Appendix.

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

Appendix4. List of TCFD-related reports

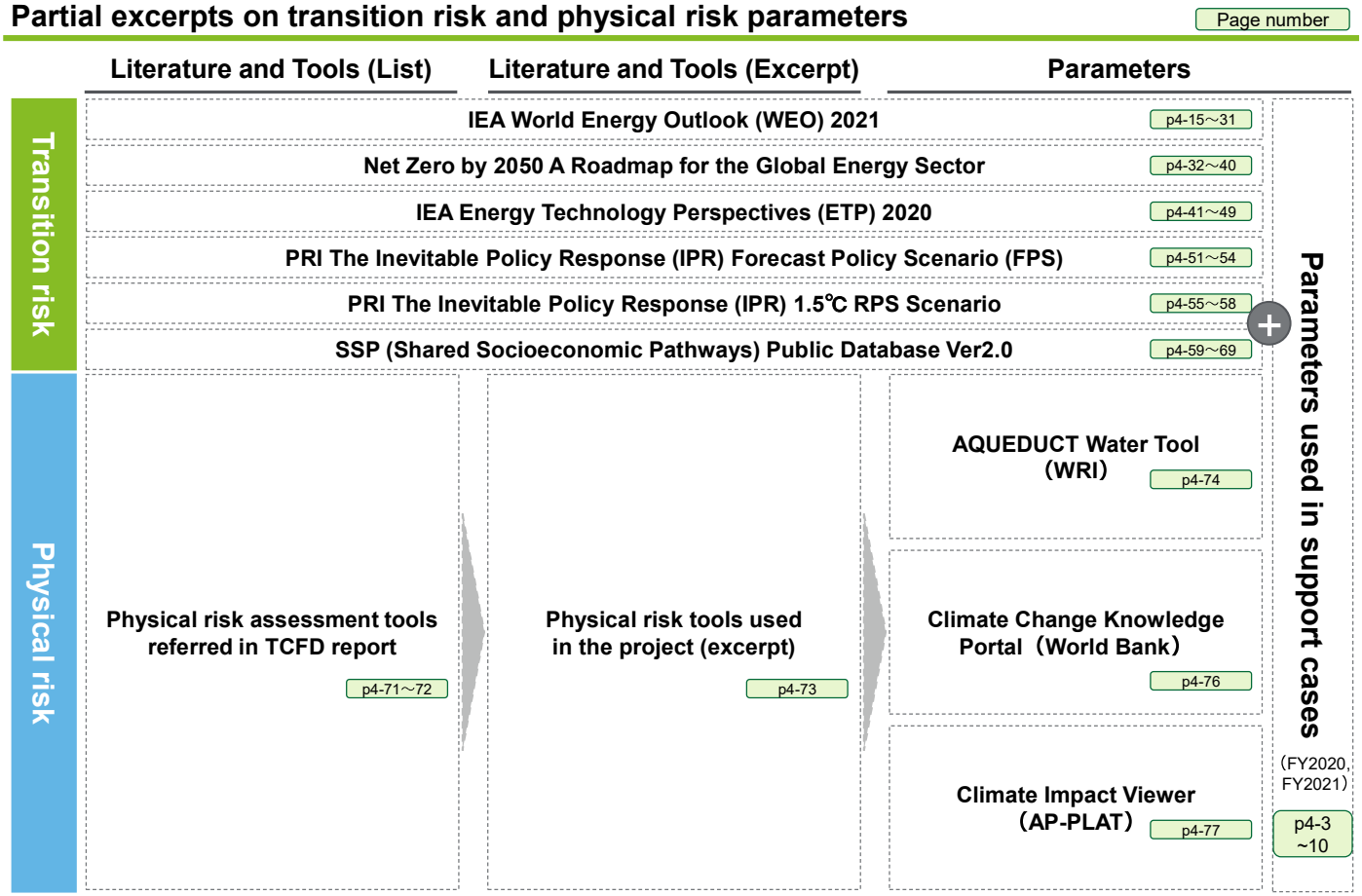
Appendix.

Provide useful materials for scenario analysis based on supporting case studies

4-1

[Summary of parameter list]

Partial excerpts on transition risk and physical risk parameters



4-2

※Data on parameters as of February 2022

[Parameters referenced in support cases]
Transition risk (1/5)

	Item	Parameter	Source	Reference: Companies referenced parameters
Transition risk	**Carbon price**	Carbon tax	• IEA WEO2019, WEO2020, NZE2050, WEO2021 • PRI IPR FPS • Information of countries • Ministry of the Environment "Introduction of Taxes to Combat Global Warming" • IPCC "Mitigation Pathways Compatible with 1.5℃ in the Context of Sustainable Development" Below 1.5℃ pathway	ASKUL Corporation, ORIX Asset Management Corporation, Kyushu Railway Company, Shin-Etsu Chemical, Mitsui Mining & Smelting, YASKAWA Electric Corporation, SCSK Corporation, GUNZE, Nishi-Nippon Railroad, Nippon Paper Industries, Fuji Oil Company, Maruha Nichiro Corporation, UACJ Corporation
		Border carbon	• IEA WEO2021 • Ministry of the Environment "Recent Developments in Carbon Tax and Border Adjustment Measures" • ICAP (Average of EU-ETS in 2020)	Fuji Oil Company, UACJ Corporation
		Electricity price	• IEA WEO2018, WEO2020	ASKUL Corporation, ORIX Asset Management Corporation, Kyushu Railway Company, Mitsui Mining & Smelting, SCSK Corporation, GUNZE, Nishi-Nippon Railroad, Nippon Paper Industries, UACJ Corporation
	Carbon emissions targets/policies in each country	Target values for emissions	• Ministry of the Environment's "Draft Japanese Commitments," "Toward Significant Reductions in Greenhouse Gases by 2050" • IEA ETP2020 • Target set by countries • Ministry of Foreign Affairs of Japan "Climate Change: Japan's Emission Reduction Targets" • Ministry of Foreign Affairs of Japan "Domestic and International Developments Concerning Carbon Neutrality in 2050" • Agency for Natural Resources and Energy "Basic Energy Plan" • UNFCCC "Thailand's Updated Nationally Determined Contribution" (October 2020)	Kyushu Railway Company, Shin-Etsu Chemical, YASKAWA Electric Corporation, SCSK Corporation, Nippon Paper Industries, Fuji Oil Company, UACJ Corporation
		Target unmet penalty amount	• IEA WEO2021	Fuji Oil Company
		Annual target of forest area decrease	• Indonesia NDC "First Nationally Determined Contribution REPUBLIC of INDONESIA"	ASKUL Corporation
		Spread of environmentally friendly vehicles (EVs and FC buses)	• IEA WEO2020, NZE2050	Nishi-Nippon Railroad
	Carbon emissions targets/policies in each country (Logging tax)	Logging tax	• Forestry Agency "Forest Environment Tax and Forest Environment Transfer Tax • Customs and Tariff Bureau, Ministry of Finance "Overview of the TPP11 Agreement (CPTPP) (tax rate differences, etc.) • Forestry Agency "Provision of Information on Legally Logged Timber, etc.	Nippon Paper Industries

 ※ 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]
Transition risk (2/5)

	Item	Parameter	Source	Reference: Companies referenced parameters
Transition risk	**Carbon emissions targets/policies in each country (Plastic Regulation)**	Recycled plastic usage rate	• EU Government • Plastic Recycling and Reuse Association, European Plastics Strategy • JPCA • EU Technical Expert Group (TEG), "Taxonomy Report Technical Annex"	ASKUL Corporation, Shin-Etsu Chemical, GUNZE, Fuji Oil Company
	Changes in the energy mix	Power Generation Mix (Japan)	• IEA WEO2019,2020, 2021 • PRI IPR FPS2019 • Japanese Government • Agency for Natural Resources and Energy "Outline of the Basic Energy Plan (Draft 2)"	Kyushu Railway Company, Mitsui Mining & Smelting, YASKAWA Electric Corporation, SCSK Corporation, Nippon Paper Industries
		Fuel price increase/decrease rate	• IEA WEO2020, NZE2050	Nishi-Nippon Railroad
		Oil supply	• IEA WEO2021	Fuji Oil Company
	Dissemination of renewable energy and energy-saving technologies	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"	ASKUL Corporation, Kyushu Railway Company, Shin-Etsu Chemical
		EV rate of new vehicles	• IEA Global EV Outlook2021	SCSK Corporation, Nippon Paper Industries
		EU Inventory	• IEA WEO2021	UACJ Corporation
		Global Telecommunications Volume Trends	• Cisco "Global IP Traffic Forecast by Cisco VNI, 2018-2023" • Nomura Research Institute, "Nomura Research Institute, Outlook for ICT and Media Market Size and Trends through FY2025" • SMART CITY PROJECT	SCSK Corporation
	Development of next-generation technologies	Spread of environmentally friendly trains	• East Japan Railway Company "Production of hybrid vehicle (fuel cell) test vehicle using hydrogen as energy source and implementation of demonstration test" June 2019	Kyushu Railway Company
		Change in the number of passengers between private cars and buses due to decarbonization	• IEA NZE2050	Nishi-Nippon Railroad

 ※ 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]
Transition risk (3/5)

	Item	Parameter	Source	Reference: Companies referenced parameters
Transition risk	**Changes in important products/ prices**	Recycled Aluminum Utilization Rate	• IAI “1.5 DEGREES SCENARIO A MODEL TO DRIVEEMISSIONS REDUCTION” • National Institute for Environmental Studies, “Estimating the Impacts of Carbon Constraints on Metal Production and Use on a Global Scale” (2021)	UACJ Corporation
		Aluminum price	• World Bank “World Bank Commodities Forecast”	UACJ Corporation
		Copper demand forecast	• Sebastiaan Deetman et al “Scenarios for demand growth of metals in electricity generation technologies, cars and electronic appliances”	Mitsui Mining & Smelting
		Zinc demand forecast	• World Bank “The Growing Role of Minerals and Metals for a Low Carbon Future“	Mitsui Mining & Smelting
		Lead demand forecast	• World Bank “The Growing Role of Minerals and Metals for a Low Carbon Future“	Mitsui Mining & Smelting
		cobalt, nickel, and platinum demand forecast	• World Bank “The Growing Role of Minerals and Metals for a Low Carbon Future“	Mitsui Mining & Smelting
		Aluminum demand forecast	• CM group, IAI “AN ASSESSMENT OF GLOBAL MEGATRENDS AND REGIONAL AND MARKET SECTOR GROWTH OUTLOOK FOR ALUMINIUM DEMAND” (2020)	UACJ Corporation
		Fuel price (Oil price, coal price, natural gas price)	• IEA WEO2020, NZE2050, WEO2021 • Agency for Natural Resources and Energy ″Basic Energy Plan″	ASKUL Corporation, Kyushu Railway Company, Shin-Etsu Chemical, Mitsui Mining & Smelting, GUNZE, Nishi-Nippon Railroad, Fuji Oil Company, UACJ Corporation
		Iron price	• 2ii “The Transition Risk-o-Meter Reference Scenarios for Financial Analysis”	Kyushu Railway Company
		Energy intensity	• Japanese government	Shin-Etsu Chemical
		Smart city market size and M2M traffic	• SMART CITY PROJECT “Smart Cities, the world's most important national strategy″ • Statista “Smart City Market revenue worldwide 2019 – 2025, by segment”	Shin-Etsu Chemical

 ※ 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]
Transition risk (4/5)

	Item	Parameter	Source	Reference: Companies referenced parameters
Transition risk	**Changes in important products/ prices**	Industrial robot market size in major countries	• Japanese Government and others	Shin-Etsu Chemical
		Sales of sustainable certified product	• Nielsen “Product Insider”	ASKUL Corporation, Nippon Paper Industries
		Purchase intention by ethical consumption	• Dentsu, “Ethical Consumption Awareness Survey 2020” • Deloitte, “Millennial Generation Z Annual Survey 2021”	GUNZE, UACJ Corporation
		Improvement rate of energy consumption intensity (Industrial sector)	• IEA WEO2019	YASKAWA Electric Corporation
		Market size of industrial robots	• IEA WEO2019 • International Federation of Robotics, World Robotics 2019 Industrial Robots	YASKAWA Electric Corporation
		Market size of AC servos for industrial robots	• Fuji Keizai “2020 Featured Mechatronics Parts Market Survey” • IEA WEO2019	YASKAWA Electric Corporation
		Market size of industrial inverters	• Research Station LCC, Global market forecast for inverters • Estimated from IEA WEO2019	YASKAWA Electric Corporation
		Neodymium dysprosium demand forecast	• Sebastiaan Deetman et al “Scenarios for demand growth of metals in electricity generation technologies, cars and electronic appliances”	YASKAWA Electric Corporation
		Server Market Trends	• IEA EV Outlook2021 • IDC Japan “Server Market Trend in Japan in FY2020”	SCSK Corporation
		Migratory Tuna Catch	• Johann D. Bell et al “Pathways to sustaining tuna-dependent Pacific Island economies during climate change”	Maruha Nichiro Corporation
		Bait fish stocks	• Ministry of Agriculture, Forestry and Fisheries "Future Prospects for Adaptation to Climate Change Impacts in FY2008"	Maruha Nichiro Corporation
		Fish size	• Global Change Biology “Sound physiological knowledge and principles in modeling shrinking of fishes under climate change” (August 2017)	Maruha Nichiro Corporation

 ※ 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]
Transition risk (5/5)

	Item	Parameter	Source	Reference: Companies referenced parameters
Transition risk	**Changes in customer reputation / behavior**	Changes in the volume of air passenger	• 2ii “The Transition Risk-o-Meter Reference Scenarios for Financial Analysis”	Kyushu Railway Company
		Number of engine-powered vehicles on the road	• IEA ETP2017	Fuji Oil Company
		Increase / decrease in rent due to environmental performance	• Xymax “Economic analysis of environmental management” • Smart Wellness Office Research Committee “Improving the sustainability of environmental real estate and its added value” • Japan Real Estate Institute “Investors' perceptions of real estate ESG investment” • JRE ”Economy of ESG Investment” （DBJ FY2019 Seminar “Sustainability and ESG Investment in Real Estate- GRESB evaluation result announcement and real estate ESG Investment outlook-”）	ORIX Asset Management Corporation
	Compliance with GHG emission regulations	Energy intensity of buildings	• IEA ETP2017 • MLIT ”Energy consumption reduction targets in global warming countermeasure plans based on the Paris Agreement”, p.1	ORIX Asset Management Corporation
		Zero emission target of Tokyo	• Tokyo	ORIX Asset Management Corporation
		Emission factor for grid electricity	• IEA WEO2020 • Ministry of Economy, Trade and Industry "Basic Energy Plan” • RITE "Scenario Analysis of Carbon Neutrality in 2050"	ORIX Asset Management Corporation, Fuji Oil Company
		Mandatory introduction of ZEB / ZEH （Government goal）	• IEA ETP2017 • Agency for Natural Resources and Energy General Energy Policy (July 2018） • METI	ORIX Asset Management Corporation

 ※ 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]
Physical risk (1/3)

	Item	Parameter	Source	Reference: Companies referenced parameters
Physical risk	**Increases in the average temperature**	Loss of labor productivity due to heat stress in the industrial sector	• ILO “Working on a warmer planet” (2019)	Mitsui Mining & Smelting, GUNZE, UACJ Corporation
		Increase of hot summer days	• WRI “The Aqueduct Global Flood analyzer” • World Bank “Climate Change Knowledge Portal”	ASKUL Corporation, Mitsui Mining & Smelting, UACJ Corporation
		Increase of temperature	• World Bank “Climate Change Knowledge Portal”	ASKUL Corporation, Kyushu Railway Company
		Relationship between temperature rise and electricity demand	• IEEJ • General Information Processing Center, Mie University "Visualization of Air Conditioning Efficiency by Power Analysis of Server Room"	Kyushu Railway Company, SCSK Corporation
		Relationship between temperature rise and air conditioner sales	• World Bank “Climate Change Knowledge Portal” (Temperature 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, Japan Meteorological Agency, "Climate Change Observation, Prediction and Impact Assessment Integrated Report 2018 - Climate Change in Japan and its Impacts"	UACJ Corporation
		Relationship between temperature rise and demand for beverage products	• National Observatory of Athens “The Impact of Climate Change on the Pattern of Demand for Bottled Water and Non-Alcoholic Beverages” (2014)	UACJ Corporation
		Increase in Aluminum Demand by Sector	• CM Group, IAI ”AN ASSESSMENT OF GLOBAL MEGATRENDS AND REGIONAL AND MARKET SECTOR GROWTH OUTLOOK FOR ALUMINIUM DEMAN” (2020)	UACJ Corporation
		Track buckling rate	• ELSEVIER “Impacts of climate change on operation of the US rail network” (2017)	Kyushu Railway Company
		Air conditioning cost	• IEA “The Future of Cooling”	ASKUL Corporation
		Forest fire outbreak situation	• AP-PLAT	ASKUL Corporation
		Forest fire incidence (Vietnam)	• Forest and Grass Fire Risk Assessment for Central Asia under Future Climate Scenarios	Nippon Paper Industries

 ※ 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]
Physical risk (2/3)

	Item	Parameter	Source	Reference: Companies referenced parameters
Physical risk	**Increases in the average temperature**	Forest fire incidence (Brazil)	• Effects of climate and land - use change scenarios on fire probability during the 21st century in the Brazilian Amazon	Nippon Paper Industries
		Forest fire incidence (Japan)	• Forestry Agency, "Recent Mountain Disasters"	Nippon Paper Industries
		Temperature rise: Underwear Sales	• World Bank “Climate Change Knowledge Portal”	GUNZE
		Temperature rise: Cotton Cultivation	• FAO “The future of food and agriculture Alternative pathways to 2050”	GUNZE
		Increase in insect infestation (Japan, Vietnam)	• The Potential Global Distribution of the White Peach Scale Pseudaulacaspis pentagona (Targioni Tozzetti) under Climate Change	Nippon Paper Industries
		Probability of heavy rainfall (Japan)	• Ministry of Education, Culture, Sports, Science and Technology and Japan Meteorological Agency "Climate Change in Japan 2020" (December 2020)	Nippon Paper Industries
		Probability of heavy rainfall (Vietnam)	• Projected changes in summer precipitation over East Asia with a high-resolution atmospheric general circulation model during 21st century	Nippon Paper Industries
		Probability of heavy rainfall (Brazil)	• Assessment of multi-model climate projections of water resources over South America CORDEX domain	Nippon Paper Industries
		Rise in sea water temperature	• IPCC AR6 ”Climate Change 2021 The Physical Science Basis”	Maruha Nichiro Corporation
		Changes in dissolved oxygen in seawater	• IPCC AR6 “Climate Change 2021 The Physical Science Basis”	Maruha Nichiro Corporation
		Ocean acidification	• IPCC AR6 “Climate Change 2021 The Physical Science Basis”	Maruha Nichiro Corporation
	Sea level rise	Sea level rise	• IPCC “Fifth Report”, “1.5°C Special Report”	SCSK, Nippon Paper Industries

 ※ 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]
Physical risk (3/3)

	Item	Parameter	Source	Reference: Companies referenced parameters
Physical risk	**Increasing extreme weather conditions (typhoons, heavy rains, sediment, storm surges, etc.)**	Flood damage in urban areas	• WRI “The Aqueduct Global Flood Analyzer”	ASKUL Corporation, ORIX Asset Management Corporation, Kyushu Railway Company, Mitsui Mining & Smelting
		Frequency of floods, Flow rate	• Ministry of Land, Infrastructure, Transport and Tourism, “Proposals for Flood Control Plans Based on Climate Change”	ASKUL Corporation, ORIX Asset Management Corporation, Kyushu Railway Company, Mitsui Mining & Smelting, GUNZE, Nishi-Nippon Railroad, Fuji Oil Company, Maruha Nichiro Corporation
		Flood occurrence probability (Japan)	• Ministry of Land, Infrastructure, Transport and Tourism, "Impacts of Climate Change"	SCSK Corporation, Nippon Paper Industries, UACJ Corporation
		Occurrence of typhoons and cyclones	• MOE・JMA and Others 「Climate Change Observation / Forecast and Impact Assessment Integrated Report 2018 - Japan's Climate Change and Its Impact-」	ORIX Asset Management Corporation, Mitsui Mining & Smelting, Maruha Nichiro Corporation
		Number of days per year of torrential rainfall	• Tokyo District Meteorological Observatory Website • World Bank「Climate Change Knowledge Portal」	Nishi-Nippon Railroad
		Average sea level rise	• IPCC “Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development” • MOE・JMA “Outline of IPCC Fifth Assessment Report -Working Group 1 Natural Science Basis-” (2014) (p.41)	ORIX Asset Management Corporation, Mitsui Mining & Smelting
		Water risk by base (flood, drought)	• WRI “The Aqueduct Global Flood analyzer” • Technical Study Group on Flood Plans Based on Climate Change "Study on Flood Control Plans Based on Climate Change"	Shin-Etsu Chemical, YASKAWA Electric Corporation, GUNZE, UACJ Corporation
		Sediment disaster occurrence probability	• A-PLAT, Climate Change Adaptation Information Platform	Kyushu Railway Company
		Domestic Disaster Response Product Market Trends	• Yano Research Institute "Research on Disaster Prevention Food Market” (2020)	Nippon Paper Industries

 ※ 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 2020, 2021
IEA Net Zero by 2050
IEA Energy Technology Perspectives 2020

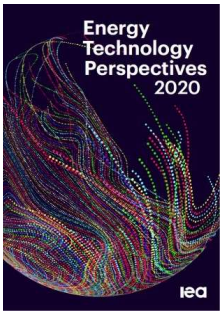
What is the International Energy Agency (IEA)?

- 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） Net Zero by 2050（NZE2050）

- A report on energy supply and demand published every autumn.
- World Energy Outlook includes medium and long-term energy market forecasts.
- NZE was additionally published in May 2021 after the WEO2020 was announced

Energy Technology Perspectives（ETP）



- Describes the process of energy technology innovation.
- Focusing on opportunities and challenges for expanding and accelerating clean energy technologies.

