Issues Surrounding Climate Change and Green Finance —Realization of a Green Recovery Is Imperative—

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Summary

1. Although global greenhouse gas (GHG) emissions in 2020 are believed to have decreased by approximately 7% from the previous year due to the novel coronavirus (COVID-19) pandemic, it will still be extremely difficult to achieve the Paris Agreement targets in the long run. It is said that there is little time left for us to implement emission reduction measures, and going forward, the expansion of renewable energy, reduction of coal use, improvement of energy efficiency, electrification in areas such as transportation, and decarbonization efforts in energy-intensive industries must be rapidly promoted.

2. Under these circumstances, the importance of green finance, which provides funds for environment-related projects, is also increasing. Expanding green finance requires three steps: 1) increasing the supply of green investment projects; 2) increasing the supply of funds to implement green finance; and 3) creating a framework for smooth implementation of green finance. These should be linked to the realization of steady financing in each field of green finance, namely infrastructure including renewable energy, improvement of energy efficiency, food, agriculture and land use.

3. ESG investment, which is considered to be part of green finance, is expanding globally and will continue to do so. However, in the face of the pandemic, the emphasis on environmental factors seems to have been reconsidered somewhat and the focus is shifting to social factors, so it is important to keep a close watch on future trends. In addition, ESG investment in Asia lags behind that in Europe and the United States, and efforts must be made to catch up.

4. The risks associated with climate change are divided broadly into physical risks and transition risks. It is essential that companies and financial institutions accurately analyze these risks and make efforts to reduce them. Central banks should also encourage financial institutions to manage and control climate-related and environmental risks appropriately.

5. The Task Force on Climate-related Financial Disclosures (TCFD) is leading the effort to disclose environment-related information to promote the expansion of green finance. In addition, the classification of economic activities (taxonomy) needs to be discussed internationally. Furthermore, although the introduction of carbon pricing is politically difficult, it is considered essential to achieve GHG emissions reduction, and it is important to deepen discussions on this issue.

6. The importance of a "green recovery," which simultaneously realizes economic recovery and climate change control in the post-pandemic world, has been emphasized, but it has not been realized in countries other than European countries. Even under the difficult circumstances posed by the pandemic, countries around the world are required to steadily promote measures to curb climate change.

Introduction

The movement to reduce greenhouse gas (GHG) emissions is becoming a global trend. This paper aims to confirm what measures are necessary to reduce emissions, and what we should do for this purpose from the viewpoint of green finance. This will be discussed as comprehensively as possible with a focus on the issues and key points for controlling climate change and promoting green finance. Trends in Asia will also be mentioned as appropriate.

The structure of this paper is as follows. In Section 1, the current situation of climate change issues (the current situation of GHG emissions) is explained, and it is indicated that the achievement of the goals set out in the Paris Agreement will be difficult. Then, necessary measures in each field will be described. Section 2 summarizes the importance of boosting the supply of investment projects, increasing the sources of financing, and establishing mechanisms to facilitate financing in order to expand green finance. Section 3 evaluates the impact of the pandemic on ESG investment, which is part of green finance, in particular changes in the attitudes of issuers and investors, and the shift in emphasis from environmental factors to social factors. Section 4 describes the necessity of identifying environmental risks and strengthening risk management, as well as the requirements for central banks and financial institutions. Section 5 explains information disclosure, classification of economic activities (taxonomy) and carbon pricing, which are necessary to promote green finance. Section 6 describes how developed and emerging countries are working to balance economic recovery in the post-pandemic world with climate change control.

1. Current Status of Climate Change Issues

(1) Trends in GHG Emissions

1) Current Status on a Global Basis and by Region and Sector

The Paris Agreement, concluded at COP21 in December 2015, set a goal of limiting the increase in average global temperature over the course of this century well below 2°C compared to pre-industrial levels, and of striving to limit it to below 1.5°C as an effort target. For this to happen, it is necessary to peak global GHG emissions as soon as possible and achieve a climate change neutral world by the middle of this century.

Global GHG emissions continued to rise steadily, increasing at an average annual rate of 1.4% over the 10 years to 2019. In 2019, global GHG emissions were up 1.1%. However, taking into account the changes associated with land-use change (LUC), which is highly uncertain and highly variable, the actual increase in 2019 was 2.6%. This is because forest fires increased markedly in Asia and the Amazon.

GHG emissions in 2019 were 52.4 Gt CO_2 equivalent when excluding LUC and 59.1 Gt CO_2 equivalent when including LUC. Looking at the breakdown, fossil fuel-derived CO_2 accounts for more than 70% of total emissions (Table 1, Table 2). Key GHG emissions other than CO_2 are methane gas (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs), in descending order. All GHG emissions are steadily increasing. The background to the increase in CO_2 emissions is the steady rise in energy consumption.

Looking at global GHG emissions by country over the past 10 years, China, the United States, the 27 EU countries and the United Kingdom, and India account for 55% of the total (the ratios were 26%, 13%, 8.5% and 7%, respectively.). Meanwhile, the members of the Group of 20 (G20) accounted for 78% of the total.

Although per capita emissions in developed countries have become high in line with eco-

Table 1 GHG Emissions by Type

	Emissions in 2019 (Gt CO_2 equivalent)	Share of emissions between 2010 and 2019 (%)	Emissions growth between 2010 and 2019 (%, annual average)	Emissions growth in 2019 (%)
Fossil fuel-derived CO_2	38.0	65.0	1.3	0.9
Methane gas (CH_4)	9.8	17.0	1.2	1.3
Nitrous oxide (N_2O)	2.8	4.9	1.1	0.8
Chlorofluorocarbons (CFCs)	1.7	2.6	4.7	3.8
Subtotal	52.4(±5.2)	89.0	1.4	1.1
Land-use change (LUC)-derived CO_2	6.3	10.0	1.3	13.3
Land-use change (LUC)-derived CH_4 and N_2O	0.5	0.5	3.7	84.6
Total	59.1(±5.9)	100.0	1.4	2.6

Source: United Nations Environment Programme [2020], p.5.

Table 2 Countries with Largest GHG Emissions

	Emissions in 2019 (Gt CO_2 equivalent)	Per capita emissions in 2019 (metric ton CO_2 equivalent)	Share of emissions between 2010 and 2019 (%)	Emissions growth between 2010 and 2019 (%, annual average)	Emissions growth in 2019 (%)
China	14.0	9.7	26.0	2.3	3.1
United States	6.6	20.0	13.0	-0.1	-1.7
27 EU countries and United Kingdom	4.3	8.6	9.3	-1.1	-3.1
India	3.7	2.7	6.6	3.3	1.3
Russia	2.5	17.4	4.8	1.0	0.8
Japan	1.4	10.7	2.8	0.1	-1.6
International transportation	1.4	—	2.5	2.3	2.9
Total	52.4(±5.2)	6.8	65.0	1.4	1.1

Notes: Land-use change (LUC)-derived GHG emissions are not included in this table.
Source: United Nations Environment Programme [2020], p.5.

nomic growth, per capita emissions in many developed countries are now on a downward trend due to their efforts to reduce coal use. Emerging economies, on the other hand, are increasing their energy consumption due to their relatively high economic growth rates, and CO_2 emissions are increasing at a pace slightly faster than energy consumption. This is a major contributor to increased GHG emissions.

The ratios of GHG emissions by sector over the past 10 years were 41% for the energy sector, 20% for the industry sector, 14% for the transportation sector, 15% for the agricultural and waste sectors, and 11% for land-use change (LUC) (Table 3). GHG emissions have been increasing in all sectors, but the growth in the ratio of electricity generation and heating in the energy sector (24% of the total) has been slowing due to the rapid expansion of renewable energy and the decline in coal

Table 3 Ratios of GHG Emissions by Sector (2010-2019)

(%)

Energy	Power generation, heating	24	41
	Other energy conversion	10	
	Fugitive emissions		
	Buildings, etc.	7	
Industry	Energy usage	11	20
	Mining products	9	
	Other industrial processes		
Transportation	Road	14	
	Other than road		
	International transportation		
Agriculture	Enteric fermentation	15	
	Agricultural soil		
	Others		
Waste			
Land-use change (LUC)		11	

Notes: Although the ratios are based on the source, the total comes to 101%.
Source: United Nations Environment Programme [2020], p.8.

usage.

There is no clear definition of land-use change (LUC), and there are many data sources. In this regard, the main emitters are Brazil, Indonesia and the Democratic Republic of the Congo. Potential emitters (countries with significant forestry resources, etc.) include China, Russia, the United States and Brazil. The actions of these countries will have a great impact.

2) Long-term Trends and Impact of the COVID-19 Pandemic

Global GHG emissions growth has declined moderately, with average annual growth rates of 2.4% for 2000-2009, 2.2% for 2010-2014, and 1.2% for 2015-2019.

It is not exactly clear yet how much GHG emissions were reduced in 2020 as a result of the novel coronavirus (COVID-19) pandemic, but some estimates suggest that CO_2 emissions were reduced by about 7% (with a range between 2-12%). Assuming that other GHG emissions were less affected than CO_2 emissions, overall GHG emissions are estimated to have declined slightly less than 7%[(1)]. While there is great uncertainty, one thing which is clear is that the biggest changes were witnessed in the transportation sector, such as airline services.

(2) Emissions Gap

1) Current Emissions Gap and Impact of the COVID-19 Pandemic

Next, let's look at the 2030 emissions gap update based on the United Nations Environment Programme [2020]. This gap is the difference between the projected GHG emissions in 2030 that would be realized if certain policies were implemented and the emissions (targets) in 2030 that should be realized to achieve the goal of limiting temperature increases. Specifically, GHG emissions as of 2030 are estimated based on the cases 1) where current climate change measures are maintained; 2) where non-conditional Nationally Determined Contributions (NDCs: climate change measures developed and determined by countries within the framework of the Paris Agreement) are implemented; and 3) where all NDC measures are implemented, and gaps are estimated in comparison with the GHG emissions targets to limit the temperature rise at the end of this century (compared to pre-industrial levels) to 2.0°C or less, 1.8°C or less, and 1.5°C or less (Table 4).

According to these results, to achieve the target of limiting warming to 2°C or less, the current efforts must be increased by 3 times, and to achieve the target of limiting warming to 1.5°C or less, they must be increased by 5 times or more. Table 5 shows the acceptable CO_2 emissions to achieve the target of limiting warming to 2.0°C or less, 1.8°C or less, and 1.5°C or less.

Although the future of the pandemic is uncertain, measures that could increase GHG emissions may be taken in order to boost the economy, and it is pointed out that there is a risk that climate change measures will be reversed[(2)]. It is essential to promote a green recovery with an emphasis on climate change measures in order to close the emissions gap.

Table 4 Estimated 2030 Emissions Gap (Gt CO_2 Equivalent)

				GHG emissions that must be realized under each temperature rise scenario		
				2.0°C or less	1.8°C or less	1.5°C or less
				41	35	25
				↓	↓	↓
Emissions to be realized under each policy	Maintain the current measures	59	→	17	24	34
	Implement unconditional NDCs	56	→	15	21	32
	Implement all NDCs	53	→	12	18	29

Source: United Nations Environment Programme [2020], p.26.

Table 5 Acceptable CO_2 Emissions (by Scenario)

(Gt CO_2)

Scenario	2018-The year in which CO_2 emissions are reduced to net zero	2018-2100
2.0°C or less	900-1,300	1,200
1.8°C or less	600-900	900
1.5°C or less	600 or less	380

Source: United Nations Environment Programme [2020], p.30.

