
Bank of Korea's Response to Climate Change

Oct. 2021

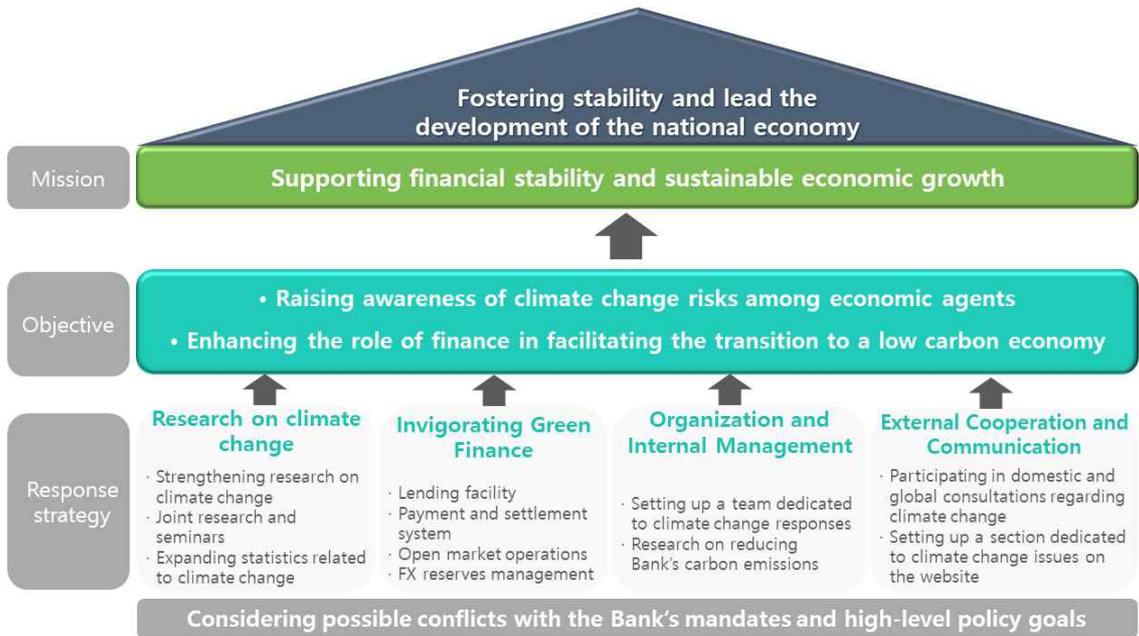
Bank of Korea

I Climate Change and the Role of the Central Bank

- Addressing the seriousness of climate change and transitioning to a green economy are pressing tasks that need to be addressed in order to achieve sustainable growth.
 - The Intergovernmental Panel on Climate Change (IPCC) has warned that global warming is already at a serious level and that any further rise in the global average temperature could lead to worsening extreme weather events, ecological instability, and restrictions on human activities.
 - The transition to a green economy could entail high costs and great effort, but it is an unavoidable challenge that must be tackled in the course of achieving sustainable growth, while also serving as an opportunity to expand our engines of future economic growth.
- As we are facing climate change-induced changes in economic conditions at home and abroad, as well as in the financial system, we need to come up with responses concerning what role a central bank should play going forward.
 - The risks associated with the transition to carbon neutrality can have substantial effects on the mandates of central banks, price stability and financial stability.
 - In addition, the role of central banks is currently expanding from being an inflation fighter to being a crisis fighter, as the world weathers the global financial crisis and the COVID-19 pandemic

- Within central banks, there has been a growing call to assess the economic impact of climate change and to devise response measures in order to effectively conduct the mandates of price stability and financial stability.
 - Throughout the transition to carbon neutrality, a rise in costs for carbon neutral companies could undermine price and financial stability. Therefore, more sophisticated measures must be reviewed by central banks.
 - In June 2020, Bank of Korea announced “BOK 2030” to confirm its mandates (stability and development of the national economy) and declare its commitments to playing a leading role in responding to climate change.
 - To this, Bank of Korea set up a Climate Change Response Task Force (in April 2021) through which it is making bank-wide efforts to establish its strategy for countering climate change.
- ⇒ This paper is a compilation of efforts made so far. Based on this, a more meticulous review will be conducted of the application of climate change components to the Bank’s policy tools and functions, to contribute to raising awareness regarding climate change risks and to strengthening the role of finance in facilitating the transition to a low carbon economy.

