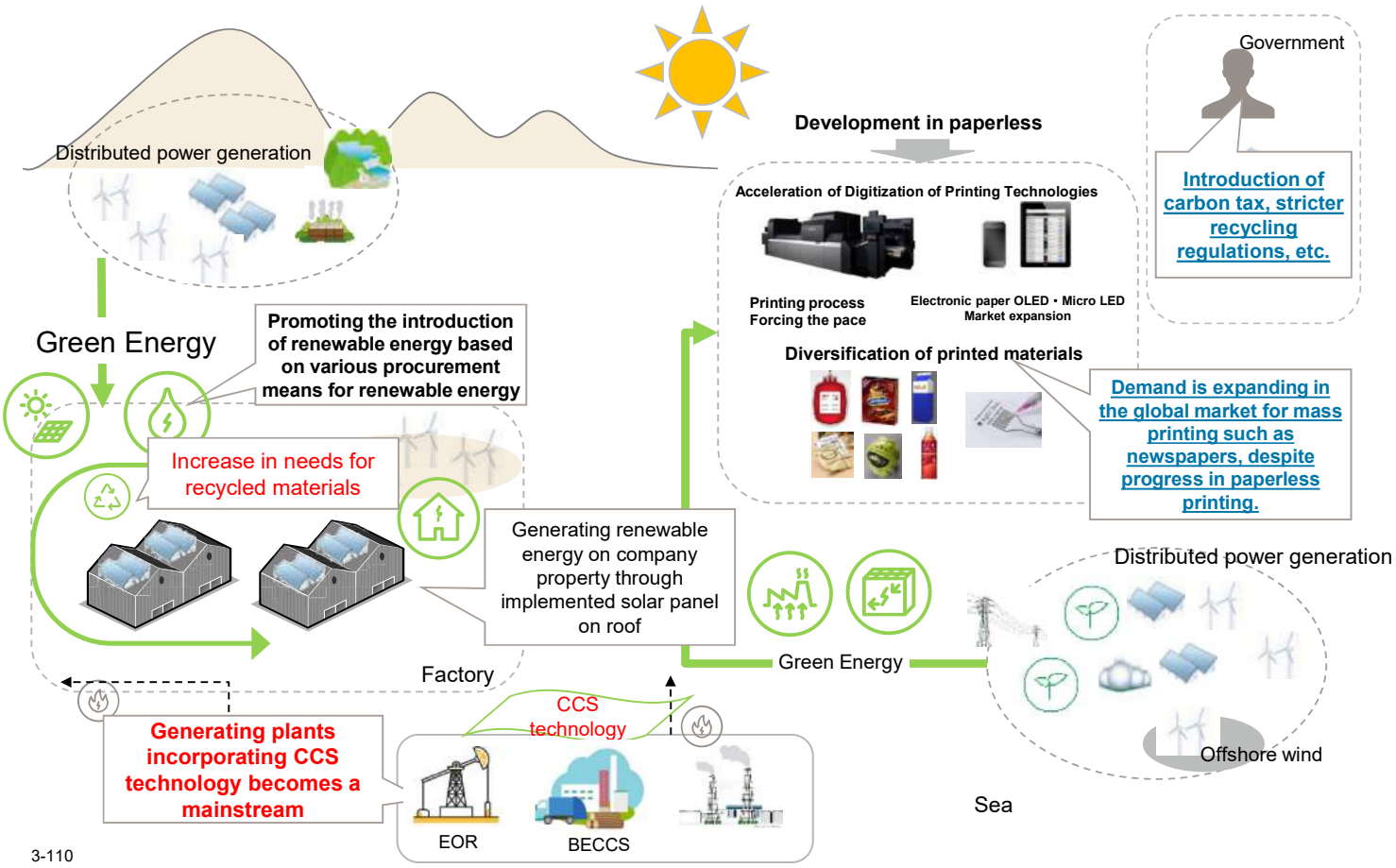
4°C world: Low carbon/decarbonisation is not promoted and physical risks increase

FUJIFILM Value from Innovation



In the 2°C world: Advanced decarbonization accelerates the progress of adopting renewable energy, recycled plastics, and CCUS.

FUJIFILM Value from Innovation



In the 4°C world: Low carbon/decarbonisation is not promoted and physical risks increase

FUJIFILM Value from Innovation

4°C worldview @2030s (Example)

: What to do

Display and industrial equipment industries

Seller (Raw Material Suppliers)

- There is no carbon regulation.
- The shift to recycled materials (PET, TAC) is assumed to be a market trend.
- Physical risks emerge for some factories and resource suppliers

Considering portfolios with high physical risk

Seller (energy, etc.)

- Grid parity remains in some areas because of the lack of renewable energy use. Renewable energy-related costs remained high in many regions.

For renewable energy-related investment Minimization (for some regions only)

New comer

- Threat of new market entrants due to the spread of the organic EL market

Industry

- No major changes due to ongoing renewable energy and energy conservation measures
- Actualization of Physical Risks to Our Bases

Implemented conventional energy-saving and re-energy-saving measures
Consideration of the portfolio of sites with high physical risks, etc.
Expansion of organic EL market

(Alternative)

- Organic EL and Micro LED display materials are becoming popular.

Buyer (Customers)

- Low-Carbon Constraints Are Weak, and CCUS Markets Have Been Popularing on Stagnation
- Needs for low-carbon, recycled materials, etc. are low, and no special response from stakeholders is required.

Traditional portfolio Maintain

Government

- Regulations are not advancing as low carbon/decarbonization trends weaken and external pressures from the international community weaken.
- Promoting renewable energy policies in some regions (U.S.)
- Regulations on the use of a carbon tax and recycled plastics (PET and TAC) are not introduced.
- Popularization of CCUS has not progressed, and no positive policies have been formulated.

Rapid access to policy information, securing subsidies (mainly in collaboration with the government on physical risks)

3-111

2°C worldview @2030s (Example)

: What to do

Display and industrial equipment industries

Seller (Raw Material Suppliers)

- Increased procurement costs due to carbon regulations
- **Shift to recycled materials expanded and procurement and manufacturing costs increased**
- Intensification of resource competition. As a result, procurement costs increased.
- Responding to factories and resource suppliers with high flooding risks

Review of low-carbon procurement methods (strengthening cooperation with suppliers of recycled materials, etc.)
Response to Physical Risks (less than 4°C risk)

Seller (energy, etc.)

- **Increase in renewable energy ratio**
- Renewable energy costs decreased

Securing power sources for private consumption
Investment in renewable energy

New comer

- **Diffreent types of industries that are strong in CCUS business emerge, and companies which are strong in organic EL-technology**

Strengthen collaboration (alliances, M&A, etc.)

Industry

- Promote the reuse and electrification of energy at factories
- Increase in procurement costs due to increase in raw material prices and intensified resource competition
- Active R&D on recycled materials
- Organic EL, electronic paper, and CCUS

Reducing the carbon content of factories
R&D on recycled materials
R&D on organic electroluminescence, electronic paper, and CCUS

(Alternative)

- Threats of market-substitution by organic EL and Micro LED display materials
- Alternative technologies for separating membranes such as CO2 absorbent solutions

Considering added value through digitalization and integration with services

Buyer (Customers)

- Low-carbon manufacturing processes (including recycling, etc.) = Increasing demand for low-cost products
- Recycling policies increase demand for recycled materials
- Customers' renewable energy needs are increasing, and reuse of energy is required in the manufacturing process as well.
- Demand for organic EL display materials.
- Low-carbon CCUS technologies are required.

Manufacturing including recycling
High efficiency and low carbon in processes
R&D on recycled materials
Develop value-added products and CCUS technologies

Government

- Aiming to achieve CO2 reductions by promoting the use of renewable energy, electrification, and the introduction of CCUS technologies. Subsidies are also enhanced.
- In some countries, CO2 emissions at factories and other facilities are regulated, and emissions trading is becoming more active. (not expected to be introduced in Japan)
- Introduction of a carbon tax. Factories that emit a large amount of CO2 are subject to the regulations.
- Introduction of regulations concerning the use of recycled plastics
- Subsidies (breakwater, etc.) associated with sea level rise will also be developed to a certain extent.
- **CCUS's infrastructure-building**

Rapid access to policy information,
And securing subsidies
Contributing to the dissemination of organic electroluminescence in cooperation with the government
Contributing to CCUS Markets

Business Impact Assessment (Example)

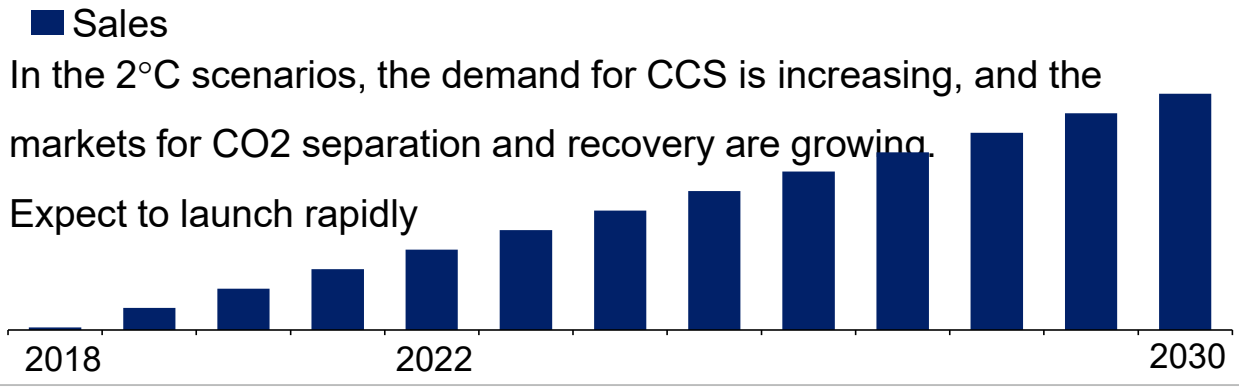
	Business impact items	Assessment
4℃	Response to flood damage caused by heavy rains and floods	- ×× billion yen
	Increase in sales of non-destructive testing services to prepare for extreme weather conditions	+ ××billion yen
	Sub total	●● Billion yen
2℃	**Cost for improving the rate of recycled plastics usage**	**- ×× billion yen**
	Responding to the strengthening of carbon taxes and regulations	- ×× billion yen
	Increase in sales of related materials due to CCUS penetration	+ ××billion yen
	Sub total	●● Billion yen

【4℃】
- Physical risks increase in a 4°C world, and costs increase in response to heavy rains and floods
- Increasing need for non-destructive testing services from the perspective of preventive maintenance

【2℃】
- Regulatorys and demand for recycled plastics are rising, and costs for recycled materials and other materials are rising.
- Financial impact of the introduction of a carbon tax and increased investment in energy conservation to comply with regulations
- Increase business opportunities by revitalizing CCS and CCUS markets

CCS-Related Market Forecasts

2℃ Scenario

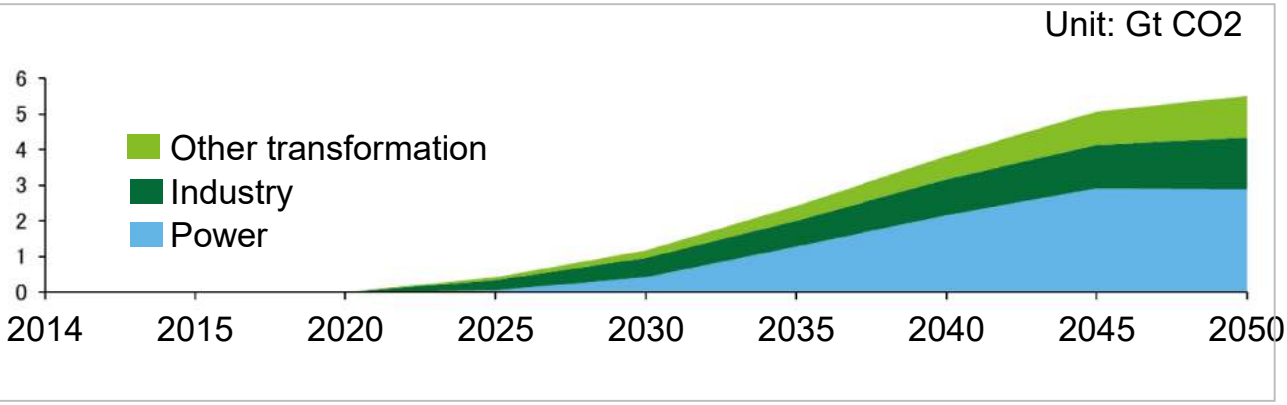


4℃ Scenario

Source: Compiled from IEA ETP2017, etc.

CO2 self-storage forecast

2°C scenario



4°C scenario

Assuming market movements

Source: Prepared by IEA ETP2017

Possible "risk preparations" for future scenarios

Important items	Current Initiatives	Examples of risk countermeasures
Carbon price	• Reduce CO2 emissions by 30% by FY2030 (compared to FY2013) • Contribute to reducing social CO2 emissions by 50 million tons by FY2030 • Setting targets for the rate of renewable energy usage	• **Reducing CO2 Emissions by Introducing Internal Carbon Pricing** • **Accelerate investment in environmental facilities by issuing green bonds**
Plastics Regulation	• Reduce waste generated by the Group by 30% by FY2030 (compared to the same level as in the previous year) • 30% improvement in resource input per unit of production by our group by FY2030 (compared to the same level above) • Recycling of PET/TAC at Plants	• Strengthened monitoring of regulatory trends related to chemical recycling for PET/TAC films and other display materials • Investigation of setting targets at the recycling PCR rate *1, including external recycling
Developing next-generation technologies	• Demonstration of gas separation membranes at overseas gas fields • Non-destructive inspections have a track record in regular inspections, detailed designs, repair designs, and repair work for the maintenance and management of social infrastructures.	• **To further develop and study methods for CO2 separation and recovery** (In-house development or alliance) • Transform business by developing and utilizing AI and other technologies in non-destructive inspection solutions
Increasing severity of extreme weather conditions (Flood damage)	• Identify water risks using indicators for water stress, water input, and business impact in each country and region.	• Establishment of specific action guidelines for floods and disasters • Preparation for long-term infrastructure disruption (response to power outages, etc.) • Establishment of procurement strategy to minimize procurement risk • Anti-liquefaction, anti-seismic reinforcement and anti-tsunami measures

* 1: post-consumer recycling ratio: Percentage of commercially recovered materials used in recycled materials.

Material

✓ Practice Example①：FUJIFILM Holdings Corporation

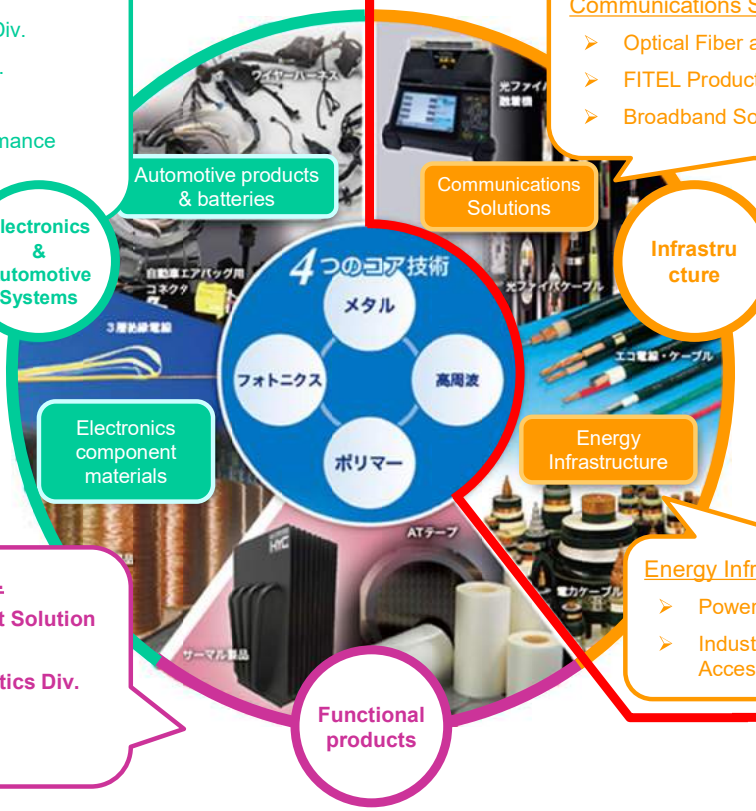
✓ **Practice Example②：Furukawa Electric Co., Ltd.**

Overview of Furukawa Electric Group Business

FURUKAWA ELECTRIC

Electronics & Automotive Systems Div.
- Automotive Products Div.
- Electric Conductor Div.
- Magnet Wire Div.
- Copper & High Performance Material Products Div.
- Copper Tube Div.

Communications Solutions Div.
- Optical Fiber and Cable Products Div.
- FITEL Products Div.
- Broadband Solutions Business Div.



Target Div.
(In this analysis)

Energy Infrastructure Div.
- Power Cable Div.
- Industrial Cable & Power Cable Accessories Div.

Functional Products Div.
- Thermal Management Solution & Products Div.
- AT & Functional Plastics Div.
- Memory Disk Div.
- Copper Foil Div.

Characteristics of Target Businesses

FURUKAWA ELECTRIC

Item	Communications Solutions Business	Energy Infrastructure Business
Target product category	• **Optical fiber cables**  Optical Fiber  Hikari/Metal Communication Cable	• **Power Cables**  Underground Power Cable  Medium-Low Voltage Cable
Materials used	• **Glass materials (optical fiber)** • **Plastics (fiber, cable dressings, etc.)** • **Copper (metal communication cable)**	• **Copper (Conducting material)** • **Plastics (cable dressings)**
Energy Amount used	• Large amount used in optical fiber manufacturing process	• Be relatively small
Bases	• Expansion of production bases globally (Asia, North and South America, EMEA)	• Japan, China

Scenario development process

Analysis step / Questions / Analysis level	② Assess materiality of climate-related risks	③ Identify and define range of scenarios	④ Evaluate business impacts	⑤ Identify potential responses
	For any variable Do you want to target?	In any scenario Do you set it?	What is the size of which position? Should we calculate in depth?	To the extent of the measures Do you consider it?
Level 1 Be based on TCFD requirements As a minimum requirement Level	Important variables identified but not fully discussed and explained their importance	In multiple scenarios, Simply cite existing scientific scenarios/only bivariate scenario branching	Qualitative and partial quantitative assessments of the business impact of each scenario	Present countermeasures are shown, but linkage with future scenarios is unclear.
This time Details of implementation	• **Communications solutions** • **Energy infrastructure** Identify high-priority risks in the 2 businesses	• **4°C (business as usual)** • **2°C (strict measures)** Define 2 scenarios	• **Estimated impact on net sales and operating income** • **Estimated Impact of Carbon Tax and Copper Price Rise**	• **Insurance, etc.** • **Consider conversion to other materials**

Assess materiality of climate-related risks (Communications Solutions Business)

②Assess materiality of climate-related risks

- **Increase in production costs due to the introduction of carbon prices, an increase in procurement costs due to the increase in copper demand, and the effects of physical risks**
- **On the other hand, opportunities such as market expansion due to the spread of smart cities have a major financial impact.**

Risk Item		Business impact		Assessment
Major classification	Small classification	Index	Discussion (Example)	
Toward a Low-Carbon Economy • Carbon tax • New Technology • Raw material cost • Reputation	Carbon Emissions Targets/Policies in Each Country	Spending Assets	➢ Depending on the amount of CO_2 discharged by the plant, the conversion to renewable energy is required, and the corresponding costs for purchasing facilities and green power, etc. are increasing.	Large
	Dissemination of renewable energy and energy-saving technologies	Revenue Assets	➢ Acceleration of introduction of renewable energy, etc. and increase of renewable energy ratio of electricity supplied to manufacturing plants	
	Carbon price	Spending	➢ When a carbon tax is introduced, taxes are levied on fuel procurement costs.	
	Energy conservation, regulations in each country	Spending	➢ If the energy conservation policy is not achieved, the company's environmental image will be damaged by the announcement of the company name.	
	Changes in the energy mix	Spending	➢ In order to achieve CO_2 reduction target, the introduction of renewable energy will be accelerated, and the ratio of electricity supplied to manufacturing plants will increase. Risks associated with the introduction of emissions trading, etc.	
	Developing next-generation technologies	Revenue Spending Assets	➢ Demand for optical fibers is increasing due to demands for increased communication volume and speed due to the spread of next-generation infrastructures utilizing AI and IoT, electrification of transportation systems (autonomous driving, EV, etc.), micro/digital grid, and smart cities.	
	Changes in Important Products/Prices (Intensification of resource competition)	Revenue Spending Assets	➢ Demand for copper and plastics, the main raw materials for electric wire and cable, has increased due to the spread of EV and renewable energy, and procurement costs have increased due to changes in the supply-demand balance.	
Physical Risk	Rising sea level	Spending	➢ The operation of coastal plants was shut down due to natural disasters such as floods and a sharp increase in tides. Increasing investment in the installation of breakwater.	
	Drought: changes in rainfall and weather patterns	Spending	➢ Drought, increased production costs due to water restrictions, additional investments for system development, etc.	
	Typhoon: Increasingly severe extreme weather conditions	Spending Assets	➢ Due to plant damage caused by typhoons, additional investments were made to shut down operations, reduce production, and restore facilities. Increase in the premium	
Other	Customer reputation changes, Increase in the average temperature Changes in the investor's reputation	Revenue Spending Assets	➢ Due to the increasing interest of business partners, preference has emerged for SBT and other companies that have made progress in environmental measures. ➢ Die Best moves faster and more winds into the enterprise. Worsening of the mining working environment due to the hot weather.	Medium

Examples of definitions based on scientific grounds such as IEA

③ Identify and define range of scenario

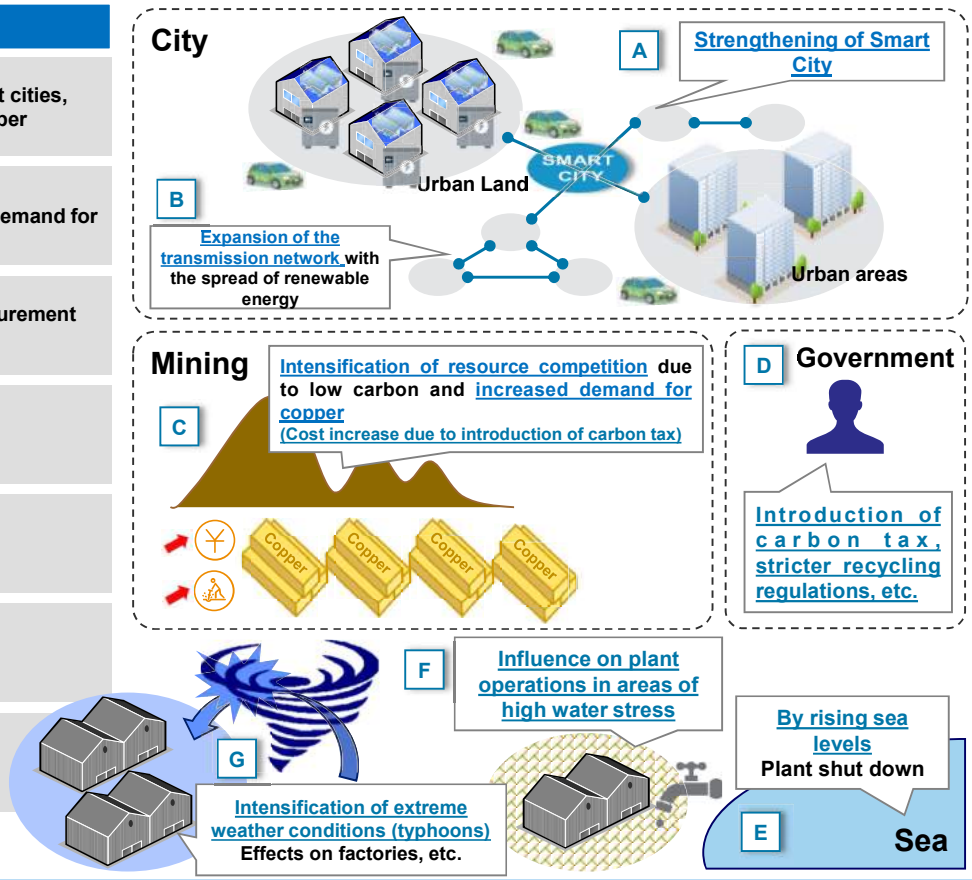
		At present	2030* 1		Source
			4°C world	2°C world	
Carbon Emissions Targets/Policies in Each Country	In the industrial sector GHG emissions	413 Million tCO_2 (2017)	401 Million tCO_2	401 Million tCO_2	• Ministry of the Environment, "Japan's draft promise" and "Toward a drastic reduction of greenhouse gases in anticipation of 2050"
Carbon price	Carbon tax	-	(Not installed at 4°C)	$88/t	• Estimated from IEA WEO 2018
In energy conservation and other countries Regulation of organic compounds	Recycled plastics Utilization rate	12.5% (2017)	(No restriction at 4°C)	14.0%	• European plastics strategy, Plastics Recycling Association
Renewable energy, etc. Subsidy policy	FIT's purchase price (yen/kWh)	Solar: 14 (bidding system) Wind: 2019-36 (2019)	(From FIT at 4°C Assuming that independence is difficult)	Solar: JPY7/kWh (2025) Wind: JPY8-9/kWh	• Agency for Natural Resources and Energy
	Unit price of renewable energy generation (yen/kWh)	Solar: 21.8 Land Wind: 21.5 (2017)	Solar: 13.5 Land wind: 20.6	Solar: 12.4 Land wind: 20.6	• IEA WEO2017 (450 scenarios)
Re-energy and Energy Conservation Dissemination of technology	Capacity to augment the transmission network	-	Increase of more than 6.65 million kW (until 2027)	Increase of more than 6.65 million kW (until 2027)	• Agency for Natural Resources and Energy
	ZEV ratio	58 thousand units (EV, PHV, FCV) (2017)	PHV/ZEV:5% (72.38 million units)	PHV/ZEV:39% (536.85 million units)	• IEAs and JETORO reports • Global Calculator
	World's storage capacity	4.67 TWh (2017)	6.62~7.82 TWh	11.89~15.27 TWh	• IRENA Report
Changes in the energy mix	Power Source Composition (Japan) (TWh)	Coal: 360 Nuclear: 33 Re-energy: 186 (2017)	Coal: 264 Nuclear: 216 Renewable energy: 250	Coal: 83 Nuclear: 247 Renewable energy: 347	• IEA WEO2018 (NPS,SDS)
Next-generation technology Progress of	Smart City Market Size and M2M Communications Volume	Smart City Market Size: JPY38 trillion M2M communication volume: 4 exerbites (10^{18})/month (2018)	(market at 4°C)	Smart City: 4 thousand trillion yen M2M: 745 Exabyte/month	• Cisco Report • Frost & Sullivan Japan • SMART CITY PROJECT
Increase/Decrease in Prices of Heavy-Use Products/Products	Predicted value of copper demand	5,000 thousand tons (2015)	9,000 thousand tons	10,500 thousand tons	• Than Sebastiaan Deetman and others Estimate
Sea level rise	Magnitude of sea level rise	-	0.25m (2050)	0. 2m (2050)	• Ministry of the Environment, Japan Meteorological Agency Report
Drought	Water stress	-	Extracting values from each country from tools (2040 *2)	-	• WRI "Aqueduct," Our CDPs
Typhoon	Number of occurrences	26 (2016)	The number of typhoons approaching is forecast to decrease, but uncertainty remains.		• Ministry of the Environment, Japan Meteorological Agency Report

3-122 *1: The time horizon to be examined for physical risks is set at 2050. * 2: Figures for 2050 are not available, and figures for 2040 are used.

Select the evaluation items for business impact

③ Identify and define range of scenario

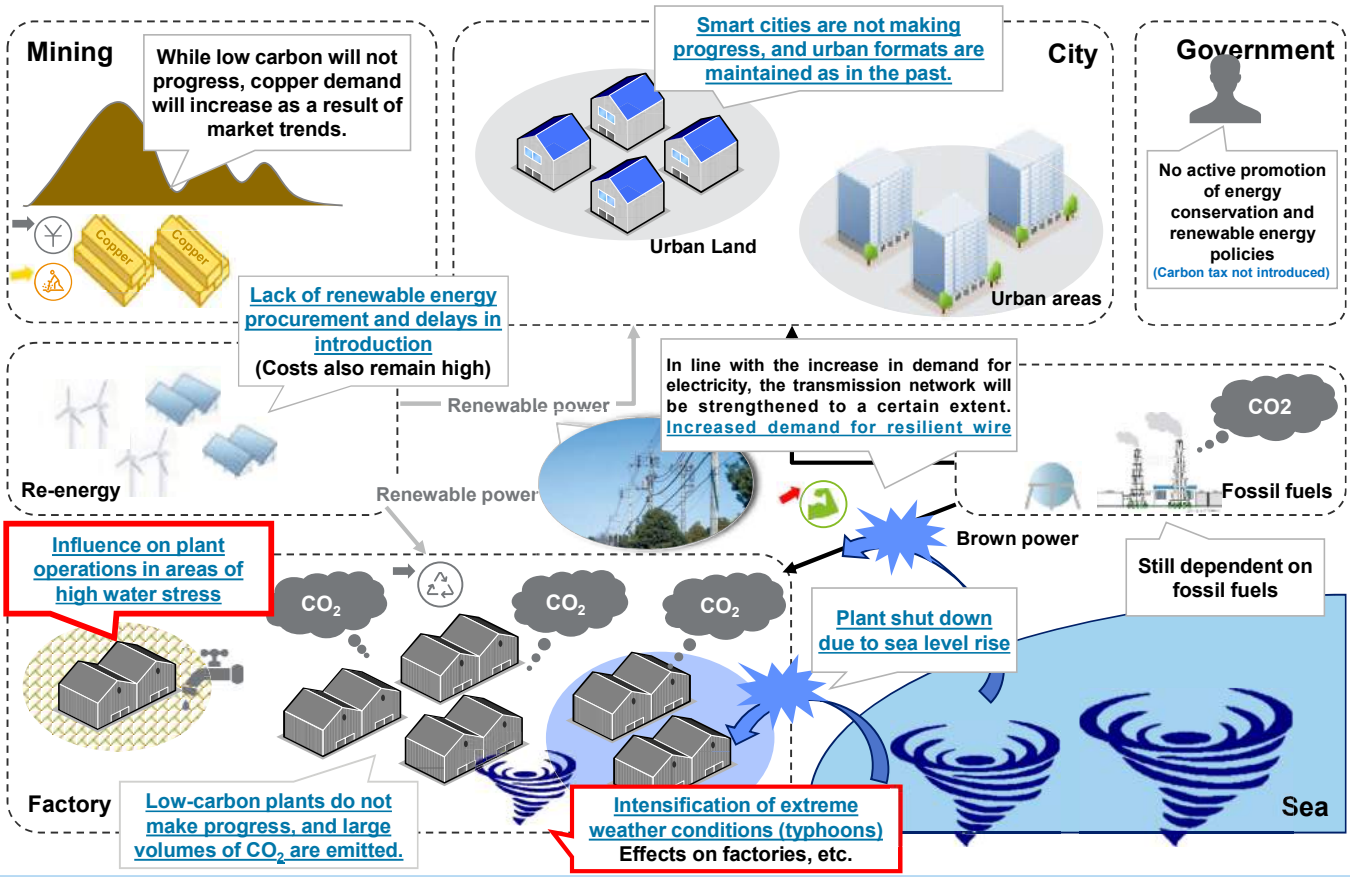
		Item
Transition risk	A	With the spread of smart cities, increased demand for fiber
	B	In the expansion of the transmission network, demand for power cable increase
	C	Increase in copper procurement costs
	D	Carbon tax
Physical risk	E	Sea level rise
	F	Drought
	G	Typhoon (Increased Storm and Flood Damage)



3-123

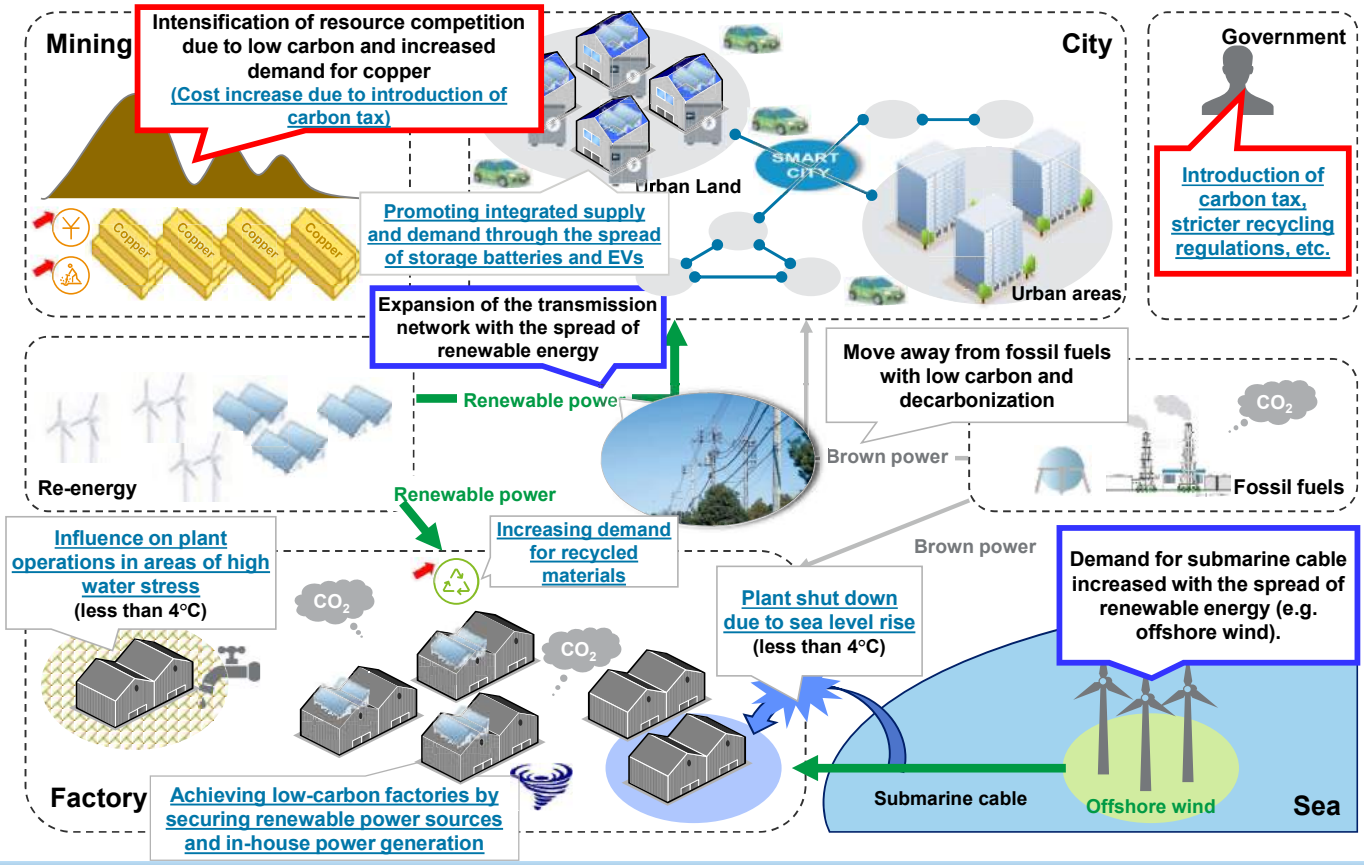
In the 4°C world, low carbon/decarbonization is not promoted, Increased physical risk (business as usual)

③ Identify and define range of scenario



In the world of 2°C, low carbon is being promoted, renewable energy consumption and smart cities become popular (severe measures)

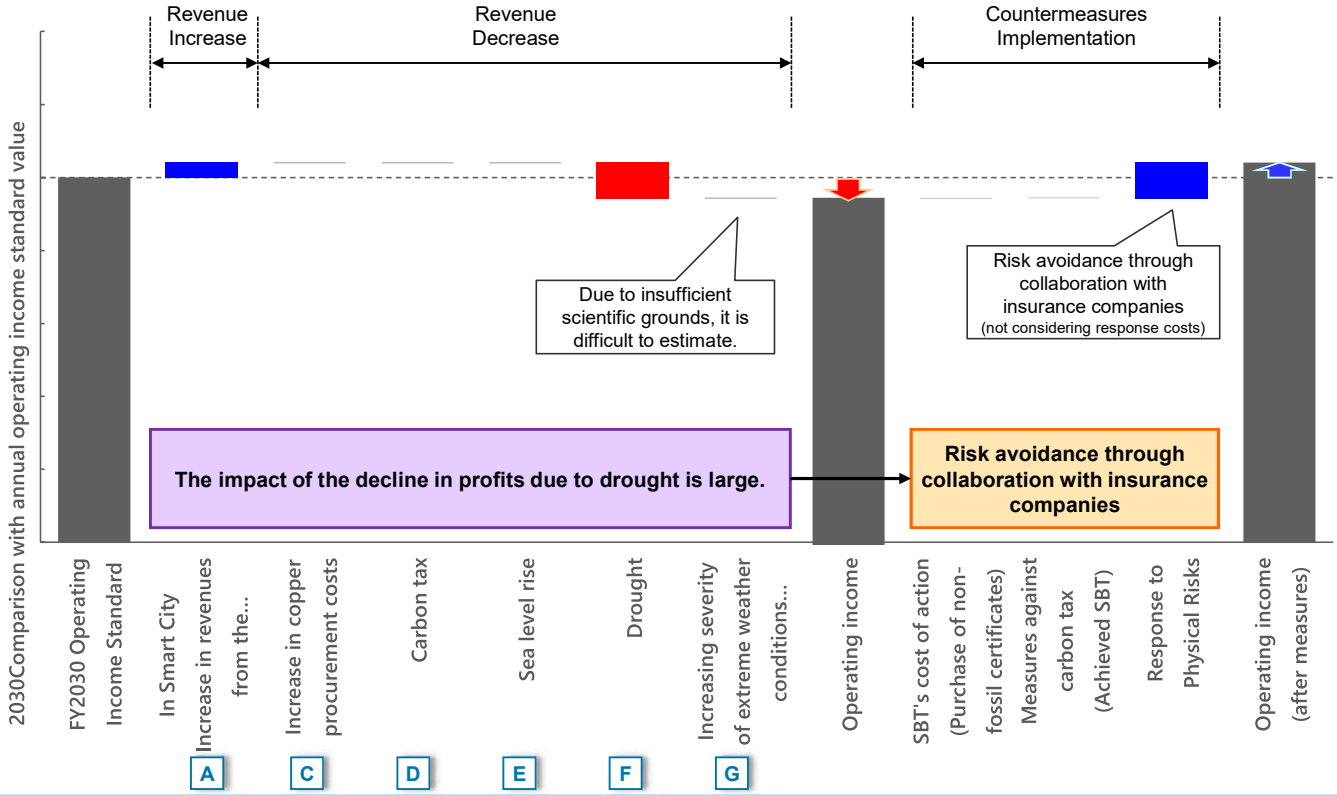
③ Identify and define range of scenario



Communications Solutions Business: 4°C (business as usual)

④ Evaluate business impacts
⑤ Identify potential responses

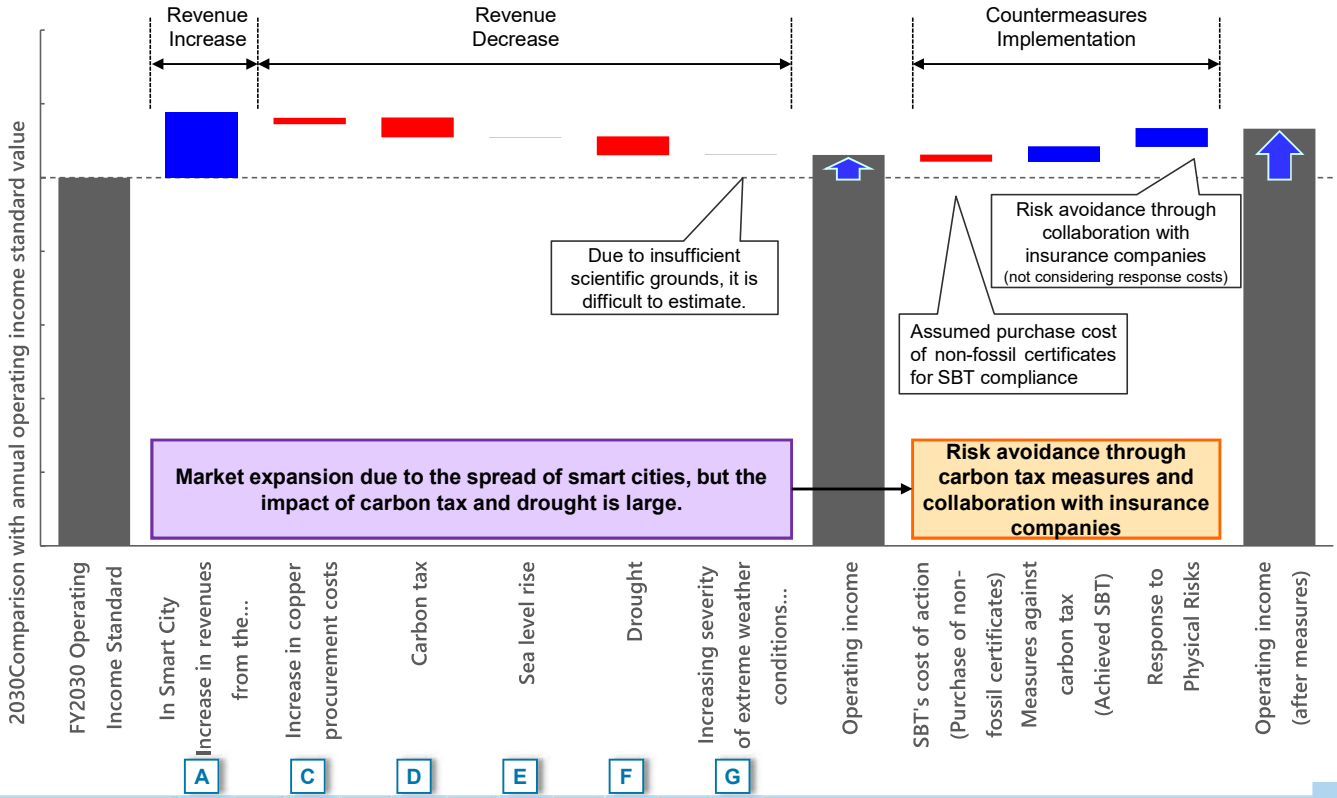
- Working with insurance companies to avoid risks and secure increased profits.



Communications Solutions Business: 2°C (strict response)

④ Evaluate business impacts
⑤ Identify potential responses

- Reduce greenhouse gas emissions and collaborate with insurance companies to avoid risks and recover the increase in revenues.



☐ Carbon tax and physical risks need to be addressed in a timely manner.

	Item	Risk response measures
Transition risk	C Cost of procuring copper Increase	➢ Consider passing on cost increases, etc. In order to minimize the risk, we will partially consider the possibility of shifting from copper to aluminum, which is expected to see a steep rise in prices.
Transition risk	D Carbon tax	➢ Re-energy introduced at headquarters, factories and value chains ➢ Implementation of ambitious target setting (SBT, etc.)
Physical risk	E Sea level rise	➢ Consider collaboration with insurance companies that have in-house tools to minimize risk ➢ Strengthen preventive measures against existing assets (breakwater, etc.)
Physical risk	F Drought	➢ Consider collaboration with insurance companies that have in-house tools to minimize risk ➢ Implementation of preventive measures for existing assets (water supply towers and reservoirs) ➢ Relocation of some bases
Physical risk	G Typhoon	➢ Be scientifically examined in the future, including the quantification of risks

Food

✓ Practice Example①：Kagome CO.,LTD.

✓ Practice Example②：Calbee, Inc.

✓ Practice Example③：Meiji Holdings Co., Ltd.