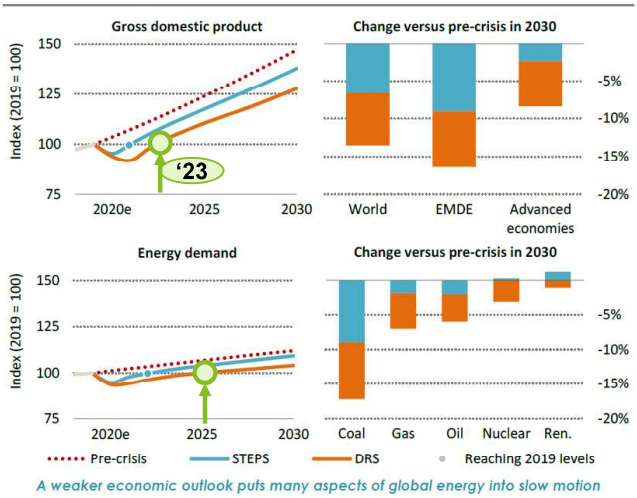
Source：IEA website

⇒Refer to the practical guide ver3.0 for parameters in WEO2020 (https://www.env.go.jp/policy/policy/tcfd/TCFDguide_ver3_0_J_2.pdf)

[(Reference) The Outline of IEA WEO 2020：Delayed Recovery Scenario (DRS)]

DRE expects a 10% reduction in GDP due to COVID, a reduction in fuel consumption based on it, and changes associated with it

Figure 1.2 ▷ Gross domestic product and primary energy demand by scenario



A weaker economic outlook puts many aspects of global energy into slow motion

Table 2.1 ▷ Real GDP average growth assumptions by region and scenario

		STEPS/SDS			DRS
	2010-19	2019-25	2025-40	2019-40	2019-40
North America	2.3%	1.4%	2.0%	1.9%	1.4%
United States	2.3%	1.3%	1.9%	1.7%	1.4%
Central and South America	1.0%	1.8%	3.1%	2.7%	2.2%
Brazil	0.7%	1.2%	3.1%	2.6%	2.0%
Europe	1.9%	1.4%	1.5%	1.5%	1.1%
European Union	1.6%	1.2%	1.3%	1.3%	0.9%
Africa	3.1%	2.6%	4.4%	3.9%	3.5%
South Africa	1.5%	1.0%	2.8%	2.3%	1.9%
Middle East	2.2%	1.1%	3.1%	2.5%	2.1%
Eurasia	2.2%	1.6%	2.1%	2.0%	1.6%
Russia	1.6%	1.2%	1.6%	1.5%	1.1%
Asia Pacific	5.5%	4.2%	3.9%	4.0%	3.5%
China	7.2%	4.9%	3.6%	4.0%	3.6%
India	6.6%	4.5%	5.7%	5.4%	4.9%
Japan	1.0%	0.7%	0.9%	0.8%	0.6%
Southeast Asia	5.1%	4.2%	4.1%	4.2%	3.6%
World	3.4%	2.7%	3.1%	3.0%	2.6%

10%

The Scenario of World Economy Stagnation due to COVID
GDP will recover to 2019 levels in 2023. Energy demand will return to 2019 levels in 2025. World economy shrinks 10% of STEPS in 2040

Source：IEA World Energy Outlook 2020

IEA World Energy Outlook 2021

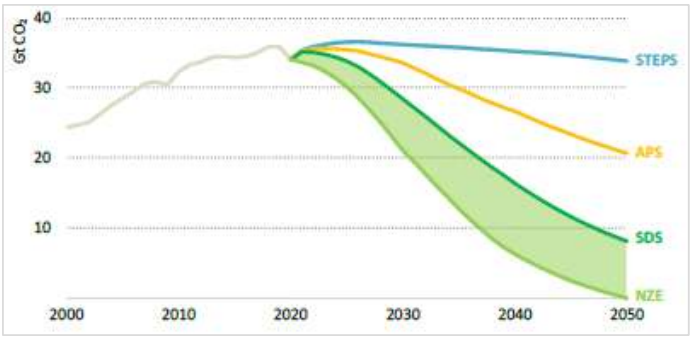
[Overview of IEA WEO2021]

Besides detailing the NZE, APS, and STEPS as main scenarios, it also describes the SDS scenario, which is the scenario for achieving the Paris Agreement targets

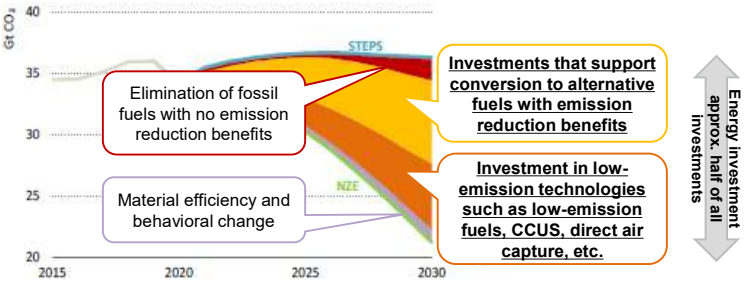
Scenarios in WEO2021

The Stated Policies Scenario (STEPS)	Temperature rise of 2.6ºC in 2100 and rising thereafter 2.6DS (2.6ºC～ scenario)
New The Announced Pledges Scenario (APS)	Temperature rise of 2.1ºC in 2100 and rising thereafter 2.1DS (2ºC scenario)
Sustainable Development Scenario (SDS)	The Scenario of Achieving the target of Paris Agreement, Peak at 1.7ºC around 2050, followed by a decrease in surface temperatures 1.6DS (below 2ºC scenario)
The Net Zero Emissions by 2050 Scenario (NZE)	Clean energy policies and investments are rapidly increasing, Advanced countries reach net zero ahead of others 1.4DS (1.5ºC scenario)

Changes in energy sector CO2 emissions and energy investments needed over the next 10 years



Investments in energy sectors for achieving NZE (1.5ºC) from the STEPS (2.6ºC and over) state



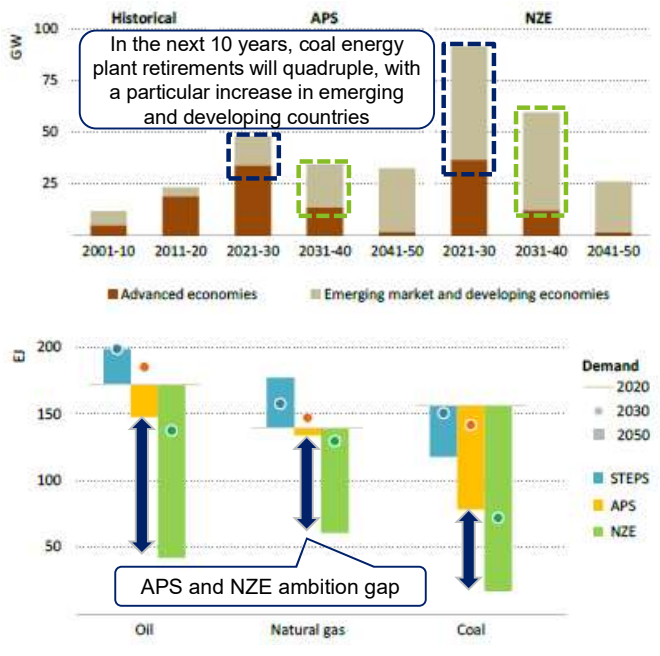
Source：IEA website

IEA World Energy Outlook 2021

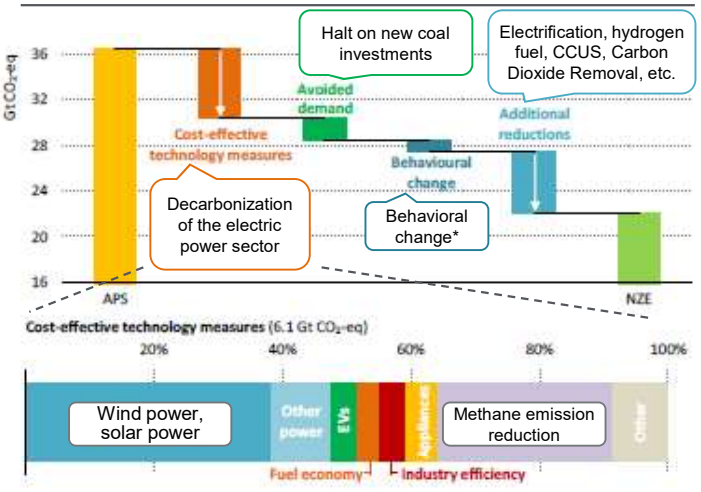
[IEA WEO2021：Outline of Announced Pledges Scenario (APS)]

There is an “ambition gap” for APS between the NZE scenario, which aims for net zero emissions by 2050; there is a need for decarbonization of the electric power sector and clean energy investments in emerging and developing countries

Average annual number of decommissioned coal energy plants and volume of fossil fuel used in the WEO2021 APS and NZE scenarios



Breakdown of measures for closing the ambition gap by 2030



- **APS coal demand far exceeds NZE levels due to lack of targets in major emerging markets and developing countries**
- **Expanding cost-effective energy sources such as wind, solar, hydro, and nuclear could close about 60% of the electric power sector gap for APS and NZE**

Source：IEA World Energy Outlook 2021

*”Behavioral change” includes increased energy efficiency and demand reduction measures in the final consumption sector, such as strengthened efficiency standards for home appliances and policies emphasizing material efficiency in industry

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Carbon price, CO2 emissions（1/3）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Carbon price	CO2 prices for electricity, industry and energy production in selected regions by scenario			○	○	○				○	
CO2 emissions	CO2 emissions by sector and scenario		○			○			○		
	CO2 emissions in the WEO-2021 scenarios over time	○	○	○	○	○			○		
	Methane emissions from fossil fuel operations and reductions to 2030 in the Net Zero Emissions by 2050 Scenario		○	○					○		
	CO2 emissions per capita by region in 2020 and the Announced Policies Scenario in 2030		○	○						○	
	Emissions reductions in the Net Zero Emissions by 2050 Scenario relative to the Stated Policies Scenario	○	○	○					○		
	Annual change in energy-related CO2 emissions	○							○		
	Number of countries with NDCs, long-term strategies and net zero pledges, and their shares of global CO2 emissions in 2020		○						○		
	CO2 and methane emissions from energy and industrial processes in the three scenarios, 2030			○					○		
	Global energy-related and industrial process CO2 emissions by scenario and temperature rise above pre-industrial levels in 2100	○	○	○	○	○			○		
	Emissions reductions from end-use efficiency, avoided demand and behavioural change in 2030 between the Announced Pledges and Net Zero Emissions scenarios			○					○		
	Global electricity sector CO2 emissions and generation by source in the Announced Pledges and Net Zero Emissions by 2050 scenarios		○	○					○		
	CO2 emissions from coal-fired power plants by age and scenario		○	○	○	○			○		
	CO2 emissions by branch and final energy consumption by fuel in industry in the Announced Pledges and Net Zero Emissions by 2050 scenarios			○					○		

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

CO2 emissions（2/3）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
CO2 emissions	Cost-competitive steel production from innovative technologies and related CO2 emissions in the Announced Pledges and Net Zero Emissions by 2050 scenarios	○	○	○	○	○			○		
	CO2 emissions and final energy consumption in transport in the Announced Pledges and Net Zero Emissions by 2050 scenarios		○	○					○		
	Cost-competitive stock of electric cars in 2030 and 2050, and CO2 emissions reduction in road transport to 2050 by scenario	○	○	○	○	○			○		
	CO2 emissions by end-use and final energy consumption by fuel in the buildings sector in the Announced Pledges and Net Zero Emissions by 2050 scenarios		○	○					○		
	Methane emissions from fossil fuel operations to 2030 by scenario		○	○					○		
	Methane emissions abatement from oil and gas by policy tool					○			○		
	Behavioural change impact on energy-related activity and CO2 emissions		○	○					○		
	Share of CO2 savings from behavioural changes and materials efficiency in NZE, 2021 - 30			○					○		
	CO2 emissions and intensity by scenario, 2020-2030 (Total emissions)	○	○	○					○		
	CO2 emissions and intensity by scenario, 2020-2030 (Emissions Intensity)	○	○	○					○		
	CO2 emissions per capita by region in 2020 and 2030 in the Announced Pledges Scenario		○	○						○	
	Energy use, carbon intensity and CO2 emissions by sector and scenario, 2020-2030		○	○					○		
	Energy and industrial process CO2 emissions and mitigation levers in the Stated Policies and Announced Pledges scenarios, 2020-2030		○	○					○		

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

CO2 emissions（3/3）, Energy demand（1/8）

Category	Datasets	Timeframe							Country / Region		
		Past	’20	’30	’40	’50	’60	100	Global	Several areas	Japan
CO2 emissions	Energy intensity by sector and scenario		○	○					○		
	Electricity sector CO2 emissions by scenario, 2010-2050	○	○	○	○	○			○		
	Global average emissions intensity of oil production	○	○	○					○		
	World CO2 emissions	○	○	○	○	○			○		
	World CO2 emissions	○	○	○	○	○			○		
	World CO2 emissions	○	○	○	○	○			○		
	World CO2 emissions	○	○	○	○	○			○		
	Total CO_2 emissions	○	○	○		○			○	○	○
	Electricity and heat sectors CO_2 emissions	○	○	○		○			○	○	○
	Total final consumption CO_2 emissions	○	○	○		○			○	○	○
	Key estimated global indicators for energy demand and emissions, 2020 and 2021		○						○		
Energy demand	Oil, natural gas and coal demand in the Stated Policies Scenario in World Energy Outlook 2021, 2020 and 2016	○		○		○			○		
	Change in global electricity generation, 2014-2021	○	○						○		
	Final energy consumption by source and sector to 2030 in the Net Zero Emissions by 2050 Scenario	○	○	○					○		
	Global solar PV, wind and unabated coal-fired electricity generation in the Announced Pledges and Net Zero Emissions by 2050 scenarios	○	○	○	○	○			○		

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Energy demand（2/8）

Category	Datasets	Timeframe							Country / Region		
		Past	’20	’30	’40	’50	’60	100	Global	Several areas	Japan
Energy demand	CO2 emissions by branch and final energy consumption by fuel in industry in the Announced Pledges and Net Zero Emissions by 2050 scenarios			○					○		
	CO2 emissions and final energy consumption in transport in the Announced Pledges and Net Zero Emissions by 2050 scenarios	○	○	○					○		
	CO2 emissions by end-use and final energy consumption by fuel in the buildings sector in the Announced Pledges and Net Zero Emissions by 2050 scenarios		○	○					○		
	Total primary energy supply by fuel and scenario	○	○	○	○	○			○		
	People without access to electricity and access rates by region in the Stated Policies and Net Zero Emissions by 2050 scenarios, 2020-2030 (People without access)	○	○	○						○	
	People without access to electricity and access rates by region in the Stated Policies and Net Zero Emissions by 2050 scenarios, 2020-2030 (Access rates)	○	○	○						○	
	Global total energy supply by scenario and low emissions energy supply sources by sector, 2010-2030	○	○	○					○		
	Change in global total energy supply by fuel and scenario, 2020-2030		○	○					○		
	Energy intensity and energy demand per capita in selected regions in the Announced Pledges Scenario, 2020-2030		○	○					○	○	○
	Energy supply and demand by fuel and sector, 2020 and 2050		○			○			○		
	Change in energy demand to 2030 and demand avoided due to energy efficiency and electrification in the Stated Policies and Announced Pledges scenarios			○						○	
	Residential space heating energy intensity and energy demand in the European Union in the Stated Policies and Announced Pledges scenarios	○	○	○					○		
	Global electricity demand and generation mix by scenario	○	○	○	○	○			○		
	Drivers of change in electricity demand in the Stated Policies and Announced Pledges scenarios, 2020 to 2030		○	○					○		

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Energy demand（3/8）

Category	Datasets	Timeframe							Country / Region		
		Past	’20	’30	’40	’50	’60	100	Global	Several areas	Japan
Energy demand	Share of electricity in useful energy demand and final consumption by sector and scenario		○	○					○		
	Hour-to-hour flexibility needs in the United States, European Union, China and India in the Stated Policies Scenario, 2020 and 2030		○	○						○	
	Range of maximum variation in daily electricity demand in the European Union and India in the Announced Pledges Scenario, 2020, 2030 and 2050		○	○		○				○	
	Oil demand over time and low emissions fuel demand in 2030	○	○	○					○		
	Change in oil demand by scenario between 2020 and 2030			○						○	
	Oil demand and supply in 2030 and 2050		○	○		○				○	
	Liquid biofuel demand by type and scenario		○	○		○			○		
	Changes in natural gas demand between 2020 and 2030		○	○						○	
	Key changes in natural gas demand in the Announced Pledges Scenario, 2020-2030		○	○						○	○
	Drivers of change in natural gas demand in selected sectors in the Announced Pledges Scenario between 2020 and 2030		○	○					○		
	Coal and solid bioenergy demand by scenario	○	○	○					○		
	Change in coal demand by scenario between 2020 and 2030		○	○						○	
	Global coal demand by sector to 2050		○	○	○	○			○		
	Wind and solar PV generation and electricity demand for sample days in Q1 by region in the Announced Pledges Scenario		○	○		○				○	

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Energy demand（4/8）

Category	Datasets	Timeframe							Country / Region		
		Past	’20	’30	’40	’50	’60	100	Global	Several areas	Japan
Energy demand	Duration curves of variable renewables, storage and demand-side response in the United States in the Announced Pledges Scenario	○	○		○	○				○	
	Reductions in coal, oil and natural gas use from switching to electricity and low-carbon energy by scenario, 2020-2050		○	○	○	○			○		
	Ratio of peak to average monthly natural gas demand in selected regions	○				○				○	○
	Changes in natural gas demand in selected sectors in the European Union and China in the Announced Pledges Scenario, 2020-2050		○	○	○	○				○	
	Global oil and natural gas demand and declines in supply by scenario	○	○	○	○	○			○		
	World energy supply	○	○	○	○	○			○		
	Oil demand	○	○	○		○			○	○	○
	World liquids demand	○	○	○		○			○		
	Natural gas demand	○	○	○		○			○	○	○
	Coal demand	○	○	○		○			○	○	○
	Import dependency in developing economies in Asia and the level of supply concentration for oil and natural gas by scenario		○	○		○			○		
	Fossil fuel use by scenario		○	○		○			○		
	Low-carbon hydrogen and hydrogen-based fuel demand and supply by scenario in 2030			○					○		
	Annual change in oil demand and supply, 2020 and 2021		○						○		

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Energy demand（5/8）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Energy demand	Transition in global total energy supply by source to 2030 in the Net Zero Emissions by 2050 Scenario	○	○	○					○		
	Change in electricity generation by source and scenario, 2020 to 2030		○	○					○		
	Nuclear power capacity by scenario, 2020-2050		○	○	○	○			○		
	Unabated coal-fired electricity generation by scenario, 2010-2050	○	○	○	○	○			○		
	Oil, natural gas, coal and low emissions fuel use to 2050	○	○	○	○	○			○		
	Consumption of liquid, gaseous and solid fuels by scenario		○	○		○			○		
	Oil use in passenger cars and petrochemicals by scenario between 2020 and 2030		○	○					○		
	Oil supply by scenario	○	○	○					○		
	Changes in oil supply in selected countries in the Stated Policies and Announced Pledges scenarios, 2020-2030		○	○						○	
	Low-carbon hydrogen-based fuel consumption in aviation and shipping, 2050					○			○		
	Natural gas use over time and low emissions gas supply in 2030	○	○	○					○		
	Changes in upstream resource development and marketed natural gas supply by scenario between 2021 and 2030			○					○		
	Natural gas imports in selected regions by source in 2020 and by scenario in 2050		○			○				○	○
	Changes in natural gas production by region and scenario between 2020 and 2050		○			○				○	

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Energy demand（6/8）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Energy demand	Low-carbon hydrogen demand and production in selected regions in the Announced Pledges Scenario, 2050					○				○	○
	Biogas production by use and scenario in 2020 and 2030		○	○					○		
	Cost ranges for global development potential and volumes of sustainable biomethane by scenario		○	○	○	○			○		
	Coal mining jobs and production in China, 2008-2019	○								○	
	Solid bioenergy supply by scenario		○	○		○			○		
	Energy supply to 2050 by scenario		○	○	○	○			○		
	Total final consumption by the number of conversion steps from primary energy supply in the Net Zero Emissions by 2050 Scenario	○	○	○	○	○			○		
	Value of international energy-related trade by scenario		○	○		○			○		
	Natural gas import requirements by scenario		○	○	○	○			○		
	World final consumption	○	○	○	○	○			○		
	World energy supply	○	○	○	○	○			○		
	World final consumption	○	○	○	○	○			○		
	World energy supply	○	○	○	○	○			○		
	World final consumption	○	○	○	○	○			○		

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Energy demand（7/8）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Energy demand	World energy supply	○	○	○	○	○			○		
	World final consumption	○	○	○	○	○			○		
	Total energy supply	○	○	○		○			○	○	○
	Renewables energy supply	○	○	○		○			○	○	○
	Oil production	○	○	○		○			○	○	
	Natural gas production	○	○	○		○			○	○	○
	Coal production	○	○	○		○			○	○	○
	Electricity generation	○	○	○		○			○	○	○
	Renewables generation	○	○	○		○			○	○	○
	Solar PV generation	○	○	○		○			○	○	○
	Wind generation	○	○	○		○			○	○	○
	Nuclear generation	○	○	○		○			○	○	○
	Natural gas generation	○	○	○		○			○	○	○
	Coal generation	○	○	○		○			○	○	○

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Energy demand（8/8）, Energy mix（1/2）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Energy demand	Total final consumption	○	○	○	○	○			○		
	Industry consumption	○	○	○	○	○			○		
	Transport consumption	○	○	○		○			○	○	○
	Buildings consumption	○	○	○		○			○	○	○
	Changes in key gas-based electricity indicators in selected regions in the Announced Pledges Scenario, 2020-2030	○	○	○		○			○	○	
Energy mix	Key indicators of energy system change by scenario		○			○			○		
	The rising share of low emissions fuels in the energy mix		○	○					○		
	Electricity system flexibility by source and scenario, 2020 and 2050		○			○			○		
	Fuel substitution of oil, coal and natural gas by low-carbon gaseous hydrogen and synthetic methane, 2050					○			○		
	Phases of renewables integration by scenario		○	○		○				○	
	Progress with economic and energy diversification in selected producer economies	○							○		
	Categorisation of producer economies by economic and energy diversification performance	○								○	
	World electricity sector	○	○	○	○	○			○		
	World electricity sector	○	○	○	○	○			○		

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Energy mix（2/2）, Price of key commodities/products

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Energy mix	World electricity sector	○	○	○	○	○			○		
	World electricity sector	○	○	○	○	○			○		
	Global energy system today and in 2050 in the Net Zero Emissions by 2050 Scenario					○			○		
Price of key commodities /products	Oil, natural gas and coal prices by region, 2010 - 2021	○	○							○	○
	Average household energy bills by fuel in the Stated Policies and Net Zero Emissions by 2050 scenarios		○	○		○			○		
	Impact of a commodity price shock on average household energy bills in 2030 by scenario		○	○						○	
	Fossil fuel prices by scenario	○	○	○		○				○	○
	Monthly price indicators for selected commodities	○	○						○		
	Change in electricity prices and generation costs for additional solar PV and wind generation in China, 2030			○						○	
	Average pack price of lithium-ion batteries and share of cathode material cost	○	○						○		
	Impacts of 2021 material price increases on the costs of selected clean energy technologies		○						○		
	Average annual import bills and export revenues for selected critical minerals by country/region, 2015-2019	○								○	○

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Predictions on production and sales, Technology（1/2）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Predictions on production and sales	Cost-competitive steel production from innovative technologies and related CO2 emissions in the Announced Pledges and Net Zero Emissions by 2050 scenarios			○		○			○		
	Cost-competitive stock of electric cars in 2030 and 2050, and CO2 emissions reduction in road transport to 2050 by scenario			○		○			○		
	Share of zero emissions vehicles sales in Canada and the United States in the Stated Policies and Announced Pledges scenarios, 2020 and 2030		○	○						○	
	Market size and level of geographical concentration for selected commodities, 2019	○							○		
	Battery chemistries and EV-related mineral demand growth in the Net Zero Emissions by 2050 Scenario in the base and constrained mineral supply cases		○			○			○		
	Seaborne crude oil trade by route and scenario	○	○	○		○			○		
Technology	Estimated market size for selected clean energy technologies by technology and region, 2020-2050		○	○		○				○	
	Global patenting for low-carbon energy technologies versus fossil fuel and other technologies, 2000-2019	○							○		
	Number of countries that have adopted selected energy and non-energy technologies, 1910-2018	○							○		
	Examples of commercial-scale project development for industrial clusters, hydrogen and CCUS	-	-	-	-	-	-	-		○	
	Impact of behavioural change and materials efficiency by sector and scenario, 2030			○					○		
	CO2 capture capacity by project and scenario, 2030			○					○		
	Planned and announced electrolyser installations to 2030 and their proportion of required additions, 2021-2030	○	○	○						○	

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Technology（2/2）, Policy/Regulation（1/3）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Technology	Mineral requirements for clean energy technologies by scenario		○			○			○		
	Refining capacity and runs	○	○	○		○			○	○	○
	Remaining technically recoverable fossil fuel resources, end-2020		○						○	○	
	Technology costs in selected regions in the Announced Pledges Scenario		○	○		○			○		
	Technology costs in selected regions in the Sustainable Development Scenario		○	○		○			○		
	Technology costs in selected regions in the Net Zero Emissions by 2050 Scenario		○	○		○			○		
	Capital costs for selected technologies by scenario		○	○		○			○		
	Technology costs in selected regions in the Stated Policies Scenario		○	○		○			○		
Policy/ Regulation	Investment in oil and gas production and clean energy in the Stated Policies and Net Zero Emissions by 2050 scenarios	○							○		
	Four key priorities to keep the door to 1.5℃ open		○	○					○		
	Selected indicators of clean electrification in the Announced Policies and Net Zero Emissions by 2050 scenarios		○	○						○	
	Average annual clean energy investment and financing in the Announced Policies and Net Zero Emissions by 2050 scenarios	○	○	○					○		
	Average annual energy investment by emissions reduction potential, 2022-30			○					○		
	Employment growth in clean energy and related areas to 2030			○					○		

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Policy/Regulation（2/3）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Policy/ Regulation	Annual average coal power plant retirements in the Announced Policies and Net Zero Emissions by 2050 scenarios	○	○	○	○	○			○		
	Average age of existing coal power plants in 2020 in selected regions and average age at retirement in the Net Zero Scenario		○							○	○
	Changes in fossil fuel employment and energy areas with overlapping skills in the Announced Policies Scenario to 2030			○						○	
	Energy investment trends by region	○	○							○	
	Global fossil fuel consumption subsidies, 2010-2021e	○	○						○		
	Breakdown of measures to close the ambition gap by 2030			○					○		
	Average annual energy investment 2016-2020, and in the Net Zero Emissions by 2050 Scenario	○	○	○	○	○			○		
	Tracking progress towards 2030 milestones in transport and industry by scenario			○					○		
	Average annual investment in clean energy by type and economic area, 2016-2020, and by scenario, 2026-2030	○	○	○					○		
	Average annual investment by type and source in the electricity sector, 2016-2020, and by scenario, 2026-2030	○	○	○					○		
	Tracking progress towards 2030 milestones by industry branch and scenario			○					○		
	Average annual clean energy investment in industry by type and source, 2016-2020, and by scenario, 2026-2030	○	○	○					○		
	Tracking progress towards 2030 milestones in the transport sector by scenario			○					○		

