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For Financial Institutions

Guide for Adaptation Finance

March 2021

Environment and Economy Division, Minister's Secretariat, Ministry of the Environment

FY2020 Study Group on Adaptation Finance

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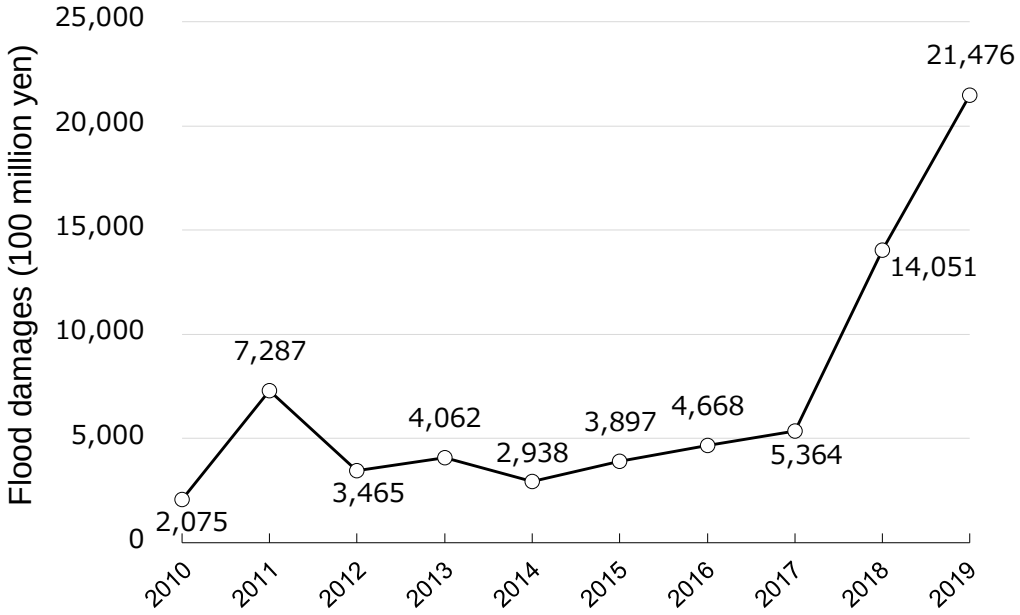
Present Status and Future Prospects of Climate Disasters in Japan

- In recent years, climate disasters have become more severe and frequent, inflicting severe damage on society and the economy as a whole, including business activities. For example, the annual amount of flood damages (nationwide) in 2019 was approximately 2.15 trillion yen (provisional figure), the largest amount of flood damages from causes other than tsunamis since the statistics started in 1961 (See the figure on the lower right).

- "The Synthesis Report on Observations, Projections and Impact Assessments of Climate Change, 2018" estimates that climate change will further raise the mean surface temperature and increase the number of days with extremely high temperatures per year and the number of heavy rainfall events in Japan. As a result, there are concerns that the quality of agricultural products will decline, areas suitable for cultivation will change, river floods, landslides, storm surges, and heat will affect human health. In the manufacturing, commercial, and construction industries, global climate change impacts may spread to domestic industries and economies through supply chains.



Changes in flood damages in Japan over the past 10 years

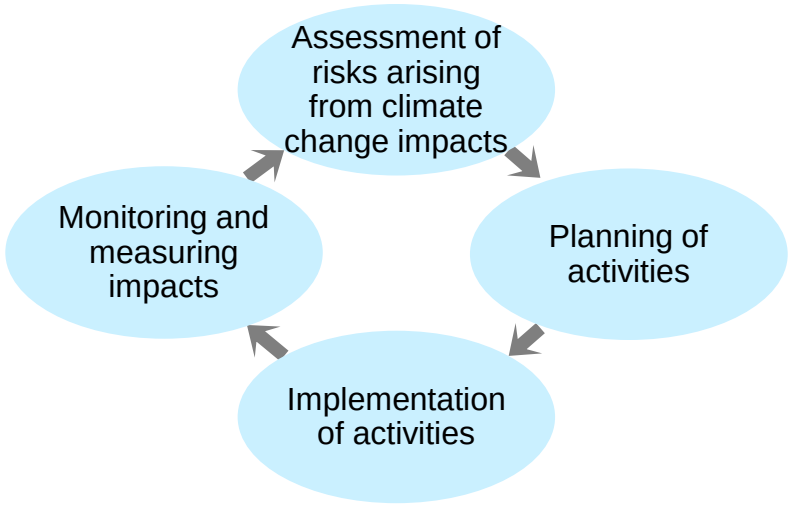
Sources) Created based on the Ministry of Land, Infrastructure, Transport and Tourism, the "Flood Damage Statistics" and press release (August 21, 2020).

Note) Figures for 2019 are provisional.

What Is Adaptation?

- The term "Adaptation" means reacting to the Climate Change Impact so as to prevent or reduce damage, and to contribute to a stable living environment and the sound development of society and the economy, as well as preserve the natural environment (from the “Climate Change Adaptation Act”). => See page 48 for the definition of "Climate Change Impacts”.
- In general, adaptation is carried out through a continuous process of "assessment of risks arising from climate change impacts → planning of activities → implementation → monitoring and measuring impacts”. Climate change impacts, on the other hand, include impacts that occur abruptly in specific regions, such as torrential rain disasters and heat waves, as well as impacts that progress gradually over a wide range and over a long period of time, such as temperature rises, changes in precipitation patterns, and sea level rises. Effective adaptation (details of activities, time frame for implementation, expected impact, etc.) varies from region to region and from entity to entity. Moreover, there is no standard methodology for monitoring and measuring impacts.

[General process of adaptation]



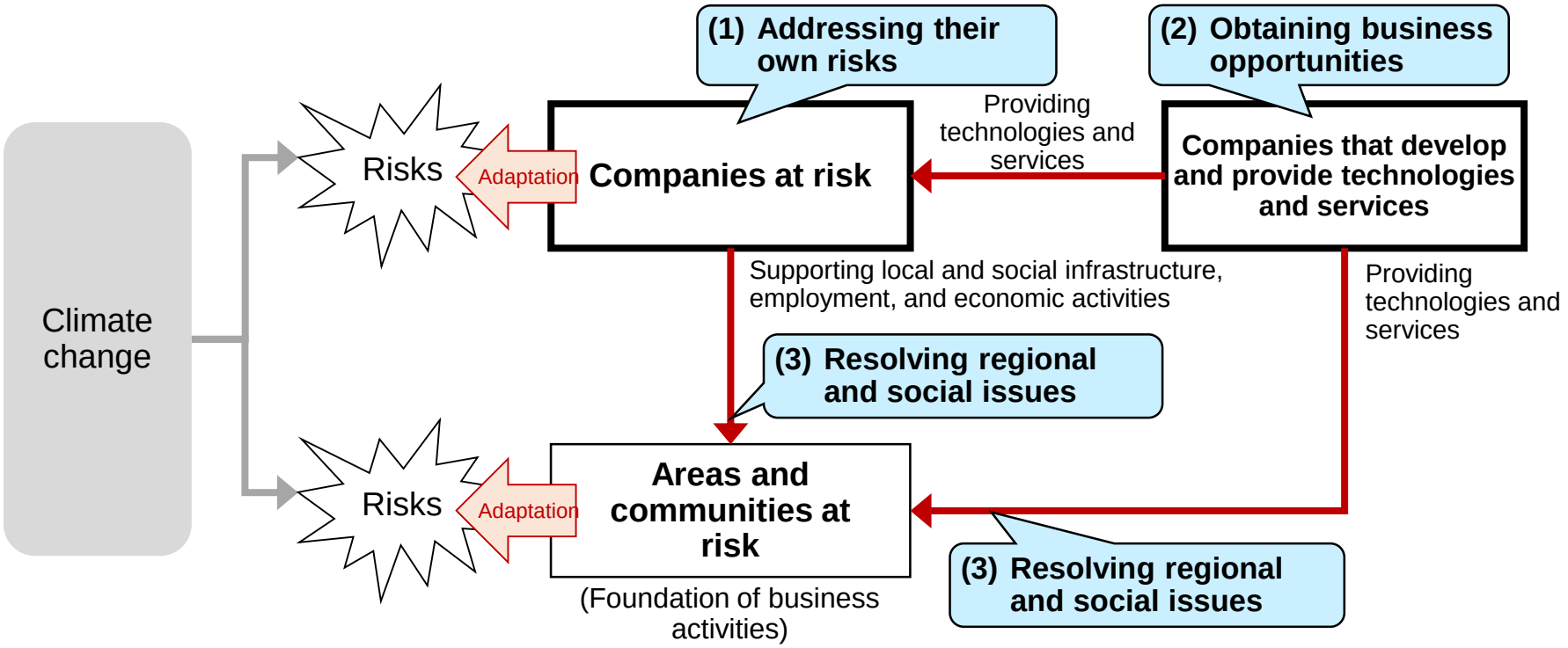
Source) Created based on the website of the United Nations Framework Convention on Climate Change (UNFCCC).

[Examples of adaptation activities and the concept of time frame]

Region and entity	Example of activities	Example of time frame
Areas and entities affected by heavy rain disasters	Installing water stops and drainage systems in facilities	Useful life of the facilities
	Building alternative distribution routes	Years of the mid-term plan
Areas and entities affected by temperature and sea level rises	Changing the procurement methods of raw materials	Expected life of related businesses
	Relocating facilities to higher ground	Years of the mid-term plan

Significance of Adaptation Initiatives by the Private Sector

- As climate change impacts are expected to increase in the future, adaptation initiatives by private companies are essential to enhance business continuity. They are also extremely important from the perspective of enhancing competitiveness by gaining the trust of customers and investors, and by obtaining new business opportunities. Internationally, “extreme weather" and "failure to address climate change" are recognized as the most important global risks, and responding to them has become a megatrend for society and the economy as a whole.
  => see page 49, World Economic Forum, "the Global Risks Report 2021".
- There are three main reasons why private companies are involved in adaptation: (1) addressing their own risks, (2) obtaining business opportunities, and (3) resolving regional and social issues.



Significance: (1) Addressing Their Own Risks

- The impacts of climate change on private companies have already become apparent, damaging companies' management resources (assets such as buildings and facilities, employees, etc.). It is important for private companies to respond appropriately to their own climate risks.
- Responding to their own climate risks will reduce and prevent these risks and is also expected to have a variety of secondary effects, such as improvement in business processes and efficiency.

[Major climate risks facing private companies]

- Business continuity risks
  - Damage to assets and public infrastructure (roads, bridges, electricity, water, etc.)
  - Disruptions to value chain linkages (drops in yield and quality of raw materials, disruptions to production, processing, and distribution, etc.)
  - Changes in the market (changes in demand, new competitive environment, etc.)
  - Policy change (Introduction of new regulations, requests for private companies to review business operation methods, etc.)
- Financing risks
  - higher financial costs due to financial deterioration
- Credit risks (mainly for financial institutions)
  - Deterioration in default rates and interest-bearing debt ratios of borrowers
  - Portfolio deterioration

Significance: (2) Obtaining Business Opportunities

- With the heightened need for climate risk response, private companies can also obtain new revenue opportunities by developing and providing technologies and services to mitigate and prevent climate risks that other companies, local governments, and others are currently facing or may face in the future.
- The introduction of new laws and regulations and revisions to various standards against the backdrop of the expanding impacts of climate change will create new needs in the market and create new business areas.

[Examples of business opportunities]

Sector	Climate risk	Example of business opportunities
Agriculture, forestry and fisheries	Decreases in crop yields and catches	• Development of crop varieties resilient to climate change • Development of aquaculture technology
Manufacturing and construction	Incompatibility of traditional quality standards with new climatic conditions	• Design and development of climate-resilient equipment (Improvement of stability of port cranes in areas where typhoons and strong winds are frequent, etc.)
	Damage caused by flooding and sea level rise	• Strengthening of disaster prevention infrastructure • Introduction of an early warning system
Food processing and distribution	Increased risk of food spoilage due to temperature rises	• Provision of refrigeration storage services under high temperature conditions
Energy	Damage to power generation facilities	• Introduction of renewable energy power generation and storage systems that can withstand various climatic conditions
Power transmission and distribution	Reduced transmission and distribution efficiency under high temperature conditions	• Investment in decentralized renewable power generation
Tourism	Loss of tourism resources	• Exploration of tourism resources in areas with relatively low climate risks
ICT	Lack of weather forecast information	• Investment in weather forecasting services
Financial services	Incompatibility of traditional risk assessments with new climatic conditions	• Development of risk assessments that integrate climate change • Provision of services to support the disclosure of climate-related financial information

Significance: (3) Resolving Regional And Social Issues

- Adaptation activities by private companies can also help resolve regional and social issues arising from climate change.
- Strengthening regional and social adaptive capacity will increase the corporate value of contributing private companies, strengthen the foundation of their business activities, and improve their business sustainability.

[Examples of resolving regional and social issues]

Adaptation activities by private companies	Resolving regional and social issues (enhancing adaptive capacity)
Provision of independent power sources that are resistant to weather disasters using renewable energy	• Stabilization of energy supply • Mitigation of climate change impacts on livelihoods, including healthcare and education
Development and introduction of technologies for drainage, irrigation pumps, water treatment membranes, septic tanks, etc.	• Supply of safe and secure water to local communities
Introduction of agricultural business methods in response to climate change and production of high-value-added agricultural products	• Maintenance and strengthening of food production bases • Stable supply of food to surrounding areas
Development and introduction of infectious disease prevention technology	• Reduction in the number of patients with diseases, medical costs, and the burden on regional medical systems
Development and introduction of disaster prevention infrastructure technology	• Construction of resilient social infrastructure • Ensuring the safety of socioeconomic infrastructure and the lives and property of local residents
Development and introduction of an early warning system	• Minimizing human damage caused by disasters

The table above mainly illustrates activities related to technology development and the provision of services. However, as private companies play a role in supporting regional and social infrastructure, employment, and economic activities, they can also contribute to the enhancement of regional and social adaptive capacity by improving their own adaptive capacity.

Necessity of Enhancing Adaptation Finance: (1) Promotion of Behavior Change

- It is of great significance for private companies to engage in adaptation, and in fact, some have already started specific activities. Even so, many companies, including SMEs, do not fully view natural disasters from the perspective of climate change impacts, and not so many private companies are aware of the needs for adaptation, compared to climate change mitigation (see the table below).
- In order to further promote adaptation in the future, firstly, it is necessary to raise awareness among businesses that are directly exposed to climate risks. However, it will take considerable time for the process of assessing the risks of climate change impacts, planning and implementing activities, and monitoring and measuring impacts to become widespread. To accelerate adaptation activities by businesses, a "gimmick" to encourage behavior change is needed.
- So, “adaptation finance” is expected to play this role. An effective approach to the use of adaptation is to integrate it with conventional financing and internalize it economically; disseminate it to many businesses; and encourage them to early introduce and continuously implement their activities in the mid- and long-term.

Comparison of the scale of adaptation and mitigation activities
(on a fund basis; unit: US $1 million)

	Adaptation activities	Mitigation activities	Cross-cutting activities	Total
Private funds	457	325,513	247	326,218
Public funds	29,357	212,056	11,425	252,838
Total	**29,814**	**537,569**	**11,672**	**579,056**

Note) Average data for the two years of 2017 and 2018
Source) Created based on the Climate Policy Initiative, "Global Landscape of Climate Finance 2019".