2) Meaning of Emissions Gap[3]

As noted above, the current policies will not close the 2030 emissions gap. Immediate action is crucial to achieving a low-carbon society by 2050.

The Paris Agreement aims to reduce CO_2 emissions to net zero by the second half of this century. As noted in the IPCC [2018], achieving the 1.5°C target requires net zero global CO_2 and GHG emissions, respectively, in 2050 (range 2046-2055) and 2067 (range 2061-2084). And, as is clear from the above descriptions, the goal of the Paris Agreement will certainly not be achieved without adopting emission reduction measures that are significantly more ambitious than they are now. Referring again to Table 4, limiting the temperature rise to 1.5°C or less requires GHG emissions to be held to the levels below 25 Gt CO_2 equivalent. Experts agree that significant climate change action is essential by 2030.

Even if all NDCs are implemented, the temperature rise at the end of this century is projected to be around 3.0°C, which means that warming will continue without stabilization. In 2020, the world's major countries announced that they would reduce their CO_2 emissions to net zero in 2050 or 2060. These efforts could reduce temperatures by an estimated 0.6-0.7°C by the end of this century, but current NDCs are completely inadequate to meet the Paris Agreement targets.

(3) Measures and Investment Required for Tackling Climate Change Issues

1) Global Discussions[4]

Major sources of GHG emissions include power generation, manufacturing, construction, agricultural land use, and transportation. In response, measures to reduce emissions include switching from high-carbon to low-carbon energy sources, improving energy efficiency (for manufacturing, construction, and transportation), and changing land use.

The energy sector plays a central role in reducing emissions, and it is necessary to fundamentally change the way energy is produced and consumed. Energy demand is expected to increase by 30% by 2040, and it is essential to improve energy efficiency.

Currently, 81.3% of energy demand is covered by coal, oil and natural gas, and the reduction of energy-related GHG emissions cannot be realized at this rate. In order to reduce GHG emissions, it is mandatory to expand renewable energy, improve energy efficiency, and promote electrification in various end usages such as transportation and building heating. Therefore, the following paragraphs will focus on: 1) expansion of renewable energy and reduction/abolition of coal use in the energy sector; 2) decarbonization in the transportation sector; and 3) decarbonization in energy-intensive industries.

First, regarding decarbonization in the energy sector, there are three pillars from the technological perspective: 1) significant expansion of power generation using renewable energy; 2) more efficient and flexible power distribution; and 3) electrification of products and processes in the construction, transportation, and industrial sectors. The necessary technologies are already in place to a considerable extent, and it should be possible to reduce energy-related CO_2 emissions in the short term.

Renewable energy is growing rapidly, reaching a 12.9% share of power generation in 2018. Still, the pace of expansion will have to be six times faster than it is now to meet the Paris Agreement

Table 6 Road Map to Realize the 2°C Target Under the Paris Agreement

	2010	2017/2018	2030	2040	2050
Ratio of electricity in final energy consumption (%)	18	20	29	38	49
Ratio of renewable energy in power generation (%)	20	25	57	75	86
Addition of solar power generation (GW/year)	17	109	300	355	360
Addition of wind power generation (GW/year)	31	54	200	210	240
Number of electric vehicles (EVs) (Million units)	Less than 0.5	6	157	745	1,166
Oil demand (Million barrels/day)	87	95	60	41	22
Natural gas demand (Billion cubic meters/year)	3,307	3,752	4,000	3,400	2,250
Coal demand (Mt/year)	4,963	5,357	3,190	2,000	713

Source: IRENA (International Renewable Energy Agency) [2019], pp.20-21.

targets.

This expansion has been driven by sustained cost reductions. In most parts of the world today, the cost of generating electricity from renewable energy sources is among the lowest compared to other means. Costs are expected to continue to decline for the foreseeable future.

Renewable power generation (especially wind and solar power) is fundamentally dependent on natural conditions and is relatively unstable. Therefore, it is important to provide flexible power supply systems. The cost of building such a system, however, is modest. In fact, some countries (such as Costa Rica, Denmark, Ireland and Uruguay) are providing 100% of their electricity from renewable sources for the short term.

Expanded use of renewable energy and electrification will account for 75% of the reduction in energy-related GHG emissions needed to meet the target of limiting warming to 2°C or less. However, to achieve this, the share of renewable energy in power generation will have to increase from 25% in 2017 to 86% in 2050 (in which wind power generation will account for one-third or more and solar power generation will account for 25% of the total), and the share of electricity in final energy consumption will have to increase from 20% to 49% over the same period (Table 6)[(5)]. Bioenergy is also expected to expand (Table 7).

In other words, clean electricity will become the primary fuel, with smart digital technologies to make the most of renewable energy.

Meanwhile, coal has remained as a major problem. As of 2018, coal accounted for 30% of CO_2 emissions, 27% of primary energy supply, and 40% of power generation[(6)]. Much of the increase in demand for coal is concentrated in Asia. In addition, the rapid increase in demand for electricity makes decarbonization in the energy sector difficult, so it is important to improve energy efficiency.

Table 7 Target Composition of Final Energy Consumption (As of 2050)

(%)

	2017	2050 (In case of aiming to achieve the Paris Agreement targets)
Coal	14	3
Natural gas	14	10
Oil	37	13
Electricity	20	49
Renewable energy in electricity	25	86
Conventional biomass	7	0
New biomass	4	16
Other renewable energy	0.5	4
District heating	3	5
Renewable energy in district heating	8	77

Source: IRENA [2020], p.72.

Second, let's look at decarbonization in the transportation sector. As shown in Table 3, GHG emissions in the transportation sector account for 14% of the total, and have increased rapidly with economic growth, behavioral changes, and population growth. The transportation sector accounts for 65% of global oil demand, making it the least diversified sector of final energy consumption. Key decarbonization measures in this sector include compact urban planning, curbing passenger travel demand, expanding public transport, im-

proving passenger car efficiency and expanding the number of electric vehicles, increasing cargo logistics and cargo vehicle efficiency, and promoting electrification of cargo vehicles.

The expansion of the number of electric vehicles is considered to be a major countermeasure. Cumulative sales of electric vehicles from 2010 to 2018 exceeded 5 million units, with a market share of around 2.1%. Decarbonization will require an increase in the share of electricity in the transport sector's final energy mix from the current 1% to 40% by 2050 (assuming that the majority of electricity is generated from renewable sources). While air pollution is a serious health hazard in China and India, widespread use of electric motorcycles and tricycles, as well as the ripple effect thereof on automobiles, are expected in India, for instance.

Third, decarbonization in energy-intensive industries (steel, cement, etc.) will be examined. These sectors account for about 17% of energy and industrial CO_2 emissions. However, decarbonization is technically very difficult.

Demand for these industries is expected to remain at a high level, and drastic measures are required. However, there are very few policy options available in these sectors toward achieving zero carbon. There seems to be no other way but to strongly promote policies as part of climate change measures under the leadership of the government.

2) Insufficient NDCs[7]

Under the current NDCs, only 85 countries have unconditional plans for renewable energy, and renewable power capacity is expected to increase from about 2.3 terawatts today to only 3.2 terawatts in 2030. Achieving the goals of the Paris Agreement will require a renewable power capacity of 7.7 terawatts in 2030, and countries will have to make the content of their NDCs more ambitious.

3) Necessary Investments[8]

Governments plan to invest at least 95 trillion dollars in energy systems over the next 30 years, but not all investments are consistent with decarbonization. According to IRENA [2020], by 2030 about 10 trillion dollars will need to be shifted from fossil fuels and related infrastructure to low-carbon technologies.

In other words, while approximately 60 trillion dollars of energy-related investments will be made by 2030, 9.6 trillion dollars will need to be devoted to expanding renewable power generation (Table 8). This means that the annual amount would increase from 289 billion dollars in 2018 to 676 billion dollars.

Investment through 2050 is also shown in Table 8. To achieve this, investment in power generation facilities using renewable energy will need to be twice the current projected amount, and investment in improving energy efficiency will need to be more than four times the current amount (1.1 trillion dollars per year).

If these investments achieve the desired scenario, costs of 65-157 billion dollars per year associated with climate change could be avoided. If the costs are realized, they must be borne by banks and governments. Delayed energy conversion is estimated to result in additional stranded assets (assets that have become obsolete and have lost value due to the implementation of climate change measures) of 7.7 trillion dollars by 2050.

Table 8 Investment Required to Achieve the Paris Agreement Targets

(Trillion dollars)

	2016-2030	2016-2050
Energy efficiency	29	37
Renewable energy (power generation)	9	22
Renewable energy (end use)	1	2
Electrification	4	13
Power generation equipment	4	13
Biofuels	0.8	2
Hydrogen	0.2	0.6
CO_2 capture and storage, etc.	0.2	0.4
Fossil fuels (supply)	9	16
Fossil fuels (power generation)	2	3
Nuclear power	0.4	1
Total	60	110

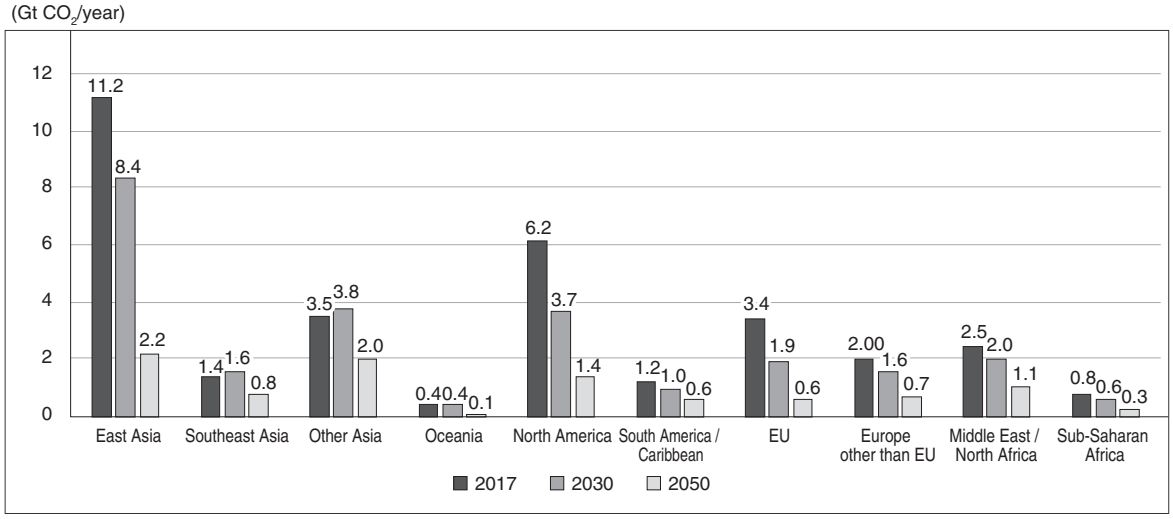
Source: IRENA [2020], p.95, p.97.

(4) Summary of Countermeasures

The estimated regional scenarios and required investment amounts are shown in Fig. 1 and Table 9. As of 2017, energy-related CO_2 emissions were the highest in East Asia, followed by North America, the rest of Asia, and the EU. These regions are also seeing greater reductions towards 2050, and therefore greater investment requirements.