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Policy/Regulation（3/3）, Air pollution, Water stress, Covid-19 related（1/2）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Policy/ Regulation	Average annual clean energy investment in transport by type and source, 2016-2020, and by scenario 2026-2030			○					○		
	Tracking progress towards 2030 milestones in the buildings sector by scenario			○					○		
	Average annual clean energy investment in buildings by type and source, 2016-2020, and by scenario, 2026-2030	○	○	○					○		
	Key indicators for the chemicals and light industry sub-sectors in India in the Stated Policies Scenario in 2030 and cost-effective energy and materials efficiency potential			○						○	
	Average annual electricity network investment by scenario, 2016-2050	○	○	○	○	○			○		
	Average annual upstream oil and gas investment by scenario		○	○	○	○			○		
	Cross-cutting policy assumptions for selected regions/countries by scenario		○			○				○	○
	Electricity sector policies and measures as modelled by scenario for selected regions/countries			○		○				○	○
	Industry sector policies and measures as modelled by scenario for selected regions/countries			○						○	○
	Buildings sector policies and measures as modelled by scenario for selected regions/countries			○		○				○	○
	Transport sector policies and measures as modelled by scenario for selected regions/countries			○		○				○	○
Air pollution	Share of population exposed to various PM2.5 concentrations and premature deaths from ambient air pollution in 2030			○					○		
Water stress	Water stress exposure of freshwater-cooled thermal and nuclear power plants, refineries and copper mines		○		○				○		
Covid-19 Related	Share of population with at least one dose of Covid-19 vaccine	○								○	

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Covid-19 related（2/2）, Other（1/2）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Covid-19 Related	Breakdown of global Covid-19 pandemic-related fiscal support	○							○		
Other	Real GDP average growth assumptions by region	○	○	○	○	○				○	○
	Change in GDP per capita by quarter for selected countries	○	○							○	○
	Government debt-to-GDP ratios for selected emerging market and developing economies	○								○	
	Ten-year returns of a global market benchmark versus publicly traded renewable power and fossil fuel portfolios	○	○						○		
	Temperature rise in the WEO-2021 scenarios (℃)			○		○		○	○		
	Selected indicators in the Net Zero Emissions by 2050 Scenario	○	○	○	○	○			○		
	Global median surface temperature rise over time in the WEO-2021 scenarios	○	○		○		○	○	○		
	Peak temperature rise in the WEO-2021 scenarios					○		○	○		
	Historical levels of sustainable debt issuance	○	○							○	
	Global energy-related and industrial process CO2 emissions by scenario and temperature rise above pre-industrial levels in 2100							○	○		
	Role of behavioural change in closing the ambition gap	-	-	-	-	-	-	-	○		
	Population with an electricity connection unable to afford an extended bundle of services in Africa and developing Asia	○	○							○	
	Population without access to clean cooking in the Stated Policies and Net Zero Emissions by 2050 scenarios	○	○	○						○	

Source：IEA World Energy Outlook 2021

IEA World Energy Outlook 2021

[Parameters in IEA WEO2021]

Other（2/2）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	100	Global	Several areas	Japan
Other	Access to clean cooking by technology and related investment in the Stated Policies and Net Zero Emissions by 2050 scenarios, 2021-2030			○					○		
	Share of energy infrastructure capacity at risk of destructive cyclones, 2020		○						○		
	Population assumptions by region	○	○	○		○			○	○	○
	All regions: Sustainable Development Scenario assumptions			○	○	○			○		
	All regions: Net Zero Emissions by 2050 assumptions			○	○	○			○		

Source：IEA World Energy Outlook 2021

IEA Net Zero by 2050

[Parameters in IEA Net Zero by 2050]

Carbon price, CO2 emissions（1/2）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
Carbon price	CO2 prices for electricity, industry and energy production in the NZE			○	○	○				○	
CO2 emissions	Energy-related and industrial process CO2 emissions by region and sector in the STEPS	○	○	○	○	○				○	
	Total energy supply and CO2 emissions intensity in the STEPS	○	○	○	○	○			○		
	Emissions from existing infrastructure by sector and region		○	○	○	○				○	
	Global energy-related and industrial process CO2 emissions by scenario and reductions by region, 2010-2050	○	○	○	○	○			○	○	○
	Global CO2 emissions by sector in the STEPS and APC	○	○	○	○	○			○		
	Global net CO2 emissions in the NZE	○	○	○	○	○			○	○	
	Global net-CO2 emissions by sector, and gross and net CO2 emissions in the NZE	○	○	○	○	○			○		
	Average annual CO2 reductions from 2020 in the NZE		○	○	○	○			○		
	Emissions reductions by mitigation measure in the NZE, 2020-2050		○	○		○			○		
	Total final consumption and demand avoided by mitigation measure in the NZE		○	○		○			○		
	Role of technology and behavioural change in emissions reductions in the NZE		○	○	○	○			○		
	CO2 emissions and energy demand reductions from behavioural change in the NZE			○	○	○			○		
	Global CO2 emissions from aviation and impact of behavioural changes in the NZE	○	○			○			○		

Source：IEA “Net Zero by 2050 A Roadmap for the Global Energy Sector”

IEA Net Zero by 2050

[Parameters in IEA Net Zero by 2050]

CO2 emissions（2/2）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
CO2 emissions	Global CO2 emissions savings and car ownership per household due to behavioural change in the NZE		○	○	○	○			○		
	CO2 emissions by sector in the NZE	○	○	○	○	○			○		
	Global CO2 emissions from industry by sub-sector in the NZE		○	○	○	○				○	
	Global CO2 emissions in heavy industry and reductions by mitigation measure and technology maturity category in the NZE		○			○			○		
	CO2 emissions from existing heavy industrial assets in the NZE		○	○	○	○			○		
	Global CO2 transport emissions by mode and share of emissions reductions to 2050 by technology maturity in the NZE	○	○	○	○	○			○		
	Global direct CO2 emissions reductions by mitigation measure in buildings in the NZE		○	○		○			○		
	Emissions reductions from policy-driven and discretionary behavioural changes by citizens and companies in the NZE			○	○	○			○		
	Global CO2 emissions changes by technology maturity category in the NZE		○	○		○			○		
	CO2 emissions in the Low International Co-operation Case and the NZE	○	○	○	○	○			○		
	CO2 emissions in the Low International Co-operation Case and the NZE in selected sectors in 2050					○			○		
	CO2 emissions	○	○	○	○	○			○		
	Annual CO2 emissions savings in the net zero pathway, relative to 2020			○		○			○		
	Global energy-related CO2 emissions in the net zero pathway and Low International Co-operation Case	○		○		○		○	○		

Source：IEA "Net Zero by 2050 A Roadmap for the Global Energy Sector"

IEA Net Zero by 2050

[Parameters in IEA Net Zero by 2050]

Energy demand（1/3）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
Energy demand	Total final consumption by sector and fuel in the STEPS	○	○	○	○	○			○		
	Electricity generation by fuel and share of coal in the STEPS	○	○	○	○	○				○	
	Total energy supply by source in STEPS and APC	○	○	○	○	○			○		
	Total final consumption in the APC		○	○	○	○			○		
	Global electricity generation by source in the APC	○	○	○	○	○			○		
	Total energy supply in the NZE	○	○	○	○	○			○		
	Total energy supply of unabated fossil fuels and low-emissions energy sources in the NZE	○	○	○	○	○			○		
	Global total final energy consumption by fuel in the NZE	○	○	○	○	○			○		
	Global final energy consumption by sector and fuel in the NZE	○	○	○	○	○			○		
	Global electricity demand and share of electricity in energy consumption in selected applications in the NZE		○	○		○			○		
	Total bioenergy supply in the NZE	○	○	○	○	○			○		
	Additional electricity demand in 2050 and additional investment between 2021-2050 for selected areas of uncertainty					○			○		
	Reduction in total final consumption due to behavioural changes by fuel in the NZE		○	○	○	○			○		
	Global bioenergy supply by source in the NZE	○	○	○	○	○			○		

Source：IEA "Net Zero by 2050 A Roadmap for the Global Energy Sector"

IEA Net Zero by 2050

[Parameters in IEA Net Zero by 2050]
Energy demand（2/3）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
Energy demand	Impact on electricity demand and ability to achieve net-zero emissions by 2050 without expanded bioenergy land use								○		
	Electricity demand by sector and regional grouping in the NZE	○	○	○	○	○			○		
	Global electricity generation by source in the NZE	○	○	○	○	○			○		
	Coal-fired electricity generation by technology in the NZE	○	○	○	○	○			○		
	Additional global alternative capacity needed in a Low Nuclear and CCUS Case			○	○	○			○		
	Global final industrial energy demand by fuel in the NZE		○	○	○	○			○		
	Global transport final consumption by fuel type and mode in the NZE		○	○	○	○			○		
	Global energy consumption by fuel and CO2 intensity in non-road sectors in the NZE		○	○	○	○			○		
	Global electricity demand and battery capacity for road transport in the NZE and the All-Electric Case		○	○		○			○		
	Global final energy consumption by fuel and end-use application in buildings in the NZE			○		○			○		
	Global building and heating equipment stock by type and useful space heating and cooling demand intensity changes in the NZE		○	○		○			○		
	Global change in electricity demand by end-use in the buildings sector		○			○			○		
	Global residential space heating and cooling energy demand in the NZE and Delayed Retrofit Case		○	○	○	○			○		

Source：IEA “Net Zero by 2050 A Roadmap for the Global Energy Sector”

IEA Net Zero by 2050

[Parameters in IEA Net Zero by 2050]
Energy demand（3/3）, Price of key commodities/products, Predictions on production and sales（1/2）

Category	Datasets	Timeframe							Country / Region		
		Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
Energy demand	Global average annual energy investment needs by sector and technology in the NZE	○	○	○	○	○			○		
	Global energy spending by fuel in the NZE	○	○	○	○	○			○		
	Average annual household energy bill in the NZE		○	○		○				○	
	Change in household spending on energy plus energy-related investment in the NZE relative to 2020			○		○				○	
	Energy supply and transformation	○	○	○	○	○			○		
	Energy demand	○	○	○	○	○			○		
	Electricity	○	○	○	○	○			○		
Price of key commodities /products	Fossil fuel prices in the NZE		○	○	○	○			○		
	Global value of coal and selected critical minerals in the NZE		○			○			○		
	Global electricity supply costs by component in the NZE		○	○	○	○			○		
	Global revenues from taxes on retail sales of oil and gas in the NZE		○	○	○	○			○		
Predictions on production and sales	Fossil fuel use and share by sector in 2050 in the NZE					○			○		
	Solid, liquid and gaseous fuels in the NZE	○	○	○	○	○			○		

Source：IEA “Net Zero by 2050 A Roadmap for the Global Energy Sector”

IEA Net Zero by 2050

[Parameters in IEA Net Zero by 2050]

Predictions on production and sales（2/2）

Category	Datasets	Timeframe							Country / Region		
		Past	’20	’30	’40	’50	’60	’70	Global	Several areas	Japan
Predictions on production and sales	Battery demand growth in transport and battery energy density in the NZE	○	○	○	○	○			○		
	Fuel shares in total energy use in selected applications in the NZE	○	○	○	○	○			○		
	Global hydrogen and hydrogen-based fuel use in the NZE		○	○	○	○			○		
	Coal, oil and natural gas production in the NZE	○	○	○	○	○			○		
	Oil and natural gas production in the NZE	○	○	○	○	○				○	
	Global supply of low-emissions fuels by sector in the NZE		○	○		○			○		
	Global biofuels production by type and technology in the NZE		○	○	○	○			○		
	Global production of hydrogen by fuel and hydrogen demand by sector in the NZE		○	○	○	○			○		
	Global industrial production of bulk materials by production route in the NZE		○	○		○			○		
	Global share of battery electric, plug-in hybrid and fuel cell electric vehicles in total sales by vehicle type in the NZE		○	○		○			○		
	Heavy trucks distribution by daily driving distance, 2050					○			○		
	Income from oil and gas sales in producer economies in the NZE	○	○	○	○	○			○		
	Global oil supply and LNG exports by region in the NZE	○	○	○	○	○				○	

Source：IEA “Net Zero by 2050 A Roadmap for the Global Energy Sector”

IEA Net Zero by 2050

[Parameters in IEA Net Zero by 2050]

Demographic variables, Technology（1/2）

Category	Datasets	Timeframe							Country / Region		
		Past	’20	’30	’40	’50	’60	’70	Global	Several areas	Japan
Demographic variables	World population by region and global GDP in the NZE	○	○	○	○	○			○	○	
	Change in annual growth rate of global GDP in the NZE relative to the STEPS		○	○					○		
	Global energy sector employment in the NZE, 2019-2030	○		○					○		
	New workers in clean energy and related sectors and shares by skill level and occupation in the NZE and the STEPS in 2030			○					○		
	People gaining access to electricity by type of connection in emerging market and developing economies in the NZE	○	○	○	○	○				○	
	Primary cooking fuel by share of population in emerging markets and developing economies in the NZE		○	○	○	○				○	
	Economic and Activity Indicators	○	○	○	○	○			○		
	Global employment in energy supply in the net zero pathway, 2019-2030	○		○					○		
Technology	Global CO2 capture by source in the NZE		○	○	○	○			○		
	Share of low-carbon technologies and fuels with and without behavioural change in 2030 in the NZE			○					○		
	CCUS by sector and emissions source in the NZE		○	○	○	○			○		
	Impacts of achieving net-zero emissions by 2050 without expanded fossil fuel-based CCUS			○		○			○		
	Cumulative CO2 emissions reductions for selected technologies by maturity category in the NZE								○		

Source：IEA “Net Zero by 2050 A Roadmap for the Global Energy Sector”

IEA Net Zero by 2050

[Parameters in IEA Net Zero by 2050]

Technology（2/2）, Policy/Regulation

Category	Datasets	Timeframe							Country / Region		
		Past	’20	’30	’40	’50	’60	’70	Global	Several areas	Japan
Technology	Solar PV and wind installed capacity in the NZE	○	○	○	○	○				○	
	Share of heating technology by temperature level in light industries in the NZE		○	○		○			○		
	Electricity system flexibility by source in the NZE		○			○				○	
	Annual average electricity grid expansion, replacement and substation capacity growth in the NZE		○	○	○	○			○		
	Illustrative example of a shared CO2 pipeline in an industrial cluster								○		
	Time from first prototype to market introduction for selected technologies in the NZE and historical examples	○	○	○					○		
	Electricity generation technology costs by selected region in the NZE		○	○		○			○		
	Capital costs for batteries and hydrogen production technologies in the NZE		○	○		○			○		
	Key clean technologies ramp up by 2030 in the net zero pathway		○	○					○		
Policy/ Regulation	Number of countries with NDCs, long-term strategies and net zero pledges, and their shares of 2020 global CO2 emissions		○						○		
	Number of national net zero pledges and share of global CO2 emissions covered	○	○						○		
	Coverage of announced national net zero pledges								○	○	
	Sectoral activity of large energy-related companies with announced pledges to reach net-zero emissions by 2050								○		
	Selected global milestones for policies, infrastructure and technology deployment in the NZE		○	○	○	○			○		

Source：IEA “Net Zero by 2050 A Roadmap for the Global Energy Sector”

IEA Net Zero by 2050

[Parameters in IEA Net Zero by 2050]

Air pollution, Other

Category	Datasets	Timeframe							Country / Region		
		Past	’20	’30	’40	’50	’60	’70	Global	Several areas	Japan
Air pollution	Global premature deaths and air pollutant emissions in the NZE					○			○		
Other	Comparison of selected indicators of the IPCC scenarios and the NZE in 2050	○	○	○	○	○			○		
	Annual average capital investment in the NZE	○	○	○	○	○			○		
	Investment in oil and natural gas supply in the NZE	○	○	○					○		
	Methane emissions from coal, oil and natural gas in the NZE		○	○	○	○			○		
	Global investment in electricity networks in the NZE	○	○	○	○	○			○		
	Annual average investment in oil and gas and low-emissions technologies with synergies for the oil and gas industry in the NZE		○	○	○	○			○		
	Key milestones in the pathway to net zero	○	○	○		○			○		
	Clean energy investment in the net zero pathway		○			○			○		
	Global energy security indicators in the net zero pathway					○			○		

Source：IEA “Net Zero by 2050 A Roadmap for the Global Energy Sector”

IEA Energy Technology Perspectives 2020

[Parameters in IEA ETP 2020]
CO2 emissions（1/4）

	Category	Datasets	Timeframe							Country/region		
			Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
CO2 emissions	General	Global primary energy demand and energy-related CO2 emissions, 1971-2020	○							○		
	General	Global energy-related CO2 emissions by region	○							○	○	
	General	Global energy sector CO2 emissions by fuel and technology in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	General	Cumulative energy sector CO2 emissions by region and scenario, 2019-70	○	○	○	○	○	○	○	○	○	
	General	Global CO2 emissions in transport by mode in the Sustainable Development Scenario, 2000-70	○	○	○	○	○	○	○	○		
	General	Global industrial energy consumption and CO2 emissions in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	General	Global energy consumption and CO2 emissions in long-distance transport by sub-sector in the Sustainable Development and Stated Policies scenarios	○	○	○	○	○	○	○	○		
	General	Global energy sector CO2 emissions reductions by current technology maturity category in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2019-70	○	○	○	○	○	○	○	○		
	General	Global CO2 emissions reductions by current technology maturity category and sector in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2040 and 2070				○			○	○		
	General	Global energy sector CO2 emissions by sector, 2019 and 2050	○				○			○		
	General	Global captured CO2 emissions by source, 2050					○			○		
	General	Share of energy-related CO2 emissions covered by national and supra-national public net-zero emissions targets today	○							○		
	Specific sector	Global energy-related CO2 emissions by fuel (left) and sector (right), 2000-19	○							○		
	Specific sector	Global CO2 emissions from existing energy infrastructure by sub-sector, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Global energy sector CO2 emissions by sector and sub-sector/fuel in the Sustainable Development Scenario, 2040 and 2070				○	○	○	○	○		
	Specific sector	Growth in global CO_2 capture by sector and fuel in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Global energy sector CO2 emissions by sector in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Global direct CO2 emissions in industry by sub-sector and region in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○		○	

4-41 Source：IEA Energy Technology Perspectives 2020

IEA Energy Technology Perspectives 2020

[Parameters in IEA ETP 2020]
CO2 emissions（2/4）

	Category	Datasets	Timeframe							Country/region		
			Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
CO2 emissions	Specific sector	Global chemical sector direct CO2 emissions and energy consumption in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	CO2 emissions from the use phase of buildings by sub-sector and region in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○		○	
	Specific sector	Global iron and steel sector direct CO2 emissions and energy consumption in the Sustainable Development Scenario, 2019-70	○	○	○		○		○	○		
	Specific sector	Global cement sector direct CO2 emissions and energy consumption in the Sustainable Development Scenario, 2019-70	○	○	○		○		○	○		
	Specific sector	Decomposition of embodied cement and steel sector CO2 emissions in buildings construction, 2000-20	○	○						○		
	Specific sector	CO2 emissions in the buildings and construction value chain in the Sustainable Development Scenario, 2010-70	○	○	○	○	○	○	○	○		
	Specific sector	World cement- and steel-related CO2 emissions in the buildings construction sector by scenario and driver, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Share of vehicle sales covered by fuel economy and/or CO2 emissions standards by vehicle type and country/region	○								○	○
	Specific sector	Global CO2 emissions from trucks by abatement measure (left) and technology readiness level (right) in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Global freight activity, energy consumption and CO2 emissions in international maritime shipping by vessel type and fuel, 2019	○							○		
	Specific sector	Global energy consumption and CO2 emissions in international shipping in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Share of activity covered by corporate carbon-neutral targets among the largest corporate players										
	Specific sector	Global CO2 emissions locked in by existing energy-related assets by sector measured against the CO2 emissions trajectory of the Sustainable Development Scenario, 2019-70										
	Specific sector	Unlocking CO2 at the next investment cycle in key industrial sectors	○		○	○	○	○			○	
	Amount of reduction	The technology portfolio for reducing direct industrial CO2 emissions, 2040 and 2070				○			○	○		
	Amount of reduction	Global CO2 emissions reductions in shipping by mitigation category (left) and technology readiness level (right) in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2019-70	○	○	○	○	○	○	○	○		

4-42 Source：IEA Energy Technology Perspectives 2020

IEA Energy Technology Perspectives 2020

[Parameters in IEA ETP 2020]

CO2 emissions（3/4）

	Category	Datasets	Timeframe							Country/region		
			Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
CO2 emissions	Amount of reduction	Selected decarbonisation indicators by scenario in 2050	○				○			○		
	Amount of reduction	Global CO2 emissions in aviation by abatement measure (left) and technology readiness level (right) in the Sustainable Development Scenario relative to the Stated Policies Scenario	○	○	○	○	○	○	○	○		
	Amount of reduction	Contribution to global energy sector annual CO2 emissions reductions in 2050 by current technology maturity category					○			○		
	Amount of reduction	Global energy sector annual CO2 emissions reductions by type of abatement measure and total primary energy demand, 2050					○			○		
	Amount of reduction	Global energy sector CO2 emissions reductions by measure in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Amount of reduction	Global CO2 emissions reductions in the cement sector by mitigation strategy and current technology maturity category, 2019-70	○	○	○	○	○	○	○	○		
	Amount of reduction	Global CO2 emissions reductions from electrification by sector in the Sustainable Development Scenario relative to the Stated Policies Scenario,2030-70			○	○	○	○	○	○		
	Amount of reduction	Global CO_2 use for fuel and feedstock production in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Amount of reduction	Global CO2 emissions reductions from hydrogen by sector in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2030-70			○	○	○	○	○	○		
	Amount of reduction	Global CO2 reductions from bioenergy use in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2030-70			○	○	○	○	○	○		
	Amount of reduction	Global CO2 emissions in the power sector by scenario and decomposition of the difference by technology type	○	○	○	○	○	○	○	○		
	Amount of reduction	Global development of electrolyser capacity and CO2 capture from hydrogen by region in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○		○	
	Amount of reduction	Global cumulative CO2 emissions reductions in the buildings sector by mitigation lever and technology readiness level in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2020-70		○	○	○	○	○	○	○		
	Amount of reduction	Global CO2 emissions reductions in the chemical sector by mitigation strategy and current technology maturity category, 2019-70	○	○	○	○	○	○	○	○		
	Amount of reduction	Global CO2 emissions reductions in the iron and steel sector by mitigation strategy and current technology maturity category, 2019-70	○	○	○	○	○	○	○	○		
	Power generation	Emissions from US coal-fired power plants, 1990-2018	○								○	

4-43 Source：IEA Energy Technology Perspectives 2020

IEA Energy Technology Perspectives 2020

[Parameters in IEA ETP 2020]

CO2 emissions（4/4）, Energy demand

	Category	Datasets	Timeframe							Country/region		
			Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
CO2 emissions	Intensity	CO2 emissions by income quartile (left) and air trips by GDP per capita and region, 2018 (right)	○								○	
Energy demand	Primary energy	Global total primary energy demand, population and GDP, 1950-2019	○							○		
	Primary energy	Annual change in GDP, total primary energy demand and energy intensity in selected countries/regions, 2000-19	○							○	○	
	Primary energy	Global primary energy demand by fuel, 1925-2019	○							○		
	Primary energy	Primary demand for low-carbon energy sources, 2000-19	○							○		
	Primary energy	Primary energy demand by fuel and scenario (Mtoe)	○			○			○	○		
	Primary energy	Global primary energy demand by fuel share and scenario, 2019 and 2070	○						○	○		
	Primary energy	Primary energy demand by region and scenario	○			○			○		○	
	Final energy	Final energy consumption by sector, fuel and scenario	○			○			○	○		
	Final energy	Change in global final energy demand by fuel and sector in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Final energy	Global final energy demand for hydrogen by sector and share of hydrogen in selected sectors in the Sustainable Development Scenario	○	○	○	○	○	○	○	○		
	Final energy	Final energy demand by fuel shares for total industry and selected sub-sectors in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Final energy	Global share of hydrogen and electricity in final energy demand by end-use sector (left) and selected adoption metrics of hydrogen technologies (right), 2019 and 2050	○				○			○		
	Renewable energy	Global bioenergy demand by sector and share of bioenergy use in key sectors in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Global transport sector energy consumption by fuel in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Global heavy-duty trucking energy demand by fuel and average vehicle efficiency in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Global aviation fuel consumption in the Sustainable Development Scenario and total fuel use in the Stated Policies Scenario, 2019-70		○	○	○	○	○	○	○		
	General	Global hydrogen production by fuel and hydrogen demand by sector in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		

Source：IEA Energy Technology Perspectives 2020

[Parameters in IEA ETP 2020]
Energy mix , Price of key commodities/products , Predictions on production and sales（1/2）

	Category	Datasets	Timeframe							Country/region		
			Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
Energy mix	Power supply	Growth in global electricity consumption by sector and scenario and electricity share in total final consumption in the Sustainable Development Scenario	○	○	○	○	○	○	○	○		
	Power supply	Contribution of residential cooling and electric vehicles to net electricity load in China in the Sustainable Development Scenario, 2030			○						○	
	Coal	Coal-fired electricity generation from existing plants in the Stated Policies and Sustainable Development scenarios, 2019-70	○	○	○	○	○	○	○	○		
	Investment	Global cumulative investment in selected energy infrastructure in the Sustainable Development Scenario				○			○			
Price of key commodities/ products	Specific sector	The effect of battery and fuel cell prices on total cost of ownership of heavy-duty trucks in long-haul operations								○		
	Specific sector	Capital cost reductions of selected clean energy technologies at early stages of adoption in the Sustainable Development Scenario, 2019-30			○							
Predictions on production and sales	Power supply	Projected synthetic kerosene production costs from different sources and impact of electricity costs and full-load hours, 2050					○			○		
	Gas	US production of shale oil* and gas, 2000-19	○								○	
	General	Production growth in key heavy industries, 2000-30	○	○	○					○		
	General	Period from first prototype to market introduction for selected technologies, including the quickest examples in recent developments	○	○	○					○		
	Renewable energy	Global biofuels production by technology in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Renewable energy	Global hydrogen production and demand in the Sustainable Development Scenario, 2070							○	○		
	Renewable energy	Global hydrogen production by technology in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Renewable energy	Production of hydrogen-based fuels in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Light-duty vehicle market share by size segment, 2005-17	○							○		
	Specific sector	Age profile of global production capacity for key industrial sub-sectors	○							○		
	Specific sector	Age profile and geographic distribution of road transport vehicles	○								○	○
	Specific sector	Reduction in global steel and cement demand through material efficiency gains by stage in the supply chain in the Sustainable Development Scenario relative to the Stated Policies Scenario in 2070							○	○		
	Specific sector	Global copper and lithium demand by sector and scenario	○	○	○	○	○	○	○	○		