Necessity of Enhancing Adaptation Finance: (2) Transfer and Diversification of Heightened Risks

- In recent years, payments for non-life insurance claims that compensate for meteorological disasters has been rapidly increasing (see the table below). The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) points out that, if insurance companies fail to coordinate climate risk management or are prevented from conducting price risk management, increased climate disasters can impair their solvency.
- According to Munich Reinsurance Company, damages from global climate disasters since 1980 have amounted to about US $4.2 trillion, only one third of which were insured. In order to respond appropriately to climate disasters expected in the future, it is essential for businesses and local governments to make efforts to reduce and prevent risks, and appropriately transfer and diversify risks to capital markets. In addition, it is important, together with expanding the horizon of existing adaptation finance, to encourage the development and introduction of new financing methods.

Amount of insurance claims paid due to past major wind and water disasters (In 100 millions of yen)

Rank	Year	Disaster name	Afflicted region	Insurance claims paid
1	2018	2018 Typhoon No. 21	Osaka, Kyoto, Hyogo, etc.	10,678
2	2019	2019 Typhoon No. 19 (Reiwa 1 East Japan Typhoon)	Mainly eastern Japan	5,826
3	1991	1991 Typhoon No. 19	Across Japan	5,680
4	2019	2019 Typhoon No. 15 (2019 Boso Peninsula typhoon)	Mainly Kanto region	4,656
5	2004	2004 Typhoon No. 18	Across Japan	3,874
6	2014	Damage from extremely heavy snowfall in February 2014	Mainly Kanto region	3,224
7	1999	1999 Typhoon No. 18	Kumamoto, Yamaguchi, Fukuoka, etc.	3,147
8	2018	2018 Typhoon No. 24	Tokyo, Kanagawa, Shizuoka, etc.	3,061
9	2018	Heavy rain in July 2018	Okayama, Hiroshima, Ehime, etc.	1,956
10	2015	2015 Typhoon No. 15	Across Japan	1,642

Note) Disasters in the last five years are shown in orange shading.
Source) Created based on the General Insurance Association of Japan, "General Insurance in Japan - Fact Book 2020".

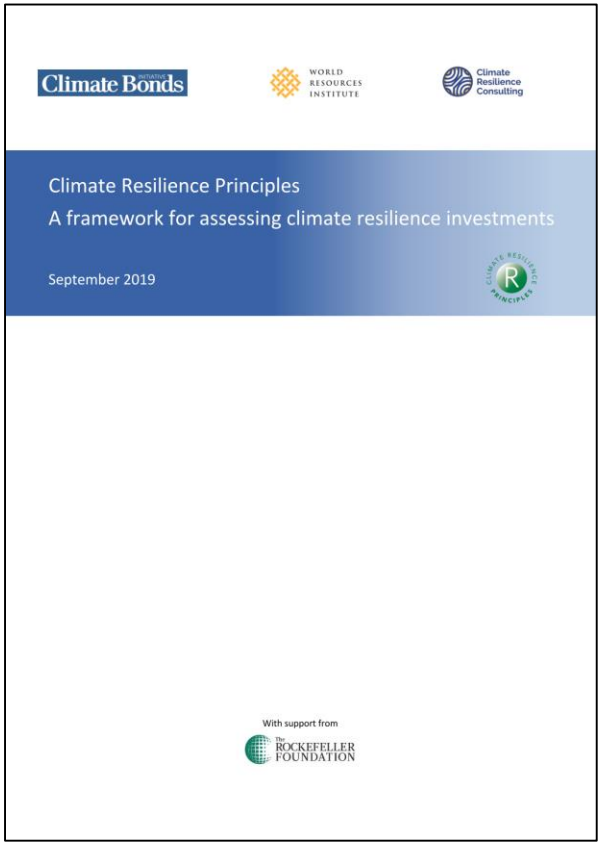
2) Purposes of this Guide

Present the basic concept of adaptation finance	● Currently, the definition of "adaptation finance" is unclear and not fully understood. Some financial institutions have already started to engage in adaptation finance, though they are not fully aware of it. ● This Guide will present the basic concept of adaptation financing to make it easier for financial institutions to judge what constitutes adaptation finance and what types of financing fall under adaptation.
Clarify the roles of financial institutions	● Adaptation activities must be carried out by a variety of actors, including government agencies and research and development institutes, bringing their respective strengths together and collaborating. Thus, this Guide will clarify the roles of financial institutions in the cooperation among these entities. ● It should be noted that financial institutions are unlikely to commit themselves to any key roles in the promotion of adaptation if they are not commercially profitable. This Guide will thus take into account the aspects of adaptation that are advantageous for financial institutions.
Present specific examples	● Adaptation finance requires different perspectives and processes than climate change mitigation finance, which is already widespread. ● This Guide will, while keeping in mind the perspectives and processes unique to adaptation, introduce a range of example methods and tools that can help financial institutions develop adaptive finance.

Encourage financial institutions to create success stories

3) Position of this Guide

- Adaptation finance, unlike green bonds and sustainability-linked bonds, does not embody any well-developed principles and guidelines. The Climate Bonds Initiative (CBI), an international NPO, has created “Climate Resilience Principles" and is working to incorporate them into the "Climate Bond Standards", but it is still at the stage of consideration.
- Yet, there is no time to wait for the expansion of adaptation finance. It is urgently necessary to respond to climate risks. It would be too late if we wait for principles and guidelines to be completed.
- We have prepared this Guide to encourage financial institutions to develop new financing methods and early undertake and expand adaptation finance. This Guide also presents the basic concept of adaptation finance with reference to relevant discussions and case studies in Japan and abroad. It should be noted that this Guide is not intended to strictly define the eligibility criteria or procedures for financing in compliance with any specific principles or guidelines.



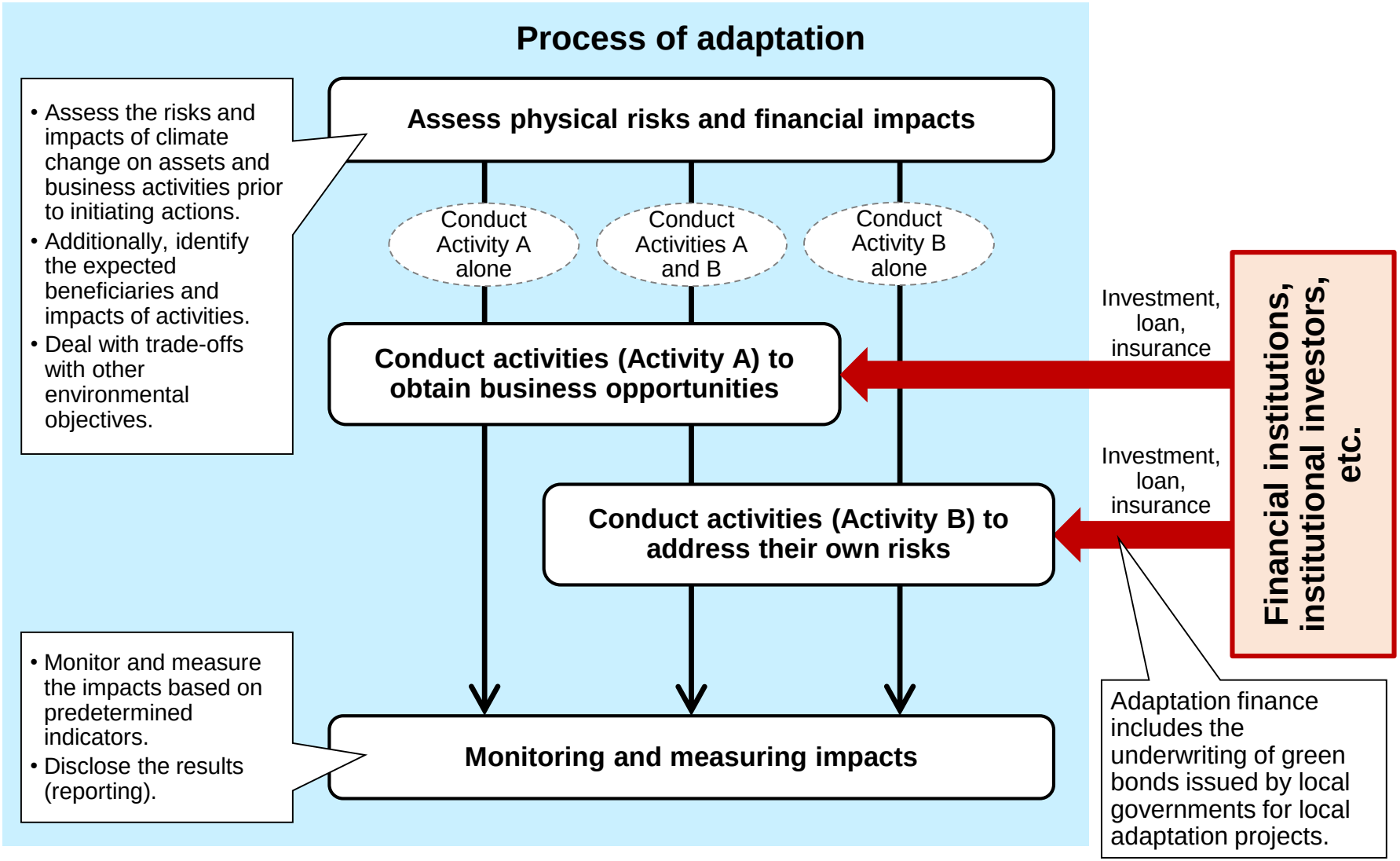
CBI, “Climate Resilience Principles”

Basic Concept

■ What Is Adaptation Finance?

- **Adaptation finance is to finance activities in response to visible climate risks or hedge against such risks so as to mitigate uncertainty in business operations, communities, and society, and increase the likelihood of gaining long-term, stable returns.**
- **Adaptation finance includes investments, loans, and insurance policies for activities to mitigate or prevent physical risks and financial impacts of pre-assessed climate change (including activities of businesses and public infrastructure projects by local governments), as well as activities for these entities to obtain business opportunities.**
- **There can be various financing methods, including traditional non-life insurance and CAT bonds. Financial institutions can finance particular projects exclusively for adaptation with limiting the use of the funds, and also finance businesses and local governments that are committed to adaptation without requiring them to specify the use of the funds.**
- **Many more financing methods can be developed and executed for a project or organization that cannot be financed by a single financial institution if, for example, multiple financial institutions - for example, a banking institution and an insurance company - work together and demonstrate their strengths.**

Image of Adaptation Finance



Example Methods of Adaptation Finance

■ Adaptation finance comes in a variety of types and has promising marketability in response to target adaptation activities (such as Activities A and B on the previous page). It is also carried out through a variety of methods.

Adaptation activity	Type of financing	Promising marketability	Example method (Reference pages for specific examples are in parentheses.)
Activities to obtain business opportunities (Activity A)	Allocate funds for activities by businesses to develop and provide technologies and services for adaptation	Products that can be assessed according to the usefulness and expected effects of technologies and services	• Resilience bonds • Sustainability bonds (p. 26) • Green bonds and loans • Sustainability-linked bonds and loans • Positive impact finance • Public-private funds (p. 27)
Conduct activities to address their own risks (Activity B)	Allocate funds for activities by businesses and local governments to mitigate or prevent their own risks (such as capital investment and review of business operation methods for businesses; and river improvement and landslide disaster countermeasures for local governments)	Products that can be assessed to reflect the risk reduction effects of activities	• Resilience bonds (p. 28) • Sustainability bonds • Green bonds and loans (p. 29) Mainly for businesses • Sustainability-linked bonds and loans • Positive impact finance • BCM rated loans Mainly for local governments • Environmental impact bonds (p. 30) • PFI (pp. 31 and 32) • Parametric insurance (p. 33)
	Hedge against risks that cannot be mitigated or prevented by the above measures	Products that trigger events, such as insurance and derivatives	Mainly for businesses • Non-life insurance with BCM Rating (p. 34) • Derivatives (p. 35) • Loans with a disaster principal waiver rider (p. 36) Mainly for local governments • Disaster prevention and mitigation expense insurance (p. 37) • CAT bonds

Note) "Example method" provides existing methods for convenience. Methods to be developed and implemented in the future are not limited to these.

Relationship with Disaster Prevention and Mitigation Finance

- In response to climate risks, many private companies and local governments are working on comprehensive measures against natural disaster risks, including earthquakes and tsunamis. Many of them are taking a combination of measures for climate change mitigation and adaptation with an eye to synergy.
- In other words, measures for adaptation, disaster prevention, and mitigation are often taken in a combined manner, so financing for them has many common aspects. To support these combined activities, adaptation finance, disaster risk reduction finance and mitigation finance are not treated as mutually exclusive but are treated flexibly, for example, as "adaptation finance as part of disaster prevention finance" and "adaptation finance that also contributes to mitigation".

[Joint Message on "Climate Change x Disaster Prevention"]

- In June 2020, the Cabinet Office (disaster prevention) and the Ministry of the Environment compiled a strategy for effectively coordinating measures against climate change and disaster prevention/mitigation measures, “Climate Change x Disaster Prevention Strategy in the Age of Climate Crisis: From ‘Prototype Restoration’ to ‘Adaptation Reconstruction’” (joint message from Minister of the Environment Koizumi and State Minister of Cabinet Office Takeda).
- The message identifies two key strategies, that is, “climate change x mainstreaming of disaster prevention” and “promotion of comprehensive measures for the construction of a society that is highly de-carbonized and has high disaster prevention capabilities”. It also states, “In disaster recovery, we are not limited to the idea of simply returning the region to its original form, and it is important to respond with an idea to adapt change through elastic responses, including control of land use”.
- It is thus necessary to consider implementing adaptation also from the perspective of disaster prevention.

Benefits for Financial Institutions

■ Adaptation finance contributes to the promotion of adaptation as part of climate change measures, and also brings benefits to the business of financial institutions.

[Major benefits for financial institutions]

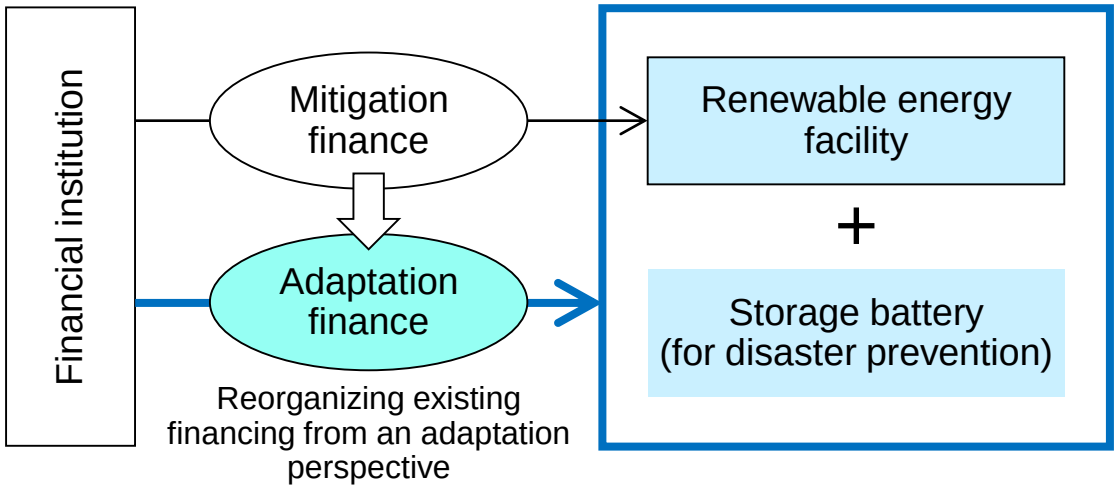
- **Can reduce downside risk by encouraging business partners to take risk response actions, including with respect to supply chains.**
- **Can build relationships with new business partners and lead to the acquisition of financing opportunities by stimulating adaptation needs in markets.**
- **Can make more accurate credit decisions by encouraging business partners to disclose information on physical risks and financial impacts. Adaptation finance will facilitate financial institutions themselves to disclose information on their own portfolios (TCFD-compatible disclosure) and discover risk management and new business opportunities.**
- **Can contribute to the achievement of the Paris Agreement, SDGs, Sendai Framework for Disaster Risk Reduction, and other initiatives as a financial institution. (Those that set targets for sustainability finance, etc., can use adaptation finance to achieve such targets.) Adaptation finance will enable financial institutions to play a central role in solving regional and social issues and establishing a regional cooperation framework.**
- **Adaptation finance will help enhance their reputation in Japan and abroad, making it easier for them to raise funds by themselves.**

Exploration of Business Opportunities to Generate Cash Flow

- As private companies, financial institutions will find it difficult to finance activities that do not produce future cash flow even if the activities can lead to corporate or community adaptation. To expand adaptation finance in the private sector, it is important to ensure that investments and loans can secure cash flow.
- Some adaptation activities can generate profits as private-sector business, including: the development of climate-resistant varieties of farm products; sales of cultivation management sensors to optimize water use; provision of systems to assess and diagnose the risk of flooding in buildings; and the development of vaccines and pharmaceuticals to combat infectious diseases that could spread as a result of climate change. It is desirable to start by finding and financing these business opportunities, or by reorganizing existing financing from an adaptation perspective and embarking on finance projects that can be considered as adaptation financing.