Bank of Korea's Direction for Climate Change Response



1. Seriousness of Climate Change and Its Economic Impact

A. Seriousness of climate change

- The Intergovernmental Panel on Climate Change (IPCC) warned in 2014 that an increase in the global average surface temperature of more than 2°C above pre-industrial era (1880-1900) levels could bring catastrophic consequences to humanity.
- In a follow-up report in 2018, the IPCC suggested that global warming should be limited to below 1.5°C above pre-industrial levels, which would require carbon emissions to reach net zero by around 2050.
- According to its latest report (2021), the global surface temperature was 1.09°C higher between 2011 and 2020 than pre-industrial levels, indicating that it would reach the tipping point of 1.5°C with a 0.4-degree increase.
 - o Global warming is expected to hit the 1.5°C level sometime between 2021 and 2040, which is a decade earlier than the 2030 to 2052 window projected in 2018.

B. Economic impact of climate change

- Climate change has recently been assessed as a new type of risk to the global economic and financial systems.

- Climate change will have a considerable real economic and financial impact through physical risks stemming from Earth's average temperature rise and through transition risks from the implementation of carbon emission reduction policies.
- **[Physical risk]** Shocks such as temperature rises and extreme weather events can cause changes in productivity and financial damage in affected regions, which could also lead to insurance losses and increased credit risk for exposed capital.
- **[Transition risk]** In the process of transitioning to a low-carbon economy, policies aimed at reducing greenhouse gas emissions and the development of low-carbon technologies will affect individual sectors of the real economy, which will also lead to a risk for financial sectors with large exposure to carbon-intensive industries.

2. Responses by International Organizations and Governments

A. International organizations

- Beginning with the signing of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, the international community has made concerted efforts in recognition of the severity of climate change.
- After the signing of the 1997 Kyoto Protocol, which required only advanced economies to reduce GHG emissions, the Paris Agreement was adopted in 2015, requiring all parties to set their own goals to reduce emissions.

- Financial consultative and international bodies such as the Network for Greening the Financial System (NGFS) and the BIS have emphasized the need for climate change responses by central banks and supervisory bodies, focusing on the financial sector's role in the transition to a low-carbon economy.

B. Governments

- After the signing of the Paris Agreement in December 2015, large countries have moved on from the planning stage to the implementation stage in their climate change responses.
 - o Advanced countries are actively promoting policies to transition to a low-carbon economy, in recognition that low-carbon and green policies are part of their new future economic growth strategies.

3. Responses by Central Banks

- Major central banks around the world started to take their climate change actions by incorporating climate change considerations into their climate risk assessments, external relations and communications, and policy instruments and mandates, to protect their financial systems and support government economic policies.

A. Assessing impacts of climate change

- Led by major central banks in Europe, there has been active research underway into what impacts climate change could have on financial stability.

- Bank of Korea has analyzed and published the transition risks of climate change that could occur over the next 30 years in its Financial Stability Report (June 2021).

B. External cooperation and communication

- Major central banks participate in discussions at climate change-related international consultative bodies and international organizations (NGFS, BCBS, etc.) to identify relevant trends and to strengthen the cooperative framework.
- The BOE published its efforts at responding to climate change on its website, sharing them with the public.
 - o Some central banks have set up policies to reduce carbon emissions and have announced the results in annual reports.

C. Policy responses

- More and more central banks are reflecting climate change components in their policy instruments.
 - o They include the purchase of green bonds (ECB, BOE, etc), the launch of climate-related lending facilities (Singapore, Japan, etc), reflecting ESG components in their asset management (Sweden, Switzerland, etc.), and reflecting climate components in financial institutions' supervisory frameworks (Hungary, ECB).

D. Establishment of teams dedicated to responding to climate change

- Major central banks are responding to climate change by operating consultative bodies within their organizations, setting up dedicated units, and introducing consultative bodies among agencies.