4-45 Source：IEA Energy Technology Perspectives 2020

[Parameters in IEA ETP 2020]
Predictions on production and sales（2/2）

	Category	Datasets	Timeframe							Country/region		
			Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
Predictions on production and sales	Specific sector	Global primary chemical production by scenario and plastic demand by market segment, 2019-70	○	○	○	○	○	○	○	○		
	Specific sector	Global primary chemicals production routes by energy feedstock in the Sustainable Development Scenario, 2000-70	○	○	○	○	○	○	○	○		
	Specific sector	Levelised cost of ammonia and methanol production under varying techno-economic assumptions								○		
	Specific sector	Global steel production by region and end use, 2019-70	○	○	○	○	○	○	○		○	
	Specific sector	Global steel production by route and iron production by technology in the Sustainable Development Scenario, 1990-2070	○	○	○	○	○	○	○	○		
	Specific sector	Levelised cost of steel production for selected production routes when they reach commercialisation	○	○	○					○		
	Specific sector	Levelised cost of steel production for selected production pathways at varying gas, electricity and CO2 prices								○		
	Specific sector	Global cement production by region and end use, 2019-70		○					○		○	
	Specific sector	Global cement production by technology and material composition in the Sustainable Development Scenario, 2000-70	○	○	○	○	○	○	○	○		
	Specific sector	Levelised cost of cement production under varying techno-economic assumptions								○		
	Specific sector	Projected year-to-year growth of residential construction activity in 2020 relative to 2019	○	○							○	○
	Specific sector	Heavy-duty truck fleet and share of road fuel demand, 2019	○							○	○	
	Specific sector	Growth of revenue passenger-kilometres by region, 2013-19	○								○	
	Specific sector	Share of flights and fuel use in overall commercial passenger aviation, 2017	○							○		
	Specific sector	Levelised production costs of sustainable aviation fuels in 2050					○			○		
	Specific sector	Heating equipment sales share and share of near-zero energy buildings by region in the Sustainable Development Scenario		○		○			○	○	○	
	Specific sector	Global share of vehicle activity electrified by mode in the Faster Innovation Case relative to the Sustainable Development Scenario, 2050					○			○		

4-46 Source：IEA Energy Technology Perspectives 2020

IEA Energy Technology Perspectives 2020

[Parameters in IEA ETP 2020]

Technology（1/2）

	Category	Datasets	Timeframe							Country/region		
			Past	’20	’30	’40	’50	‘60	‘70	Global	Several areas	Japan
Technology	General	Global power generation by fuel/technology in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
	General	Electricity generation mix by region, fuel/technology and scenario, 2019 and 2070	○						○	○	○	
	General	Four stages of technology innovation, feedbacks and spillovers that improve successive generations of designs								○		
	General	Public energy technology R&D and demonstration spending by IEA member governments by technology, 1977-2019	○								○	
	General	Technology readiness level scale applied by the IEA								○		
	General	Global corporate R&D spending as a share of revenue in selected sectors, 2007-19	○							○		
	General	Global early-stage venture capital deals for energy technology start-ups	○							○		
	General	Technology readiness level of technologies along the CO2 value chain								○		
	General	Growth rates for revenue and R&D for selected sectors, 2007-12	○							○		
	General	Time to materiality for selected technologies in the Sustainable Development Scenario	○	○	○	○				○		
	General	Energy technology attributes that can favour more rapid innovation cycles or faster learning								○		
	General	Global CO2 emissions savings by current technology readiness category in the Faster Innovation Case relative to the Sustainable Development Scenario in 2050					○					
	Renewable energy	Technology readiness level of technologies along the low-carbon hydrogen value chain								○		
	Renewable energy	Competitiveness of bioenergy for power generation and biofuels, 2050					○			○		
	Renewable energy	Technology readiness level of technologies along the bioenergy value chain								○		
	Renewable energy	Role of hydrogen and liquid and gaseous biofuels in the Sustainable Development Scenario		○			○		○	○		
	Renewable energy	Hydrogen production costs by technology in the Sustainable Development Scenario, 2019 and 2050	○				○			○		
	Renewable energy	Issuance of patents for low-carbon energy technologies in selected countries/regions	○								○	○

4-47 Source：IEA Energy Technology Perspectives 2020

IEA Energy Technology Perspectives 2020

[Parameters in IEA ETP 2020]

Technology（2/2）, Policy/Regulation

	Category	Datasets	Timeframe							Country/region		
			Past	’20	’30	’40	’50	‘60	‘70	Global	Several areas	Japan
Technology	Renewable energy	Number of clean energy technology designs and components analysed in the "ETP Clean Energy Technology Guide"								○		
	Renewable energy	Technology readiness level of technologies along the low-carbon electricity value chain								○		
	Specific sector	Status of the main emerging technologies in the chemical sector	○	○	○					○		
	Specific sector	Status of main emerging technologies in the iron and steel sector	○	○	○					○		
	Specific sector	Status of main emerging technologies in the cement sector	○	○	○					○		
	Specific sector	Logistic companies and electric trucks	○	○	○		○			○		
	Specific sector	Status of the main emerging technologies in heavy-duty road freight	○	○	○	○	○			○		
	Specific sector	Status of main emerging technologies in shipping		○	○					○		
	Specific sector	Status of the main emerging technologies in the aviation sector			○					○		
	Fossil fuel	Age structure of existing fossil power capacity by region and technology								○		
	Investment	Reduction in capital cost since 2010 for PV and wind power generation technologies	○							○		
	Investment	Average annual investment in technologies by technology readiness level in the Sustainable Development Scenario			○	○	○	○	○	○		
	Amount of reduction	Unit cost reductions for selected technologies in the Sustainable Development Scenario, 2020-70		○	○	○	○	○	○	○		
	Amount of reduction	Contribution of material efficiency to reducing cumulative cement and steel demand for buildings construction in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○	○		
Policy/ Regulation	Policy	A policy framework for achieving deep emissions reductions in industry								○		
	Policy	Government carbon or climate neutral targets by legal status									○	
	Policy	Governing process for a strategy towards net-zero emissions										
	Policy	Core target areas for policy instruments to advance a net-zero emissions strategy by technology maturity level										
	Policy	Number of clean energy technology designs and components analysed in the "ETP Clean Energy Technology Guide"										
	Policy	Technology readiness level of technologies along the low-carbon electricity value chain	○	○						○		

4-48 Source：IEA Energy Technology Perspectives 2020

IEA Energy Technology Perspectives 2020

[Parameters in IEA ETP 2020]
Other

	Category	Datasets	Timeframe							Country/region		
			Past	'20	'30	'40	'50	'60	'70	Global	Several areas	Japan
Other	General	Global average energy intensity in selected end-use sectors, 2000-19	○							○		
	General	Typical lifetimes for key energy sector assets								○		
	General	Value and number of global energy-related venture capital deals (early and late stage) by semester and year	○	○						○		
	Specific sector	Building stock by year of construction and share of stock that remains in 2050	○				○				○	
	Specific sector	Age profile and geographic distribution of aircraft	○								○	
	Specific sector	Total cost of ownership of hydrogen, ammonia and electric vessels by ship type, 2030			○					○		
	Specific sector	Passenger aviation activity by region in the Sustainable Development Scenario, 2019-70	○	○	○	○	○	○	○		○	
	Specific sector	Heavy-duty truck fleet by powertrain in the Sustainable Development Scenario		○		○			○	○		
	Renewable energy	Total cost of ownership of heavy-duty trucks by low-carbon fuel in the Sustainable Development Scenario, 2040 and 2070				○			○	○		
	Investment	Change in average annual energy-related investment by sector and decade in the Sustainable Development Scenario relative to the Stated Policies Scenario	○	○	○	○	○	○	○	○		

Source：IEA Energy Technology Perspectives 2020

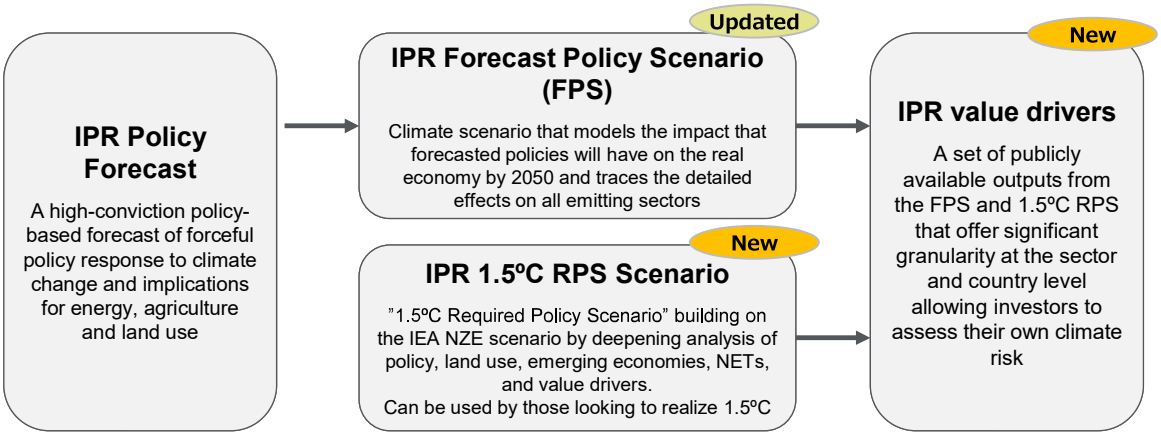
PRI The Inevitable Policy Response

[Outline of IPR scenario]
IPR (the Inevitable Policy Response) is an initiative for supporting investor efforts to incorporate climate change risks into portfolio valuation; in December 2021, it released detailed information for the 1.5ºC scenario group

Summary

- Initiative commissioned by PRI in 2018 to promote industry knowledge of climate change risk and support investor efforts to incorporate climate change risk into portfolio valuation
- The Energy Transition Advisers and Vivid Economies led policy research and scenario modeling, working together with institutions such as 2Dii, Carbon Tracker Initiative, Climate Bonds Initiative, Quinbrook Infrastructure Partners, and Planet Tracker

Overview of IPR



Release schedule

January – October 2021
- Announced the IPR explanatory materials, FPS report on land use / energy, and the 1.5ºC RPS policy summary

December 2021
- Announced drivers for portfolio valuation and the detailed edition of the 1.5ºC RPS 2021 report

Source：Investable Policy Response "Preparing financial markets for climate-related policy and regulatory risks" (October 2021)

PRI IPR FPS 2021

[Parameters in PRI FPS 2021]

CO2 emissions, Fuel demand, Power and hydrogen（1/2）

Datasets		Unit	Timeframe	Applicable pages
#1	#2			
CO2 emissions	Energy and industry CO_2 emissions (IPR 2021 FPS, IPR 2019 FPS, IEA STEPS)	GtCO2	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.13
	Energy and industry CO_2 emissions (IPR FPS 2021, IEA SDS, IEA APC, IEA STEPS)	GtCO2	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.14
	CO_2 emissions by sector in 2050, GtCO2 (Power, Transport, Industry, Buildings) (IPR FPS 2021, IEA SDS)	GtCO2	'50	p.15
Fuel demand	Primary energy demand (Coal, Oil, Gas, Biomass, Renewable and nuclear)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.17
	Fossil fuel demand (Coal, Oil, Gas)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.18
	Coal demand by sector (Power, Industry, Buildings, Other)	Million tonnes EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.19
	Coal demand by sector, IPR FPS and IEA SDS (Power, Transport, Industry, Buildings, Other)	Million tonnes EJ per year	'20 / '50	p.20
	Oil demand by sector (Power, Transport, Industry, Buildings, Other)	MMbbl/day EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.21
	Oil demand by sector, IPR FPS 2021 and IEA SDS (Power, Transport, Industry, Buildings, Other)	MMbbl/day EJ per year	'20 / '50	p.22
	Gas demand by sector (Power, Transport, Industry, Buildings, Other)	bcm EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.23
	Gas demand by sector, IPR FPS and IEA SDS (Power, Transport, Industry, Buildings, Other)	bcm EJ per year	'20 / '50	p.24
	Biomass demand by sector (Power, Transport, Industry, Buildings, Oher)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.25
	Biomass demand by sector, IPR FPS 2021 and IEA SDS (Power, Transport, Industry, Buildings, Other)	EJ	'20 / '30 / '50	p.26
Power and hydrogen	Electricity generation mix, global (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.28
	Electricity generation mix, IPR FPS and IEA SDS (Coal, Oil, Gas, Nuclear, Hydro, Biomass, Biomass CCS, Solar, Wind, Hydrogen, Other)	Thousand TWh	'20 / '50	p.29
	Electricity generation mix, European Union (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.30
	Electricity generation mix, United States (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.31
	Electricity generation mix, China (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.32
	Electricity generation mix, India (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.33

Sources：PRI "IPR FPS 2021 Detailed energy system results", "IPR FPS 2021 Detailed land use system results"

PRI IPR FPS 2021

[Parameters in PRI FPS 2021]

Power and hydrogen（2/2）, Transport, industry and buildings

Datasets		Unit	Timeframe	Applicable pages
#1	#2			
Power and hydrogen	Electricity generation mix, Japan (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar, Onshore wind, Offshore wind, Hyrdogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.33
	Electricity generation mix, Canada (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.34
	Electricity generation mix, Australia (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.34
	Coal generation by region (China, India, USA, Southeast Asia, EU, Other OECD, Other non-OECD)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.35
	Gas generation by region (USA, MENA, EU, Southeast Asia, Russia, Central and South America, Other non-OECD, Other OECD)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.36
	Hydrogen demand by sector (Existing feedstock uses, Power, Transport, Industry, Buildings)	Million tonnes per year EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.37
	Hydrogen production by route (Unabated, Blue, Green)	Million tonnes per year EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.38
Transport, industry and buildings	Passenger cars by powertrain (Fossil, Plug-in hybrid, Battery electric, Hydrogen, Natural gas)	million vehicles	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.40
	Truck fleet by powertrain (Fossil, Plug-in hybrid, Battery electric, Hydrogen, Natural gas)	million vehicles	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.41
	Industry energy mix (Coal, Coal CCS, Oil, Gas, Gas CCS,Biomass, Biomass CCS, Heat, Electricity, Hydrogen)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.42
	Industry energy mix, IPR FPS and IEA SDS （Coal, Oil, Natural gas, Bioenergy, Imported heat, Electricity, Hydrogen, Other)	EJ	'20 / '50	p.43
	Steel production by technology (Conventional coal (BF-BOF), BF BOF with CCS, Gas DRI, Hydrogen DRI, Scrap with EAF)	Mt per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
	Cement production by technology (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass CCS)	Mt per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.45
	Coal demand by industry sector (Iron and steel, Non-metallic minerals, Chemicals, Other, CCS)	EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.46
	Oil demand by industry sector (Iron and steel, Non-metallic minerals, Chemicals-fuel, Chemicals-feedstock, Other)	EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.47
	Gas demand by industry sector (Iron and steel, Non-metallic minerals, Chemicals, Other, CCS)	EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.48
	Building heating technology mix (Coal, Oil, Gas, Biomass, District heat, Resistive, Heat pump, Hydrogen)	Thousand GW	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.49
	Thermal efficiency of building floorspace (Conventional, Net zero ready-retrofit, Net zero ready-new build)	billion m2	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.50

Sources：PRI "IPR FPS 2021 Detailed energy system results", "IPR FPS 2021 Detailed land use system results"

PRI IPR FPS 2021

[Parameters in PRI FPS 2021]

Land use, Policy, technology and behavioral expectations

Datasets		Unit	Timeframe	Applicable pages
#1	#2			
Land use	–	GtCO2e/year in 2050	'50	p.12
	Meat production in IPR FPS 2021 (Monogastric (pig), Poultry, Ruminant meat, Alternative meat)	Mt DM/ yr	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.17
	Crop production productivity in IPR FPS 2021	t DM / hectare	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.18
	NBS supply by region (incl. avoidance) in IPR FPS 2021 (AU, SSA, CAN, CSA, EEU, BRA, EURA, GCC, IND, INDO, JAP, MENA, RU, SA, SAF, CHI, SEAO, SK, UK, USA, WEU)	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.20
	NBS supply by region (excl. avoidance) in IPR FPS 2021(AU, SSA, CAN, CSA, EEU, BRA, EURA, GCC, IND, INDO, JAP, MENA, RU, SA, SAF, CHI, SEAO, SK, UK, USA, WEU)	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.21
	–	billion USD 2021	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.23
	Source of greenhouse gas emissions 2019 (Agriculture, Forestry and Land use)	Mean estimated emissions (Gt CO2e)	'19	p.25
	Land use 2017 (Cropland, Pastures and Rangelands, Forests, Other Land)	Mean estimated land use (million Ha)	'17	p.25
	Production volume by type of livestock (Monogastric, Poultry, Ruminant meat, Dairy)	Mt wet matter	'19	p.26
	Emissions by type of livestock (Dairy, Monogastric, Poultry, Ruminant meat)	Mt CO2e	'19	p.26
	Primary energy demand (2018) (Coal (unabated), Oil, Natural gas (unabated), Nuclear, Bioenergy (conventional), Bioenergy CCS, Hydro, Wind, Solar PV)	EJ	'18	p.27
	Land use change in BAU (2017 base year) (Cropland, Pastures and Rangelands, Forest, Other Land)	Million Ha	'25 / '30 / '35 / '40 / '45 / '50	p.38
	Land use change in IPR FPS 2021 (2017 base year) (Cropland, Pastures and Rangelands, Forest, Other Land)	Million Ha	'25 / '30 / '35 / '40 / '45 / '50	p.38
	Land use GHG emissions in IPR FPS 2021 (CO2, N2O, CH4, Total)	Gt CO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50 / '55 / '60 / '70 / '80 / '90 / 2100	p.39
Policy, technology and behavioral expectations	Emissions prices in IPR FPS 2021 - early adopters (Early adaopter CO2, Early adopter N2O)	2021 USD / tCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.33
	Emissions prices in IPR FPS 2021 late adopters (Late adopter CO2, Late adpter N2O)	2021 USD / tCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.34
	World GDP (SSP1,SSP2, SSP3. SSP4. SSP5)	Trillion 2005USD(PPP)	'10 / '15 / '20 / '25 / '30 / '35 / '40 / '45 / '50 / '55 / '60 / '65 / '70 / '75 / '80 / '85 / '90 / '95 / 2100	p.36
	World Population (SSP1, SSP2, SSP3, SSP4, SSP5)	Billions	'10 / '15 / '20 / '25 / '30 / '35 / '40 / '45 / '50 / '55 / '60 / '65 / '70 / '75 / '80 / '85 / '90 / '95 / 2100	p.36

 Sources：PRI "IPR FPS 2021 Detailed energy system results", "IPR FPS 2021 Detailed land use system results"

PRI IPR FPS 2021

[Parameters in PRI FPS 2021]

Carbon Capture and Storage (CCS), NBS, Agriculture

Datasets		Unit	Timeframe	Applicable pages
#1	#2			
Carbon Capture and Storage (CCS)	CO_2 captured by fuel and sector (Power-coal, Power-gas, Power-biomass, Industry-coal, Industry-gas, Industry-biomass, Industry-process, Hydrogen-gas, Direct air capture)	GtCO2	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.52
	Carbon capture and storage, IPR FPS 2021 and comparable IPCC scenarios	GtCO2	'10 / '20 / '30 / '40 / '50	p.53
NBS	NBS supply by NBS type (incl. avoidance) in IPR FPS 2021	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.49
	NBS average cost curve in 2030 in IPR FPS 2021 (Avoided, Removal)	GtCO2e	'30	p.50
Agriculture	Bioenergy land use in IPR FPS 2021 (Maize, Oil palm, Soybean, Sugar cane, Bioenergy)	Average Cost (USD/tCO2e), log scale Quantity Supplied (GtCO2e)	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.41
	Second generation bioenergy production in IPR FPS 2021	EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.42
	Food price index in IPR FPS 2021 (IPR FPS 2021, IPR FPS 2021 with no food production shift) (CHA, SAS, ANZ, MEA, BRA, LAM, USA, RUS, NEU, CAN, SSA, DEA, EUR, IND, REF, OAS, Global)	Annual food price change 2020-2050	'20 / '50	p.43
	Maize production in IPR FPS 2021 (IPR FPS 2021, BAU)	Mt DM	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
	Sugar cane production in IPR FPS 2021 (IPR FPS 2021, BAU)	Mt DM	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
	Soyebean production in IPR FPS 2021 (IPR FPS 2021, BAU)	Mt DM	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
	Palm oil production in IPR FPS 2021 (IPR FPS 2021, BAU)	Mt DM	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
	Timber production in IPR FPS 2021 (IPR FPS 2021, BAU)(Roundwood, Wood fuel)	Cubic meters per year (million)	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.45

 Sources：PRI "IPR FPS 2021 Detailed energy system results", "IPR FPS 2021 Detailed land use system results"

[Parameters in PRI 1.5℃ RPS]

CO2 emissions, NBS, Transport, industry and buildings

Datasets		Unit	Timeframe	Applicable pages
#1	#2			
CO2 emissions	Energy and industry CO2 emissions (IPR FPS 2021, IPR RPS 2021)	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.20
	Energy-related CO2 emissions (IEA STEPS, IPR 1.5℃ RPS, IEA NZE)	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.21
NBS	NBS supply by NBS type (excl. avoidance) in IPR RPS 2021	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.48
	NBS average cost curve in 2030 in IPR RPS 2021 (Afforestation, Sustainable forestry, Agroforestry, Mangrove, Silvopasture, Peat, Seagrass, Soil)	Average Cost (USD/tCO2e), log scale Quantity supplied (GtCO2e)	'30	p.49
Transport, industry and buildings	Passanger cars by powertrain (Fossil, Plug-in hybrid, Battery electric, Hydrogen, Natural gas)	million vehicles	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.46
	Truck fleet by powertrain (Fossil, Plug-in hybrid, Battery electric, Hydrogen, Natural gas)	million vehicles	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.47
	Industry energy mix (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass CCS, Heat, Electricity, Hydrogen)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.48
	Industry fuel mix, IPR 1.5℃ RPS and IEA NZE (Other, Hydrogen, Electricity, imported heat, Bioenergy, Natural gas, Oil, Coal)	EJ	'20 / '50	p.49
	Steel production by technology (Conventional coal (BF~BOF), BFBOF with CCS, Gas DRI, Hydrogent DRI, Scrap with EAF)	Mt per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.50
	Cement production by technology (Coal, Coal CCS, Oil, Gas, Gas CCS, Biomass, Biomass CCS)	Mt per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.51
	Coal demand by industry sector (Iron and steel, Non-metallic minerals, Chemicals, Other, CCS)	EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.52
	Oil demand by industry sector (Iron and steel, Non-metallic minerals, Chemicals-fuel, chemicals-feedstock, Other)	EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.53
	Gas demand by industry sector (Iron and steel, Non-metallic minerals, Chemicals, Other, CCS)	EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.54
	Building heating technology mix (Coal, Oil, Gas, Biomass, District heat, Resistive, Heat pump, Hydrogen)	Thousand GW	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.55
	Thermal efficiency of building floorespace (Conventional, Net zero ready-retrofit, Net zero ready-new build)	billion m2	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.56

Sources：PRI "IPR FPS 2021 Detailed energy system results", "IPR FPS 2021 Detailed land use system results"

PRI IPR 1.5℃ RPS 2021

[Parameters in PRI 1.5℃ RPS]

Power and hydrogen, Policy, technology and behavioral expectations, Carbon Capture and Storage (CCS), Power and hydrogen (1/2)