The measures necessary for energy conversion include the following: 1) establishing a power sector with a large share of renewable energy; 2) promoting digitization in order to accelerate energy conversion; 3) accelerating electrification in the fields of transportation and heating; 4) using hydrogen produced through renewable energy to reduce dependence on fossil fuels in areas where it is difficult to reduce emissions; and 5) developing a biomass supply network to meet the demand for sustainable bioenergy. Table 10 summarizes decarbonization measures by sector.

Fig. 1 Regional Scenarios of Energy-derived CO_2 Emissions to Achieve the Paris Agreement Targets



Source: IRENA [2020], p.130.

Table 9 Annual Investment by Region Required till 2050 to Achieve the Paris Agreement Targets

(Billion dollars)

	Renewable energy	Energy efficiency	Electrification of heating and transportation	Power generation equipment	Others	Total
East Asia	268	229	139	105	22	763
Southeast Asia	45	56	11	22	7	141
Other Asia	93	157	54	52	20	376
Oceania	13	13	3	4	1	34
North America	119	221	74	65	8	487
South America / Caribbean	31	59	10	15	3	118
EU	82	147	33	56	5	323
Europe other than EU	25	94	30	6	10	165
Middle East / North Africa	18	96	5	23	6	148
Sub-Saharan Africa	43	25	16	18	3	105
World total	737	1,097	375	366	85	2,660

Source: IRENA [2020], p.133.

Table 10 Measures Required for Decarbonization in Energy Sector

Power generation	Transportation	Industry	Buildings
• Accelerate the construction of power generation facilities using renewable energy. No new construction of coal-fired power plants.	• Reduce traffic and congestion. Improvement of urban transportation planning and services by utilizing advanced digital communication technology, promotion of mobility services (autonomous driving and car sharing), acceleration in the shift from private cars to public transportation, etc.	• Reduce energy consumption in industry. Promotion of a circular economy through the recycling of raw materials and waste management, improvement of energy efficiency through the establishment of energy efficiency standards, etc.	• Reduce energy consumption in buildings. Establishing and strengthening building standards for energy efficiency, linking energy efficiency with renewable energy methods, etc.
• In response to the increasing share of renewable energy (solar power, wind power, etc.), which fluctuates widely, strive to establish flexible power generation systems.	• Accelerate the shift to electric vehicles (EVs). Prioritization of electric vehicles for access to urban areas, provision of incentives for the development of EV charging infrastructure, etc.	• Facilitate the utilization of renewable energy by enterprises. Consideration of direct transactions between companies and renewable energy sales companies, provision of support for investment in in-house power generation, etc.	• Support the development of distributed energy resources, such as solar power and storage batteries.
• Support the development of distributed energy resources, such as solar power and storage batteries.	• Prioritize the use of biofuels for trucks, aircraft and ships. Increase the competitiveness of biofuels by eliminating fossil fuel subsidies and introducing a carbon tax.	•Accelerate the use of low-carbon technologies for heating in manufacturing processes. Promotion of low-carbon heating, support for developing biomass and hydrogen technologies, etc.	• Increase the share of renewable energy in the buildings sector. Promotion of low-carbon heating technology, elimination of conventional biomass fuel for cooking purposes (conversion to electricity), etc.

Source: IRENA [2020], pp.134-135.

2. Outline of Green Finance

(1) Green Finance Instruments, Targets, and Challenges

1) Green Finance Instruments and Targets

This section examines the outline of green finance from various perspectives. First of all, any measures related to green investment are included in green finance instruments. According to Sachs et al. [2019], "we need to open a new file for green projects and scale up the financing of investments that provide environmental benefits, through new financial instruments and new policies, such as green bonds, green banks, carbon market instruments, fiscal policy, green central banking, financial technologies, community-based green funds, etc., which are collectively known as 'green finance.'[(9)]" Green finance is a concept that entails public financing instruments and policies. Green finance instruments are diverse and can be interpreted to include most financial instruments.

Next, there is a discussion on the strict definition of "classification" (taxonomy) of sectors or projects to be covered by green finance (the details will be discussed later), but at least most of the decarbonization projects discussed so far are considered to be included.

Examples of international standards that define the scope of green investment include, for instance, the International Capital Markets Association (ICMA)'s Green Bond Principles (Table 11), which cover measures aimed at pollution prevention and management and adaptation to climate change (including biodiversity protection), in addition to measures related to renewable energy, energy efficiency improvement, electrification, and change in land use as measures to reduce GHG emissions.

2) Challenges for Green Finance

The challenges for green finance can be divided into "prerequisites for promoting efforts to address climate change" and "concrete measures to expand green finance."[(10)]

Table 11 Eligible Green Projects in Green Bond Principles

Categories of green projects	Environmental objectives				
	Climate change mitigation	Adaptation to climate change	Biodiversity	Protection of natural resources	Prevention and control of pollution
1. Renewable energy	●●●			●	●
2. Energy efficiency	●●●				●
3. Prevention and control of pollution				●	●●●
4. Environmentally sustainable management of living things and land use	●	●●	●●●	●●●	
5. Protection of terrestrial and aquatic biodiversity		●	●●●	●●●	
6. Clean transportation	●●●			●	●●●
7. Sustainable water and wastewater management		●●	●●	●●	●●●
8. Adaptation to climate change		●●●			
9. Eco-efficient and/or circular economy-oriented products, production technologies and processes	●●		●	●●●	●
10. Green buildings	●●●	●		●●●	●

Notes: The greater the number of "●," the greater the contribution of projects in respective categories to their environmental objectives.
Source: ICMA [2019], p.4.

The former means that it is a precondition that the momentum and framework for full-fledged climate change measures will be established in society as a whole, and this will lead to the continuous expansion of the supply of green investment projects. Specifically, governments need to strengthen and clarify environmental regulations, recognize that climate change risks affect financial stability and reflect them in financial regulations, and raise public awareness of climate change risks in various ways.

On the other hand, the "concrete measures to expand green finance" are primarily the following. First and foremost, environmental factors such as GHG emissions reductions should be taken into account in determining the returns and risks associated with transactions. In order to expand green finance, it is necessary to increase returns and reduce risks by making the details of returns and risks transparent. The analysis of environmental risks will be described later.

The second is to increase the supply of projects. It is important to increase the number of bankable projects (projects for which banks can extend credit) by reducing project risks and improving returns through policies.

For example, in terms of renewable energy, as it is a new technology which has not been widely utilized yet, investors (financial institutions and banks) find it difficult to understand and risky. There is also the risk of regulatory changes, such as changes in incentives for the development and promotion of new technologies. Therefore, it is necessary for governments to enhance governance and implement consistent policies, and to implement policies that reduce risks and increase returns, such as guarantees on revenues from projects and tax breaks.

In addition, investment in emerging economies is riskier than investment in developed economies[(11)]. A number of factors discourage investment, including the lack of a policy framework that creates an enabling environment, high market risks, and other barriers to market entry. On the other hand, since these countries are expected to see a rapid increase in emissions, it is particularly important to increase investment in emerging countries, including in Asia, and it is essential to improve the environment for project implementation. It is also effective for private sector investors to participate with the support of multilateral development banks (MDBs).

The third is to strengthen the efforts of financial institutions as providers of funds. In particular, it is important to secure human resources with specialized knowledge. In order to be in charge of in-

vestment in the renewable energy field, it is necessary to have expertise in the financial, energy and environmental fields, and efforts must be made to secure and develop such human resources.

The fourth, which is relevant to the first point, is to develop financial regulations, market infrastructure, and financial instruments. Green finance requires explicit treatment of climate change factors. Climate change factors must be reflected in laws and regulations on investment, financing, ratings, accounting, etc.

Companies, including financial institutions, should also be required to include climate-related and environment-related information in listing procedures and other information disclosures. Details of the information disclosure will be described later.

In this context, rating agencies are expected to incorporate important climate-related and environment-related information into the rating process using transparent methods.

In addition, financial authorities should provide financial institutions with incentives to expand green finance, as well as develop rules and regulations. In green finance, it is important to clarify the scope of target projects as much as possible by classification (taxonomy), and to confirm that the funds raised can be used for the purpose and that they are effective for environmental improvement.

The fifth, which is also relevant to the first point, is to quantify climate-related risks. If such a method can be established, it will be helpful to making investment decisions. Of particular importance is the pricing of GHG emissions (carbon pricing). Actual methods considered and implemented include a carbon tax and emissions-trading systems.

A carbon tax is a fee imposed on CO_2 emissions, which is aimed at increasing the price of fossil fuels and limiting their use and GHG emissions. On the other hand, in emissions trading, emission allowances (caps) are set for individual companies, and if the actual emissions exceed the emission allowances, companies are obliged to procure additional emission allowances. The methods for procurement include 1) purchasing from the government through bidding, 2) free allocation from the government, and 3) purchasing from other companies. Emission allowances can be traded between companies, and their supply and demand relationship decides the price of GHGs.

The sixth is to establish voluntary rules by the private sector as well as international rules on green finance. The former is seen in many countries such as Singapore and India. On the other hand, since climate change is a global issue, international efforts are essential. Through such efforts, benefits can be expected including the sharing of experience and knowledge among countries and provision of technical assistance. In many cases, it is desirable for regulations and rules to be unified globally from the viewpoint of fairness. Because efforts to reduce emissions are costly, strict regulations imposed only on companies in one country would hamper their international competitiveness. It has also been pointed out that production bases may move to countries with less strict regulations.

There are many international rule-making efforts, including the Equator Principles established in 2003; the UN Principles for Responsible Investment (PRI) that require institutional investors to consider and reflect ESG factors in their investment decisions, proposed in 2006; and the Green Bond Principles announced by the ICMA in 2014.

(2) Details and Challenges of Green Finance by Sector

DBS [2017] estimates the amount of green investment required of ASEAN countries (Table 12). Based on this document, the current status and challenges of green finance will be examined by sector below[12].

1) Renewable Energy

Solar power, hydropower, wind power, bioenergy, etc. are included in renewable energy, but as mentioned above, there are cases where the progress of a project entails uncertainty due to risk factors such as the fact that technologies related to renewable energy may be new and that it is

Table 12 Required Amount of Green Investment (2016-2030)

(Billion dollars)

	Sector	Investment opportunity	Total amount of investment
Renewable energy	Solar power	140	400
	Hydropower	90	
	Wind power	35	
	Bioenergy, etc.	135	
Energy efficiency	Buildings	152	400
	Industry	57	
	Transportation	191	
Infrastructure	Railways	60	1,800
	Power transmission and distribution	700	
	Water supply	380	
	Telecommunications	260	
	Measures against climate change	400	
Food, agriculture, and land use	Agriculture and food production	170	400
	Food distribution and management	180	
	Forest and land management	50	
Total			3,000

Source: DBS [2017], p.14.

highly likely that they could be affected by regulatory changes. In general, the proximity to existing transmission and distribution networks and the establishment of power purchase contracts are important considerations in assessing the feasibility of renewable energy projects.

In terms of cash flow, large construction costs are required in the early stages of the project, with relatively small operating costs thereafter. When there are various high risks, financing with public funds becomes necessary. It is also possible to renew the borrowing if the operating income and expenses are stable. In addition, insurers can act as both income-related risk guarantors and financing providers.

Renewable energy projects often require public financing due to a variety of problems, such as cases where the creditworthiness of power producers is ineligible for investment and where finance by banks is difficult as the scale of the project is too small. In particular, bioenergy projects are relatively risky in terms of the novelty of the technology and the operational risks. As a result, the proportion of bioenergy projects that depend on public finance is higher than that of other renewable energy projects.