4. The Korean Government and Public Sector's Responses to Climate Change

- The government has laid the institutional foundation for achieving carbon neutrality and for establishing a framework for responding to climate change by passing the Carbon Neutrality Act, and by operating an emissions trading scheme and an emissions target management scheme.

Climate change-related acts and schemes in Korea

| Carbon Neutrality Act | Emissions Trading Scheme | Emissions Target Management Scheme |
|---|---|--|
| · Setting national greenhouse gas emission targets (reduce carbon emissions by over 35% by 2030 from 2018 levels) | · Market-based greenhouse gas emission reduction scheme based on national greenhouse gas emission targets | · Greenhouse gas emission reduction scheme with a direct regulatory method based on national greenhouse gas emission targets |

- To strengthen the capacities of the financial sector to address climate change, the government is pursuing the revitalization of green funds and bond markets and establishing disclosure and classification systems related to climate change.

III

Impacts of Climate Change on Real Economy and Financial System

1. Impacts of Climate Change on Macro Economy

A. Transmission channels

- Climate change affects the real economy and prices through physical risks that climate change itself causes, and through the transition risks that arise in the course of low-carbon transition (Batten et al., 2020; BOE, 2015; Carney, 2015).

Transmission channels of climate change risks¹⁾²⁾

| | | Physical risk | | Transition risk | |
|-------------|--------------------------|--|---|---|--|
| | | Acute shocks (e.g. natural disaster) | Chronic shocks (e.g. rise in average temperature) | Regulation on greenhouse gas emissions | Growth of low-carbon industries |
| Demand-side | Consumption | Property damage → negative asset effects | | Rising prices → decline in purchasing power [Rising price of carbon intensive-products] | |
| | Investment | Decline in assets, rising uncertainties | | Rise in production costs | Expansion of environment-friendly investment |
| | Exports | Disruption to supply chain, weaker competitiveness, rising uncertainties | | Worsening terms of trade | |
| Supply-side | Labor supply | | Decline in labor productivity [Increase in unit production cost] | | |
| | Input component | | Reduction of agricultural product output [Increase in unit price] | | |
| | Capital stock | Destruction of physical capital → decline in production capacity | | Decline in productivity due to stranded assets | |
| | Technological innovation | | | | Growth of industries related to low-carbon technology [Decline in product prices stemming from production technology innovation] |

Notes : 1) The shaded areas in red indicate the negative effects on the macro economy and the shaded areas in blue refer to the positive effects.

2) Those in parentheses indicate inflation effects.

3) Assets whose life has shortened more than expected at the time the investment decision was made due to environmental regulations.

B. Scenario analysis on the impacts of transition risks on real economy

[Scenarios]

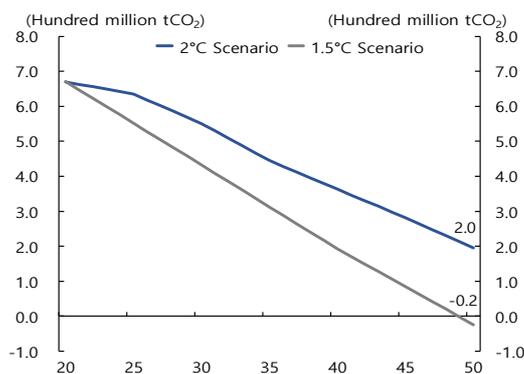
- The scenarios build on the transition pathways, proposed by the NGFS, that achieves the Paris Agreement's goals*.

* Limit the increase in the average global temperature to 2 degrees (1.5 degrees, if possible) from pre-industrial levels (1850-1900).

- o 2°C Scenario: Reduce carbon dioxide emissions by about 70% by 2050, from 670 million tons in 2020 to 200 million tons in 2050, to limit the increase in the average global temperature to between 1.5 and 2.0 degrees above pre-industrial levels.
- o 1.5°C Scenario: Reduce carbon dioxide emissions by 100% by 2050* compared to 2020 levels to limit the growth in the average global temperature temperature to below 1.5 degrees above pre-industrial levels.