Datasets		Unit	Timeframe	Applicable pages
#1	#2			
Key Policy Assumptions	Phase out of existing unabated coal (IPR FPS 2021, IPR RPS 2021)	%	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.13
	100% clean power (IPR FPS 2021, IPR RPS 2021)	%	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.14
	Fossil vehicle phase out (light duty) (IPR FPS 2021, IPR RPS 2021)	%	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.15
	Fossil vehicle phase out (heavy duty) (IPR FPS 2021, IPR RPS 2021)	%	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.16
	100% clean industry (IPR FPS 2021, IPR RPS 2021)	%	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.17
	New fossil heating system phase out (IPR FPS 2021, IPR RPS 2021)	%	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.18
Policy, technology and behavioural expectations	Emissions prices in IPR 1.5℃ RPS - early adopters (Early adopter CO2, Early adopter N2O)	2021 USD / tCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.34
	Emissions prices in IPR 1.5℃ RPS - late adopters (Late adopter CO2, Late adopter N2O)	2021 USD / tCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.35
	World GDP	Trillion 2005 USD (PPP)	'10 / '15 / '20 / '25 / '30 / '35 / '40 / '45 / '50 / '55 / '60 / '65 / '70 / '75 / '80 / '85 / '90 / '95 / 2100	p.37
	World Population	Billions	'10 / '15 / '20 / '25 / '30 / '35 / '40 / '45 / '50 / '55 / '60 / '65 / '70 / '75 / '80 / '85 / '90 / '95 / 2100	p.37
	Land use change in BAU (2017 base year)(Cropland, Pastures and Rangelands, Forest, Other Land)	Million Ha	'25 / '30 / '35 / '40 / '45 / '50	p.39
Carbon Capture and Storage (CCS)	CO2 captured by fuel and sector (Power-coal, Power-gas, Power-biomass, indsutry-coal, industry-gas, industry-biomass, industry-process, Hydrogen-gas, Direct air capture)	GtCO2	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.58
	Carbon capture and storage, IPR RPS and comparable IPCC scenarios	GtCO2	'10 / '20 / '30 / '40 / '50	p.59
Power and hydrogen	Electricity generation mix, global (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar PV, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.34
	Electricity generation mix, IPR 1.5℃ RPS and IEA NZE (Coal, Oil, Gas, Nuclear, Hydro, Biomass, Solar PV, Wind, Hydrogen, Other)	Thousand TWh	'20 / '50	p.35
	Electricity generation mix, European Union (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar PV, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.36
	Electricity generation mix, United States (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar PV, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.37
	Electricity generation mix, China (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar PV, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.38

Sources：PRI "IPR FPS 2021 Detailed energy system results", "IPR FPS 2021 Detailed land use system results"

PRI IPR 1.5℃ RPS 2021

[Parameters in PRI 1.5℃ RPS]

Power and hydrogen（2/2）, Land use

Datasets		Unit	Timeframe	Applicable pages
#1	#2			
Power and hydrogen	Electricity generation mix, India (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar PV, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.39
	Electricity generation mix,Japan (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar PV, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.39
	Electricity generation mix, Canada (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar PV, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.40
	Electricity generation mix, Australia (Coal, Coal CCS, Oil, Gas, Gas CCS, Nuclear, Hydro, Biomass, Biomass CCS, Solar PV, Onshore wind, Offshore wind, Hydrogen, Other)	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.40
	Coal generation by region	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.41
	Gas generation by region	Thousand TWh	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.42
	Hydrogen demand by sector (Existing feedstock uses, Power, Transport, Industry, Buildings)	Million tonnnes per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.43
	Hydrogen production by route (Unabated, Blue, Green)	Million tonnes per year EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
Land use	End of deforestation, Change in forest cover 2020-2050	m ha	'20 / '25 / '30 / '50	p.15
	Reduction in per capita meat consumption, 2020-2050	%	'20 / '25 / '30 / '35 / '40 / '50	p.16
	Meat production in IPR FPS 2021 (Monogastric (pig), Poultry, Ruminant meat, Alternative meat)	Mt DM/ yr	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.18
	NBS supply by region (excl. avoidance) in IPR 1.5C RPS	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.21
	NBS supply by region (incl. avoidance) in IPR RPS 2021	GtCO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.22
	Cumulative cost of assets (market size) Potential annual revenues	billion USD 2021	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.24
	Source of greenhouse gas emissions 2019 (Agriculture, Forestry and Land use)	Mean estimated emissions (Gt CO2e)	'19	p.26
	Land use 2017 (Cropland, Pastures and Rangelands, Forest, Othre Land)	Mean estimated land use (million Ha)	'17	p.26
	Production volume by type of livestock (Monogastric, Poultry, Ruminant meat, Dairy)	Mt wet matter	（Not available）	p.27
	Emissions by type of livestock (Monogastric, Poultry, Ruminant meat, Dairy)	Mt CO2e	（Not available）	p.27
	Primary energy demand (2018) (Coal(unabated), Oil, Natural gas (unabated), Nuclear, Bioenergy (conventional), Bioenergy CCS, Hydro, Wind, Solar PV)	EJ	'18	p.28
	Land use change in IPR 1.5℃ RPS (2017 base year)(Cropland, Pastures and Rangelands, Forest, Other Land)	Million Ha	'25 / '30 / '35 / '40 / '45 / '50	p.39
	Land use GHG emissions in IPR RPS 2021 (CO2, N2O, CH4, Total)	Gt CO2e	'20 / '25 / '30 / '35 / '40 / '45 / '50 / '55 / '60 / '70 / '80 / '90 / 2100	p.40

4-57 Sources：PRI "IPR FPS 2021 Detailed energy system results", "IPR FPS 2021 Detailed land use system results"

PRI IPR 1.5℃ RPS 2021

[Parameters in PRI 1.5℃ RPS]

Fuel demand, Agriculture value drivers

Datasets		Unit	Timeframe	Applicable pages
#1	#2			
Fuel demand	Primary energy demand (Coal, Oil, Gas, Biomass, Renewables and nuclear)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.23
	Fossil fuel demand (Coal, Oil, Gas)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.24
	Coal demand by sector (Power, Industry, Builldings, Other)	Million tonnes EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.25
	Coal demand by sector, IPR 1.5℃ RPS and IEA NZE (Power,Transport, Industry, Builldings, Other)	Million tonnes EJ per year	'20 / '50	p.26
	Oil demand by sector (Power, Transport, Industry, Builldings, Other)	MMbbl/day EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.27
	Oil demand by sector, IPR 1.5℃ RPS and IEA NZE (Power, Transport, Industry, Builldings, Other)	MMbbl/day EJ per year	'20 / '50	p.28
	Gas demand by sector (Power, Transport, Industry, Buildings, Hydrogen, Other)	bcm EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.29
	Gas demand by sector, IPR 1.5℃ RPS and IEA NZE (Power, Transport, Industry, Builldings, Other)	bcm EJ per year	'20 / '50	p.30
	Biomass demand by sector (Power, Transport, Industry, Buildings, Other)	EJ per year	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.31
	Biomass demand by sector, IPR 1.5℃ RPS and IEA NZE (Power, Transport, Industry, Builldings, Other)	EJ per year	'20 / '50	p.32
Agriculture value drivers	Bioenergy land use in IPR 1.5℃ RPS (Maize, Oil palm, Soybean, Sugar cane, Bioenergy (2nd gen))	Land cover (million ha)	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.42
	Second generation bioenergy production in IPR RPS 2021	EJ	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.43
	Maize production in IPR 1.5C RPS (IPR 1.5℃ RPS, BAU)	Mt DM	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
	Sugar cane production in IPR 1.5C RPS (IPR 1.5℃ RPS, BAU)	Mt DM	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
	Soybean production in IPR 1.5C RPS (IPR 1.5℃ RPS, BAU)	Mt DM	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
	Palm oil fruit production in IPR 1.5C RPS (IPR 1.5℃ RPS, BAU)	Mt DM	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.44
	Timber production in IPR 1.5℃ RPS (Industrial Roundwood, Wood fuel)	Cubic meters per year (million)	'20 / '25 / '30 / '35 / '40 / '45 / '50	p.45

Sources：PRI "IPR RPS 2021 Detailed energy system results", "IPR RPS 2021 Detailed land use system results"

[SSP]

SSP was developed as a socio-economic scenario based on recent policies and socio-economic environment

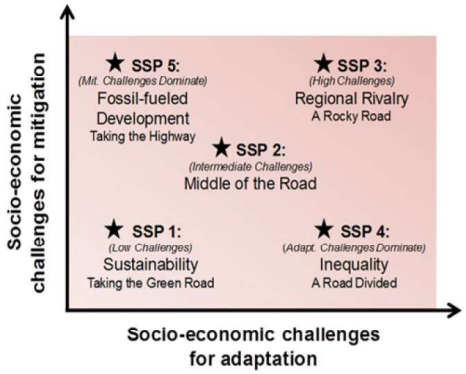
SSP Public Database Version2.0

The outline of SSP（Shared Socioeconomic Pathways）

- Based on the issues of the socio-economic scenario “SRES” related to the evaluation of existing climate change, National Institute for Environmental Studies（Japan）, PNNL（US）, PBL（Netherland）, IIASA（Austria）and Germany（PIK）has developed SSP*1
  - SPES has problems such as the old base year (1990) and the inability to reflect recent policies
  - SSP considers recent changes in the external environment such as recent policies, vital statistics, GDP, and urbanization *2, and has relevance to existing socio-economic scenarios such as "SERS" and "RCPs". Developed as a scenario. It consists of 5 scenarios

5 Scenario Composition of SSP

SSP	Scenario	Scenario Outline *3
SSP1	Sustainability	A scenario that assumes the realization of both international mitigation measures and adaptation measures related to climate change
SSP2	Middle of the Road	A scenario that assumes that the current socio-economic growth will continue
SSP3	Regional Rivalry	A scenario that assumes a situation where the country is divided and it is difficult to realize international mitigation measures and adaptation measures
SSP4	Inequality	A scenario that assumes an international economic society with widening disparities
SSP5	Fossil-fueled Development	A scenario that assumes that the international community will develop depending 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

SSP Public Database Version2.0

[Parameters in SSP Public Database Version2.0 (1/10)]

IAM Scenarios Model：GDP, Population, Primary Energy, Secondary Energy (Electricity)

Category			Unit	SSP					Remark
Large	Medium	Small		SSP1	SSP2	SSP3	SSP4	SSP5	
GDP	PPP	—	billionUS$ 2005/yr	○	○	○	○	○	
Population	Population	—	million	○	○	○	○	○	
Energy	Primary Energy	Total	EJ/yr	○	○	○	○	○	
Energy	Primary Energy	Biomass(Total / Traditional / with CCS/ without CCS)	EJ/yr	○	○	△	○	○	Some data（Traditional, CCS）is not available in SSP3
Energy	Primary Energy	Coal (Total / with CCS /without CCS)	EJ/yr	○	○	△	○	○	Some data（CCS）is not available in SSP3
Energy	Primary Energy	Oil (Total / with CCS / wihout CCS)	EJ/yr	○	△	△	○	△	Some data（CCS）is not available in SSP2,3,5
Energy	Primary Energy	Gas (Total / with CCS/ without CCS)	EJ/yr	○	○	△	○	○	Some data（CCS）is not available in SSP3
Energy	Primary Energy	Fossil (Total , with CCS, wihout CCS)	EJ/yr	○	○	△	○	○	Some data（CCS）is not available in SSP3
Energy	Primary Energy	Nuclear	EJ/yr	○	○	○	○	○	
Energy	Primary Energy	Non-Biomass Renewables	EJ/yr	○	○	○	○	○	
Energy	Primary Energy	Hydro	EJ/yr	○	○	○	○	○	
Energy	Primary Energy	Geothermal	EJ/yr	—	○	○	○	○	Data is not available in SSP1
Energy	Primary Energy	Other	EJ/yr	○	○	○	—	—	Data is not available in SSP4,5
Energy	Primary Energy	Solar	EJ/yr	○	○	○	○	○	
Energy	Primary Energy	Wind	EJ/yr	○	○	○	○	○	
Energy	Primary Energy	Secondary Energy Trade	EJ/yr	—	—	○	—	—	Data is not available in SSP1,2,4,5
Energy	Secondary Energy (Electricity)	Total	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Electricity)	Biomass(Total / with CCS/ without CCS)	EJ/yr	○	○	△	○	○	Some data（CCS）is not available in SSP3
Energy	Secondary Energy (Electricity)	Coal (Total / with CCS /without CCS)	EJ/yr	○	○	△	○	○	Some data（CCS）is not available in SSP3
Energy	Secondary Energy (Electricity)	Oil	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Electricity)	Gas (Total / with CCS/ without CCS)	EJ/yr	○	○	△	○	○	Some data（CCS）is not available in SSP3
Energy	Secondary Energy (Electricity)	Geothermal	EJ/yr	—	○	○	○	○	Data is not available in SSP1
Energy	Secondary Energy (Electricity)	Hydro	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Electricity)	Non-Biomass Renewables	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Electricity)	Nuclear	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Electricity)	Solar	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Electricity)	Wind	EJ/yr	○	○	○	○	○	

Source：SSP Public Database Version2.0（As of February 2022）

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

SSP Public Database Version2.0

[Parameters in SSP Public Database Version2.0 (2/10)]
IAM Scenarios Model：Secondary Energy, Final Energy

Category			Unit	SSP					Remark
Large	Medium	Small		SSP1	SSP2	SSP3	SSP4	SSP5	
Energy	Secondary Energy (Gases)	Total	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Gases)	Biomass	EJ/yr	—	○	—	○	○	Data is not available in SSP1,3
Energy	Secondary Energy (Gases)	Coal	EJ/yr	—	○	—	○	○	Data is not available in SSP1,3
Energy	Secondary Energy (Gases)	Natural Gas	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Heat)	Total	EJ/yr	—	○	○	—	○	Data is not available in SSP1,4
Energy	Secondary Energy (Heat)	Geothermal	EJ/yr	—	○	○	—	○	Data is not available in SSP1,4
Energy	Secondary Energy (Hydrogen)	Total	EJ/yr	○	○	—	○	○	Data is not available in SSP3
Energy	Secondary Energy (Hydrogen)	Biomass(Total / with CCS/ without CCS)	EJ/yr	○	○	—	○	○	Data is not available in SSP3
Energy	Secondary Energy (Hydrogen)	Electricity	EJ/yr	○	○	—	○	○	Data is not available in SSP3
Energy	Secondary Energy (Liquids)	Total	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Liquids)	Biomass(Total / with CCS/ without CCS)	EJ/yr	△	○	△	○	○	Some data（CCS）is not available in SSP1，（CCU･without CCU）is not available in SSP1
Energy	Secondary Energy (Liquids)	Coal (Total / with CCS /without CCS)	EJ/yr	—	○	—	—	○	Data is not available in SSP1,3,4
Energy	Secondary Energy (Liquids)	Gas (Total / with CCS/ without CCS)	EJ/yr	—	○	—	—	—	Data is not available in SSP1,3,4,5
Energy	Secondary Energy (Liquids)	Oil	EJ/yr	○	○	○	○	○	
Energy	Secondary Energy (Solids)	—	EJ/yr	○	○	—	—	○	Data is not available in SSP3,4
Energy	Final Energy	Total	EJ/yr	○	○	○	○	○	
Energy	Final Energy	Electricity	EJ/yr	○	○	○	○	○	
Energy	Final Energy	Gases	EJ/yr	○	○	○	○	○	
Energy	Final Energy	Heat	EJ/yr	○	○	○	○	○	
Energy	Final Energy	Hydrogen	EJ/yr	○	○	—	○	○	Data is not available in SSP3
Energy	Final Energy	Liquids	EJ/yr	○	○	○	○	○	
Energy	Final Energy	Solar	EJ/yr	○	○	—	—	—	Data is not available in SSP3,4,5
Energy	Final Energy (Solids)	Total	EJ/yr	○	○	○	○	○	
Energy	Final Energy (Solids)	Biomass (Total, Traditional)	EJ/yr	○	○	△	○	○	Some data（Traditional）is not available in SSP3
Energy	Final Energy (Solids)	Coal	EJ/yr	○	○	○	○	○	
Energy	Final Energy	Industry	EJ/yr	○	○	○	○	—	Data is not available in SSP5
Energy	Final Energy	Residential and Commercial	EJ/yr	○	○	○	○	—	Data is not available in SSP5
Energy	Final Energy	Transportation	EJ/yr	○	○	○	○	○	

Source：SSP Public Database Version2.0（As of February 2022）

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

SSP Public Database Version2.0

[Parameters in SSP Public Database Version2.0 (3/10)]
IAM Scenarios Model：Energy Service (Transportation), Land Cover, Emissions（unharmonized）

Category			Unit	SSP					Remark
Large	Medium	Small		SSP1	SSP2	SSP3	SSP4	SSP5	
Energy	Energy Service (Transportation)	Freight	bn tkm/yr	○	—	—	○	○	Data is not available in SSP2,3
Energy	Energy Service (Transportation)	Passenger	bn pkm/yr	○	—	—	○	○	Data is not available in SSP2,3
Land Cover	Built-up Area	—	million ha	○	—	○	○	○	Data is not available in SSP2
Land Cover	Cropland	—	million ha	○	○	○	○	○	
Land Cover	Forest	—	million ha	○	○	○	○	○	
Land Cover	Pasture	—	million ha	○	○	○	○	○	
Emissions (unharmonized)	BC	—	Mt BC/yr	○	○	○	○	○	
Emissions (unharmonized)	CH4	Total	Mt CH4/yr	○	○	○	○	○	
Emissions (unharmonized)	CH4	Fossil Fuels and Industry	Mt CH4/yr	—	—	—	○	○	Data is not available in SSP1,2,3
Emissions (unharmonized)	CH4	Land Use	Mt CH4/yr	○	○	○	○	○	
Emissions (unharmonized)	CO	—	Mt CO/yr	○	○	○	○	○	
Emissions (unharmonized)	CO2	Total	Mt CO2/yr	○	○	○	○	○	
Emissions (unharmonized)	CO2 (Carbon Capture and Storage)	Total	Mt CO2/yr	○	○	—	○	○	Data is not available in SSP3
Emissions (unharmonized)	CO2 (Carbon Capture and Storage)	Biomass	Mt CO2/yr	○	○	—	○	○	Data is not available in SSP3
Emissions (unharmonized)	CO2	Fossil Fuels and Industry	Mt CO2/yr	○	○	○	○	○	
Emissions (unharmonized)	CO2	Land Use	Mt CO2/yr	○	○	○	○	○	
Emissions (unharmonized)	F-Gases	—	Mt CO2-equiv/yr	○	○	○	○	○	
Emissions (unharmonized)	Kyoto Gases	—	Mt CO2-equiv/yr	○	○	○	○	○	
Emissions (unharmonized)	N2O	Total	kt N2O / yr	○	○	○	○	○	
Emissions (unharmonized)	N2O	Land Use	kt N2O / yr	○	○	○	○	○	
Emissions (unharmonized)	NH3	—	Mt NH3/yr	○	○	○	○	○	
Emissions (unharmonized)	NOx	—	Mt NO2/yr	○	○	○	○	○	
Emissions (unharmonized)	OC	—	Mt OC/yr	○	○	○	○	○	
Emissions (unharmonized)	Sulfur	—	Mt SO2/yr	○	○	○	○	○	
Emissions (unharmonized)	VOC	—	Mt VOC/yr	○	○	○	○	○	

Source：SSP Public Database Version2.0（As of February 2022）

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

[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	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	CH4	Total	Mt CH4/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	CH4	Fossil Fuels and Industry	Mt CH4/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	CH4	Land Use	Mt CH4/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	CO	—	Mt CO/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	CO2	Total	Mt CO2/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	CO2	Fossil Fuels and Industry	Mt CO2/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	CO2	Land Use	Mt CO2/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	F-Gases	—	Mt CO2-equiv/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	Kyoto Gases	—	Mt CO2-equiv/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	N2O	—	kt N2O/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	NH3	—	Mt NH3/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	NOx	—	Mt NO2/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	OC	—	Mt OC/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	Sulfur	—	Mt SO2/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Emissions (harmonized)	VOC	—	Mt VOC/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Climate	Concentration	CO2	ppm	○	○	○	○	○	
Climate	Concentration	CH4	ppb	○	○	○	○	○	
Climate	Concentration	N2O	ppb	○	○	○	○	○	
Climate	Forcing	Total	W/m2	○	○	○	○	○	
Climate	Forcing	CO2	W/m2	○	○	○	○	○	
Climate	Forcing	CH4	W/m2	○	○	○	○	○	
Climate	Forcing	N2O	W/m2	○	○	○	○	○	
Climate	Forcing	Kyoto Gases	W/m2	○	○	○	○	○	
Climate	Forcing	F-Gases	W/m2	○	○	○	○	○	
Climate	Forcing	Aerosol	W/m2	○	○	○	○	○	
Climate	Temperature	Global Mean	℃	○	○	○	○	○	

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

Source：SSP Public Database Version2.0（As of February 2022）

[Parameters in SSP Public Database Version2.0 (5/10)]
IAM Scenarios Model：Agricultural Indicators, Economic Indicators, Technological Indicators

Category			Unit	SSP					Remark
Large	Medium	Small		SSP1	SSP2	SSP3	SSP4	SSP5	
Agricultural Indicators	Demand	Crops	million t DM/yr	○	○	○	—	—	Data is not available in SSP4,5
Agricultural Indicators	Demand	Crops (Energy)	million t DM/yr	—	—	○	—	○	Data is not available in SSP1,2,4
Agricultural Indicators	Demand	Livestock	million t DM/yr	○	○	○	—	○	Data is not available in SSP4
Agricultural Indicators	Production	Crops (Energy)	million t DM/yr	○	○	○	○	○	
Agricultural Indicators	Production	Crops (Non-Energy)	million t DM/yr	○	○	○	○	○	
Agricultural Indicators	Production	Livestock	million t DM/yr	○	○	○	○	○	
Economic Indicators	Consumption	—	billion US$2005/yr	○	○	○	—	○	Data is not available in SSP4
Economic Indicators	Price (Carbon)	—	US$2005/t CO2	○	○	—	○	○	Data is not available in SSP3
Technological Indicators	Capacity (Electricity)	Total	GW	○	○	○	○	○	
Technological Indicators	Capacity (Electricity)	Biomass	GW	○	○	○	○	○	
Technological Indicators	Capacity (Electricity)	Coal	GW	○	○	○	○	○	
Technological Indicators	Capacity (Electricity)	Gas	GW	○	○	○	○	○	
Technological Indicators	Capacity (Electricity)	Geothermal	GW	—	○	○	○	○	Data is not available in SSP1
Technological Indicators	Capacity (Electricity)	Hydro	GW	○	○	○	—	○	Data is not available in SSP4
Technological Indicators	Capacity (Electricity)	Nuclear	GW	○	○	○	○	○	
Technological Indicators	Capacity (Electricity)	Oil	GW	○	○	○	○	—	Data is not available in SSP5
Technological Indicators	Capacity (Electricity)	Other	GW	○	—	—	—	—	Data is not available in SSP2,3,4,5
Technological Indicators	Capacity (Electricity)	Solar (Total, CSP, PV)	GW	○	○	△	△	○	Data is not available in SSP3（CSP），and SSP4（CSP, PV）
Technological Indicators	Capacity (Electricity)	Wind (Total, Offshore, Onshore)	GW	○	○	△	△	△	Data is not available in SSP3（Onshore），and SSP4,5（Onshore, Offshore）

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

Source：SSP Public Database Version2.0（As of February 2022）

[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	○	○	○	○	○	
BC	Aircraft	Mt BC/yr	○	○	○	○	○	
BC	Energy Sector	Mt BC/yr	○	○	○	○	○	
BC	Forest Burning	Mt BC/yr	○	○	○	○	○	
BC	Grassland Burning	Mt BC/yr	○	○	○	○	○	
BC	Industrial Sector	Mt BC/yr	○	○	○	○	○	
BC	International Shipping	Mt BC/yr	○	○	○	○	○	
BC	Peat Burning	Mt BC/yr	○	○	○	○	○	
BC	Residential Commercial Other	Mt BC/yr	○	○	○	○	○	
BC	Transportation Sector	Mt BC/yr	○	○	○	○	○	
BC	Total	Mt BC/yr	○	○	○	○	○	
BC	Waste	Mt BC/yr	○	○	○	○	○	
C2F6	—	kt C2F6/yr	○	○	○	○	○	
CF4	—	kt CF4/yr	○	○	○	○	○	
CH4	Agricultural Waste Burning	Mt CH4/yr	○	○	○	○	○	
CH4	Agriculture	Mt CH4/yr	○	○	○	○	○	
CH4	Energy Sector	Mt CH4/yr	○	○	○	○	○	
CH4	Forest Burning	Mt CH4/yr	○	○	○	○	○	
CH4	Grassland Burning	Mt CH4/yr	○	○	○	○	○	
CH4	Industrial Sector	Mt CH4/yr	○	○	○	○	○	
CH4	International Shipping	Mt CH4/yr	○	○	○	○	○	
CH4	Peat Burning	Mt CH4/yr	○	○	○	○	○	
CH4	Residential Commercial Other	Mt CH4/yr	○	○	○	○	○	
CH4	Transportation Sector	Mt CH4/yr	○	○	○	○	○	
CH4	Total	Mt CH4/yr	○	○	○	○	○	
CH4	Waste	Mt CH4/yr	○	○	○	○	○	

Source：SSP Public Database Version2.0（As of February 2022）

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

[Parameters in SSP Public Database Version2.0 (7/10)]
CMIP6 Emissions Model：CO2, CO, HFC, N2O