2) Improvement of Energy Efficiency

The building, industrial and transportation sectors are the main targets, and it is essential to promote the adoption of energy efficiency standards in these sectors through policy and financial incentives to promote efficiency improvements. In Malaysia, Singapore, and Thailand, systems exist to provide financial incentives to promote efficiency improvements.

In addition, the size of funds for individual projects is often small, and in order to form large-scale projects, it is often necessary to set up a scheme to aggregate projects.

Most of the energy efficiency improvements in buildings are financed entirely by the private sector. Large building developers and private companies often raise funds through green bonds. In the case of residential buildings in ASEAN nations, however, funds are generally procured through Energy Service Companies (ESCOs) that help customers cut utility costs, and ESCOs bear the performance risk in efficiency improvements.

Schemes utilizing ESCOs are also available in the industrial sector. The existence of government targets for energy efficiency in industrial production processes is important for private financing.

In the transportation sector, it is estimated that 90 billion dollars, which is nearly half of the required investment, will go to electric vehicle production. A part of long-term financing for capital investment through bank loans and green bond issuance will be allocated to this. The repayment period is also expected to be relatively short.

3) Infrastructure

Regarding infrastructure, according to the Asian Development Bank and the Global Infrastructure Hub, an investment of 3.1 trillion dollars is required in ASEAN countries between 2016 and 2030. DBS [2017] estimates that 1.8 trillion dollars of this will be for green infrastructure.

Infrastructure investment requires a long investment horizon, if the operational period is includ-

ed, and involves various risks. Therefore, it is often made through public finance or public-private partnership (PPP). Cambodia, Laos, Myanmar, and Vietnam, which are the relatively least developed countries among ASEAN nations, still rely heavily on financing through MDBs. In Indonesia and the Philippines, on the other hand, their governments have announced their intention to promote infrastructure development through PPP, and the amount of PPP investments is rapidly increasing.

In the infrastructure sector, investment in climate change mitigation and adaptation is growing. The former relates primarily to power and transportation infrastructure. The latter, on the other hand, aims to make water and agricultural infrastructure resilient to climate change.

In general, the former type of investment is relatively larger. In addition, investments to adapt to climate change often do not generate direct returns, and thus depend largely on public finance (subsidies, concessional loans, guarantees, etc. by governments and bilateral and multilateral aid agencies).

Waste management and pollution control are long-term processes and involve many parties. Waste disposal facilities require huge investments. While the average repayment period of public finance is about five years, that of facilities that convert waste into energy requires about 20 years.

In addition to governments and MDBs, the private sector, which is responsible for innovation, and consumers, who contribute to reducing waste and preventing pollution, also play important roles. In addition to public finance, PPP, green bonds, ESG funds, crowdfunding and microfinance may also be applicable.

4) Food, Agriculture and Land Use

The targets in this sector cover a range of small landowners, medium-sized food producers, and large plantations and commodity exporters.

When considering agriculture and food production, financing is difficult because small landowners face a variety of risks, including complex land tenure regimes, lack of collateral, and climate risks. Small-scale financing is inefficient for financial institutions, and the same difficulties as small and medium-sized enterprises (SME) financing are obstacles. In this case, crowdfunding and microfinance are easier to implement. Financial institutions that provide microfinance are common in the Philippines and Thailand. On the other hand, it is not possible to carry out a nation-wide project by the private sector alone, and it is essential to do so basically through government subsidies and other incentives. In addition, it is important to cooperate with knowledgeable MDBs.

In the area of food distribution and management, food waste is a major problem. As regulations promote the reduction of food waste, large amounts of investment are required in various fields such as warehousing, transportation and logistics management.

In recent global developments, it is becoming more common for large food-producing companies to raise funds and conduct sustainable agriculture and food production through supply chains. If this is the case, private bank loans and green bonds can be used without problem.

Investment in diverse agricultural technologies is increasing in ASEAN countries. A variety of technologies are being introduced, including production monitoring sensors, water management, knowledge sharing platforms for farmers, and supply chain and online market management. Increased investment in agricultural technologies is a global trend[13].

Next, in the area of forest and land management, large investments are needed for sustainable forestry and forest restoration in Southeast Asia, where forests have been lost at a rate of about 1% per year in recent years. Reforestation takes many years and is largely funded by the government because of the high risk of regulatory changes to reforestation programs. However, private financing using bonds and equities has also been devised.

(3) Summary of Challenges to Expand Green Finance[14]

The following is a brief summary of the green

finance issues discussed so far. There are three major ways to expand green finance: 1) increase the supply of green investment projects, 2) increase the supply of funds for the implementation of green finance, and 3) establish a mechanism for the smooth implementation of green finance.

The analysis of DBS [2017] concluded that private capital needs to be increased by nearly 11 times, which means that there is a lack of funds to meet the potential green investment needs. Therefore, as a way to increase green finance, it is necessary to seek to secure means to increase the supply of funds while considering increasing the supply of green investment projects.

First, the government's role is important in increasing green investment projects. Environmental measures are an area where market failure can occur, and it is a prerequisite that environmental regulations consistent with NDCs based on the Paris Agreement are established and continue without unreasonable changes. Green investment often involves new technologies, so policies to promote technology development are also essential. If the country as a whole is not moving towards decarbonization, green finance will not increase.

Second, "establishing a mechanism for the smooth implementation of green finance" in 3) above is important. These include the definition and classification of green finance, ratings, and accounting standards. Only when these are clarified will it become clear what constitutes green investment and how to account for such investment. In addition, it will be made easier to develop green financial instruments using securitization schemes. These tools will also help companies manage environmental risks.

Furthermore, such mechanisms include those that contribute to the creation of new financial instruments, such as stock market indices, green investment funds, and market-based insurance products.

The third is to increase the number of bankable projects by reducing risks and improving returns on investment projects. Again, the role of the government is important, and it is necessary to guarantee the return on investment, provide incentives, and undertake various other risks associated with investment.

On the other hand, one possible way to boost funding for green investment is for banks and other financial institutions to increase their expertise in green investment. To this end, it is important not only to secure human resources but also to develop them through training and other means.

The second is the fostering of domestic institutional investors and the promotion of cross-border investment (introduction of overseas funds). As mentioned above, green investment includes a variety of components, but many of them are of a long-term nature and overlap with infrastructure investment in many aspects.

The Asian financial system is basically centered around banks, and it is necessary to promote the sharing of roles with institutional investors in making long-term investments. For infrastructure investment, banks provide financing at the initial stage and bonds are often utilized at the operational stage. This financing method needs to be considered for green investments.

The third is to promote ESG investment. It is essential that investors become more willing to invest in green projects. As will be described later, there is a growing momentum in ASEAN countries to curb climate change. It is necessary not only to invest in green projects but also not to invest in non-green projects. In addition, as emphasized in this paper, it is mandatory to invest in green projects as soon as possible. It is effective for the government and related organizations to develop a comprehensive and long-term green finance roadmap to increase this momentum.

Fourth, while SME financing is generally a weak point in the financial system in ASEAN countries, improving it is also relevant to green finance. Green finance often targets small economic entities such as SMEs and small farm operators that aim to improve their energy efficiency, and the promotion of SME financing also leads to the expansion of green finance.

Fifth, "establishing a mechanism for the smooth implementation of green finance" in 3) above is important also from the perspective of expanding the range of investors. In addition, financial institutions need to manage environmental risks and

enhance information disclosure.

Finally, as an overall means of contributing to the promotion of green finance, various entities such as financial institutions, institutional investors, enterprises, NGOs, and researchers can form cooperative relationships to share investment risks and formulate investment projects.

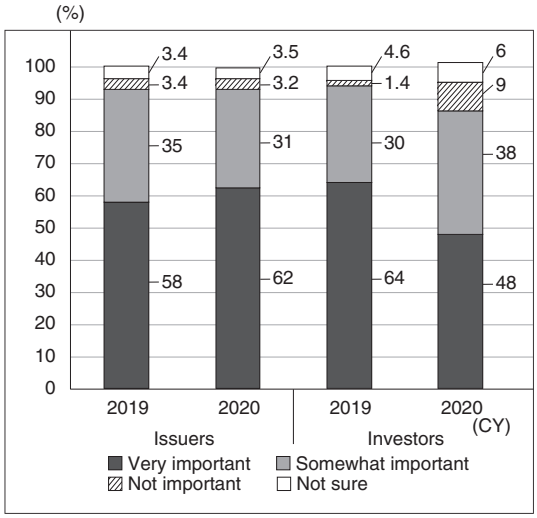
3. ESG Investment

(1) Current Status and Prospects of Global ESG Investment

ESG investment is investment that takes into account ESG (Environmental, Social and Governance) factors, which are non-financial factors. The "E (Environmental)" portion of the investment is considered to be an important factor influencing corporate environment-related behaviors as well as promoting expansion of green finance. In addition, ESG investment with a focus on environmental factors (E) can be considered as a part of green finance. Given this fact, the expansion of ESG investment is expected to accelerate the expansion of green finance. Therefore, it is essential to take into account ESG investment when considering green finance.

Recent trends in ESG investment are described below[15]. Interest in sustainable finance is growing rapidly among capital market issuers and investors, but the outbreak of the COVID-19 pandemic in 2020 has had a certain impact (Fig. 2). While the percentage of issuers who consider environmental and social factors to be "important" to their organizations remained at 93% both in 2019 and 2020, that of investors declined from 94% in 2019 to 86% in 2020. In particular, the percentage of investors who selected "very important" decreased from 64% to 48%, while the percentage of investors who selected "not very important" increased from 1.5% to 8.5%. Some investors may have temporarily lost interest in environmental and social factors as they continued their efforts to maintain return on investment in a highly volatile market environment due to the pandemic. This contrast between issuers and investors can be interpreted as reflecting investors' emphasis on short-term return on investment. Nevertheless, 86% of investors believe that environmental and social factors are "very" or "somewhat" important, which indicates that ESG investment remains a major trend.

Fig. 2 Importance of Environmental and Social Factors



Source: HSBC Bank [2020a], p.6.

(2) ESG Investment and ESG-Related Bond Issuance in Asia[16]

ESG investment trends are also steadily expanding in Asia. Both issuers and investors have a strong interest in sustainable infrastructure against the background of large-scale infrastructure development demand, and the green bond market is expanding mainly in China.

Over the past three years, ESG investment in Asia has grown rapidly. In particular, China, Hong Kong, Singapore, and India are actively improving their investment environments. In Singapore, for example, the Monetary Authority of Singapore (MAS) established institutions to conduct green

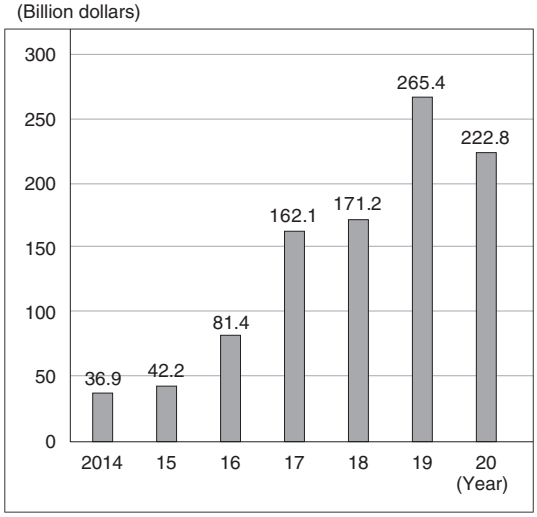
finance research and develop human resources, considered guidelines for environmental risk management of financial institutions, and established a green investment fund worth 2 billion US dollars in November 2019.