[Reorganizing existing financing from an adaptation perspective]

- Investments and loans for renewable energy are generally regarded as mitigation finance. On the other hand, for example, if renewable energy facilities and storage batteries are installed together and used as a power source for disaster prevention in an emergency in areas with a risk that a lifeline will be cut off due to power outages caused by typhoons or heavy rains, that can be considered as adaptation finance.

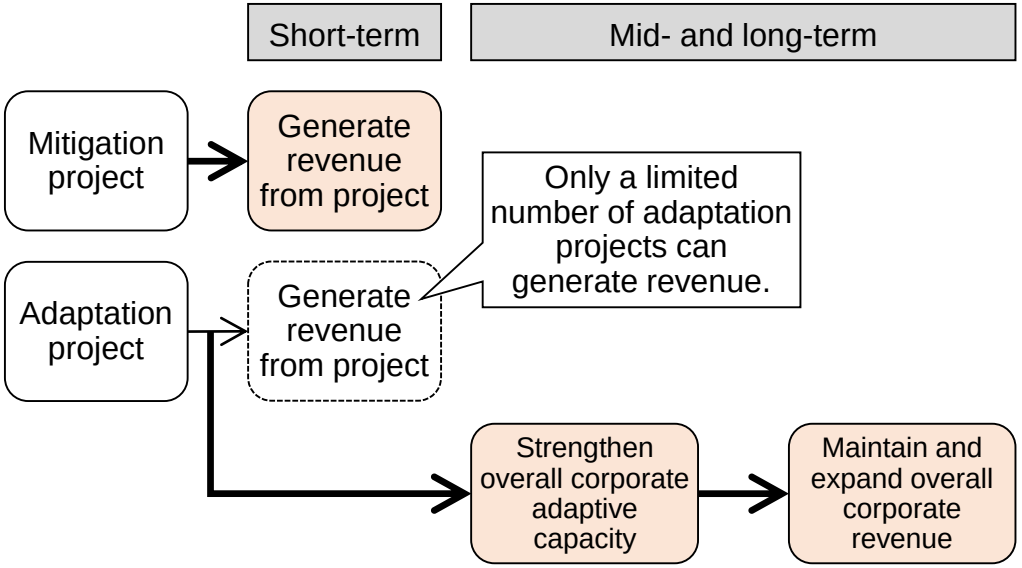


Corporate Finance to Address Their Own Risks

- In general, mitigation projects can generate cash flow by themselves through, for example, sales of electricity produced from renewable energy sources, and the profits can be used to repay loans. On the other hand, some adaptation activities can generate revenue (See the previous page), but it is more difficult to secure cash flow than it is for mitigation activities, which thus poses a challenge for financial institutions in adaptation finance.
- Therefore, it will be less demanding to structure an adaptation finance arrangement as corporate finance, rather than project finance, and call on the borrowing company to secure the source of repayment from its revenue as a whole.

[Comparison of mitigation and adaptation projects]

- Mitigation and adaptation have different flows and timescales to revenue generation.



[Examples of corporate finance]

- "Positive impact finance" analyzes and assesses the impacts of corporate activities on the environment, society, and economy, and invests in and provides loans for activities intended to create positive impacts. This is a financing method that can develop into adaptation finance.
- Sumitomo Mitsui Trust Bank has concluded with Sumitomo Forestry the Positive Impact Finance (a loan for business companies that do not specify the purpose of use of funds), which adopts, as key performance indicators (KPI), items closely related to adaptation, such as certified forest areas in Japan and overseas and the number of sales of indigenous species.

Response to Long-Term Risks

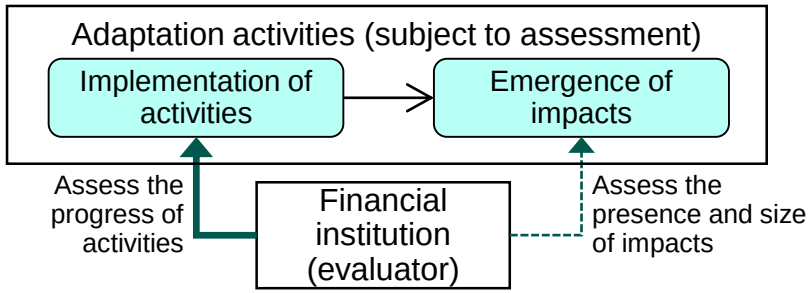
- Some financial institutions have already begun to assess the risk of climate disasters that may occur abruptly, and are also providing financing. On the other hand, there is not much progress in response to long-term risks, such as temperature increases, changes in precipitation patterns, and sea level rise, which will show gradual effects on a scale of several decades.
- Responding to long-term risks is extremely important for sectors such as agriculture and urban real estate, which are forced to change their business models due to the impacts of climate change. So, these sectors need to respond to long-term risks while developing future forecast data and analytical tools, as well as fostering awareness.

[Goldman Sachs research report]

- In September 2019, Goldman Sachs released a report entitled "Taking the Heat: Making Cities Resilient to Climate Change". The report points out that cities are home to 55% of the world's population and currently generate roughly 80% of global GDP and, at the same time, they are vulnerable to climate change on several fronts, such as higher temperatures, more frequent and/or intense storms, rising sea levels and stronger storm surges. The report also warns that it may be prudent for some cities to start investing in adaptation now.
- The report also presents an analysis of the impact of rising sea levels on coastal cities, including New York, Lagos, and Tokyo. The report is interpreted as a message to domestic financial institutions that there is a risk that urban real estate will become stranded assets in the future.

[Challenges for responding to long-term risks]

- Behind the slow progress of the response to long-term risks lies the fact that financial institutions do not have enough data and analytical tools to forecast future events, that they have difficulty tangibly recognizing such risks, and that even if they take action, impacts are unlikely to emerge in the short term.
- Therefore, in financing, they need to flexibly establish assessment methods, such as including in the assessment target not only the impact obtained as a result of activities but also the progress of activities.



Role of Financial Institutions in Adaptation Finance

■ Financial institutions have different roles in different industries from three perspectives: (1) assessment of physical risks and financial impacts; (2) implementation of financing based on the assessment results; and (3) utilization of the assessment results related to financing.

Financial institution	Assess physical risks and financial impacts	Implementation of financing based on assessment results	Utilization of assessment results related to financing
Banks	• Assessment of credit portfolio risk • Risk assessment of individual companies and projects	• Loans (project/corporate) • Bond underwriting	• Engagement in dialogue with business partners • Reflection in assessment of business potential • Support for the establishment of regional cooperation frameworks • Credit judgment
Securities firm	• Risk assessment of individual companies and projects	• Underwriting and sale of stocks and bonds • Securitization of receivables	• Proposals and adjustments of stock and bond issuance terms
institutional investor (AM/AO)	• Risk assessment of investment portfolios • Risk assessment of individual companies and projects	• Investments (stocks/bonds/real estate)	• Formulation of fund management policies • Engagement in dialogue with business partners
Insurance company	• Development and provision of risk assessment services	• Provision of risk finance (insurance, derivatives, etc.)	• Consultation on risk management • Support for the formulation of business continuity plans (BCP)

Note) Some items in the table have yet to be implemented.

Reflection in Assessment of Business Potential, etc.

- In order to promote adaptation in the private sector, it is necessary to incorporate elements of adaptation into all assessments of business potential, financing terms, and insurance premium rates.
- For example, current real estate appraisal values do not reflect flood risks, the presence of adaptation measures, or other elements of adaptation. These are not fully reflected in market transaction prices determined with reference to the appraisal values, either. On the other hand, real estate appraisal values are affected by market transaction prices. So, it is important for financial institutions to conduct their own assessments from the perspective of climate risk and adaptation, and to create examples where the value of real estate increases due to the existence of adaptation measures on the market side.

[Reflection in real estate due diligence]

- For real estate properties such as land and buildings, performance, such as energy conservation, is taken into consideration in due diligence to evaluate their value, and earthquake risk analysis is conducted using the probable maximum loss (PML) rate as an indicator. Climate risks, on the other hand, are checked on the hazard maps, and are not adequately considered in value ratings.
- In the future, it will be necessary to increase the assessment items in due diligence and consider climate risks for all real estate properties.

[Expansion of regional ESG finance]

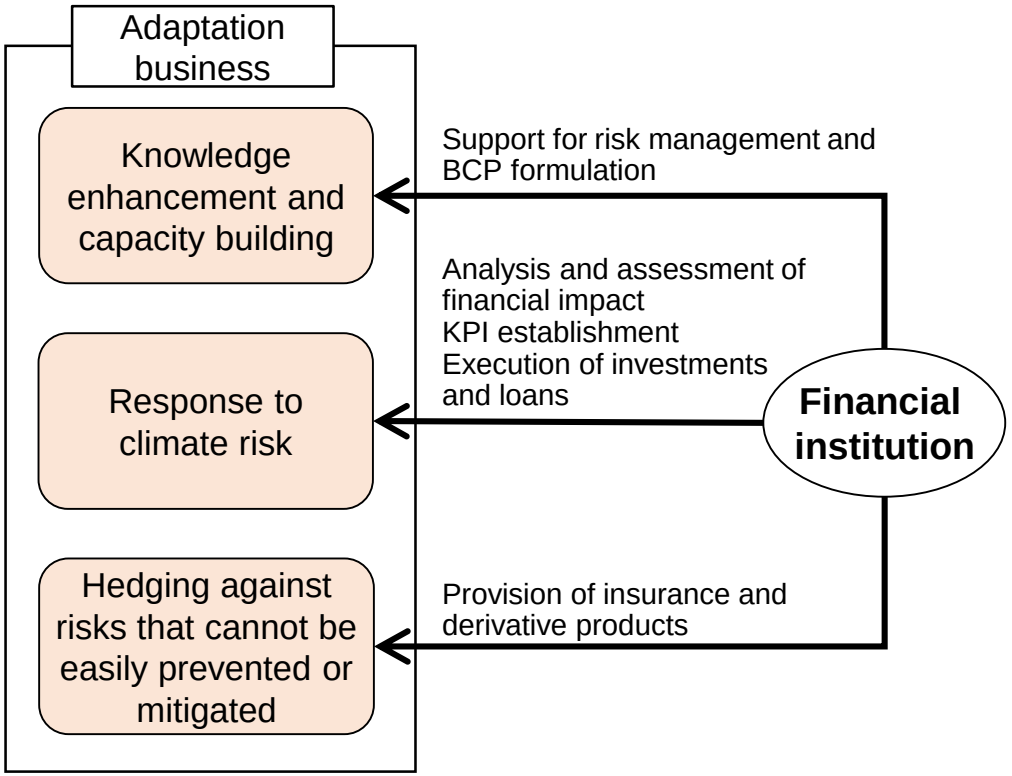
- The Ministry of the Environment has prepared “Practical Guide to ESG Regional Finance" and "Case Studies on ESG Regional Finance: Toward the Spread of ESG Regional Finance" and has encouraged the implementation of business feasibility evaluation that take into account ESG elements.
- These documents include case studies where adaptation elements are used as a single item in the business feasibility assessment. In other words, it is possible to realize adaptation finance by expanding ESG regional finance, which has been considered and implemented.

Utilization and Provision of Know-How

- Financial institutions have a wealth of know-how, including with respect to financial analysis of business partners, rating functions, KPI establishment and assessment based thereon, and can contribute to adaptation finance by utilizing and providing this know-how.
- In addition, they are expected to provide knowledge on climate risk and adaptation to business partners, and build capacity through support for risk management and BCP development.

[Financial institutions' contribution to adaptation business]

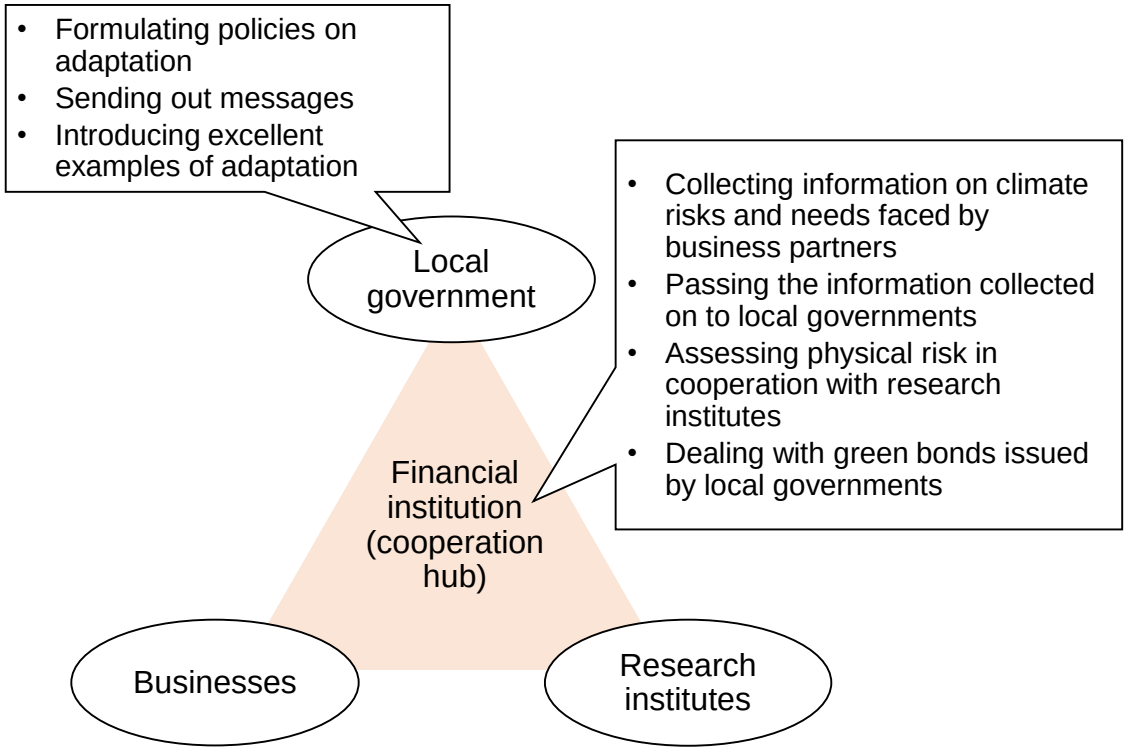
- Adaptation business consists of three main elements: (1) knowledge enhancement and capacity building; (2) response to climate risks; and (3) hedging against risks that cannot be easily prevented or mitigated.
- There is a lot of room for financial institutions to contribute to each of these three elements, and in fact, insurance companies and other financial institutions have begun to develop businesses.