Introduction of Kagome

▸ Company Overview

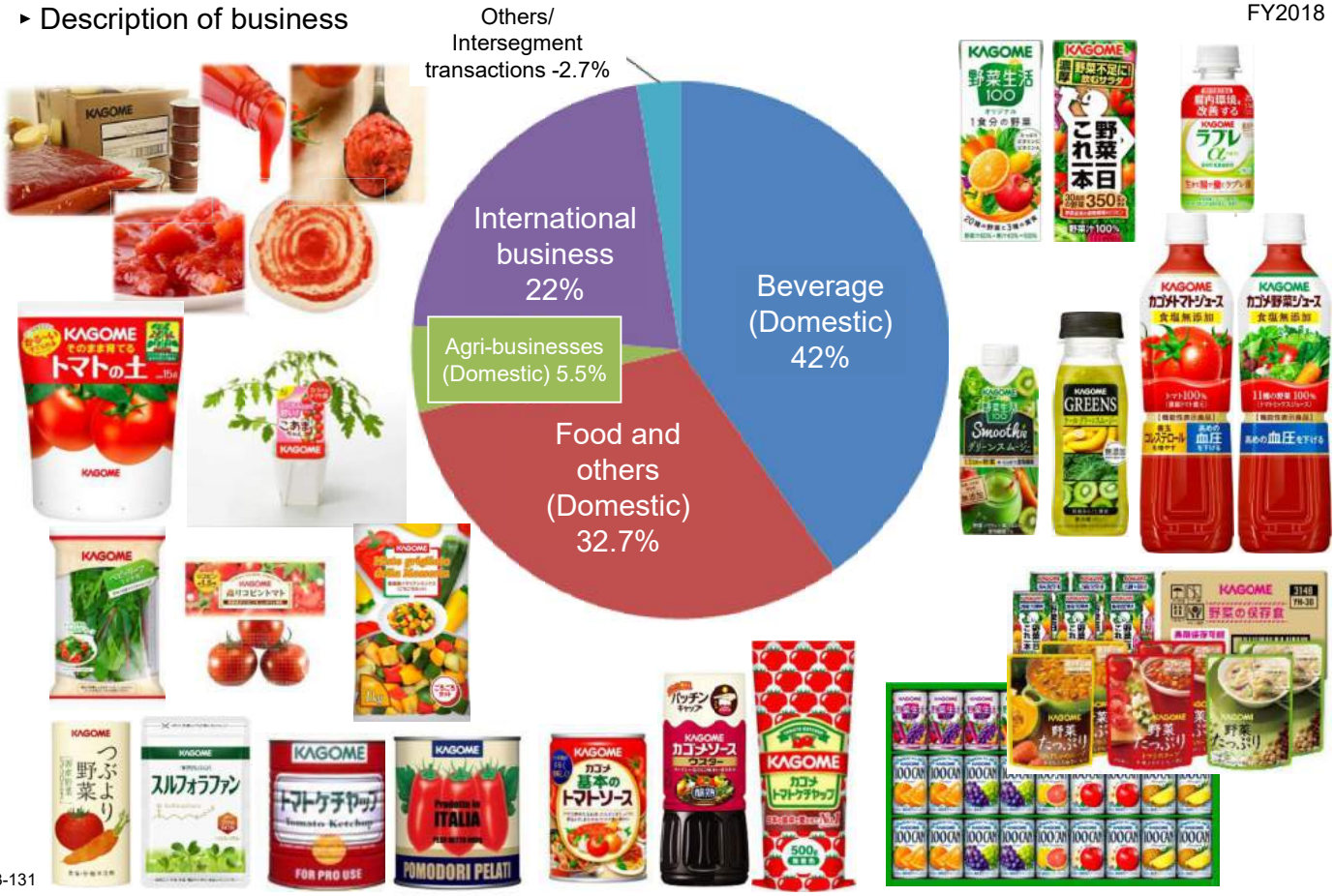
As of the end of December 2018

Head Office	Nagoya-shi, Aichi
Founded	**1899**
Common stock	**JPY19,985 million**
No. of individual investors	**186,095**
Sales consolidated)	**JPY209,865 million**
Number of employees(Consolidated)	**2,504**
Business Offices	Head Office, Tokyo Head Office, 1 division office, 8 branches, 6 plants, Innovation Division (Research Institute)
Group Companies	Hibikinada Green Farm Co,. Ltd. Iwaki Onahama Green Farm Co., Ltd. Kagome Axis Corporation KAGOME LOGISTICS SERVICE CO., LTD. **Kagome Inc.** **United Genetics Holdings LLC** **Vegitalia S.p.A.** **Holding da Industria Transformadora DoTomate, SGPS S.A. (HIT)** **Kagome Australia Pty Ltd.** Taiwan Kagome Co., Ltd. and others (40 subsidiaries and 5 affiliates)

Introduction of Kagome (Manufacture and sale of beverages and foodstuffs, development of vegetable varieties, and cultivation)

▸ Description of business

FY2018



[Step 2: Assess materiality of climate-related risks]

Step 2 3 4 5 Scenario 4℃ 2℃

Extract the risk of Kagome, evaluate the impact on a large, medium, or small scale, and identify those with the greatest impact.

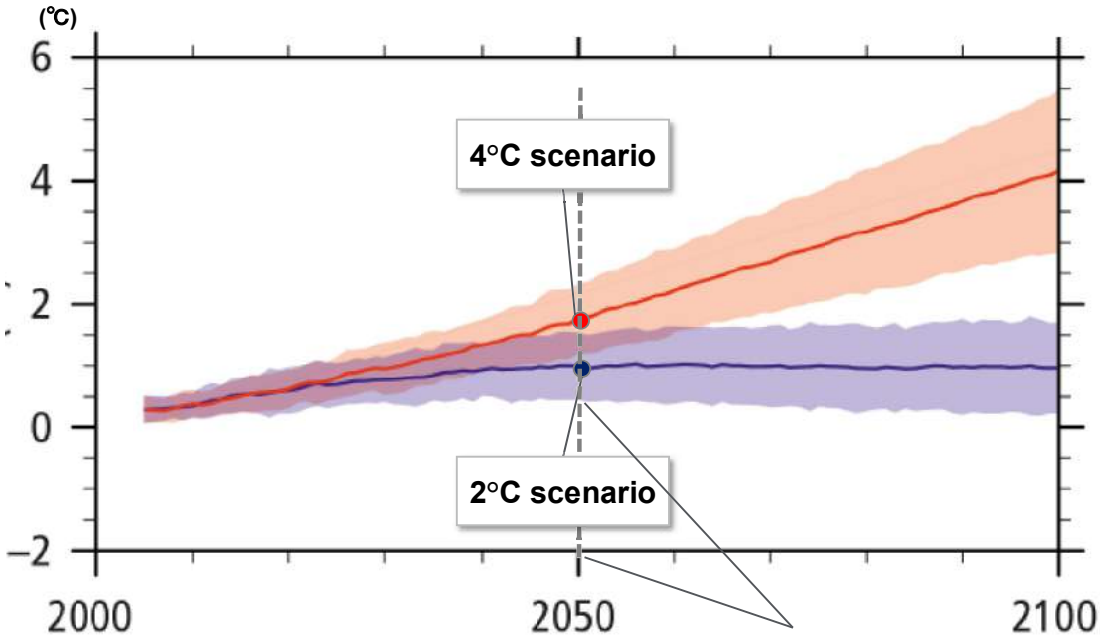
Risk Item			Business impact		
Classification	Major classification	Small classification	Index	Discussion (Example)	Assessment
Transition risk	Policies/ Regulation	Increase in carbon tax	Spending	・With the introduction of a carbon tax having a broad impact on raw materials, containers, and packaging materials Cost increases	Large
		CO2 emissions in each country Strengthening Reduction Policies	Expenditures and assets	・Energy-saving policies are strengthened and high-efficiency machines for manufacturing facilities are developed. Need to be renewed	Medium
	Reputation	Changes in consumer behavior	Revenue	・Expansion of purchasing behavior considering environmental impact due to climate change	Large
		Changes in the investor's reputation	Capital	・Investor reputation if climate change response is inadequate Deterioration and difficulty in raising funds	Small
Physical risk	Chronic	Increase in the average temperature	Expenditures and revenues	・Crop quality and yield deterioration occur.	Large
		Changes in rainfall and weather patterns	Expenditures and revenues	・Increased rainfall and drought adversely affect crop areas Reflecting high raw material prices	Large
		Reduction of biodiversity	Spending	・Procurement due to difficulty of plant pollination due to decrease in insects Generation of raw materials that are impossible	Large
		From the generation of pests Declines in production	Expenditures and revenues	・With the expansion of pests and pests lowering the production and quality of crops Difficulty of stable procurement	Medium
		Farmers Lower productivity	Expenditures and revenues	・By lowering the labor productivity of agricultural workers due to higher temperature Higher funding costs	Small
	Acute	Due to water stress Declines in production	Expenditures and revenues	・Water shortage makes it difficult to secure water and prices soar.	Large
		Increasing severity of extreme weather conditions	Expenditures and revenues	・Damage due to frequent extreme weather events such as storms Frequent production areas	Large

[Step 3: Identify and define range of scenarios]

Step 2 3 4 5 Scenario 4℃ 2℃

Consider a 2050 society under 2 scenarios (4°C, 2°C) for highly uncertain climate change (4°C: If the temperature rises without taking any measures, 2°C: If a variety of measures are taken)

[Global Average Terrestrial Temperature Change (Difference from the 1986-2005 Average)]



The temperature will rise 3.2-5.4°C above pre-industrial levels, unless more rigorous measures are taken.

The temperature will rise 0.9-2.3°C above pre-industrial levels, if strict measures are taken.

Source: AR5 SYR Diagram SPM.6

Set 2050-year time horizon for transition risk and physical risk

[Step 3: Identify and define range of scenarios]

Step 2 **3** 4 5 Scenario **4℃** **2℃**

Collect scientific evidence on the situation for 2050 (use in calculating the future impact amount)

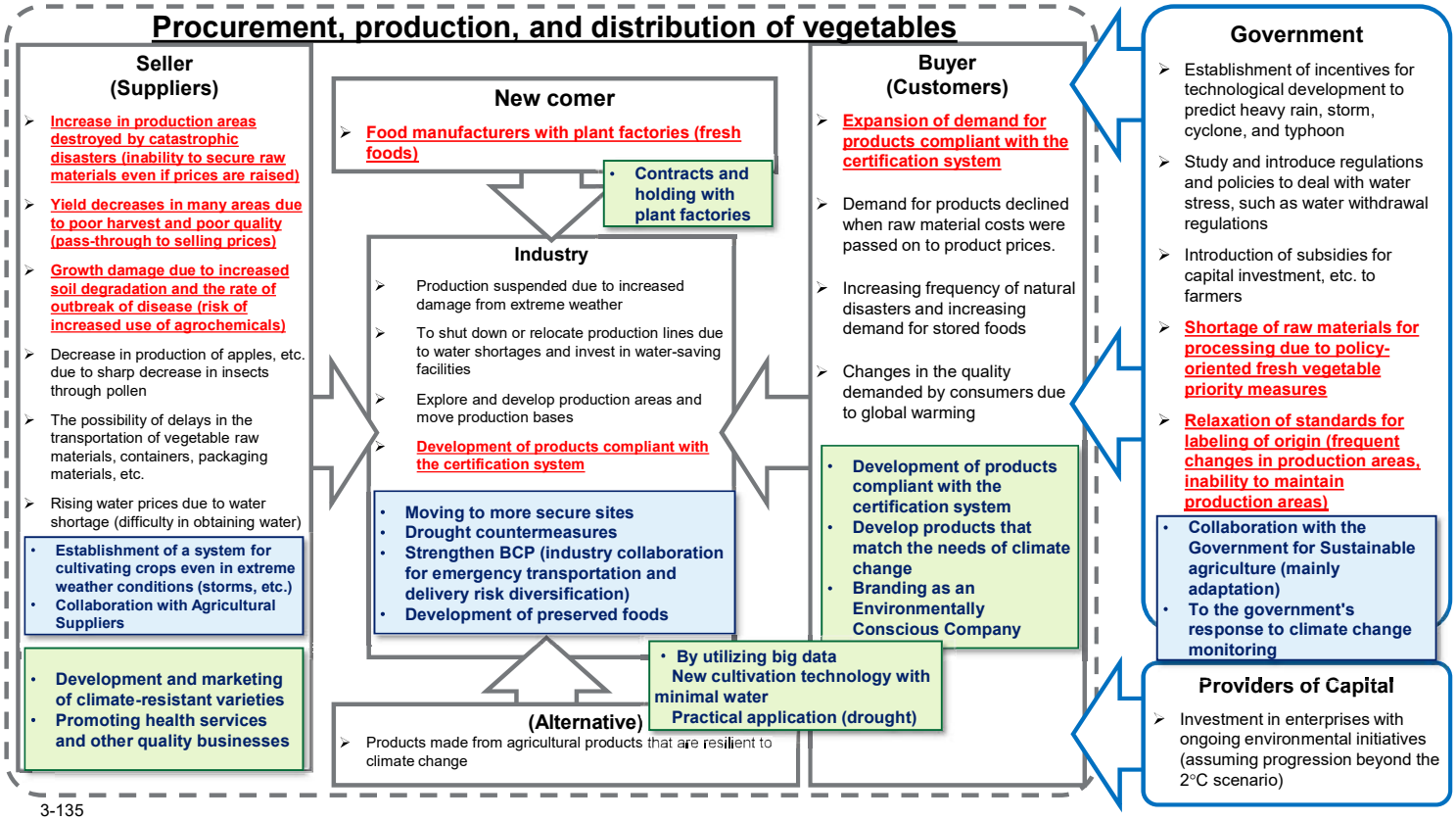
		At present	2050		Source
			4°C world	2°C world	
Carbon price	Carbon tax	-	**53USD/tCO2 (EU)**	**180 USD per tCO2 (developed countries)**	• IEA WEO 2019
Changes in consumer behavior	Purchasing behavior choices, Sales of Sustainable Certification Products (U.S.)	128.5 billion USD	397.5 billion USD (3.1 times the current level)	397.5 billion USD (3.1 times the current level)	• The Deloitte Global Millennial Survey 2019 • Nielsen "product Insider"
Increase in the average temperature **Changes in rainfall and weather patterns**	Changes in tomato yields	-	**-17~7%**	**-2~10%**	• GAEZ (yield per hectare)
	Change in carrot yield	-	**-0.1~2%**	**-2~1%**	
	Orange yield change	-	**4%**	**5%**	
	Changes in apple yield	No data			
Reduction of biodiversity	Reduction of pollen-borne organisms	No data			
Decrease in production due to water stress	Production bases in water-stressed areas	No. of production bases with water stress of Extremely high: 1	Number of manufacturing sites that are Extremely high to water stress: 7	No. of manufacturing sites with Extremely high water stress: **7**	• WIRI Aqueduct
Increasing severity of extreme weather conditions	Annual occurrence of heavy rain Incremental days	2.5 days	**4.3 days**	**2.9 days**	• "Japan's Climate at the End of the 21st Century," Ministry of the Environment and the Japan Meteorological Agency, "Observations and Forecasts of Climate Change and Integrated Report on Impact Assessments 2018-Climate Change and Its Impact in Japan."
	Amount of rainfall	-	**+8~+15%**	**+8~+15%**	
	Flood damage increase rate	-	**5.9 times**	**2.2 times**	• Supplemental to WRI 2030 annual data

[Step 3: Identify and define range of scenarios]

Step 2 **3** 4 5 Scenario **4℃** 2℃

Using Michael Porter's 5Forces to forecast the 2050 worldview

4°C worldview @2050s (Example)



[Step 3: Identify and define range of scenarios]

Step 2 **3** 4 5 | Scenario 4℃ **2℃**

Using Michael Porter's 5Forces to forecast the 2050 worldview

2°C worldview @2050s (Example)

Procurement, production, and distribution of vegetables

Seller (Suppliers)

- Some areas where raw material cultivation is difficult
- Yield decreases in some areas due to poor harvest or poor quality (pass-through to sales prices)
- The possibility of delays in the transportation of vegetable raw materials, containers, packaging materials, etc.
- Carbon price burden for logistics, containers and packaging (passed on to sales prices)
- Rising water prices due to water

- Review of Procurement Strategy(Exploration and development of new production areas)
- Strengthening the procurement network (Strengthening the alternative procurement structure)
- Collaboration with agricultural suppliers

- Development and marketing of climate-resistant varieties
- Promotion of health services and other quality businesses

New comer

- Active entry into new businesses through low-carbon and non-carbon products and low-carbon business models (certified products, etc.)

To consider an aggressive business model for decarbonizing

Industry

- Partial suspension of production due to increased damage from extreme weather
- To shut down or relocate production lines due to water shortages and invest in water-saving facilities
- Enterprises with contract farms bail out part of the damage
- Shift to low-carbon production, use of low-carbon substitutes, and low-carbon transportation
- Development of products compliant with the certification system
- CO2 carbon offsets that cannot be reduced

- Drought countermeasures
- Strengthen BCP
- To expand into high-profit, low-carbon businesses

(Alternative)

- Products made from agricultural products that are resilient to climate change

Buyer (Customers)

- Expansion of demand for products compliant with the certification system
- Selection of products with a high price advantage that do not pass through carbon price increases
- Demand for products declined when raw material costs were passed on to product

- Shifting costs to carbon prices and low/decarbonizing

- Development of products compatible with certified products
- To the needs of climate change product development that matches
- As an environmentally conscious company branding

Government

- Consider, implement and strengthen carbon taxes on a national and local level to implement national commitments, such as NDCs.
- Establishment of incentives for technological development to predict heavy rain, storm, cyclone, and typhoon
- Study and introduce regulations and policies to deal with water stress, such as water withdrawal regulations
- Considering relief in the event of frequent agricultural damage
- Limited amount of water available for 1 product
- Introduction of a government system for certification of low-carbon labeled agricultural products

- Cooperation with Government for Sustainable Agriculture (mainly Mitigation)
- Government's monitoring of climate change countermeasures
- Introduction of Internal Carbon Pricing

Providers of Capital

- Progress in investment in companies that are making progress in environmental initiatives

[Step 3: Identify and define range of scenarios]

Step 2 **3** 4 5 | Scenario **4℃** 2℃

In the 2°C world, several production areas will be damaged by storms, and many production will not be able to harvest in the 4°C world. Water shortage will worsen due to global warming.

Major Worldwide Views in 2050

Suppliers and ourselves

Production area

2℃: Partial damage

4℃: Large number of damage

Water procurement

2℃: Price increase

4℃: Rising prices; Difficulty of obtaining water for 4 in 10 people; Factory; Field

Carbon tax 2℃

CO2; Steep rise in carbon taxes

Insect pollination crop 4℃

Insect loss; Decline in apple production

Product 2℃ 4℃

Increase in certified products; Certification; Cost increase; TOMATO; Certification

Customers and investors

Changes in purchasing behavior

Customer

I would buy vegetables even if they are expensive

I would prefer certified products

I want to eat meat, maybe soybean meat

I want to have something refreshing because it is hot today

I need preserved foods because natural disaster occurs frequently

I take nutrition from supplements because vegetables are expensive

Providers of Capital

Invest in the environmentally conscious companies

Shift to low-carbon

Investment target

[Step 4: Evaluate business impacts]

Step 2 3 **4** 5 Scenario **4℃** **2℃**

Summary of estimated risk items

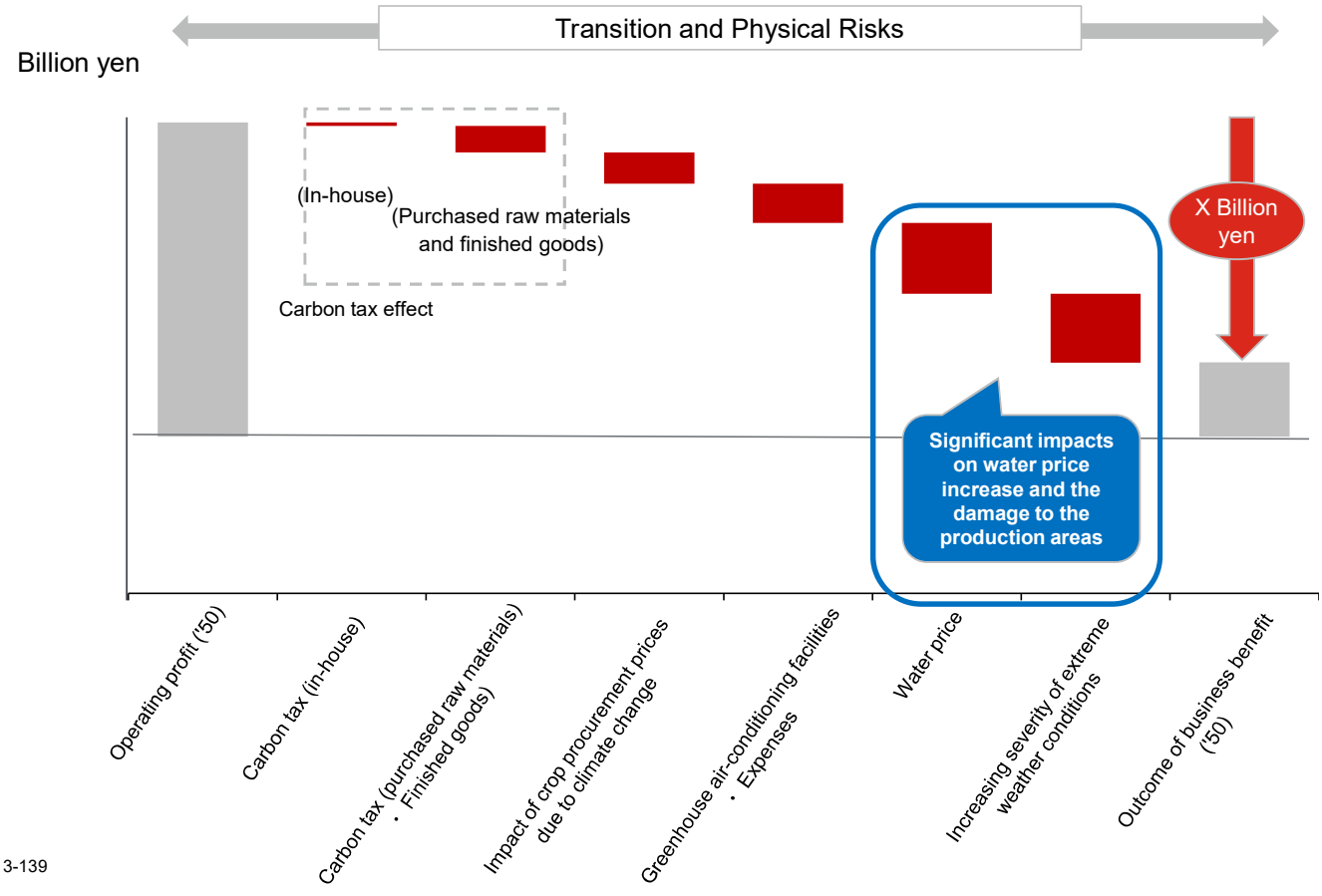
Determine the calculation logic for risk items and calculate the impact on business.

Risk Item	Assumed parameter		Overview of Impact and Assumptions	Effect factor	Impact (Billions of yen)		Pricing logic
					4℃	2℃	
Carbon price	①	Carbon tax	Scope 1 and 2 (in-house) emissions: CO2 emissions in the process of processing and manufacturing raw materials are subject to a carbon tax.	Sales Cost			CO2 emissions from manufacturing countries × business growth rate × carbon prices
			Scope 3 (Supplier) emissions: CO2 emissions from purchased raw materials and products are subject to a carbon tax.	Sales Cost			CO2 emissions of purchased raw materials and products (excluding N2O) × business growth rate × carbon prices
Increase in the average temperature Changes in rainfall and weather patterns	②	-	Rising raw material prices, including those in undesired areas, due to changes in weather patterns and rising average temperatures	Sales Cost			Amount procured × degree of price increase
	③	-	Increased temperatures in summer in Japan require air-conditioning in greenhouses resulting in capital expenditures and expenses.	Sales Cost			Estimated Cost of Cooling (Equipment + Expenses)
Rising water prices	④	Water stress data	Water shortage increases water prices and puts pressure on profits.	Business Profit			Actual increase in costs during drought × Rate of increase in water-stressed production sites
Increasing severity of extreme weather conditions	⑤	Flood damage increase rate data	Damage to production sites and production sites due to heavy rain, typhoons, and cyclones	Damage Cost			Results of damage in the event of a disaster × Flood damage increase rate
Total							

[Step 4: Evaluate business impacts]

Step 2 3 **4** 5 Scenario **4℃** 2℃

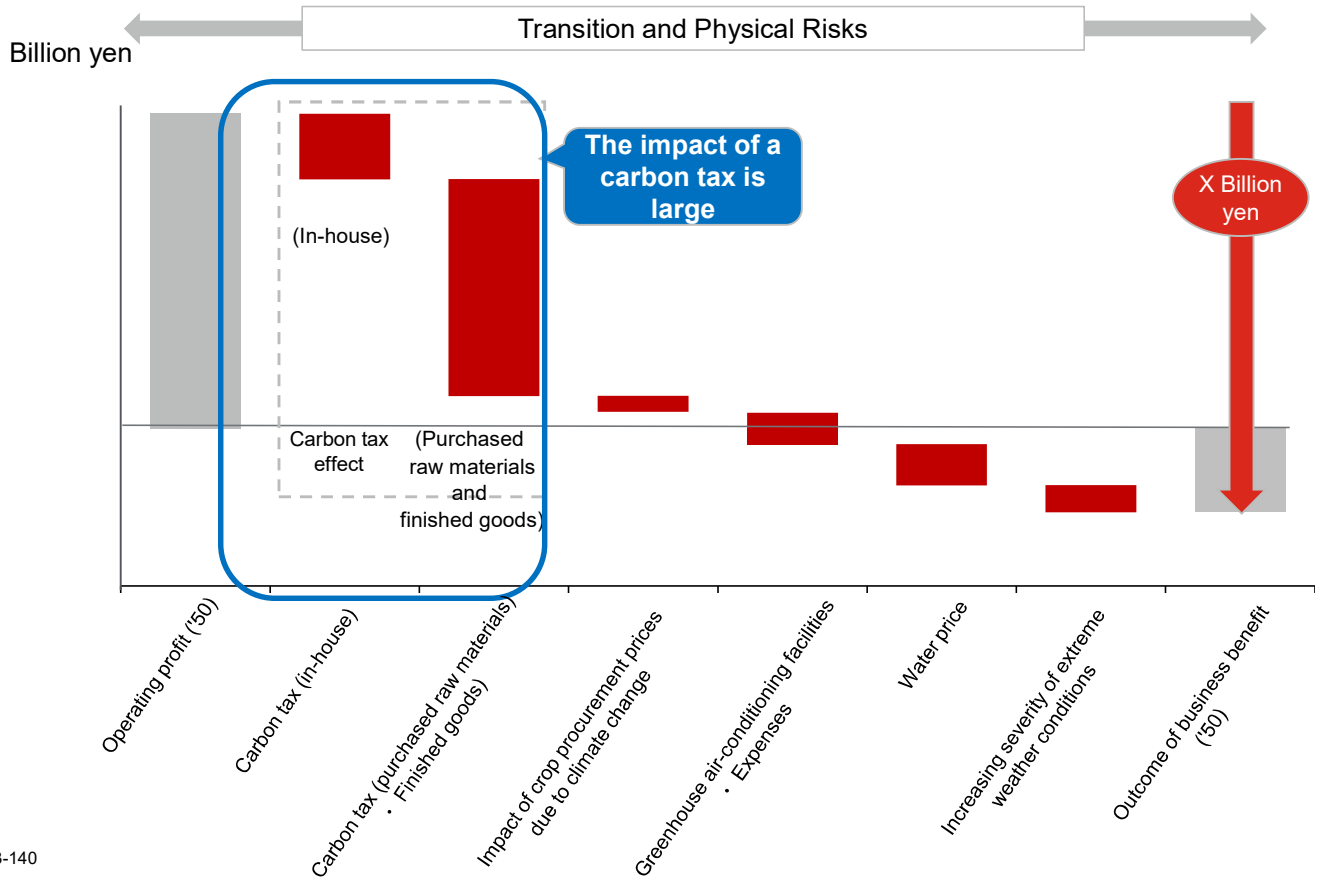
In the 4°C world, business profit will decrease by X billion yen due to water price increase and damage to production areas.



[Step 4: Evaluate business impacts]

Step 2 3 **4** 5 Scenario 4℃ **2℃**

In the world of 2°C, the impact of a carbon tax is large, and the business profit will decrease by X billion yen.



[Step 5: Identify potential responses]

Step 2 3 4 **5** Scenario **4℃** **2℃**

Summary of estimated countermeasures

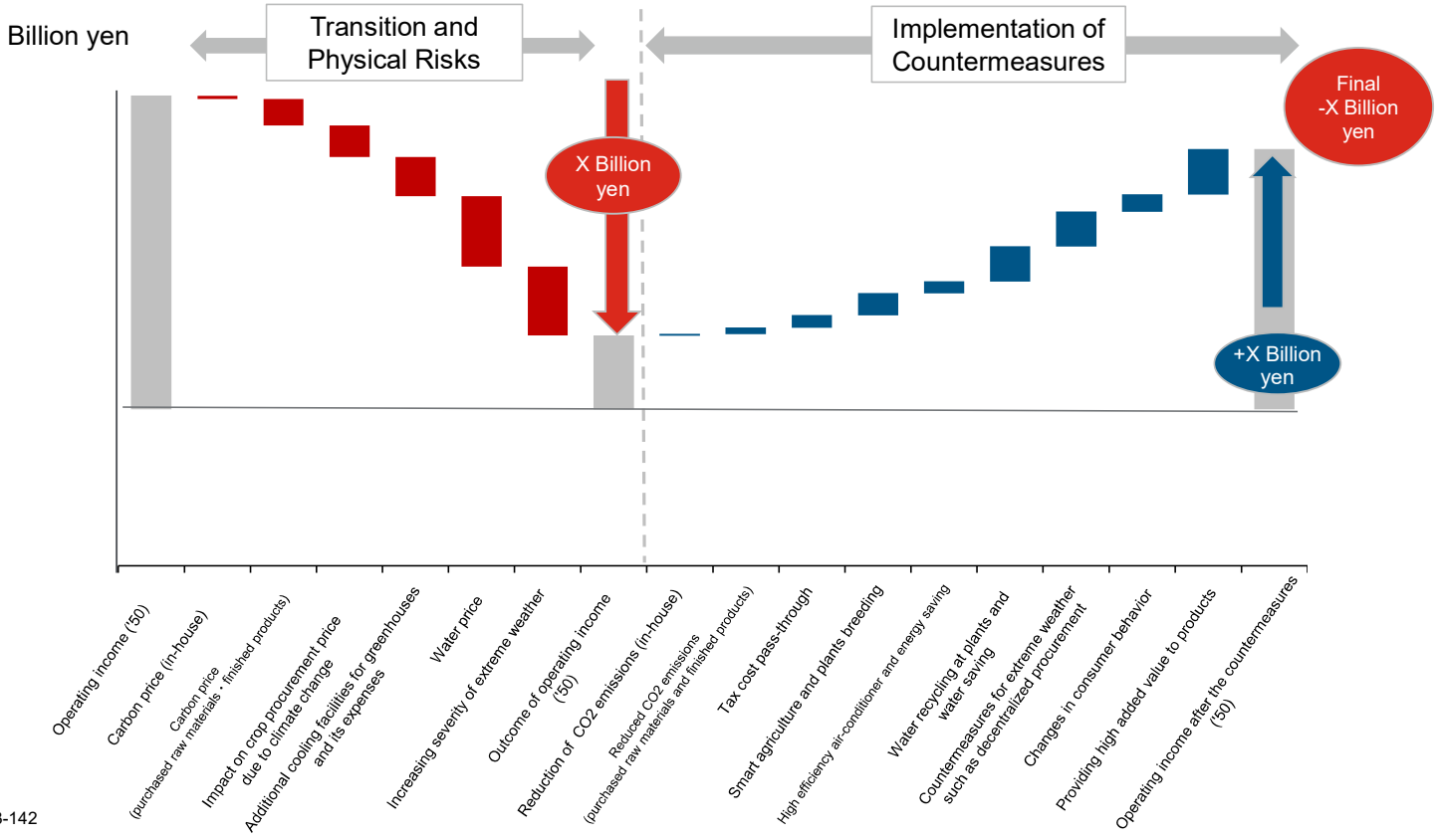
The following measures are necessary in order to recover the business impact that decreasing operating profits

Risk Item	Assumed parameter		Means of recovering the business impact	Effect factor	Impact (Billions of yen)		Pricing logic
					4℃	2℃	
Reduced CO2 emissions	⑥	Carbon tax	Achieve the 2050 CO2 reduction target for Scope 1 and 2 (in-house) (50% reduction)	Cost of sales			Estimate the avoided costs of a carbon tax if CO2 target of 2050 CO2 emissions is at the current 50% level.
		Carbon tax	CO2 reductions at Scope 3 (suppliers)	Cost of sales			Assuming a 25% reduction on a basic unit basis
		Pass-through of tax burdens accompanied by CO2 reductions	Passing on cost increases for carbon taxes that meet reduction targets and remain	Cost of sales			Shifts over 60% of the carbon tax costs that cannot be avoided by reducing CO2 above to products.
Smart Agriculture and Climate Change Resilience	⑦	—	Climate Change Responses in Agriculture	Cost of sales			Avoidance of about 70% of cost increase
For summer air-conditioning High efficiency	⑧	—	Reduction of Costs for Cooling of Greenhouses	Cost of sales			Avoid about 30% of the increase in costs (assuming an annual level of about 1% based on the Energy Conservation Law, etc.)
Water recycling Water saving	⑨	—	Reduction of rising water costs due to drought	Cost of sales			Reducing and Assuming a 50-Fraction of Elevated Water Costs During Drought.
Resistance to abnormal weather	⑩	—	Establishment of a system that can be procured even during extreme weather conditions	Cost of sales			Assumed to be about 50% of the amount of damage
Consumer Behavioral change	⑪	Choice of buying behavior Sales of certified products	Follow-up to and sales expansion of environmentally conscious purchasing behavior of consumers	Operating profit			Sales of certified products × Business growth rate × Projected Increase in Sales of Certified Products
High added value of products Valuing	⑫	—	Environmentally conscious products with high added value	Operating profit			Assumed to be about 50% of the cost that cannot be absorbed by the above-mentioned method at 4°C. (Temporary assumption of 4°C for 2°C)
Total of measures							

Scenario 4℃ 2℃

Business impact of risks and its recovery through countermeasures

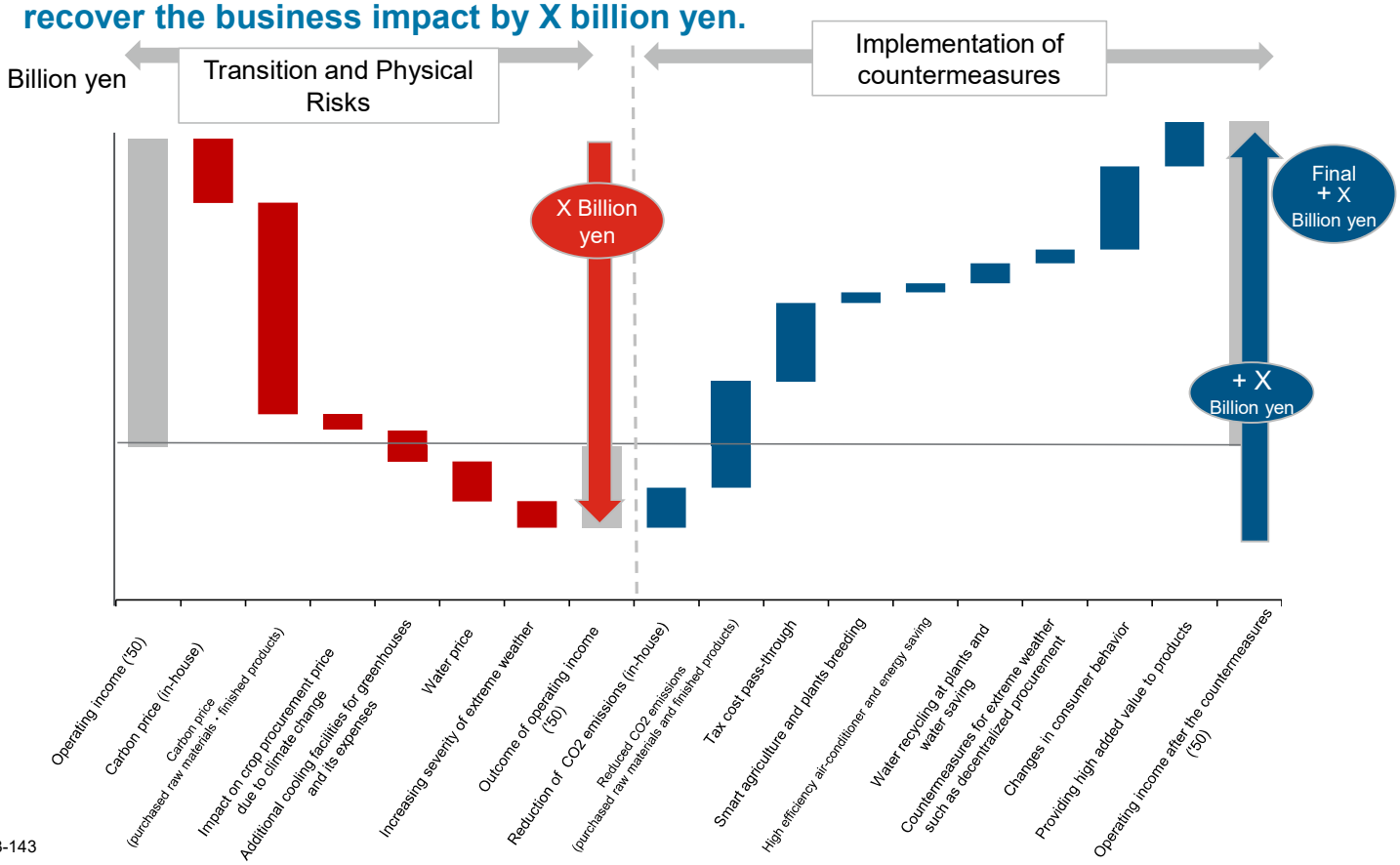
In the world of 4°C, operating profits decline by X billion yen, and countermeasures recover the business impact by X billion yen



Scenario 4℃ 2℃

Business impact of risks and its recovery through countermeasures

In the world of 2°C, operating profits decline by X billion yen, and countermeasures recover the business impact by X billion yen.



[Step 5: Identify potential responses]

Step 2 3 4 **5** Scenario **4℃** **2℃**

Practical measures at Kagome to restore business impact

	Item	Specific risk countermeasures	Opportunity
A	**Carbon price Increase**	✓ Achieve the goal of reducing CO2 emissions by 50% by 2050 through energy conservation, energy creation, and energy purchase within the Kagome Group ✓ Reduce CO2 through collaborating with suppliers ✓ Formulate and implement cost-shifting measures for each product ✓ Raise in-house CO2 reduction target (emissions 50% → 0%)	
B	**Consumer Behavioral change**	✓ Understanding of consumers' purchasing behavior and accurate sales activities ✓ Development of environmentally conscious products and certified products proactively	✓ Develop and sell products that meet the needs of customers under extreme weather conditions
C	**Average temperature Increase** **Rainfall and weather conditions Shifts in patterns**	✓ Respond to climate change through smart agriculture, such as data utilization ✓ Acquire vegetable varieties that can cope with climate change (such as high temperature resistance and pest resistance)	✓ Global expansion of sales of vegetable varieties that can cope with climate change
D	**Biodiversity decrease**	✓ Propose and disseminate agriculture that coexists with all living things	✓ Promote a tomato cultivation that does not use bees in greenhouses
E	**To water stress production by decrease**	✓ Promote water recycling and water conservation efforts at plants (membrane treatment, etc.) ✓ Develop and use a tomato cultivation system that can be produced with minimal water ✓ Promote recycling-oriented agriculture (use of factory wastewater and rainwater in agricultural land)	✓ Global expansion of a tomato cultivation system capable of producing with minimal water
F	**In extreme weather conditions, increasing severity**	✓ Upgrade procurement strategies (reviewing and diversifying production areas) ✓ Create a system that can be cultivated even during storms ✓ Upgrade BCP measures (assuming climate change)	✓ Transition to Koto Businesses (To be a service business that is not susceptible to cost fluctuations)

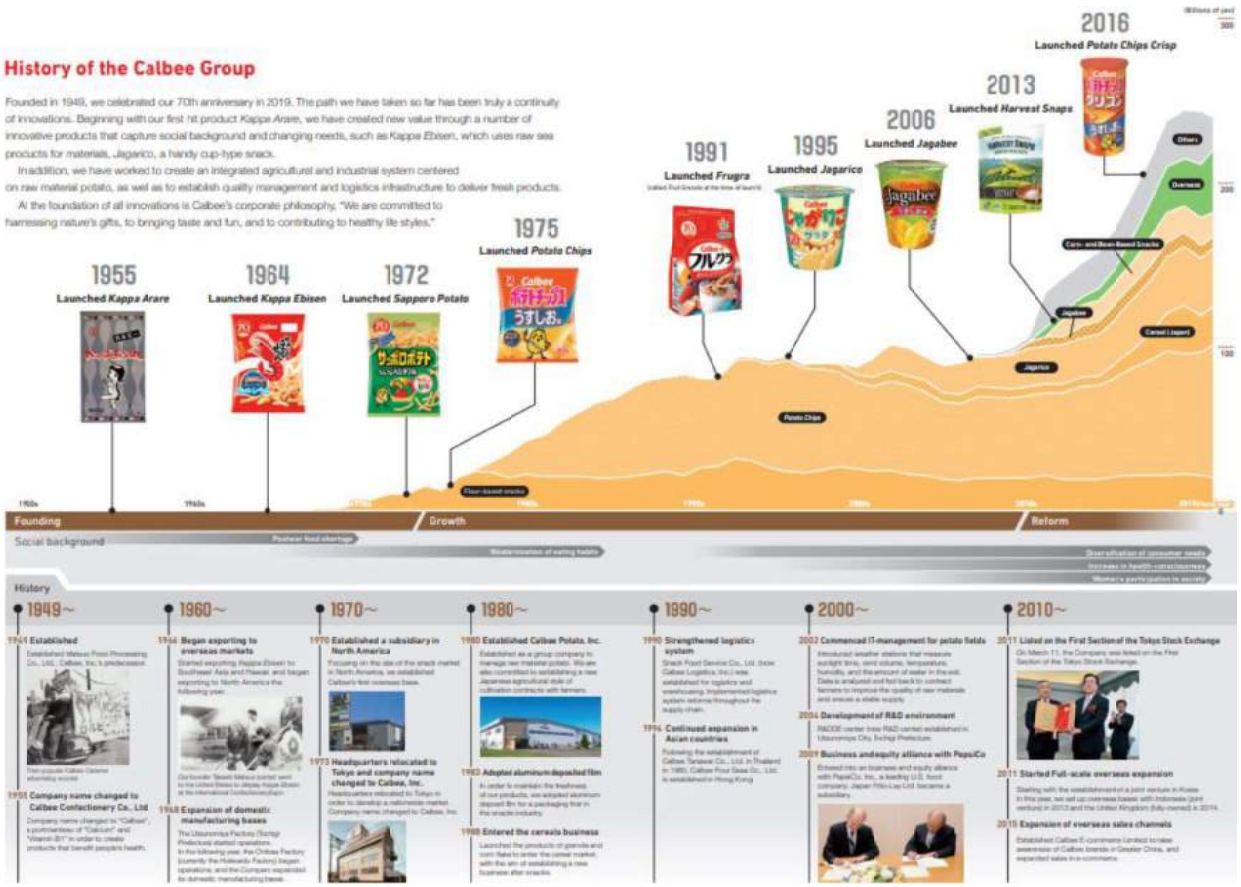
Food

✓ Practice Example①：Kagome CO.,LTD.

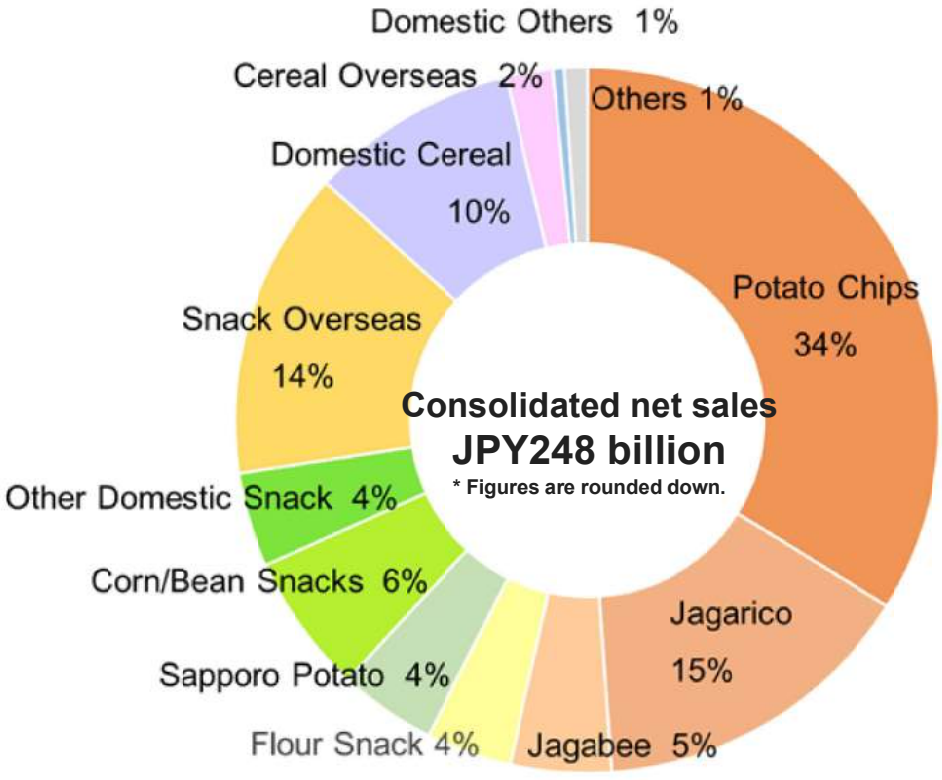
✓ **Practice Example②：Calbee, Inc.**

✓ Practice Example③：Meiji Holdings Co., Ltd.

History of the Calbee Group



Product Mix (Fiscal year ended March 2019)

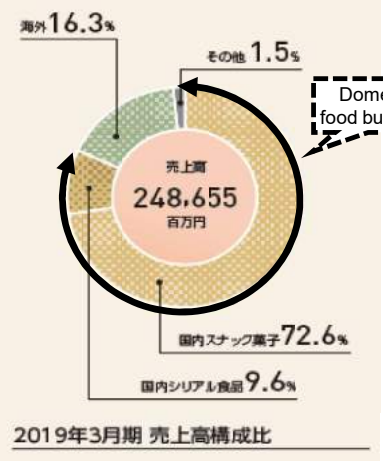


More than 50% of total sales consist of products made from potato.

Assessed Material Risks in Major Value Chain of Domestic Food Business

① Selected domestic food business for materiality assessment because it consists of more than 80% of total business

Business Portfolio



② Selected procurement, production, logistics and sales as key value chains for materiality assessment

R&D → **Procurement** → **Production** → **Distribution** → **Sales** → Consume / Disposal

- **Procurement**
  - Main raw materials include potato and oat
  - Specialty raw materials include shrimp
- **Production**
  - Facilities
- **Distribution**
  - Distribution
  - Inventory
- **Sales**
  - Shift in demand orientation

Main raw materials and specialty raw materials are taken into consideration.

Not only production but also distribution, package and sales activities are taken into consideration.