In September 2020, China declared that it would be carbon neutral by 2060, which is said to be the biggest news since the signing of the Paris Agreement. This is also expected to increase the presence of foreign investors in the Chinese capital market, which is opening up to foreign markets. ESG investment is taking hold also in China.

The global issuance of green bonds increased from 1.5 billion dollars in 2007 to 265.4 billion dollars in 2019, accounting for 56% of sustainability bonds (Fig. 3)[17]. In 2019, issuances in Asia and the Pacific amounted to 33.1 billion dollars, 12.5% of the total. Of this, in ASEAN countries, issuance rose from 4.1 billion dollars in 2018 to 8.1 billion dollars in 2019.

In 2020, however, due to the outbreak of the pandemic, the flow of issuance shifted to social bonds, etc. Issuance of green bonds in 2020 decreased 16.1% from the previous year to 222.8 billion dollars. However, it recovered in the second half of the year from 91.8 billion dollars during the January-June 2020 period.

Fig. 3 Global Issuance of Green Bonds



Source: Climate Bonds Initiative [2020] "Green Bonds: Global State of the Market 2019", Climate Bonds Initiative website.

Issuance of social bonds, meanwhile, surged from 280 million dollars in 2014 to 20.0 billion dollars in 2019. Social bonds are bonds issued to finance projects that contribute to solving social problems (social projects). Their importance has increased dramatically in the face of the pandemic. Issuance of social bonds in 2020 was 10.9 billion dollars during the January-March period and 33 billion dollars during the April-June period.

In Asia, social bonds are issued mainly in South Korea and Japan, and are also issued in China, India, and the Philippines. The main uses of the funds are cash-strapped small businesses and financing for coronavirus vaccine development.

The proceeds of sustainability bonds are used for both environmental and social projects. In 2019, global issuances amounted to 46.0 billion dollars, and in the January-June 2020 period, they amounted to 56.7 billion dollars. The number of issues in 2020 also rose 94% from a year earlier. Large-scale issues in Asia-Pacific region included the following: 1) Mitsubishi UFJ Finance Group issued sustainability bonds worth 150.0 billion yen in September. 2) The Thai government issued sustainability bonds worth 966 million dollars in September, which were oversubscribed by about three times. 3) The Indonesian government issued sustainability bonds worth 4.3 billion dollars (of which 1.0 billion dollars were 50-year bonds) in June. The government also issued Islamic bonds (Global Sukuk) worth 2.5 billion dollars for environmental and social purposes, which were oversubscribed by 6.7 times. The purpose of issuing these bonds was to combat the pandemic.

It is expected that the issuance of ESG-related bonds will continue to increase, but the lack of standardization of ESG ratings has been pointed out as a problem.

4. Discussion of Environmental Risks

(1) Significance and Content of Environmental Risk Assessment

1) Significance of Assessing Environmental Risks

Identifying, quantifying and managing major risks in financial transactions is essential to creating an efficient and resilient financial system. According to the World Economic Forum's Global Risk Report 2020, the top five long-term risks that are likely to occur in the next 10 years are extreme weather, failure in climate change measures, natural disasters, loss of biodiversity, and human-induced environmental hazards, all of which are related to the environment. Major financial institutions such as banks, insurance companies, and asset management companies have come to recognize that environmental risks, particularly climate change risks, cause financial losses, increased market fluctuations, and destabilization of the financial sector.

The objective of environmental risk analysis is to improve the governance of risk management. Specifically, it is to reduce environmental risks by influencing corporate decision-making through changes in credit policies, introduction of sectoral limits, and establishment of ESG principles at the board level. In addition, financial institutions may use environmental risk analysis to develop products and change the allocation of funds. Furthermore, if financial institutions communicate these results to customers, investment recipients, market intermediaries, and policy makers, these stakeholders will be able to participate in green investment more efficiently[18].

2) Physical Risks[19]

The risks associated with climate change have a major impact on the macroeconomy and the stability of the financial system. The general idea is to divide such risks into two broad categories. The first are physical risks. These are the risks posed by climate change-related extreme weather events (heat waves, landslides, floods, forest fires, typhoons, etc.) as well as long-term and gradual changes in climate (changes in precipitation, increased short-term climate variability, ocean acidification, sea level rise, mean temperature rise, etc.).

The second are transition risks. They relate to the process of adjustment towards a low-carbon economy. The process of reducing emissions has a profound impact on all sectors of the economy and changes the value of financial assets. While decisive action is required, a rapid transition can have unfavorable effects in the face of changes in policy, technology, and market sentiment.

Climate change is a unique structural change. First, it is a huge problem that affects the entire world. Second, risk realization is certain. Third, changes are irreversible. Fourth, it depends on short-term responses. It is necessary to fully recognize these points and consider how to deal with the problem.

Further on physical risks, globally, in seven years of the last 10 years, the economic costs of natural disasters have exceeded the 30-year average of 140 billion dollars. The number of extreme weather events has more than tripled compared with the 1980s. Significant temperature increases also pose a threat to human habitability in many areas. This includes human health, the stable supply of food, water resources, heat and rising sea levels.

Some estimates suggest that if climate change is left as it is, the world's average income could decline by 25% by the end of this century due to the realization of various risks[20]. In addition, social and political risks such as large-scale migration, political instability and conflict need to be considered.

The Asian Development Bank [2016] describes the risks that Asia faces by classifying them into biophysical risks, economic risks, and social risks. Biophysical risks include changes in the natural environment and the effects of climate change on human health.

Next, let's look at the impact of physical risks

on financial stability. The first is business risks (including operational and reputation risks). They include, for example, the difficulties of business continuity caused by the destruction of banking facilities due to natural disasters and the deterioration of reputation caused by investment in brown assets. The second is credit risk. For example, a decline in corporate income due to climate change or a decline in the value of collateral assets could impair the ability to repay debts. The third is underwriting risk. This is a problem of insurance, and when natural disasters increase, insurance companies will face difficulties due to increased insurance liabilities. The fourth is market risk. The damage caused by climate change reduces the value of stocks and other investment assets.

3) Transition Risks

On the other hand, with regard to transition risks, the transition to a low-carbon economy as required by the Paris Agreement requires extremely significant changes in areas such as energy, land, cities, infrastructure, and industry. Such changes will require significant resources. For example, the Intergovernmental Panel on Climate Change (IPCC) estimates that additional energy-related investments of 830 billion dollars per year will be needed between 2016 and 2050 to limit temperature increase to 1.5°C or less. There are many other estimates, but the bottom line is that large amounts of money need to be channeled into green finance. This will result in major structural changes in the economy. The IPCC estimates that global consumption will decline by 1-4% until 2030 in order to limit warming to 2°C.

However, the form of "transition" will vary from country to country and will be diversified. In addition, there is a possibility that the course of action may change in each country due to policy changes. The cost of transition may be reduced to some extent because the transition process involves innovation, job creation, and lower production costs. What is clear, however, is that the longer transition is postponed, the more complex and difficult it will be. Therefore, a smooth and early transition is required.

Next, regarding the impact of transition risks on the financial system, the same approach is applied as in the case of physical risks. The risks considered are: (a) business risk; (b) credit risk (including counterparty risk); (c) market risk (arising from price fluctuations in green and brown assets); and (d) legal risk (including liability risk arising from losses to interested parties in connection with changes in the environment).

What is in the center of discussion when considering the impact of transition risks on financial stability is the loss of asset value due to the stranding of assets, which, along with the loss to owners, leads to increased market and credit risks for lenders and investors of funds. Some estimates point to losses of up to 20 trillion dollars[21].

There are three main reasons why companies may fall into such a predicament[22]. First, the introduction of climate change control measures (for example, carbon pricing) could result in some companies' assets becoming stranded and unable to earn profits. Second, technological progress affects the relative price of products and changes their profitability. Third, people's sentiment, demand patterns, preferences and expectations affect the economy and the financial system. Insurance companies are also expected to face increased claims due to direct and indirect damage to individuals and companies from climate-related risks.

Table 13 and Table 14 summarize the aforementioned environmental risks and the relationship between environmental risks and the soundness risks of financial institutions.

(2) Response Required of Central Banks and Financial Institutions

1) Response of Central Banks

NGFS (Network for Greening the Financial System) [2019a] provides six recommendations for central banks and financial supervisors (Table 15). NGFS [2020a] discussed the first of these, incorporating climate-related risks into regulatory oversight, and made five recommenda-

Table 13 Sources of Environmental Risks

Physical risks	Examples
Extreme weather	Typhoons, floods, snowstorms, heat waves, droughts, forest fires, haze
Environmental pollution	Soil pollution and degradation, air, water and marine pollution, and environmental accidents
Sea level rise	Gradual sea level rise
Depletion of water resources	Drought or inadequate water supply
Deforestation and desertification	Deforestation leads to species loss, climate change, desertification, and forced human displacement

Transition risks	Examples
Change in government policy	Energy conversion policies, pollution regulations, and resource conservation regulations
Technological advance	Clean energy, energy conservation, clean transportation, and other green technologies
Change in sentiment	Changes in consumer preferences and investor sentiment toward specific asset classes
Disruptive business model	New business methods with rapidly expanding market share (online meetings, vertical agriculture, etc.)

Source: NGFS [2020b], p.5.

Table 14 Relationship Between Climate-related Risks and Soundness Risks by Category

Category of soundness risk	Examples of climate change-related factors that have impact on soundness risk
Credit risk	• The destruction of production facilities by wildfires increases the probability of bankruptcy of owned enterprises • Lenders are more likely to lose money if the value of buildings as collateral assets falls under new energy efficiency standards
Operational risk	• Extreme climate events that damage critical functions make it difficult for financial institutions to continue their businesses • Financial institutions and their customers are required to compensate for losses caused by environmental risks
Market risk	• Severe climate events and transition policies reduce the value of securities and collateral held by financial institutions • The introduction of a carbon tax would lead to investment losses and a decline in asset values
Underwriting risk	• Extreme climate events damage insured assets, leading to unexpected insurance payments
Liquidity risk	• Insufficient and uncertain disclosure of climate-related information by financial institutions can lead to cyclical market developments, such as fire sales of carbon-inefficient assets and liquidity problems

Source: NGFS [2020a], p.14.

Table 15 Recommendations to Central Banks, Financial Supervisors and Policymakers

1. Incorporating climate-related risks into financial stability monitoring and supervision of individual financial institutions
2. Central bank's incorporation of sustainability factors into its portfolio management
3. Developing missing climate and environmental data
4. Raising awareness and knowledge on climate and environmental issues and promoting technical assistance and knowledge sharing
5. Achieving strong and internationally consistent disclosure of climate and environmental information
6. Supporting the development of taxonomy for economic activities

Source: NGFS [2019a]

tions.

First, financial supervisors should have a clear understanding of how climate-related and environmental risks affect the economy and financial sector in their countries and how significant these risks are to their institutions.

Second, in order to address climate-related and environmental risks, a clear strategy should be in place, specialized organizations should be established internally, and appropriate resources should be allocated. These risks are very large and are likely to affect the overall operations of the central bank. Therefore, it is necessary to integrate these risks into its daily operations.