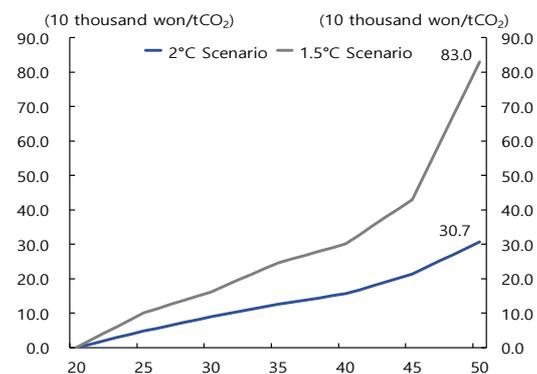
* Acheives carbon neutrality by 2050

Greenhouse gas emission pathways



Source: NGFS

Emission price pathways



Source: NGFS

[Analysis method]

- To estimate transition risk impact from various perspectives, we used the BOK-DSGE and the BOK-Climate Stress Test models for scenario analysis.
 - **(BOK-DSGE model)** We imposed a capital gains tax similar to the carbon tax in the current DSGE model and estimated its effects on GDP and inflation.
 - **(BOK-Climate Stress Test model)** We calculated the changes in corporate production costs, affected by the toughened greenhouse gas emissions trading scheme and advances in low-carbon technologies, and estimated changes in GDP based on this.

[Results]

- **(GDP changes)** According to our scenario analyses, the carbon pricing policy negatively affects the economy over the long haul if not complemented by effective environment-friendly technologies and policies.
 - **2°C scenario:** The GDP growth rate is expected to fall by 0.08-0.09%p on an average annual basis.
 - Under this scenario, as the effects of low-carbon technology development considerably offset the effects of carbon pricing policy, the impact of transition risks is relatively small.
 - **1.5°C scenario:** The GDP growth rate is projected to decline by an average annual rate 0.25-0.32%p.

- Under this scenario, the effects of transition risks expand greatly as the emission costs rapidly rises following 2040.

Impact¹⁾ of transition risks on GDP

(compared to baseline scenarios²⁾)

| Scenario | Model | Average annual GDP growth rates between 2021 and 2050 (%p) |
|----------------|-------------------------|--|
| 2°C scenario | BOK-DSGE | -0.08 |
| | BOK-Climate Stress Test | -0.09 |
| 1.5°C scenario | BOK-DSGE | -0.32 |
| | BOK-Climate Stress Test | -0.25 |

Notes: 1) It means GDP losses caused by transition risks. Since physical risks are not considered in the analysis, the impact differs from real GDP changes.

2) The BOK-DSGE model sets a growth path that reflects existing trends without incorporating climate shocks as the baseline scenario. The BOK-Climate Stress Test presumes in the baseline scenario that the economic structure remains at the level of 2020, without climate shocks.

- **(Inflation changes)** The carbon pricing policy (e.g. carbon tax) could cause inflation through a rise in corporate production costs if it is not complemented by effective environmental-friendly technologies and policies.
 - **2°C scenario:** Consumer price inflation is expected to rise by 0.02%p annually, on average.
 - **1.5°C scenario:** Consumer price inflation is expected to rise by an average annual rate of 0.09%p.

Impact of transition risks on inflation

(compared to baseline scenario¹⁾)

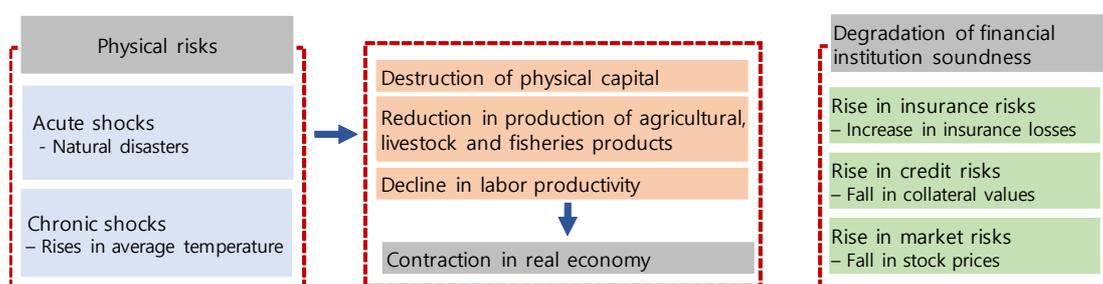
| Scenario | Model | Average annual inflation between 2021 and 2050 (%p) |
|----------------|----------|---|
| 2°C scenario | BOK-DSGE | 0.02 |
| 1.5°C scenario | BOK-DSGE | 0.09 |

Note: 1) This entails the existing consumer price inflation trend without climate shocks.