Referenced to the list of important parameters of each value chain

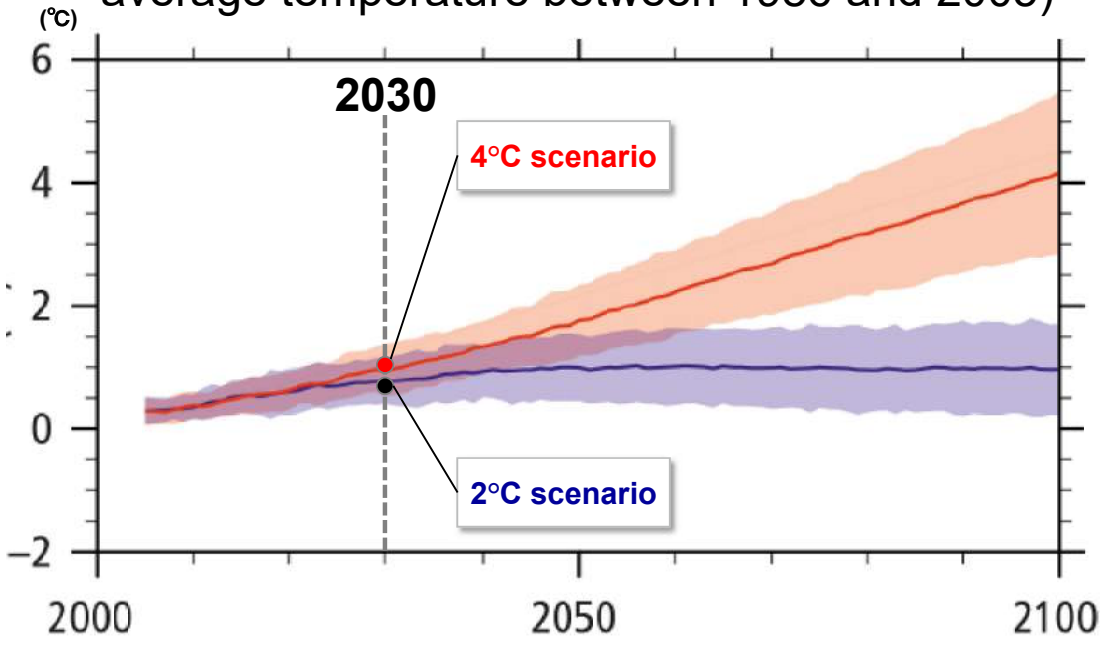
Procurement	Production	Distribution	Sales
✓ Carbon price ✓ Precipitation change ✓ Extreme weather occurrence ✓ Rise in temperature	✓ Carbon price ✓ Energy-saving policy	✓ Carbon price	✓ Changes in customer behaviours

Listed Material Risks Related to Climate Change

Risks		Financial impact		
		Metrics	Impact	Assessment
1	Carbon price	Cost	• GHG emissions: Scope 1&2+ packaging material +supply chain	Large
2	Precipitation changes	Cost Revenue	• Decreased yield of potato • Decreased yield of Oats	Large
3	Extreme weather occurrence e.g. heat wave, tropical cyclone, flood	Cost Revenue Assets	• Decreased yield of potato • Decreased yield of Oats • Suspended production • Damage on facilities	Large
4	Rise in temperature	Cost Revenue	• Decreased yield of potato • Decreased yield of Oats	Large
5	Changes in ocean environment (e.g. temperature rise, acidification)	Cost Revenue	• Decreased yield of prawn	Large
6	Changes in consumer behavior	Revenue	• Decreased sales of anti-environmental products	Large

Considered 2030 Societal Impact of 2 Scenarios as to Climate Change

Changes in Global Ground Temperature from average temperature between 1986 and 2005)



The temperature will rise 3.2-5.4°C above pre-industrial levels, unless more rigorous measures are taken.

The temperature will rise 0.9-2.3°C above pre-industrial levels, if strict measures are taken.

Source: AR5 SYR Diagram SPM.6

Defined Worldview of 2 Scenarios Based on Scientific Grounds of IEA

		At present	2030		Source
			2°C world	4°C world	
Carbon price	Carbon tax	※ Average successful bid in the European EU-ETS: Approx. $8 per tonne	For the developed countries 88 USD per tonne CO2	Assumed no carbon tax in Japan	IEA WEO 2016 (450, NPS Scenario
Changes in customer behaviours	Response to certification	No procurement	Certification price +●●%	Assuming no certification	Private research firm (No scenario)
Raw material impacts due to precipitation changes caused by rise in temperature	Changes in potato yields	(Base year)	Domestic yield -●●% U.S. yield -●●%	Domestic yield -●●% U.S. yield -●●%	Academic literature (RCP8. 5, RCP4. 5, SI92a scenarios)
	Changes in oat yields	(Base year)	Australian yield +●● %	Australian yield +●● %	GAEZ (United Nations) (Scenarios A2 and B1)
Change in ocean environment	Changes in fishery	(Base year)	Assume no change	Japan -●% U.S. import -●% China import - ●%	Academic literature (A2 scenario)
Occurrence of extreme weather events such as heat waves, tropical cyclones, floods, etc.	Increase in the number of days of heavy rain	2.5 days a year on average in Japan	2.5 days a year on average in Japan	3.0 days a year on average in Japan	The Ministry of the Environment and other government offices, Academic literature (RCP2.6、RCP8.5 Scenario)
	Severe typhoons and cyclones	(Base year)	Damage +120%	Damage +200%	Temporarily based on IPCC Report

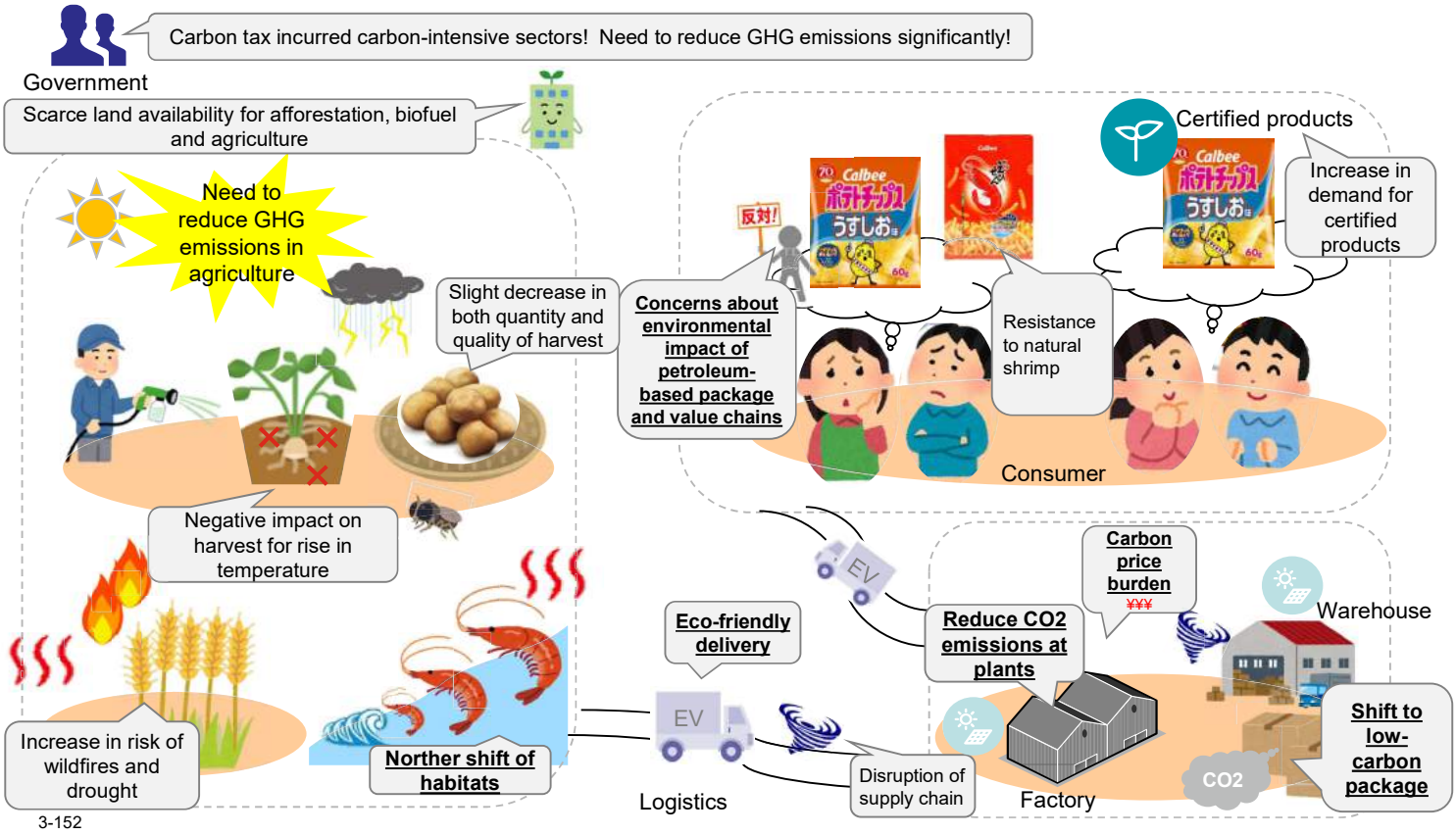
The parameters were set at 2°C and 4°C for each transition risk and physical risk.

[Step 3: Identify and define range of scenarios] Step 2 **3** 4 5 Scenario 4℃ **2℃**

Demand for sustainable products increases as low-carbon and de-carbon

掘りだそう、自然の力。 Calbee

2°C scenario

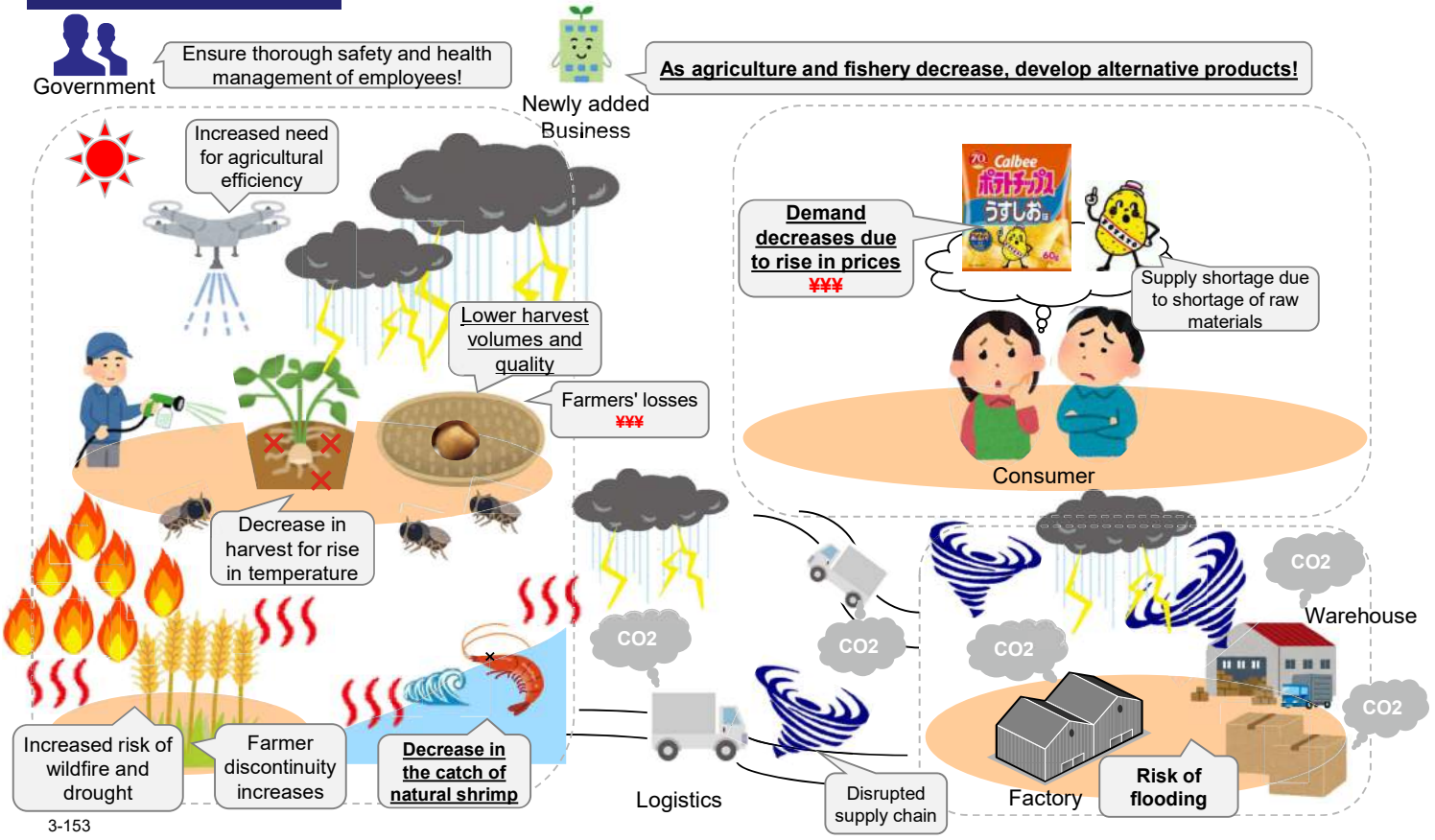


[Step 3: Identify and define range of scenarios] Step 2 **3** 4 5 Scenario **4℃** 2°C

Potato harvest and shrimp fishery reduce and extreme weather damage increases

掘りだそう、自然の力。 Calbee

4°C scenario



[Step 4: Evaluate business impacts]

Step 2 3 **4** 5 Scenario **4℃** **2℃**

Evaluate the impact of transition and physical risks based on sales, market size, etc. in 2030.

Risk Item				Parameter	Impact 2℃	Impact 4℃	Estimated assumptions (common for 2°C and 4°C)
Transition risk	Policy	Carbon price	①	Carbon tax			・CO2 Emissions from Manufacturing Sites × Carbon-Prices ・CO2 emissions from use of cardboard and packaging materials × carbon prices ・CO2 emissions on logistics × carbon prices → Calculated on the assumption that 100% of the carbon price will be passed on.
	Market	Changes in customer behaviours	②	Selective purchasing and need for the certified sustainable products in US			・Decrease in sales of products not certified for sustainability × sales
Physical risk	Chronic	Changes in precipitation, Impact on raw material harvest	③	Changes in potato yields			・Shift harvest area to make up for potential decline in yields
			④	Changes in oat yields			・Other factors would allegedly exist to hinder the correlation between the increase in yields and the price increase in the market principle,
		Changes in ocean environment	⑤	Changes in fishery			・Estimated changes in procurement from each area by referring to the fluctuations of fishery in Japan, the U.S., and China.
	Acute	Frequency of extreme weather events (tropical waves, tropical cyclones, floods, etc.)	⑥	Response to drought and wildfires			・Insufficient parameters of palms and oats (not estimated)
			⑦	Increasing number of days of heavy rain per year			・Damage from past heavy rain × Increase rate of heavy rain
							・Damage due to past heavy rainfall × Increase rate of heavy rainfall ・Production suspension due to inability of employees to come to work (including suspension of operations due to high tides)
			⑧	The number of typhoons and cyclones			・Damage from past typhoons × Rate of increase in typhoons

Impact assessments are performed using parameters of 2°C and 4°C.

[Step 5: Identify potential responses]

Step 2 3 4 **5** Scenario **4℃** **2℃**

Consider initiatives for multiple scenarios

Item	Existing Initiatives	Additional counter measures against risks
Carbon price increase	✓ CO_2 Reduction Target (30% Reduction by 2030) ✓ Conversion to liquefied natural gas (LNG) ✓ Implementation of high-efficiency operation of biomass boilers ✓ Aggressive introduction of energy-saving equipment and energy-saving activities at offices Improve load factor by standardizing cases ✓ Low and decarbonized logistics – Promoting joint delivery and modal shifts	✓ Integration of production lines and factories to improve energy efficiency ✓ Implementation of carbon offset by credit, tree-planting and blue-carbon offsetting ✓ Achieve 100% renewable energy
Sales decrease for shifting consumer behavior	✓ Reducing packaging materials and eliminating plastics ✓ Assessing and obtaining certification ✓ Expansion of best before date to reduce food losses	✓ Actively participating in the initiative ✓ Obtaining sustainability certification and establishing voluntary certification system
Harvest change due to rise in temperature **Change in precipitation** **Increase in extreme weather events** **In the marine environment Change**	✓ Diversification of farming areas for potato and other raw materials ✓ Promotion of field storage management system ✓ Development of varieties resilient to climate change and environmental change ✓ Product development using materials other than potato	✓ Utilization of development tools of and collaboration with research institutions, etc. to mitigate risks ✓ Promotion of consortia and initiatives in Japan and participate in working groups to consider countermeasures ✓ Lobbying to deregulations on agriculture ✓ Diversification of product portfolio and raw materials ✓ Storage of carbon in soil, innovation in cultivation methods and enhancement of variety cultivation ✓ Strengthening BCP with alignment among production and logistics sites globally

Food

✓ Practice Example①：Kagome CO.,LTD.

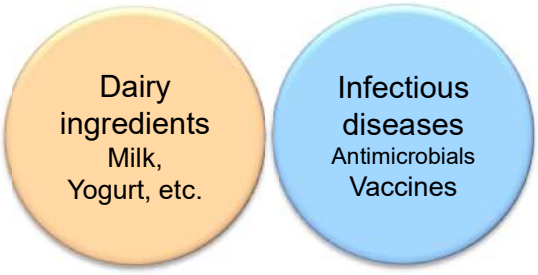
✓ Practice Example②：Calbee, Inc.

✓ **Practice Example③：Meiji Holdings Co., Ltd.**

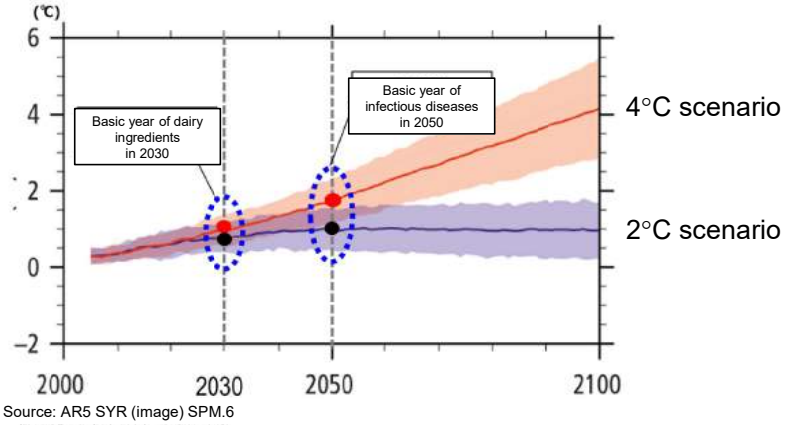
TCFD scenarios (summary)

meiji

Themes to be analyzed

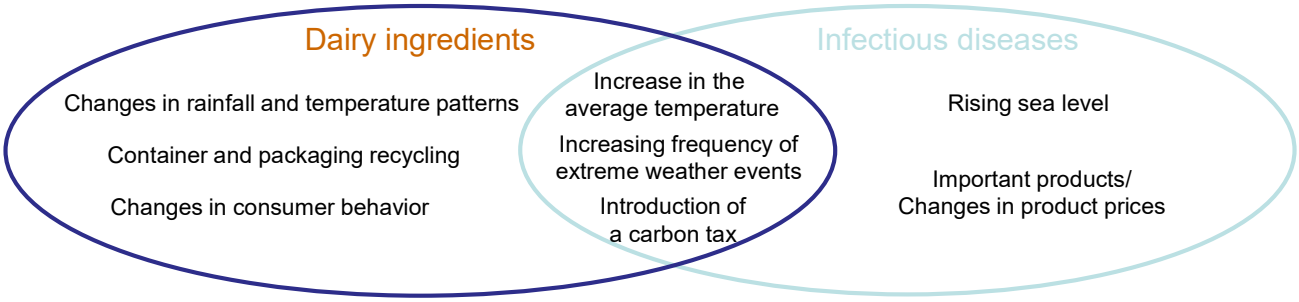


Scenario setting at 2°C and 4°C



Source: AR5 SYR (image) SPM.6

Important risk items



Risk assessment for dairy ingredients

Risk Item	Business impact		
Small classification	Index	Discussion	Assessment
Increase in the average temperature	Expenditures and revenues	Decrease in production of raw milk. Measures to cope with heat (feeding management, cattle barn environment) are required, and the cost of procuring raw materials is increasing. Increased interest in environmentally conscious consumption (ethical consumption) and increased costs associated with conscious procurement of raw materials.	◎
Changes in rainfall and temperature patterns	Expenditures and revenues	Risks associated with changes in rainfall and temperature patterns (e.g., deterioration of water quality, drought) increase. Costs of securing adequate water will increase.	
Increasing frequency of extreme weather events (typhoons, floods, etc.)	Expenditures, revenues, and assets	Natural disasters (e.g. heavy rain, floods, droughts) have resulted in suspension of operations or suspension of distribution of manufacturing bases and distribution routes. Cost increase for recovery. Yields of biological resources may decrease and procurement costs may increase due to higher feed costs.	
Carbon price	Expenditures	Increased production and transportation costs due to the introduction of a carbon tax, and higher production costs due to higher fossil fuel-derived electricity prices, as well as higher operating costs for data centers, etc.	
Container and packaging recycling	Revenues and expenditures	Costs incurred for raw materials, such as the use of environmentally friendly raw materials (certified paper, biomass plastics, etc.) and the introduction of recyclable raw materials.	
Changes in consumer behavior	Revenues	Consumers are increasingly interested in the use of natural materials, recycling of packaging materials, and CO_2 emissions, and they are increasingly purchasing products from companies that are proactive in addressing climate change (increased ethical consumption).	
Changes in Important Products/Prices	Expenditures and assets	Rising operational costs and the threat of collapse of the entire value chain.	
Food loss	Expenditures and assets	Increased procurement costs due to stricter regulations on the disposal of milk and GHG emissions, and higher equipment costs due to the introduction of cooling facilities.	
Carbon emissions targets/policies in each country	Expenditures and assets	Dairy ingredients emit large amounts of GHG in the process. The unit price of raw milk rises if it becomes regulated in each country.	
Soil degradation	Expenditures and revenues	Dairy farms are subject to tighter regulations, which may increase the cost of operating equipment and restrict business expansion, thereby affecting raw material availability and procurement costs.	○
Energy-saving policy	Expenditures and assets	Expenses for changing manufacturing processes, procuring alternative materials, and installing energy-saving equipment and highly efficient equipment increased.	
Rising sea level	Revenues, assets and expenditures	Water disasters such as floods and a sudden increase in droughts have an impact on production, such as the shutdown of plants located in coastal areas vulnerable to disasters and areas with low sea levels.	
Changes in the investor's reputation	Revenues and assets	Investors' increased interest in climate change and other environmental issues and sustainability, and inadequate countermeasures, will adversely affect PL/BS and reputation of investors.	

Risk Assessment in Infectious Diseases

Risk Item	Business impact		
Small classification	Index	Discussion (Example)	Assessment
Rising sea level	Revenue Assets and expenditures	Influence from floods, etc., that shut down the operations of plants located in coastal and other areas. Also affects the reproduction of infectious agents and changes the supply and demand of products.	◎
Increase in the average temperature	Revenue	The frequency, spread timing and area of infectious diseases may change, and demand for each product may fluctuate significantly.	
Increasing frequency of extreme weather events (heat waves, typhoons, floods, etc.)	Revenue Assets and expenditures	Frequent heavy guerrilla rains, typhoons, etc., cause major damage to inventories and facilities, resulting in an increase in facility restoration costs, etc.	
Changes in important products/prices	Expenditures and assets	Product prices fluctuate due to the risk of sharp rises in raw material prices and decreases in the amount that can be secured.	
Carbon price	Expenditures and assets	The introduction of a carbon tax will impose taxes on transportation fuel for raw materials and commodities and increase transport costs. Production costs at plants in countries with high carbon taxes also increased.	
Carbon emissions targets/policies in each country	Expenditures and assets	New technologies and equipment installation costs are incurred due to the tightening of regulations on carbon emission policies in each country.	○
Investments in low carbon technology	Expenditures and assets	Capital expenditures in the entire value chain, including raw material procurement and transportation, were incurred in order to transition to low-carbon technologies.	
Investment in temperature adjustment equipment	Expenditures and assets	Additional temperature control equipment is required for product processing and transportation, resulting in an increase in equipment costs.	
Changes in the investor's reputation	Revenue	There is growing interest in sustainability, so investors' reputation will deteriorate if insufficient measures are taken.	

Forecasts of various factors in the base year

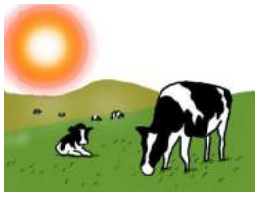
		At present	Dairy ingredients (food)		Infectious diseases (pharmaceuticals)		Source
			2030		2050		
			4°C world	2°C world	4°C world	2°C world	
Carbon price	Carbon tax	-	EU $23 per tonne China $23 per tonne Japan not yet introduced	Japan and Europe $100 per tonne China $75/ton	China $29/ton Japan not yet introduced	Japan and Europe $191 per tonne China $180 per tonne	• IEA WEO 2018
Recycling of containers and packaging	Recycled plastics Utilization rate	Not introduced	Not introduced	30%	-	-	• EU government
Change in customer behavior	Rate of decline in sales due to failure to comply with sustainability certification	-	Down 2%	Down 3%	-	-	• Private research firm
Changes in rainfall and weather patterns	Rate of increase in the frequency of floods	1 times	Japan 1.5 times China 2.1 times	No change	Japan 1.5 times China 2.1 times Indonesia 2.9 times India 5.8 times Spain 1.1 times	No change	• AQUADUCT
Increase in the average temperature	Increase ratio of cost for operating the barn	-	Up 4.02%	No increase	-	-	• USDA (U.S. government agency)
	Mosquito-borne infectious diseases Population at Risk (Asia)	Approx. 3.82 billion	-	-	Approx. 4.36 billion	Approx. 3.86 billion	• Academic literature
	Number of outbreaks of waterborne infections (diagnostics) (Asia)	Approx. 2.53 billion	-	-	Approx. 2.92 billion	Approx. 2.72 billion	• Academic literature
Rising sea level	Magnitude of sea level rise	-	-	-	0.25m	0.2m	• Ministry of the Environment and Japan Meteorological Agency Report

・ International Energy Agency: An advisory body to 29 member countries to provide reliable, affordable and clean energy to their citizens.
・ AQUEDUCT (in the Japanese language, "pipelines and pipelines"): A tool that provides free global maps and other information about the latest water risks released by the World Resources Laboratory (WRI)
・ USDA(United States Department of Agriculture): Government Offices governing U.S. agricultural policies

Conceptual diagram: 4°C scenario

While low carbon/decarbonization is not promoted (business as usual) and the physical risk increases, the possibility of the market expansion of infectious diseases is considered.

Dairy ingredients (food)



Productivity decline in dairy cows due to heat stress
Cost increase for air-conditioning and other measures

Increase in facility operation and transportation costs due to natural disasters

✓ **Support for dairy farmers due to declining production of raw milk**
✓ **Support for countermeasures against physical risks such as water stress and natural disasters**

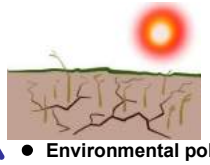
Government

Increase in facility operation and transportation costs due to natural disasters

Influence on plant operations in areas of high water stress

Infectious diseases (pharmaceuticals)

- **Increased risk of mosquito-borne infectious diseases**
- **Diarrhea due to water contamination (enteritis, cholera, etc.)**



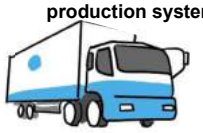
- **Environmental pollution**
- **Effects of food shortages**

Government

☐ **Collaboration with Asian countries based on Industry-Government-Academia collaboration**
☐ **Support for countermeasures against physical risks such as natural disasters**

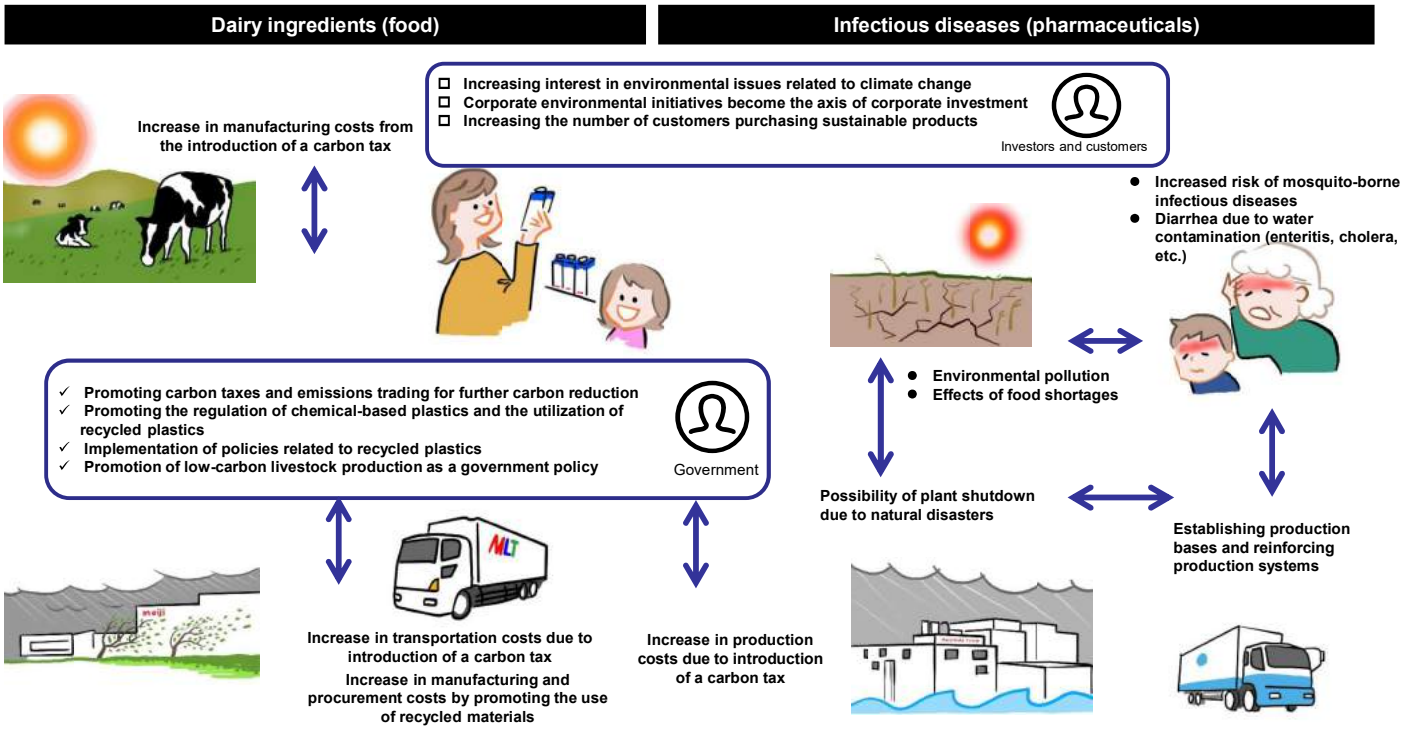
Possibility of plant shutdown due to natural disasters

Establishing production bases and reinforcing production systems



Conceptual Diagram: 2°C scenario

Measures to reduce carbon emissions will be promoted, and investors and customers will be more interested in environmental issues.
While various cost increases may occur, there is a possibility that the customer's ethical orientation will increase.

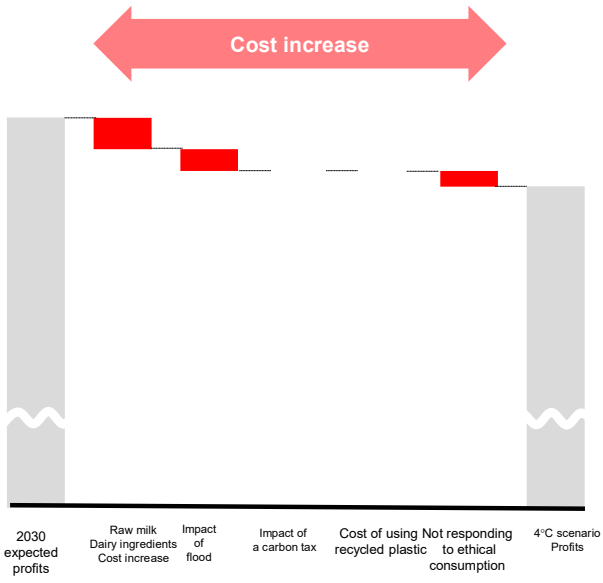


Important risk items and evaluation of business impacts on dairy ingredients

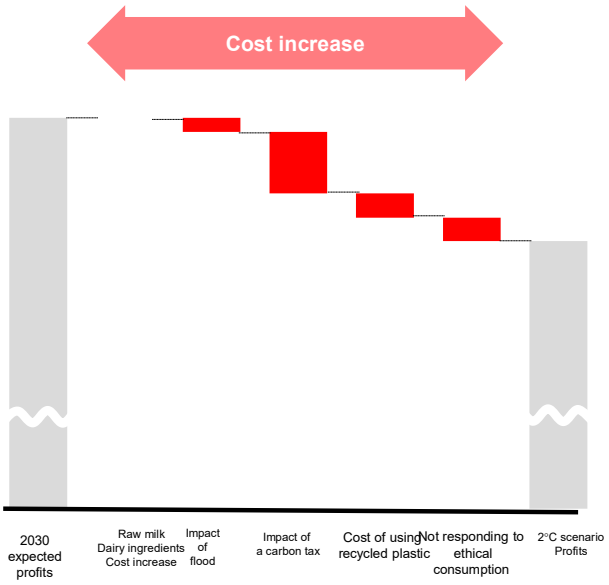
Risk item	Expected business impact		Impact value
Changes in average temperature	Nurturing cows by preventing hot weather (feeding management, cattle barn environment)	Increased cost of raw milk, dairy raw materials	4℃ : XX billion USD 2℃ : No impact
	Increase in the price of cattle feed ingredients due to a decrease in crop yield		
	Increased demand for products to prevent thirst due to temperature increase, and increased heatstroke due to temperature increase	Increased demand for products for prevention of thirst and heatstroke	-
Changes in precipitation patterns	Need to improve quality of water in manufacturing and rearing due to water quality deterioration*not in 2030	Increased cost due to water risk responses	-
	Increase in the unit price for water supply in animal-rearing areas due to drought		
Frequency of extreme weather events (typhoons, floods, etc.)	Lost opportunities due to suspension of production and logistics	Decreased opportunity because of stopped supply chain	4℃ : XX billion USD 2℃ : XX billion USD
	Restoration of damaged facilities for production and logistics due to flood		
Carbon price	Introduced a carbon tax in manufacturing sites (plants)	Increased cost due to a carbon tax	4℃ : XX billion USD(only in China) 2℃ : XX billion USD
	Introduced a carbon tax in logistics		
Recycling of packages	Introducing recycled plastics due to plastics ban	Increased cost due to replacement with recycled plastics	4℃ : No plastics ban 2℃ : XX billion USD
Changes in customer behaviors	Growing environmental consciousness (reduction of environmental burden・environmentally-friendly) due to increased frequency of extreme weather and environmental regulation (such as CO2 and plastics).	Increased ethical consumption	4℃ : XX billion USD 2℃ : XX billion USD

Profit simulation in Dairy Ingredients by Scenario

Simulation under the 4°C Scenario



Simulation under the 2°C Scenario



Outline of measures to deal with business risks and opportunities in dairy ingredients

	Existing Initiatives	Future Initiatives
Seize opportunities Expansion of ethical consumption ・ Expansion of demand for responding to temperature increases, etc.	☐ Requirements for anti-thirst and heat stroke countermeasures are increasing. In response to these needs, products for anti-thirst drinks and heat stroke countermeasures are launched ☐ Shift to environmentally conscious raw materials FSC-certified paper and recycled paper: FY2018 Result 55.3% Certified palm oil: FY2019 Plan Use approx. 10% 	☐ Examination of products that meet the possibility of expanding demand for products with minimal environmental impact ☐ Considering expansion of anti-thirst and anti-heat stroke products ☐ Aggressive use of environmentally friendly raw materials in response to heightened environmental awareness due to extreme weather and various regulations
Risk mitigation Raw material price increase ・ Plastic regulations ・ Increased water risk ・ Introduction of a carbon tax	☐ Reduction in plastic consumption due to thinning, etc. ☐ Introduce solar power facilities for renewable energy  Completion drawing (image) the solar facilities of Meiji Co., Ltd. Kyushu Plant	☐ Significant reduction in plastic consumption due to thinner-walled plastics and shift to paper, and replacement with recycled plastics. ☐ Considering the use of raw materials with minimal logistics impact ☐ Efficiency of water consumption in production and flood countermeasures ☐ Further promotion of energy conservation and shift to renewable energy ☐ Considering support for heat countermeasures to maintain milk production for dairy farmers

Infectious diseases particularly affected by temperature increases

The vaccine for Japanese encephalitis and dengue fever, and antimicrobials for diarrhea (cholera, etc.) are assumed to be affected by temperature rise.

Various infectious diseases and routes

	Routes of transmission	Vectors/ Vehicles	Infection
Direct transmission		Bite Feces	Rabies Toxoplasmosis, Ascaris
Indirect transmission	Vector-borne	Mosquito Tick Rodens Flea Snails	**Japanese encephalitis,** malaria**, dengue fever,** West Nile fever, and Rift Valley fever Tick-borne Encephalitis Hantavirus Pulmonary Syndrome Plague Schistosomiasis japonica
	Water/ Soil-borne	Water Soil contamination	**Diarrhea (cholera, etc.)** Anthrax
	Food (animal derived) - borne	Meat Fish meat	Enterohemorragic E. coli O157 infection, salmonellosis Anisakiasis

Infectious Diseases assumed to be impacted by global warming

Source: What is known about global warming and infectious diseases today? (Ministry of the Environment)

Relationship with Global Warming in Infectious Diseases

It has been suggested that the risk of infectious diseases is generally increased by global warming.

Climate change affects rainfall volumes and patterns

Increase rainfall volumes during a specific period

Increase **the number of mosquitos and the number of natural hosts**

Climate change raises temperature

Raises the highest temperatures in summer

Raises the lowest temperature in winter

Mosquitoes that had been dead during the winter **live over the winter**

Expansion of living areas where the number of mosquitos and the number of natural hosts increase

Changes in human clothing and living environments
(Increase in short-sleeve and field activities, etc.)

Agents intrude into the body
Number of agents and opportunities that penetrate the human body

Existence of vector And natural host
Vector (mosquitoes, etc.)
Natural hosts (mice, livestock, etc.)

Social environment where agents can easily intrude
Building patterns, economic activities, cultural lifestyles, and other environments that facilitate contact with vectors and natural hosts

Human health
Nutritional and hygiene conditions that are easily affected

Climate change has also been reported to increase diarrhea by 3%, malaria by 5%, and malnutrition by 10%, assuming that the risk of infections other than Japanese encephalitis, dengue fever, and diarrhea has also increased.

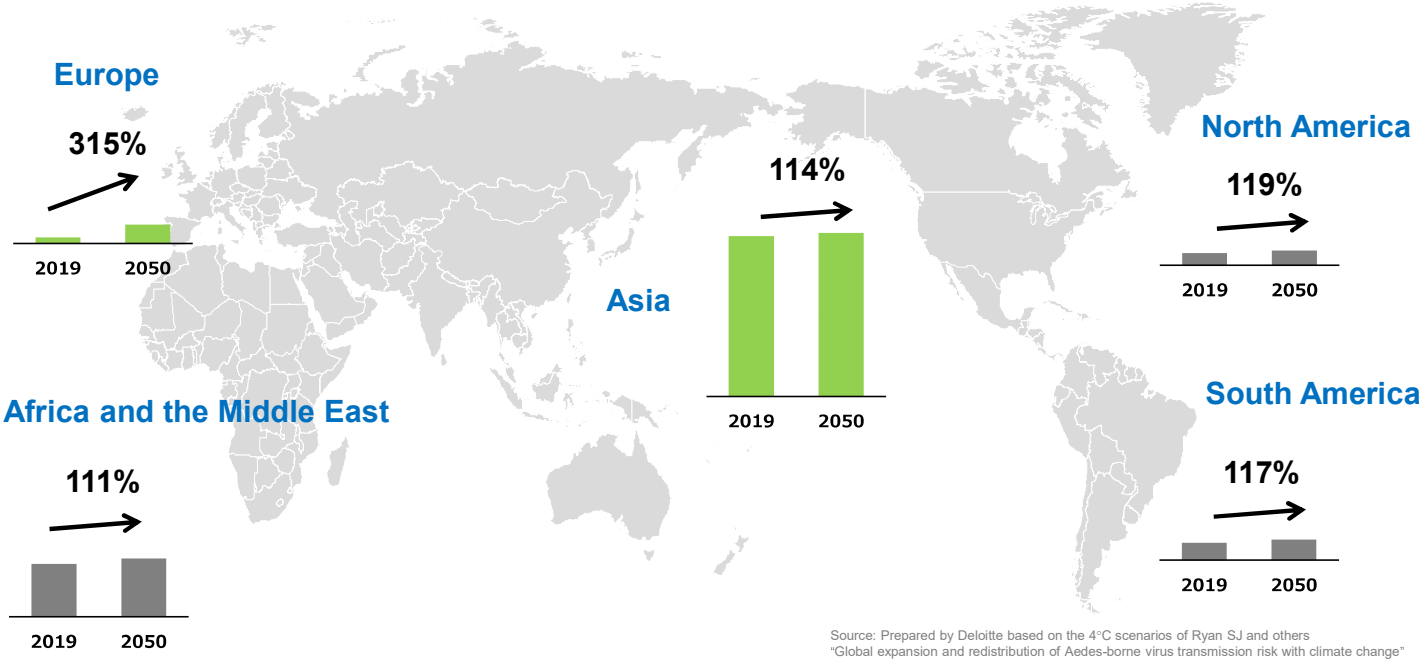
Source: What is known about global warming and infectious diseases today? (Ministry of the Environment)

Population growth rate at risk due to increased temperature of mosquito-borne infectious diseases (4°C scenario)

The population at risk for mosquito-borne infections is predominantly in Asia.

※ Market size: Population at risk for mosquito-borne infectious diseases (100 millions of people)

Pharma sales bases (subsidiaries) No pharma sales base (subsidiary)



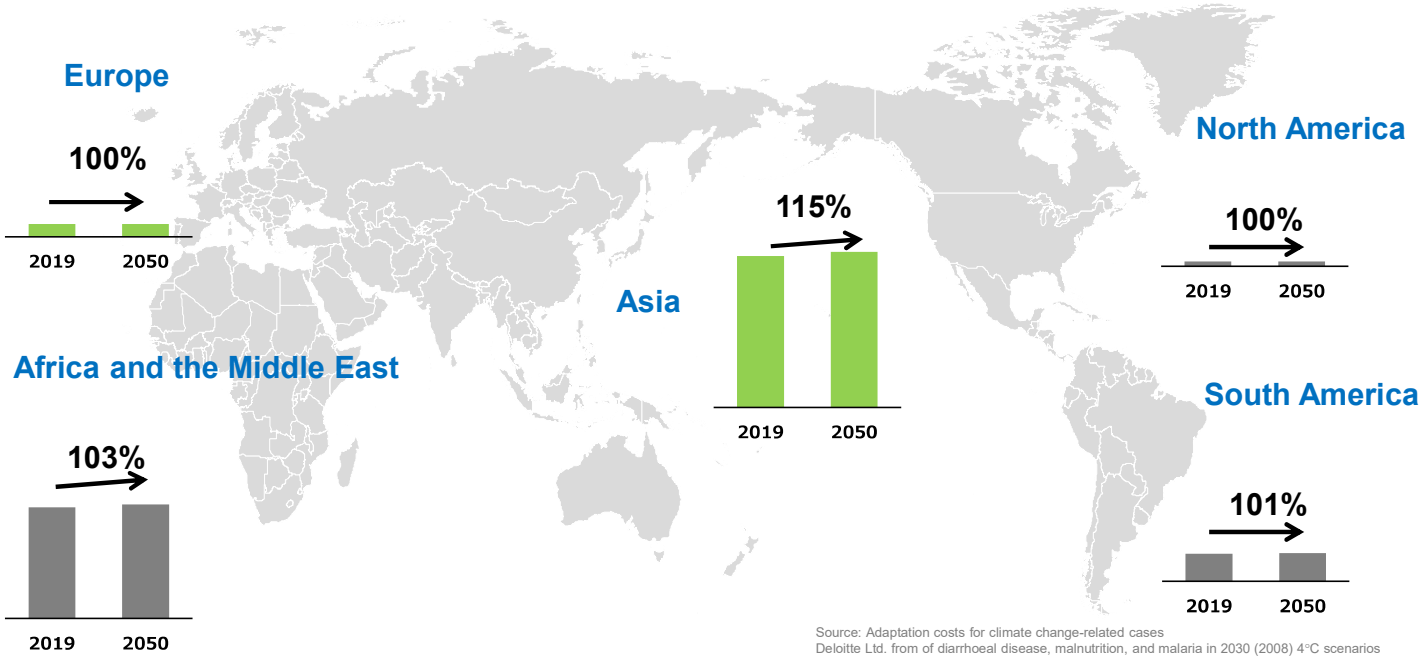
Source: Prepared by Deloitte based on the 4°C scenarios of Ryan SJ and others
"Global expansion and redistribution of Aedes-borne virus transmission risk with climate change"

Increasing rate due to number of diarrhea and temperature increases (4°C scenario)

The number and increase rate of diarrhea are high in Asia and Africa.