Support for the establishment of regional cooperation frameworks

■ For the efficient and effective expansion of adaptation finance, local governments, research institutes, businesses and financial institutions must cooperate with each other. In such cooperation, it is desirable for financial institutions, which are particularly closely related to businesses, to act as hubs to promote the sharing of ideas across the region and to contribute to the establishment of a cooperation framework, where each player is able to address climate risks under the same policy.

[Position of financial institutions as a cooperation hub]



[Examples of cooperative approach]

- Some regional financial institutions participate as members of prefectural councils on basic environmental plans. These regional financial institutions, through participation in meetings of such councils, often inform local governments of climate risks faced by themselves and businesses and their adaptation activities, while calling on them to send out policy messages.
- Other regional financial institutions are working to link their adaptation activities with local government policies and KPIs. Where the prefectural government is proactive in ESG investment, regional financial institutions are actively adopting a loan policy consistent with the policy of these governments. Where the local government posts its specific adaptation measures on its website, regional financial institutions are actively implementing financing to promote the commercialization of these measures.

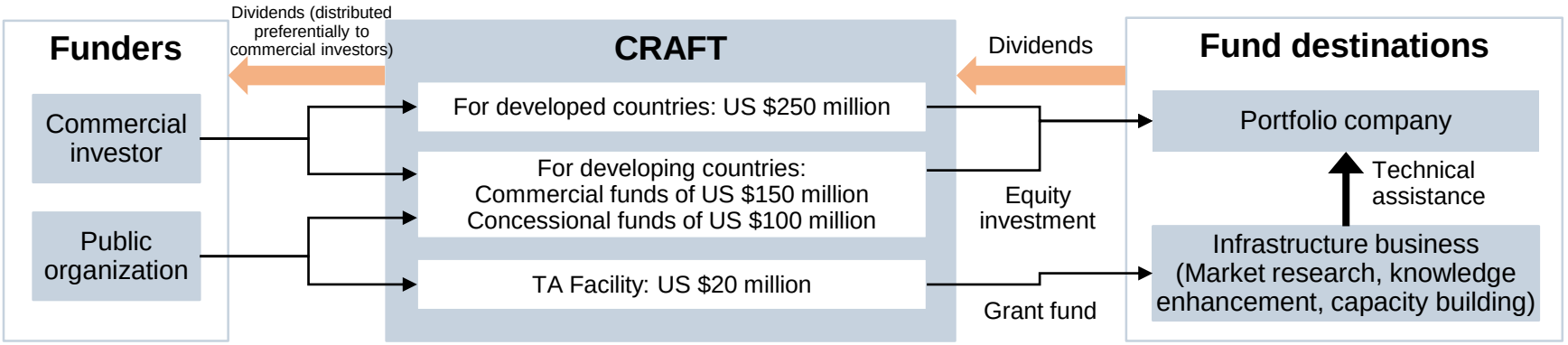
Sustainability bonds

Fund raising for emergency batteries in train cars and other sustainability measures	
Bond issued by	Tokyo Metro Co., Ltd.
Summary	• In June 2020, Tokyo Metro issued a sustainability bond to raise stakeholders' awareness of its ESG activities and to use the funds raised for measures that contribute to solving both environmental and social issues. • The bond issuance totaled 10 billion yen; the bond has a maturity of 10 years, and the interest rate is 0.275% per annum. • The funds will be used for three purposes, that is, the introduction of new train cars, improvement of platform door safety and installation of solar power generation systems. The new model of train cars will be designed to consume less electricity and, as an adaption solution for climate change, will be equipped with emergency batteries that enable trains to travel to the nearest station in case of a climate disaster and power failure.

Sources) Created based on the website and news releases of Tokyo Metro Co., Ltd.

Public-Private Funds

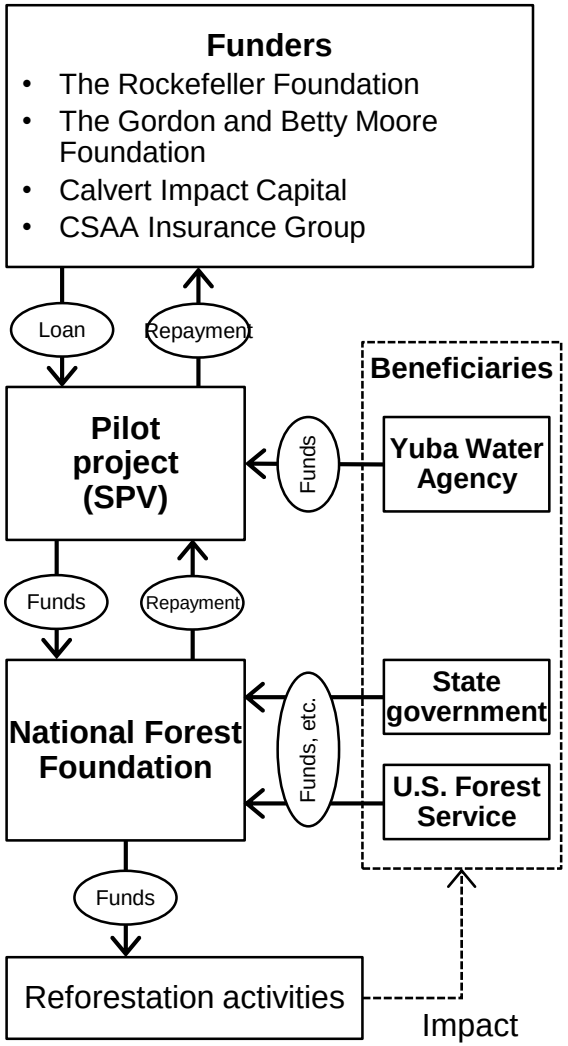
Accelerating the development of adaptation technologies and solutions by mobilizing commercial investments	
Fund established by	Lightsmith Group
Summary	• During the period between 2003 and 2013, natural disasters caused US $1.5 trillion in economic damages worldwide, of which US $550 billion worth of damages occurred in developing countries. With climate change in mind, businesses and communities are looking for ways to reduce their vulnerability. • The Lightsmith Group thus created a commercial investment fund "CRAFT" for climate adaptation and resilience solutions. It invested in growth stocks (10 to 20 companies) in both developed and developing countries, including weather analysis companies, disaster risk modeling services, and developers of drought-tolerant seeds at a ratio of $3.30 to $1.00 in concessional loans or technical assistance grants. • It combines a standard equity investment fund structure with technical assistance to enable the development of technologies and services primarily in developing countries. The fund project also considers risk mitigation for commercial investors, and distributes some of the returns preferentially to commercial investors.



Source) Created based on the website of the Lab.

Resilience bonds

Blending private loan funds with public funds for reforestation projects	
Service provided by	Blue Forest Conservation (US NPO)
Summary	• Blue Forest Conservation developed a model (Forest Resilience Bond, FRB) that blends private sector financing, including charitable organizations, with public financing to support reforestation efforts. In 2018, Blue Forest Conservation rolled out a pilot project at the Tahoe National Forest (approx. 60km^2) with the FRB. • Private funds raised prior to the implementation of the forest restoration project totaled US $4 million, of which half came from concessional loans (at an annual interest rate of 1%) and the remaining from commercial loans (at an annual interest rate of 4%, plus a commitment fee of 0.5% per annum). • Beneficiaries such as the California State Government and Yuba Water Agency will repay investors upon completion of the work. The U.S. Forest Service also committed to the project through project planning and financing. Public funds raised totaled more than US $4.3 million. • Private financing with the FRB sped up restoration efforts in the Tahoe National Forest. The period of reforestation activities is expected to be shortened from 10 to 12 years to about 4 years.



Sources Created based on Blue Forest Conservation, "Case Study: The Forest Resilience Bond (FRB)" (June 2020).

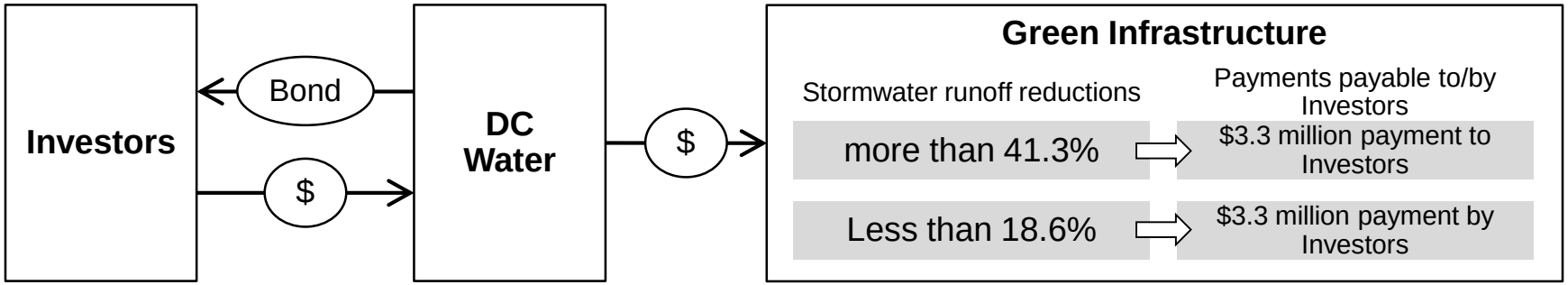
Green Bonds

Financing measures to address both climate change adaptation and mitigation	
Bond issued by	Nagano Prefecture
Summary	• On October 16, 2020, Nagano Prefecture issued a green bond as an initiative to achieve net zero carbon dioxide emission by 2050 and to prevent and mitigate damage from natural disasters resulting from climate change. • The bond issuance totaled 5 billion yen; the bond has a maturity of 10 years, and the interest rate is 0.14% per annum. • The funding will be used for five projects: renewable energy, clean transportation, energy efficiency, climate change adaptation, and sustainable management of bioresources and natural resources. Among these projects, the climate change adaptation project aims at (1) traffic infrastructure development (signal power supply unit, road disaster prevention, etc.), (2) river improvement for flood damage countermeasures, and (3) erosion control, forest conservation, landslide and steep slope collapse countermeasures for sediment disaster countermeasures.

Source) Created based on the website and the "Nagano Green Bond Framework" of Nagano Prefecture.

Environmental Impact Bonds

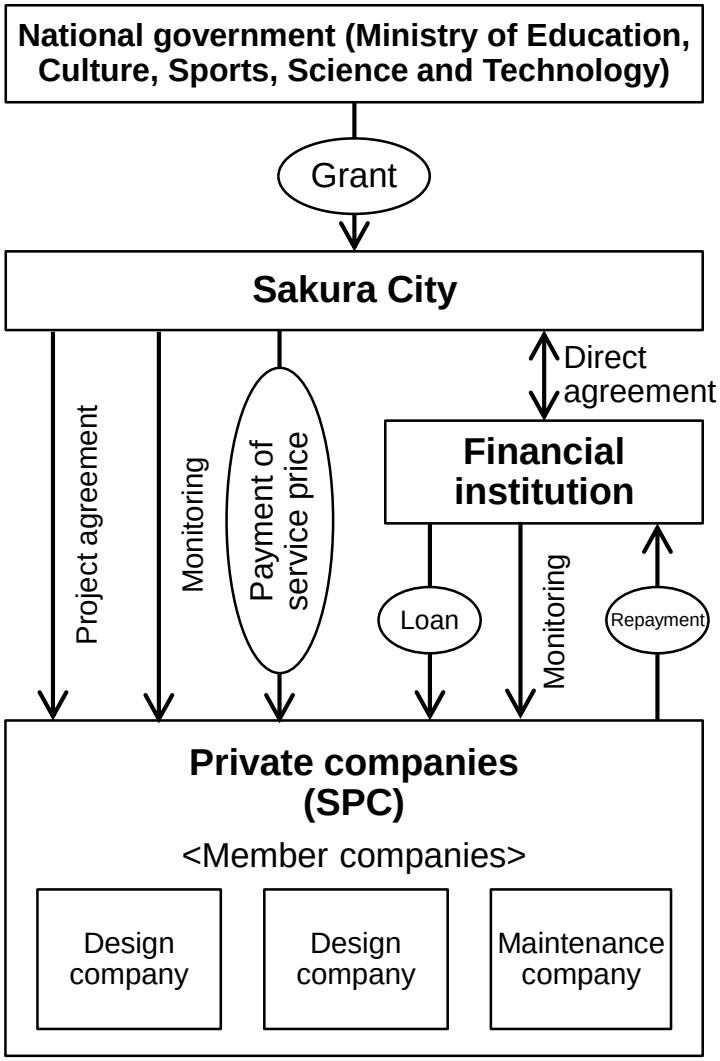
Sharing performance risks of constructed green infrastructure with investors	
Bond issued by	District of Columbia Water and Sewer Authority (DC Water)
Summary	• The US capital, Washington DC, has suffered from sewage overflows (CSOs) when rainfall exceeds the capacity of the sewer system, which have caused adverse impacts on the quality of river water in the region. As torrential rain events took place more frequently and severely with climate change, reducing CSOs was a pressing issue for the authority. • DC Water therefore issued an environmental impact bond to fund the creation of green infrastructure to manage sewage runoff and improve water quality in DC. • The bond issuance totaled US $25 million; the bond has a maturity of 25 years, and the interest rate is 3.43% per annum. • DC Water bore the cost of building green infrastructure, but shared performance risk with investors (Goldman Sachs Urban Investment Group, Calvert Foundation). If runoff was reduced by less than 18.6% of the measured baseline, the Investors would make a one-time Risk Share Payment to DC Water of $3.3 million. If the GI produced stormwater runoff reductions greater than 41.3% of the measured baseline, DC Water would make a one-time additional Outcome Payment to the Investors of $3.3 million.



Sources) Created based on the U.S. Environmental Protection Agency (US EPA), "DC Water's Environmental Impact Bond: A First of its Kind", and Goldman Sachs, "Fact Sheet: DC Water Environmental Impact Bond".