Third, the vulnerability of supervisory exposures to climate-related and environmental risks should be identified and potential losses in cases

where these risks are materialized should be assessed. For such purposes, it is necessary to first evaluate the determinants of physical and transition risks, and to consider how to collect data if it is insufficient. In addition, in order to determine the size of exposure, it is necessary to develop methods such as scenario analysis and stress testing. At the same time, it is also required to establish micro risk indicators to monitor risks.

Fourth, the transparency of financial institutions should be ensured in order to establish prudential regulations on climate-related and environmental risks. To do so, it is necessary to clarify what is required of financial institutions, mainly the following five points. (1) Governance: The department responsible for dealing with these risks must have been clarified. (2) Strategy: Strategies to address these risks must be established. To this end, an ultra-long-term perspective is essential. (3) Risk management: There must be policies and procedures to recognize, assess, monitor, report and manage all significant risks. (4) Scenario analysis and stress testing: These tools are essential because the risks are long-lived and uncertain. (5) Information disclosure: Information on the relationship of financial institutions to climate-related and environmental risks should be disclosed in line with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) (see below).

Fifth, financial institutions should be encouraged to manage and control climate-related and environmental risks appropriately. At present, there is not enough accurate understanding of these risks to impose additional capital requirements, for example. NGFS also needs to continue to conduct research on risk transfer channels and risk management methods.

2) Response of Financial Institutions[23]

At present, only a small number of financial institutions in developed countries conduct environmental risk analysis, and many are still in the testing stage. In emerging countries, many financial institutions do not recognize the necessity of environmental risk analysis, and it is necessary to promote such analysis. The outline of environmental risk analysis is described below.

The framework for environmental risk analysis and management by financial institutions consists of four main stages. The first is risk identification. The types of environmental factors that cause financial risk (e.g.: extreme weather, reduced demand for fossil fuels, decline in the value of relevant infrastructure) are strategically assessed. The second is risk measurement. The size of a financial institution's exposure to environmental risk is measured. The third is risk assessment. The potential and magnitude of financial losses arising from these risks are estimated. The fourth is risk mitigation. Actions are taken to reduce risk by implementing internal policies and processes to limit exposure to assets with high environmental risks. Examples include the reduction of exposure to infrastructure assets that are contrary to decarbonization and the support for the efforts of enterprises to reduce environmental risk.

A model that actually evaluates environmental risk (physical risk) first estimates the impact of environmental risk on financial statements (a decrease in income or an increase in costs), and then inputs the results into a default probability calculation model to quantify it as financial risk (credit risk for lenders and market risk for institutional investors). This set of analysis results is typically presented as a scenario analysis or a stress testing.

In the case of transition risks, the first step is to develop a number of scenarios based on macroeconomic models, and to estimate the impact on financial statements as a result of changes in policies and technologies motivated by environmental and climate factors. Close attention must be paid to companies in carbon-intensive sectors, where the impact of transition risk is significant. The final process of converting changes in the financial statements to financial risk is the same as in the case of physical risks. In this case, the initial process for modeling transition risks is complex. Such analyses may also be used for environmental risks other than climate change, such as pollution.

5. Other Factors for Supporting Green Finance

(1) Disclosure of Environmental Risk Information

1) Necessity of Information Disclosure and Current Initiatives

In order to expand green finance, it is critical that companies disclose details of their exposure to climate-related and environmental risks. These disclosure rules are developed mainly by the Task Force on Climate-related Financial Disclosures (TCFD).

The Financial Stability Board (FSB) established the private-sector-led TCFD in December 2015 at the direction of the G20 Finance Ministers and Central Bank Governors (FMCBG). The TCFD was chaired by Michael R. Bloomberg, founder of Bloomberg, and had 32 members with the mission of preparing for disclosure of climate-related financial risks.

The TCFD released its final report in June 2017. The report recommends that climate-related disclosures for public companies and financial institutions should include four elements: governance, strategy, risk management, and indicators and targets (Table 16). These recommendations, while not mandatory, provide necessary information to financial providers such as banks, insurance companies and other investors.

The number of companies and organizations that support the TCFD has steadily increased to 1,669 as of December 24, 2020. By country, Japan topped the list with 332 companies, followed by the United Kingdom with 258 companies and the United States with 244 companies[24]. Approximately 60% of the world's top 100 public companies on a corporate scale endorse or disclose information in line with the TCFD recommendations[25]. In Japan, the TCFD Consortium was established in May 2019 to promote the TCFD efforts[26]. In July 2020, the Consortium published "Guidance on Climate-related Financial Disclosures 2.0 (TCFD Guidance 2.0)" to promote corporate information disclosure in line with the TCFD recommendations. In addition, the TCFD Summit was held in Tokyo in October 2019 and online in October 2020.

One of the reasons for the rapid spread of the TCFD is investor demand. The UN Principles for Responsible Investment (PRI) require signatory institutions to submit annual reports on responsible investment activities. Since 2018, indicators in line with the TCFD have been included in the report items. While reporting on these climate-related indicators had been voluntary, it became mandatory in 2020 (disclosure is still voluntary). This is a measure to encourage investors to systematically incorporate climate-related risks and opportunities into their investment strategies, but at the same time, it also means that it will be difficult to invest in companies that do not make disclosure in accordance with the TCFD, thus strengthening the position of the TCFD as an information disclosure framework[27].

Table 16 Overview of Recommendations by the TCFD (Task Force on Climate-related Financial Disclosures)

Governance	Strategy	Risk management	Metrics and targets
Disclose the governance of the organization with respect to climate-related risks and opportunities.	Disclose the actual or potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial plans.	Disclose how the organization recognizes, assesses and manages climate-related risks.	Disclose indicators and targets used to assess and manage climate-related risks and opportunities.

Source: TCFD (Task Force on Climate-related Financial Disclosures) [2020]

2) Current Status and Issues of Information Disclosure

The TCFD issues annual Status Reports on the status of corporate information disclosure. The Status Report was published in September 2018, June 2019, and October 2020. The following points were pointed out in the 2nd Status Report published in June 2019. (a) Disclosure is improving, but is not yet sufficient for investors. (b) The potential financial impact of climate-related issues on enterprises needs to be more clearly stated. (c) In the scenario analysis, many enterprises have not disclosed information on the resilience of their business strategies. (d) It is required that not only the specialized department in charge of sustainability, but also various departments within the enterprise such as those in charge of risk management, finance and corporate management are involved to make climate-related problems mainstream in the enterprise.

According to the 3rd Status Report published in October 2020, the number of companies endorsing the TCFD increased by more than 85% over the 15 months between the 2nd and 3rd Report to exceed 1,500. These include more than 1,340 companies with a market capitalization of 12.6 trillion dollars and financial institutions with 150 trillion dollars in assets. Many of them have implemented the TCFD recommendations, have discussed effective disclosure at international forums, and have initiated the work necessary to enhance the effectiveness thereof. In addition, there has been an increase in the activity in which investors ask their investee companies to implement the TCFD recommendations.

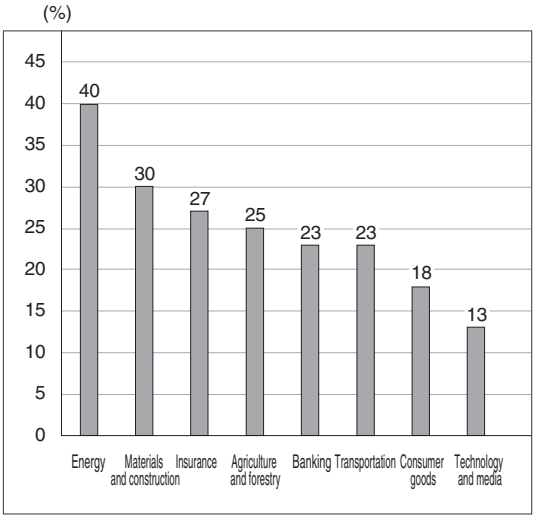
More than 110 regulators and government agencies have also endorsed the TCFD, and regulators are increasingly asking securities issuers to disclose information in line with the TCFD recommendations. As the world moves to curb climate change, it is imperative that climate-related information disclosure be consistent and comparable across countries.

According to the 3rd Report, the status of information disclosure has the following characteristics[28]. First, disclosure of climate-related financial information has increased since 2017, but further expansion and improvement are needed. By 2019, there was an average 6% increase in disclosures for the 11 items that are recommended. However, the level of disclosure is low regarding the potential financial impacts of climate change on business, strategy and financial planning. Second, sustainability reports outnumber financial filings and annual reports by more than four times in the media in which the information is disclosed. Third, only about 1 in 15 companies disclose information on the resilience of their strategies under different climate change-related scenarios. Fourth, while 42% of large companies with a market capitalization of 10 billion dollars or more disclose information based on the TCFD recommendations, only 15% of companies with a market capitalization of less than 2.8 billion dollars disclose the said information. Fifth, the percentage of companies that disclose information based on the TCFD recommendations is high in the energy, materials, and construction sectors. In 2019, 40% of energy companies and 30% of materials and construction companies made such disclosures (Fig. 4).

3) Situation in the ASEAN Region

The ASEAN Working Committee on Capital

Fig. 4 Ratio of Information Disclosure in Accordance with TCFD Recommendations



Source: TCFD (Task Force on Climate-related Financial Disclosures) [2020], p.17.

Market Development [2020] describes about sustainable finance in the capital markets of ASEAN countries. According to this, in order to increase sustainable investment, a stable supply of investment projects is necessary, and acceptable classification (taxonomy), standards and labeling, and an established framework for information disclosure and reporting are indispensable. In many ASEAN countries, sustainability disclosure and reporting regulations already exist. However, as in the case of the global situation, there is no single disclosure or reporting standard or framework in use by all ASEAN countries.

Sustainability information disclosure frameworks have been published by a number of organizations, such as the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), the International Integrated Reporting Council (IIRC), and the TCFD. The ASEAN Capital Markets Forum (ACMF), a group of ASEAN regulators, said that global discussions are also under way and that for the time being it will consider the possibility of adopting a unified information disclosure standard across the region[29].

In March 2019, the ACMF announced the Roadmap for ASEAN Sustainable Capital Markets (ACMF [2019]), which states that the ACMF will develop investment stewardship codes and strengthen ESG investment in each country.

(2) Classification of Economic Activities (Taxonomy)

1) Overview[30]

A system for classifying whether an economic activity is green or sustainable is fundamental to green investment. There is currently no mandatory classification globally. International organizations, such as the Climate Bonds Initiative, have only voluntarily classified green bonds, and the classification differs by country and region. As with disclosure standards, if some sort of unification or harmonization is possible, it will be more convenient for investors.

In Europe, the EU Taxonomy Regulation provides a general framework for classifying "environmentally sustainable economic activities." In this classification, power generation using solid fossil fuels such as coal is clearly excluded from sustainable activities.

Meanwhile, in China, the Green Bond Endorsed Project Catalogue, issued by the People's Bank of China, specifies 31 projects in six sectors where green bonds can be issued. This classification differs from that of the EU and allowed green bonds to be issued for clean coal projects. Recognizing these differences, the European Investment Bank (EIB) and the People's Bank of China continued to adjust their definitions of green finance.

In July 2020, the People's Bank of China, the National Development and Reform Commission (NDRC), and the China Securities Regulatory Commission (CSRC) issued a draft of the 2020 version of this document for consultation, in which coal projects were excluded[31]. While the NDRC had adopted different standards from those of the People's Bank of China in the past, they seem to have been unified now.