※ Market size: Number of diarrhea occurring (100 millions of incidents)

Pharma sales bases (subsidiaries) No Pharma sales bases (subsidiaries)



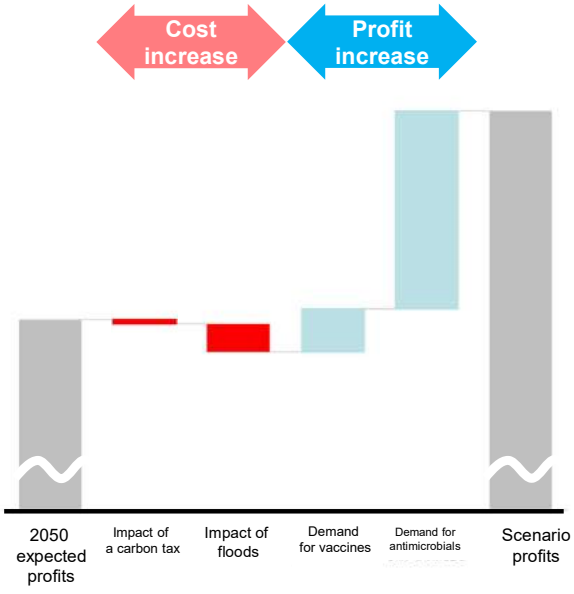
Source: Adaptation costs for climate change-related cases
Deloitte Ltd. from of diarrhoeal disease, malnutrition, and malaria in 2030 (2008) 4°C scenarios

Important risk items and evaluation of business impacts on Infectious Diseases

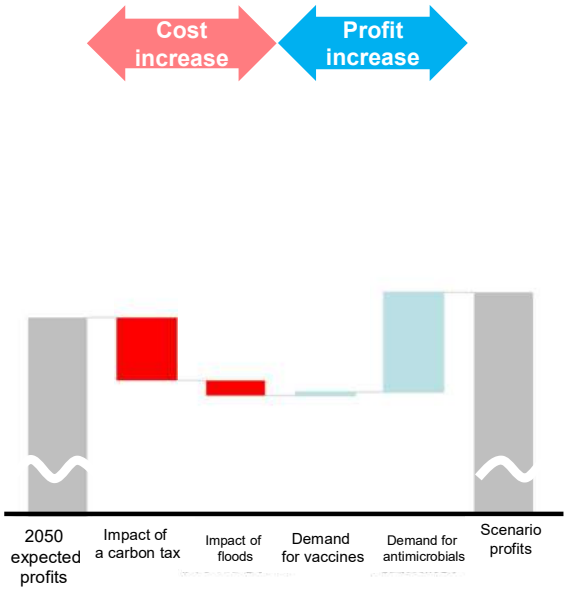
Risk item	Expected business impact		Impact value
Changes in average temperature	Increased risk for Mosquito-borne infection	Increased demand for vaccine and antimicrobials	4℃ : XX billion USD 2℃ : XX billion USD
	Increased cases of diarrhea		
Frequency of extreme weather events (typhoons, floods, etc.)	Lost opportunities due to suspension of production and logistics	Decreased opportunity because of stopped supply chain	4℃ : XX billion USD 2℃ : XX billion USD
	Restoration of damaged facilities for production and logistics due to flood		
Carbon price	Introduced a carbon tax in manufacturing bases (plants)	Increased cost due to a carbon tax	4℃ : XX billion USD (only in China) 2℃ : XX billion USD
	Introduced a carbon tax in logistics		
Rising sea level	Increased flood damage due to the sea level rise	Increase cost due to cancelled manufacturing	4℃ : Assume no damage due to rising sea level 2℃ : Assume no damage due to rising sea level

Profit simulation in Infectious diseases by Scenario

Simulation under the 4°C Scenario



Simulation under the 2°C Scenario



Outline of Business Risks and Opportunities for Infectious Diseases

	Existing Initiatives	Future Initiatives
Seize opportunities Growing demand for infectious disease drugs and vaccines	☐ Increase in sales volume of products due to the expansion of infectious diseases ☐ Upgrading of production bases in Asian countries ☐ Reinforcement of product lineup 	☐ Strengthen business development in Asian countries with subsidiaries as bases. ☐ Contributing to the Asian market through industry-government-academia-medical collaboration 
Risk mitigation Increased water risk ・ Introduction of a carbon tax	☐ Strengthening of stable procurement system ☐ Building a Production System to Ensure Stable Supply ☐ Periodic maintenance of equipment ☐ Energy conservation promotion ☐ Ensuring the safety of plant employees ☐ Proper management of equipment using fluorocarbons 	☐ Implement measures to increase the efficiency of water consumption in production and to prevent plant shutdowns due to natural disasters ☐ Promotion of energy conservation and shift to renewable energy ☐ Reinforcement of management for chemical resistance in factory wastewater ☐ Appropriate management of plant waste and total material input ☐ Reduction of plastic consumption by considering use of thinner-walled and biodegradable plastics

Other Sector

✓ **Practice Example①：KYOCERA Corporation (Electronic Equipment)**

✓ **Practice Example②：Seven & i Holdings Co., Ltd. (Retailing)**

✓ **Practice Example③：Lion Corporation (Consumer Products)**

Step 2 3 4 5 Scenario 4℃ 2℃

Assessing the impact of climate change on the energy sector

Analyzed mainly in the energy field of the Kyocera Group

Item		Major Impact	Assessment
Technological Development	Response to decarbonized society	Developments in VPP※ technologies (e.g., power generation forecasting technologies, power generation stabilization technologies), power generation and storage efficiencies, high-volume storage batteries production technologies, environmentally friendly technologies to introduce renewable energy (e.g., offshore and water-based photovoltaics), and alternative energies (e.g., hydrogen technologies) can have a significant impact on decarbonized society and sales.	Large
Transition Risk (Policy Risk)	Carbon emissions targets for each country /Energy policy	National targets/energy policies have a major impact on societal decarbonisation and sales.	Large
	Carbon tax	When a carbon tax is introduced, manufacturing costs increase.	Medium
	Recycling regulations	When recycling regulations are introduced, businesses may bear the recycling fee, which affects sales.	Medium
Physical Risk (Natural Disaster Risk)	Increasing severity of extreme weather conditions	Natural disasters cause costs such as shutdowns, production declines, and equipment restoration. Costs for natural disaster countermeasures and insurance premiums increase.	Medium

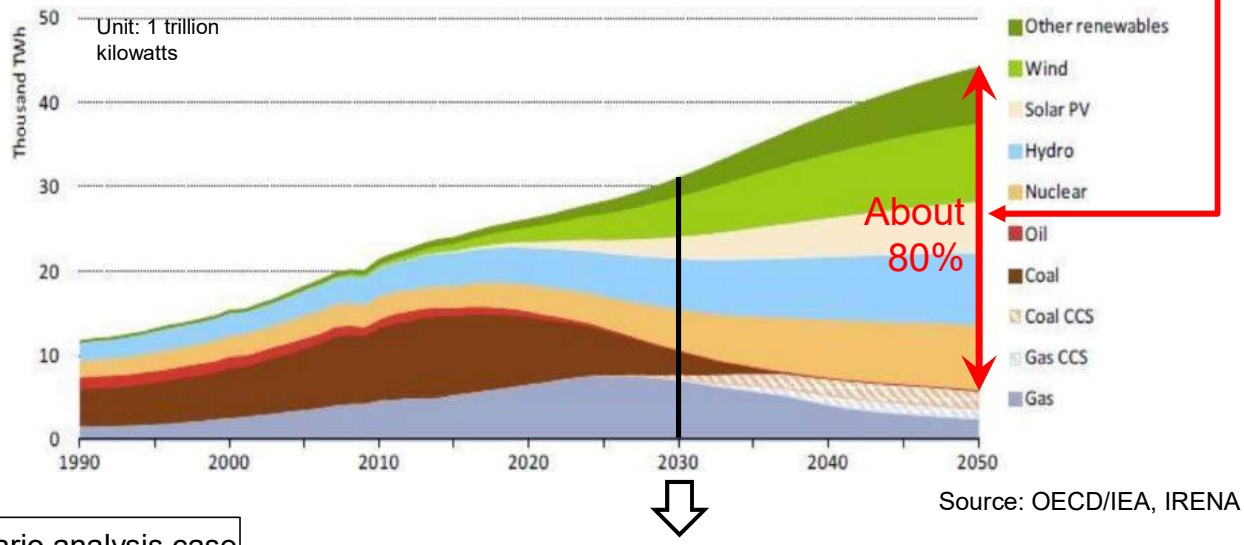
※ VPP (Virtual Power Plant): Technologies that can be used to balance power supply and demand by combining distributed energy resources possessed by factories, households, etc., and then controlling these resources remotely and in an integrated fashion.
Since it functions like a single power plant, it is called a “virtual power plant.”

Assumptions for Scenario Analysis

Step 2 3 4 5 Scenario 4℃ 2℃

To keep temperature increases below 2°C

Temperature increases can be limited to less than 2℃ by increasing the proportion of non-fossil fuels in the world



Source: OECD/IEA, IRENA

Scenario analysis case

2°C Scenario: The Future of Decarbonized society
4°C Scenario: A Current Extended Future

Scenario analysis is conducted with 2030 as the target year.

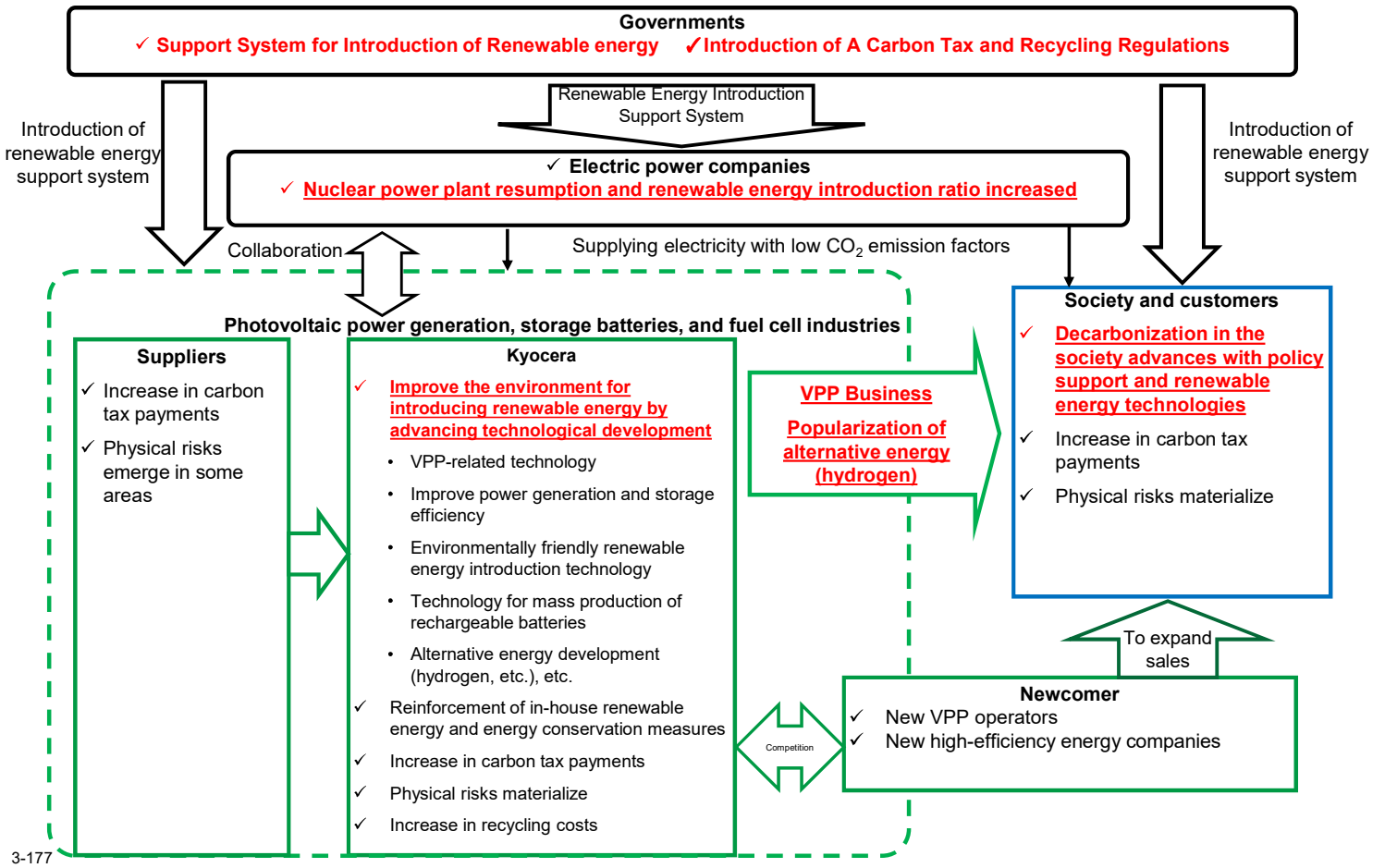
Assumptions for Scenario Analysis

Step 2 3 4 5 Scenario 4℃ 2℃

			At present	2030		Source
				4°C world	2°C world	
Economic Efficiency	Renewable energy, etc. Subsidies Policy	FIT's purchase price (yen/kWh)	Solar: 14 (bidding system) Wind: 19-36 (2019)	(Assumed to have difficulty in become self-reliant from FIT at 4°C)	Solar: 7 (2025) Wind: 8-9	• Agency for Natural Resources and Energy
		Unit price of renewable energy generation (yen/kWh)	Solar: 21.8 Land wind: 21.5 (2017)	Solar: 13.5 Land wind: 20.6	Solar: 12.4 Land wind: 20.6	• IEA WEO2017 (450 scenarios)
Natural Disaster	Increasing severity in extreme weather conditions	Frequency of floods	1 times	3 times	1.7 times	• Technical Review Committee on Flood Control Plans Based on Climate Change "Recommendations on Water Control Plans Based on Climate Change"
Other		Battery cost (USD/kWh)	280 (2015)	(business as usual)	150 (0.54 times)	• Estimated from IEA ETP 2017 • 2014 Advanced Battery Society of Europe Target Value
		Demand for solar power Amount of electricity (TWh)	190 (2014)	1,402 (7.38 times)	1,757 (9.25 times)	• Estimated from IEA ETP 2017 • 2014 Advanced Battery Society of Europe Target Value
		Demand for batteries Reserves of power (GW)	159 (2015) EV application 98.8%	219 (1.38 times)	172 (1.08 times) EV application: 99.8%	• Estimated from IEA ETP 2017
		Demand response capacity (GW)	11 (2015)	25 (2.3 times)	39 (3.5 times)	• Estimated from IEA ETP 2017

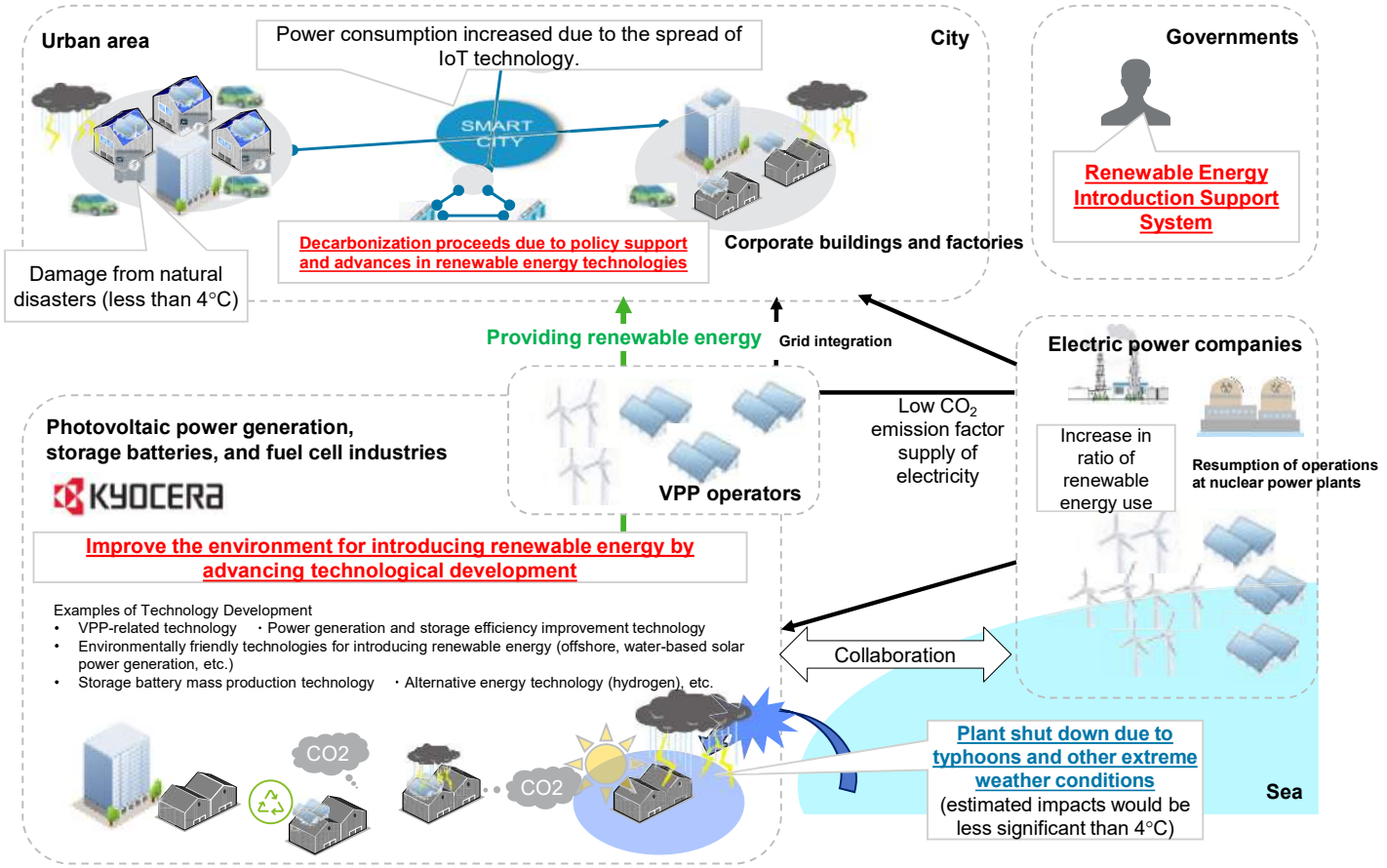
The 2°C World: Shift toward decarbonized society

Step 2 3 4 5 Scenario 4℃ 2℃



The 2°C World: Shift toward decarbonized society

Step 2 3 4 5 Scenario 4°C 2°C



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The 4°C World: Current Extension

Step 2 3 4 5 Scenario 4°C 2°C

Governments
✓ Policies will remain unchanged
✓ A carbon tax will not be introduced

Electric power companies
✓ Generation continues using fossil fuels and CO_2 emission factor of electricity does not decrease
✓ Energy prices of fossil fuels fluctuate depending on social conditions in oil-producing countries.

Supplying electricity with higher CO_2 emission factors

Photovoltaic power generation, storage batteries, and fuel cell industries

Suppliers
✓ Increase in costs for responding to changes in energy prices
✓ Physical risks materialize

Kyocera
✓ Technology development for the introduction of renewable energy has been delayed, and the spread of renewable energy in the market has not progressed
- VPP-related technology
- Technologies for Improving the Efficiency of Power Generation and Storage
- Environmentally friendly renewable energy introduction technology
- Technology for mass production of rechargeable batteries
- Alternative energy technologies, etc.

✓ Reinforcement of in-house renewable energy and energy conservation measures
✓ Physical risks materialize
✓ Increase in costs for responding to changes in energy prices

No progress in penetration of renewable energy

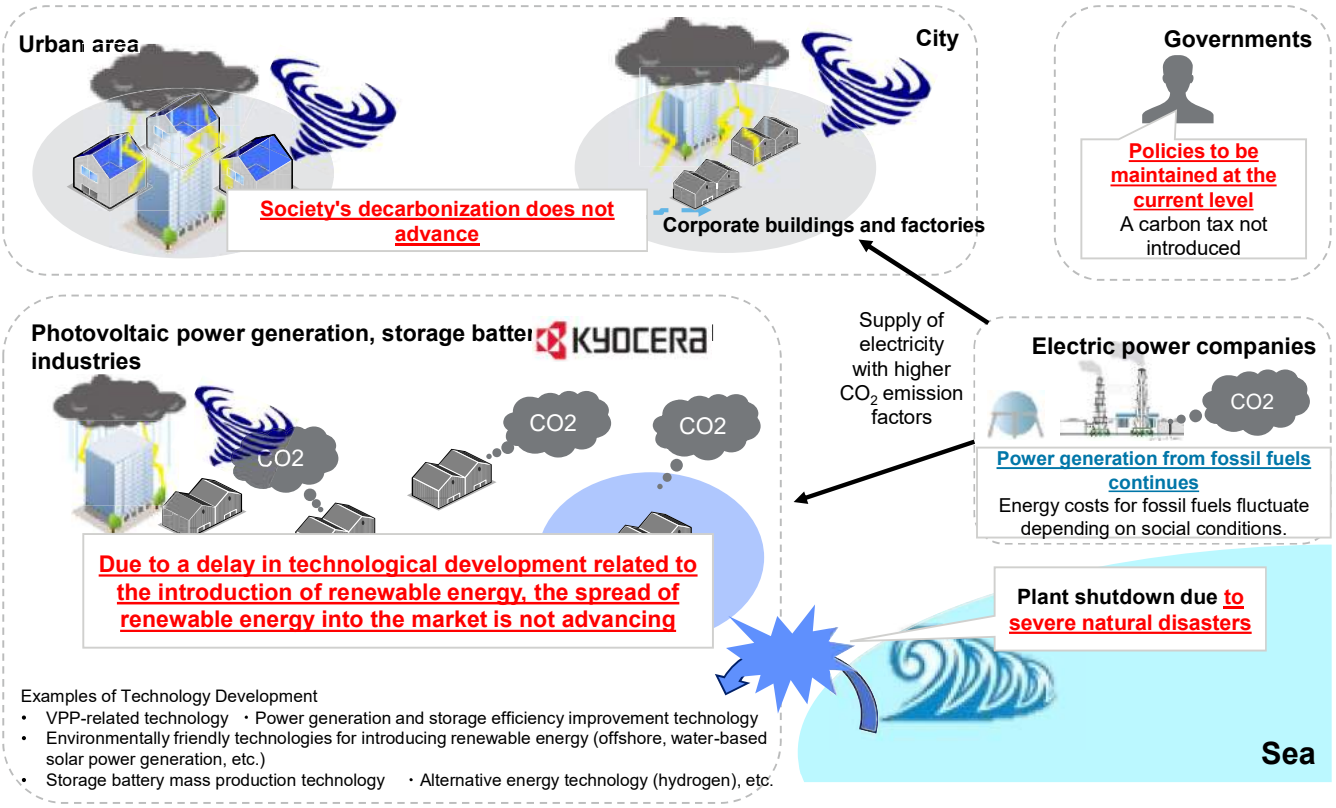
Society and customers
✓ Decarbonization fails to evolve due to weak policy support and fewer renewable energy technology options
✓ Physical risks materialize
✓ Increase in costs for responding to changes in energy prices

In many companies, most businesses are stagnant and they would be in crisis. Don't make it the 4°C world

3-179

The 4°C World: Current Extension

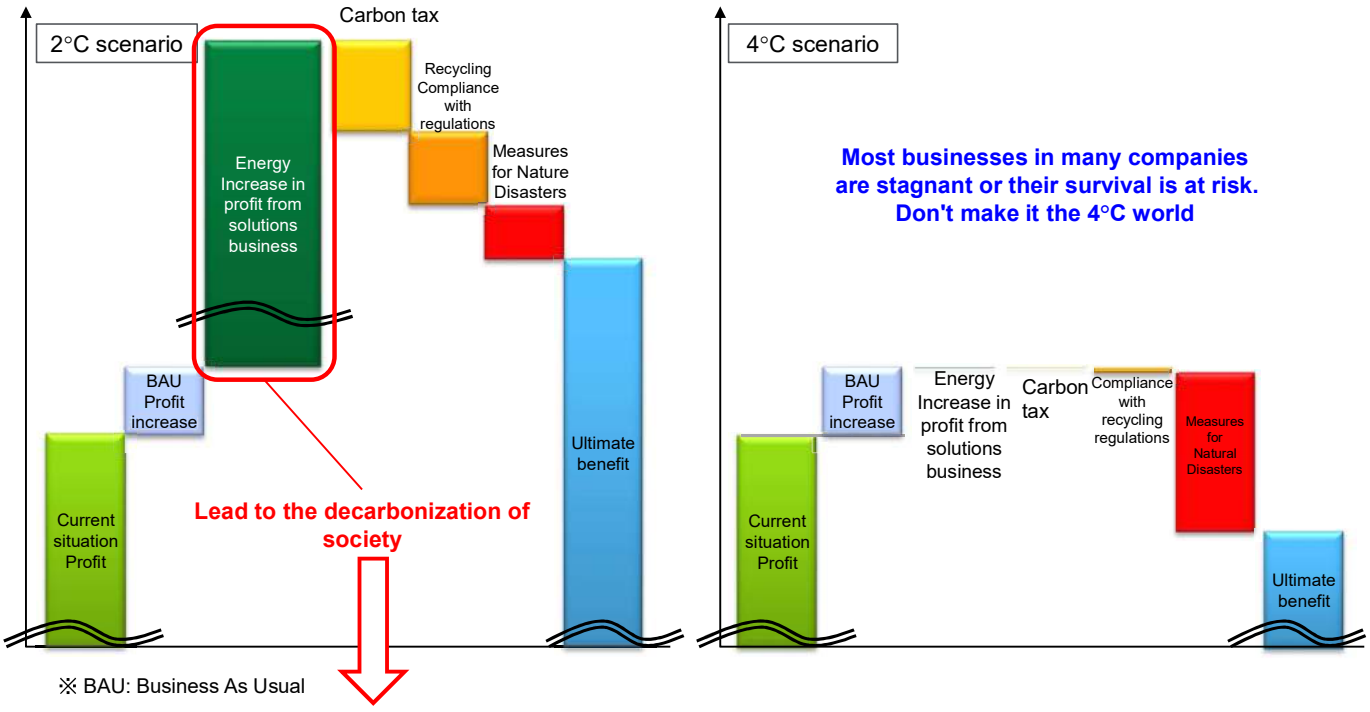
Step 2 3 4 5 Scenario 4℃ 2°C



Most businesses in many companies are stagnant or their survival is at risk.
Don't make it the 4°C world

Evaluate business impacts

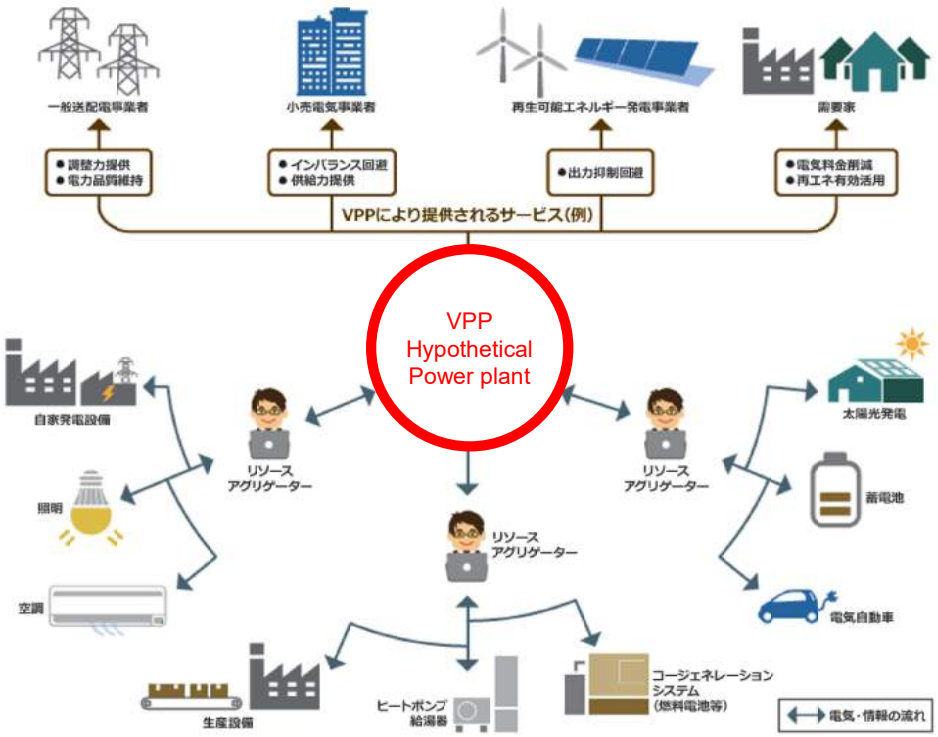
Step 2 3 4 5 Scenario 4℃ 2℃



1. "Technical issues" related to the introduction of renewable energy
2. Economic challenges for renewable energy introduction
Attempt to solve these problems

Countermeasure 1: Solving Technical Challenges

Step 2 3 4 **5** Scenario **4℃** **2℃**



Technical Challenges for VPP

- Power generation forecasting technology
- Power stabilization technology to connect to the power system
- Capacity improvement of storage batteries to achieve power stabilization, etc.

Rapid diffusion of distributed resources

Source: Ministry of Economy, Trade and Industries Agency for Natural Resources and Energy

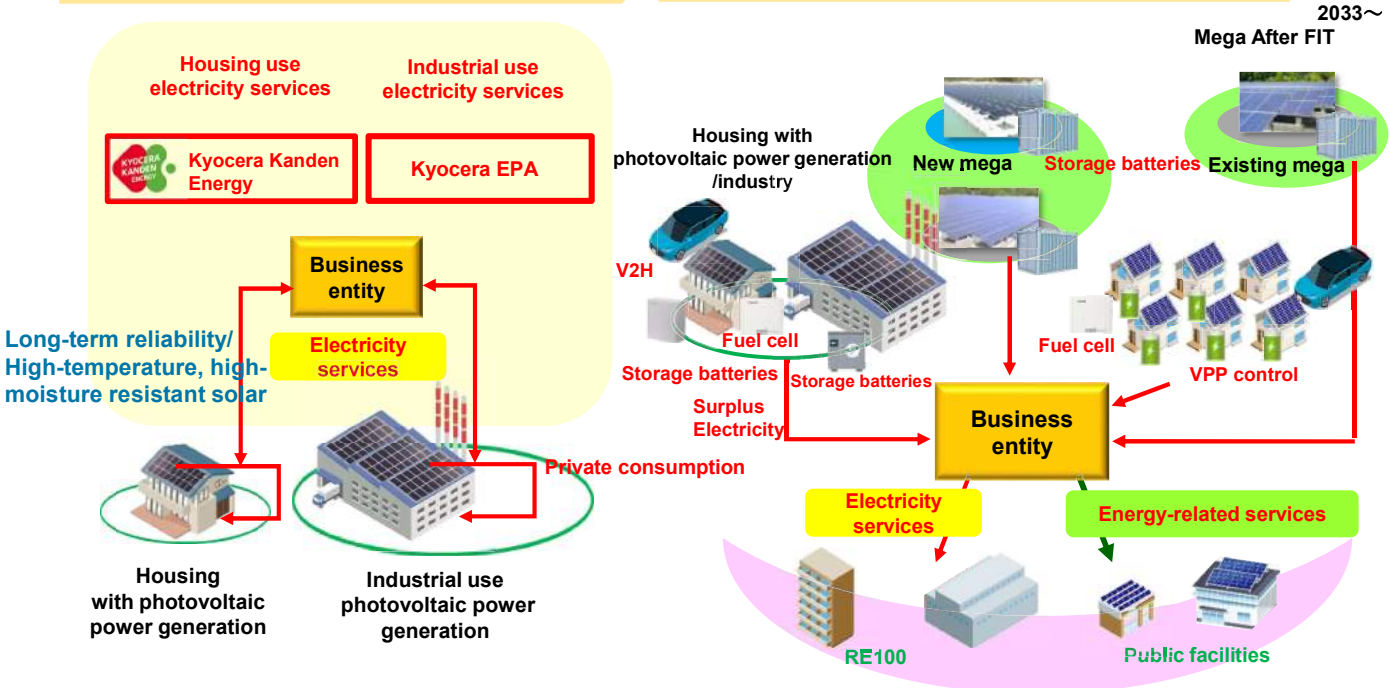
Solve technical issues related to VPP and increase the rate of renewable energy use

Countermeasure 2: Solving Economic Issues and Future Energy Utilization

Step 2 3 4 **5** Scenario **4℃** **2℃**

Power supply by photovoltaic power generation on the roof (Private consumption)

Optimization of intra-regional energy (local production for local consumption)

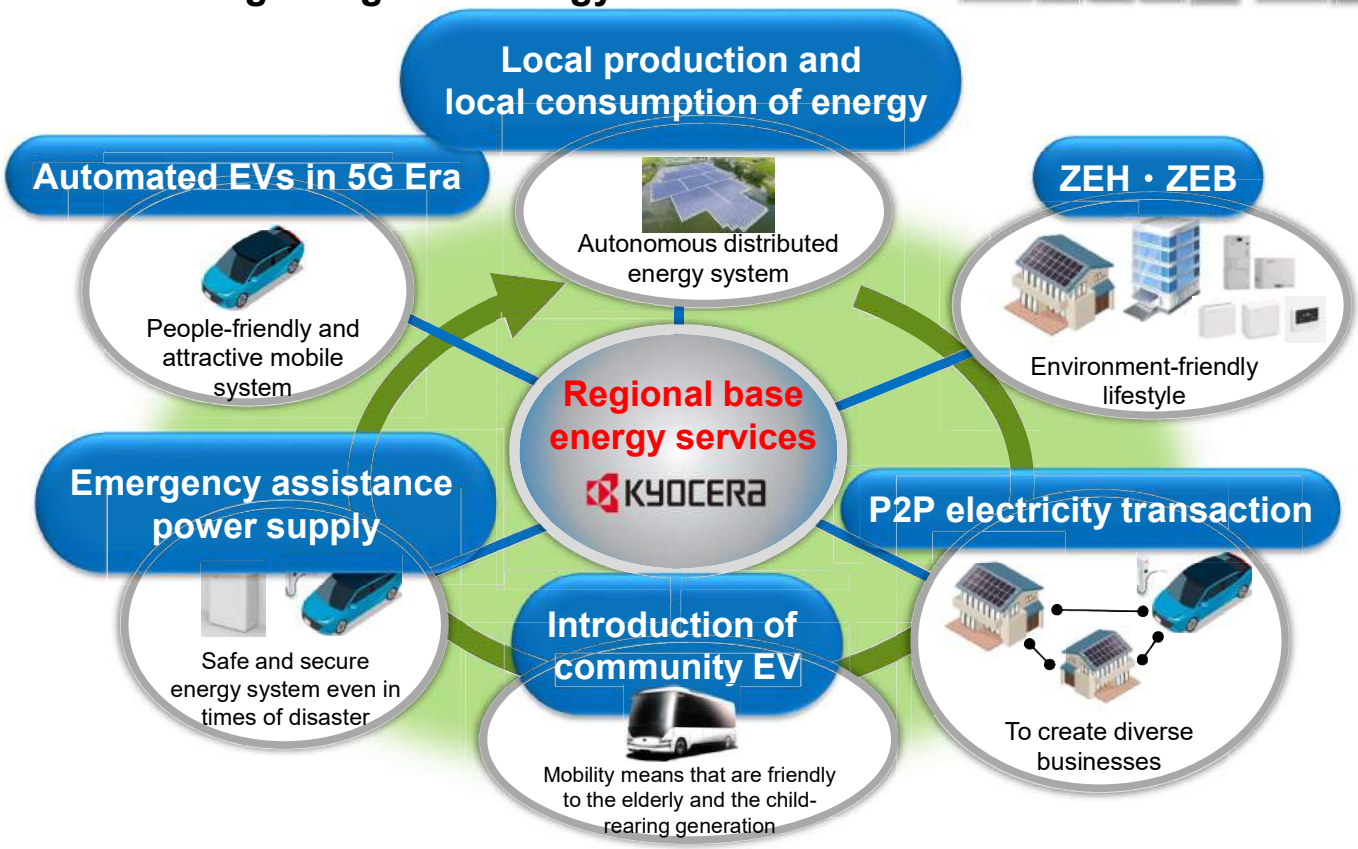


Launched a service that enables the introduction of photovoltaic power generation without initial investment

Promote regional energy optimization by resolving technological and economic issues

Future: Building a Regional Energy Service Base

Step 2 3 4 **5** Scenario **4℃** **2℃**



Build regional energy service infrastructure by linking many services

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Other Sector

- ✓ Practice Example①：KYOCERA Corporation (Electronic Equipment)
- ✓ **Practice Example②：Seven & i Holdings Co., Ltd. (Retailing)**
- ✓ Practice Example③：Lion Corporation (Consumer Products)

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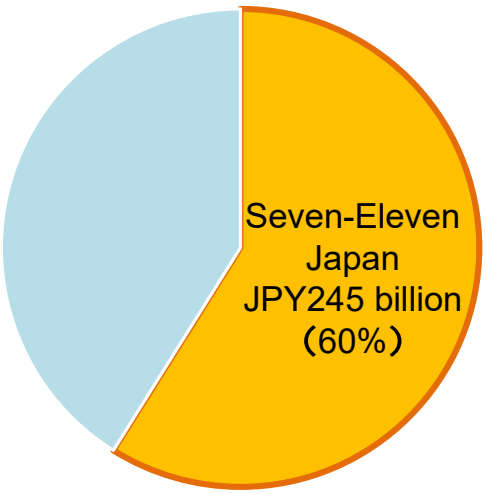
Scope of this analysis

The scope of consideration is Seven-Eleven Japan, which accounts for 60% of consolidated operating income

Seven & i Holdings Co., Ltd.
Consolidated Operating Income
JPY411.5 billion
(Fiscal year ended in February, 2019)



Corporate Profile: Seven-Eleven Japan

(as of February 28, 2019)

Revenue from operations
873,555 millions yen

Net Income
153,233 millions yen

Operating Income
245,088 millions yen

Total Store Sale in Japan
4,898,872 millions yen

Ordinary Income
252,917 millions yen

Number of Stores in Japan
21,005 (as of July 31, 2019)

Assess materiality of climate-related risks and opportunities

Risks and opportunities at Seven-Eleven Japan are extracted from the items listed in TCFD based on external views

Risks and Opportunities in TCFD

Classification	TCFD Risks/Opportunities	
Transition risks and opportunities	Policies/ Regulation	Carbon price
		Carbon Emissions Targets/Policies in Each Country
		Energy-saving policy
		Fossil fuel subsidies
		Renewable energy subsidy policy
	Industry/ Market	Changes in the energy mix
		Energy Demand
		Changes in important products/prices
	Technologies	Spread of low-carbon technologies
		Dissemination of renewable energy and energy-saving technologies
		Developing next-generation technologies
	Reputation	Customer reputation change
		Changes in the investor's reputation

Classification	TCFD Risks/Opportunities	
Physical risks and opportunities	Acute	Increasing severity of extreme weather conditions
	Chronic	Increase in the average temperature
		Changes in rainfall and weather patterns
		Rising sea level

External Views
(Examples)
① SASB
② EBRD
③ Retail Industry Leaders Association “Retail Horizons Toolkit”
④ CDP

Risks and Opportunities in Seven - Eleven Japan

Classification	TCFD Risks/Opportunities	
Transition risks and opportunities	Policies/ Regulation	Carbon price
		Carbon Emissions Targets/Policies in Each Country
	Technologies	Efficiency of resources through the introduction of technology
	Reputation	Customer reputation change
		Changes in the investor's reputation
Physical risks and opportunities	Acute	Increasing severity of extreme weather conditions
	Chronic	Changes in rainfall and weather patterns
		Rising sea level

Assess materiality of climate-related risks and opportunities

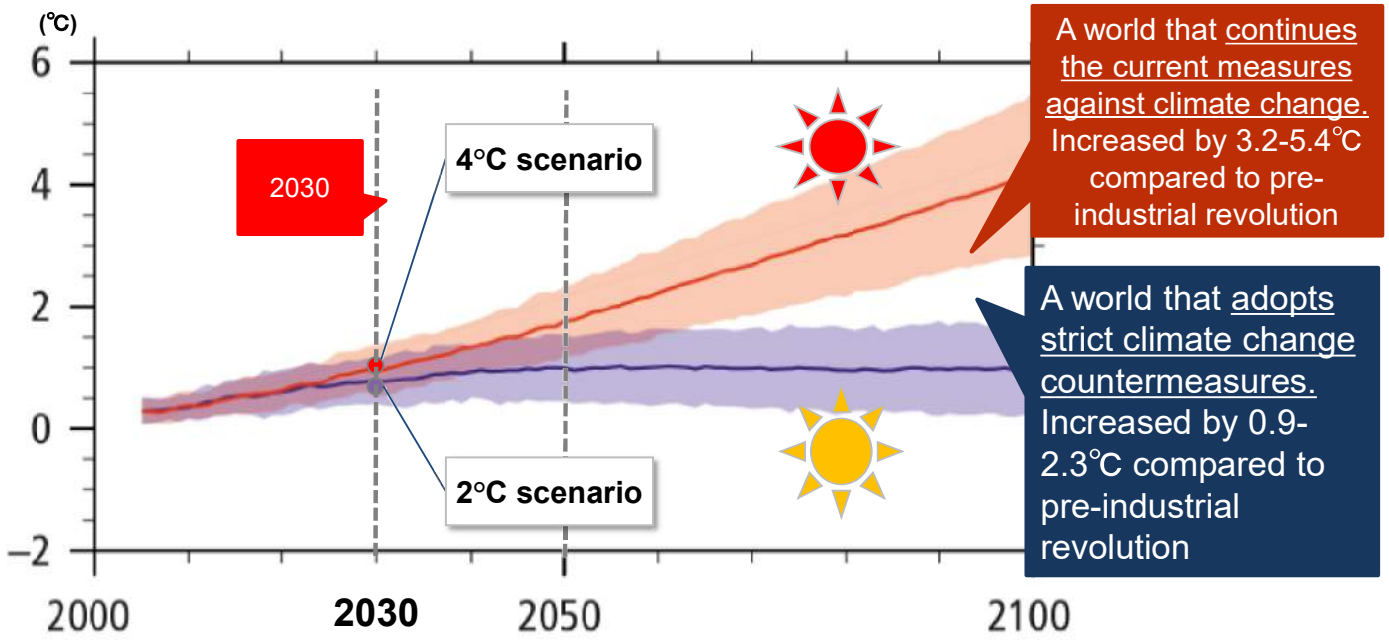
Assess the significance of risk and opportunity for Seven-Eleven Japan (Qualitatively)

Significance level Large	[Transition risks and opportunities] ・ Carbon prices ・ National carbon emissions targets and policies ・ Changing consumer reputation [Physical risks and opportunities] ・ Severity of extreme weather (acute) ・ Changes in precipitation and weather patterns (chronic)
Significance level Medium ～ Small	[Transition risks and opportunities] ・ Efficiency of resources through the introduction of technology [Physical risks and opportunities] ・ Rising sea level
Significance level Small	[Transition risks and opportunities] ・ Changes in investor's reputation

Identify and define range of scenarios

Consideration of 2030 society based on representative scientific scenarios “2°C scenario” and “4°C scenario”
※ Multiple different forecasts are used, because accurate forecasts are almost impossible.

[Global Average Terrestrial Temperature Change (Difference from the 1986-2005 Average)]



Source: AR5 SYR chart, SPM. 6 IEA.

Definitions of worldview

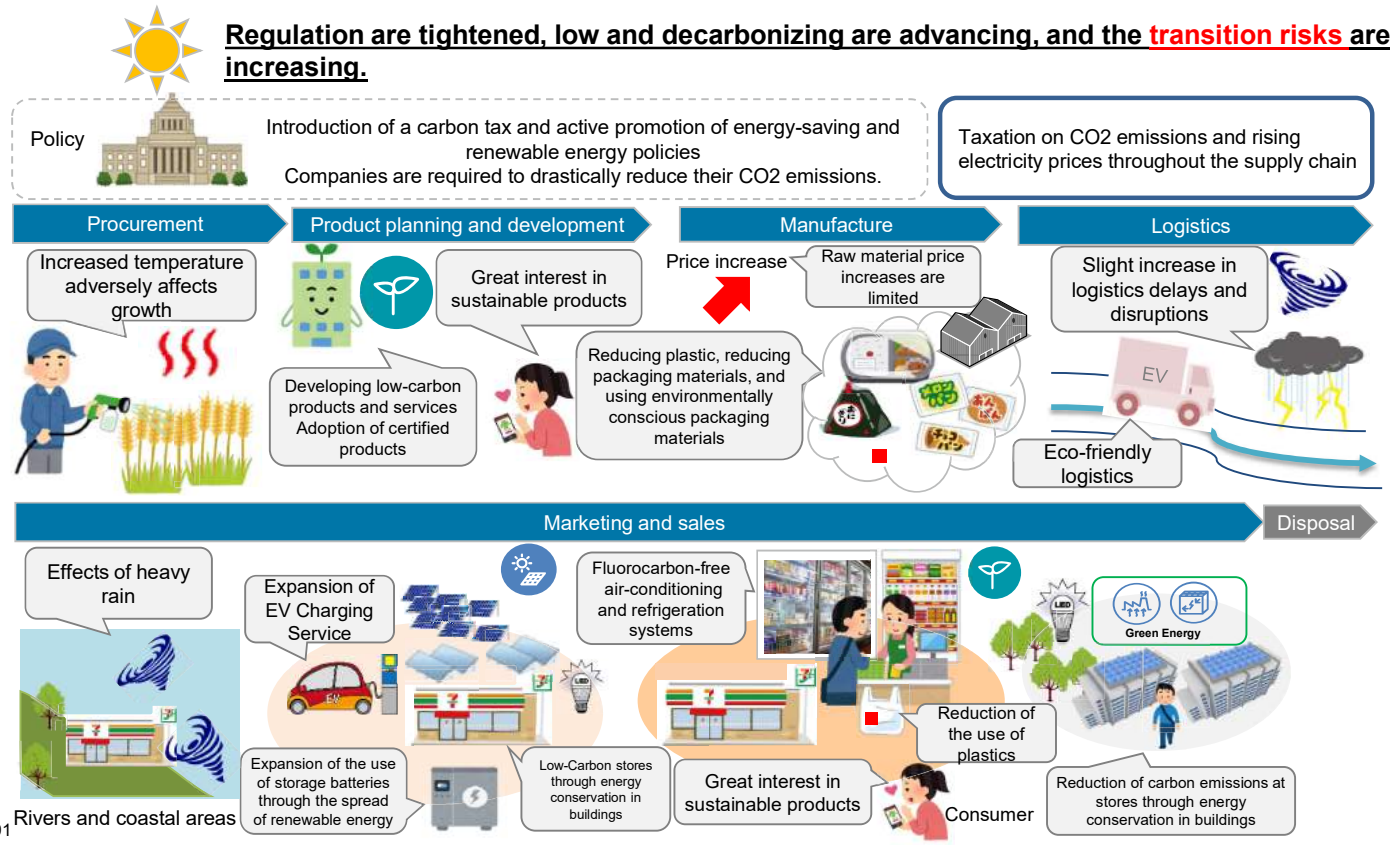
Define a worldview based on scientific grounds such as IEA

Important items (Items of high significance)	Assumed parameter	At present	2030		Source (excerpt)
			4℃	2℃	
Carbon prices, national carbon emissions targets and policies	Carbon price	No introduction	Not adopted at 4° C	$100 per t-CO2	IEA
	Target for GHG emissions	207.5 Million t-CO2	168 Million t-CO2		Ministry of the Environment
	Electricity price	$216/MWh	$209/MWh	$231/MWh	IEA
Changing consumer reputation	Sales of sustainable certification products	128.5 billion USD	296.7 billion USD		Nielsen, etc.
	Diffusion of EV	Percentage of vehicles owned 0.3%	Percentage of vehicles owned 5%	Percentage of vehicles owned 39%	Next Generation Vehicle Promotion Center
Increasing severity of extreme weather conditions	Frequency of typhoons and cyclones	-	High uncertainty (frequency may decrease or remain unchanged; severity may increase)		Japan Meteorological Agency and the Ministry of the Environment
	Frequent heavy rains	2.5 days of occurrence	3.0 days of occurrence	2.5 days of occurrence	Ministry of the Environment
	Flood damage	3.6 billion USD/ years	8 billion USD/ years	Not adopted at 2° C	WRI
Changes in rainfall and weather patterns	Changes in rice (prime rice) yields	(Base year: 2012)	7% decrease	5% decrease	Mitsubishi UFJ Research and Consulting
	Increase in hot weather days	(Base year: 2019)	+0.3 days per year	+0.05 days per year	Ministry of the Environment
	Increase in the amount of electricity used for air-conditioning	(Base year: 2016)	1.7 times	1.6 times	IEA

Identify and define range of scenarios (2°C, 2030)

Seven-Eleven Japan in 2°C scenario

Regulation are tightened, low and decarbonizing are advancing, and the transition risks are increasing.