PFI (1)

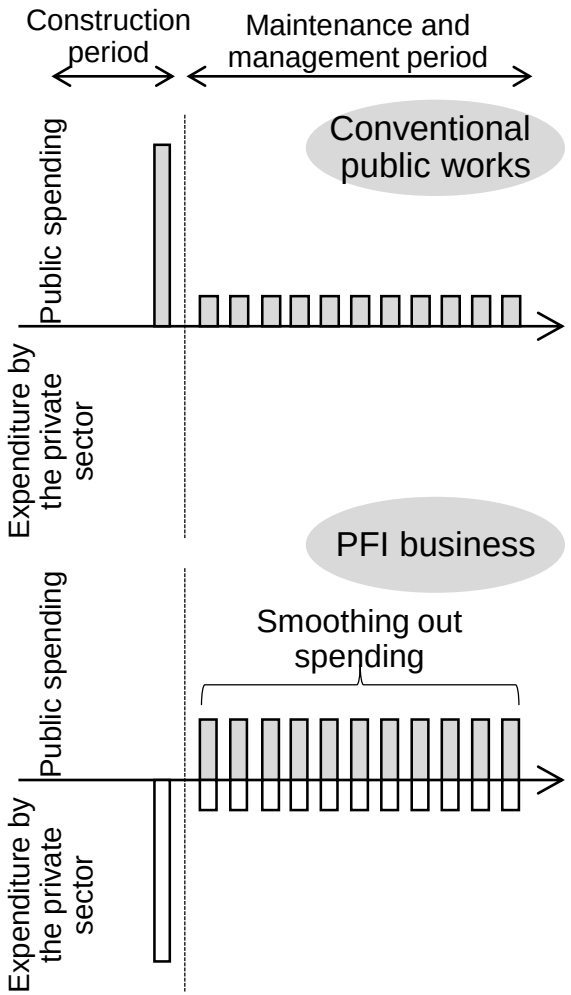
Early and simultaneous installation of air conditioning systems in elementary and junior high schools in the city	
Coverage	Sakura City, Chiba Prefecture
Summary	• Sakura City, Chiba Prefecture, installed air conditioning systems in regular classrooms of municipal elementary and junior high schools and kindergartens (a total of 683 rooms) in order to improve the learning environment and take into consideration the management of the physical condition of children, pupils, and kindergarteners due to temperature rise in the summer. • The city used the PFI method to finance air conditioning systems. The city utilized private funds to cover part of the construction costs, and smoothed out the financial burden and promptly and simultaneously installed air conditioning systems in all schools by making payments every fiscal year during the project term as the service price (a project term of some 13 years, a contract value of some 2.4 billion yen). • Thanks to the ingenuity of private companies, the project installed self-reliant gas air conditioners in some schools for power outages in preparation for disasters. Moreover, the project helped improve the maintenance and management quality of newly installed facilities as the special purpose company of the project consisted chiefly of local companies, which can quickly respond to emergencies.



Source) Created based on Public Private Partnership / Private Finance Initiative Promotion Office, the Cabinet Office, “PPP/PFI Case Studies” (April 2020).

PFI (2)

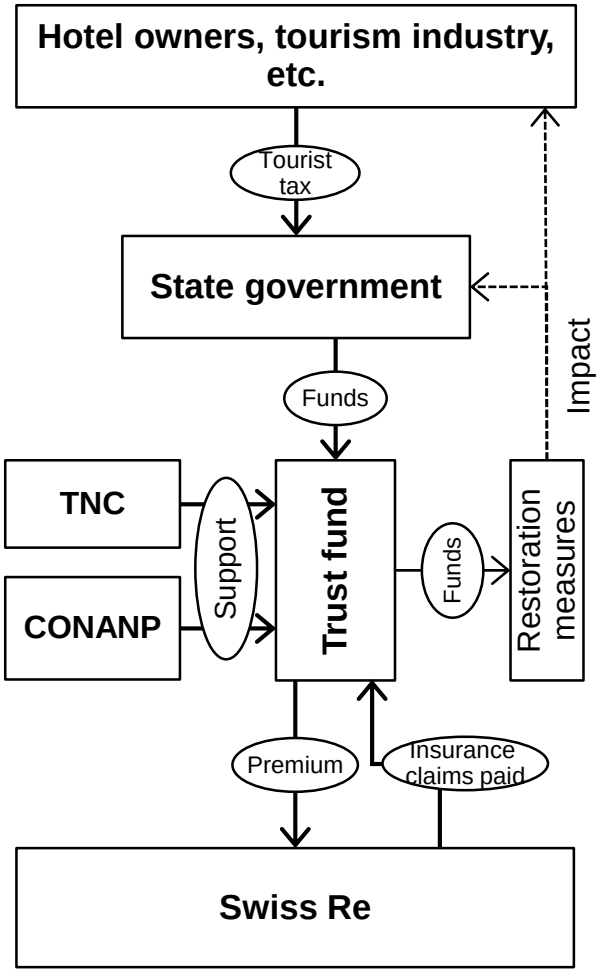
Smoothing out Local Government Spending and Making up for Their Shortage of Technical Know-How	
Coverage	Oiso-machi, Kanagawa Prefecture
Summary	• In recent years, various situations have occurred, including the collapse of utility poles due to typhoon damage, which blocked roads and hampered restoration activities, and large-scale power outages. In response, the city decided to accelerate its efforts to eliminate utility poles and construct a common cable conduit on National Route 1 (About 0.5 km in the vicinity of Oiso-machi, Kanagawa Prefecture). However, the city was faced with a number of problems such as an increase in maintenance costs, difficulty in coordinating with cable managers and roadside areas, and a shortage of technical know-how on the part of its officials. • Thus, the city decided to use the PFI method. It concluded a comprehensive contract, under which private-sector funds cover the entire process from the start of design to facility development, installation of electric wires, and the following improvement of pavement, as well as maintenance and management for a certain period after the delivery of the common cable conduit (a project term of 16 years, project value of approximately 1 billion yen). • The contract permitted installment payments for the cost of development, maintenance, and management, which enabled the municipal government to smooth out its spending. The contract also made it possible to systematically respond to the lack of technical know-how of its officials and fund shortage, and was also expected to reduce the overall costs by taking advantage of economies of scale.



Sources) Created based on Wataru Ogawa, "Introduction of PFI Method to Promote No Utility Poles" and materials of the Ministry of Land, Infrastructure, Transport and Tourism.

Parametric insurance

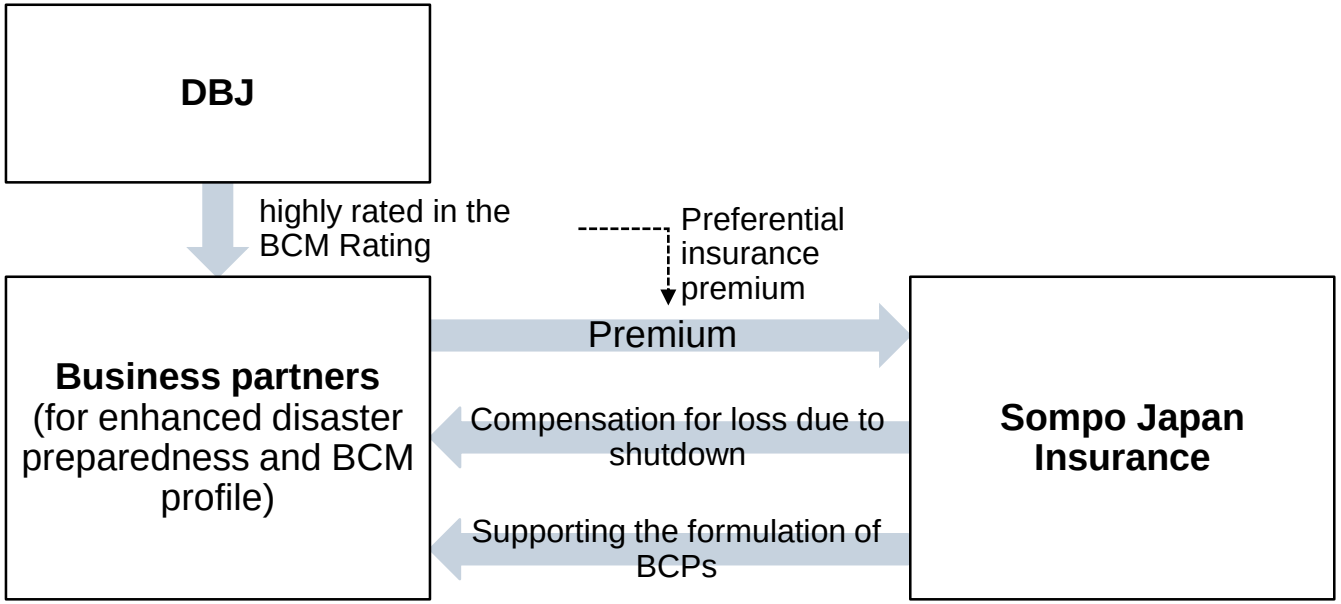
Prompt payment of insurance claims to restore coral reefs in the event of hurricanes	
Service provided by	Swiss Reinsurance Company Ltd.
Summary	• In 2005, two hurricanes hit the Caribbean coast of Mexico. The damages amounted to US $8 billion and caused serious economic impact, and afflicted local tourist hotels were forced to close. • In order to control hurricane damage, it is necessary to conserve coral reefs, which protect coastal areas and are also important as tourism resources. The Quintana Roo state government, hotel owners, the Nature Conservancy (TNC) and the National Nature Reserve Board (CONANP) jointly launched an innovative coral reef conservation strategy. The state government set up a trust fund, raised funds and purchased parametric insurance provided by Swiss Re. • Under the policy, insurance claims are paid automatically when certain conditions (wind velocity of 100 knots or more) are met at designated points. As the insurance policy requires no damage investigations, the state government was paid quickly and uses the claims for restoration measures, such as debris removal and coral reef restoration.



Sources) Created based on the websites of Swiss Re and TNC.

Insurance with BCM Rating

Strengthen disaster prevention measures by utilizing bank rating functions, insurance company products, and risk management know-how	
Service provided by	Sompo Japan Insurance Inc., Development Bank of Japan, Inc. (DBJ)
Summary	• Sompo Japan offers a discount of up to 20% on premiums for its corporate insurance product, the Corporate Comprehensive Compensation Insurance, which insures against losses incurred when plants and facilities are shut down. Discounts are available to companies that are rated high in the DBJ Business Continuity Management (BCM) Rating. • The insurance company also provides, via Sompo Risk Management Inc., support services for the formulation of business continuity plans to business partners of the DBJ that plan to enhance their disaster prevention measures.



Sources) Created based on the websites of Sompo Japan Insurance Inc. and Development Bank of Japan Inc.

Derivatives

Using weather derivatives to hedge against losses caused by abnormal weather or unseasonable weather	
Service provided by	Mitsui Sumitomo Insurance Company, Ltd.
Summary	• The company develops indicators based on weather data published by the Japan Meteorological Agency, such as temperature, precipitation, wind velocity, amount of snow cover and amount of snowfall, and carries out monetary transactions according to the difference between the value of indicators specified in a contract (disclaimer values) and the value of indicators generated by an actual weather phenomenon. • If a customer incurs a loss, the company will make payment promptly because the insurance policy requires no damage investigation.

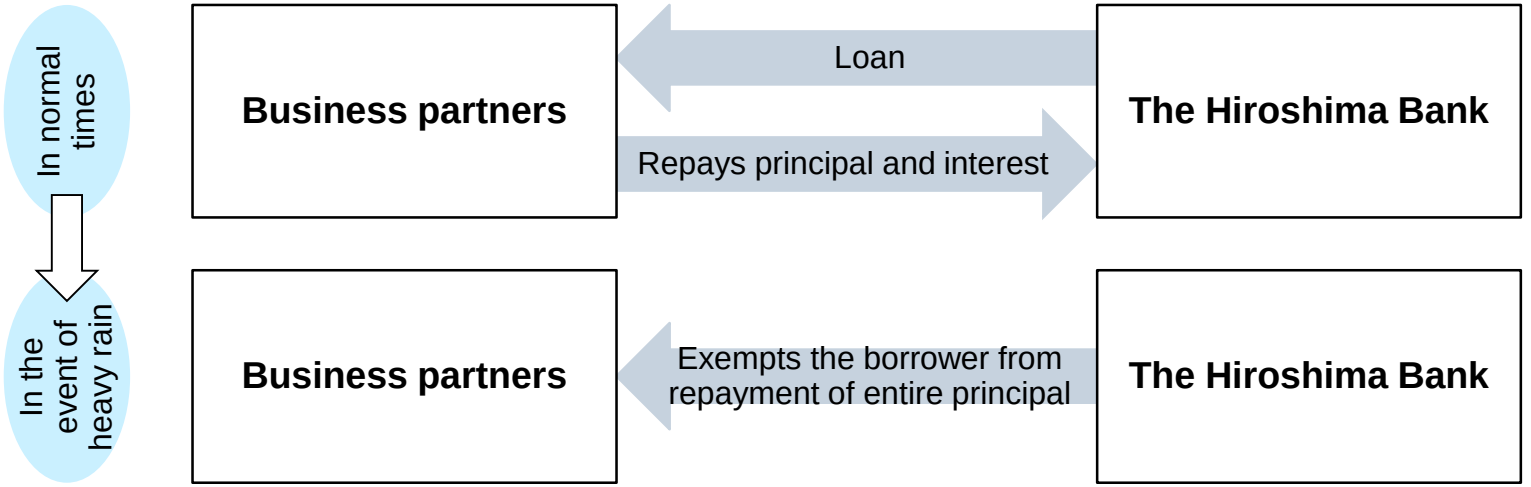
[Examples of hedgeable risks of loss]

Abnormal and unseasonable weather	Industry	Risk of loss
Heavy rain, little rain, strong wind and weak wind	Construction	delay in construction
	Mining	stoppage of mining operations
	Retail	decline in the number of customers
	Agriculture	decrease in yield
	Manufacturing	shutdown of plants
	Transportation	flight cancellation
	Leisure and tourism	decrease in the number of visitors and tourists and cancellation of events
Low Temperature (cool summer)	Leisure and tourism	decrease in the number of visitors and tourists
	Agriculture	decrease in yield
	Manufacturing	decrease in sales of air conditioners and fans
	Retail	decrease in beverage, ice cream and summer apparel sales
High temperature (warm winter)	Leisure and tourism	decrease in the number of visitors and tourists
	Retail	decrease in sales of winter clothing and winter food

Source) Created based on the website of Mitsui Sumitomo Insurance Company, Ltd.

Loans with a disaster principal waiver rider

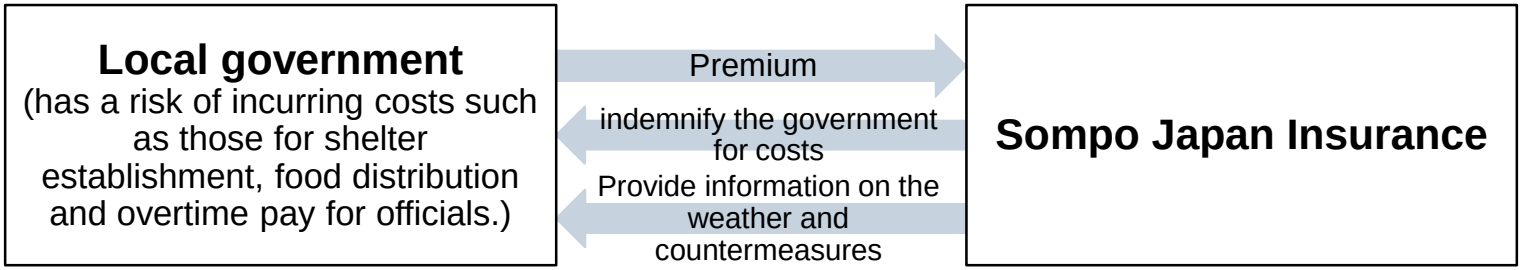
Principal waiver in the event of heavy rain exceeding the predetermined amount of precipitation	
Service provided by	The Hiroshima Bank, Ltd.
Summary	• The banking institution provides loans with a special clause for principal waiver at the predetermined rate (100 or 50%) regardless of whether or not the borrower suffers any direct or indirect damage in the event that heavy rain exceeding a predetermined amount of precipitation occurs at a predetermined observation point. • The borrower is able to compensate for financial damage in the event of a heavy rain disaster as the loan scheme exempts it from a portion of principle repayment. The loan scheme also enables borrowers to raise funds in an emergency as the exemption from principal repayment helps increase their borrowing capacity. • Sompo Japan Nipponkoa Insurance Co., Inc. and the Development Bank of Japan Inc. cooperated in the analysis of torrential rain risks and the construction of risk finance.