2) EU Classification[32]

For the EU, it is essential to direct its investment towards sustainable projects and activities, and the COVID-19 pandemic has increased the need to implement the European Green Deal, announced in December 2019, to further strengthen the economy, businesses, society and, in particular, health systems against climate and environmental risks. Therefore, it became essential to clarify what is "sustainable," and the EU taxonomy has been designed for this purpose. This helps to avoid greenwashing (pretending to be environmentally friendly) and support companies with their transition plans.

The EU taxonomy was published in the official journal of the EU on June 22, 2020 and entered into force on July 12, 2020. The taxonomy has six environmental objectives: (a) climate change mitigation; (b) adaptation to climate change; (c) sustainable use and protection of water and marine resources; (d) transition to a circular economy; (e) pollution prevention and control; and (f) biodiver-

sity and ecosystem protection and restoration. In order for an economic activity to be judged as an environmentally sustainable economic activity, it must meet the following four conditions[33]. First, it has to contribute significantly to one or more of the above six objectives. Second, it does not cause significant damage to other objectives. Third, it complies with minimum social safeguards (the OECD Guidelines for Multinational Enterprises related to social and governance factors, ILO Declaration on Fundamental Principles and Rights at Work, etc.). Fourth, it must follow certain technical screening criteria based on scientific grounds.

Economic activities that are "environmentally sustainable" can be divided into the following categories in terms of "climate change mitigation" (Fig. 5). First, there are economic activities that make a significant contribution based on their own performance (see Article 10 of the Taxonomy Regulation (TR)). These include activities that already have low CO_2 emissions and activities that contribute to the transition to a net zero emissions economy by 2050. The latter are defined as activities that make important contributions to climate change mitigation by supporting the transition to a climate-neutral economy, while there are no technically and economically viable alternatives with low CO_2 emissions.

Second, there are activities that directly enable other activities to make significant contributions to one or more environmental objectives (see Article 16 of the TR).

3) Situation in ASEAN[34]

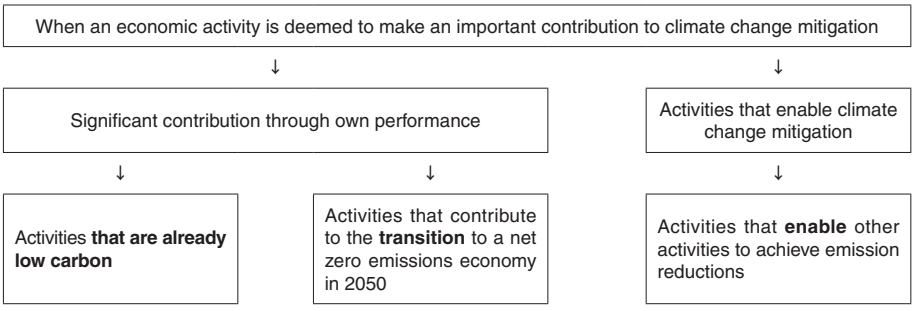
From 2017 to 2018, the ACMF formulated and published the ASEAN Green Bond Standards, ASEAN Social Bond Standards, and ASEAN Sustainability Bond Standards. They draw on similar standards developed by the ICMA and are intended to enhance the transparency, consistency and uniformity of bonds and to assist in issuer screening and investor decision-making.

More refined classifications are needed to prevent greenwashing and attract more sustainable investments. In the view of the ACMF, the establishment of ASEAN's own standards is not necessarily desirable because it would lead to the proliferation of standards. It is also desirable to use international standards (or similar standards) to attract foreign investors.

Since there has been little movement to unify classifications globally, the ACMF intends to closely monitor developments in the EC, CBI, and ICMA. While it is desirable to unify standards within ASEAN, it is also necessary to seek a single taxonomy that best meets the needs of each country, as each country's level of development is diverse.

In Malaysia, the central bank issued a discussion paper in December 2019, proposing a principles-based taxonomy[35]. The paper classifies economic activities into six categories: green, transition (three stages), brown, and illegal activities, with emphasis on encouraging financial institutions to raise their awareness of climate-related risks. In addition, Indonesia, Vietnam, and Singa-

Fig. 5 Economic Activities That Contribute to Climate Change Mitigation



Source: NATIXIS [2020], p.21.

pore are also considering the development of taxonomies.

4) Classification Challenges

In addition to green finance, the challenge is to establish transition finance for the investments needed to transition to a low-carbon economy. In the case of transition finance, it is difficult to define the scope of finance and there are no clear rules, so it is more difficult to ensure transparency than with green finance.

Progress on this point was made in December 2020 when the ICMA issued the Climate Transition Finance Handbook (ICMA [2020]). The objective is to secure funding for issuers seeking to implement strategies to address climate change risks. To this end, the Handbook summarized the practices, actions, and information disclosure of capital market participants when they raise funds. Taking into account the diversity of issuers by industry and by country, consideration is given to the issuers' desirable information disclosure rather than providing definitions and classifications.

According to the Handbook, there are four items to disclose (Table 17). The first is the issuer's transition strategy and governance. The purpose of funding labeled as transition investment must be to enable the issuer to implement its strategy to combat climate change. An independent technical assessment of the issuer's strategy is also effective in enhancing its credibility. The second is the environmental importance of the business model. The planned transition path should relate to an environmentally significant portion of the issuer's business model, taking into account potential future scenarios. The third is the objectives and pathways of evidence-based transition strategies. The planned transition path should be quantifiable, scientifically based, disclosed, and supported by external certification. The fourth is transparency of implementation. When raising funds, it is necessary to ensure the transparency of investment programs, including the amount of capital expenditures and working capital. In addition, information on how the program will support the implementation of the transition strategy must be provided, including the details of divestitures, governance and process changes (if applicable).

The third point is the most important of the above four items. Investment programs to implement a transition strategy must bear positive results and thus require a scientific approach. In any case, the Handbook is a starting point, and it is an urgent task to build a more detailed transition financing framework.

Carney [2019] states that the EU taxonomy is

Table 17 Elements Subject to Information Disclosure in Transition Finance

Issuer's transition strategies and governance	• Long-term warming targets related to the Paris Agreement targets • Related interim targets • Decarbonization measures and strategic planning • Monitoring and governance of transition strategies • Sustainability strategies that contribute to the SDGs by reducing environmental and social impacts
Environmental materiality of business models	• Consideration of materiality by accounting standards bodies, etc.
Objectives and pathways of science-based transition strategies	• Short-, medium- and long-term GHG reduction targets in line with the Paris Agreement • Baseline • Scenarios used and methods applied • GHG targets covering all scopes (scopes 1, 2, and 3) • Targets for both intensity and absolute terms
Transparency of implementation	• Ratio of assets, revenues, expenditures and divestments related to the various instruments listed in Element 1 above • Capital investment implementation plans in line with overall strategy and climate science

Source: ICMA [2020]

binary (dark green or brown only) and that mainstreaming sustainable investment calls for a richer taxonomy—50 shades of green. Transition finance could be one of the answers to this.

(3) Carbon Pricing

1) Overview

Carbon tax is a method of carbon pricing. It is imposed as a fee on the carbon component of fossil fuels. Carbon taxes are a very effective means of controlling GHG emissions. The tax will lead to a shift from fossil fuel power generation to energy conservation and electric vehicles. A 35-dollar tax on 1 metric ton of CO_2 emissions would raise the prices of coal, electricity and gasoline by 100%, 25% and 10%, respectively[36]. Such a tax is particularly effective in reducing emissions in countries with high coal consumption, such as China, India and South Africa.

Other advantages of a carbon tax include the availability of increased tax revenues for many appropriate purposes, environmental benefits such as improved air pollution, and the simplicity of the tax system.

Another method of carbon pricing is emissions trading systems. Companies are required to obtain allowances to make emissions, and the government controls the total amount of allowances. Emission allowances are traded between companies and the prices of "emissions" are determined.

Currently, only power producers and companies in large industries are participating in the trading, and the effectiveness of the introduction of the system for reducing emissions is limited. This situation is similar to the carbon tax which includes tax exemptions. In addition, in the case of emissions trading systems, the levels of the prices of emissions are uncertain, and it may be difficult to introduce the system because of the time and effort required to operate the system.

Because of these obstacles, while nearly 60 carbon pricing schemes have been introduced worldwide, the average price of emissions is only 2 dollars per metric ton. Therefore, building an effective system remains a major challenge. Since there is strong resistance from companies and consumers to the introduction of the schemes, it is necessary to devise measures such as phased introduction and sufficient promotion activities.

Furthermore, it is possible to create a mechanism for international carbon pricing, but it is essential to deepen discussions to this end. Carbon pricing is considered to be an essential system for controlling climate change, but the steady development of such a system in the midst of international efforts to curb climate change will be a way to increase its effectiveness.

2) Situation in ASEAN

Singapore introduced a carbon tax in January 2019. Facilities emitting more than 25,000 metric tons of CO_2 per year (approximately 50 facilities, covering approximately 80% of national emissions) will be taxed at 5 Singapore dollars (3.7 U.S. dollars) per metric ton, which is scheduled to be increased to 10-15 Singapore dollars per metric ton after 2023. Singapore also envisions linking this with emissions trading schemes in other countries.

In addition, Indonesia, the Philippines, Thailand and Vietnam are also considering the introduction of carbon pricing. In particular, a pilot market for emissions trading has been established and operated in Thailand since 2015. However, it remains to be seen how a formal carbon pricing scheme will be introduced. The general trend in these countries is that carbon taxes are unpopular and the introduction of some form of emissions trading seems to be considered a more likely method.

In the case of carbon pricing, although ASEAN countries are still in the early stages, there is a possibility that they will benefit from regional cooperation in terms of cost reduction and market size.

6. Green Recovery Required by Countries Around the World

1) Developments in Europe

A policy to aim to both recover from the COVID-19 pandemic and control climate change is called "green recovery." There is no clear definition of the content. In December 2019, the European Commission announced the "European Green Deal," a comprehensive policy package centered on climate change. On July 21, 2020, an agreement was reached in the EU on the establishment of a reconstruction fund totaling 750 billion euros. About one-third of that will be allocated to climate change measures. At the same time, agreement was reached on the Multiannual Financial Framework (MFF: 1,074.3 billion euros) for the 2021-2027 medium-term budget. Finally, on December 10 of the same year, Poland and Hungary agreed to the MFF, and it was officially enacted then.

2) Balancing Economic Growth and Climate Change Control

The IMF [2020] discussed the feasibility of achieving both recovery from the pandemic and climate change mitigation. First, it is important to provide incentives to reduce GHG emissions, such as by introducing carbon pricing. Second, there is a need to increase demand, investment, and supply in the low-carbon energy sector through subsidies, price guarantees, and promotion of research and development. This also includes improvements in complementary technologies, such as CO_2 capture and storage. Of course, discussions on how to combine and implement these policies remain to be held.

According to IMF [2020], many previous studies have concluded that it is difficult to achieve the required reduction of GHG emissions without a major impact on the economy, but simulations in this study indicate that it is possible. The main approach is a combination of green investment (green supply policy) and carbon pricing.

Green supply policy here consists of 80% subsidies for renewable energy production and a 10-year green public investment program[37]. In addition, carbon pricing with an annual increase of 7% is assumed. At the time of introduction, it will be 6-20 dollars per metric ton of CO_2, 10-40 dollars per metric ton of CO_2 in 2030, and 40-150 dollars per metric ton of CO_2 in 2050. This assumes an 80% reduction in emissions in 2050 in combination with green supply policies. The remaining 20% will be realized by expanding forests and utilizing CO_2 capture and storage technologies. Under the green supply policy, it is assumed that the low-carbon industries will expand but the high-carbon industries will not diminish, so the introduction of carbon pricing is expected to play the roles of changing the relative price and transforming the industry structure.