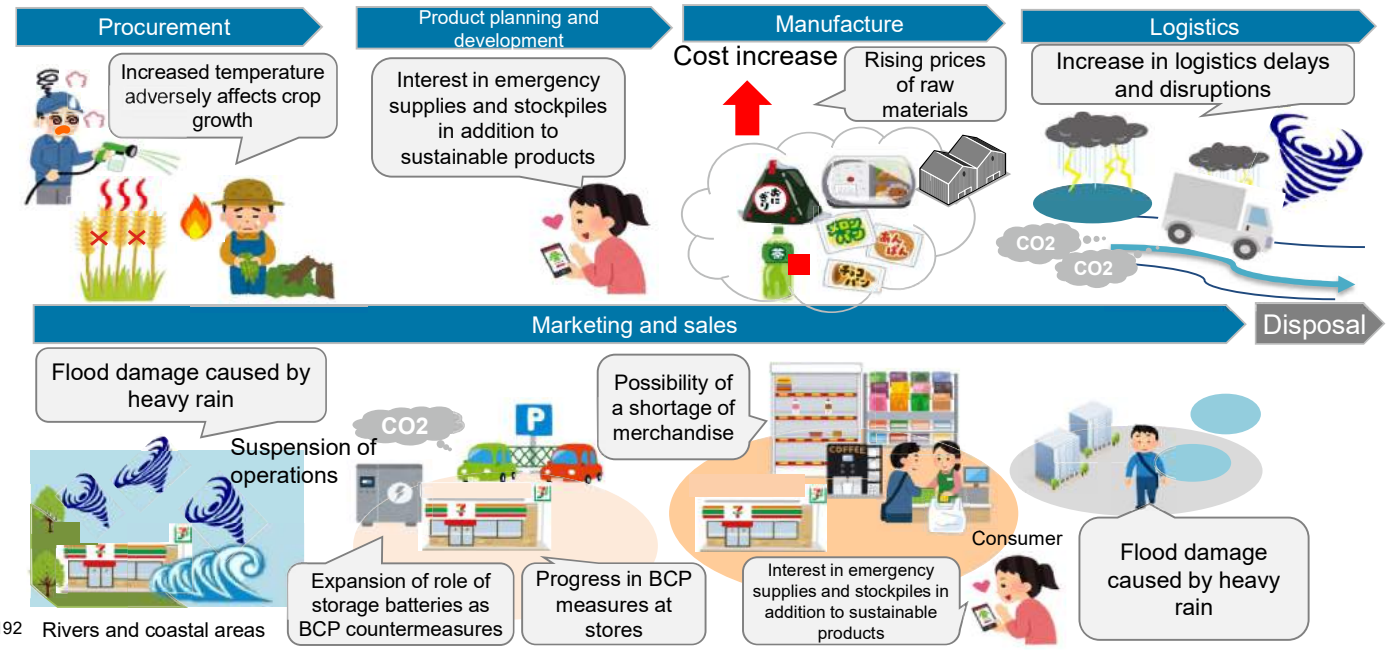
Identify and define range of scenarios (4°C, 2030)

Seven-Eleven Japan in 4°C scenario

Increase physical risks such as extreme weather

Policy

Energy-saving and renewable energy policies are not actively promoted (carbon tax not introduced)

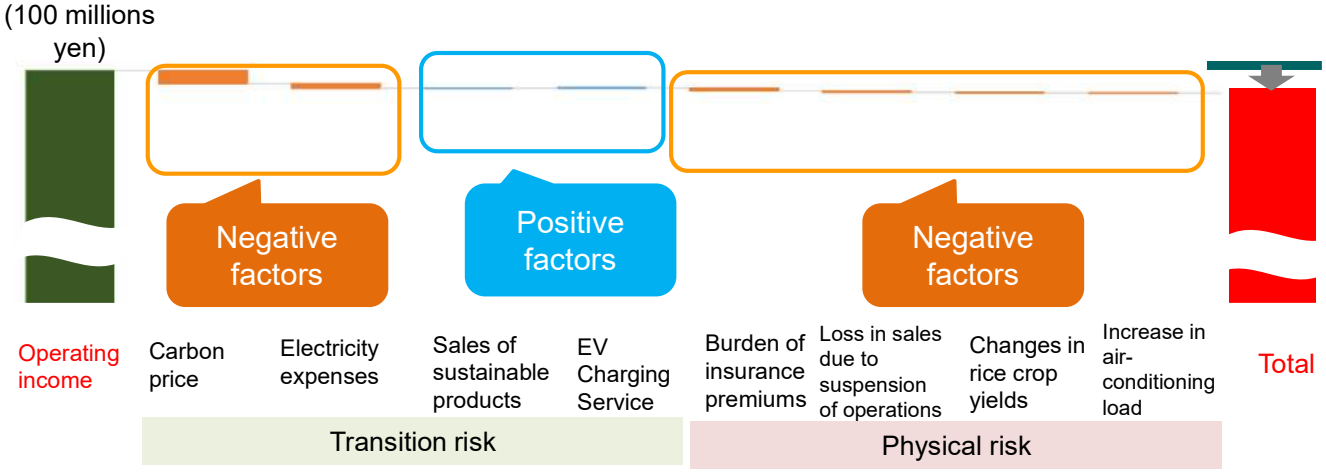


Rivers and coastal areas

Evaluate business impacts (2°C, 2030)

We have picked up specific examples of risks and opportunities which were assessed as significant and estimated their impact (based on business as usual) .

◆ Business impact of 2°C



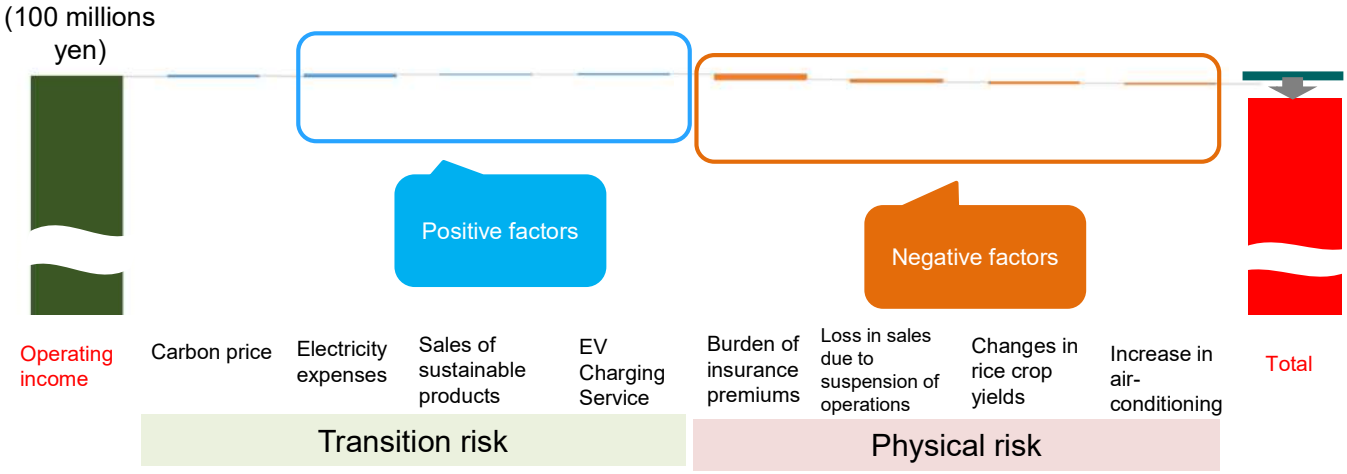
Increased transition risks

Regulations are tightened, low-carbon and decarbonization are advancing, and carbon taxes and electricity prices are rising.

Evaluate business impacts (4℃, 2030)

We have picked up specific examples of risks and opportunities which were assessed as significant and estimated their impact (based on business as usual) .

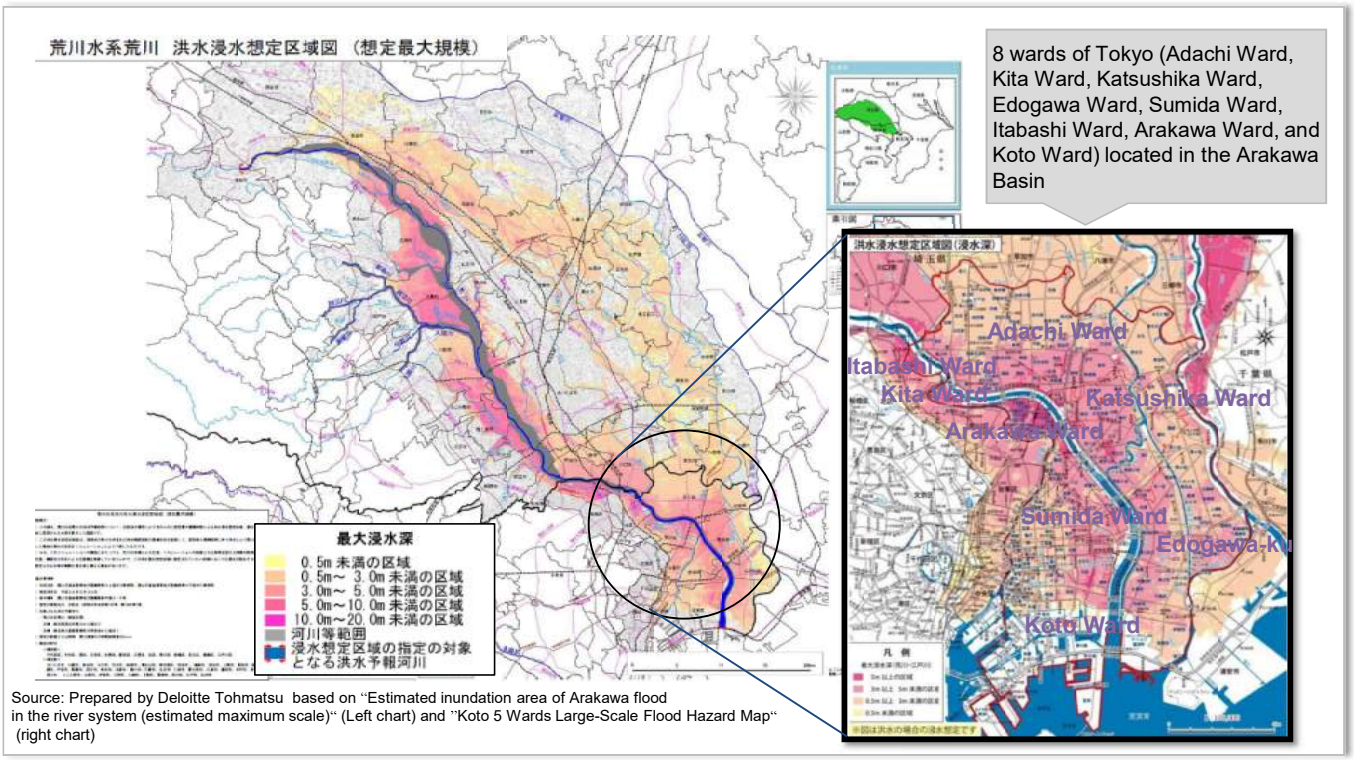
◆ Business impact of 4°C



Increased physical risks
Increase in insurance premiums and loss due to suspension of operations due to extreme weather.

Evaluate business impacts - flood risk assessment

The flood risk at the time of Arakawa collapse is assessed by using a hazard map. Store damages in 8 wards of Tokyo located along Arakawa river were evaluated.



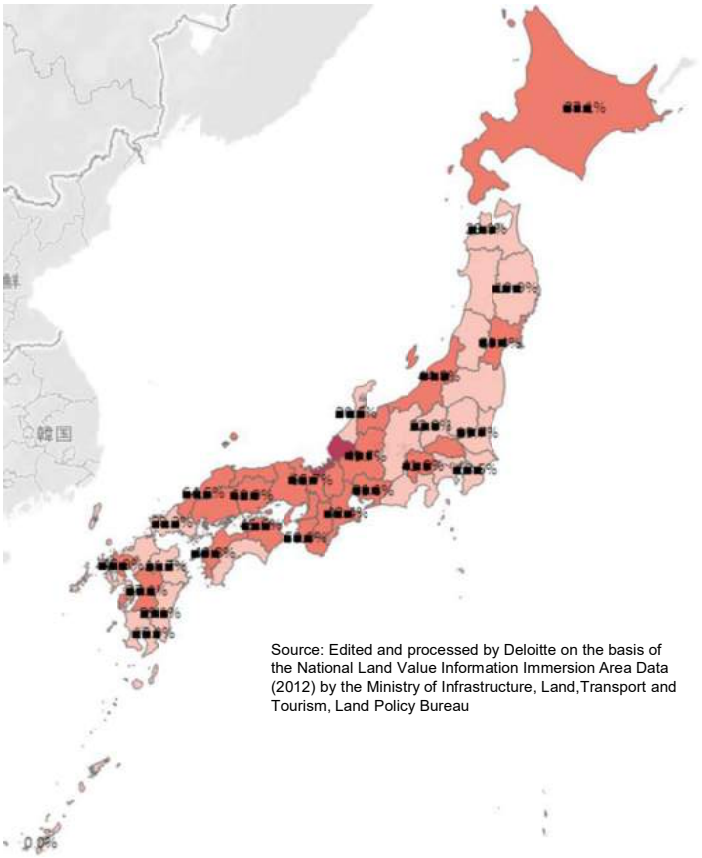
Source: Prepared by Deloitte Tohmatsu based on "Estimated inundation area of Arakawa flood in the river system (estimated maximum scale)" (Left chart) and "Koto 5 Wards Large-Scale Flood Hazard Map" (right chart)

Evaluate business impacts - flood risk assessment

◆ Percentage of stores that may have flood risk

Calculate the proportion of stores that may be flooded by comparing domestic store locations with hazard maps

Increasing importance of disaster response



Source: Edited and processed by Deloitte on the basis of the National Land Value Information Immersion Area Data (2012) by the Ministry of Infrastructure, Land,Transport and Tourism, Land Policy Bureau

Identify potential responses

Countermeasures to mitigate climate-related risks and expand opportunities

Items that have a major impact on Seven-Eleven Japan

- Carbon price
- Electricity expenses
- Changing consumer reputation
- Increasing severity of extreme weather conditions
- Changes in rainfall and weather patterns

- Reducing risks by promoting our initiatives, 7&i's environmental declaration "GREEN CHALLENGE 2050"
- We, as Seven-Eleven Japan, will expand business opportunities through our contribution to implementing various measures at stores where can contact with customers

Other Sector

✓ Practice Example①：KYOCERA Corporation (Electronic Equipment)

✓ Practice Example②：Seven & i Holdings Co., Ltd. (Retailing)

✓ **Practice Example③：Lion Corporation (Consumer Products)**

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Scope of Scenario Analysis and Promotion Structure

- **Timeline: 2030**
- **Target businesses: Oral care business and Fabric care business in Japan (Taking into account our core business and the impact of climate change)**

	2030 Domestic business	Overseas business
Risk	**[Scope of this investigation] Mainly Oral Care Business Fabric Care Business** 	Not considered
Opportunity		

- **Promotion System: Internal Project**
  Corporate Planning Division (including IR), Accounting Division, Marketing Division, and Purchasing Division, CSV Promotion Department Environmental Strategy Office (Secretariat)

Assess materiality of climate-related risks: Transition Risk

Increases in production costs due to carbon taxes, changes in raw material procurement regulations and prices, and changes in customer behavior can have significant financial consequences

Blue: Risk,
Red: Opportunity

Risk Item		Business Impact	Assessment
Carbon emissions targets/ Policies in each country	Carbon tax	➢ **Full-scale introduction of emissions trading and the application of carbon taxes by governments will increase the operating costs of factories** and increase expenditures ➢ The use of low-carbon energy will enable us **to cope with future rises in carbon prices** and reduce costs.	Large
	Containers	➢ **Introduction of regulations on plastic and other packaging materials and products in each country, incurring response costs and** increasing expenditures ➢ **By making use of low-carbon, non-plastics products, it is possible to provide products that meet the ethical needs of consumers,** thereby increasing corporate value and generating profits	Large
Raw materials procurement	Regulations relating to land use	➢ **If demand for raw materials for biofuels and petrochemical substitutes increases and competition arises with the use of agricultural land to produce agricultural products, procurement costs for agricultural products (palm oil, etc.) will increase** and expenditures will increase ➢ Although regulations are tightened as forest area decreases, **by using sustainable paper products (certified paper) that comply with regulations,increase the sustainability of products and companies,** and may contribute to increasing corporate value and earnings	Large
	Steep rise in prices	➢ **Higher premium prices for certified palm oil (nuclear oil)** and increased expenditures due to tighter regulations and demand for biofuels ➢ **Costs associated with the switch to alternative raw materials are also incurred**, resulting in an increase in expenditures ➢ In procuring palm oil, we can **increase the sustainability of our products by helping themacquire RSPO certification** May contribute to enhancing corporate value and increasing earnings	Large
Changes in customer behaviours		➢ **As consumers become more aware of ethical consumption, demand for products using unsustainable plastics and palm oil declines** and profits decline ➢ On the other hand, as consumers **become more aware of the importance of ethical consumption, demand for water saving products, non-plastics, and sustainable raw materials expands** and revenues increase	Large
Changes in the investor's reputation		➢ If climate change is not addressed, the investor may have a poor impression, and there is a possibility that a high interest rate may have to be charged for the issuance of corporate bonds. This may affect the BS due to the impairment of capital.	Small

Assess materiality of climate-related risks: Physical risk

Rising average temperature, raw material prices, water stress, and extreme weather events can have significant financial influence

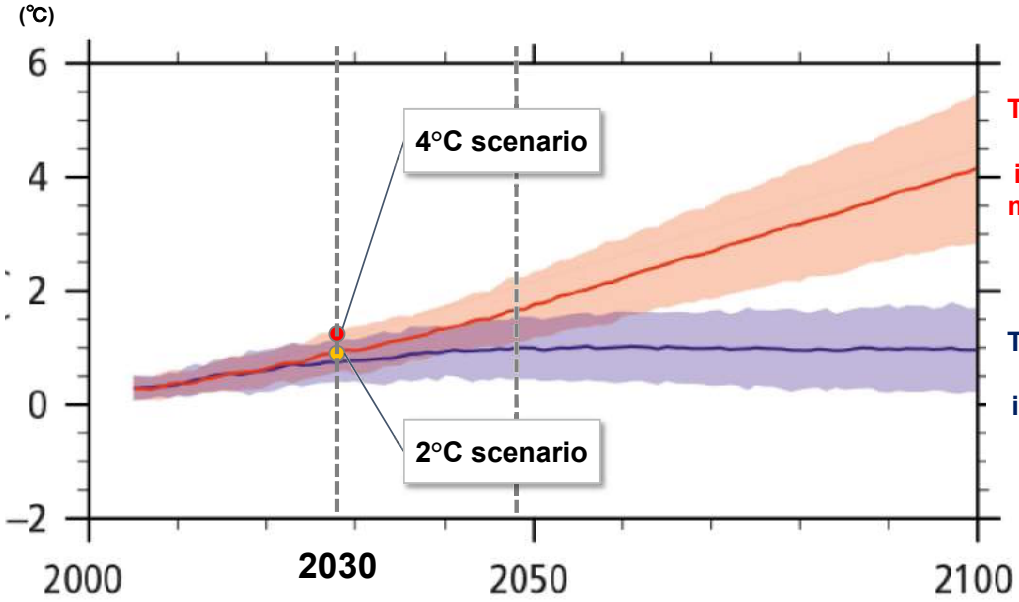
Blue: Risk,
Red: Opportunity

Risk Item		Business impact	Assessment
Increase in the average temperature		➢ Expenditures will increase **due to higher operating and personnel costs resulting from increased energy costs and burdens on workers.** ➢ **Higher average temperature** will increase the number of laundry operations**, while demand for laundry detergents and antiperspirants will increase**, leading to higher earnings**.** ➢ In some areas, a certain increase in temperature may contribute to increased crop productivity, **leading to higher production and lower raw material costs**	Large
Raw materials procurement	Pests	➢ Large outbreaks of pests **affect the production volume and price of plant-derived raw materials, increase raw material costs,** and increase expenditures ➢ In some areas, a certain increase in temperature may contribute to a decrease in pests, **leading to an increase in production and a decrease in raw material costs**	Medium
	Atmospheric CO2 concentrations Increase	➢ **Increased use of herbicides** due to improved water efficiency and growth efficiency of weeds and **increased expenditure** ➢ On the other hand, **increased crop growth potential and increased crop yields could lead to lower raw material costs** ➢ Expenditures increase due to a decrease in earnings associated with a **decline in the quality** of plant-derived raw materials or an **increase in raw material costs**	Medium
Water stress (drought)		➢ Expenditure increases due to **shortage of water supply due to drought, deterioration of water quality, and increase in operating costs** ➢ On the other hand, **demand for water-saving products and products that do not require water may increase** and profits may increase	Large
Increasing severity of extreme weather conditions (Direct/ Indirect effects)	Flood	➢ **Revenue declines due to delays or disruptions in logistics** caused by climate events, etc. ➢ In preparation for natural disasters such as floods, **demand for specific products that provide clean and healthcare in the event of a disaster may increase** and earnings may increase	Large
	Heavy rains, typhoons and storms	➢ Revenues and asset values will decrease due to **damage to equipment caused by heavy rains, typhoons and storms, and have an impact on infrastructure and business continuity (including transfer costs)** ➢ **The market for disaster prevention goods used for evacuation in the event of natural disasters** such as large-scale typhoons and concentrated torrential rains **will expand**, and profits will increase	Large

Identify and define range of scenarios: Consider society in 2030 under two scenarios

Since there is no unified climate change scenario in the consumer goods industry and it is thought that the influence of the average temperature change is large, we examined society in 2030 by using the 2° C scenario (tightened regulation) and the 4° C scenario (business as usual).

[Global Average Terrestrial Temperature Change (Difference from the 1986-2005 Average)]



The temperature will rise 3.2-5.4°C above pre-industrial levels, unless more rigorous measures are taken.

The temperature will rise 0.9-2.3°C above pre-industrial levels, if strict measures are taken.

Source: AR5 SYR Diagram SPM.6

Definition of each worldview based on scientific grounds, etc. of the IEA, etc.

Risk Item	Assumed parameter	Current situation	2030		Source
			4℃	2℃	
Carbon emission targets and policies of each country (A Carbon tax)	Carbon prices in each country	–	(Not iintroduced at 4° C)	**10,900 Yen and tCO2**	IEA WEO 2019
Carbon emission targets and policies of each country (Plastics)	Use rate of recycled plastics in equipment *1	–	(Not iintroduced at 4° C)	**14.0%**	European plastics strategy
Changes in customer behaviours	Sales of sustainable certified products	–	(Expand in the millennial generation)	(Expand among consumers as a whole)	Deloitte Survey, Nielsen
Increase in the average temperature	Increase in the average temperature	–	**+1.14℃**	**+1.02℃**	Climate Change Knowledge Portal
	Due to heat stress Loss of labor productivity	–	(Extract figures for each region)	(Extract figures for each region)	ILO "Working on a warmer planet"
Water stress (drought)	Probability of occurrence of drought (Water stress)	–	(Extract figures for each region)	(Extract figures for each region)	WRI AQUEDUCT
Extreme weather conditions (flooding)	Frequency of flooding *2	–	**4 times**	**2 times**	Ministry of Land, Infrastructure, Transport and Tourism, "Recommendation for Ideal Flood Control Plan Based on Climate Change"
	Population affected by floods	**0.704 million**	**1.03 million**	**1.154 million**	WRI AQUEDUCT
Increasing severity of extreme weather conditions (heavy rain, storm, typhoon)	Increasing number of days of heavy rain per year	**4.0 days/year**	**4.0 days/year**	**4.2 days/year**	Tokyo Regional Meteorological Observatory HP and Climate Change Knowledge Portal
	Number of typhoons occurring	(There are no clear figures, but the frequency of occurrence may be decreasing or unchanged, and the severity may increase)			–

*1 It is assumed that regulations similar to those in Europe will be applied to Japan.
* 2. Figures for 2040 are used as substitute for figures as of 2030.
* 3 Converted at $ 100 per tCO2, 109 ¥/US$

Identify and define range of scenarios: World View at 2°C @ 2030s

Raw material costs soar due to the introduction of regulations and certification
Growing environmental awareness and increased demand for "ethical" value-added products

Seller (Raw Material Suppliers)

Compliance with RSPO certification, Consideration of alternative raw materials in anticipation of rising procurement costs

- Increase in raw material production and procurement costs **due to carbon regulations**
- **Increase in procurement and manufacturing costs for products using plastics** due to increasingly shift to recycled materials
- **Demand for raw materials to acquire RSPO certification increased**, and procurement and manufacturing costs increased
- Increased temperatures lead to heat stress, rising labor costs related to agriculture, and **soaring prices for natural raw materials (palm oil, etc.)**. There is a possibility that production may decline due to pests and changes in vegetation areas
- Dealing with plants and resource suppliers with high water risk

Newcomer

- Entry and expansion of Loop and other recycle industries
- Other consumer goods manufacturers with cooling-effective products

Consumer products industry

Reduction of CO_2 emissions at plants
R&D on recycled materials
Providing ethical products

- **Rising production, procurement, and transportation costs** due to soaring fuel prices and rising raw material prices
- Active R&D activities for recycled materials (plastics, etc.)
- Possibility of **passing on cost increases to recycled materials products as ethical products**

(Alternative)

Changing containers and brush materials to biodegradable plastics

- Bio-plastics, Bio-degradable plastics
- Air-conditioning clothes, highly deodorizing clothes, and cooling sprays

Buyer (Consumer)

Provision of products in line with the ethical orientation (RSPO certification, use of recycled plastic, etc.), expansion of stockpiled products for disaster prevention

- Demand for ethical raw material-using products (RSPO certification, recycled plastics, etc.) increased due to **increased consumer preference for ethical materials.**
- **Demand for antiperspirants is expanding gradually** due to the increase in midsummer days. Potential growth in **demand for household fabric care products** with more frequency of laundry
- Gradual increase in demand for hand soap and other products with fungicide effects
- **Increase in stockpiling for disasters in households**

Government

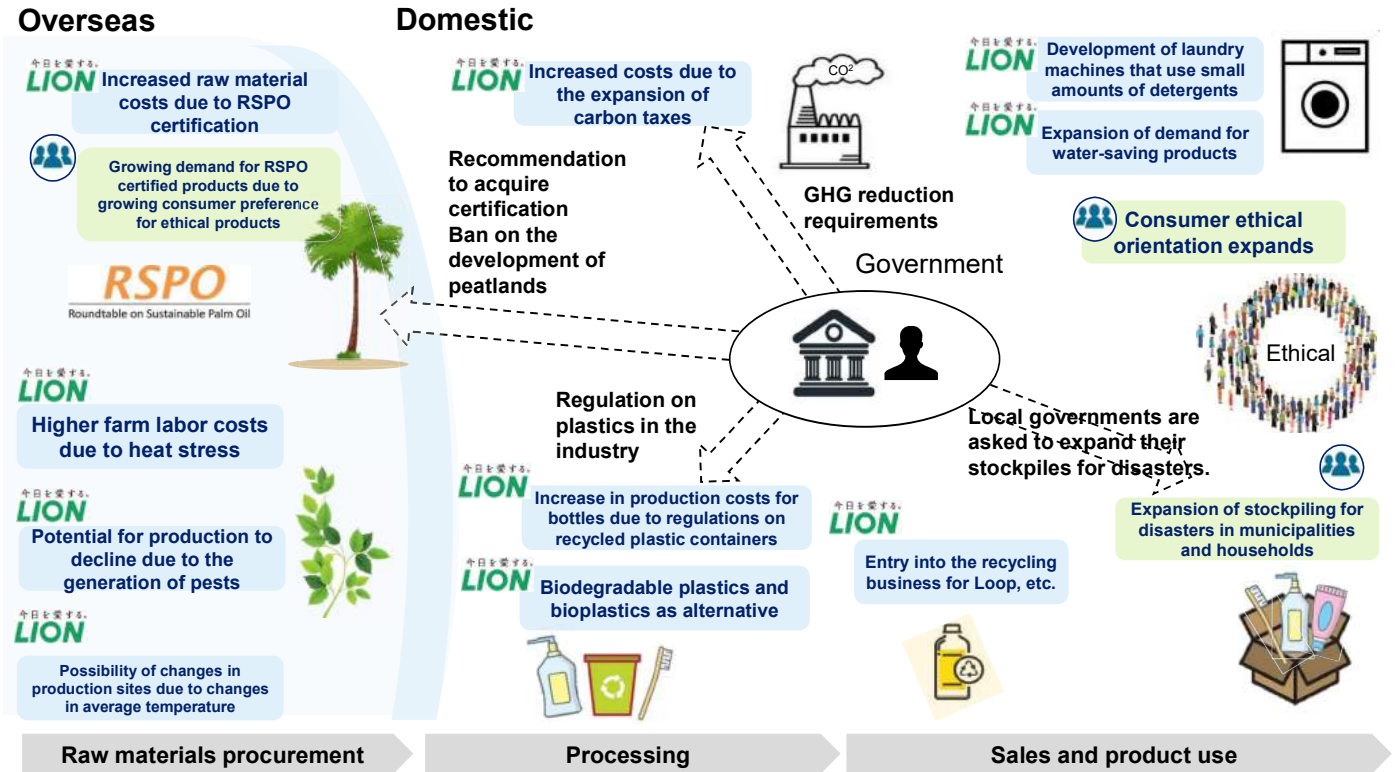
Compliance with regulations related to GHGs, recycled plastics and palm oil

Expansion of stockpiled products for disaster prevention in line with the timing of the government's stockpiling of disaster preparation sets

- **Introduction of a carbon tax**. Factories that emit a large amount of CO_2 are subject to the regulations
- **Introduction of regulation on the use of recycled plastics**
- Peat land development banned. Recommendation for acquiring RSPO certification when using palm oil
- **Stockpiling of disaster prevention sets** to enhance the facilities of evacuation centers

Identify and define range of scenarios: Future Social Image under the 2°C Scenario

Raw material costs soar due to the introduction of regulations and certification
Growing environmental awareness and increased demand for "ethical" value-added products



Identify and define range of scenarios: 4°C Worldwide @ 2030s

Step 2 | 3 | 4 | 5

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Low carbon/decarbonization trends weaken and physical risks increase
Increase in demand for certain products due to temperature increase

Seller (Raw Material Suppliers)

Response to physical risks at plants and suppliers

- Raw material costs remain unchanged
- Assuming no shift to recycled materials
- **RSPO Certification required for domestic use palm oil**
- Increased temperature leads to heat stresses, rising labor costs related to agriculture, and **soaring prices for plant-derived raw materials**. Potential for lower production due to pest generation and changes in vegetation areas
- Responses to plants and resource suppliers **with high water risk**
- **Physical risks materialized** for some factories and suppliers

Newcomer

- Entry of recyclers such as Loop
- Manufacturers of consumer goods with products having cooling effects

Consumer products industry

Existing energy-saving measures Response to Physical Risks at Factories

- Implement energy-saving measures as in the past (no major changes)
- **Emerging physical risks to the company's plants**

(Alternative)

- Air-conditioning clothes, highly deodorizing clothes, and cooling sprays

Buyer (Consumer)

Expanding demand for products for daily use in the midsummer and emergency supplies

- Need for low-carbon, recycled materials, etc. are low
- **Interest in ethical products increased** among the millennial generation
- **Demand for antiperspirants expanded** due to the increase in midsummer days. Potential growth in **demand for household fabric care** with more frequency of laundry
- Demand for hand soaps and other products with fungicide effects expanding
- **Increase in stockpiling for disasters** in households

Government

Expansion of reserve products for disaster prevention in line with the timing of the government stockpiling disaster preparation sets

- Regulations are not advancing as low carbon/decarbonization trends weaken and external pressures from the international community weaken.
- Regulations on carbon tax and use of recycled plastics are not introduced.
- **Stockpiling of disaster prevention sets** to enhance the facilities of evacuation centers

Step 2 | 3 | 4 | 5

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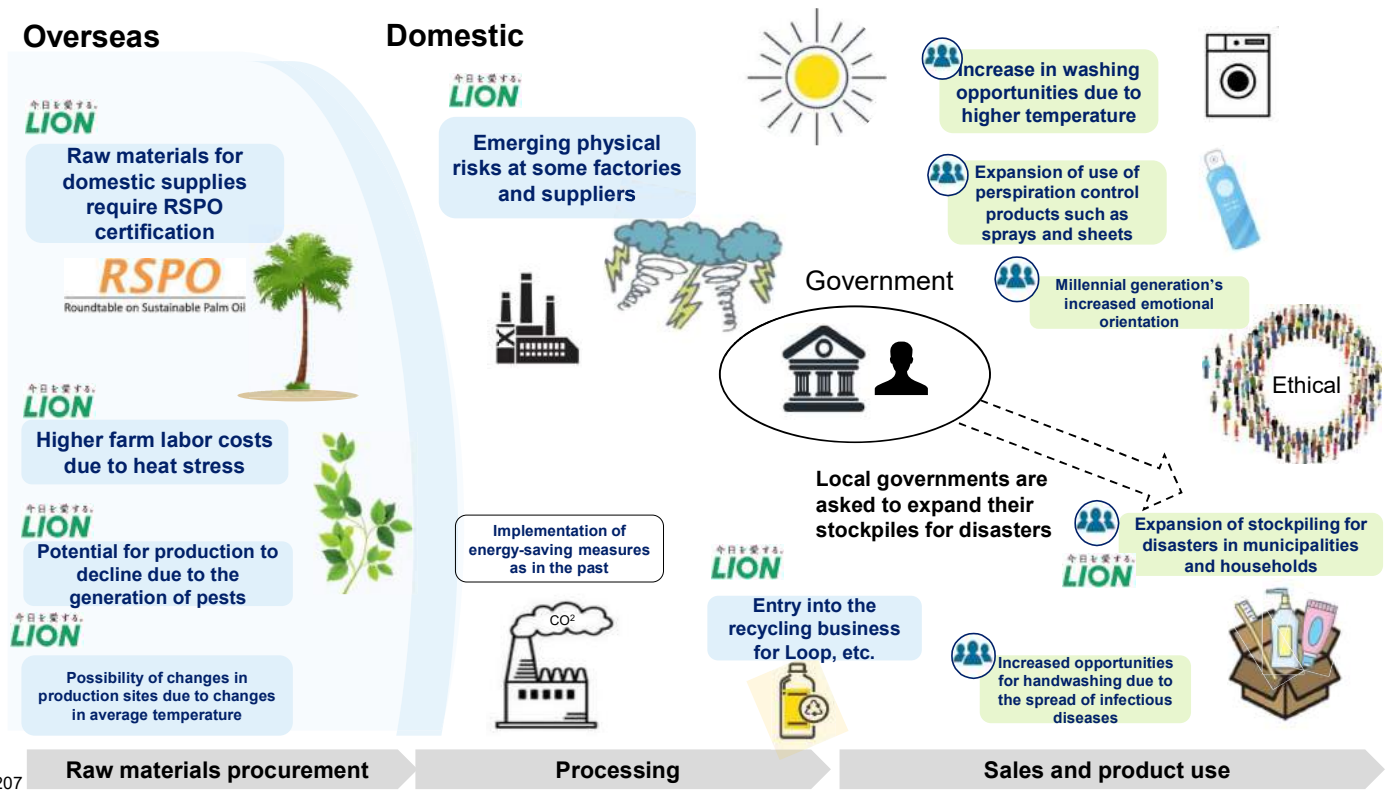
Identify and define range of scenarios: Image of the future society of the 4°C scenario

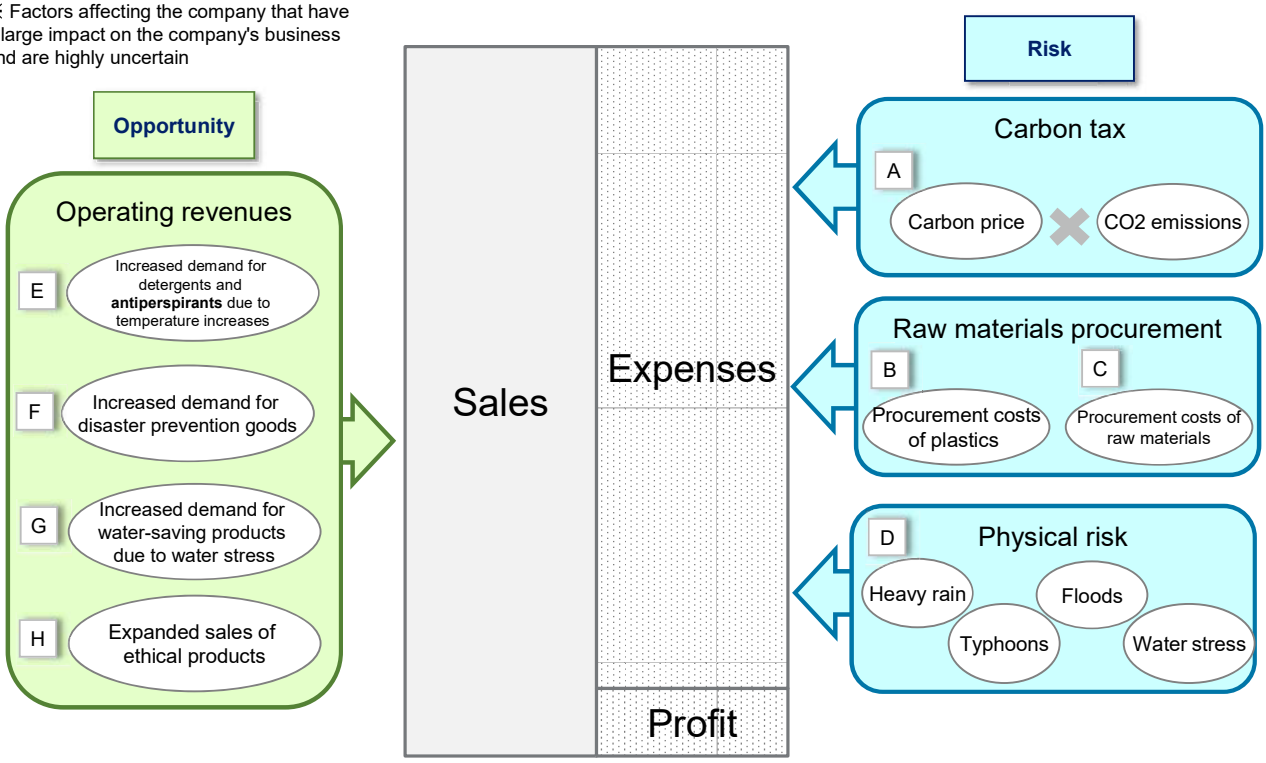
Low carbon/ decarbonization trends weaken and physical risks increase
Increase in demand for certain products due to temperature increase



Evaluate business impacts: Image

8 key driving forces* are set to estimate the impact on each of our businesses.

※ Factors affecting the company that have a large impact on the company's business and are highly uncertain



Evaluate business impact: Transition and Physical Risks

Due to the difficulty of obtaining data, there are items that are limited to qualitative evaluations
Costs are expected to increase due to rising raw material prices caused by policy changes and rising temperatures, and natural disasters such as typhoons

Risk Item				Impact on business	Business impact on annual earnings	
					2℃	4℃
Transition risk	Carbon emission targets and policies of each country	Carbon tax	A	• The effect of carbon tax is significant at 2℃, and operating costs increase • In case of 4℃, no carbon tax is included	X.X billion yen	JPY 0 billion
	Carbon emission targets and policies of each country	Plastics	B	• Cost increase at 2℃ due to introduction of recycled plastic regulations • It is assumed that the regulation for recycled plastics will not be implemented at 4℃	X.X billion yen	JPY 0 billion
	Soaring feedstock costs	Palm oil	C	• At 2℃, stricter RSPO regulations tighten the supply-demand balance for certified oil and raise palm oil procurement costs (transition risks) • At 4℃, harvest volume increases with temperature increase, supply-demand tightness does not progress, and prices remain at the current level (physical risk)	X.X billion yen	X.X billion yen
Physical risk	Increase in the average temperature	Procurement price of plant-derived raw materials	C	• Increase in procurement cost due to decrease in cultivated area due to change in vegetation area of vegetable raw materials	X.X billion yen	X.X billion yen
	Increase in the average temperature	Procurement price of natural raw materials	C	• Decrease in cultivated area of natural crops and increase in procurement costs • Besides, the harvest volume of plant-based raw materials in the sub-tropical region is expected to increase (qualitative assessment)	Qualitative	Qualitative
	Increasing severity of extreme weather conditions	Damage to facilities, impact on infrastructure	D	• Increasing frequency of typhoons, storm surges, etc., is expected to cause damage to plant facilities and infrastructure and increase costs	X.X billion yen	X.X billion yen
	Increasing severity of extreme weather conditions	Shutdown and damage to the supply chain	D	• Sales are expected to decline due to plant shutdowns or suspension of product transportation (supply chain breakdown) (qualitative assessment)	Qualitative	Qualitative
	Water stress	Drought damage	D	• Water shortages are anticipated, leading to an increase in operating costs at production sites and a decline in sales due to supply chain breakdowns (qualitative assessment)	Qualitative	Qualitative

※ Quantitative assessments are difficult, but qualitative assessments are conducted on important matters.

Evaluate business impact: Opportunity

The 2℃ scenario has a greater impact on business profits than the 4℃ scenario, as the business impact is expected to see an increase in sales of detergents and other products along with an increase in temperature, as well as an increase in demand for disaster-prevention goods and water-saving products.

Risk Item				Impact on business	Business impact on annual earnings	
					2℃	4℃
Opportunity	Increase in the average temperature	Sales of detergents	E	• Increase in sales of detergents due to higher temperature	X.X billion yen	X.X billion yen
	Increase in the average temperature	Sales of perspiration control products	E	• Increase in sales of **antiperspirants** due to higher temperature	X.X billion yen	X.X billion yen
	Increase in the average temperature	Increase in infections	E	• Expansion of infectious diseases increases opportunities forhandwashing and profits of hand soap are expected to increase (qualitative assessment)	Qualitative	Qualitative
	Increasing severity of extreme weather conditions	Sales of disaster prevention goods	F	• Increase in demand for stockpiles (disaster prevention goods) at evacuation centers (qualitative assessment)	Qualitative	Qualitative
	Water stress (drought)	Water-saving products	G	• As the frequency of water shortages increases, consumer demand for water-saving products increases, and sales of water-saving products are expected to increase (qualitative assessment).	Qualitative	Qualitative
	Changes in customer behaviours	Ethical products	H	• Increased consumer interest in ethical products (qualitative assessment)	Qualitative	Qualitative
Total (transition risk, physical risk, opportunity)					**▲ X.X billion yen**	**▲ X.X billion yen**

※ Quantitative assessments are difficult, but qualitative assessments are conducted on important matters.

Identify potential responses: Proposed Future Countermeasures for Risks/Opportunities

Promoted along with LION Eco Challenge 2050 measures and sustainable raw material purchasing measures

Item	Lion's Current Initiatives	Risk Countermeasures (Example)	Measures to Incorporate Opportunities (Examples)
Carbon price	✓ CO2 emissions generated by each of departments 30% reduction by 2030 (vs. 2017) Set the total amount and the target of zero emissions by 2050.	✓ Introduction of renewable energy	✓ N/A
Recycled plastics	✓ Set a target to double the amount of recycled plastics and biomass plastics used by 2030 ✓ Cooperation with TerraCycle to develop toothbrush recycling program	✓ Set further targets for reduction of virgin plastics from petrochemical ✓ Conversion to a sustainable resource circulation program	✓ Promoting cooperation with the recycling industry
Steep rise in the price of raw materials (palm oil)	✓ Replace all palm oil derivatives from no-certified to RSPO certified products by 2020. Formulation of sustainable raw material procurement policy for 2030	✓ Implement measures based on the company's own Sustainable Raw Material Procurement Guidelines	✓ N/A
Steep rise in the price of raw materials (other than palm oil)	✓ N/A	✓ Identification and monitoring of risks associated with the procurement of plant raw materials due to climate change	✓ N/A
Changes in customer behavior	✓ Establishment of in-house Lion Eco Standards and labeling of Eco-Products	✓ N/A	✓ Expansion of Eco/Ethical Products ✓ Promotion and educational activities concerning eco/ethical consumption
Increasing severity in extreme weather conditions	✓ Carry out awareness-raising activities for hygiene and health care in the event of a disaster ✓ Establishment of BCPs at business sites	✓ Understand the impact on supply chain (raw material suppliers, transportation and delivery) and strengthen countermeasures	✓ Expand sales of products for disaster prevention

Appendix.