Sources) Created based on news releases of the Hiroshima Bank, Ltd.

Disaster Prevention and Mitigation Expense Insurance

Alleviating the cost burden risk of local governments	
Service provided by	Sompo Japan Insurance Inc.
Summary	• When a natural disaster occurs, the relevant local governments have to make decisions and issue evacuation advisories as soon as possible to prevent damage to residents resulting from the disaster. However, if a disaster does not occur as expected and the Disaster Relief Act does not apply and if national or prefectural subsidy is not granted, the governments will have to bear the costs of establishing evacuation centers and other costs. So, it has been a challenge for local governments to ensure the timely transmission of evacuation warnings, advisories and other messages to minimize damage to citizens. • Sompo Japan Insurance has developed insurance products that reduce the costs incurred by local governments in issuing emergency advisories and that encourage them to issue these alerts at an early stage, as promoted by the national government. The insurance company also provides local governments with information on the weather and countermeasures, supporting their prompt establishment of an initial response system.

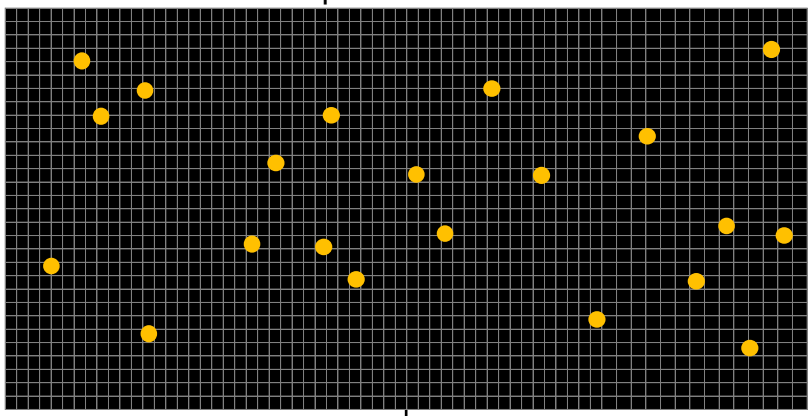


Source) Created based on the website of Sompo Japan Insurance Inc.

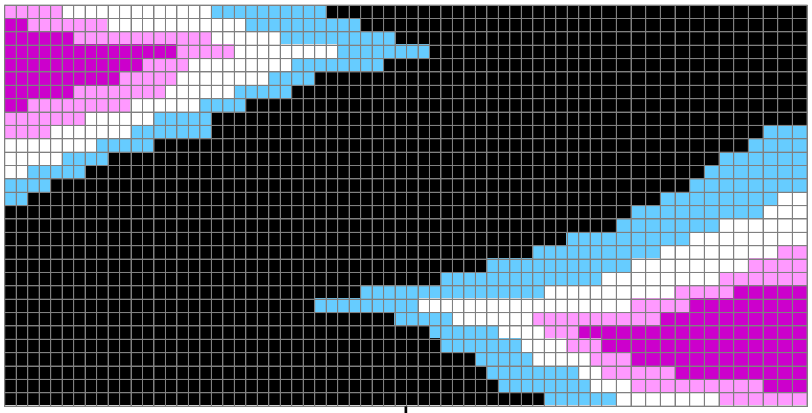
General Assessment Method

- There are various methods for assessing physical risks and financial impacts. Generally, (1) map information data on the assets and business activities of enterprises to be assessed and (2) map information data on climate change impacts are superimposed to assess the impact on each asset and business activity and to estimate the amount of damages.

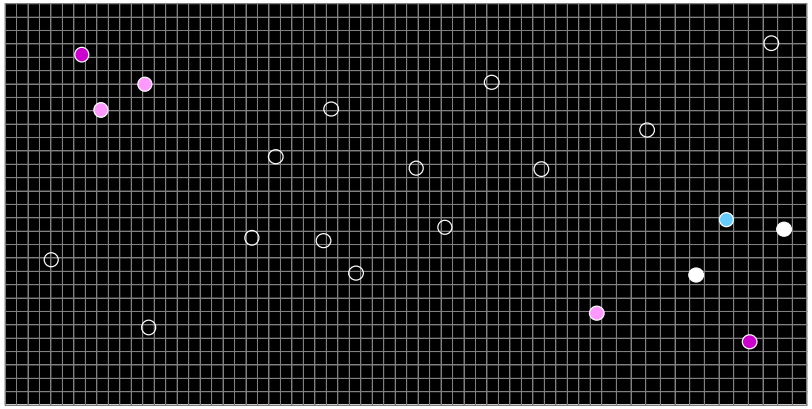
Map information data on the assets and business activities of the companies to be assessed



Map information data on climate change impacts



Impact on assets and business activities



Assessment Process

■ There is no standard assessment process, but it is generally recommended that physical risks and financial impacts should be assessed in the following process:

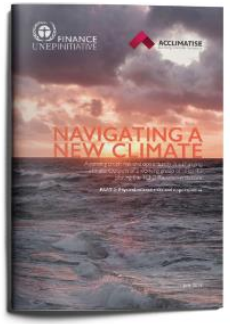
Step 1	• Organize the assets, business activities, and value chains of the companies to be assessed. • Describe the organized data as map information data (1).
Step 2	• Determine the assessment framework (climate scenarios, time horizon for assessment, etc.). • Identify projected climate change impacts under the determined framework (changes in temperature, precipitation patterns, the frequency of meteorological disasters, etc.). • Describe the identified climate change impacts as map information data (2).
Step 3	• Superimpose map information data (1) and (2) to identify key impacts of climate change on the companies to be assessed.
Step 4	• Assess physical risks and financial impacts in detail for the identified key impacts.

In-House and Outsourced Assessment

- Financial institutions have two approaches to the assessment of the physical risks and financial impacts of their business partners: in-house assessment and outsourced assessment.
- Each of them can apply either approach in accordance with their capacity. Either way, **a crucial point is that financial institutions themselves have to interpret the obtained results of assessment, and engage in enhanced dialogue with business partners, or incorporate the results into credit decisions for the supply of risk money. It is also necessary to secure human resources capable of dealing with this process on their own.**
  - Global trends in climate finance, including adaptation, are accelerating, and assessment methodologies are being developed. To this end, it is desirable to develop human resources who can interact with business partners from the ESG and sustainability perspectives over the medium to long term, rather than temporarily securing personnel with specialized knowledge.

Reference: Pilot project of the United Nations Environment Programme Finance Initiative (UNEP FI)

- Following the publication of the final recommendations by the Task Force on Climate-Related Financial Disclosures (TCFD) in June 2017, UNEP FI began a series of TCFD Pilot Projects for financial institutions in Japan and abroad to explore practical approaches for evaluating and disclosing climate risks and opportunities.
- Banking institutions participating in pilot projects for them pioneered approaches for assessing physical risks and financial impacts by using external tools to analyze online space risks and climate data portals These pilot projects identified several challenges: the external tools and data portals used in these pilots were inferior in terms of resolution and were not suitable for banking institutions to upload the asset data of their portfolios for technical or security reasons.
- The projects thus structured a system enabling advanced space analysis within the banking institutions and concluded that external tools and portals have certain advantages in assessing and analyzing risks and impacts while ensuring the security and privacy of data (without taking information off the users' premises). In fact, the Royal Bank of Canada (RBC) invested in the building of an in-house assessment system and announced that their investment yielded a certain degree of results.



Examples of Available Map Information Tools (List)

Data set name	Climate Change Knowledge Portal	UNEP Global Risk Data Platform	A-PLAT, Climate Change Adaptation Information Platform	MLIT Hazard Map Portal	d4PDF
Developer	World Bank	UNEP/GRID Geneva	National Institute for Environmental Studies (NIES, entrusted by MOE)	MLIT	JAMSTEC, National Research Institute for Earth Science and Disaster Prevention (entrusted by MEXT)
Date of development, update	N/A	N/A	June 2019	June 2016	February 2020
Future scenario	RCP2.6/4.5/6.0/8.5	N/A (Historical data only)	RCP2.6/4.5/8.5	N/A	Non-global warming/2°C/4°C
Data coverage	temperature, precipitation	Cyclones, high tides, droughts, earthquakes, forest fires, floods, landslides, tsunamis, volcanic eruptions	Climate, agriculture, water environment, natural ecosystems, natural disasters, health	Based on disaster prevention information prepared by the user	Variables such as precipitation, temperature, cloud cover, and wind speed
Area coverage	Whole world	Whole world	Japan	Japan and surrounding areas	Whole world and Japan's surrounding areas
Period covered	1901-2059	1970-2015	1981-2000, 2031-2050, 2081-2100	Based on disaster prevention information prepared by the user	Past: 6000 years (3000 years for Japan's surrounding areas) Future: 3240/5400 years
Frequency	N/A	N/A	N/A	Based on disaster prevention information prepared by the user	N/A
Spatial resolution	N/A	N/A	About 1-10 km (depends on the subject)	Levels 2 to 18 in terms of "Zoom Level" defined in the GSI Tiles of the Geospatial Information Authority of Japan (GSI)	• Global climate model: 60 km horizontal resolution • Regional climate model: Japan area 20 km
Data format	Metadata/Reporting	Metadata	Maps, graphs	Same as "GSI Tiles of Geographical Academy" of GSI	Metadata

⇒ See pages 51-55 for related information.

Examples of Available Map Information Tools (List)

Data set name	Climate Value-at-Risk	Four Twenty Seven	Climate Risk Platform	Location Risk Intelligence
Developer	MSCI ESG Research LLC	Moody's (ESG Solutions Group)	GRESB	Munich Reinsurance
Date of development, update	N/A	October 2020	August 2020	April 2020
Future scenario	1.5ºC/2ºC/3ºC	N/A	RCP2.6/4.5/8.5	RCP2.6/4.5/8.5
Data coverage	Extreme weather, floods, cyclones	Heat waves, wildfires, torrential rains, hurricanes and typhoons, sea level rises, floods	14 physical risks (details available after engagement), including floods, torrential rains, droughts, heat waves, earthquakes, and tsunamis	Acute: cyclones, floods Chronic: sea level rises, heat waves, torrential rains, wildfires, and droughts
Area coverage	Over 10,000 companies worldwide	Over 2,000 listed companies and about 1 million facilities worldwide	Whole world	Whole world
Period covered	N/A	2030-2040	up to 2100	up to 2100
Frequency	N/A	Quarterly data updates	50 years	50 years
Spatial resolution	Acute risk: 3 ” x 3 ” (90m cell) Chronic risk: 0.5° x 0.5° (50km cell)	90m x 90m	30m x 30m	30m x 30m
Data format	Two types of reports	The platform can output various forms of visual data	The platform can output various forms of visual data	CSV/Excel/PDF API connectivity

⇒ See pages 56-57 for related information.

9) Examples of Impact Monitoring and Measurement Indicators

- While the impact of mitigation activities is measured by common indicators (greenhouse gas emissions and sinks), there is no common monitoring and measurement indicators for adaptation. One or more indicators are set on a case-by-case basis to meet the objectives and environmental conditions of the activities. Some guidance and reports present monitoring and measurement indicators for adaptation, but they are merely examples.
- The following pages present such examples of major monitoring and measurement indicators for adaptation provided in CBI's "Climate Resilience Principles" and the "Report on Assessment of Impacts of Climate Change" of the MOE.

9) Examples of Impact Monitoring and Measurement Indicators

Sector	Indicators to assess adaptation investment in the CBI report	Impact assessment items in the “Report on Assessment of Impacts of Climate Change”
Agriculture	• additional capacity for agricultural potential • additional agricultural production • diversified agricultural income • % cropping area with less susceptible crops/varieties • % cropping area with integrated pest control measures • % cropping area with soil conservation measures	• production volume of farm products • quality of farm products • growing period of farm products • production volume of livestock and poultry • quality of livestock and poultry • status of animal infectious diseases • occurrence of pests and diseases • distribution of pests and diseases • status of agricultural production base (farmland, agricultural water, water facilities, etc.)
Forestry	• increased frequency of wildfires, fire risk • reduction in wildfires and associated loss of biodiversity, infrastructure, human life from wildfires • soil/ land or coastal erosion • biodiversity • reduced exposure of communities to typhoons • reduced evapotranspiration • increased soil carbon and nutrients • increases in timber yields • increased water catchment capacity	• net primary production of planted forests • frequency of wind damage in planted forests • distribution of pests and diseases • number of generations of pests • nociceptive power of the pathogen • production of log cultivation mushrooms

9) Examples of Impact Monitoring and Measurement Indicators

Sector	Indicators to assess adaptation investment in the CBI report	Impact assessment items in" the "Report on Assessment of Impacts of Climate Change"
Water resources	• reduction in flood damage costs of commercial facilities and residential property • reduction in service outages • reduction in insurance premiums • total number or length of sewerage and drainage networks at risk of flooding • reduced investment in the repair of sewer networks damaged by precipitation, rainstorms and/or flooding • reduced number of infectious disease patients during outbreaks following flooding • additional water made available	• river flow rate • water supply for agriculture, etc. • reservoir capacity of dams • salinization of fresh water
Energy	• annual probability of loss of power events • number of customers suffering loss of power • increased electricity production • reduced repair costs or decreased number of downed power lines during storms	• energy demand • hydroelectric power generation • damage to energy infrastructure
Buildings	• reduced damage to buildings and households • reduction in clean water demand • less infrastructure degradation due to heat • reduced demand for worker and resident cooling stations	• design conditions and standards to ensure the performance of buildings and construction sites • building materials and structural integrity of buildings • damage to infrastructure, etc.
ICT	• increase in flood-proof telecommunications assets • improved range and quality of warning systems • decreased number of residents requiring post-event evacuation	-

10) Trade-Offs with Other Environmental Objectives

- In implementing adaptation finance, it should be kept in mind that the activities of the organizations being financed, or the financing itself, may have trade-offs with other environmental objectives.
- Trade-offs with other environmental objectives need to be appropriately addressed based on the principles and guidelines of each financing scheme.

[Examples of trade-offs with other environmental objectives]

Sector	Actor's adaptation objective	Adaptation option	Real or perceived trade-off
Agriculture	Enhance drought and pest resistance; enhance yields	Biotechnology and genetically modified crops	• Perceived risk to public health and safety • Ecological risks associated with the introduction of new genetic variants to natural environments
	Suppress opportunistic agricultural pests and invasive species	Increased use of chemical fertilizer and pesticides	• Increased discharge of nutrients and chemical pollution to the environment • Adverse impacts of pesticide use on non-target species • Increased emissions of greenhouse gases • Increased human exposure to pollutants
Biodiversity	Facilitate conservation of valued species	Assisted migration	• Possible adverse impacts on indigenous flora and fauna from introduction of species into new ecological regions
Coasts	Provide financial assets with near-term protection from inundation and/or erosion	Sea walls	• High direct costs and opportunity costs • Equity concerns • Ecological impacts on coastal wetlands
	Minimize property damage and the risk of stranded assets	Migration out of low-lying areas	• Loss of sense of place and cultural identity • Erosion of kinship and familial ties • Impacts on receiving communities
Water resources management	Increase water resource reliability and drought resilience	Desalination	• Ecological risk of saline discharge • High energy demand and associated carbon emissions • Creates disincentives for conservation

Source) Created based on the IPCC 5th Assessment Report (Working Group 2 Report).

Examples of Adaptation measures

■ By analyzing the impact on the company's business activities and advancing efforts according to the characteristics of each, it is possible to promote climate change adaptation economically and effectively.