2. Impact of Climate Change on the Financial System

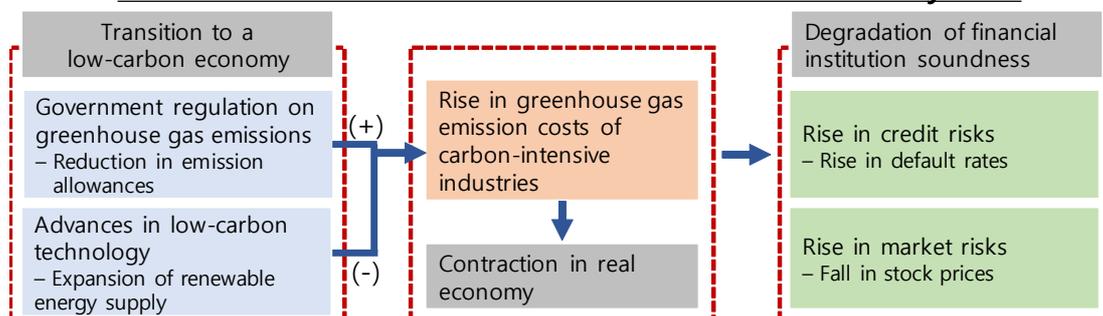
- **(Physical risks)** If the transition toward a low-carbon economy is not smooth, and so climate change is materialized, the value of financial assets of corporations suffering from physical risks could decline and the soundness of the financial institutions holding these assets could worsen.

Transmission channels of physical risks to the financial system



- **(Transition risks)** If the negative effects of greenhouse gas emission regulations outweigh the positive effects of advances in low-carbon technologies in the process of transitioning to a low-carbon economy, credit and market risks of financial assets of carbon-intensive industries could rise and thus worsen the soundness of financial institutions holding these assets, thereby negatively affecting financial stability.

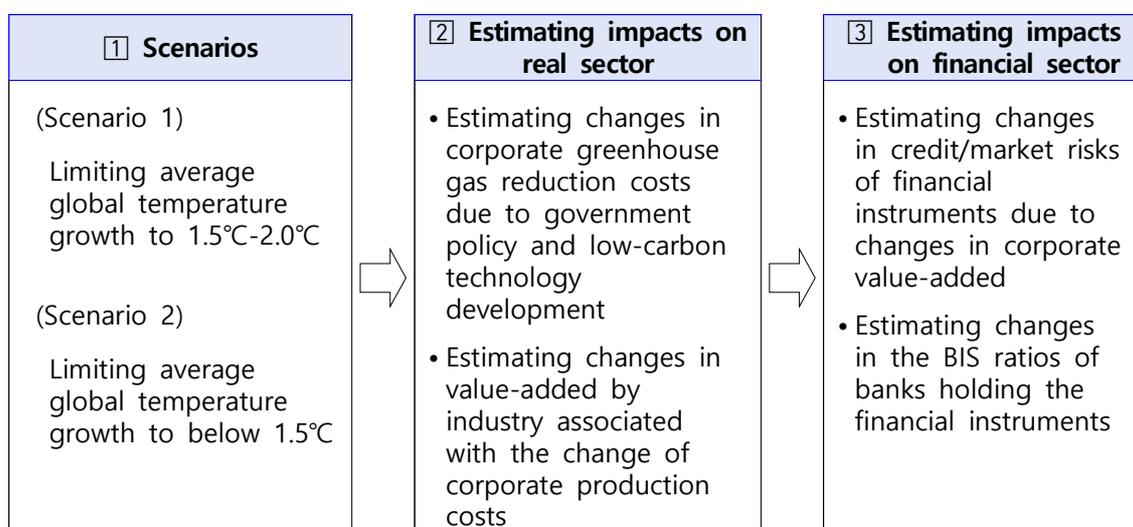
Transmission channels of transition risks to the financial system



[Analysis methods]

- The BOK-Climate Stress Test model and the NGFS's climate scenarios that were mentioned earlier were used for scenario analysis.
- We first estimated the effects of the government's climate policy and low-carbon technology development on the real economy, and then estimated the impact on the financial sector based on this.