Appendix1. Parameter list

Appendix2. Physical risk assessment tools

Appendix3. Examples of scenario analysis

Appendix.

Provide useful materials for scenario analysis based on supporting case studies

Appendix.

Appendix1. Parameter list

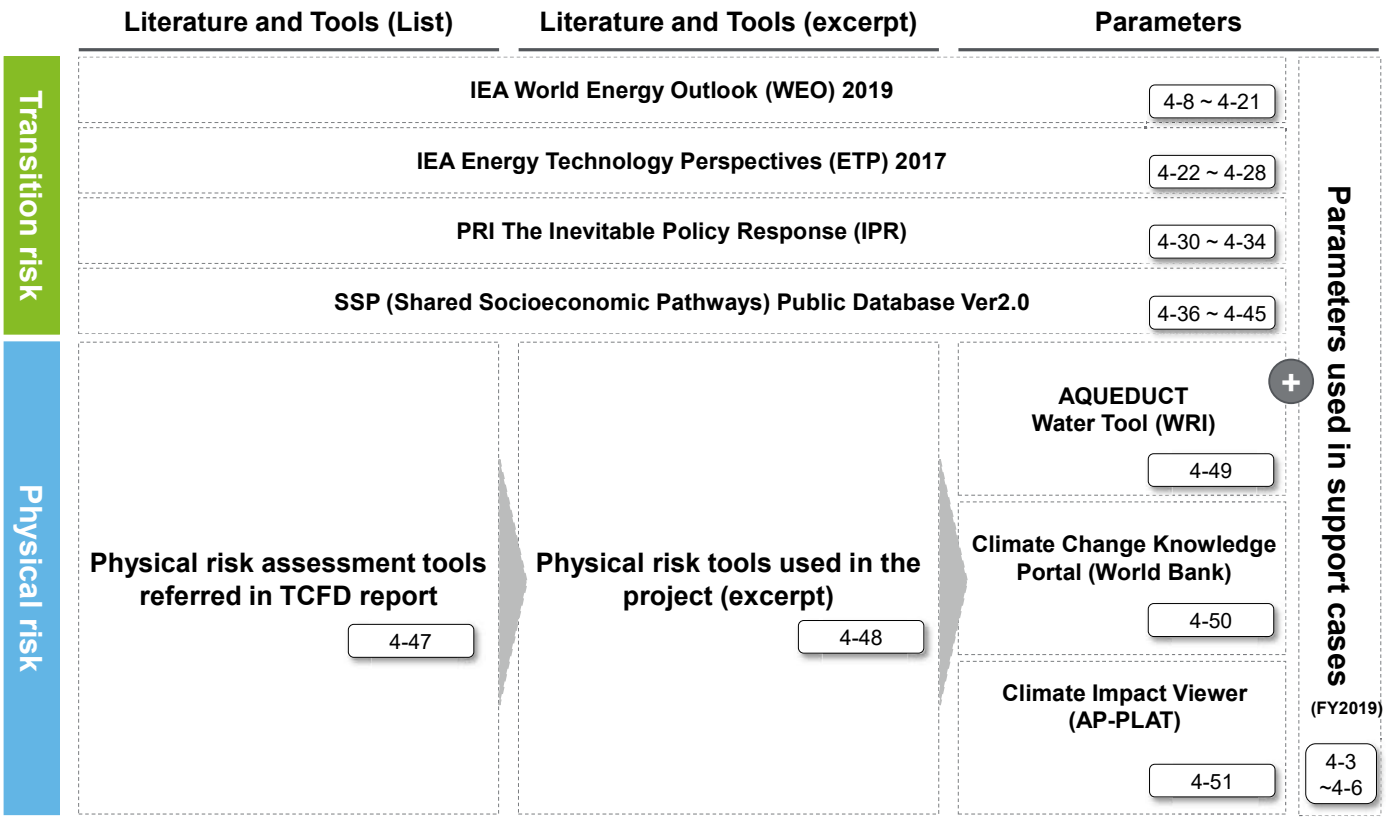
Appendix2. Physical risk assessment tools

Appendix3. Examples of scenario analysis

Appendix.

Provide useful materials for scenario analysis based on supporting case studies

[Summary of parameter list]
Partial excerpts on transition risk and physical risk parameters



※ Data on parameters as of February 2020

[Parameters referenced in support cases 1/4]
Transition risk 1/2

	Item	Parameter	Source	Reference: Companies referenced parameters
Transition risk	Carbon price	Carbon tax	• IEA WEO 2018,2019 • PRI IPR FPS	Kagome, Kashima Construction, Calbee, Seven & i HD, Chiyoda Corporation, FUJIFILM HD and Furukawa Electric, Meiji HD, Lion Corporation, and LIXIL
		Electricity price	• IEA WEO 2018	Kyocera, Seven & i Holdings, LIXIL
	Carbon emissions targets/policies	Target values for emissions	• Ministry of the Environment's "Draft Japanese Commitments," "Toward Significant Reductions in Greenhouse Gases by 2050," IEA ETP	Kajima Corp., Kyocera Corp., Seven & i HD, Chiyoda Corporation, FUJIFILM HD, Furukawa Electric Co., Ltd., LIXIL
	Changes in the energy mix	Power Generation Mix (Japan)	• IEA WEO2018,2019 • PRI IPR FPS	Kajima Corporation, FUJIFILM HD, Furukawa Electric Co., Ltd., Chiyoda Corporation, LIXIL
		Primary energy demand	• IEA WEO2019 • PRI IPR FPS	Chiyoda Corporation
		Final energy demand	• IEA WEO2019	Chiyoda Corporation
		LNG: pipeline ratio	• IEA WEO2019	Chiyoda Corporation
		Unit price of renewable energy generation	• IEA WEO2017	Kyocera and Furukawa Electric
	Changes in important products	Production of newsprint	• IEA WEO2018	FUJIFILM HD
		Rate of recycled aluminum Production of aluminum	• IEA WEO2018 • IEA ETP2017	FUJIFILM HD and LIXIL
		Price of aluminum	• World Bank ," World Bank Commodities Forecast"	LIXIL
	Dissemination of renewable energy and energy-saving technologies	ZEB target	• METI's Basic Energy Program	Kajima Corporation
		ZEH introduction target	• Ministry of Economy, Trade and Industry, "Policy Trends for Promoting ZEV and Related Budget Draft for FY2018"	LIXIL
		ZEV ratio	• IEA ETP2017 • Shinichiro Fujimori et al. “The marker quantification of the Shared Socioeconomic Pathway 2: A middle-of-the-road scenario for the 21st century”	Seven & i HD, Chiyoda Corporation, Development Bank of Japan, Furukawa Electric
		Increase in the amount of electricity used for air-conditioning	• IEA “The Future of Cooling”(2018)	Seven & i HD
		World's storage capacity	• IRENA “ELECTRICITY STORAGE AND RENEWABLES: COSTS AND MARKETS TO 2030”	Chiyoda Corporation and Furukawa Electric

※ The parameters surveyed in the course of support program by the Ministry of the Environment are shown regardless of whether or not they are actually used by each company.

[Parameters referenced in support cases 2/4]
Transition risk 2/2

	Item	Parameter	Source	Reference: Companies referenced parameters
Transition risk	Development of next-generation technologies	CO2 recovery by CCSs	• IEA WEO 2018	FUJIFILM HD
		Hydrogen penetration rate	• IEA WEO 2019 • PRI IPR FPS	Chiyoda Corporation
		CCU penetration rate	• IEA WEO 2019 • ICEF Roadmap	Chiyoda Corporation
		Biomass production (primary energy)	• SSP Public Database Version 2.0	Development Bank of Japan
		Share of biomass in primary energy	• SSP Public Database Version 2.0	Development Bank of Japan
		Hydrogen-production (primary energy)	• SSP Public Database Version 2.0	Development Bank of Japan
		Share of hydrogen in primary energy	• SSP Public Database Version 2.0	Development Bank of Japan
		Production of renewable energy	• SSP Public Database Version 2.0	Development Bank of Japan
		Non biomass renewables's share in primary energy	• SSP Public Database Version 2.0	Development Bank of Japan
		CCSs' share of primary energy	• SSP Public Database Version 2.0	Development Bank of Japan
		Percentage of each energy (biomass, coal, oil, gas, fossil) in CCSs	• SSP Public Database Version 2.0	Development Bank of Japan
		Demand response capacity	• IEA ETP 2017	Kyocera

※ The parameters surveyed in the course of support program by the Ministry of the Environment are shown regardless of whether or not they are actually used by each company.

[Parameters referenced in support cases 3/4]
Physical risk 1/2

	Item	Parameter	Source	Reference: Companies referenced parameters
Physical risk	Increases in the average temperature	Average temperature in Japan	• "Japan's weather at the end of the 21st Century" (2015) by the Ministry of the Environment and the Japan Meteorological Agency • Climate Change Knowledge Portal	Kajima Corporation and Lion Corporation
		Changes in tomato, carrots and orange yield	• FAO, "GAEZ(Global Agro-Ecological Zones)"	Kagome
		Population at risk for mosquito-borne infections in East Asia	• Ministry of the Environment, "Global Warming and Infectious Diseases" • National Institute for Environmental Research on the Impact of Global Warming on Infections • Ryan SJ and others "Global expansion and redistribution of Aedes-borne virus transmission risk with climate change" (2019)	Meiji HD
		Number of outbreaks of waterborne infections (diagnostics) (Asia)	• Ministry of the Environment, "Global Warming and Infectious Diseases"	Meiji HD, Lion
	Changes in rainfall and weather patterns	Days of heavy rain (Japan)	• Japan's Weather at the End of the 21st Century (2015) by the Ministry of the Environment and the Japan Meteorological Agency • Ministry of the Environment, Ministry of Education, Culture, Sports, Science and Technology, Ministry of Agriculture, Forestry and Fisheries, Ministry of Land, Infrastructure, Transport and Tourism, Meteorological Agency, "Observation and Prediction of Climate Change and Integrated Impact Assessment Report 2018-Climate Change and Its Impact in Japan" • World Bank, "Climate Change Knowledge Portal For Development practitioners and Policy Makers"	Kagome, Kajima Corporation, Seven & i HD, FUJIFILM HD and Lion
		Amount of rainfall	• "Japan's Climate at the End of the 21st Century," Ministry of the Environment and the Japan Meteorological Agency, "Observations and Forecasts of Climate Change and Integrated Report on Impact Assessments 2018-Climate Change and Its Impact in Japan." • Technical Review Committee on Flood Control Plans Based on Climate Change "Recommendations on Water Control Plans Based on Climate Change"	Kagome, LIXIL
	Impacts of changes in rainfall patterns and increases in average temperature on raw material growth	Changes in potato yield due to the impact of climate change	• "Climate change impact on global potato production" (2018)	Calbee Corp.
		Changes in oat yield due to the impact of climate change	• FAO, "GAEZ(Global Agro-Ecological Zones)"	Calbee Corp.

※ The parameters surveyed in the course of support program by the Ministry of the Environment are shown regardless of whether or not they are actually used by each company.

[Parameters referenced in support cases 4/4]
Physical risk 2/2

	Item	Parameter	Source	Reference: Companies referenced parameters
Physical risk	**Sea level rise**	Magnitude of sea level rise	• Ministry of the Environment, Ministry of Education, Culture, Sports, Science and Technology, Ministry of Agriculture, Forestry and Fisheries, Ministry of Land, Infrastructure, Transport and Tourism, Meteorological Agency, “Observation and Prediction of Climate Change and Integrated Impact Assessment Report 2018-Climate Change and Its Impact in Japan” • Japan Meteorological Agency Website “Past and Future Sea Level Changes in the World”	Furukawa Electric and Meiji HD
	Deterioration of labor and construction conditions	Rate of decline in labor productivity due to heat stress	• ILO, "Working on a warmer planet"	Kajima Corporation and Lion Corporation
		Extreme heat (Japan)	• Ministry of the Environment press release (2014) • Academic paper "Anthropogenic-contribution-to-global-occurrence-of-heavy-precipitation-and-high-temperature-extremes" (2015) • Ministry of the Environment, Ministry of Education, Culture, Sports, Science and Technology, Ministry of Agriculture, Forestry and Fisheries, Ministry of Land, Infrastructure, Transport and Tourism, Meteorological Agency, "Observation and Forecasting of Climate Change and Integrated Impact Assessment Report 2018-Climate Change and its Impact in Japan."	Calbee, Seven&i HD
	Drought	Water stress	• WRI, “The Aqueduct”	Kagome, Furukawa Electric, Lion
	Changes in the marine environment	Changes in fish catches in general	• “Shrinking of fishes exacerbates impacts of global ocean changes on marine ecosystems” (2012)	Calbee, Furukawa Electric
	Increasing extreme weather conditions (typhoons, heavy rains, sediment, storm surges, etc.)	Flood damage in urban areas	• WRI “The Aqueduct Global Flood analyze”	Kajima Corporation
		Flow rate	• Ministry of Land, Infrastructure, Transport and Tourism, “Proposals for Flood Control Plans Based on Climate Change”	LIXIL
		Frequency of floods	• Ministry of Land, Infrastructure, Transport and Tourism, “Proposals for Flood Control Plans Based on Climate Change”	Kyocera, Lion Corporation and LIXIL

※ The parameters surveyed in the course of support program by the Ministry of the Environment are shown regardless of whether or not they are actually used by each company.

【IEA WEO, ETP】
Report on transition scenarios published by the IEA

IEA World Energy Outlook 2019

IEA Energy Technology Perspectives 2017

What is the International Energy Agency (IEA)?

- Organization established in 1974 after the first oil crisis to avert oil supply crises (to establish a stable energy supply and demand structure) of the member countries.
- The objective is to promote energy security through collective response by members to the physical disruptions of oil supply.
- Energy-related surveys, statistical compilation, and publication of various reports and books.
- There are 30 members, including Japan.

World Energy Outlook (WEO)

- A report on energy supply and demand published every autumn.
- World Energy Outlook includes medium and long-term energy market forecasts.

Energy Technology Perspectives (ETP)

- Describes the process of energy technology innovation.
- Focusing on opportunities and challenges for expanding and accelerating clean energy technologies.
- Presenting more ambitious scenarios, ETP 2017 presents three pathways for the energy sector towards 2060.

Source: IEA website

【Parameters in IEA WEO 2019 1/14】 CO2 emissions 1/3

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
CO2 emissions	World energy-related CO2 emissions by fuel and scenario	○			○		○					○		
	Cumulative energy-related CO2 emissions (since 1890) and annual emissions by fuel and scenario	○	○		○		○					○		
	Average CO2 emissions intensity of hourly electricity supply in India and the European Union, 2018, and by scenario, 2040	○					○						○	
	Effects of including announced net-zero carbon pledges on CO2 emissions in the Stated Policies Scenario	○			○		○					○		
	Installed power generation capacity by source and CO2 emissions from electricity generation in India in the Stated Policies Scenario and Cheap Battery Case	○			○		○						○	
	Energy-related CO2 emissions and reductions by source in the Sustainable Development Scenario	○							○			○		
	Average annual post-peak CO2 emissions reductions and power sector mix in various WEO scenarios	○										○		
	Energy-related CO2 emissions in the Sustainable Development Scenario to 2050 and extended pathway to 2100	○	○		○		○		○		○	○		
	Electricity generation by source and carbon intensity of electricity in the Sustainable Development Scenario	○			○		○		○			○		
	Energy-related CO2 emissions by region in the Stated Policies Scenario	○	○		○		○		○			○	○	○
	Net-zero carbon or GHG emissions reduction announcements	○							○				○	
	Effects of including announced net-zero carbon pledges on CO2 emissions in the Stated Policies Scenario	○	○		○		○		○			○		
	CO2 emissions reductions by measure in the Sustainable Development Scenario relative to the Stated Policies Scenario	○	○		○		○		○			○		
	Global fossil fuel demand by CO2 content in the Sustainable Development Scenario, 2018 and 2050	○							○			○		
	CO2 emissions in advanced and developing economies in the Sustainable Development Scenario	○	○		○		○		○				○	
	Carbon emissions of different car powertrains by region	○			○								○	
	Savings in energy-related CO2 emissions in industry by measure and scenario	○	○		○		○		○			○		

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 2/14】 CO2 emissions 2/3

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
CO2 emissions	Emissions trajectories for total CO2 emissions in the Sustainable Development Scenario and to limit warming to 1.5 ° C	○	○				○				○	○		
	Cumulative net-negative CO2 emissions between 2018 and 2100 in 1.5° C scenarios assessed by the IPCC	○										○		
	Illustrative trajectory of energy-related CO2 emissions to achieve a 50% chance of 1.5 ° C in advanced and developing economies	○			○		○		○				○	
	Locked-in emissions from international shipping and the maximum potential remaining emissions from LNG		○	○	○	○	○	○	○			○		
	CO2 emissions reductions since 2010	○										○	○	
	Average cost of potential emissions savings from coal-to-gas switching in the power sector, 2025			○									○	
	Potential CO2 savings from coal-to-gas switching at various gas prices using existing power plants	○											○	
	Cumulative effects on electricity generation and emissions in Southeast Asia of spending $5 billion in the power sector	–											○	
	Growth in global GDP, coal demand and related CO2 emissions by scenario	○	○		○		○					○		
	Indirect CO2 and methane emissions intensity from global coal supply, 2018	○										○		
	Indirect CO2 and methane emissions, and emissions intensities for the ten-largest coal producing countries, 2018	○											○	
	Lifecycle emission intensities of coal and natural gas used for heat and electricity generation, 2018	○										○		
	Annual CO2 emissions from the power sector by scenario	○		○	○	○	○					○		
	CO2 intensity of electricity generation by region and scenario	○			○		○						○	
	Global CO2 emissions from existing coal-fired power plants by technology with a 50-year lifetime in the Stated Policies Scenario	○	○		○		○					○		
	Cumulative CO2 emissions from existing coal-fired power plants by assumed lifespan, 2019-2040	○	○	○	○	○	○					○	○	
	Measures to reduce CO2 emissions from coal-fired power plants	–										○		

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 3/14】
CO2 emissions 3/3, Energy demand 1/4

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
CO2 emissions	Reducing CO2 emissions from existing coal-fired power capacity by measure	○			○		○					○		
	Installed capacity by source and CO2 emissions from electricity generation in India in the Stated Policies Scenario and Cheap Battery Case	○			○		○						○	
	CO_2 emissions reductions resulting from material demand reductions for steel, cement and aluminium	○			○		○					○		
	Impact of energy efficiency on CO_2 emissions from electricity supply in the Sustainable Development Scenario, 2040						○						○	
	Installed CCGTs equipped with CCUS and emissions avoided in the Sustainable Development Scenario	○		○	○	○	○					○		
	Avoided CO2 emissions due to the deployment of offshore wind in the Stated Policies and Sustainable Development scenarios	○		○	○	○	○					○	○	
Energy demand	World primary energy demand by fuel and related CO2 emissions by scenario	○					○					○		
	World primary energy demand by fuel and scenario	○			○		○					○		
	Total primary energy demand by region and scenario	○			○		○					○	○	
	Change in energy demand and average annual GDP growth rate by region in the States Policies Scenario,2018-2040	○					○						○	○
	Final energy consumption by sector, fuel and scenario	○			○		○					○		
	Change in final energy consumption by sector 2000-2018 and by scenario to 2040	○					○					○		
	World electricity generation by fuel, technology and scenario	○			○		○					○		
	Change in fossil fuel production and demand in selected regions in the Stated Policies Scenario, 2018-2040	○					○						○	
	Net oil and gas imports to Asia by scenario	○			○		○						○	○
	Net import (shaded) and export shares by fuel, region and scenario	○					○						○	○
	US tight oil production and assumed resources in the announced policies scenarios of the WEO-2018 and WEO-2019	○		○	○	○	○						○	

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 4/14】
Energy demand 2/4

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Energy demand	Differences in oil supply and power generation in the announced policies scenarios of the WEO-2019 and WEO-2018	○		○	○	○	○					○		
	Tight oil and shale gas output in the United States, 2010-2018, and in the Stated Policies Scenario	○		○	○	○	○						○	
	Total final consumption by sector and fuel in the Sustainable Development Scenario	○							○			○		
	Oil demand in transport by mode (left) and change in transport energy use by scenario in 2050 relative to today	○							○			○		
	Change in energy demand by end-use in the buildings sector in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2050								○				○	
	Change in oil demand, supply and net trade position in the Stated Policies Scenario, 2018-2040	○	○	○	○	○	○						○	
	Global oil demand and production by scenario	○			○		○					○		
	Oil demand by region and scenario	○		○	○	○	○					○	○	○
	Change in oil demand by region in the Stated Policies Scenario	○			○		○					○	○	
	Annual average change in global oil demand by sector in the Stated Policies Scenario	○	○	○	○	○	○					○		
	Oil production by type in the Stated Policies Scenario	○		○	○	○	○						○	
	Composition of global production in the Stated Policies Scenario	○		○	○	○	○					○		
	World liquids demand by scenario	○		○	○	○	○					○		
	Oil net imports and import dependency in selected developing Asian economies in the Stated Policies Scenario	○			○		○						○	
	Major exporters and importers of crude oil traded via the Strait of Hormuz, 2018	○											○	○
	Oil and gas trade volumes via major chokepoints in the Stated Policies Scenario	○			○		○					○		
	Crude oil quality of selected producers and refiners, 2018	○											○	○
	Global gas demand, production and trade by scenario	○			○		○					○		

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 5/14】 Energy demand 3/4

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Energy demand	Change in gas demand by region and scenario, 2018-2040	○	○	○	○	○	○						○	
	Gas demand by region and scenario	○		○	○	○	○					○	○	○
	Change in gas supply and demand in developing Asian markets in the Stated Policies Scenario, 2018-2040	○	○	○	○	○	○						○	
	Annual average change in gas demand and production in selected regions in the Stated Policies Scenario, 2018-2040	○	○	○	○	○	○					○	○	
	LNG trade volumes by contract type and assumed oil indexation levels in the Stated Policies Scenario	○		○	○		○					○	○	
	Change in gas and coal demand by scenario, 2018-2040	○	○	○	○	○	○						○	
	Global coal demand by scenario	○	○				○					○		
	Global coal demand, production and trade by scenario	○			○		○					○		
	Coal demand by region and scenario	○		○	○	○	○					○	○	○
	Global coal demand by key sector and scenario	○					○					○		
	Share of global coal demand by sector and scenario	○					○					○		
	Global industrial use of energy by fuel and scenario	○					○					○		
	Industrial use of energy by fuel and key sub-sector in China in the Stated Policies Scenario	○					○						○	
	Change in heat demand by temperature in China in the Stated Policies Scenario, 2018-2040	○	○	○	○	○	○						○	
	Global electricity demand and generation by scenario	○			○		○					○		
	Electricity demand by region and scenario	○			○		○					○	○	○
	Per capita electricity demand and share of electricity in total final consumption in advanced and developing economies	○					○						○	○
	Electricity demand by sector and scenario	○			○		○					○		
	Electricity demand growth by end-use and scenario in advanced and developing economies, 2018-2040	○	○	○	○	○	○						○	
	Growth in electricity demand and flexibility needs by selected region and scenario, 2018-2040	○	○	○	○	○	○						○	

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 6/14】 Energy demand 4/4

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Energy demand	World renewable energy demand by scenario	○			○		○					○		
	Renewable energy in total primary energy demand by category and region in the Stated Policies Scenario, 2018 and 2040	○					○					○	○	
	Demand for key materials in the Stated Policies Scenario	○	○		○		○					○		
	Average hourly electricity supply and demand in China in the Sustainable Development Scenario, 2040						○						○	
	Global biogas demand in the Sustainable Development Scenario	○		○	○	○	○						○	
	Change in global gas demand in the Sustainable Development Scenario, 2010-2040	○	○	○	○	○	○						○	
	Monthly electricity and natural gas use in Europe and the United States	○											○	
	Global final energy consumption in industry and buildings in the Future is Electric Scenario	○					○					○		
	Change in natural gas demand in selected regions in the Sustainable Development Scenario	○	○	○	○	○	○						○	○
	Historic global annual demand for hydrogen	○										○		
	Estimated tolerance to hydrogen blend shares of selected elements of existing gas distribution networks	○										○		
	Current limits on hydrogen blending in natural gas networks and gas demand per capita in selected locations	○											○	○
	Biomethane production and share of total biogas production that is upgraded in selected regions, 2017	○											○	
	Biomethane consumption by sector and region in the Stated Policies Scenario	○		○	○	○	○					○	○	
	Biomethane consumption by sector and region in the Sustainable Development Scenario	○		○	○	○	○					○	○	
	Low-carbon hydrogen and biomethane injected into gas grids in the Sustainable Development Scenario	○		○	○	○	○					○		

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 7/14】 Energy mix 1/2

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Energy mix	Share of renewables in total capacity additions by region and scenario, 2019-2040	O	O	O	O	O	O					O	O	O
	Global installed power generation capacity by scenario	O	O		O		O					O		
	Reducing CO2 emissions from existing coal-fired power capacity by measure	O			O		O					O		
	Average annual capacity factors for various power generation technologies by region/country	O										O	O	O
	Electricity access by sub-Saharan region in the Stated Policies Scenario	O			O		O						O	
	Operational nuclear power capacity in advanced economies absent further investment	O		O	O	O	O						O	O
	Primary energy mix and fuel use by sector in the Sustainable Development Scenario, 2018 and 2050	O							O			O		
	Global industrial energy use by fuel (left) and energy mix for selected sub-sectors (right)	O										O		
	Energy mix in industrial use for selected regions, 2018	O											O	
	Global power capacity by source in the Stated Policies Scenario	O	O		O		O					O		
	Global electricity generation by source and scenario	O		O	O	O	O					O		
	Global electricity generation mix by scenario	O					O					O		
	Global power generation capacity by source and scenario	O	O		O		O					O		
	Renewables share in capacity additions by region in the Stated Policies and Sustainable Development scenarios, 2019-2040	O	O	O	O	O	O					O	O	O
	Electricity generation by region in the Stated Policies (STEPS) and Sustainable Development (SDS) scenarios	O					O						O	O
	Global coal-fired power capacity by plant age, 2018	O										O	O	
	Germany's existing coal-fired power capacity by age and phase-out plan	O					O						O	
	Sources of flexibility by region in the Stated Policies Scenario	O					O						O	
	Energy intensity improvement and renewables share of total final consumption by scenario	O					O					O		
	Year-on-year changes in the share of global energy consumption covered by mandatory efficiency standards by selected end-uses	O										O		

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 8/14】 Energy mix 2/2

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Energy mix	Annual offshore wind capacity additions by region, 2010-2018	O										O	O	
	Offshore wind installed capacity and share of electricity supply by country, 2018	O											O	
	Indicative annual capacity factors by technology and region	O										O	O	O
	Simulated average weekly capacity factors for new offshore wind and solar PV projects by region	O											O	
	Range of simulated hour-to-hour variations in output for new projects by technology, 2018	O											O	
	Projected global offshore wind capacity and share of electricity supply by scenario	O			O		O					O		
	Installed capacity of offshore wind by region and scenario	O			O		O					O	O	O
	Outlook for offshore wind in the European Union, 2018-2040	O			O		O						O	
	Outlook for offshore wind in China, 2018-2040	O			O		O						O	
	Outlook for offshore wind in the United States, 2018-2040	O			O		O						O	
	Regional average annual capacity factors for new projects	O			O		O					O	O	O
	Energy value by technology and region relative to average wholesale electricity price in the Stated Policies Scenario	–											O	
	Average capacity credit by technology and region in the Stated Policies Scenario	O					O						O	
	Average simulated capacity factors for offshore wind worldwide	–										O		
	Offshore wind capacity needed to produce 1 Mt of hydrogen	–										-		
	Share of potential cross-border connection projects developed by case in Europe to 2030	O	O	O	O								O	

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 9/14】
Price of key commodities/products

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Price of key commodities /products	Supply costs of natural gas, biomethane and hydrogen in the Sustainable Development Scenario, 2018 and 2040	○					○					○		
	Evolution of debt risk premiums for solar PV and wind in India and sensitivity of solar PV LCOE 2018 to debt financing	○											○	
	Evolution of capital costs of solar PV in the Stated Policies and Sustainable Development scenarios				○							○		
	Global oil demand and crude oil price by scenario	○	○		○		○					○		
	Domestic natural gas production costs, LNG import prices and industry gas prices in developing Asian import markets, 2018	○											○	
	Capital costs of liquefaction projects	○	○										○	
	Investment cost ranges for liquefaction capacity and long-run marginal costs in the Stated Policies Scenario, 2018-2040	○	○	○	○	○	○						○	
	Fuel cost competitiveness of small-scale LNG versus oil products for stationary uses, 2018	○										○		
	Residential electricity prices in selected regions by scenario	○			○		○						○	○
	Sensitivity analysis of residential electricity prices by scenario, 2040						○						○	○
	Household energy bill by fuel, 2018 and 2040 by scenario	○					○						○	○
	Battery storage capital costs and installed capacity by scenario	○			○		○					○	○	
	Average hourly CO_2 emissions intensity, electricity demand and wholesale electricity prices in India and the European Union	○					○						○	
	Cost curves of potential global biogas supply by feedstock	○					○					○		
	Cost of using the least expensive biomethane to meet 10% of gas demand and natural gas prices in selected regions, 2018	○											○	
	Marginal abatement costs for global biomethane potential with and without credit for avoided methane emissions, 2018	○											○	
	Growing markets and falling costs for offshore wind in the Stated Policies Scenario	○		○	○	○	○					○	○	
	Offshore wind indicative shares of capital costs by component and levelised cost of electricity for projects completed in 2018	○										○		
	Historical LCOE of offshore wind and strike prices in recent auctions in Europe	○	○	○									○	

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 10/14】
Price of key commodities/products，Predictions on production and sales 1/2

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Price of key commodities/ products	Cumulative capital spending on offshore wind, gas- and coalfired capacity worldwide by scenario, 2019-2040	○	○	○	○	○	○					○		
	Capital costs of offshore wind projects excluding transmission, historical and projects in development	○	○		○								○	○
	Indicative upfront capital cost for high-voltage transmission cables by type and distance from shore	○												
	Regional average annual O&M costs for new projects	○			○		○					○	○	○
	Offshore wind: indicative nominal cost of debt in Europe (left) and LCOE sensitivity analysis to cost component changes (right)	○											○	
	LCOEs for new offshore wind projects in the European Union, China and the United States, 2018-2040	○			○		○						○	
Predictions on production and sales	Leading market players in the offshore wind industry, 2018	○												
	Leading manufacturers of offshore wind turbines, 2018	○												
	Urban population and cement demand growth in China (historical) India (Stated Policies Scenario) and Africa (Africa Case)	○	○		○		○						○	
	Non-OPEC oil production in the Stated Policies Scenario	○		○	○	○	○						○	
	OPEC oil production in the Stated Policies Scenario	○		○	○	○	○						○	
	Refining capacity and runs by region in the Stated Policies Scenario	○			○		○					○	○	○
	Oil trade by region in the Stated Policies Scenario	○			○		○						○	○
	Cumulative oil and natural gas supply investment by region in the Stated Policies Scenario, 2019-2040	○	○	○	○	○	○					○	○	
	Electric car targets of the world's 20 largest car manufacturers	○	○	○	○									
	Share of SUV sales in key car markets	○											○	
	Historical global trends in car sales by size	○										○		
	Passenger car sales in the Stated Policies Scenario	○		○	○		○						○	
	Share of SUVs in total sales and oil demand in the Stated Policies Scenario and two cases examining differences in the SUV market	○			○		○					○		
	US tight crude oil production in the Stated Policies Scenario	○		○	○	○	○						○	
	Year-on-year growth from new wells and underlying declines from existing wells in the Stated Policies Scenario	○		○	○	○	○					○		

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 11/14】
Predictions on production and sales 2/2, Efficiency

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Predictions on production and sales	Change in global oil production by type, 2008-2018	○										○		
	Net income from oil and gas production in selected producer economies in the Stated Policies Scenario	○											○	
	Change in gas supply balance by region in the Stated Policies Scenario, 2018-2040	○	○	○	○	○	○						○	
	Natural gas production by region in the Stated Policies Scenario	○		○	○	○	○					○	○	
	Natural gas trade by region in the Stated Policies Scenario	○			○		○					○	○	
	Natural gas net trade by region in the Stated Policies Scenario	○					○					○	○	○
	Use of associated gas by region, 2018	○											○	
	Associated gas volumes in the total output from oil fields, 2018	○											○	
	Associated and non-associated gas production in selected countries in the Middle East in the Stated Policies Scenario	○			○		○						○	
	Associated gas production in the United States in the Stated Policies Scenario, 2010-2025	○		○									○	
	Natural gas demand and production in Brazil in the Stated Policies Scenario	○			○		○						○	
	Change in global gas and oil production in the Sustainable Development Scenario	○	○	○	○	○	○					○		
	Coal production by region in the Stated Policies Scenario	○		○	○	○	○					○	○	
	Share of coal production by key country in the Stated Policies Scenario	○			○		○						○	
	Coal trade by region in the Stated Policies Scenario	○			○		○					○	○	○
	Top-ten global coal producing companies	○												
	Global coal production by type in the Stated Policies Scenario	○		○	○	○	○					○		
	Material demand worldwide by scenario and end-use	○					○					○		
	Power sector demand for steel, cement and aluminium by scenario	○					○					○		
	Biogas production by region and feedstock, 2017	○										○	○	
Efficiency	Changes in the average efficiency and economics of US tight oil production, 2012-2018	○											○	
	Summary of material efficiency strategies in the Sustainable Development Scenario	–										○		
	EV charging patterns and average hourly CO_2 emissions intensity of electricity in the European Union in the Sustainable Development Scenario, 2040						○						○	

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 12/14】
Technology, Policy, Other 1/3

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Technology	Examples of technologies that scale from low levels today to over 3% market share in the Sustainable Development Scenario				○							○		
	Low-carbon technologies by unit size and average annual installations in the Sustainable Development Scenario	○	○	○	○	○	○					○		
	Global sustainable technical potential of biomethane	○					○						○	
	Evolution of the largest commercially available wind turbines	○			○							○		
	Ratio of technical potential to domestic electricity demand by region in the Stated Policies Scenario, 2040						○						○	○
	Regional technical potentials for offshore wind	–											○	
	Offshore wind potential supply curves by region	–											○	
Policy	Policies targeting at least 10 GW of offshore wind by 2030				○								○	
	Policy targets for offshore wind in the European Union				○								○	
	Offshore wind targets by province in China's 13th Five-Year Plan	○											○	
	Offshore wind targets and support policies in the United States			○	○	○							○	
Other	Offshore wind: average distance from shore by country	○											○	
	Evolution of offshore wind competitiveness: value-adjusted LCOEs by technology and region in the Stated Policies Scenario		○		○		○						○	
	Rise in the number of hours of cross-border grid congestion with the addition of a 12 GW hub in the North Sea	–											○	
	Global offshore wind capital spending and potential synergies with offshore oil and gas activities	○										○	○	
	Global average annual energy investment by type and scenario	○	○	○	○	○	○					○		
	Global average annual energy supply investment by type and scenario	○	○	○	○	○	○					○		
	Estimated value of subsidies to fossil fuel consumption, renewables and electric vehicles, and carbon pricing, 2010-2018	○										○		
	Energy investment indicators by economy and scenario	○					○						○	
	Key energy indicators in the Sustainable Development and Stated Policies scenarios	○			○				○			○		
	Pathways to universal access in the Sustainable Development Scenario	○	○	○	○	○	○						○	

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 13/14】 Other 2/3

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Other	Global premature deaths attributable to air pollution	○							○			○		
	Average annual energy investment in the Sustainable Development Scenario, 2014-2018 and 2019-2050	○							○			○		
	Average annual upstream oil and gas investment in the Stated Policies and Sustainable Development scenarios	○	○	○	○	○	○	○	○			○		
	Population without modern energy access and premature deaths due to air pollution in the Stated Policies Scenario, 2018 and 2050	○							○			○		
	Financial flows in energy investment	–										–		
	Key financing issues in the Sustainable Development Scenario	–										–		
	Sensitivity of US tight crude oil production in 2030 to technical and economic uncertainties				○								○	
	Seaborne crude oil trade by route in the Stated Policies Scenario	○		○	○	○	○					○		
	Cumulative coal supply investment by region in the Stated Policies Scenario, 2019-2040 ($2018 billion)	○	○	○	○	○	○					○	○	
	Coal supply investment	○										○	○	
	Selected financial and investment institutions committed to reduce or end involvement in coal supply and coal-fired power	–											○	○
	Return on invested capital and after-tax weighted average cost of capital for selected coal companies	○												
	Depth of coal production in selected countries, 2018	○											○	
	Global annual average power sector investment, historical and by scenario, 2019-2040	○	○	○	○	○	○					○		
	Average annual power sector investment by region, 2019-2040	○	○	○	○	○	○						○	
	Value-adjusted levelised cost of electricity by technology in selected regions in the Stated Policies Scenario, 2020-2040		○		○		○						○	
	SO2, NOX and PM2.5 emissions in the power sector by region and scenario, 2018-2040	○					○						○	
	Value-adjusted LCOE for select power technologies in India in the Stated Policies Scenario		○		○		○						○	
	Key indicators by scenario	○			○		○					○		
	Energy intensity of GDP by scenario	○			○		○					○	○	○

Source：IEA World Energy Outlook 2019

【Parameters in IEA WEO 2019 14/14】 Other 3/3

IEA World Energy Outlook 2019

Category	Datasets	Timeframe										Country/region		
		Past	'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Other	Annual average investment in energy efficiency in selected regions by scenario	○	○	○	○	○	○					○	○	
	Global annual average investment in renewables by scenario													
	Per capita material consumption and GDP for selected countries, 2000-2017	○	○	○	○	○	○					○		
	Average annual investment in LNG and gas pipeline infrastructure in the Sustainable Development Scenario	○										○	○	○
	Alternative supply routes to produce low-carbon gases												○	
	Global offshore wind capital spending and potential synergies with offshore oil and gas activities	○	○	○	○	○	○							

Source：IEA World Energy Outlook 2019

【Parameters in IEA ETP 2017 1/7】
Energy demand

IEA Energy Technology Perspectives 2017

	Category	Datasets	Timeframe								Country / region		
			'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Energy demand	General	Total final industrial energy consumptions by region	○	○									○	
		Final electricity demand by sector and region, 2014-60	○	○	○	○	○	○	○	○	○		○	
	Primary energy	Global primary energy demand (Biomass and waste, Hydro, Other renewables, Nuclear, Natural gas, Oil, Coal)	○	○	○	○	○	○	○	○	○	○		
	Final energy	Final energy demand industry sector (Oil, Coal, Natural gas, Electricity, Heat, Biomass and waste, Hydrogen)		○										
	Renewable energy	Bioenergy in final energy consumption by end use										○		
	Power supply	Fuel input electricity and heat generation		○	○	○	○	○	○	○	○	○		
	Specific sector	Final energy demand (Transport, Residential, Services, Agriculture, Fisheries and forestry)		○	○	○	○	○	○	○	○	○	○	
		Cement production energy use, Energy intensity and direct CO2 emissions intensity of global cement production		○										
		Sector-wide energy consumption and CO2 emissions		○								○		
		Energy intensity development under current regulation and 2DS Energy intensity in 2DS, Energy intensity with EEDI	○	○	○									
		Final energy use by fuel and per person		○	○	○	○	○	○	○	○	○		
		Global direct CO2 emissions and process energy intensities of primary chemicals			○						○	○		
		Global energy intensity and direct CO2 emissions of crude steel production			○						○	○		
		Bus and rail activity by scenario and passenger transport activity by mode, 2015-60									○	○		
		Energy intensity improvements in global aviation by scenario	○	○	○	○	○	○	○	○	○	○		
		Floor area additions to 2060 and share of additions built by 2035 for selected regions (Non-residential, Residential)									○		○	
		Final energy demand (Oil, Coal, Natural gas, Electricity, Heat, Biomass and waste, Hydrogen)			○			○			○	○		
		Cumulative energy savings by end use relative to the RTS	○		○		○		○		○	○		
		Passenger/Freight transport final energy consumption		○	○	○	○	○	○	○	○	○	○	
		Energy demand (Space heating, Water heating, Space cooling, Lighting/Appliances and miscellaneous equipments, Cooking)		○	○	○	○	○	○	○	○	○		
		Residential - Total final energy consumption by end-use		○	○	○	○	○	○	○	○	○		
		Energy demand (Cement, Chemicals and petrochemicals, Iron and steel, Pulp and paper, Aluminum)		○	○	○	○	○	○	○	○	○		

Source：IEA Energy Technology Perspectives 2017

【Parameters in IEA ETP 2017 2/7】
Energy mix, Price of key commodities/products, Macroeconomic Variables, Demographic variables, Efficiency

IEA Energy Technology Perspectives 2017

	Category	Datasets	Timeframe								Country / region		
			'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Energy mix	Renewable energy	Final energy demand in the RTS and 2DS, 2014-60（Biomass and waste, Natural gas, Electricity, Commercial heat, Oil, Coal, Other, Renewable share, Low-carbon share)	○	○	○	○	○	○	○	○	○	○		
		Bioenergy use and CO2 capture in the RTS, 2DS and B2DS (Power, Fuel Tranformation, Agriculture, Buildings, Industry, Transport, %BECCS)									○	○		
		Tracking by technology and region (Solar PV, Hydropower, Bioenergy, CSP, Onshore wind, Offshore wind, Geothermal, Ocean)	○	○								○		
	Power supply	Power generation fuel mix by scenario, 2014 and 2060 (Fossil w/o CCS, Fossil with CCS, Nuclear, Bioenergy with CCS, Renewables)									○	○		
	Nuclear power	Nuclear electricity generation, Capacity additions and reactors under construction	○	○								○		
	Power supply	Coal capacity development (Subcritical, Supercritical, Ultra-supercritical)	○	○								○		
	Specific sector	Investment needs in the power sector	○	○	○	○	○	○	○	○	○	○		
		Role of transport biofuels - final energy demand in the 2DS	○	○	○	○	○	○	○	○	○	○		
Price of key commodities/ products	Renewable energy	Solar PV LCOE and contract prices	○											
	Fossil-fuel	Fossil fuel prices by scenario	○		○		○		○		○	○	○	○
Macroeconomic Variables	GDP	Global GDP, primary energy demand and CO2 emissions	○		○		○		○		○			
		Real GDP growth projections in ETP 2017 (assumed identical across scenarios)	○		○		○		○		○			
Demographic variables	General	Population projections used in ETP 2017 (millions)	○		○		○		○		○			
Efficiency	Efficiency	Natural gas-fired power technology intensity	○	○									○	
		Builings energy use and intensity per m2 since 1990			○						○	○		
		Global fleet average and new-build plants emissions	○	○	○	○	○	○	○	○	○	○		
		Global fleet average and new-build plants emissions	○	○	○	○	○	○	○	○	○	○		
		Cost components in battery storage in the scenarios			○			○			○	○		
		Battery scale-up in the 2DS and B2DS			○			○			○	○		

Source：IEA Energy Technology Perspectives 2017

【Parameters in IEA ETP 2017 3/7】 Technology, CO2 emissions

IEA Energy Technology Perspectives 2017

	Category	Datasets	Timeframe								Country / region		
			'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Technology	General	Development of storage technologies in the scenarios		○			○				○	○		
	CCS	Globally installed electricity storage (GW)	○	○								○		
		Global CO2 captured and stored in the chemicals and petrochmicals/ iron and steel/cement subsector by scenario	○	○	○	○	○	○	○	○	○	○		
		Share of CCS in power generation and capacity - B2DS	○	○	○	○	○	○	○	○	○	○		
		Share of CCS in industrial production	○	○	○	○	○	○	○	○	○	○		
		CO2 captured, BECCS		○	○	○	○	○	○	○	○	○	○	
	Specific sector	Global technology penetrations in LDV stock by scenario, 2015-60	○	○	○	○	○	○	○	○	○	○		
		Comparative cost of PLDV technologies by country/region in the RTS and B2DS, 2015 and 2060									○		○	○
		Model shift from aviation to HSR, RTS and B2DS	○	○	○	○	○	○	○	○	○	○		
		Deployment rates for renwables-based power technologies in the B2DS	○		○		○		○		○	○		
	Investment	Investment needs by scenario, 2017-60									○	○		
		Buildings investment to 2060 and share of total B2DS investment by key region	○	○	○	○	○	○	○	○	○		○	
CO2 emissions	CCS	Sector-wide energy consumption and CO2 emissions		○								○		
	Specific sector	International well-to-wake shipping CO2-eq emissions trajectories	○	○										
		Global direct CO2 emissions and process energy intensities of primary chemicals by scenario			○						○	○		
		Energy intensity and direct CO2 emissons of crude steel/global cement production			○						○	○		
		WTW GHG emissions reductions by transport mode and scenario, 2015 - 60	○	○	○	○	○	○	○	○	○	○		
		Direct CO2 emissions (Mt CO2)	○	○	○	○	○	○	○	○	○	○		
		Well-to-wheel emissions by mode	○	○	○	○	○	○	○	○	○	○		
		Buildings - Total emissions by end-use	○	○	○	○	○	○	○	○	○	○		

Source：IEA Energy Technology Perspectives 2017

【Parameters in IEA ETP 2017 4/7】 Predictions on production and sales, Carbon pricing