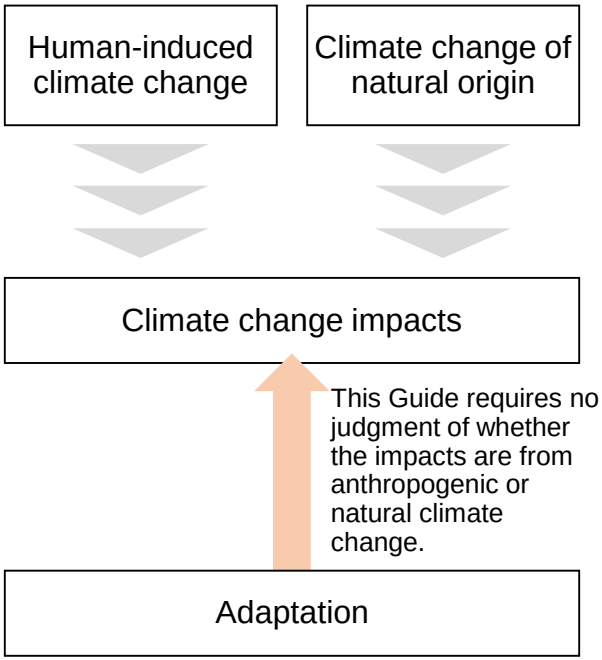
【Examples of adaptation measures by industry】

Industry	Examples of Adaptation measures
Finance	• Considering the risk of natural disasters such as floods when selecting the location of new stores • Formulate a BCP for each branch to ensure employee safety and continue service in the event of a natural disaster
Energy	• As the increase in warm winters may reduce energy demand such as heating in winter, diversification of business fields will reduce the risk of climate change
Real Estate	• Introduced highly efficient air-conditioning equipment in preparation for the use of air-conditioning and the increase in power consumption due to the heat wave in the future
Transportation	• Evaluate risks such as storm surges, sea level rise, floods, etc., and move warehouses and other bases to higher ground as necessary
Food	• Research and development on the possibility of introducing new varieties and tropical crops in collaboration with farmers
Manufacture	• Build a BCP that includes the supply chain to understand possible risks in advance and take a smooth initial response
Construction	• Consideration should be given to the construction plan, such as implementing the construction period when there is little rain, as the risk of damage to facilities under construction and construction delays is increasing

Source) Created based on the Ministry of the Environment “Climate Change Adaptation Guide for Private Sector - Preparing for Climate Risk and Surviving - ”.

Definition of "Climate Change Impacts”

- The Climate Change Adaptation Act defines "climate change impacts" as “impact from Climate Change that negatively affects human health and the living environment, causes a decline in biodiversity, and impacts daily life, society, the economy, and the natural environment in other ways”.
- It should be noted that there are two types of approaches to "climate change" in Japan and overseas.
  - The UNFCCC defines climate change as “change of climate which is attributed directly or indirectly to human activity” and does not consider climate change of natural origin.
  - On the other hand, the Climate Change Adaptation Act defines climate change as global warming originating from manmade emissions and natural climate variability. Similarly, the IPCC states in its 5th Assessment Report that “climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use”, concluding that it includes both human-induced climate change and that of natural origin.
- This Guide defines "climate change impacts" and "climate change" in accordance with the Climate Change Adaptation Act, and does not require the judgment of whether an individual event such as a strong typhoon or torrential rain is induced by human activity or natural climate variability such as El Niño-Southern Oscillation.



World Economic Forum, "the Global Risks Report 2021"

- “The Global Risks Report 2021” published in January 2021 by the World Economic Forum warns that climate change continues to be a catastrophic risk, and, after lockdowns related to COVID-19 are lifted, greenhouse gas emissions could increase again.
- The report also presents the findings of its analysis, stating that among the highest global risks, infectious diseases take the top spot, followed by “climate action failure”, and that among the highest likelihood risks are “extreme weather”, followed by “climate action failure”.

Rank	Top risks by likelihood	Top risks by impact
1	**Extreme weather**	Infectious diseases
2	**Climate action failure**	**Climate action failure**
3	Human environmental damage	Weapons of mass destruction
4	Infectious diseases	Biodiversity loss
5	Biodiversity loss	Natural resource crises
6	Digital power concentration	Human environmental damage
7	Digital inequality	Livelihood crises
8	Interstate relations fracture	**Extreme weather**
9	Cybersecurity failure	Debt crises
10	Livelihood crises	IT infrastructure breakdown

Source) Created based on World Economic Forum, "the Global Risks Report 2021".

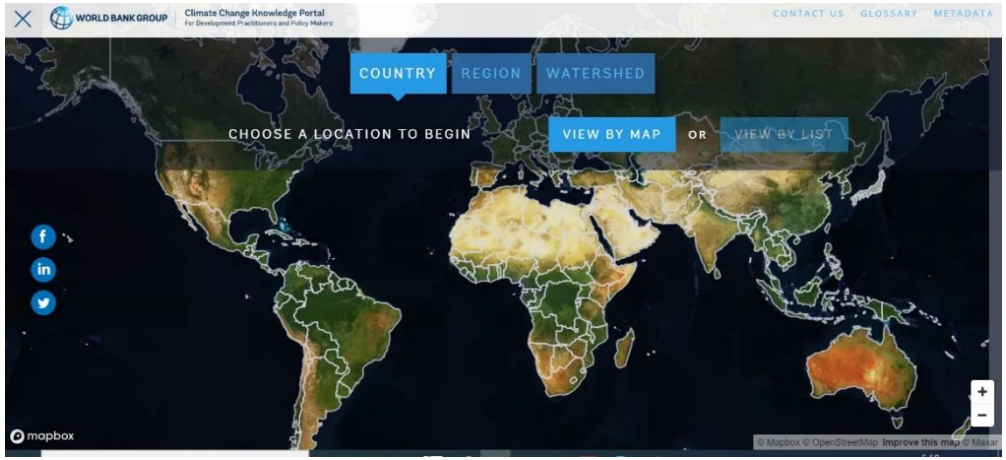
Differences from Disaster prevention and Resilience

- "Adaptation" and "disaster prevention" are similar concepts, but the former is characterized in relation to the objective of addressing climate change impacts.
  - According to the UN Office for Disaster Risk Reduction (UNDRR), disaster prevention activities and measures are intended to prevent new disaster risks, reduce existing disaster risks, and manage remaining risks, all of which can contribute to the enhancement of resilience and thus the achievement of sustainable development. (Source: the website of UNDRR)
  - The Basic Act on Disaster Management stipulates that the term "disaster" means damage resulting from a storm, tornado, heavy rainfall, heavy snowfall, flood, slope failure, mudflow, high tide, earthquake, tsunami, volcanic eruption, landslide, or other abnormal natural phenomena, or a large fire or explosion or other causes provided for by Cabinet Order and similar to the above with regard to the extent of damage they cause, and that the term "disaster management" means preventing a disaster preemptively, preventing the expansion of damage after a disaster has occurred, and recovering from a disaster. (Source: Article 2, items (i) and (ii) of the Basic Act on Disaster Management)
- As for the relationship with “resilience”, it includes responses to short-term shocks and long-term stressors and activities for recovery, whereas adaptation includes responses to existing climate change impacts, activities to reduce and prevent possible future impacts, and, as new opportunities, activities to restore the original state and transform or develop society and the economy in a sound manner.
  - The Global Real Estate Sustainability Benchmark (GRESB) defines resilience in its “2020 Resilience Module Reference Guide” as “the ability of an entity (i.e., organization or fund) to plan for, respond to, and rebound from short-term shocks and long-term stressors”.

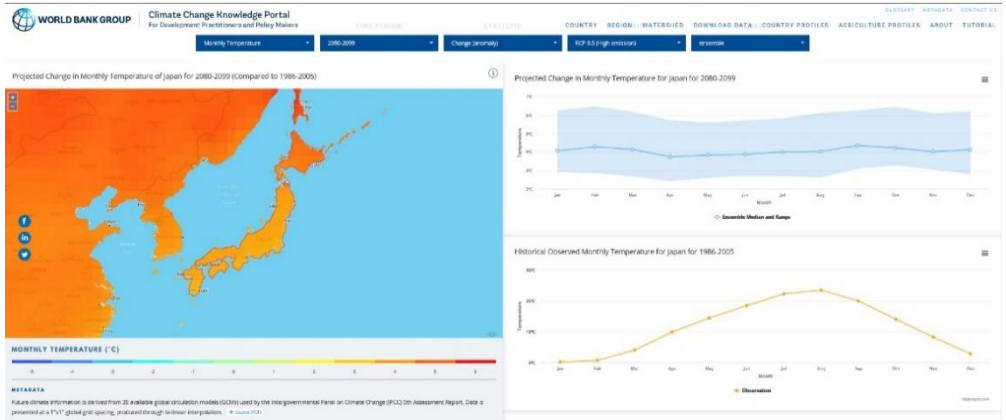
Climate Change Knowledge Portal (CCKP)

☞ https://climateknowledgeportal.worldbank.org/

- CCKP is an online data platform for climate change and development developed by the World Bank. It provides comprehensive information to a wide range of users and supports the use of scientific information in project design.
- The platform enables analysis of climate change impacts and projections in the energy, water resources, agriculture and health sectors. CCKP resources enable users to gain deeper insight by country and watershed.
- Data on annual temperatures and precipitation are downloadable in MS-Excel format.
- CCKP resources by country also feature links to official documents and external data on the country's climate change policies.



Top screen of the CCKP



Downloaded data for Japan
Historical temperatures (1986-2005) and projected temperatures (2080-2099)

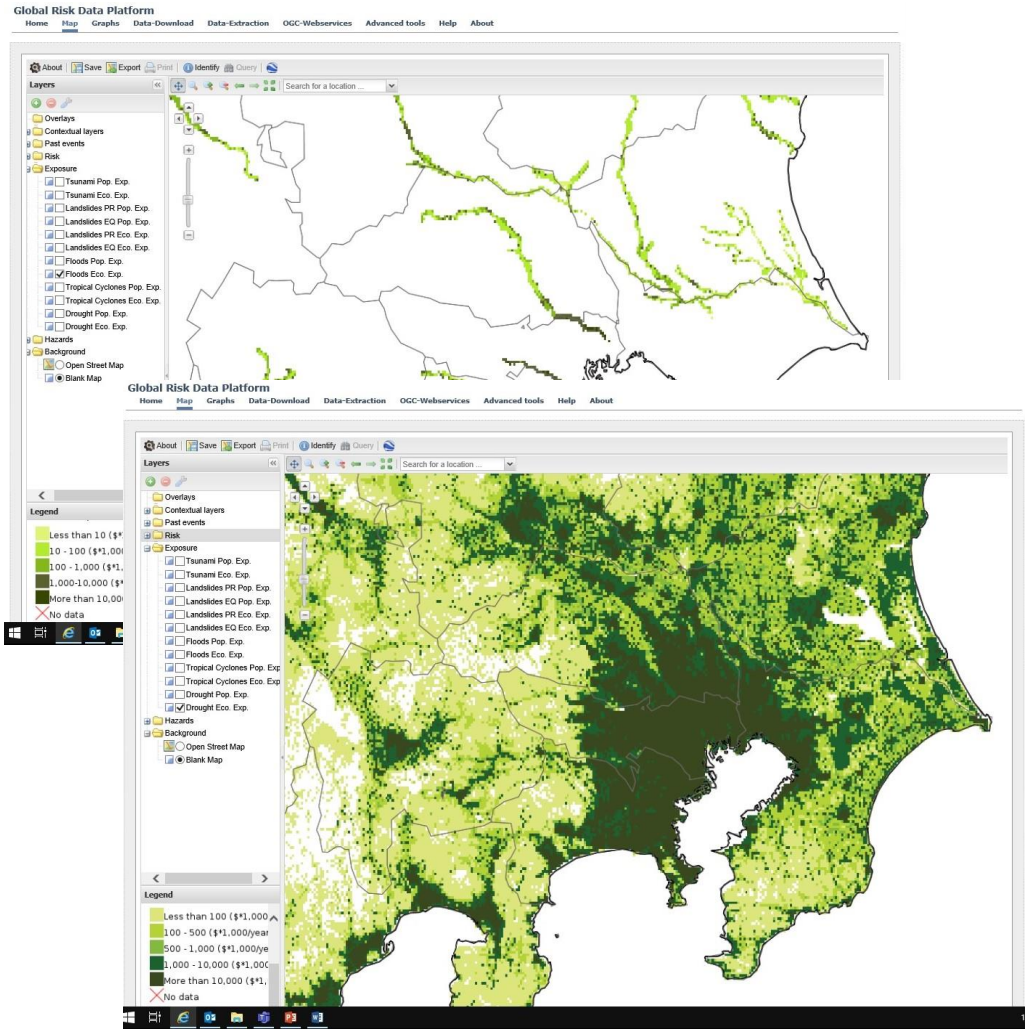
UNEP Global Risk Data Platform

☞ https://preview.grid.unep.ch/

- A platform for sharing spatial data information on natural disaster risks. Users can visualize online and download data on human and economic exposure to past disaster events.
- Hazard types and data periods are as follows.

Hazards	Data period
Cyclones - winds	1970-2015
Cyclones - surges	1975-2007
Droughts	1980-2001
Earthquakes	1970-2015
Forest fires	1995-2011
Floods	1999-2007
Earthquake-induced landslides	1970-2015
Tsunamis	1970-2015
Volcanoes	1970-2015

- Data on future projections are unavailable.



Spatial distribution of annual economic loss resulting from floods (top) and droughts (bottom) (Kanto region and surrounding areas)

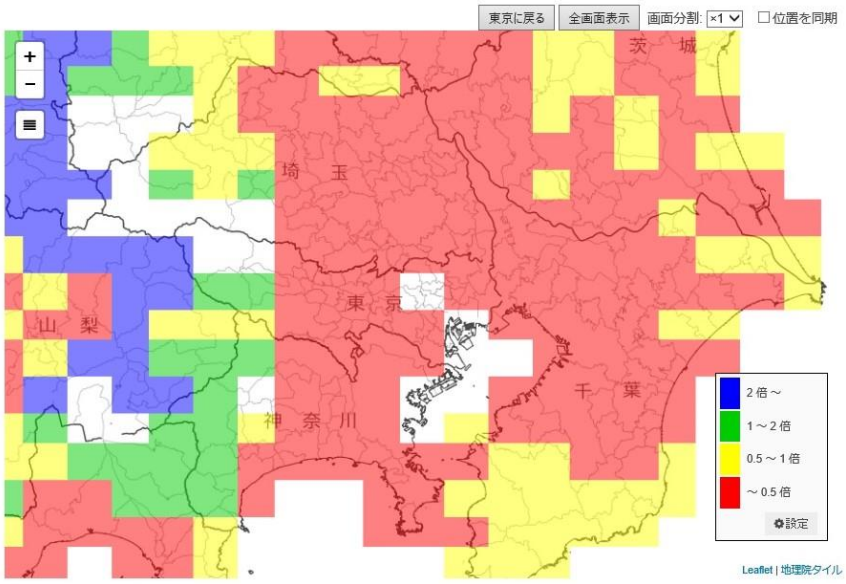
A-PLAT, Climate Change Adaptation Information Platform

☞ https://a-plat.nies.go.jp/webgis/index.html

- Based on results from four climate models used in the IPCC 5th Assessment Report and setting the period between 1981 and 2000 as the base period, the platform provides future projections for “mid-21st century” (2031-2050) and “late 21st century” (2081-2100) as GIS data.
- The platform covers Japan only. The areas covered and assessment indicators are as follows.