Category		Unit	SSP					Remark
Large	Medium		SSP1	SSP2	SSP3	SSP4	SSP5	
CO2	AFOLU	Mt CO2/yr	○	○	○	○	○	
CO2	Aircraft	Mt CO2/yr	○	○	○	○	○	
CO2	Energy Sector	Mt CO2/yr	○	○	○	○	○	
CO2	Industrial Sector	Mt CO2/yr	○	○	○	○	○	
CO2	International Shipping	Mt CO2/yr	○	○	○	○	○	
CO2	Residential Commercial Other	Mt CO2/yr	○	○	○	○	○	
CO2	Solvents Production and Application	Mt CO2/yr	○	○	○	○	○	
CO2	Transportation Sector	Mt CO2/yr	○	○	○	○	○	
CO2	Total	Mt CO2/yr	○	○	○	○	○	
CO2	Waste	Mt CO2/yr	○	○	○	○	○	
CO	Agricultural Waste Burning	Mt CO/yr	○	○	○	○	○	
CO	Aircraft	Mt CO/yr	○	○	○	○	○	
CO	Energy Sector	Mt CO/yr	○	○	○	○	○	
CO	Forest Burning	Mt CO/yr	○	○	○	○	○	
CO	Grassland Burning	Mt CO/yr	○	○	○	○	○	
CO	Industrial Sector	Mt CO/yr	○	○	○	○	○	
CO	International Shipping	Mt CO/yr	○	○	○	○	○	
CO	Peat Burning	Mt CO/yr	○	○	○	○	○	
CO	Residential Commercial Other	Mt CO/yr	○	○	○	○	○	
CO	Transportation Sector	Mt CO/yr	○	○	○	○	○	
CO	Total	Mt CO/yr	○	○	○	○	○	
CO	Waste	Mt CO/yr	○	○	○	○	○	
HFC	—	Mt CO2-equiv/yr	○	○	○	○	○	
N2O	—	kt N2O/yr	○	○	○	○	○	

Source：SSP Public Database Version2.0（As of February 2022）

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

SSP Public Database Version2.0

[Parameters in SSP Public Database Version2.0 (8/10)]
CMIP6 Emissions Model：NH3, Nox

Category		Unit	SSP					Remark
Large	Medium		SSP1	SSP2	SSP3	SSP4	SSP5	
NH3	Agricultural Waste Burning	Mt NH3/yr	○	○	○	○	○	
NH3	Agriculture	Mt NH3/yr	○	○	○	○	○	
NH3	Aircraft	Mt NH3/yr	○	○	○	○	○	
NH3	Energy Sector	Mt NH3/yr	○	○	○	○	○	
NH3	Forest Burning	Mt NH3/yr	○	○	○	○	○	
NH3	Grassland Burning	Mt NH3/yr	○	○	○	○	○	
NH3	Industrial Sector	Mt NH3/yr	○	○	○	○	○	
NH3	International Shipping	Mt NH3/yr	○	○	○	○	○	
NH3	Peat Burning	Mt NH3/yr	○	○	○	○	○	
NH3	Residential Commercial Other	Mt NH3/yr	○	○	○	○	○	
NH3	Transportation Sector	Mt NH3/yr	○	○	○	○	○	
NH3	Total	Mt NH3/yr	○	○	○	○	○	
NH3	Waste	Mt NH3/yr	○	○	○	○	○	
Nox	Agricultural Waste Burning	Mt NOx/yr	○	○	○	○	○	
Nox	Agriculture	Mt NOx/yr	○	○	○	○	○	
Nox	Aircraft	Mt NOx/yr	○	○	○	○	○	
Nox	Energy Sector	Mt NOx/yr	○	○	○	○	○	
Nox	Forest Burning	Mt NOx/yr	○	○	○	○	○	
Nox	Grassland Burning	Mt NOx/yr	○	○	○	○	○	
Nox	Industrial Sector	Mt NOx/yr	○	○	○	○	○	
Nox	International Shipping	Mt NOx/yr	○	○	○	○	○	
Nox	Peat Burning	Mt NOx/yr	○	○	○	○	○	
Nox	Residential Commercial Other	Mt NOx/yr	○	○	○	○	○	
Nox	Solvents Production and Application	Mt NOx/yr	○	○	○	○	○	
Nox	Transportation Sector	Mt NOx/yr	○	○	○	○	○	
Nox	Total	Mt NOx/yr	○	○	○	○	○	
Nox	Waste	Mt NOx/yr	○	○	○	○	○	

Source：SSP Public Database Version2.0（As of February 2022）

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

SSP Public Database Version2.0

[Parameters in SSP Public Database Version2.0 (9/10)]
CMIP6 Emissions Model：OC, SF6, Sulfur

Category		Unit	SSP					Remark
Large	Medium		SSP1	SSP2	SSP3	SSP4	SSP5	
OC	Agricultural Waste Burning	Mt OC/yr	○	○	○	○	○	
OC	Aircraft	Mt OC/yr	○	○	○	○	○	
OC	Energy Sector	Mt OC/yr	○	○	○	○	○	
OC	Forest Burning	Mt OC/yr	○	○	○	○	○	
OC	Grassland Burning	Mt OC/yr	○	○	○	○	○	
OC	Industrial Sector	Mt OC/yr	○	○	○	○	○	
OC	International Shipping	Mt OC/yr	○	○	○	○	○	
OC	Peat Burning	Mt OC/yr	○	○	○	○	○	
OC	Residential Commercial Other	Mt OC/yr	○	○	○	○	○	
OC	Transportation Sector	Mt OC/yr	○	○	○	○	○	
OC	Total	Mt OC/yr	○	○	○	○	○	
OC	Waste	Mt OC/yr	○	○	○	○	○	
SF6	—	kt SF6/yr	○	○	○	○	○	
Sulfur	Agricultural Waste Burning	Mt SO2/yr	○	○	○	○	○	
Sulfur	Aircraft	Mt SO2/yr	○	○	○	○	○	
Sulfur	Energy Sector	Mt SO2/yr	○	○	○	○	○	
Sulfur	Forest Burning	Mt SO2/yr	○	○	○	○	○	
Sulfur	Grassland Burning	Mt SO2/yr	○	○	○	○	○	
Sulfur	Industrial Sector	Mt SO2/yr	○	○	○	○	○	
Sulfur	International Shipping	Mt SO2/yr	○	○	○	○	○	
Sulfur	Peat Burning	Mt SO2/yr	○	○	○	○	○	
Sulfur	Residential Commercial Other	Mt SO2/yr	○	○	○	○	○	
Sulfur	Transportation Sector	Mt SO2/yr	○	○	○	○	○	
Sulfur	Total	Mt SO2/yr	○	○	○	○	○	
Sulfur	Waste	Mt SO2/yr	○	○	○	○	○	

Source：SSP Public Database Version2.0（As of February 2022）

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

[Parameters in SSP Public Database Version2.0 (10/10)]
CMIP6 Emissions Model：VOC

Category		Unit	SSP					Remark
Large	Medium		SSP1	SSP2	SSP3	SSP4	SSP5	
VOC	Agricultural Waste Burning	Mt VOC/yr	○	○	○	○	○	
VOC	Aircraft	Mt VOC/yr	○	○	○	○	○	
VOC	Energy Sector	Mt VOC/yr	○	○	○	○	○	
VOC	Forest Burning	Mt VOC/yr	○	○	○	○	○	
VOC	Grassland Burning	Mt VOC/yr	○	○	○	○	○	
VOC	Industrial Sector	Mt VOC/yr	○	○	○	○	○	
VOC	International Shipping	Mt VOC/yr	○	○	○	○	○	
VOC	Peat Burning	Mt VOC/yr	○	○	○	○	○	
VOC	Residential Commercial Other	Mt VOC/yr	○	○	○	○	○	
VOC	Solvents Production and Application	Mt VOC/yr	○	○	○	○	○	
VOC	Transportation Sector	Mt VOC/yr	○	○	○	○	○	
VOC	Total	Mt VOC/yr	○	○	○	○	○	
VOC	Waste	Mt VOC/yr	○	○	○	○	○	

Source：SSP Public Database Version2.0（As of February 2022）

* Extract parameters for which Global values can be obtained
* GDP and population are data for each 5 years from 2010 to 2100, and other parameters are data for 2005 and 2010 to 2100 for each 5 years.

Appendix.

Appendix.

Provide useful materials for scenario analysis based on supporting case studies

[Physical risk assessment tool referred in TCFD]

Physical risk assessment tools referred in TCFD report（As of the 2020 release）

	Issuing agency	Literature / Tool name	URL	Summary	
1	Bloomberg	Bloomberg Scenario Analysis Tool（Physical Risk Assessment)		Uses a map to display assets with high exposure to specific physical risks such as cyclones, floods, extreme heat, water stress, storm surge and wildfires	Tools at a global level
2	Oasis HUB	OASIS Loss Modelling Framework	https://oasislmf.org/our-modelling-platform	Web-based open-source tool that enables development of catastrophe models such as fires and floods. Users input hazard, exposure, and vulnerability data and the tool calculates risk and financial cost of events	
3	XDI	Easy XDI	https://easyxdi.com/	Free tool for users to self-investigate climate risks at the asset level for physical risks such as forest fires, riverine flooding, overland flooding due to heavy rainfall, coastal inundation, heat extremes, subsidence (soil movement due to drought), extreme wind, and freeze-thaw	
4	Climate Impact Lab	The Climate Impact Map		Web-based open-source platform that projects the future impacts of climate change under various scenarios for physical risks such as sea level rise, temperature, precipitation, and humidity	
5	World Bank Global Facility for Disaster Reduction And Recovery	ThinkHazard!	https://thinkhazard.org/en/	Web-based free tool that assesses the level of physical climate hazards such as river floods, urban floods, coastal floods, cyclones, water scarcity, extreme heat, and wildfire for a user-specified location and provides guidance on how to reduce risks associated with development projects	

 Sources： TCFD "Guidance on Scenario Analysis for Non-Financial Companies" p.88-106

[Physical risk assessment tool referred in TCFD]

Physical risk assessment tools referred in TCFD report（As of the 2017 release）

	Issuing agency / Tool name	Subject area	Summary	
1	WRI Aqueduct Atlas	Global	■ Risk mapping tool that helps companies, investors, governments, and other users understand where and how water risks and opportunities are emerging worldwide	Tools at a global level
2	WBCSD Water Tool	Global	■ 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	
3	Global Agro- Ecological Zones	Global	■ 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.	
4	UK Climate Impact Programme	UK	■ 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	Tools at a local / national level
5	US Interagency Archive of Downscaled Climate Data and Information	US	■ 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	
6	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（2017）

[Physical risk tools used in this project]

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 Risk Atlas	https://www.wri.org/aqueduct	Global	4-74
2	World Bank	Climate Change Knowledge Portal	https://climateknowledgeportal.worldbank.org/	Global	4-76
3	AP-PLAT	Climate Impact Viewer	https://a-plat.nies.go.jp/ap-plat/asia_pacific/index.html	Asia	4-77
4	A-PLAT	Web GIS	https://adaptation-platform.nies.go.jp/webgis/index.html	Japan	4-78～4-85
5	European Commission	European Climate Adaptation Platform （Climate-ADAPT）	https://climate-adapt.eea.europa.eu/	EU	― ※European Adaptation Platform
6	IPCC TGICA	IPCC Data Distribution Centre	https://www.ipcc-data.org/	Global	― ※Database of the Intergovernmental Panel on Climate Change (IPCC)
7	FAO	The future of food and agriculture Alternative pathways to 2050	https://www.fao.org/global-perspectives-studies/food-agriculture-projections-to-2050/en/	Global	―

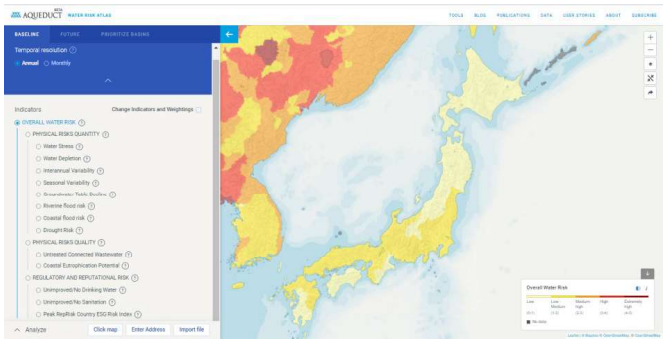
WRI AQUEDUCT Water Risk Atlas

[Physical risk tools used in this project (excerpt): Parameter]

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 (As of February 2022）

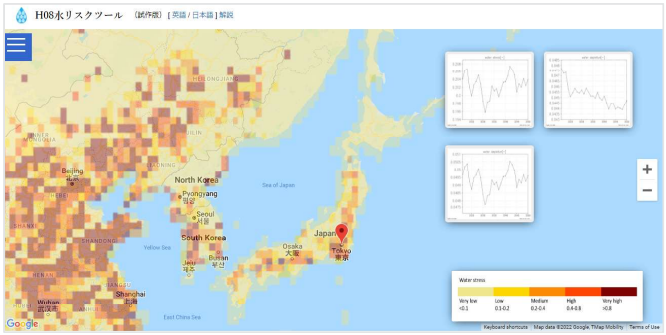
National Institute for Environmental Studies
H08 Water Risk Tool

[(Reference) Physical risk tools (excerpt): Parameter]

H08 Water Risk Tool（National Institute for Environmental Studies）

H08 Water Risk Tool

Issuing agency	National Institute for Environmental Studies
Scenario	RCP4.5 / RCP7.0 / RCP8.5
Timeframe	1901~2090 (Selectable per year)



Results from the H08 water risk tool can also be compared with results from other tools, such as Aqueduct, to enhance analysis and improve the reliability of information on the tightness of water resources.

Indicators

Indicators (Map)	
Climate model	• GFDL-ESM4 • MPI-ESM1-2-HR • IPSL-CM6A-LR • MRI-ESM2-0 • UKESM1-0-LL • Ensemble（Average of the above five models）
Water risk index	• Water stress • Water depletion • Interannual variability • Seasonal variability • Groundwater table decline • Cumulative abstraction to demand
Basic variables	• Annual river discharge • Total water withdrawal from all sources • Total water withdrawal from renewable sources

Indicators（Time series）
• Specify the location on the map • Specify the location from the name of place • Specify the location from the latitude and longitude

Source：H08 Water Risk Tool https://h08.nies.go.jp/~ddc/cgi-bin/viewer2021/index_ja.php （As of February 2022）

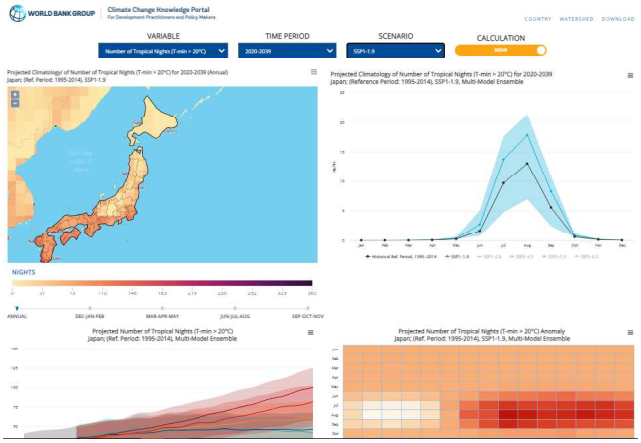
World Bank Climate Change Knowledge Portal

[Physical risk tools used in this project (excerpt): Parameter]

Climate Change Knowledge Portal (World Bank)

Climate Change Knowledge Portal

Issuing agency	World Bank
Scenario	SSP1-1.9 / SSP1-2.6 / SSP2-4.5 / SSP3-7.0 / SSP5-8.5
Timeframe	2020-2039 / 2040-2059 / 2060-2079/ 2080-2099



Indicators

Item	Variable
Essential Climate Variables	• Mean-Temperature（Monthly, Annually） • Max-Temperature（Monthly, Annually） • Min-Temperature（Monthly, Annually） • Precipitation（Monthly, Annually）
Temperature	• Days with Heat Index >35℃ • Maximum of Daily Max-Temperature • Number of Frost Days（T-min< 0℃） • Number of Hot Days（T-max＞25℃） • Number of Tropical Nights（T-min＞20℃） • Number of Summer Days（T-max＞35℃）
Precipitation	• Average largest 1-Day Precipitation • Average largest 5-Day cumulative rainfall • Days with Precipitation >20mm • Max Number of Consecutive Dry Days • Max Number of Consecutive Wet Days • Precipitation Percent Change

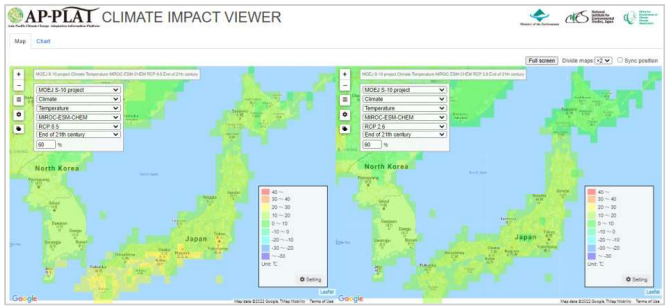
Source: World Bank, Climate Change Knowledge Portal https://climateknowledgeportal.worldbank.org/country/japan/climate-data-projections
（As of February 2021）

[Physical risk tools used in this project (excerpt): Parameter]

Climate Impact Viewer (AP-PLAT)

Climate Impact Viewer（MOEJ S-14 project）

Issuing agency	AP-PLAT
Scenario	RCP2.6 / 4.5 / 6.0 / 8.5
Timeframe	2011-2020 / 2021-2030 / 2031-2040 / 2041-2050 / 2051-2060 / 2061-2070 / 2071-2080 / 2081-2090 / 2091-2100



The AP-PLAT Platform page introduces climate information for each region and country, which can be referred to.
https://ap-plat.nies.go.jp/platforms/index.html

Indicators

Item	Index
Climate	• Daily mean 2-m air temperature • Daily maximum 2-m air temperature • Daily minimum 2-mair temperature • Daily total precipitation • Daily mean downward shortwave radiation flux • Daily mean downward longwave radiation flux • Daily mean 2-m relative humidity • Daily mean 2-m specific humidity • Daily mean 10-m wind speed • Daily mean surface pressure • Daily mean 2-m absolute humidity • Number of days that reached 35℃ or greater • Number of days that reached 30℃ or greater • Number of dry days • Number of days that reached 50mm/day precipitation or greater • Number of days that reached 100mm/day precipitation or greater • Number of days that reached 150mm/day precipitation or greater • Number of days that reached 200mm/day precipitation or greater • Annual maximum daily precipitation

Item	Index	
Impact	• Crop Yield	• Maize • Rice • Soybean • Wheat
	• Hydropower	–
	• Sea level rise	• Inundated area • Affected population • Economic damage
	• Heat mortality	–
	• Labor capacity	–
	• Degree days	–

Source： AP-PLAT, Climate Impact Viewer https://a-plat.nies.go.jp/ap-plat/asia_pacific/index.html （As of February 2022）

Appendix.

Appendix.
Provide useful materials for scenario analysis based on supporting case studies

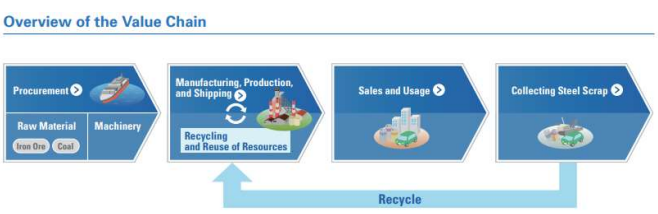
Extract examples of the disclosure of scenario analysis that can be used as “reference” for further implementation

	Analysis step	Stage	Examples of disclosure	Page number
1	For beginning scenario analysis	Prep (2) What is the analysis implementation system	✓Domestic case (4) : Nichirei Corporation	p4-86
2	Assess materiality of climate-related risks	Stage 2 How the risks and opportunities are described	✓Domestic case (1) : JFE Holdings, Inc. ✓Domestic case (2) : FUJI OIL HOLDINGS INC. ✓Domestic case (4) : Nichirei Corporation	p4-80 p4-83 p4-87
			✓Overseas case Ⅱ : RENAULT（France） ✓Overseas case Ⅳ : HPE（US）	p4-90 p4-93
3	Identify and define range of scenarios	Stage 3 How the future world views are described	✓Domestic case (1) : JFE Holdings, Inc. ✓Domestic case (3) : Mitsubishi Corporation	p4-81 p4-84
			✓Overseas case Ⅱ : RENAULT（France）	p4-91
		Supplement Method of analysis using 1.5℃ scenario	✓Domestic case (3) : Mitsubishi Corporation ✓Domestic case (4) : Nichirei Corporation	p4-84 p4-87
			✓Overseas case Ⅰ : Volvo Group（Sweden） ✓Overseas case Ⅱ : RENAULT（France） ✓Overseas case Ⅲ : BHP（Australia） ✓Overseas case Ⅳ : HPE（US）	p4-89 p4-91 p4-92 p4-93
4	Evaluate business impacts	Stage 2 How the business impacts are described	✓Domestic case (4) : Nichirei Corporation	p4-88
			✓Overseas case Ⅳ : HPE（US）	p4-93
5	Identify potential responses	Stage 2 How the future countermeasures are described	✓Domestic case (1) : JFE Holdings, Inc. ✓Domestic case (2) : FUJI OIL HOLDINGS INC. ✓Domestic case (3) : Mitsubishi Corporation	p4-82 p4-83 p4-85
			✓Overseas case Ⅲ : BHP（Australia）	p4-92
1 3 5	Common	Supplement How transition paths are shown	✓Overseas case Ⅰ : Volvo Group（Sweden）	p4-89

[Case ①:JFE Holdings, Inc. (Materials) (1/3)]
JFE breaks down risks/opportunities based on the 7 key factors identified in the “selection process for critical risks/opportunities and factors that impact the business”

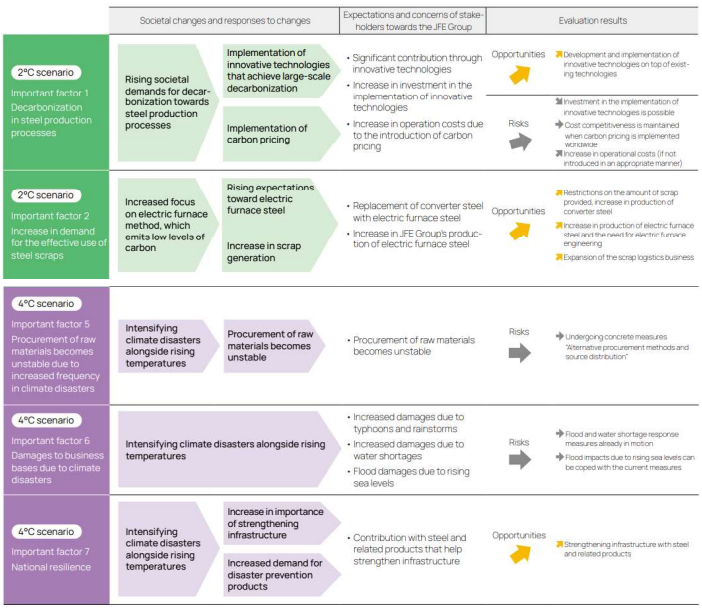
1 2 3 4 5
1.5ºC Transition

✓ **Gets an overhead view from the value chain perspective of the factors that impact the target business and organizes them**



- The 7 key factors identified
  - **(1) Decarbonization of steel processes**
  - **(2) Increased needs for effective use of iron scrap**
  - **(3) Change in demand for steel products for automobiles, etc.**
  - **(4) Growing demand for solutions facilitating decarbonization**
  - **(5) Increased instability in raw material procurement due to frequent weather disasters**
  - **(6) Damage to local sites due to weather disasters**
  - **(7) Building of national resilience**

✓ **Discloses “Societal changes / responses to change”, “Stakeholder expectations and concerns for the JFE Group” and “Evaluation results”**



Source：JFE Holdings「JFE Group Report 2021 (Integrated Report)」、「CSR Report 2021」 *Partial excerpt

[Case ①:JFE Holdings, Inc. (Materials) (2/3)]
JFE chooses the 2ºC scenario and 4ºC scenario, and describes the scenario worldview as a “vision for the company”

1 2 3 4 5
1.5ºC Transition

✓ **Conducts analysis based on the scenario released by IEA, with the assumption that common carbon pricing will be introduced to all major emitting countries in order to increase the feasibility of achieving 2ºC targets**

✓ **Sets a goal of aiming to achieve carbon neutrality by 2050 in the long-term scenario analysis, along with the expected achievement of the 2ºC scenario targets in steel production**

Selected Scenario		2°C Scenario	4°C Scenario
Reference Scenario	Transition Risks	Transition scenarios developed by the IEA · Sustainable Development Scenario (SDS)*1 · 2°C Scenario (2DS)*2	Transition scenarios developed by the IEA · New Policies Scenario (NPS)*1 · Reference Technology Scenario (RTS)*2
	Physical Risk	Climate change projection scenario developed by the Intergovernmental Panel on Climate Change (IPCC) · Representative Concentration Pathways (RCP) Scenario*3	
How Society will Look		Dynamic policies will be adopted and technical innovations will progress to limit the average temperature rise by the end of this century to 2°C and realize sustainable development. Assume a society in which our business is affected by social changes accompanying transition to a decarbonized society. · World-wide/industry-wide uniform carbon pricing*4 · Increase in the ratio of sales of electric vehicles to overall vehicle sales	Despite new policies implemented in each country based on approaches under the Paris Agreement, average temperature rises about 4°C by the end of this century. Assume a society in which our business is affected by temperature rise and other climate change. · Increase in the occurrence of flooding · Sea level rise

Source：JFE Holdings「JFE Group Report 2021 (Integrated Report)」、「CSR Report 2021」

[Case ①:JFE Holdings, Inc. (Materials) (3/3)]
JFE discloses the response status and future initiatives for each of the 7 key factors, dividing them into medium-term (2030) and long-term (2050)

1 2 3 4 5
1.5ºC Transition

✓ **Leverages the results of scenario analysis for developing future business strategies by selecting key factors that impact the business and analyzing their impact in more detail**

FOCUS Key Factor (2) Increased Need for Effective Utilization of Steel Scrap

To achieve carbon neutrality, we are focusing on high-grade steel manufacturing and raising efficiency by applying our industry-leading electric furnace technology. Furthermore, we will open up opportunities for the entire JFE Group by expanding the use of our electric furnaces, increasing the use of our electric furnace construction technology, and expanding scrap logistics.