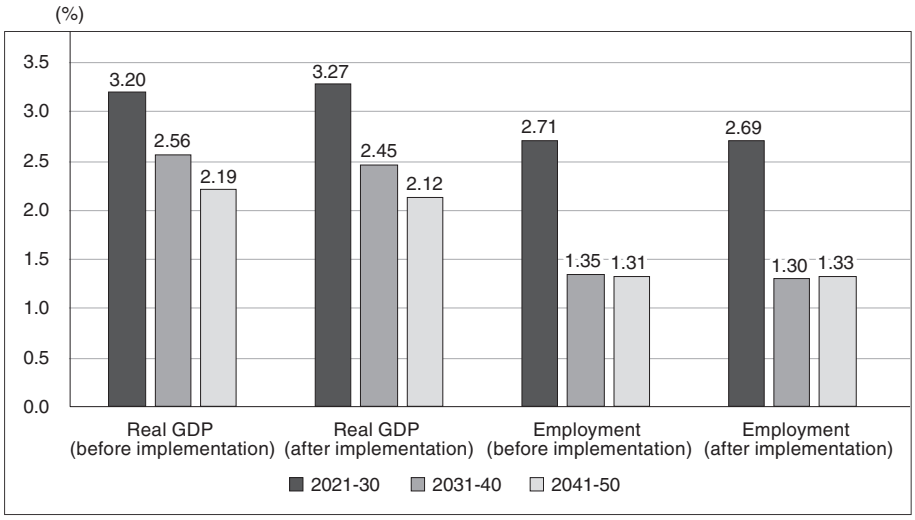
In addition to green supply policies and carbon pricing, financial support is provided to the low-income households most affected by these policies. If a carbon tax is introduced, low-income households will be affected more by higher electricity rates, and workers in the high-carbon industries will be forced to change jobs. The financial support is a measure to compensate for such burdens.

These policies will largely achieve the required emission reductions and will help to achieve a green recovery because they will boost economic growth as they will increase investment in the short term and the initial burden of carbon taxes tends to be small (Fig. 6)[38]. In the long run, there will be an effect of lowering the growth rate, but there will not be a significant negative growth on a total basis from the current level. Rather, there is no other choice given the enormous negative impacts that can occur if no action is taken against climate change.

Compared with high-carbon industries, low-carbon industries are generally more labor-intensive, so their macro-employment impacts are likely to be limited (on a micro level, there are transition risks as described above.). Over the long term, innovation in the low-carbon sector has a significant positive impact on growth.

In principle, this policy will be implemented uniformly by each country (the only exceptions

Fig. 6 Impact of Climate Change Mitigation Measures on Macro Economy



Notes: The figures indicate annual average growth rates.
Source: IMF [2020], p.97.

are oil-exporting countries, which are largely affected by relative price increases), but the economic impact on each country will vary. The burden on Europe, where renewable energy is already widespread, is relatively small, while that on the United States, China and India is large. However, it should be noted that China and India will also benefit greatly from climate change mitigation.

There was once a debate that developed countries, which have exacerbated the problem of climate change, should be responsible for reducing emissions, but the ratio of developed countries to total emissions has been declining, and it is no longer an issue that can be solved by developed countries alone. According to Climate Watch data, OECD countries' share of global GHG emissions fell from 41.4% in 1990 to 28.8% in 2018. Concerted action by the United States, Europe, China, Japan and India will make a significant contribution to reducing emissions[(39)].

3) Trends by Country

According to Vivid Economics [2020], the global economic stimulus package to recover from the COVID-19 pandemic has reached about 13 trillion dollars by December 2020, of which 4 trillion dollars, or 31%, has been allocated to the agriculture, forestry and fisheries, manufacturing, waste, energy, and transportation sectors that have impact on environment. The question, of course, is whether each investment is green or not. The report pointed out very severely that there are few measures that can be evaluated as being conducive to green recovery on the whole, and that there is considerable room for improvement for governments. Only European countries (such as Switzerland, Germany, Spain, the United Kingdom, and France) and Canada are rated relatively highly.

The evaluation of the United States is low. While the report's rating is for 25 countries and regions, mainly the G20 members, the United States ranked 10th from bottom. During the previous Trump administration, environmental regulations were relaxed in areas such as energy, manufacturing, transportation, and agriculture, and support for the aviation industry without green conditions was also seen as problematic.

China ranks sixth from bottom. In response to the pandemic, the Chinese government has relaxed environmental regulations (reporting requirements) in key sectors, such as transportation and manufacturing, and has approved several coal projects and given subsidies to gasoline-powered vehicles. At the same time, however, it is also supporting electric vehicles and establishing a green investment fund. Thus, although there are some

promising policies, economic stimulus measures are, on the whole, being implemented while preserving existing industries with high emissions. In addition, expansion of coal-fired power generation is included in China's next (14th) Five-Year Plan. This indicates that policies have been adopted that run counter to the goal of becoming carbon neutral in 2060.

India ranks 13th from bottom, almost in the middle (however, only the top seven countries and regions have a positive overall rating). In India, too, environmental considerations are insufficient, and there are many problems, such as relaxation of environmental monitoring and approval of projects with insufficient environmental considerations. There are only a few positive factors such as investment in solar power generation and railway development. The economic stimulus package announced in November 2020 includes the positive elements of large-scale investment in biogas and clean fuels, and it is necessary to further enhance environmental considerations in the future.

The EU has the highest rating. As noted above, the reconstruction fund totaling 750 billion euros includes various green investments to support the European Green Deal. These include policies to increase agricultural sustainability and support renewable energy and electric vehicles. Financial assistance to member countries will also be subject to conditions that will not adversely affect the environment.

The evaluation of ASEAN countries is low, with Singapore ranking fourth from bottom, the Philippines seventh from bottom, and Indonesia ninth from bottom. According to Sembiring [2020], restrictions on the movement of people and goods have had a significant impact on new solar and wind power projects in ASEAN countries. On the other hand, as economic recovery becomes an imminent issue, consideration for climate change control has declined. There have been no new examples of environmental considerations in economic stimulus measures aimed at recovering from the COVID-19 pandemic.

Even before the pandemic, ASEAN countries had prioritized economic growth, and the target ratio of renewable energy in their energy mix has remained low. Each country's approach is "economic growth is a priority and we will endeavor to curb climate change if possible." In Indonesia, for example, measures were taken to relax licensing criteria for wood producers after the outbreak of the COVID-19 pandemic (although this measure was withdrawn afterwards). In addition, policies that run counter to climate change control have been implemented, including unconditional financial support to state-owned oil, gas, power and airline companies.

After all, the right way for green recovery is not to see the pandemic as an opportunity to implement climate change control measures, but to continue to promote climate change control measures even amid the pandemic.

Conclusion

This paper described in detail the issues surrounding climate change and green finance. Global GHG emissions are believed to have decreased by approximately 7% in 2020 from the previous year due to the effects of the COVID-19 pandemic, but it is extremely difficult to achieve the Paris Agreement targets in the long run. Experts say that unless drastic measures are taken by 2030, it will be impossible to achieve the targets, and there is little time left. In the future, the expansion of renewable energy, the reduction of coal use, the improvement of energy efficiency, electrification in fields such as transportation, and decarbonization in energy intensive industries must be rapidly promoted.

At the same time, green finance, which provides funds to support the implementation of various policies, is becoming increasingly important. Expanding green finance requires three steps: (1) increasing the supply of green investment projects; (2) increasing the supply of funds to implement green finance; and (3) creating a framework for smooth implementation of green finance. These should be linked to the realization of steady financing in each field of green finance, namely infrastructure including renewable energy, improvement of energy efficiency, food, agriculture and

land use.

The nature of green finance varies from sector to sector, and the appropriate division of roles between public and private finance is required. Some estimates suggest that a significant increase in private funds is necessary, and thus it is also essential to increase ESG investment in this context. In Asia, ESG investment lags behind that in Europe and the United States, and efforts must be made to catch up.

Climate change, on the other hand, is not a problem that can be solved by conventional market principles. It is also an extremely long-term challenge, and its solution is complex. It is therefore necessary to develop a country-based road map. It should be closely related to the NDCs of the Paris Agreement.

In addition, it is desirable to have international standards as far as possible for environmental risk analysis, information disclosure and taxonomy. Discussions in Europe tend to take the lead, but Asian countries must follow this up and participate in setting standards.

Achieving a green recovery through both pandemic response and climate change mitigation is not easy due to financial constraints. However, its realization is indispensable. In order to maintain momentum for the promotion of climate change measures, promotional and educational activities that encourage voluntary efforts by individuals and companies will be important, on top of initiatives by international organizations and governments.

End Notes

1. United Nations Environment Programme [2020], p.9.
2. United Nations Environment Programme [2020], p.32.
3. Based on the descriptions of United Nations Environment Programme [2020], p.33 and onward.
4. Based primarily on United Nations Environment Programme [2019], Chapter 6.
5. IRENA [2020], p.72.
6. United Nations Environment Programme [2019], p.48.
7. IRENA [2020], p.91.
8. IRENA [2020], p.95.
9. Abstract of Sachs et al. [2019]
10. Shimizu, S. [2020a], p.107.
11. Climate Finance Leadership Initiative [2019], p.46.

12. DBS [2017], p.27 and onward.

13. See Business and Sustainable Development Commission [2017] for the details of agriculture-related investment.

14. Referred to DBS [2017], p.51 and onward.

15. HSBC Bank [2020a], which summarized the results of a survey of 1,000 issuers and investors each in the capital market.

16. HSBC Bank [2020b].

17. The following descriptions are based on Asian Development Bank [2020], pp.47-49.

18. The above descriptions are based on G20 Green Finance Study Group [2017], pp.7-10.

19. NGFS (Network for Greening the Financial System) [2019a] and [2019b]

20. NGFS (Network for Greening the Financial System) [2019a], p.13.

21. NGFS [2019b], p.17.

22. NGFS [2020a]. p.12.

23. NGFS [2020b], p.11 and onward.

24. TCFD Consortium's website.

25. Financial Stability Board (FSB)'s website.

26. Information on Japan is based on "Trends in Disclosure of Information Related to Climate Change" on the Ministry of Economy, Trade and Industry (METI)'s website.

27. In addition, an international environmental NGO CDP (formerly, Carbon Disclosure Project which was established in 2000) places importance on the TCFD framework for information disclosure in its questionnaires to major companies around the world (In Japan, the questionnaires are sent to 500 companies).

28. This is the result of using AI to analyze information disclosed by 1,701 public companies in 69 countries.

29. ASEAN Working Committee on Capital Market Development [2020], p.70.

30. ASIFMA (Asia Securities Industry and Financial Markets Association) [2020], p.13.

31. Esaki [2020], p.38.

32. “EU taxonomy for sustainable activities” on the EU’s official website.

33. Kato [2020].

34. ASEAN Capital Markets Forum [2019], p.16.

35. For details, refer to Esaki [2020], p.39.

36. Parry [2019].

37. For the following explanation, refer to IMF [2020], p.94.

38. IMF [2020], p.96.

39. IMF [2020], p.101.

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