Area	Assessment indicators
Agriculture	• Rate of change in rice yield
Water environment and water resources	• Rate of change in chlorophyll a concentration
Ecology system	• Potential forest habitat
Natural disasters and coastal areas	• Probability of slope failure • Rate of beach loss
Health	• Habitat of Aedes albopictus (Asian tiger mosquito) • Rate of change in the number of persons hospitalized due to heatstroke • Rate of change in excess deaths due to heat stress

- Parameters such as climate models and emission scenarios can be customized, and data for user-specified metrics can be output in the form of maps or graphs.



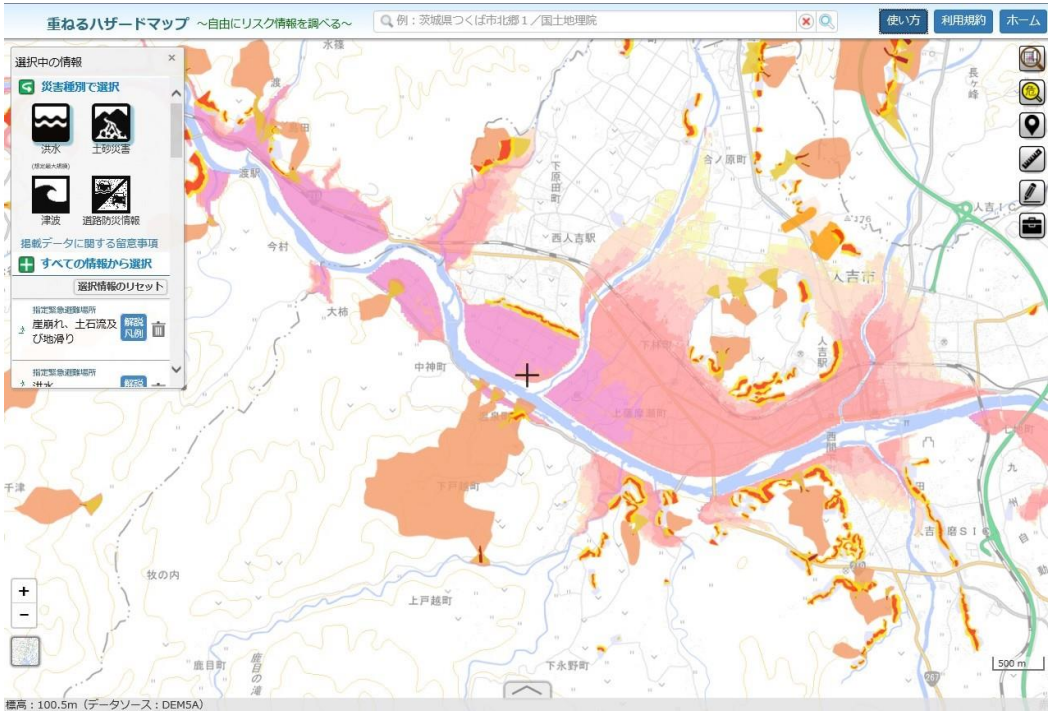
Rate of change in rice yield under RCP8.5 at the end of the 21st century
(Kanto region and surrounding areas)

Note) The figure shows yields of varieties with a low risk of quality deterioration due to high temperatures.
The total yields, including those with a high risk of quality deterioration, are on an upward trend.

MLIT Hazard Map Portal

☞ https://disaportal.gsi.go.jp/index.html

- A portal site for hazard maps published by the Ministry of Land, Infrastructure, Transport and Tourism. Users can browse various disaster risk information and hazard maps created by municipalities across Japan.
- Users can also freely superimpose information on the risk of floods, landslides, storm surges, and tsunamis, information on road disaster prevention, and the characteristics and formation of land on maps and photographs.



Areas at high risk of flooding and landslides (Hitoyoshi City and surrounding areas)

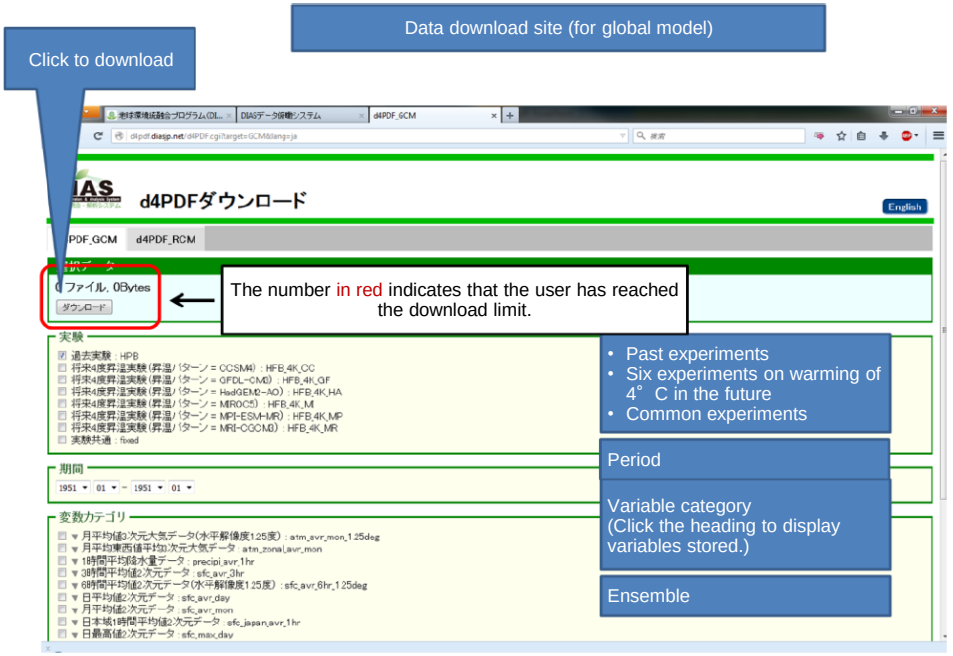
[Disaster risk information on the website]

- Expected flood inundation area: areas expected to be inundated by river flooding and water depth
- Expected tsunami inundation area: areas expected to be inundated by a tsunami and water depth
- Expected surge inundation area: areas expected to be inundated by a surge and water depth
- Sediment disaster prone area: areas with a risk of sediment disasters
- Expected inundation area due to reservoir failure: areas with a risk of reservoir failure

Ensemble Climate Prediction Database (d4PDF)

- A database created under the Program for Risk Information on Climate Change of MEXT and financed by a fund program of the Japan Agency for Marine-Earth Science and Technology and the Earth Simulator.
- The database is expected to be used for research on disaster prevention, and for impact assessment and the formulation of global warming countermeasures by national and local governments, and industries. In October 2020, SOMPO Risk Management Inc. started a service using this dataset.
- Users can, after account registration, download d4PDF metadata (tar file) on the Data Integration and Analysis System "DIAS" (http://www.diasjp.net/).
- The most convenient way to use d4PDF datasets is to use the Grid Analysis and Display System (GrADS)*, which is widely used for analyzing and visualizing weather and climate data.

☞ https://diasjp.net/service/d4pdf-data-download/



d4PDF data download site (image)
Source) Excerpt from the d4PDF User's Guide.

Downloadable data:

Surface air data, thermodynamic-related two-dimensional data, soil-related data, atmospheric three-dimensional data, and altitudinal and land-sea distribution data

* openGrADS http://opengrads.org/
* GrADS−Note http://seesaawiki.jp/ykamae_grads-note/

Others

MSCI Real Estate Climate Value-at-Risk

☞ https://www.msci.com/scenario-analysis

- A tool developed by MSCI ESG Research to assess climate-related impacts on corporate valuations.
- The tool covers the following climate risks.
  - Transition risk: risks arising from laws and regulations accompanying the decarbonization of countries
  - Physical risk: risks arising from weather disasters, such as extreme events (heat wave, cold wave, etc.), floods, and cyclones.
- The tool is intended for over 10,000 corporate and individual real estate assets around the world. Major clients include asset management companies, banks, asset owners, insurance companies and other financial institutions.
- Users who have contracted with MSCI can have paid access to the tool, reporting and other services.

Four Twenty Seven

☞ https://427mt.com/

- Founded in 2012, Four Twenty Seven develops and provides data, market intelligence and analysis related to physical climate and environmental risks. Headquartered in Berkeley, California, the company also has offices in Washington D.C., Paris, and Tokyo. The company became affiliated with Moody's Corporation, a US bond credit rating business, in 2019.
- Four Twenty Seven offers sensitivity analysis for physical risks at corporate production and sales bases, such as heat waves, forest fires, heavy rain, hurricanes, typhoons, sea level rises, and floods. The database covers more than 2,000 listed companies and 1 million corporate facilities worldwide.
- Users can, after contracting with 427 companies, receive risk analysis and reporting services, as well as various other services ranging from data licensing to analytics tools (online app), corporate scoreboards, scenario analysis, and risk analysis of real estate and infrastructure.
- Major clients include portfolio managers, asset owners, and financial institutions.

Others

Climate Risk Platform

☞ https://gresb.com/climate-risk-platform/

- An online platform launched by the Global Real Estate Sustainability Benchmark (GRESB), which provides ESG evaluation information to companies and funds in the real estate sector.
- The platform targets real estate with a total asset value of ¥450 trillion and infrastructure fund assets in over 500 locations, and provides impact assessment information related to 14 physical risks, including floods, torrential rains, droughts, heat waves, and earthquakes and tsunamis. Datasets are obtained primarily from Munich Re.
- The datasets can be applied to various analysis axes, such as scenarios, periods and risk areas.
- Users can, after contracting with GRESB, receive paid reports and other services. The fee is determined in proportion to the number of assets to be covered.
- The platform enables users to output reporting in formats compatible with the TCFD information disclosure rules.

Location Risk Intelligence

☞ https://www.munichre.com/en/solutions/for-industry-clients/location-risk-intelligence/climate-change-edition.html

- In 2017, Munich Reinsurance established a business unit, “Risk Management Partners,” to develop risk-related business models. The unit has developed and created databases that can display disaster risk information on maps.
- Their databases have three editions - natural hazard, climate change, and wildfire HD. The climate change edition has the following features.
  - Users can display 12 hazard maps and four risk scores with one click.
  - Users can also upload and analyze their corporate portfolio data in CSV format.
  - After contracting with Munich Re., they can access paid systems, and upload and download data.

Reputation Risk

- Adaptation finance is by no means exclusive and is often treated together with disaster prevention finance and mitigation finance, but "response to the impacts of climate change" must be clearly included in the objective.
- If financing is positioned as adaptation financing, though it has no clear relationship with climate change impacts, or though it is for activities for which adaptation is hardly expected as the expected impact, the business concerned may be criticized as overestimating the impacts and face a reputational risk.
- The following financing may not fall under the category of adaptation finance.
  - Investments and loans for projects to build roads and bridges to meet urban traffic needs
  - Investments and loans for infrastructure projects to enhance local earthquake resistance to deal with risks of potential large earthquakes
  - Agricultural loans to meet growing food demand, etc.

Current Discussions on Trade-Offs with Other Environmental Objectives

■ Trade-offs with other environmental objectives are an important topic for discussion in international schemes. Yet, specific methodologies to evaluate them are still under development.

■ Climate Bonds Initiative(CBI)

- In September 2019, the CBI established the Climate Resilience Principles. One of the Principles is the requirement for policy designs that adequately account for “mitigation trade-offs” in order to screen adaptation financing in conformity with CBI certification.
- However, the principle cites that mitigation requirements may be lowered or considered inconsequential for climate resilience focused assets or activities whose resilience benefits considerably outweigh associated emissions.
- Discussion is ongoing as to a set of rules to determine under what circumstances such a trade-off might be permitted and the nature of the trade-off analysis in such circumstance. As for the nature of trade-off analysis, some options are still under discussion, such as exceptions to the assessment requirements based on location (areas with high climate resilience risks and needs) and based on inclusion on a list of exempt activities.

■ EU Taxonomy

- The EU Taxonomy seeks to ensure that economic activities that contribute substantially to adaptation do not cause significant harm to environmental objectives other than adaptation (“the Do No Significant Harm (DNSH) principle”).
- The environmental objectives covered by the Taxonomy Regulation, other than adaptation, are (1) climate change mitigation; (2) sustainable use and protection of water and marine resources; (3) circular economy; (4) pollution prevention and control; and (5) protection and restoration of biodiversity and ecosystems.
- For economic activities that pose a risk of significant harm to the above five environmental objectives, DNSH requirements for the five environmental objectives will be established for each activity (currently, the draft is under consideration).

12) Links

- Impacts and projections of climate change
  - 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; and Japan Meteorological Agency, “The Synthesis Report on Observations, Projections and Impact Assessments of Climate Change, 2018”. <http://www.env.go.jp/earth/tekiou/report2018_full.pdf> (in Japanese)
  - Ministry of the Environment, “Report on Assessment of Impacts of Climate Change”. <https://www.env.go.jp/press/108790.html> (in Japanese)
  - Ministry of Education, Culture, Sports, Science and Technology and Japan Meteorological Agency, “Climate Change in Japan 2020 - Report on Observations and Projections Assessment on Atmosphere, Land, and Oceans”. <https://www.data.jma.go.jp/cpdinfo/ccj/index.html> (in Japanese)
  - Working Group II, Intergovernmental Panel on Climate Change (IPCC), “Climate Change 2014: Impacts, Adaptation, and Vulnerability”. <https://www.ipcc.ch/report/ar5/wg2/>
  - Goldman Sachs, “Taking the Heat: Making Cities Resilient to Climate Change”. <https://www.goldmansachs.com/insights/pages/gs-research/taking-the-heat/report.pdf>
  - World Economic Forum, “The Global Risks Report 2021”. <http://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2021.pdf>
- Laws, regulations, and policies
  - Climate Change Adaptation Act (summary) <http://www.env.go.jp/earth/tekiou/tekiouhou_gaiyou.pdf> (in Japanese)
  - Climate Change Adaptation Act (provision) <http://www.env.go.jp/earth/tekiou/tekiouhou_jyoubun_r1.pdf> (in Japanese)
  - Joint message on “Climate Change x Disaster Prevention Strategy” <https://www.env.go.jp/press/files/jp/114189.pdf> (in Japanese)

12) Links

- Related guides in Japan
  - Ministry of the Environment, “A Guide to Climate Change Adaptation for Private Companies: Preparing for and Surviving Climate Risks”. <http://www.env.go.jp/earth/minkann2.pdf> (in Japanese)
  - Ministry of the Environment, “A Practical Guide to ESG Regional Finance”. <http://www.env.go.jp/policy/ESG%E5%9C%B0%E5%9F%9F%E9%87%91%E8%9E%8D%E5%AE%9F%E8%B7%B5%E3%82%AC%E3%82%A4%E3%83%89.pdf> (in Japanese)
  - Ministry of the Environment, “Findings from Case Studies on ESG Regional Finance”. <http://www.env.go.jp/seisaku/list/keizai/pdf/ESG_report201903.pdf> (in Japanese)
- International principles, guidelines, etc.
  - CBI, “Climate Resilience Principles”. <https://www.climatebonds.net/files/page/files/climate-resilience-principles-climate-bonds-initiative-20190917-.pdf>
  - GRESB, “2020 Resilience Module Reference Guide”. <https://documents.gresb.com/generated_files/survey_modules/2020/resilience/reference_guide/complete.html>
  - UNEP FI, “Navigating a new climate: Assessing credit risk and opportunity in a changing climate”. <https://www.unepfi.org/publications/banking-publications/navigating-a-new-climate-assessing-credit-risk-and-opportunity-in-a-changing-climate/>