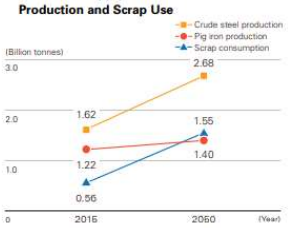
Mid-term, 2030, 2050

The JISF predicts that the demand for crude steel will continue to grow as the world's population increases and the economy develops and that both the blast furnace and electric furnace methods will be indispensable as major steelmaking processes (JISF's Long-term Vision for Climate Change Mitigation). To achieve carbon neutrality, we need to expand the production of steel products using the electric furnace method, which emits less CO_2. For this to happen, we need to work on technologies that improve the productivity of electric furnaces and address the constraints in producing high-grade steel products. We must also work on technologies that increase the amount of scraps used in converter furnaces.

The JFE Group is viewing the increase in demand for electric furnace steel as well as the world-wide increase in the amount of scrap generated as an opportunity, and it will enhance its electric furnace steel production while applying its engineering technology for constructing an entirely cutting-edge, energy-saving electric furnace facility with the ultimate goal of opening up other business opportunities. Moreover, the Group will advance the development of technologies to utilize scrap and increase the industry-wide use of this material.

Meanwhile, expanding the use of scrap will bring about an increase in logistics for distributing it, and this will provide an opportunity for JFE Shoji to expand its logistics business.

■ **Estimated Supply and Demand for Steel Production and Scrap Use**

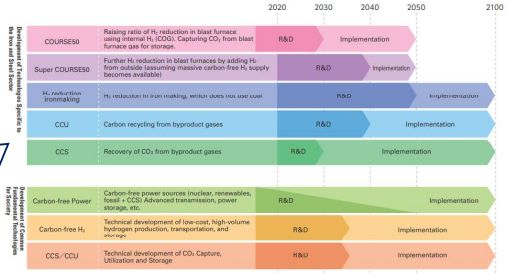


✓ **Adopts a “long-term vision for addressing global warming” for the steel industry and shows the results of scenario analysis and their consistency with the Japan Iron and Steel Federation’s “Low Carbon Society Action Plan”**

■ CO_2 Reduction Medium- to Long-term Targets (The Japan Iron and Steel Federation's "Commitment to a Low Carbon Society")

Three Ecos		Eco Processes	Eco Products	Eco Solutions
Goal		Further improve energy efficiency by taking full advantage of cutting-edge technologies	Provide high-performance steel materials that result in high performing end-products and thus reducing CO_2 emissions	Reduce CO_2 in developing countries through the transfer and application of world-leading, energy-saving Eco Process technologies
Targets	FY2020 (phase-I)	Reduce CO_2 emissions by 5 million t-CO_2 compared to the BAU benchmark • Energy-saving: 3 million t-CO_2 • Efficient use of waste plastics, etc.: 2 million t-CO_2	The use of major high-performance steel materials to contribute to a CO_2 reduction of approximately 34.0 million t-CO_2	Estimated CO_2 reduction impact of 70 million t-CO_2
	FY2030 (phase-II)	Reduce CO_2 emissions by 9 million t-CO_2 compared to the BAU benchmark	The use of major high-performance steel materials to contribute to a CO_2 reduction of approximately 42.0 million t-CO_2	Estimated CO_2 reduction impact of 80 million t-CO_2
Status as of FY2019 year-end		Reduced 3.3 million t-CO_2 emissions (energy conservation etc.), compared to the BAU benchmark	Domestic and international use contributed to a CO_2 reduction of 31.94 million t-CO_2	CO_2 reduction impact of 68.57 million t-CO_2

Efforts toward zero carbon steel show the **need for ultra-innovative technology for achieving the 1.5ºC scenario**



Source：JFE Holdings「JFE Group Report 2021 (Integrated Report)」、「CSR Report 2021」

[Case ②:FUJI OIL HOLDINGS INC. (Agriculture, Food, and Forest Products)]

Fuji Oil discloses the details of initiatives with detailed description of key risk items in detail for each scenario

1 **2** 3 4 **5**

1.5ºC Transition

✓ **Describes in detail the risks for both the 2ºC scenario and the 4ºC scenario**

Example 1: Increased costs for responding to environmental regulations (2ºC scenario)

-Assumes tighter environmental regulations may cause carbon taxes to be imposed in some countries, increasing costs

-Predicts that fossil fuels will be replaced by renewable energy sources in production processes and logistics, and that there will be reductions in GHG emissions, which may increase costs due to impairment of existing assets and additional capital investment

なお、シナリオ分析は次ページ「気候変動リスク・機会および財務インパクトの影響度評価」のとおりです。当社グループが識別している４つのリスクに対し、以下の施策を進めています。

１．環境規制対応コストの増加	環境ビジョン2030のグループ各社での実践。技術開発部に環境や省エネの専門チームを設け、環境負荷を低減する生産設備の検討や構築
２．サプライヤーの森林破壊による影響	グローバルサステナブル調達委員会を設置し、グループ全体のリスクを管理できる体制を構築
３．異常気象による自然災害の激甚化	自然災害時に操業が継続できるBCP体制の構築など
４．世界的な主要原料の不足懸念・価格高騰	グローバルサステナブル調達委員会を設置し、グループ全体のリスクを管理できる体制を構築

✓ **Discloses initiatives for the four key risks**

Example 1: Increased costs for responding to environmental regulations

Implements the environmental vision 2030 for each group company. Establishes teams specializing in the environment and energy conservation in technology development divisions to investigate and build production facilities that reduce environmental impact

*Partial excerpt from individual risks

気候変動リスク・機会および財務インパクトの影響度評価

項目	No.	リスク・機会 内容	2050年頃における財務インパクトの評価（↓：マイナスのインパクト、↑：プラスのインパクト、↓↓の数はインパクトの大きさ） 2℃シナリオ 内容	2℃シナリオ 影響度	4℃シナリオ 内容	4℃シナリオ 影響度
リスク 移行リスク 政策・法規制	1	環境規制対応コストの増加	・環境関連の規制強化により、一部の国において炭素税が課され、コストが増加する可能性がある。 ・生産工程および物流において、化石燃料から再生可能エネルギーへの置換や温室効果ガス排出削減が求められ、既存資産の減損や追加設備投資によりコストが増加する可能性がある。	↓↓ (※2030年頃における財務インパクト)	２℃シナリオよりも炭素税の導入国が少なく、炭素税感が小さいが、当社のグループ会社が所在する一部の国において炭素税が課され、コストが増加する可能性がある。	↓ (※2030年頃における財務インパクト)
移行リスク 評判	2	サプライヤーの森林破壊による影響	・主要原料であるパーム油、カカオ、大豆等を調達するサプライヤーが森林破壊を行った場合、当社グループが間接的に森林破壊を行ったとみなされ、当社グループの評判が低下し、主要顧客から取引を停止され売上が減少する可能性がある。 ・欧米を中心とする世界各国が森林破壊を行ったサプライヤーに対して禁輸措置を講じることで、各国に所在する当社グループ会社の原料調達および生産に支障を来たし売上が減少する可能性がある。	↓↓	２℃シナリオと同様	↓↓
物理的リスク 急性	3	異常気象による自然災害の激甚化	風水害の頻度や威力の増加により、台風被害が多い日本に工場を立地する不二製油（株）、ハリケーン被害が多い米国のニューオリンズ及びジョージア州に工場を立地するフジベジタブルオイル社など、当社グループ会社の工場が風水害による被害を受け、操業停止となる可能性がある。	↓↓	２℃シナリオを上回る風水害の頻度や威力の増加により、不二製油（株）、フジベジタブルオイル社など、当社グループ会社の工場がより甚大な風水害による被害を受け、長期間に渡り操業停止となる可能性がある。	↓↓↓
物理的リスク 慢性	4	世界的な主要原料の不足懸念・価格高騰	森林の開発制限強化により、耕地面積の増加が見込めず、パーム油、カカオ、大豆など当社グループ主要原料の収穫量が現状程度である一方、人口増により、需要が増加することで供給量が不足し、主要原料の一部を調達できず、当社グループ製品の生産に支障を来たし、売上が減少する可能性がある。	↓↓	パーム油、カカオ、大豆など当社グループ主要原料の栽培適地移動、耕地面積の減少により、主要原料の収穫量が減少する一方、人口増による需要増加により供給量が大幅に不足し、主要原料の大部分を調達できず、当社グループ製品の生産に大きな支障を来たし、売上が大幅に減少する可能性がある。	↓↓↓

4-83 Source：FUJI OIL HOLDINGS INC. “Annual Securities Report” EDINET (edinet-fsa.go.jp)

[Case ③:Mitsubishi Corporation (Industrials) (1/2)]

Mitsubishi Corp. conducts analysis using multiple IEA scenarios, including a 1.5ºC scenario; the analysis covers the 8 businesses where climate change has a significant impact from the perspective of risks/opportunities

1 2 **3** 4 **5**

1.5ºC Transition

Scenario selection

Uses three scenarios (shown at right) **for businesses receiving a significant impact from climate change in terms of risk**; **conducts analysis using the two scenarios of SDS and NZE for businesses receiving a significant impact from climate change in terms of opportunity.**

Demand prediction

Predicts future demand over seven levels such as “significant decrease”, “kept at current levels”, and “significant increase”.

Detailed description of the business environment defined by each scenario

Describes the general business environment under each scenario.

Policies/initiatives based on understanding of the business environment from the above scenarios

Describes the specific impacts and policies/initiatives for the business based on the above scenarios.

Considers the 1.5ºC scenario as the decarbonization scenario when developing business strategies for businesses that are thought to have significant transition risks and incorporates the analysis results for those risks into strategy

Target businesses (businesses specified as receiving a significant impact from climate change)

Risk perspective: Power generation (fossil fuels), coking coal, natural gas / LNG, automobiles (passenger cars and pickup trucks), ships, petroleum products (domestic service stations)

Opportunity perspective: Power generation (renewable energy), copper

How to view the charts

Name of Selected Business

	STEPS Scenario *1	2ºC Scenario (SDS) *2	1.5℃ Scenario (NZE) *3
Demand Outlook	The trajectory forecast from the present to 2040-2050 *4 for the global supply and demand related to the selected businesses under the STEPS scenario in publications such as the IEA's World Energy Outlook and Energy Technology Perspectives is expressed in seven levels (significant decrease, decrease, slight decrease, flat, slight increase, increase, significant increase).	The trajectory forecast from the present to 2040-2050 *4 for the global supply and demand related to the selected businesses under the 2ºC scenario in publications such as the IEA's World Energy Outlook and Energy Technology Perspectives is expressed in seven levels (significant decrease, decrease, slight decrease, flat, slight increase, increase, significant increase).	The trajectory forecast from the present to 2040-2050 *4 for the global supply and demand related to the selected businesses under the 1.5ºC scenario in publications such as the IEA's Net Zero by 2050 is expressed in seven levels (significant decrease, decrease, slight decrease, flat, slight increase, increase, significant increase).
Awareness of the Business Environment	Introduction of the general awareness of the business environment as expressed in the STEPS scenario, etc. (BAU scenario)	Introduction of the general awareness of the business environment under the 2ºC (SDS) Scenario.	Introduction of the general awareness of the business environment under the 1.5ºC (NZE) Scenario.

Policies and Initiatives Based on the Awareness of the Business Environment

Analysis of the impact to MC's business based on the awareness of the business environment detailed in the scenarios above, and related policies and initiatives.

*1 STEPS Scenario
One of the primary scenarios of the World Energy Outlook 2019 and Energy Technology Perspectives 2020 published by the IEA. It is a scenario based on each country's reduction targets and climate change mitigation measures post-2020 as pledged in the Paris Agreement. Businesses that refer to documents other than World Energy Outlook 2019 and Energy Technology Perspectives 2020 are clearly indicated in the footnotes.

*2 SDS Scenario
One of the primary scenarios of Energy Technology Perspectives 2019 and Energy Technology Perspectives 2020 published by the IEA. It is a scenario based on mitigation of climate change while taking into account the stable supply of energy. Businesses that refer to documents other than World Energy Outlook 2019 and Energy Technology Perspectives 2020 are clearly indicated in the footnotes.

*3 NZE Scenario
The scenario in Net Zero by 2050 - A Roadmap for the Global Energy Sector, published by the IEA, which describes the pathway required for the global energy sector to reach net zero by 2050. Businesses that refer to sources other than Net Zero by 2050 are clearly indicated in the footnotes.

*4 For businesses for which data from 2040 to 2050 is not available, demand is calculated based on the available data and is noted as such in the footnotes.

4-84 Source: Mitsubishi Corporation “Sustainability Website”

*Partial excerpt

[Case ③:Mitsubishi Corporation (Industrials) (2/2)]

Mitsubishi Corp. incorporates the 1.5ºC scenario into strategy for businesses expected to have significant transition risks; MC also conducts analysis for businesses with significant business opportunities, and not only for those with transition risks

1 2 **3** 4 **5**

1.5ºC Transition

Responses for businesses with significant transition risks

-Example for natural gas / LNG-

	STEPS Scenario	2°C Scenario (SDS)	1.5℃ Scenario (NZE)
Demand Outlook			
Awareness of the Business Environment	In all regions with the exception of Europe, demand for natural gas is expected to increase (average annual growth of 1.4% between 2018-2040), mainly as fuel for power generation to support the increasing electricity demand that will surpass the deployment of renewable energy, as chemical feedstock and as transportation fuel, among other uses. It is recognized that LNG demand in particular will grow due to its high transportability (at an annual rate of 3.4% from 2018 to 2040).	Global gas demand is projected to increase by 8% by 2030 compared to 2018 levels, and then to decrease to 2% below 2018 levels by 2040*. By region, natural gas demand in Asia-Pacific will increase significantly through 2040, primarily in China and India. On the other hand, in North America, Europe and Eurasia, natural gas demand is expected to decrease from 2040. By industry, demand for gas in power generation and for use in buildings will gradually decline, but demand for alternative fuels and heat sources in hard-to-decarbonize sectors such as large-scale transport and heavy industry is expected to increase.	Global natural gas demand and LNG trade are expected to decline by 46% and 33%, respectively, by 2040 compared to 2018. On the other hand, the demand for hydrogen, a next-generation energy source that is expected to support a low/ decarbonized society, will increase especially in the shipping, land transportation, and heavy industry sectors, and the significance of natural gas as a raw material for blue hydrogen is expected to increase further in the future. Approximately half of the total demand for natural gas in 2050 will be directed to hydrogen production, and 40% of hydrogen demand will be sourced by natural gas.

Policies and Initiatives Based on the Awareness of the Business Environment

In addition to strengthening the foundations of existing businesses and steadily launching projects under construction, MC will fulfill its responsibility to provide a stable supply of LNG, an important energy source in the transition to a low/ decarbonized society, as well as aim to increase its profits from the LNG business by participating in competitive new projects to meet growing demand, developing demand in emerging markets, and strengthening our sales functions. Global demand for LNG is expected to increase in the medium to long term under the 2°C scenario, while it is expected to decrease under the 1.5°C scenario. However, MC believe demand in Asia to be remained firm for the time being, and also the demand for LNG as a next-generation energy source, such as hydrogen and ammonia, to be grown as well.

MC will continue to monitor the policies of various countries, such as the introduction of carbon taxes, and trends in technology development, such as CCUS, which may affect the competitiveness and profitability of our LNG business under the 2ºC/ 1.5ºC scenarios. At the same time, MC will promote initiatives that contribute to making the LNG value chain itself carbon neutral, and study the possibility of utilizing existing LNG infrastructure for the production and supply of blue hydrogen, in order to strengthen our resilience to the risks associated with the transition to a low/ decarbonized society and to proactively capture opportunities.

Responses for businesses with significant transition opportunities

-Example for power generation (renewable energy)-

Power Generation: Renewable Energy

	2°C Scenario (SDS)	1.5°C Scenario (NZE)
Demand Outlook		
Awareness of the Business Environment	Under a 2ºC Scenario, it is believed that policies to capture renewable energy as a main power source will become mainstream. It will be necessary to promote deregulation and technological innovation to construct an energy system that is not only sound environmentally, but economically and socially as well. Regarding this point, MC understands the need for multifaceted initiatives involving technologies that support the expansion of renewable energy while maintaining safe and stable supplies of power (energy storage, hydrogen, transmission technology, supply and demand adjustment technology, and energy trading) and anticipates that these markets will expand. As the expansion of renewables progresses together with the proactive deployment of renewable technologies in each region around the world, starting with offshore wind in Europe, the grid configuration and supply of power will change. As a result, opportunities are anticipated for energy transmission and businesses that regulate the supply and demand for power such as battery storage, services using storage batteries, and VPP (virtual power plant) businesses. In the renewable energy generation business, as is the case for thermal power generation, 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. On the other hand, as the market expands and commoditization progresses, cost competition is expected to intensify. Furthermore, MC recognizes that trends towards decentralization of the energy system driven by the spread of renewable energy, batteries and other technologies along with movements around thermal power generation, including next-generation types, may vary greatly in terms of timing and content depending on the status of government regulation and technological innovation, as well as the country or region.	Under a 1.5ºC Scenario, electricity demand is expected to double by 2040, with about 85% coming from renewable energy sources, assuming the further spread of electrification. In particular, solar and wind power are growing rapidly, and will require about 18 times (for solar) and 10 times (for wind) more additional capacity than in 2019. This means that additional solar and wind power generation capacity of approximately five times the average of the last three years will be required every year after 2020, and continuous large-scale investment will be essential to achieve this goal. Also, in line with the expansion of renewable energy, power generation amount of which varies according to weather conditions and which has a strong aspect as a distributed power source, further business opportunities are expected to increase, such as the expansion of transmission capacity, utilization of storage batteries, and demand response, which will contribute to improving the flexibility of the power supply and demand system. In addition, due to the rapid progress of electrification in a variety of fields, the significance of policies and regulations to strengthen and ensure the security of the electricity supply and demand system is expected to increase further.

Policies and Initiatives Based on the Awareness of the Business Environment

Under the 2ºC/ 1.5ºC scenarios, energy management services that utilize battery storage, electric vehicles (EVs), and plug-in hybrid vehicles (PHVs) are expected to become widespread due to the increased introduction of renewable power generation (solar and wind) in the shift toward a low-carbon society as well as changes in the power business structure (increased need for grid stabilization due to increased VRE*). The introduction of renewable energy and the spread of battery storage, as well as the accompanying trend toward decentralization of the power supply system, will vary according to country and to region depending on the status of policies, regulations, and technological innovations, and the timing of their manifestation may also differ significantly. While taking into account the characteristics of each country and region, MC will work to increase the business value of the entire power value chain by promoting the integration of supply-side power generation and demand-side retail businesses, while optimizing our portfolio to "double renewable energy power generation capacity by FY2030 compared to FY2019 (from 3.3 GW to 6.6 GW). In addition, we will promote the energy management and virtual power plant (VPP) businesses, which are becoming increasingly necessary as renewable energy becomes more widespread.

Based on this policy, we are actively engaged in the development of offshore wind power generation and distributed power supply businesses, mainly in Japan, the US and Europe.

Implements ongoing monitoring of policies and technologies based on understating of the business environment, suggesting that the company is resilient against climate change

Continues monitoring and paying attention to trends in national policies such as introduction of carbon taxes and technological developments such as CCUS. Also promotes initiatives that contribute to carbon neutrality in the LNG value chain, and considers the possibility of utilizing LNG for the production and supply of blue hydrogen

Describes policies/initiatives for appropriately taking in climate change-related business opportunities

Considers portfolio optimization, such as aiming to "double the renewable energy generation capacity from 2019 (3.3G GW to 6.6 GW)"

 Source: Mitsubishi Corporation "Sustainability Website"

*Partial excerpt

[Case ④:Nichirei Corporation (Consumer Staples) (1/3)]

Nichirei Group has established a capability for conducting scenario analysis, and formulated a low-carbon policy as one of the long-term goals based on the results of scenario analysis

1 **2** 3 **4** 5

1.5ºC Transition

- ✓ **Nichirei participates in the "TCFD Consortium" along with declaring support for the TCFD recommendations in June 2020**
- ✓ **Scenario analysis was initiated as a group-wide project with the representative director and president acting as project owner. Management's understanding was gained after discussion and consideration at the "group environmental conservation committee", and the low-carbon policy was approved by the Board of Directors as one of the group's long-term environmental goals**

1 Governance

In October 2019, we began analyzing climate change scenarios as an interdepartmental Group project, headed by the president, and are reviewing the scenarios across the Nichirei Group. Following discussion and review by the Group Environmental Protection Committee in May 2020, the Board of Directors approved low-carbon policies as a long-term environmental goal in June and disclosed them in August of the same year.

In October 2020, the director, executive officer responsible for implementing climate change strategies was appointed as project head. The project reviewed and analyzed climate change scenarios in relation to water-related risks arising from abnormal weather, which, out of the risks identified in FY2020, would have a particularly significant financial impact on the Group. Following discussion and review by the Group Environmental Protection Committee in May 2021, the Board of Directors approved goals (measures and KPIs) for water-related risks as one of the Nichirei Group material measures in June and disclosed those measures and KPIs in August of the same year.

The director, executive officer in charge reports at least once a year on the progress of the initiatives at Board of Directors meetings. Relevant strategies, goals and plans are revised as appropriate on the basis of these reports.

FY2021–2022 Project Organization

Project name	Project for the Analysis of Climate Change Scenarios
Project head	Director, Executive Officer
Project leader	General Manager, Technology Management
Department in charge	Technology Management
Departments participating in the project	Group Communication
Controlling committee	Group Environmental Protection Committee (meets twice annually)
Reports to Board of Directors	At least once a year

 Sources：Nichirei Corporation "Nichirei Integrated Report 2021", Website "Climate Change Scenario"

[Case ④:Nichirei Corporation (Consumer Staples) (2/3)]

The Nichirei Group gradually developed scenario analysis by evaluating risks and opportunities for the entire group in 2020, and deepening scenario analysis optimized for water risk in 2021

1 2 3 4 5

1.5ºC Transition

- ✓ **In FY2020, the group identified an "overall low-carbon policy (CO2 emissions reduction)" as the most important risk factor shared over the group, and established long-term CO2 emission reduction targets**
- ✓ **In FY2021, it selected "water risk due to extreme weather conditions", which is a risk shared by both processed foods and temperature-controlled logistics businesses, and developed climate change scenarios**

Material Risks and Opportunities by Business and Scenario

Business			Risks	
Risks common to both the Foods and Logistics businesses	Foods Business	Chicken	Baseline scenario	General abnormal weather	・Reduction of agricultural and dairy production, and steep rise in purchase prices due to deterioration in quality ・Difficulty in obtaining raw materials and production delays due to logistic network disruptions
		Rice			
		Shrimp		Flooding, rising sea levels	・Reductions in production efficiency and volume and submerged aquafarms
		Vegetables, marine products, and meat and poultry products			・Submerged agriculture farms, aquafarms and processing factories ・Difficulty in obtaining raw materials and production delays due to supply chain disruptions
		Common	1.5ºC scenario	Low-carbon policies	・Increased cost for measures for converting to renewable energy and equipment electrification, elimination of emissions
				Environmental countermeasures within the supply chain	・Curtailment of transactions; higher cost of measures such as the maintenance of global certifications
	Logistics Business		Baseline scenario	General abnormal weather	・Damage to refrigerated warehouses and logistics centers
					・Difficulty securing human resources in disaster risk areas
			1.5ºC scenario	Low-carbon policies	・Opportunity loss caused by the slow increase of investment in natural refrigerants and the slow adoption of technological platforms such as electrical and low-carbon vehicles

Business		Opportunities	
Foods Business	Baseline scenario	Changes in weather patterns	・Increased demand for frozen and processed foods
	1.5ºC scenario	Strengthening of environmental countermeasures within the supply chain	・Increased demand for ethical products that are compliant with the Sedex platform and are created using globally certified raw materials
			・Increased demand for the curtailment of food loss within the supply chain through the development of eco-friendly products and technological development
		Increased environmental awareness	・Development and expansion of demand for products created using sustainable raw materials
Logistics Business	Baseline scenario	General abnormal weather	・Increase in sales resulting from customer base expansion achieved through strengthened disaster countermeasures and greater resilience
	1.5ºC scenario	Modal shift	・Cost reduction achieved through a modal shift that improves transportation efficiency
		Increased environmental awareness	・Increase in number of business partners due to higher evaluations as a company that actively discloses information related to environmental countermeasures

Selection of 1.5ºC scenario

 Sources：Nichirei Corporation "Nichirei Integrated Report 2021", Website "Climate Change Scenario"

[Case ④:Nichirei Corporation (Consumer Staples) (3/3)]

For the deepened scenario analysis conducted in FY2021, the Nichirei Group performed qualitative evaluation for water risk and estimated the baseline burden of carbon tax for transition risk as well as the amount of burden when reduction targets are met

1 2 3 4 5

1.5ºC Transition

- ✓ **For transition risk, the group quantitatively calculates the baseline as well as the amount incurred when reduction targets are met for carbon tax burden, and evaluates the difference between those amounts in disclosing the financial impact**
- ✓ **For physical risks, the group performs qualitative evaluation using hazard maps for riverine flood risk and rising sea level risk**

(Billions of yen)

	Burden (baseline)	Burden (upon achievement of emission reduction targets)	Reduction of burden achieved upon fulfillment of emission reduction targets
			Compared to baseline
Cumulative total	Approximately 10.5–13.0	Approximately 6.7–8.3	Approximately 3.7–4.7
Average (2025–2030)	Approximately 1.7–2.2	Approximately 1.1–1.4	Approximately 0.6–0.8

* Carbon tax assumption: Estimated as 100 yen / dollar, assuming $ 30 / t-CO2 in 2025, $ 75-100 / t-CO2 in 2030, and assuming a fixed amount increase each year from 2026 to 2029.