IEA Energy Technology Perspectives 2017

	Category	Datasets	Timeframe								Country / region		
			'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Predictions on production and sales	Specific sector	Vehicle sales and technology shares in 2015 and 2060 in the RTS and B2DS , Light-duty vehicles (Gasoline internal combustion engine, Diesel combustion engine, Compressed natural gas/ Liquified petroleum gas, Hybrids, Electric & fuel cell vehicles)									○	○		
		Share of 2-wheelers in major Asian regions and the OECD average in the B2DS, 2015-60			○						○		○	
		Passenger kilometers		○	○	○	○	○	○	○	○	○	○	
		Freight tonne kilometers		○	○	○	○	○	○	○	○	○	○	
		Global material production projections in the RTS and B2DS									○		○	
		Crude steel/HVC production by process route, scenario and region									○	○		
		Production and energy intensity for primary chemicals		○										
		Global HVC/ammonia/methanolproduction by process technology in the B2DS		○	○	○	○	○	○	○	○	○		
		Global hot metal production in the iron and steel subsector by process technology in the B2DS, Hot metal production in the iron and steel subsector by process route and region									○		○	
		Average CO2 intensity of electricity producation and primary alumnium production									○	○	○	
		Production of pulp, paper and paperboard		○										
		Product mix of pulp production by region and scenario									○		○	
		Energy mix of pulp and paper production and CO2 intensity			○						○			
	Renewable energy	Global biofuels production	○	○								○		
Carbon pricing	CO2 price	CO2 price in selected regions by scenario	○		○		○					–	○	–

Source：IEA Energy Technology Perspectives 2017, IEA World Energy Outlook 2017

【Parameters in IEA ETP 2017 5/7】
Energy demand

IEA Energy Technology Perspectives 2017

	Category	Datasets	Timeframe									Country / region		
			'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Energy demand	General	Evolution of electricity demand	○	○	○	○	○					○		
	Coal	Incremental coal demand by key sector and region	○		○		○						○	
	Fossil-fuel	Coal , Oil and liquids, Fossil fuel, Natural gas demand		○	○	○	○					○	○	○
		Oil and total liquids demand and supply, Change in global oil product demand for petrochemical feedstock	○	○	○	○	○					○		
		Difference in oil demand by sector in the Low Oil Price Case relative to the New Policies Scenario	○	○	○	○	○					○		
		Global liquefaction capacity and demand	○	○	○	○	○					○		
	Gas	Key natural gas demand growth centres, additional use in the New Policies Scenario,					○						○	
	Coal, Gas	Share of coal consumption by technology in electricity					○					○	○	○
	Renewable energy	World renewable energy consumption		○			○					○		
		Renewable energy use by sector from a consumer perspective and by region					○							
	Heat	Growth in global industrial heat demand by temperature level, Change in global industrial heat supply mix by temperature level					○					○	○	
	Electricity	Electricity demand by region	○	○	○	○	○					○	○	○
	Power supply	Energy demand(TPED, Power generation, Other energy sector, TFC, Industry, Transport, Buildings, Other)		○	○	○	○					○	○	○
	Energy access	Electrification rate	○	○	○								○	
		Population without access to electricity	○	○	○	○	○						○	
	Primary energy	World primary energy demand by fuel and scenario		○			○					○		
		Global primary energy demand(Coal, Oil, Gas, Other renewables, Bioenergy, Nuclear)					○					○		
	Final energy	Average annual global energy efficiency and renewables investments	○	○	○	○	○					○	○	
		Avoided final energy demand in 2040 due to energy efficiency policies by fuel, sector and region					○						○	
	Specific sector	Residential LED stock and lighting electricity demand in the New Policies Scenario					○					○		
		Global road freight fuel demand by vehicle category					○					○		

Source：IEA Energy Technology Perspectives 2017, IEA World Energy Outlook 2017

【Parameters in IEA ETP 2017 6/7】
Energy mix, Price of key commodities/products, Efficiency, Technology(1/2)

IEA Energy Technology Perspectives 2017

	Category	Datasets	Timeframe									Country / region		
			'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Energy mix	Power supply	Electricity generation(Total generation, Coal, Oil, Gas, Nuclear, Renewables)		○	○	○	○					○	○	○
		Offshore electricity generation		○	○	○	○					○	○	○
	Power plant	Electrical capacity(Total capacity, Coal, Oil, Gas, Nuclear, Renewables)		○	○	○	○					○	○	○
		Cumulative power plant capacity retirements by region and source in the New Policies Scenario, 2017-2040 (GW)		○	○	○	○					○	○	○
	Nuclear power	Top-five regions by installed capacity of nuclear power plants		○	○	○	○					○	○	○
	CCS	Power generation by source and installed capacity					○					○		
	Investment	Cumulative global energy investment by scenario					○					○		
		Average annual offshore energy investment		○	○	○	○					○		
		Cumulative investment needs by sector in the New Policies and Sustainable Development Scenarios, 2017-2040					○					○		
Price of key commodities/ products	Coal	Steam coal prices by key region in the New Policies Scenario	○	○	○	○	○						○	
		Average FOB cash costs for global seaborne steam coal trade and Richard's Bay FOB coal price	○	○	○	○	○						○	
Efficiency	Efficiency	Global energy intensity reduction		○	○	○	○					○		
		Evolution of global average cost for utility-scale solar PV, Evolution of global average cost for EV battery	○	○	○	○	○					○		
		Powertrain cost comparison of conventional and electric cars		○									○	
		Potential additional impact of material efficiency improvements on oil demand for plastics production					○						○	
		Historical and projected levelised costs of electricity improvements on oil demand for plastics production		○	○	○	○						○	
Technology	Coal, Gas	Delivered cost of coal and natural gas to different power systems in the United States		○									○	
	Fossil-fuel	Deepwater and ultra-deepwater production by region in the New Policies Scenario	○	○	○	○	○					○		

Source：IEA Energy Technology Perspectives 2017, IEA World Energy Outlook 2017

【Parameters in IEA ETP 2017 7/7】 Technology(2/2), Policy, CO2 emissions, Predictions on production and sales

IEA Energy Technology Perspectives 2017

	Category	Datasets	Timeframe									Country / region		
			'20	'25	'30	'35	'40	'45	'50	'55	'60	Global	Several areas	Japan
Technology	Gas	Average costs of resources developed in the New Policies Scenario by year and average Henry Hub price	○	○	○	○	○							
		Estimated average time to procure an extra 10% of LNG import volumes by selected importer			○		○						○	○
	Renewable energy	Average annual global energy efficiency and renewables investments		○	○	○	○					○		
	Investment	Cumulative oil and gas supply investment by region					○						○	
Policy	Policy	Cross-cutting policy assumptions by scenario for selected regions										○	○	○
	Specific sector	Selected recent initiatives for electric mobility										○		
		Recent developments in regional power sector policies included in the New Policies Scenario										○		
	Subsidy	Estimated value of global fossil-fuel consumption subsidies										○		
	Renewable energy	Share of supported wind and solar PV generation by mechanism type	○	○	○							○		
	Final energy	Share of global final energy consumption covered by mandatory efficiency regulations by sector										○		
	Renewable energy	Selected renewable energy targets proposed or introduced since mid-2016											○	
CO2 emissions	Gas	Average CO2 emissions intensity of electricity generation in selected regions		○			○						○	
Predictions on production and sales	Coal	World coal demand, production and trade		○			○					○		
	Fossil-fuel	Changes in oil production by region											○	
	Power supply	Offshore oil and gas production					○					○		
	Specific sector	Deployment levels of electric cars					○					○		
		Deployment levels of solar PV					○					○		

Source：IEA Energy Technology Perspectives 2017, IEA World Energy Outlook 2017

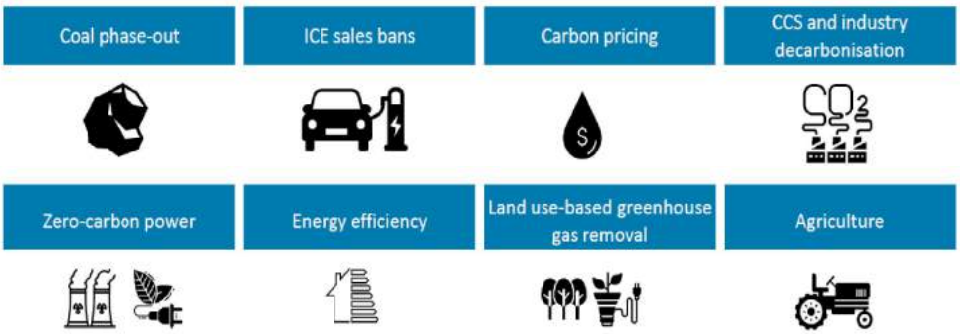
【PRI IPR】 Scenarios for possible short-term climate policies released by the PRI in September 2019

PRI The Inevitable Policy Response

- The International Principles for Responsible Investment (PRI) is an initiative by global investors to “incorporate ESG issues into investment decisions and actions as shareholders, improve long-term investment performance, and better fulfill fiduciary responsibilities.”
- The PRI launched The Inevitable Policy Response (IPR) as a project for investors to prepare for possible short-term climate-related policy risks. As part of the project, Forecast Policy Scenario scenarios have been developed to depict **the impact on 2025-2050 of policies expected to be released between 2023 and 2025**.
- Scenarios include the perspectives of “how will the economy be affected,” “which sectors are most exposed to risk,” and “which asset classes are affected.”

PRI: The Forecast Policy Scenario (FPS)

Hypothetical policy for the 8 items



Sources: PRI Awareness Working Group, "Introduction of ESG Investment Standards" (2013), "The Inevitable Policy Response : Policy Forecasts", PRI (2019.9)

【Parameters in PRI IPR 1/5】
Carbon pricing, Energy demand

PRI The Inevitable Policy Response

Datasets		Unit	Timeframe	Country / region			Corresponding page
#1	#2			Global	Several areas	Japan	
Carbon pricing	Carbon pricing	US$		○	○	○	Policy Forecasts
Energy demand	Coal demand by sector (Electricity, Industry, Other)	million tonnes coal per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.27, 52
	Oil demand by sector (Transport, Industry, Buildings, Other)	MMbbl/d	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.28, 46
	Gas demand by sector (Electricity, Buildings, Industry, Other)	bcm per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.30, 55
	Industry fuel mix (Coal (unabated) , Coal CCS, Gas (unabated), Gas CCS, Oil, Biomass, Heat, Electricity, Hydrogen)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.34, 67
	Hydrogen contribution of energy demand in hard-to abate sectors (Iron and steel, Non-metallic minerals, Chemicals) (Hydrogen, Other fuels)	%	'50	○			p.35, 71
	Biomass Availability	EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.39, 74, 84
	Primary energy demand (Coal, Oil, Natural Gas, Biomass, Other low-carbon)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.44
	Primary energy demand (Coal, Oil, Natural Gas, Biomass, Other low-carbon)(IPR FPS, IEA NPS, IEA SDS, Shell Sky, Statkraft Scenario)	EJ per year	'40	○			p.45
	Oil use by sector, FPS and comparator scenarios (Transport, Industry, Buildings, Total, Other) (IPR FPS, IEA SDS, Shell Skye, BP Energy Outlook, OPEC Reference case)	MMbbl/d	'40	○			p.47
	Coal demand by sector, IPR FPS vs comparators (Electricity, Industry, Other, Total) (IPR FPS, IEA NPS, IEA SDS, Shell Sky)	million tonnes coal per year	'40	○			p.53
	Coal demand by industry sector (Non-metallic minerals, Iron and steel, Chemical and petrochemical, Pulp and paper, Non-ferrous metals, Autogeneration, Other industry)	million tonnes coal per year	'40	○			p.54
	Gas use by sector, FPS and comparator scenarios (Electricity, Buildings, Industry, Other) (IPR FPS, IEA NPS, IEA SDS)	bcm per year	'40	○			p.56

Sources：PRI "The Inevitable Policy Response: Forecast Policy Scenario", "The Inevitable Policy Response: Policy Forecasts"

【Parameters in PRI IPR 2/5】
Energy mix 1/2

PRI The Inevitable Policy Response

Datasets		Unit	Timeframe	Country / region			Corresponding page
#1	#2			Global	Several areas	Japan	
Energy mix	Electricity generation by fuel (Low-carbon, Gas, Coal)	%	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.27, 52
	Electricity generation mix (Coal ,Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass w/CCS, Nuclear, Hydro, Solar, Wind)	%	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.31,48
	Electricity generation, IPR FPS vs comparators (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass with CCS, Nuclear, Hydro, Solar, Wind, Other low-carbon) (IPR FPS, IEA NPS, IEA SDS, BNEF NEO)	Thousand TWh	'40	○			p.49
	Generation mix (Western Europe) (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass with CCS, Nuclear, Hydro, Solar, Wind, Other low-carbon)	TWh	'20 / '30 / '40 / '50		○		p.50
	Generation mix (United States) (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass with CCS, Nuclear, Hydro, Solar, Wind, Other low-carbon))	TWh	'20 / '30 / '40 / '50		○		p.50
	Generation mix (China) (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass with CCS, Nuclear, Hydro, Solar, Wind, Other low-carbon)	TWh	'20 / '30 / '40 / '50		○		p.50
	Generation mix (India) (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass with CCS, Nuclear, Hydro, Solar, Wind, Other low-carbon)	TWh	'20 / '30 / '40 / '50		○		p.51
	Generation mix (Japan) (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass with CCS, Nuclear, Hydro, Solar, Wind, Other low-carbon)	TWh	'20 / '30 / '40 / '50			○	p.51
	Generation mix (Canada) (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass with CCS, Nuclear, Hydro, Solar, Wind, Other low-carbon)	TWh	'20 / '30 / '40 / '50		○		p.51
	Generation mix (Australia) (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass with CCS, Nuclear, Hydro, Solar, Wind, Other low-carbon)	TWh	'20 / '30 / '40 / '50		○		p.51
	Nuclear generation	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50				p.58
	Nuclear generation by region, 2020 and 2050 (Western Europe, United States, Australia, Canada, China, India, Japan, World)	TWh per year	'20, '50	○	○	○	p.59
	World nuclear generation in 2040, IPR FPS vs comparators (IPR FPS, IEA NPS, IEA SDS, BNEF NEO)	TWh per year	'40	○			p.59
	Gas generation by region, 2020 and 2050 (United States, China, Western Europe, Japan, India, Australia, Canada, World)	TWh per year	'20, '50	○	○	○	p.60
	World gas generation in 2040, IPR FPS vs comparators (IPR FPS, IEA NPS, IEA SDS)	TWh per year	'40	○			p.60

Sources：PRI "The Inevitable Policy Response: Forecast Policy Scenario", "The Inevitable Policy Response: Policy Forecasts"

PRI The Inevitable Policy Response

【Parameters in PRI IPR 3/5】
Energy mix 2/2, Price of key commodities/products, Policy 1/2

Datasets		Unit	Timeframe	Country / region			Corresponding page
#1	#2			Global	Several areas	Japan	
Energy mix	Coal generation by region (China, USA, India, Western Europe, Australia, Japan, Canada, ROW)	TWh per year	'20 / '30 / '40 / '50		○	○	p.61
	Coal generation by region (China, USA, India, Western Europe, Australia, Japan, Canada, ROW)	TWh per year	'40	○			p.61
	Industry fuel mix, IPR FPS and comparator scenarios (Coal (unabated) , Coal CCS, Gas (unabated), Gas CCS, Oil, Biomass, Heat, Electricity, Hydrogen) (IPR FPS, IEA NPS, IEA SDS)	%	'40	○			p.68
	Iron and steel sector energy mix (Coal (unabated) , Coal CCS, Gas (unabated), Gas CCS, Oil, Biomass, Heat, Electricity, Hydrogen) (IPR FPS, IEA NPS, IEA SDS)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.69
	Cement sector energy mix (Coal (unabated) , Coal CCS, Gas (unabated), Gas CCS, Oil, Biomass, Heat, Electricity, Hydrogen) (IPR FPS, IEA NPS, IEA SDS)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.69
	Biomass demand by sector (Industry, Agriculture, Electricity, Transport)	EJ per year	'20 / '30 / '40 / '50	○			p.72
	CCS power generation in the SDS scenario (Coal with CCS, Gas with CCS, Share of CCS)	TWh, %	'20 / '25 / '30 / '35 / '40	○			p.73
	Coal-fired power generation in the SDS scenario (Coal with CCS-China, Coal with CCS-ROW, Coal total)	TWh	'17/ '25 / '30 / '35 / '40		○		p.73
	Zero-carbon power, Nuclear capacity and renewable power generation	TWh			○	○	Policy Forecasts
Price of key commodities /products	Food Price Index (2020=100)	(Index)	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.38, 82
	Share of food in household expenditure	%	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.38, 82
	Bioenergy Price Index (2020=100)	(Index)	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.39, 74, 84
Policy	phase-out of coal in electricity globally	-			○	○	Policy Forecasts
	ICE sales bans	-			○	○	Policy Forecasts
	Carbon Capture and Storage (CCS) and industry decarbonisation	-			○	○	Policy Forecasts
	Energy efficiency	-			○	○	Policy Forecasts
	Afforestation and reforestation	Mha		○			Policy Forecasts
	Restoration of degraded Land	Mha		○	○		Policy Forecasts
	Soil sequestration	-		○			Policy Forecasts

Sources：PRI "The Inevitable Policy Response: Forecast Policy Scenario", "The Inevitable Policy Response: Policy Forecasts"

PRI The Inevitable Policy Response

【Parameters in PRI IPR 4/5】
Policy 2/2, CO2 emissions

Datasets		Unit	Timeframe	Country / region			Corresponding page
#1	#2			Global	Several areas	Japan	
Policy	Dietary shifts	-		○	○		Policy Forecasts
	Mitigation potential	GtCO2e/yr		○			Policy Forecasts
	Productivity	-		○			Policy Forecasts
	Enabling the Green Economy	-		○	○	○	Policy Forecasts
CO2 emissions	Global energy-related CO2 emissions (IPR FPS, IEA NPS, IEA SDS, IPCC P1)	GtCO2	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.15
	Global GHG Emissions (Land CO2, Land CH4, Land N2O, Industrial Process CO2, Energy net CO2 emissions , CH4 from gas production, Total)	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.18, 88
	Global energy-related CO2 emissions (IPR FPS, IEA NPS, IEA SDS)	GtCO2	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.19
	Global GHG Emissions (Land CO2, Land CH4, Land N2O, Industrial Process CO2, Energy net CO2 emissions , CH4 from gas production, Total)	GtCO2	2020-2100 (every 5 years)	○			p.20
	Land use GHG emissions (CO2, CH4, N2O, Total Baseline Gt CO2e/year)(IPR FPS)	GtCO2e	2020-2100 (every 5 years)	○			p.21, 79
	Global GHG emissions (IPR SPF, IPCC P1, IPCC P2)	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	○			p.22, 89
	CO2 emissions by sector in 2040 (Power) (Low-carbon generation, Total electricity demand)	GtCO2	'40	○			p.26
	CO2 emissions by sector in 2040 (Transport) (Low carbon fuel share, Total fuel demand)	GtCO2	'40	○			p.26
	CO2 emissions by sector in 2040 (Industry) (Low carbon fuel share, Total fuel demand)	GtCO2	'40	○			p.26
	CO2 emissions by sector in 2040 (Buildings) (Low carbon fuel share, Total fuel demand)	GtCO2	'40	○			p.26
	Energy CO2 emissions by fuel (Coal, Oil, Natural Gas, Fossil CCS, Biomass CCS, Net CO2)	GtCO2	2020-2100 (every 5 year)	○			p.36, 90
	Emissions captured globally per year (Power (fossil), Power (biomass), Industry) (IEA 2C, IEA B2C, IPCC 2C avg, IPCC 1.5 avg, Shell Sky)	GtCO2	'20 / '30 / '40 / '50	○			p.75
	Regional land use emissions (Australia, Canada, Developing East Asia, United States, Western Europe, Africa, Brazil, Central and South America, Middle East, Mexico, China, Eurasian Economic Union, Former Soviet Union, India, Other developing Asia)	GtCO2e/year	'20 / '25 / '30 / '35 / '40 / '45 / '50		○		p.80

Sources：PRI "The Inevitable Policy Response: Forecast Policy Scenario", "The Inevitable Policy Response: Policy Forecasts"

【Parameters in PRI IPR 5/5】
Predictions on production and sales, Other

PRI The Inevitable Policy Response

Datasets		Unit	Timeframe	Country / region			Corresponding page
#1	#2			Global	Several areas	Japan	
Predictions on production and sales	Passenger vehicles by powertrain (ICE, ULEV)	milion vehicles	'20 / '25 / '30 / '35 / '40 / '45 / '50	O			p.28, 63
	ICE passenger vehicles	billion	'20 / '25 / '30 / '35 / '40 / '45 / '50	O			p.29, 46
	Passenger vehicles stock by powertrain, IPR FPS and BNEF scenarios (ICE, ULEV)	%	'40	O			p.64
	Truck travel by powertrain (ICE, ULEV)	Billion vehicle km	'20 / '25 / '30 / '35 / '40 / '45 / '50	O			p.65
	Trucks stock share by powertrain, IPR FPS and BNEF scenarios	%	'40	O			p.66
Other	Cumulative afforested land	Mha	'20 / '25 / '30 / '35 / '40 / '45 / '50	O			p.40, 81
	Total Forest Land	Mha	'20 / '25 / '30 / '35 / '40 / '45 / '50	O			p.40, 81
	Crop Yields	tDM/ha	'20 / '25 / '30 / '35 / '40 / '45 / '50	O			p.41
	Irrigated area	Mha	'20 / '25 / '30 / '35 / '40 / '45 / '50	O			p.41
	Regional food price indices (2020=100)（Australia, Canada, Developing East Asia, United States, Western Europe, Africa, Brazil, Central and South America, Middle East, Mexico, China, Eurasian Economic Union, Former Soviet Union, India, Other developing Asia)	(Index)	'20 / '25 / '30 / '35 / '40 / '45 / '50		O		p.83
	Irrigated area by region (Australia, Canada, Developing East Asia, United States, Western Europe, Africa, Brazil, Central and South America, Middle East, Mexico, China, Eurasian Economic Union, Former Soviet Union, India, Other developing Asia)	Mha	'20 / '25 / '30 / '35 / '40 / '45 / '50		O		p.85
	Total cropland by region (Australia, Canada, Developing East Asia, United States, Western Europe, Africa, Brazil, Central and South America, Middle East, Mexico, China, Eurasian Economic Union, Former Soviet Union, India, Other developing Asia)	Mha	'20 / '25 / '30 / '35 / '40 / '45 / '50		O		p.86

Sources：PRI "The Inevitable Policy Response: Forecast Policy Scenario", "The Inevitable Policy Response: Policy Forecasts"

【SSP】
SSPs are developed as socioeconomic scenarios based on recent policies and socioeconomic conditions

SSP Public Database Version2.0

Outline of Shared Socioeconomic Pathways

- National Institute for Environmental Research (Japan), PNNL (United States), PBL (Netherlands), IIASA (Austria), and PIK (Germany) to develop SSPs based on the issues of SRES, an existing socioeconomic scenario for evaluating climate change [*1].
  - SPES had an older base year (1990) and failed to reflect recent policies.
  - SSPs are developed considering recent changes in external environments such as **policies, demographics, GDPs, and the increase in urbanization** [*2], and as scenarios related to existing socioeconomic scenarios such as "SERS" and "RCPs." To be composed of 5 scenarios.

5 SSP Scenario Structures

SSP	Scenario	Scenario-Summary [*3]
SSP1	Sustainability	Scenarios that envisage both international mitigation and adaptation measures related to climate change
SSP2	Middle of the Road	Scenario based on the assumption that current socioeconomic growth will continue
SSP3	Regional Rivalry	A scenario in which countries are segmented and it is difficult to implement international mitigation and adaptation measures
SSP4	Inequality	Scenario that assumes an expanding disparity in the international economy and society
SSP5	Fossil-fueled Development	Scenario that assumes the development of the international community by relying on fossil fuels

* 1: https://www.nies.go.jp/whatsnew/20170221/20170221.html、*2:https://unfccc.int/sites/default/files/part1_iiasa_rogelj_ssp_poster.pdf
* 3:https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change

【Parameters in SSP Public Database Version2.0 1/10】 IAM Scenarios model: GDP, Population, Primary Energy, Secondary Energy (Electricity)

SSP Public Database Version2.0

Category			Unit	SSP					Remark
Large	Medium	Small		SSP1	SSP2	SSP3	SSP4	SSP5	
GDP	GDP（PPP）	—	billionUS$2005/yr	○	○	○	○	○	
Population	Population	—	million	○	○	○	○	○	
/Energy	Primary Energy	Total	EJ/yr	○	○	○	○	○	
		Biomass(Total / Traditional / with CCS/ without CCS)	EJ/yr	○	○	△	○	○	Some data about CCS and Traditional biomass are not available
		Coal (Total / with CCS /without CCS)	EJ/yr	○	○	△	○	○	Some data about CCS is not available
		Oil (Total / with CCS / wihout CCS)	EJ/yr	○	△	△	○	△	Some data about CCS is not available
		Gas (Total / with CCS/ without CCS)	EJ/yr	○	○	△	○	○	Some data about CCS is not available
		Fossil (Total , with CCS, wihout CCS)	EJ/yr	○	○	△	○	○	Some data about CCS is not available
		Nuclear	EJ/yr	○	○	○	○	○	
		Non-Biomass Renewables	EJ/yr	○	○	○	○	○	
		Hydro	EJ/yr	○	○	○	○	○	
		Geothermal	EJ/yr	○	○		○	○	
		Other	EJ/yr	○	○		○		
		Solar	EJ/yr	○	○	○	○	○	
		Wind	EJ/yr	○	○	○	○	○	
		Secondary Energy Trade	EJ/yr			○			
	Secondary Energy (Electricity)	Total	EJ/yr	○	○	○	○	○	
		Biomass(Total / with CCS/ without CCS)	EJ/yr	○	○	△	○	○	Some data about CCS is not available
		Coal (Total / with CCS /without CCS)	EJ/yr	○	○	△	○	○	Some data about CCS is not available
		Oil	EJ/yr	○	○	○	○	○	
		Gas (Total / with CCS/ without CCS)	EJ/yr	○	○	△	○	○	Some data about CCS is not available
		Geothermal	EJ/yr	○	○		○	○	
		Hydro	EJ/yr	○	○	○	○	○	
		Non-Biomass Renewables	EJ/yr	○	○	○	○	○	
		Nuclear	EJ/yr	○	○	○	○	○	
		Solar	EJ/yr	○	○	○	○	○	
		Wind	EJ/yr	○	○	○	○	○	

Source：SSP Public Database Version 2.0

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

【Parameters in SSP Public Database Version2.0 2/10】 IAM Scenarios model : Secondary energy, Final energy, Energy service

SSP Public Database Version2.0

Category			Unit	SSP					Remark
Large	Medium	Small		SSP1	SSP2	SSP3	SSP4	SSP5	
Energy	Secondary Energy (Gases)	Total	EJ/yr	○	○	○	○	○	
		Biomass	EJ/yr		○		○	○	
		Coal	EJ/yr		○		○	○	
		Natural Gas	EJ/yr	○	○	○	○	○	
	Secondary Energy (Heat)	Total	EJ/yr		○		○	○	
		Geothermal	EJ/yr		○		○	○	
	Secondary Energy (Hydrogen)	Total	EJ/yr	○	○		○	○	
		Biomass(Total / with CCS/ without CCS)	EJ/yr	○	○		○	○	
		Electricity	EJ/yr	○	○		○	○	
	Secondary Energy (Liquids)	Total	EJ/yr	○	○	○	○	○	
		Biomass(Total / with CCS/ without CCS)	EJ/yr	△	○	△	○	○	Some data about CCS is not available
		Coal (Total / with CCS /without CCS)	EJ/yr		○			○	
		Gas (Total / with CCS/ without CCS)	EJ/yr		○				
		Oil	EJ/yr	○	○	○	○	○	
	Secondary Energy (Solids)	—	EJ/yr	○	○			○	
	Final Energy	Total	EJ/yr	○	○	○	○	○	
		Electricity	EJ/yr	○	○	○	○	○	
		Gases	EJ/yr	○	○	○	○	○	
		Heat	EJ/yr	○	○	○	○	○	
		Hydrogen	EJ/yr	○	○		○	○	
		Liquids	EJ/yr	○	○	○	○	○	
		Solar	EJ/yr	○	○				
	Final Energy (Solids)	Total	EJ/yr	○	○	○	○	○	
		Biomass (Total, Traditional)	EJ/yr	△	○	△	○	○	Some data about Traditional biomass is not available
		Coal	EJ/yr	○	○	○	○	○	
	Final Energy	Industry	EJ/yr	○	○	○	○		
		Residential and Commercial	EJ/yr	○	○	○	○		
		Transportation	EJ/yr	○	○	○	○	○	
	Energy Service (Transportation)	Freight	bn tkm/yr	○			○	○	
		Passenger	bn pkm/yr	○			○	○	

Source：SSP Public Database Version 2.0

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

SSP Public Database Version2.0

【Parameters in SSP Public Database Version2.0 3/10】
IAM Scenarios model：Land Cover, Emissions(unharmonized)

Category			Unit	SSP					Remark
Large	Medium	Small		SSP1	SSP2	SSP3	SSP4	SSP5	
Land Cover	Built-up Area	—	million ha	○		○	○	○	
	Cropland	—	million ha	○	○	○	○	○	
	Forest	—	million ha	○	○	○	○	○	
	Pasture	—	million ha	○	○	○	○	○	
Emissions (unharmonized)	BC	—	Mt BC/yr	○	○	○	○	○	
	CH4	Total	Mt CH4/yr	○	○	○	○	○	
		Fossil Fuels and Industry	Mt CH4/yr				○	○	
		Land Use	Mt CH4/yr	○	○	○	○	○	
	CO	—	Mt CO/yr	○	○	○	○	○	
	CO2	Total	Mt CO2/yr	○	○	○	○	○	
	CO2 (Carbon Capture and Storage)	Total	Mt CO2/yr	○	○		○	○	
		Biomass	Mt CO2/yr	○	○		○	○	
	CO2	Fossil Fuels and Industry	Mt CO2/yr	○	○	○	○	○	
		Land Use	Mt CO2/yr	○	○	○	○	○	
	F-Gases	—	Mt CO2-equiv/yr	○	○	○	○	○	
	Kyoto Gases	—	Mt CO2-equiv/yr	○	○	○	○	○	
	N2O	Total	kt N2O / yr	○	○	○	○	○	
		Land Use	kt N2O / yr	○	○	○	○	○	
	NH3	—	Mt NH3/yr	○	○	○	○	○	
	NOx	—	Mt NO2/yr	○	○	○	○	○	
	OC	—	Mt OC/yr	○	○	○	○	○	
	Sulfur	—	Mt SO2/yr	○	○	○	○	○	
	VOC	—	Mt VOC/yr	○	○	○	○	○	

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

Source：SSP Public Database Version 2.0

SSP Public Database Version2.0

【Parameters in SSP Public Database Version2.0 4/10】
IAM Scenarios model：Emissions (harmonized), Climate

Category			Unit	SSP					Remark
Large	Medium	Small		SSP1	SSP2	SSP3	SSP4	SSP5	
Emissions (harmonized)	BC	—	Mt BC/yr			○		○	
	CH4	Total	Mt CH4/yr			○		○	
		Fossil Fuels and Industry	Mt CH4/yr			○		○	
		Land Use	Mt CH4/yr			○		○	
	CO	—	Mt CO/yr			○		○	
	CO2	Total	Mt CO2/yr			○		○	
		Fossil Fuels and Industry	Mt CO2/yr			○		○	
		Land Use	Mt CO2/yr			○		○	
	F-Gases	—	Mt CO2-equiv/yr			○		○	
	Kyoto Gases	—	Mt CO2-equiv/yr			○		○	
	N2O	—	kt N2O/yr			○		○	
	NH3	—	Mt NH3/yr			○		○	
	NOx	—	Mt NO2/yr			○		○	
	OC	—	Mt OC/yr			○		○	
	Sulfur	—	Mt SO2/yr			○		○	
	VOC	—	Mt VOC/yr			○		○	
Climate	Concentration	CO2	ppm	○	○	○	○	○	
		CH4	ppb	○	○	○	○	○	
		N2O	ppb	○	○	○	○	○	
	Forcing	Total	W/m2	○	○	○	○	○	
		CO2	W/m2	○	○	○	○	○	
		CH4	W/m2	○	○	○	○	○	
		N2O	W/m2	○	○	○	○	○	
		Kyoto Gases	W/m2	○	○	○	○	○	
		F-Gases	W/m2	○	○	○	○	○	
		Aerosol	W/m2	○	○	○	○	○	
	Temperature	Global Mean	℃	○	○	○	○	○	

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

Source：SSP Public Database Version 2.0

SSP Public Database Version2.0

【Parameters in SSP Public Database Version2.0 5/10】
IAM Scenarios model：Agricultural/Economic/Technological Indicators

Category			Unit	SSP					Remark
Large	Medium	Small		SSP1	SSP2	SSP3	SSP4	SSP5	
Agricultural Indicators	Demand	Crops	million t DM/yr	○	○	○			
		Crops (Energy)	million t DM/yr			○		○	
		Livestock	million t DM/yr	○	○	○		○	
	Production	Crops (Energy)	million t DM/yr	○	○	○	○	○	
		Crops (Non-Energy)	million t DM/yr	○	○	○	○	○	
		Livestock	million t DM/yr	○	○	○	○	○	
Economic Indicators	Consumption	—	billion US$2005/yr	○	○	○		○	
	Price (Carbon)	—	US$2005/t CO2	○	○		○	○	
Technological Indicators	Capacity (Electricity)	Total	GW	○	○	○	○	○	
		Biomass	GW	○	○	○	○	○	
		Coal	GW	○	○	○	○	○	
		Gas	GW	○	○	○	○	○	
		Geothermal	GW		○	○	○	○	
		Hydro	GW	○	○	○	○	○	
		Nuclear	GW	○	○	○		○	
		Oil	GW	○	○	○	○		
		Other	GW	○					
		Solar (Total, CSP, PV)	GW	○	○	△	△	○	Some data about CSP and PV is not available
		Wind (Total, Offshore, Onshore)	GW	○	○	△	△	△	Some data about Offshore and Onshore is not available

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

Source：SSP Public Database Version 2.0

SSP Public Database Version2.0

【Parameters in SSP Public Database Version2.0 6/10】
CMIP6 Emissions model: BC, C2F6, CF4, CH4

Category		Unit	SSP					Remark
Large	Medium		SSP1	SSP2	SSP3	SSP4	SSP5	
BC	Agricultural Waste Burning	Mt BC/yr	○	○	○	○	○	
	Aircraft	Mt BC/yr	○	○	○	○	○	
	Energy Sector	Mt BC/yr	○	○	○	○	○	
	Forest Burning	Mt BC/yr	○	○	○	○	○	
	Grassland Burning	Mt BC/yr	○	○	○	○	○	
	Industrial Sector	Mt BC/yr	○	○	○	○	○	
	International Shipping	Mt BC/yr	○	○	○	○	○	
	Peat Burning	Mt BC/yr	○	○	○	○	○	
	Residential Commercial Other	Mt BC/yr	○	○	○	○	○	
	Transportation Sector	Mt BC/yr	○	○	○	○	○	
	Total	Mt BC/yr	○	○	○	○	○	
	Waste	Mt BC/yr	○	○	○	○	○	
C2F6	—	kt C2F6/yr	○	○	○	○	○	
CF4	—	kt CF4/yr	○	○	○	○	○	
CH4	Agricultural Waste Burning	Mt CH4/yr	○	○	○	○	○	
	Agriculture	Mt CH4/yr	○	○	○	○	○	
	Energy Sector	Mt CH4/yr	○	○	○	○	○	
	Forest Burning	Mt CH4/yr	○	○	○	○	○	
	Grassland Burning	Mt CH4/yr	○	○	○	○	○	
	Industrial Sector	Mt CH4/yr	○	○	○	○	○	
	International Shipping	Mt CH4/yr	○	○	○	○	○	
	Peat Burning	Mt CH4/yr	○	○	○	○	○	
	Residential Commercial Other	Mt CH4/yr	○	○	○	○	○	
	Transportation Sector	Mt CH4/yr	○	○	○	○	○	
	Total	Mt CH4/yr	○	○	○	○	○	
	Waste	Mt CH4/yr	○	○	○	○	○	

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

Source：SSP Public Database Version 2.0

【Parameters in SSP Public Database Version2.0 7/10】
CMIP6 Emissions model：CO2, CO, HFC, N2O

SSP Public Database Version2.0

Category		Unit	SSP					Remark
Large	Medium		SSP1	SSP2	SSP3	SSP4	SSP5	
CO2	AFOLU	Mt CO2/yr	○	○	○	○	○	
	Aircraft	Mt CO2/yr	○	○	○	○	○	
	Energy Sector	Mt CO2/yr	○	○	○	○	○	
	Industrial Sector	Mt CO2/yr	○	○	○	○	○	
	International Shipping	Mt CO2/yr	○	○	○	○	○	
	Residential Commercial Other	Mt CO2/yr	○	○	○	○	○	
	Solvents Production and Application	Mt CO2/yr	○	○	○	○	○	
	Transportation Sector	Mt CO2/yr	○	○	○	○	○	
	Total	Mt CO2/yr	○	○	○	○	○	
	Waste	Mt CO2/yr	○	○	○	○	○	
CO	Agricultural Waste Burning	Mt CO/yr	○	○	○	○	○	
	Aircraft	Mt CO/yr	○	○	○	○	○	
	Energy Sector	Mt CO/yr	○	○	○	○	○	
	Forest Burning	Mt CO/yr	○	○	○	○	○	
	Grassland Burning	Mt CO/yr	○	○	○	○	○	
	Industrial Sector	Mt CO/yr	○	○	○	○	○	
	International Shipping	Mt CO/yr	○	○	○	○	○	
	Peat Burning	Mt CO/yr	○	○	○	○	○	
	Residential Commercial Other	Mt CO/yr	○	○	○	○	○	
	Transportation Sector	Mt CO/yr	○	○	○	○	○	
	Total	Mt CO/yr	○	○	○	○	○	
	Waste	Mt CO/yr	○	○	○	○	○	
HFC	—	Mt CO2-equiv/yr	○	○	○	○	○	
N2O	—	kt N2O/yr	○	○	○	○	○	

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

Source：SSP Public Database Version 2.0

【Parameters in SSP Public Database Version2.0 8/10】
CMIP6 Emissions model：NH3, NO2

SSP Public Database Version2.0

Category		Unit	SSP					Remark
Large	Medium		SSP1	SSP2	SSP3	SSP4	SSP5	
NH3	Agricultural Waste Burning	Mt NH3/yr	○	○	○	○	○	
	Agriculture	Mt NH3/yr	○	○	○	○	○	
	Aircraft	Mt NH3/yr	○	○	○	○	○	
	Energy Sector	Mt NH3/yr	○	○	○	○	○	
	Forest Burning	Mt NH3/yr	○	○	○	○	○	
	Grassland Burning	Mt NH3/yr	○	○	○	○	○	
	Industrial Sector	Mt NH3/yr	○	○	○	○	○	
	International Shipping	Mt NH3/yr	○	○	○	○	○	
	Peat Burning	Mt NH3/yr	○	○	○	○	○	
	Residential Commercial Other	Mt NH3/yr	○	○	○	○	○	
	Transportation Sector	Mt NH3/yr	○	○	○	○	○	
	Total	Mt NH3/yr	○	○	○	○	○	
	Waste	Mt NH3/yr	○	○	○	○	○	
NO2	Agricultural Waste Burning	Mt NOx/yr	○	○	○	○	○	
	Agriculture	Mt NOx/yr	○	○	○	○	○	
	Aircraft	Mt NOx/yr	○	○	○	○	○	
	Energy Sector	Mt NOx/yr	○	○	○	○	○	
	Forest Burning	Mt NOx/yr	○	○	○	○	○	
	Grassland Burning	Mt NOx/yr	○	○	○	○	○	
	Industrial Sector	Mt NOx/yr	○	○	○	○	○	
	International Shipping	Mt NOx/yr	○	○	○	○	○	
	Peat Burning	Mt NOx/yr	○	○	○	○	○	
	Residential Commercial Other	Mt NOx/yr	○	○	○	○	○	
	Transportation Sector	Mt NOx/yr	○	○	○	○	○	
	Total	Mt NOx/yr	○	○	○	○	○	
	Waste	Mt NOx/yr	○	○	○	○	○	

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

Source：SSP Public Database Version 2.0

【Parameters in SSP Public Database Version2.0 9/10】 CMIP6 Emissions model：OC, SF6, Sulfur

SSP Public Database Version2.0

Category		Unit	SSP					Remark
Large	Medium		SSP1	SSP2	SSP3	SSP4	SSP5	
OC	Agricultural Waste Burning	Mt OC/yr	O	O	O	O	O	
	Aircraft	Mt OC/yr	O	O	O	O	O	
	Energy Sector	Mt OC/yr	O	O	O	O	O	
	Forest Burning	Mt OC/yr	O	O	O	O	O	
	Grassland Burning	Mt OC/yr	O	O	O	O	O	
	Industrial Sector	Mt OC/yr	O	O	O	O	O	
	International Shipping	Mt OC/yr	O	O	O	O	O	
	Peat Burning	Mt OC/yr	O	O	O	O	O	
	Residential Commercial Other	Mt OC/yr	O	O	O	O	O	
	Transportation Sector	Mt OC/yr	O	O	O	O	O	
	Total	Mt OC/yr	O	O	O	O	O	
	Waste	Mt OC/yr	O	O	O	O	O	
SF6	—	kt SF6/yr	O	O	O	O	O	
Sulfur	Agricultural Waste Burning	Mt SO2/yr	O	O	O	O	O	
	Aircraft	Mt SO2/yr	O	O	O	O	O	
	Energy Sector	Mt SO2/yr	O	O	O	O	O	
	Forest Burning	Mt SO2/yr	O	O	O	O	O	
	Grassland Burning	Mt SO2/yr	O	O	O	O	O	
	Industrial Sector	Mt SO2/yr	O	O	O	O	O	
	International Shipping	Mt SO2/yr	O	O	O	O	O	
	Peat Burning	Mt SO2/yr	O	O	O	O	O	
	Residential Commercial Other	Mt SO2/yr	O	O	O	O	O	
	Transportation Sector	Mt SO2/yr	O	O	O	O	O	
	Total	Mt SO2/yr	O	O	O	O	O	
	Waste	Mt SO2/yr	O	O	O	O	O	

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

Source：SSP Public Database Version 2.0

【Parameters in SSP Public Database Version2.0 10/10】 CMIP6 Emissions model：VOC

SSP Public Database Version2.0

Category		Unit	SSP					Remark
Large	Medium		SSP1	SSP2	SSP3	SSP4	SSP5	
VOC	Agricultural Waste Burning	Mt VOC/yr	O	O	O	O	O	
	Aircraft	Mt VOC/yr	O	O	O	O	O	
	Energy Sector	Mt VOC/yr	O	O	O	O	O	
	Forest Burning	Mt VOC/yr	O	O	O	O	O	
	Grassland Burning	Mt VOC/yr	O	O	O	O	O	
	Industrial Sector	Mt VOC/yr	O	O	O	O	O	
	International Shipping	Mt VOC/yr	O	O	O	O	O	
	Peat Burning	Mt VOC/yr	O	O	O	O	O	
	Residential Commercial Other	Mt VOC/yr	O	O	O	O	O	
	Solvents Production and Application	Mt VOC/yr	O	O	O	O	O	
	Transportation Sector	Mt VOC/yr	O	O	O	O	O	
	Total	Mt VOC/yr	O	O	O	O	O	
	Waste	Mt VOC/yr	O	O	O	O	O	

※Listed parameters that is capable of extracting global data
※Listed parameters from 2005, ever 5 years between 2015~2100

Source：SSP Public Database Version 2.0

Appendix.

Appendix1. Parameter list

Appendix2. Physical risk assessment tools

Appendix3. Examples of scenario analysis

Appendix.

Provide useful materials for scenario analysis based on supporting case studies

Physical risk assessment tools referred in TCFD report

Tools at a global level	
WRI Aqueduct Atlas	■ Risk mapping tool that helps companies, investors, governments, and other users understand where and how water risks and opportunities are emerging worldwide
WBCSD Water Tool	■ A multifunctional resource for identifying corporate water risks and opportunities, including a workbook, a mapping functionality, and Google earth compatibility ■ Organizations can compare sites based on water availability, sanitation, population, and biodiversity
Global Agro- Ecological Zones	■ Based on he Global Agro-Ecological Zones (GAEZ) methodology for assessing agricultural resources and potential ■ Users can understand forecast changes in yields, production, and other outputs due to climate change.
Tools at a local / national level	
UK Climate Impact Programme	■ Gathered historical climate records and future climate projections ■ Climate projections cover low-, medium- and high- emissions scenarios and can be viewed through an online user interface and associated briefing report
US Interagency Archive of Downscaled Climate Data and Information	■ Provides an archive of simulated historical and future climatology and hydrology ■ Maintained at Lawrence Livermore National Lab by a consortium of federal and non-federal partners.. Information available from this archive is free and open to all
Management and Impacts of Climate Change (France)	■ Meteo-France is the primary provider of climate projections out to 2100, covering temperature, precipitation, and wind speeds, aligned with the IPCC's RCPs ■ Projections are provided for the medium term (2021-2050) and long term (2071-2100)

※Similar resources are available in other countries including, but not limited to, Australia, Canada, Germany, Japan, the Netherlands, and South Africa

Source：TCFD "The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities" p.28-29

Physical risk tools used in this project (excerpt)

#	Issuing agency	Tool name	URL	Subject Area	Explanation Related Page
1	**World Resources Institute (WRI)**	**Aqueduct Water Tool**	https://www.wri.org/aqueduct	**Global**	4-49
2	**AP-PLAT**	**Climate Impact Viewer**	https://adaptation-platform.nies.go.jp/en/ap-plat/	**Asia**	4-51
3	**World Bank**	**Climate Change Knowledge Portal**	http://sdwebx.worldbank.org/climateportal/	**Global**	4-50
4	**European Commission**	**European Climate Adaptation Platform (Climate-ADAPT)**	http://climate-adapt.eea.europa.eu/	**Europe**	— ※ European Adaptation Platform
5	**IPCC TGICA**	**IPCC Data Distribution Centre**	http://www.ipcc-data.org/	**Global**	— ※ Database of the Intergovernmental Panel on Climate Change (IPCC)

WRI AQUEDUCT Water Risk Atlas

AQUEDUCT Water Risk Atlas (WRI)

AQUEDUCT Water Risk Atlas

Issuing agency	**World Resource Institution**
Scenario	**Pessimistic / Business as usual / Optimistic**
Timeframe	**Baseline / 2030~2040**

Indicators

Indicators (Baseline)	
Physical risks (quantity)	• Water stress • Water Depletion • Interannual Variability • Seasonal Variability • Groundwater Table Decline • Riverine flood risk • Coastal flood risk • Drought Risk
Physical risks (quality)	• Untreated Connected Wastewater • Coastal Eutrophication Potential
Regulatory and reputational risk	• Unimproved / No Drinking Water • Unimproved / No Sanitation • Peak RepRisk Country ESG Risk Index

Indicators (2030-2040)

- Water Stress
- Seasonal Variability
- Water Supply
- Water Demand

Source：AQUEDUCT Water Risk Atlas https://www.wri.org/applications/aqueduct/water-risk-atlas/#/?advanced=false&basemap=hydro&indicator=w_awr_def_tot_cat&lat=30&lng=-80&mapMode=view&month=1&opacity=0.5&ponderation=DEF&predefined=false&projection=absolute&scenario=optimistic&scope=baseline&timeScale=annual&year=baseline&zoom=3

Climate Change Knowledge Portal (World Bank)

Climate Change Knowledge Portal

Issuing agency	World Bank
Scenario	RCP2.6 / 4.5 / 6.0 / 8.5
Timeframe	2020-2039 / 2040-2059 / 2060-2079/ 2080-2099

Source：World Bank, Climate Change Knowledge Portal
https://climateknowledgeportal.worldbank.org/country/japan/climate-data-projections

Indicators (excerpt)

Category	詳細
Essential Climate Variables	• Monthly Temperature • Monthly Maximum Temperature • Monthly Minimum Temperature • Monthly Precipitation
Temperature Indicators	• Maxima of Daily Tmax • Minima of Daily Tmin • Summer Days (Tmax > 25℃) • Tropical Nights (Tmin > 20℃) • Frost Days (Tmin < 0℃) • Ice Days (Tmax < 0℃) • Hot Day (Tmax > 35℃) • Hot Day (Tmax > 40℃) • Heat Index 35
Precipitation Indicators	• Days with Rainfall > 20mm • Maximum Monthly Rainfall (10-yr RL) • Maximum Monthly Rainfall (25-yr RL) • Days with Rainfall > 50mm • Rainfall of Very Wet Days • Maximum Daily Rainfall • Maximum 5-day Rainfall • Maximum Daily Rainfall (10-yr RL) • Maximum 5-day Rainfall • Maximum daily Rainfall (25-yr RL) • Maximum 5-day Rainfall (25-yr RL)
Agriculture Indicators	• Growing Season Length • Days of Consecutive Dry Spell • Days of Consecutive Wet Spell • Rainfall Seasonality

Climate Impact Viewer (AP-PLAT)

Climate Impact Viewer

Issuing agency	AP-PLAT
Scenario	RCP2.6 / 4.5 / 6.0 / 8.5
Timeframe	Current / Mid of 21th century / End of 21th century

Indicators

Climate	• Temperature • Precipitation
Water resources	• Falkenmark Index
Vegetation	• Net Primary Production • Vegetation carbon • Soil carbon pool • Net Biome Production • Soil erosion • Fire
健康	• Heat stress

Source：https://a-plat.nies.go.jp/ap-plat/asia_pacific/index.html

Appendix.

Appendix1. Parameter list

Appendix2. Physical risk assessment tools

Appendix3. Examples of scenario analysis

Appendix.

Provide useful materials for scenario analysis based on supporting case studies

Extract examples of the disclosure of scenario analysis that can be used as “reference” for further implementation

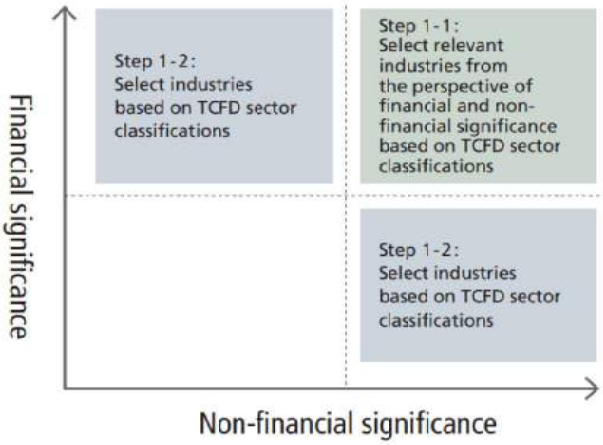
Analysis step	Stage	Examples of disclosure
For beginning scenario analysis	Prep ③ How the subjects for analysis are chosen	✓ Mitsubishi Corporation (Example ①-1)
2 Assess materiality of climate-related risks	Stage2 How the risks and opportunities associated with transition / physical risks are described	✓ Mitsubishi Corporation (Example ①-2) ✓ Sekisui Chemical Co., Ltd. (Example ②-1) ✓ JFEHD (Example ③-1)
3 Identify and define range of scenarios	Stage1 Which scenarios are used	✓ Sekisui Chemical Co., Ltd. (Example ②-2) ✓ BP (Example I) ✓ Downer Group (Example II)
4 Evaluate business impacts	Stage2 How the business impacts are described	✓ Mitsubishi Corporation (Example ①-3) ✓ JFEHD (Example ③-2) ✓ Kirin HD (Example ④) ✓ Atlantica Yield (Example III) ✓ BHP (Example IV) ✓ South32 (Example V)
5 Identify potential responses	Stage2 How resilience against climate change is described	✓ Hitachi, Ltd. (Example ⑤)

[Example①-1: Mitsubishi Corporation]
Mitsubishi Corporation selects the subjects of analysis from the sectors of business that has a large financial / non-financial impact and from TCFD recommendations

Company name and sector	Mitsubishi Corporation	Trading company

Point ① **Choose subjects for analysis**

- ✓ Scenario analysis chooses industries in which businesses with significant financial and non-financial impacts belong.
- ✓ Furthermore, based on TCFD Recommendations, industries belonging to 4 sectors (energy, transportation, materials and buildings, agriculture, food and forestry products) that are considered to have particularly large impacts on climate change are selected as target industries.



＊1：TCFD's four sector classifications

Sector	Main industries
Energy	Oil and gas, etc.
Transportation	Automobiles, passenger air, etc.
Materials and Buildings	Metals and mining, chemicals, etc.
Agriculture, Food and Forest Products	Food, agriculture, etc.

Source: Mitsubishi Corporation "ESG DATA BOOK 2019 "

[Example ①-2: Mitsubishi Corporation]
Mitsubishi Corporation assesses the significance of risks on a 3-point scale by multiplying the impact on demand and the impact on earnings. Also conducted risk assessments related to the value chain

Company name and sector	Mitsubishi Corporation	Trading company

Point ② **Assess materiality of climate-related risks**

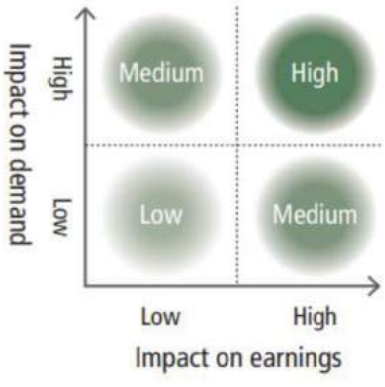
- ✓ Identify businesses with financial and non-financial significance
- ✓ Extract climate-related opportunities and risks under a 2° C scenario for each element of the industry value chain
- ✓ In the future, company plan to confirm the impact on each of our businesses, and to consider how to monitor them (including identifying indicators and setting targets), as well as strategies and risk management methods

Description about risk analysis in the value chain (Integrated report 2019)

- Moreover, after identifying businesses of major financial and non-financial importance according to each scenario, MC is performing a climate change opportunity and risk analysis for each element in the value chain.

Raw Materials	Trading	Manufacturing & Processing	Trading	Customers
Risk (small impact) Some infrastructure upgrades	Opportunities (large impact) Increase in transactions	Risk (large impact) Investments in carbon capture technologies and other infrastructure	Risk (small impact) Decrease in transactions	Opportunities (large impact) New business opportunities via market restructuring

- ✓ Each risk and opportunity is divided into "impact on demand" and "impact of earnings", and the impact of climate change is plotted and classified into large, medium, and small



Sources:Mitsubishi Corporation "ESG DATA BOOK 2019", "Integrated Report 2019"

[Example ①-3: Mitsubishi Corporation]

Mitsubishi Corporation conducts qualitative business impact evaluation

Company name and sector	Mitsubishi Corporation	Trading company

Point ③ **Evaluate business impacts**

Power Generation (Fossil Fuels)

	Awareness of the business environment under the NPS/RTS *1 Scenario	Awareness of the business environment under the 2°C (2DS/SDS) *2 Scenario
Demand Outlook	Significant decrease / Decrease / Slight decrease / Flat / Slight increase / Increase / Significant increase	Significant decrease / Decrease / Slight decrease / Flat / Slight increase / Increase / Significant increase
Awareness of the Business Environment	In order to respond to an increase in electricity demand, opportunities are anticipated for businesses such as renewable energy and clean gas-fired power generation. However, given the nature of power generation being produced locally for local consumption, MC feels it is important to continue managing businesses by responding to the policies, etc. of each country and region.	Business opportunities are expected to decline in line with the reduction of fossil fuel power generation amount from the 2020s. In the 2030s, it is anticipated that the strengthening of regulations including carbon taxes could increase the cost of existing thermal power plants, and the profit structure will further change as gas-fired power generation shifts to a dispatchable source of power. Moreover, from the 2040s, thermal power plants used for regulating supply and demand may also be required to reduce their CO_2 emissions, which could necessitate further reductions in operating hours.

Policies and Initiatives Based on the Awareness of the Business Environment

In the thermal power generation business, in addition to facilitating collaboration between its gas-fired power generation business which uses a fuel source with a lower environmental footprint, and its upstream natural gas business, MC is also strengthening its power trading function.
In line with "Transitioning to a Low-carbon Society", MC is taking steps such as converting to alternative fuel sources and raising the percentage of biomass co-combustion at existing coal-fired power plants. Furthermore, MC has adopted a policy not to enter into any new coal-fired power generation businesses, with the exception of projects which MC has already commenced development. Going forward, paying attention to factors including future technology trends for reducing CO_2 emissions (such as CCS), which will become necessary for promoting businesses while considering the environment, as well as progress towards achieving the energy mix of 2030 (including policy trends), MC will aim to reduce its coal-fired power generation capacity on a net equity basis based on 2°C scenario analyses. In the gas-fired power generation business as well, by conducting a risk analysis based on the impacts of climate change, MC will confirm the future outlook of the business and determine its strategic significance.
Furthermore, for the trading of components, MC has a policy to use best available technology (BAT) to the extent possible.

- ✓ Demand forecasts obtained from objective data (IEA WEO, ETP) are presented qualitatively
- ✓ Qualitatively describes the company's general perception of business environment based on demand forecasts
- ✓ **Qualitatively describes the impact analyses on the Company's business** based on the business climate perception for **the two scenarios of NPS/RTS scenario (scenario based on the targets set under the current Paris Agreement) and the 2° C scenario (scenario with a 2DS/SDS of 2° C or less)**
- ✓ Based on this, the company's policies and initiatives are described

Source: Mitsubishi Corporation "ESG DATA BOOK 2019"

[Example ②-1: Sekisui Chemical]

Sekisui Chemical conducted detailed risk analysis and deliberation on countermeasures

Company name and sector	Sekisui Chemical Co., Ltd.	Materials and Buildings (Chemicals)

Point ① **Assess materiality of climate-related risks**

Type	Climate change risk item	Rating	Business risk	Business opportunity	SEKISUI responses
Transition / Policy / regulation	Carbon tax hike	Large	<Medium- to long-term> ・Increase in energy procurement costs ・Decrease in sales due to shift to product prices	<Medium- to long-term> ・Acquire business opportunities by differentiating through early response ・Stabilization of energy costs by introducing renewable energy	・Increase internal awareness of in-house carbon pricing management through "Environment-Contributing Investments Promotion Measures" ・Increase effectiveness with commitments to society through SBT certification
	Energy saving/ low-carbon regulations	Large	<Short-term> ・Increase in capital investment to strengthen energy saving and renewable energy <Medium- to long-term> ・Increase in introduction costs for renewable energy certificates, etc.	<Short-term> ・Increased sales from energy conservation/storage/creation businesses ・Increased sales from CO_2-regulation compliant products	・Establish Environment-Contributing Investments quota (12 billion yen/3 years) ・Develop new energy creation technologies (Ex.: perovskite PV) ・Appropriate revision of green procurement standards ・Standardization of ZEH housing
	Policy	Large	<Short-term> ・Increase in renewable energy procurement and waste treatment costs <Medium- to long-term> ・Share reduction from loss of differentiation due to mandating of low-carbon products such as ZEH	<Short-term> ・Increased needs for CO_2 reducing technologies during waste incineration <Medium- long-term> ・Increase in sales of newly built homes due to expansion of ZEH market due to mandating of ZEH	・Development of technologies to create ethanol from garbage (Ex.: BR) ・Utilization of purchased electricity after FIT (Ex.: Smart Hom Denki) ・Expansion of Environment-Contributing Products (Net sales ratio 50%→100% (2030))
	Litigation	Medium	<Medium- to Long-term> ・Lawsuits against companies using fossil fuels	<Medium-term> ・Increase in business opportunities due to consumer trust earned from commitments to society	・Disclose long-term vision and long-term GHG reduction targets ・Improve standing in various external rating systems
	Technology / Transition to low-carbon products	Medium	<Short-term> ・Increase in re-authorization costs due to change of low-carbon materials <Medium-term> ・Changeover to lower-carbon materials and processes	<Short- to medium-term> ・Increase in business opportunities for Environment-Contributing Products that contributes to low-carbon emissions	・Use LCA evaluations in planning, development and marketing ・Use LCA evaluations in marketing ・Consider product development using bio-materials
	Market / Change in consumer behaviour	Medium	<Long-term> ・Decrease in sale of new cars	<Long-term> ・Increase in profitability from shift to higher-performance products ・Expansion of market for ICT-related products	・Develop strong heat-resistant, high durability and other high performance products ・Develop lightweight PV, heat dissipating products
	Market Uncertainty	Medium	<Long-term> ・Investments to stabilize power supply for dispersed renewable energies	<Long-term> ・Increase in sales of products to support a more dispersed society	・Sale of self-sufficient detached housing ・Development of resource recycling technologies (Ex.: BR)
	Reputation / Changes in consumer preferences	Medium	<Long-term> ・Decrease in sales due to increase preference for sharing over owning	<Long-term> ・Creation of new businesses to meet the preferences	・Begin services utilizing housing's data (Ex.: Smart Hom Denki)
	Industry criticism	Large	<Medium- to long-term> ・Decrease in investor evaluation for non-low carbon companies	<Short- to medium-term> ・Secure stable funding by demonstrating compatibility with resource recycling	・Utilization of purchased electricity after FIT
Physical / Acute	Frequent typhoons	Large	<Short-term> ・Damage such as increase in plant stoppages and decrease in sales ・Increase in flooding/flood control costs ・Decrease in sales due to supply chain disruption <Medium- to Long-term> ・Increase in insurance costs	<Short-term> ・Increase in needs for promoting resilient infrastructure ・Increase in sales of products for high water-related risk areas ・Increase in needs for equipment/facilities for disaster preparedness	・Understanding water risks and implement countermeasures ・Develop highly durable infrastructure ・Accelerate infrastructure renewal in developed nations (Ex.: DPR method) ・Expand infrastructural business in developing nations ・Develop disaster response products (Ex.: drinkby water storage systems)
	Heavy rain/ droughts	Large			
Chronic	Changes in rainfall patterns	Medium	<Short-term> ・Increase in costs for supply chain restructuring <Medium- to long-term> ・Increase in heat stroke/other warming-related illnesses ・Increase in cooling costs	<Short-term> ・Increase in sales of heat insulating/heat shielding products <Medium- to long-term> ・Increase in needs for pharmaceutical products/diagnostic drugs to contribute to treatments	・Encourage changes on the part of raw material suppliers in accordance to the procurement standards ・Globally disperse production bases ・Strengthen backup manufacturing support in accordance with increase in diseases
	Sea level rise	Medium			
	Rises in average temperatures	Medium			

- ✓ Risk assessments were conducted in 5 areas, taking into account financial impact and business growth potential. The time horizon, which is expected to be affected, is also mentioned
- ✓ Describes the expected impact of each item in detail, although it is qualitative

Source:S "SEKISUI CHEMICAL Group's Response to Climate Change : Information Disclosure based upon the TCFD Statement of Support"

[Example ②-2: Sekisui Chemical]

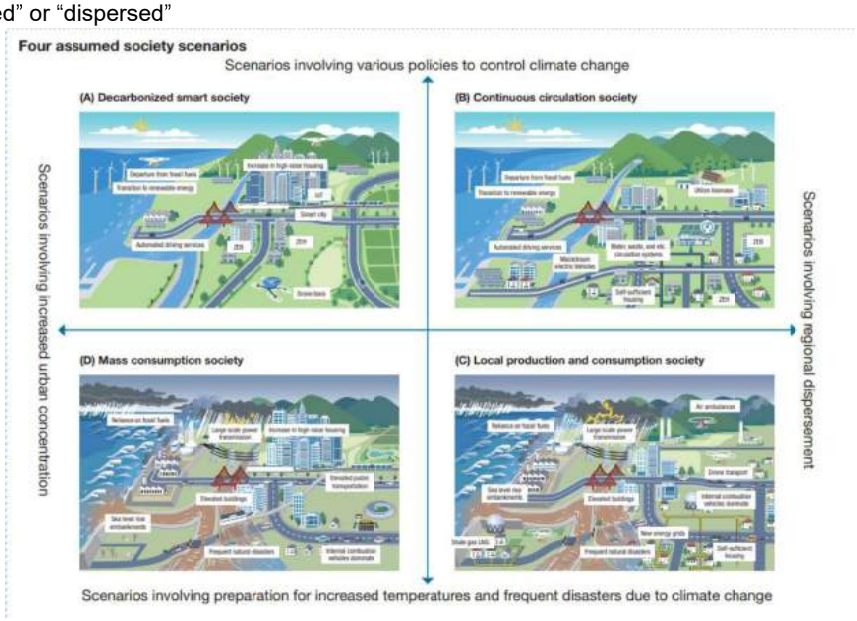
Sekisui Chemical sets specific original scenarios when identify and define a range of scenarios

Company name and sector	Sekisui Chemical Co., Ltd.	Materials and Buildings (Chemicals)

Point ②

Identify and define range of scenarios

- ✓ Assuming four unique scenario-based societies
- ✓ ① Analyses are based on two axes: climate change scenario (2° C scenario: RCP2. 6, 4° C scenario: RCP8. 5), ② social system transition to “centralized” or “dispersed”



Source: Sekisui Chemical Integrated Report 2019

[Example ③-1:JFE Holdings]

JFE Holdings conducts risk assessments incorporating impact and external perspectives

Company name and sector	JFE Holdings	Materials and Buildings (Iron and steel)

Point ①

Assess materiality of climate-related risks

- ✓ Selection of risk and opportunity factors that affect business in two stages
- ✓ After getting a comprehensive overview of the factors in the value chain, consider the degree of impact on the factors and stakeholder expectations and concerns, and identify the factors considered to be important
- ✓ Evaluation of risk and opportunity factors based on the 2° C and 4° C scenarios

	2°C scenario	4°C scenario
Impact on procurement		5. Procurement of raw materials becomes unstable due to increased frequency in climate disasters
Impact on direct business operations	1. Decarbonization in steel production processes 2. Increase in demand for the effective use of steel scraps	6. Damages to business bases due to climate disasters
Impact on demand for products and services	3. Change in demand for steel for automobiles and others 4. Increase in demand for solutions promoting decarbonization	7. National resilience

Impact × Expectations and concerns of stakeholders → Identifying important factors

Criteria for identifying important factors: • Impact (possibility of risk opportunities × impact upon occurrence) • Expectations and concerns of stakeholders

Source: JFE GROUP REPORT 2019 - Integrated Report -

[Example ③-2:JFE Holdings]

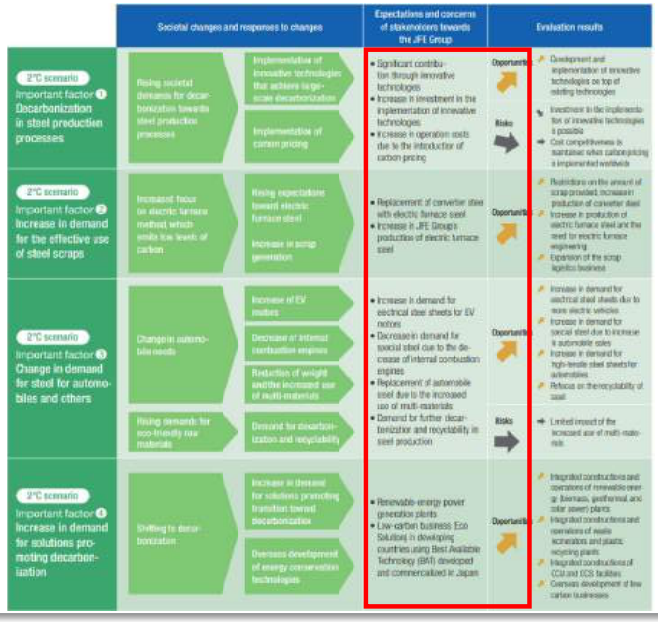
JFE Holdings conducts detailed business impact evaluation (qualitative)

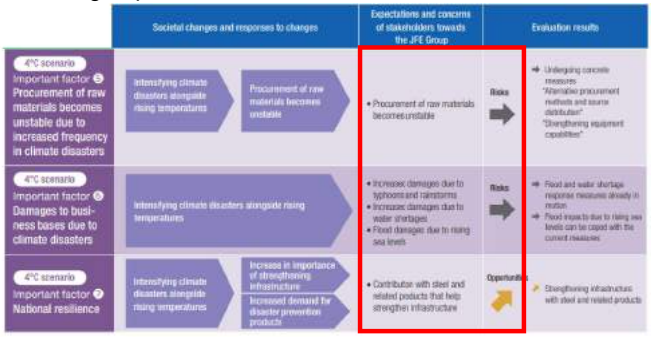
Company name and sector	JFE Holdings	Materials and Buildings (Iron and steel)

Point ②

Evaluate business impacts

- ✓ Qualitatively (with arrows) assess identified risk and opportunity factors
- ✓ Detailed descriptions are provided, and stakeholders' perspectives on the group are also mentioned





Source: JFE GROUP REPORT 2019 - Integrated Report -

[Example ④: Kirin Holdings]

Kirin quantitatively describes the yield of major agricultural products

Company name and sector	Kirin Holdings	Agriculture, food and forestry products (Foods)

Point ①

Impact evaluation on yields of major agricultural products

Impact of climate change on major agricultural product yields/land suitable for cultivation

Legend: Negative/positive impact of less than 10% ▲/+
From 10% to less than 50% ▲▲/++
50% or more ▲▲▲/+++

Agricultural products	Kirin Group Scenario3: 4°C, unwanted world, 2050			
	United States	Asia	Europe/Africa	Oceania
Barley		West Asia Yield▲/+ South Korea Yield+	Finland Spring wheat yield▲ Mediterranean coast (West) yield▲, (East) yield+ France Winter barley and spring barley: Both yields▲	Western Australia Yield▲▲
Hops			Czech Republic Yield▲	
Black tea		Sri Lanka Yields down in lowlands Little impact of temperature rise in highlands India (Assam region) For each 1°C temperature rise above average temperature of 28°C, yields down 3.8% India (Darjeeling region) Yield▲▲~▲▲▲ (Sources from tea industry, not academic papers)	Kenya Rise in altitude of suitable cultivation land Major contraction of suitable cultivating land in Nandhi region and western Kenya Kenyan mountain regions will remain suitable for cultivation Malawi Chitipa district: Suitable land▲▲▲ Nkhata Bay district: Suitable land▲▲▲ Mulanje district: Suitable land++ Thyolo district: Suitable land++	
Wine grapes	United States (California) Suitable land ▲▲▲ Northwestern United States Suitable land +++ Chile Suitable land ▲▲	Japan (Hokkaido) Expansion of suitable land Enable cultivation of Pinot Noir Japan (Central Honshu) Suitable land expanded on the one hand, but high-temperature damage also caused	Northern Europe Suitable land: +++ Mediterranean coast Suitable land: ▲▲▲ Spain Production volumes▲to▲▲ Western Cape, South Africa Suitable land: ▲▲▲	New Zealand Suitable land: +++ Southern coastal regions of Australia Suitable land: ▲▲▲ Outside southern coastal regions of Australia Suitable land: ▲▲
Coffee beans	Brazil Suitable land for Arabica: ▲▲▲ Suitable land for Robusta: ▲▲▲	Southeast Asia Suitable land for Arabica: ▲▲▲ Suitable land for Robusta: ▲▲▲	East Africa Suitable land for Arabica: ▲▲ Suitable land for Robusta: ▲▲	
Corn	Southwestern United States Yield ▲▲ United States (Iowa in mid-West) Yield ▲~▲▲			

- ✓ The quantitative changes in the yields of major agricultural products (barley, hops, tea leaves, wine grapes, coffee beans, and corn) in the major regions (the United States, Asia, Europe, Africa, and Oceania) under the 4° C scenario in 2050 are described

Source: Kirin Group Environmental Report 2019

[Example ④: Kirin Holdings]

Kirin qualitatively describes the impact assessment of water stress

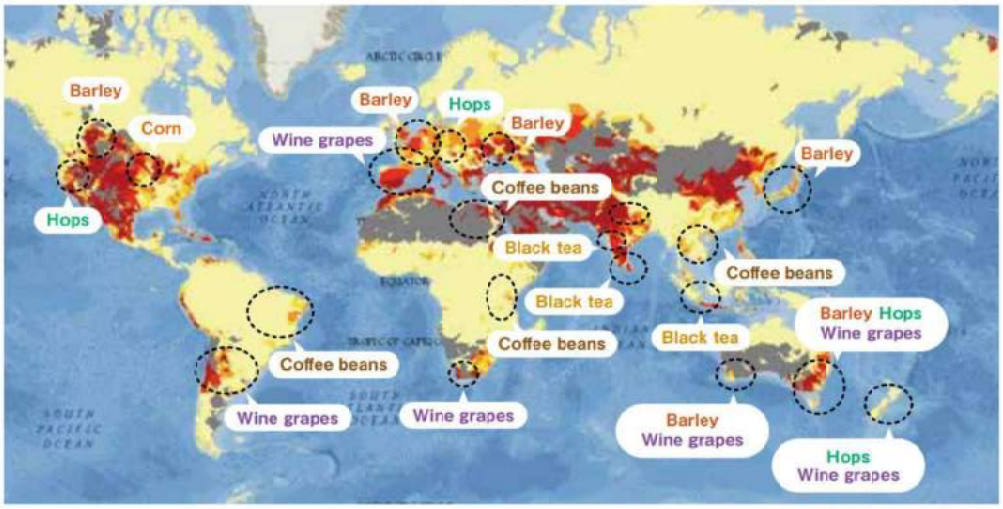
Company name and sector	Kirin Holdings	Agriculture, food and forestry products (Foods)

Point ②

Impact evaluation of water stress in primary production areas

- ✓ Water stress in primary agricultural land in 2040 and indication of each agricultural product procured
- ✓ Using the WRI heat map, the areas with high impact of water stress are shown qualitatively

Water stress in major agricultural production regions (2040, equivalent to Kirin Group Scenario 3)



Source: Kirin Group Environmental Report 2019

[Case ④: Kirin Holdings]

Kirin quantitatively describes the impact assessment of carbon pricing

Company name and sector	Kirin Holdings	Agriculture, food and forestry products (Foods)

Point ③

Impact evaluation of carbon pricing

- ✓ Regarding the impact evaluation under the 2° C and 4° C scenarios for carbon pricing in 2030, the impacts in the case of tackling and not tackling GHG reduction targets are quantitatively described

Assessment of impact of carbon pricing

In event of inaction on medium-term GHG emission reduction target of 30% by 2030

Kirin Group Scenario1:2℃, sustainable deverepment
Kirin Group Scenario1:4℃, unwanted world

	Kirin Group Scenario 3		Kirin Group Scenario 1	
	2025	2040	2025	2040
Estimate cost of impact (unit: 1,000 USD)	10,944	14,448	51,268	80,374
Estimate cost of impact (unit: 1 million JPY)	**1,215**	**1,604**	**5,691**	**8,921**

In event of achievement of medium-term GHG emission reduction target of 30% by 2030

	Kirin Group Scenario 3		Kirin Group Scenario 1	
	2025	2040	2025	2040
Estimate cost of impact (unit: 1,000 USD)	8,956	6,905	41,958	38,411
Estimate cost of impact (unit: 1 million JPY)	**994**	**766**	**4,657**	**4,264**

* Calculated by multiplying assumed CO_2 emissions in 2025/2040 by carbon price forecasts

Source: Kirin Group Environmental Report 2019

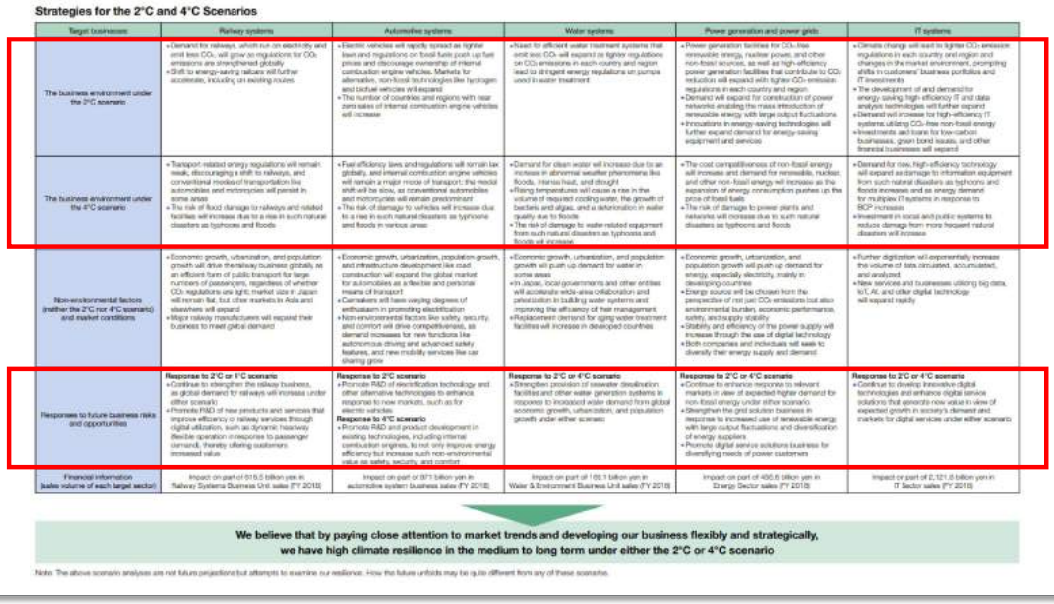
[Example ⑤: Hitachi, Ltd.]

Hitachi, Ltd. summarizes the business environment for each scenario and division, and describes how to respond to future business risks and business opportunities

Company name and sector	Hitachi, Ltd.	Electric and Electronic

Point ① **Identify potential responses**

✓ Describes the business environment for the five businesses (railway systems, automotive systems, water systems, power generation and power grids, and IT systems) in each scenario (2° C and 4° C), as well as related responses and business opportunities



Strategies for the 2°C and 4°C Scenarios

Target businesses	Railway systems	Automotive systems	Water systems	Power generation and power grids	IT systems
The business environment under the 2°C scenario	•Demand for railways, which run on electricity and emit less CO_2, will grow as regulations for CO_2 emissions are strengthened globally •Shift to energy-saving railcars will further accelerate, including on existing routes	•Electric vehicles will rapidly spread as tighter laws and regulations on fossil fuels push up fuel prices and discourage ownership of internal combustion engine vehicles. Markets for alternative, non-fossil technologies like hydrogen and biofuel vehicles will expand •The number of countries and regions with near zero sales of internal combustion engine vehicles will increase	•Need to efficient water treatment systems that emit less CO_2 will expand as tighter regulations on CO_2 emissions in each country and region lead to stringent energy regulations on pumps used in water treatment	•Power generation facilities for CO_2-free renewable energy, nuclear power, and other non-fossil sources, as well as high-efficiency power generation facilities that contribute to CO_2 reduction will expand with tighter CO_2 emission regulations in each country and region •Demand will expand for construction of power networks enabling the mass introduction of renewable energy with large output fluctuations •Innovations in energy-saving technologies will further expand demand for energy-saving equipment and services	•Climate change will lead to tighter CO_2 emission regulations in each country and region and changes in the market environment, prompting shifts in customers' business portfolios and IT investments •The development of and demand for energy-saving high-efficiency IT and data analysis technologies will further expand •Demand will increase for high-efficiency IT systems utilizing CO_2-free non-fossil energy •Investments and loans for low-carbon businesses, green bond issues, and other financial businesses will expand
The business environment under the 4°C scenario	•Transport-related energy regulations will remain weak, discouraging a shift to railways, and conventional modes of transportation like automobiles and motorcycles will persist in some areas •The risk of flood damage to railways and related facilities will increase due to a rise in such natural disasters as typhoons and floods	•Fuel efficiency laws and regulations will remain lax globally, and internal combustion engine vehicles will remain a major mode of transport; the modal shift will be slow, as conventional automobiles and motorcycles will remain predominant •The risk of damage to vehicles will increase due to a rise in such natural disasters as typhoons and floods in various areas	•Demand for clean water will increase due to an increase in abnormal weather phenomena like floods, intense heat, and drought •Rising temperatures will cause a rise in the volume of required cooling water, the growth of bacteria and algae, and a deterioration in water quality due to floods •The risk of damage to water-related equipment from such natural disasters as typhoons and floods will increase	•The cost competitiveness of non-fossil energy will increase, and demand for renewable, nuclear, and other non-fossil energy will increase as the expansion of energy consumption pushes up the price of fossil fuels •The risk of damage to power plants and networks will increase due to such natural disasters as typhoons and floods	•Demand for low, high-efficiency technology will expand as damage to information equipment from such natural disasters as typhoons and floods increases and as energy demand for multiple IT systems in response to BCP increases •Investment in social and public systems to reduce damage from more frequent natural disasters will increase
Non-environmental factors (neither the 2°C nor 4°C scenario) and market conditions	•Economic growth, urbanization, and population growth will drive the railway business globally, as an efficient form of public transport for large numbers of passengers, regardless of whether CO_2 regulations are tight; market size in Japan will remain flat, but cities' markets in Asia and elsewhere will expand •Major railway manufacturers will expand their business to meet global demand	•Economic growth, urbanization, population growth, and infrastructure development like road construction will expand the global market for automobiles as a flexible and personal means of transport •Carmakers will have varying degrees of enthusiasm in promoting electrification •Non-environmental factors like safety, security, and comfort will drive competitiveness, as demand increases for new functions like autonomous driving and advanced safety features, and new mobility services like car sharing grow	•Economic growth, urbanization, and population growth will push up demand for water in some areas •In Japan, local governments and other entities will accelerate wide-area collaboration and privatization in building water systems and improving the efficiency of their management •Replacement demand for aging water treatment facilities will increase in developed countries	•Economic growth, urbanization, and population growth will push up demand for energy, especially electricity, mainly in developing countries •Energy source will be chosen from the perspective of not just CO_2 emissions but also environmental burden, economic performance, safety, and supply stability •Stability and efficiency of the power supply will increase through the use of digital technology •Both companies and individuals will seek to diversify their energy supply and demand	•Further digitization will exponentially increase the volume of data circulated, accumulated, and analyzed •New services and businesses utilizing big data, IoT, AI, and other digital technology will expand rapidly
Responses to future business risks and opportunities	**Response to 2°C or 1°C scenario** •Continue to strengthen the railway business, as global demand for railways will increase under either scenario •Promote R&D of new products and services that improve efficiency in railway services through digital utilization, such as dynamic headway flexible operation in response to passenger demand, thereby offering customers increased value	**Response to 2°C scenario** •Promote R&D of electrification technology and other alternative technologies to enhance response to new markets, such as for electric vehicles **Response to 4°C scenario** •Promote R&D and product development in existing technologies, including internal combustion engines, to not only improve energy efficiency but increase such non-environmental value as safety, security, and comfort	**Response to 2°C or 4°C scenario** •Strengthen provision of seawater desalination facilities and other water generation systems in response to increased water demand from global economic growth, urbanization, and population growth under either scenario	**Response to 2°C or 4°C scenario** •Continue to enhance response to relevant markets in view of expected higher demand for non-fossil energy under either scenario •Strengthen the grid solution business in response to increased use of renewable energy with large output fluctuations and diversification of energy suppliers •Promote digital service solutions business for diversifying needs of power customers	**Response to 2°C or 4°C scenario** •Continue to develop innovative digital technologies and enhance digital service solutions that generate new value in view of expected growth in society's demand and markets for digital services under either scenario
Financial information (sales volume of each target sector)	Impact on part of 515.5 billion yen in Railway Systems Business Unit sales (FY 2018)	Impact on part of 971 billion yen in automotive system business sales (FY 2018)	Impact on part of 183.1 billion yen in Water & Environment Business Unit sales (FY 2018)	Impact on part of 466.6 billion yen in Energy Sector sales (FY 2018)	Impact on part of 2,121.6 billion yen in IT Sector sales (FY 2018)

We believe that by paying close attention to market trends and developing our business flexibly and strategically, we have high climate resilience in the medium to long term under either the 2°C or 4°C scenario

Note: The above scenario analyses are not future projections but attempts to examine our resilience. How the future unfolds may be quite different from any of these scenarios.

Source: Hitachi, Ltd. Sustainability Report 2019

[Case I: BP]

Analyzes global trends in energy supply and demand, and refers to technologies required to achieve the 2℃ target by sector

Country Name Company name and sector	United Kingdom	BP	Energy

Point ① **Identify and define range of scenarios for each sector**

✓ Analysis of **<u>global energy supply and demand trends (by region and fuel)</u>** by 2040, **<u>based on four scenarios</u>**

✓ Evolving transition (ETs): Based on scenarios in which policies, regulations, and technological developments move in the same way as in recent years.
In addition, the RT scenario based on the 2° C target, the ME scenario in which energy demand increases, and the LG scenario in which globalization slows down are set

✓ Quantitatively describe the technologies and countermeasures required to achieve the 2° C target and the reduction effects **<u>for each sector (industry, construction, transportation, electricity)</u>**

Technologies and measures for each sector and CO2 reductions (emissions) under the ET scenarios

Detailed examples of next-generation technologies that contribute to reducing emissions in each sector

Source: BP "Energy Outlook 2019 edition"

[Case II: Downer Group]

SSPs are used as scenarios in the Downer Group, a construction/infrastructure-related company

Country Name Company name and sector	Australia	Downer Group	Construction and infrastructure

Point ① **Identify and define range of scenarios**

- ✓ In addition to RCPs, range of scenarios including SSPs (Shared Socio-economic Pathways)
- ✓ **Scenario analyses were conducted based on four scenarios: Sustainability (2° C + SSP1 (sustainable scenario)), Follower (2° C + SSP4 (gap scenario)), Fossil Fuel development (4° C + SSP5 (fossil-fuel-dependent development scenario)), and Global decline (4° C + SSP3 (regional segmentation scenario)).**
- ✓ The results of the scenario analysis are as follows
  - ✓ Downer strategies are resilient in all scenarios
  - ✓ Significant opportunities in scenarios below 2° C
  - ✓ To this end, significant decarbonization needs to be advanced by 2030

Definition of 4 Scenarios Using SSPs

Scenarios	
Sustainability	~2 degrees global warming (SSP 1- RCP 2.6)
Follower	~2 degrees global warming (SSP 4- RCP 2.6)
Fossil fuel development	~4 degrees global warming (SSP 5- RCP 8.5)
Global decline	~4 degrees global warming (SSP 3- RCP 8.5)

Source: "Downer Annual Report 2019"

[Case III: Atlantica Yield]

Estimates the quantitative business impact of changes in climate patterns and temperature increases on the company

Country Name Company name and sector	Spain	Atlantica Yield	Power & Utility

Point ①

Cost increase due to changes in climate patterns

- ✓ Changes in climate patterns reduce rainfall and reduce the amount of water stored in the aquifer
- ✓ Need to expand water purification facilities in-house, and consumption of chemicals for water purification will increase by 10% per year

Business impact

Annual cost increase of USD 800,000

Point ②

Cost increase due to higher temperature

- ✓ Estimated annual reduction of 0.04-0.21% in the company's turbine efficiency when temperature rises by 1° C

Business impact

Annual cost increase of USD 300,000

Point ③

Increase in costs of solar and wind power generation due to higher temperature

- ✓ In the case of solar power generation, it is estimated that the module efficiency will decrease by 0.39% due to a temperature increase of 1° C
- ✓ In wind power generation, the air density decreases by 0.34% when the temperature rose by 1° C. Annual power generation is estimated to decrease by 1.2GWh

Business Impact (Solar)

Annual cost increase of USD 50,000

Business impact (wind power generation)

Annual cost increase of USD 100,000

Source: Atlantica ESG Report 2018 (Atlantica Yield)

[Case IV: BHP]

BHP uses arrows to evaluate the possible impact on each commodity price during the transition to the 2° C scenario

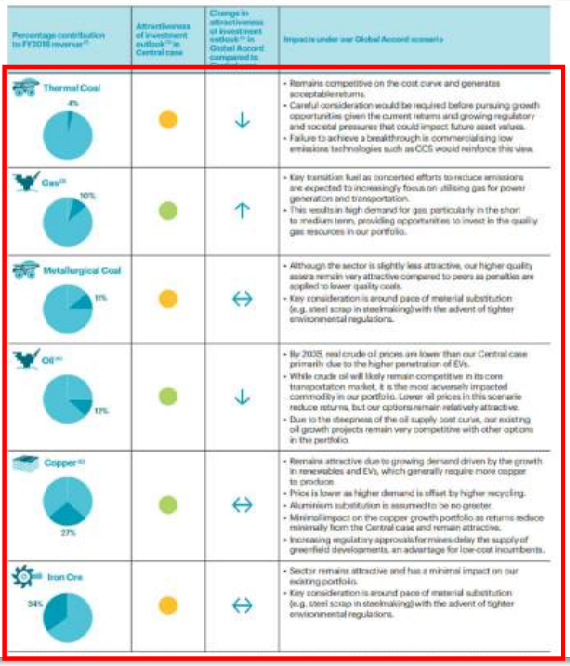
Country Name Company name and sector	Australia	BHP	Mining

Point ①

Business impact evaluation

Evaluation of the impact of transition to a 2° C scenario for each commodity

- ✓ Analyze four scenarios: New Gear (a scenario in which innovation brings about gradual economic development in developed countries); Closed Doors (a scenario of low-growth economic policies due to nationalism and protectionism, etc.); Global Accord (a scenario in which technological development is proceeding while coordinating toward a 2° C target); and Two Giants (a scenario in which technological growth is centered around the United States and China)
- ✓ To analyze the impact on prices of commodities over the next 10 years (as of 2016) that could occur in transitioning to the baseline Global Accord scenarios
- ✓ 6 types of commodities: **thermal coal, gas, metallurgical coal, oil, copper, iron ore**



Source: BHP "Climate Change ; Portfolio Analysis Views after Paris"

[Example V: South32]

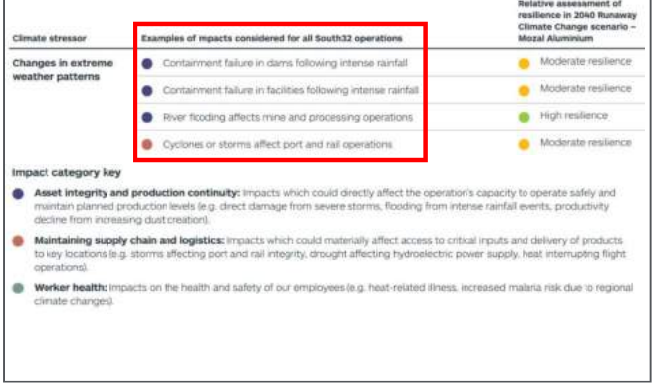
Assessment of risk significance by value chain and business impact evaluation by site

Country Name Company name and sector	Australia	South32	Mining

Point ①

Impact Assessment by Value Chain

- ✓ Evaluation of the risk of climate change in the Mozambique aluminum mining business is qualitatively listed by direct operation, supply chain, and employee health impact (see example below)
- ✓ In addition, the company assesses the degree of resilience to risk items on a 5-point scale



Point ②

Business Impact Evaluation by Site

- ✓ Qualitatively analyze the impact of the company's climate change by site (Australia, South Africa, Mozambique, Colombia) (example below)

Business Impact Assessment in Northern Australia

GEMCO (manganese)

Adaptation focus indicated under the Runaway Climate Change scenario

- More cyclone events may severely damage port infrastructure. Adaptation options include designing for greater tolerances, or infrastructure that can be installed and reinstated quickly.

Business Impact Evaluation in South Africa

Hillside Aluminium

Adaptation focus indicated under the Runaway Climate Change scenario

- Power supply to operations may be interrupted during heatwaves. Adaptation is heavily reliant upon the power provider to enhance reliability and capacity of generation, transmission and distribution facilities.

Source:South32 “Our Approach to Climate Change 2019”

Ministry of the Environment, Government of Japan
Climate Change Policy Division

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