✓ Evaluation of carbon tax impact
- Assumes cumulative carbon tax burden of about 10.5 to 13.0 billion yen (annual average of about 1.7 to 2.2 billion yen) until 2030 based on the group's current CO2 emission trajectory (baseline)
- Assumes that achieving the group's CO2 emission reduction targets (30% reduction compared to FY2015 by 2030) would reduce the cost of carbon tax to about 6.7 to 8.3 billion yen, mitigating the impact by about 3.7 to 4.7 billion yen compared to the baseline

Climate Change Scenarios in Relation to Water-Related Risks Arising from Abnormal Weather

	(1) Risk of Future River Flooding		(2) Risk of Future Rising Sea Levels (Tidal Flooding)	
	Description	Results	Description	Results
Assessment criteria	The location criterion is the scale of rainfall assumed to result in flooding according to the hazard maps of municipalities in the region where the facility is located. The assessment is conducted based on predicted rainfall amounts.	When creating hazard maps for regions where the facilities are located, **three facilities in Japan** were found in locations where the number of rainfall events exceeding the anticipated maximum rainfall amount was expected to be around the same as the current number of rainfall events or potentially higher in the future.	For facilities in areas with either no risk or unknown risk of flooding according to the municipal hazard map of the region where they are located, an assessment was conducted of the risk of flooding assuming the occurrence of a typhoon on the scale of the Ise Bay Typhoon, one of the most destructive typhoons in Japanese history, and future rising sea levels (set at 1 meter by the Japan Meteorological Agency in *Climate Change in Japan 2020*).	**39 of the 145 facilities** were in flood areas according to municipal hazard maps. • **No facilities overseas** • Based on an Ise Bay Typhoon-scale typhoon and rising sea levels, a simple calculation was performed for the facilities outside of flood areas according to municipal hazard maps or in areas for which hazard maps had not been prepared (106 facilities). As a result, **27 facilities** were found to be in flood areas when rising sea levels were not considered, and **32** when rising sea levels associated with climate change were considered.
Facilities to be assessed	21 facilities in Japan (8 plants and 13 refrigerated warehouses)		145 facilities in Japan 1 facility overseas	
Facility selection criteria	• Facilities located in regions where hazard maps have been prepared • Food factories with large production volume • Refrigerated warehouses (distribution centers) in areas with high base flood elevation according to current hazard maps • Selected to avoid overrepresentation of certain regions		• All facilities in Japan, and facilities where significant financial risk and distance from the coast were considered (Thailand: Chicken production facility)	

✓ Future riverine flood risk
- On the hazard map of regions where the group's business sites are located, there are three sites in Japan for which the frequency of rainfall exceeding maximum expected rainfall levels is predicted to be "the same as current levels or likely to increase"

✓ Future risk for rising sea level
- Of the 145 total sites, 39 are sites in locations that have been evaluated as flood zones by regional government hazard maps

 Sources：Nichirei Corporation "Nichirei Integrated Report 2021", Website "Climate Change Scenario"

[Case Ⅰ : Volvo Group (Sweden, Transportation)]

The Volvo Group conducts 1.5ºC scenario analysis and establishes a scenario unique to the group; has committed to SBTi, and has made a goal of achieving net zero emissions by 2050 while showing a transition path to this

1 2 3 4 5

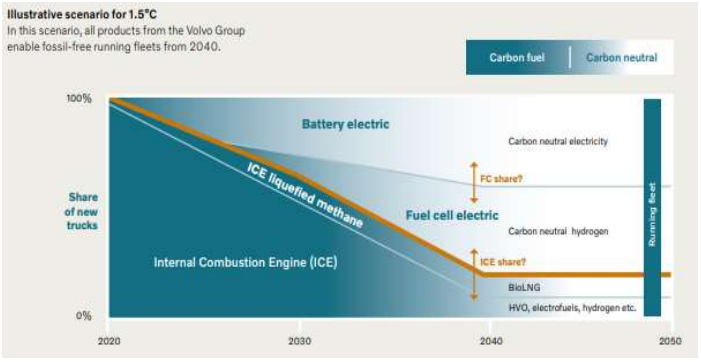
1.5ºC Transition

- ✓ **Has set unique 1.5ºC and 2ºC scenarios assuming decarbonization of the transport and energy sectors**
- ✓ **Has committed to SBTi, and has set business targets for achieving net zero by 2050**
- ✓ **The 1.5ºC scenario illustrates a transition path with a view toward eliminating the use of fossil fuels in all group products starting in 2040**

Scenario analysis

Potential pathways to a 1.5°C or a well below 2°C scenario include a successive decarbonization of the transport sector and of the energy sector. New technology solutions such as electric vehicles are, in order to deliver their full potential, depending on access to energy sources with low CO_2 intensity.

The Volvo Group has committed to the business ambition of the Science Based Target initiative to limit the global temperature rise to 1.5°C above pre-industrial levels and to reach net-zero by 2050. In working towards this ambition, the Volvo Group has performed CO_2 emission reduction scenarios based on the composition of the annual volume and CO_2 intensity of products forecasted to be put on different markets over time. Each Business Area and Truck Division have made their own scenario analyses, covering factors such as customer demand, regulatory requirements, infrastructure roll-out, access to renewable energy, governmental incentives for clean technologies, removal of governmental subsidies for fossil fuels etc. The analyses are made to set a strategy with the right mix of products for the respective market over time, a mix which may include electrified products as well as conventional combustion engine products powered by renewable liquid and gaseous fuels.



Source：Volvo Group “Annual and Sustainability Report 2020”

[Case Ⅱ : RENAULT (France, Transportation) (1/2)]

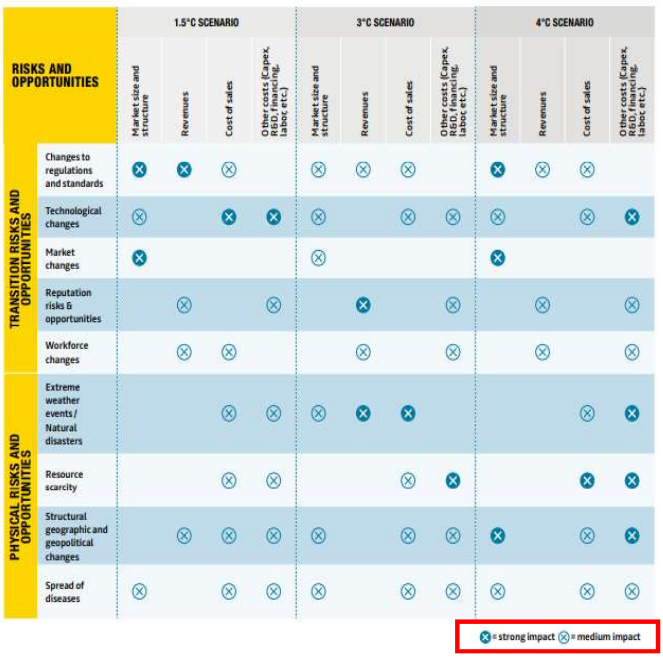
Renault describes the group’s risks/opportunities based on the supply chain ecosystem and value chain, and specifies the magnitude of impact

1 2 3 4 5

1.5ºC Transition

- ✓ **Evaluates risks/opportunities based on the company’s business model and the supply chain ecosystem and value chain**
- ✓ **Performs evaluations while also considering the timeline for impact, such as short-term (until 2030), medium-term (2030 – 2040), and long-term (2040 – 2050)**
- ✓ **Specifically describes the magnitude of impact for risk/opportunity items in each scenario**

PHYSICAL RISKS	SHORT-TERM (< 2030)	MEDIUM-TERM (2030-2040)	LONG-TERM (2040-2050)	DESCRIPTION AND IMPACT ON THE GROUP'S PERFORMANCE
EXTREME WEATHER EVENTS/NATURAL DISASTERS		⊗	⊗	Some extreme weather events may disrupt or, in more serious cases, temporarily interrupt the activity of a number of the Group's production and logistics facilities. An increased frequency or intensity of floods, hurricanes or droughts, combined with higher temperatures and sea levels, can push up risk prevention and maintenance costs, as well as insurance premiums.
RESOURCE SCARCITY	⊗	⊗	⊗	The increasing scarcity of some natural resources, such as water, may directly impact the automotive industry. It may oblige the Group to make investments to reduce its consumption or pay financial compensation to residents living near production facilities or to local communities. Furthermore, the use of new raw materials such as cobalt may generate upward price pressure, as sales of electrified vehicles steadily grow.
STRUCTURAL GEOGRAPHIC AND GEOPOLITICAL CHANGES		⊗	⊗	Climate change may lead to structural and geopolitical changes in certain regions. Because the Group has many sites around the world, this could directly impact its activity. Instability in one region or country could require the Group to adjust its industrial strategy. Regional and geopolitical instability can also create weaknesses in the supply chain ecosystem and oblige the Group to reorganize its value chain, pushing up purchase costs.



Source：RENAULT GROUPE “CLIMATE REPORT 2021”

[Case Ⅱ: RENAULT (France, Transportation) (2/2)]
Renault references external data and sets unique scenarios including 1.5ºC; the report describes worldviews for overall transition to low carbon for major emitting industries in the 1.5ºC scenario

1 2 3 4 5

1.5ºC Transition

✓ **Establishes multiple unique scenarios including 1.5ºC and presents worldviews**
- **The 1.5ºC scenario describes the following: "the raised awareness of climate risk by all stakeholders around the world (governments, financial institutions and citizen-consumers) drives more sustainable regulations, business models and lifestyles. The main emitting industries participate fully in the transition to a low-carbon economy"**

	NEW GREEN DEAL	ECO-TECHNO DRIVEN	RETREAT AND FRAGMENTATION
	1.5°C	3°C	4°C
SCENARIO DESCRIPTION	In this scenario, the raised awareness of climate risk by all stakeholders around the world (governments, financial institutions and citizen-consumers) drives more sustainable regulations, business models and lifestyles. This scenario is enabled by worldwide public-private collaborations. The main emitting industries participate fully in the transition to a low-carbon economy. Through efficient coordination with legislators and robust planning at a global level, new technologies to respond to climate change are developed. This systemic approach to mobility paves the way for the growth of efficient, multimodal services.	In this scenario, the most developed regions maintain worldwide growth. These regions succeed in combining low local levels of emissions with climate-focused economic expansion, through the development of new technologies (including mobility services). Despite this, the lack of worldwide commitment and of coordinated climate policy lead to global warming of about 3°C, whose physical impacts affect all populations. Carmakers are faced with a wide diversity of usages and demand from one region to another.	Global governance and technologies are lacking, leading to a general economic decline and a retreat from globalization in the aftermath of climate, economic and political crises. Physical risks such as floods, fires and droughts become frequent and uncontrollable, leading to population migration and wider inequalities. Low-tech and low-cost become the norm, including in mobility, and long-distance travel is discouraged.
HIGHEST RISKS	Transition risks and opportunities	Transition risks Physical risks	Physical risks including structural, geographic and geopolitical changes

✓ **States that it has referenced external data in creating its unique scenarios**
- **"World Automotive Powertrain Outlook", used by the French automotive industry platform (PFA)**
- **"1.5TECH" and "1.5LIFE" scenarios presented by the European Commission in 2018**
- **B2DS ("Beyond 2ºC" scenario) by the IEA's ETP**

- World Automotive Powertrain Outlook, used by the French automotive industry platform (PFA);
- 1.5TECH and 1.5LIFE scenarios presented by the European Commission on November 28, 2018;
- Energy Technology Perspectives, published by the International Energy Agency (the B2DS, or "Beyond 2°C" scenario).

Source：RENAULT GROUPE "CLIMATE REPORT 2021"

[Case Ⅲ: BHP (Australia, Materials)]
BHP conducts 1.5ºC scenario analysis; the report describes specific measures to transition to a 1.5ºC worldview, including carbon capture, utilization and storage and afforestation

1 2 3 4 5

1.5ºC Transition

✓ Defines **measures for transition to a 1.5ºC worldview** aimed at **zero emissions by 2050**, stating the following details:
- The company will seek opportunities to commercialize, at scale and acceptable cost, low emissions and negative emissions technologies that are critical for the transition to a 1.5ºC world. These technologies include **carbon capture, utilization and storage (CCUS), direct air capture (DAC),** and the natural climate solutions of **reforestation and afforestation**
- The company will continue to seek opportunities to collaborate with value chain partners, investors, researchers, and governments to **work towards net-zero emissions globally by 2050**

Looking ahead

Our commitments provide a pathway for action

This Report is a foundation for action. We have laid out a comprehensive series of metrics, targets and goals. We have committed to holding management to account through a direct linkage of climate-related targets and goals to executive remuneration. And we have affirmed our commitment to advocate for public policy in pursuit of global decarbonisation. We will remain alert to technological, political and societal developments that may indicate changes to our signposts and the development of new uncertainties for our portfolio analysis. We will continue to monitor developments and review our approach as necessary, to respond to evolving approaches to climate change and climate-related disclosures.

A shared global challenge

We also recognise our role in collaborating with others to achieve progress in managing the challenges of climate change. Without collaboration, the world will not be able to achieve the goals of growth, equity and decarbonisation for the long-term. The challenges inherent in our 1.5°C scenario illustrate the scale of the task ahead. We will seek opportunities to work with partners to commercialise, at scale and acceptable cost, low emissions and negative emissions technologies that are critical for the transition to a 1.5°C world. These technologies include carbon capture, utilisation and storage (CCUS), direct air capture (DAC) and the natural climate solutions of reforestation and afforestation. Consideration of the 1.5°C scenario in our portfolio analysis highlights that the world needs these technologies without delay and at scale. We will continue to seek opportunities to collaborate with value chain partners, investors, researchers and governments to work towards net-zero emissions globally by 2050.

Building a better world

Ultimately, BHP's business is founded on providing the resources that communities and nations need to build better lives for their citizens today, and to create a brighter future for the decades to come. Building that future around a stable climate would mean that the potential of the resources we produce is maximised, their value should be higher, and the quality of life of hundreds of millions of people around the world would be better.

Source：BHP "Climate Change Report 2020"

[Case Ⅳ: Hewlett Packard Enterprise (US, Information Technology)]
HPE conducts 1.5ºC scenario analysis and estimates the financial impact through concrete figures; the report presents its resilience through increased product/market opportunities in the 1.5ºC scenario

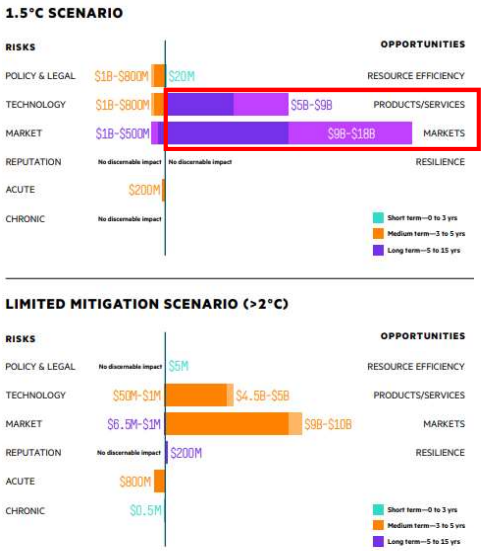
1 2 3 4 5
1.5ºC Transition

- ✓ **Implements a 1.5ºC scenario and describes risks/opportunities for the company's business, including for supply chain partners and customers**
- ✓ **Also implements evaluation that considers the timeline for impact, such as short-term (0 – 3 years), medium-term (3 – 5 years), and long-term (5 – 15 years)**

- ✓ **Quantitatively evaluates business impact using concrete amounts**
  Presents its resilience particularly in the 1.5ºC scenario as opportunities will increase in this worldview
  - **Products/services: 5 – 9 billion USD opportunity**
  - **Market: 9 – 18 billion USD opportunity**

1.5°C SCENARIO

	Impact quantification	Timeline	Potential results
OPPORTUNITIES			
Resource efficiency and energy sources	$20M	0–3 years	Aggressive building energy reduction through innovative technologies as well as renewable energy procurement reduces operational energy cost.
Products and services[34]	$5B–$9B	5–15 years	Need to reduce industry electricity use increases demand for IT solutions that are also energy efficient.
Markets[35]	$9B–$18B	5–15 years	Economy-wide drive for socio-technical transition opens new markets to IT infrastructure and increases need for solutions such has hybrid cloud and edge compute.
Resilience	No discernable impact	N/A	Increased investments in renewable energy, efficiency, and IT infrastructure builds resilience by minimizing single points of failure and improving data feedback to response times. Enhanced partnerships with supply chain partners and customers builds resiliency.
TRANSITION RISKS			
Policy and legal[36]	$800M–$1B	3–5 years	Stringent regulation on carbon-pricing, technology policies, and energy-efficiency requirements raise the bar for market entry and cost of energy consumption.
Technology[37]	$800M–$1B	3–5 years	Technologies that do not facilitate transition to a low-carbon economy will not be viable, which includes low-performing IT technologies.
Market[38]	$500M–$1B	5–15 years	Inability to anticipate new applications of IT solutions that reduce industry energy demand and facilitate transition to a low-carbon economy may lead to lost opportunities in emerging markets.
Reputation	No discernable impact	N/A	Companies that do not accelerate transition to a low-carbon economy are less competitive with customers. Investors and analysts evaluate companies based on ESG metrics.
PHYSICAL RISKS			
Acute	$200M	3–5 years	Frequency of extreme weather events continues at current rate and current severity.
Chronic	No discernable impact	N/A	Today's frequency and duration of drought conditions continues, but does not increase or expand to other areas vulnerable to water scarcity.



Source：Hewlett Packard Enterprise "Living Progress Report 2019"

Appendix.

Appendix.
Provide useful materials for scenario analysis based on supporting case studies

[List of reports released by the TCFD]

The TCFD has issued recommendations, manuals and guidance on the recommended disclosure items, including scenario analysis

Category	Document title and URL (Original / Japanese)	Overview
TCFD recommendations as a whole	■ **Final Report: "Recommendations of the Task Force on Climate-related Financial Disclosures"** (June 2017) ➢ (Original) https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf ➢ (Japanese*1) https://www.sustainability-fj.org/susfjwp/wp-content/uploads/2019/01/ccc822ae11df3bb3f0543d9bd3c7232d.pdf	Final report providing background and frameworks for climate-related financial disclosures
Strategy	■ **Annex: "Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures"** (revised in October 2021)*2 ➢ (Original) https://assets.bbhub.io/company/sites/60/2021/07/2021-TCFD-Implementing_Guidance.pdf	Report providing detailed information that is useful when **implementing the recommended disclosure items**
Strategy	■ **Technical Supplement: "The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities"** (June 2017) ➢ (Original) https://assets.bbhub.io/company/sites/60/2021/03/FINAL-TCFD-Technical-Supplement-062917.pdf ➢ (Japanese*1) https://www.sustainability-fj.org/susfjwp/wp-content/uploads/2019/01/ccc822ae11df3bb3f0543d9bd3c7232d.pdf	Report providing detailed information for referencing when **considering scenario analysis**
Strategy	**(Non-financial)** ■ **"Guidance on Scenario Analysis for Non-Financial Companies"** (October 2020) ➢ (Original) https://assets.bbhub.io/company/sites/60/2020/09/2020-TCFD_Guidance-Scenario-Analysis-Guidance.pdf	Guidance on practical processes for scenario analysis and ideas for resilience disclosures for different climate-related scenarios
Risk management	■ **"Guidance on Risk Management Integration and Disclosure"** (October 2020) ➢ (Original) https://assets.bbhub.io/company/sites/60/2020/09/2020-TCFD_Guidance-Risk-Management-Integration-and-Disclosure.pdf	Guidance targeted at companies that integrate climate-related risks into their existing risk management processes and disclose this information
Metrics & targets	■ **"Guidance on Metrics, Targets, and Transition Plans"** (October 2021) ➢ (Original) https://assets.bbhub.io/company/sites/60/2021/07/2021-Metrics_Targets_Guidance-1.pdf	Guidance explaining the latest trends in climate-related metrics, transition plans, and cross-industry climate-related metrics
Other	■ **"2021 Status Report"** (October 2021) ➢ (Original) https://assets.bbhub.io/company/sites/60/2021/07/2021-TCFD-Status_Report.pdf	Annual report explaining progress, insights, and challenges in climate-related disclosure (Issued annually from 2018)

For those looking to understand the general concept of the TCFD recommendations

For those looking to learn the details of the individual TCFD recommendation items

Progress status

Can be referred together with this guide

*Lists information as of February 2022

*1: Non-official translation by the Sustainability Forum japan (as of October 2018): revised Japanese translations of the Annex will be available around Spring 2022
*2: The Annex includes financial and non-financial sectors (key sectors are energy, transport, materials/architecture, and agriculture/food/forestry products)

[List of Japanese reports related to the TCFD and scenario analysis]

Some excerpts from the guidelines on TCFD and scenario analysis practices in Japan

Category	Document title and URL	Overview
For all industries	■ "Guidance on Climate-related Financial Disclosures 2.0 (TCFD Guidance 2.0)" (TCFD Consortium, July 2020) https://tcfd-consortium.jp/pdf/news/20073103/TCFD%20Guidance%202.0.pdf	Explains the TCFD Final Report from a corporate perspective
For all industries	■ "Practical guide for Scenario Analysis in line with the TCFD recommendations 2021" (Ministry of the Environment, March 2022) *This guide	Aimed at the smooth implementation of corporate scenario analysis in line with the TCFD recommendations; contains explanations covering procedures for those in charge of implementation to those for management, as well as summarized explanations of disclosure case studies, etc.
By sector	**(Banking)** ■ "A Practical Guide to Implementing Scenario Analysis for Climate Change Risks and Opportunities in Line with the TCFD Recommendations (Banking Sector)" (Ministry of the Environment, March 2021) http://www.env.go.jp/policy/TCFD.pdf	Released as guidance focusing on scenario analysis methods for quantifying and evaluating transition risks/physical risks that are reliable enough to withstand disclosure
By sector	**(Real estate)** ■ "Guidance for the Real Estate Sector on Addressing the 'TCFD Recommendations for Climate-Related Financial Disclosures' (TCFD Response Guidance for the Real Estate Field)" (Ministry of Land, Infrastructure, Transport and Tourism, March 2021) https://www.mlit.go.jp/totikensangyo/totikensangyo_tk5_000215.html	Comprehensive explanation based on progress of ESG investment covering information specific to the real estate sector for information disclosures in line with the TCFD recommendations; also covers illustrative examples of scenario analysis
By sector	**(Food products)** ■ "Introduction to Disclosure of Climate-Related Risks and Opportunities in the Food, Agriculture, Forestry, and Fishery Industries: A Guide to Climate-Related Information Disclosure for Food Product Operators in Japan" (Ministry of Agriculture, Forestry and Fisheries, June 2021) https://www.maff.go.jp/j/kanbo/kankyo/seisaku/climate/attach/pdf/visual-60.pdf	Explains information on climate-related risks and opportunities for information disclosures in line with the TCFD recommendations for the food, agriculture, forestry, and fishery industries by sectors such as livestock and agricultural products
For investors	■ "Guidance for Utilizing Climate-related Information to Promote Green Investment 2.0 (Green Investment Guidance 2.0)" (Ministry of Economy, Trade and Industry, October 2021) https://tcfd-consortium.jp/pdf/news/21100501/green_investment_guidance20-j.pdf	Explains perspectives from which investors and others can interpret corporate information disclosures based on the TCFD recommendations

For those looking to understand the general concept of the TCFD recommendations

For those looking to learn the details of the individual TCFD recommendation items

Investment related

*Lists information as of February 2022

Ministry of the Environment, Government of Japan
Climate Change Policy Division

Deloitte. デロイト トーマツ

This report is supported by Deloitte Tohmatsu Consulting LLC.