Procedure for transition risk stress test



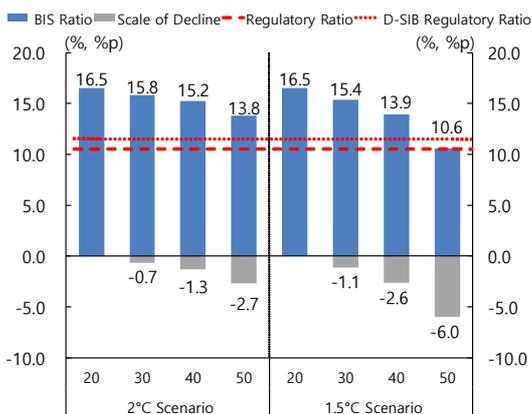
[Results]

- **(Impact on credit and market risks)** Stronger efforts to reduce greenhouse gas emissions increase credit (rising default rates) and market risks (falling stock prices) of financial assets of carbon-intensive industries.
- The default rates of carbon-intensive industries is expected to rise significantly (maximum of 10.2%p-18.8%p, annual average of 0.34%p-0.63%p), and their stock prices are expected to decline to a large extent (maximum of 51.0%-53.7%, annual average of 1.7%-1.8%) compared to 2019.

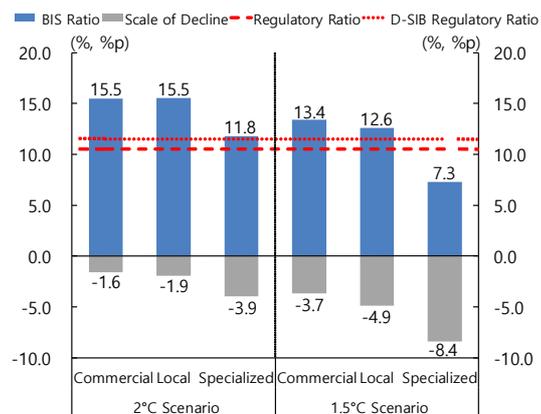
- **(Impact on BIS ratios)** The falling value of financial assets of carbon-intensive industries lowers the BIS ratios (BIS capital adequacy ratio) of domestic banks by 2.6%p-5.8%p in 2050 compared to 2020 (annual average of 0.09%p-0.19%p from 2021 to 2050).
 - In the 2°C scenario, the BIS ratio of domestic banks exceeds the regulatory ratio (10.5%) until 2050.
 - In the 1.5°C scenario, the BIS ratio of domestic banks falls to the regulatory ratio, as the default rates of carbon-intensive companies rises and their stock prices declines significantly since 2040.

Changes in the BIS ratios of banking sector due to transition risks¹⁾²⁾

Changes in the BIS ratios of domestic banks



Changes in the BIS ratios by bank type³⁾



- Notes: 1) The regulatory ratio is 10.5% (D-SIB 11.5%).
 2) Reference time is Dec 2020.
 3) Changes in BIS ratios of commercial, local, and specialized banks, as of 2050.

IV BOK' s Response to Climate Change

1. Strengthening Research and Analytical Work

- It is necessary to start an assessment of the economic impacts of climate change, including its influence on financial stability and monetary policy transmission channels.
- Bank of Korea will strengthen its research abilities by establishing channels through which it can collect various pieces of information related to climate change issues.
- Bank of Korea will set up a statistical basis and expand related statistics through cooperation with international organizations and domestic institutions, while monitoring the international and domestic trends of statistics related to climate change.

2. Reviewing Available Policy Tools

- Bank of Korea will actively play its role as a central bank, in an attempt to minimize any negative effects of climate change on the economy.
- While referring to examples of ways in which major central banks have responded to climate change, Bank of Korea will review tools that suit its policy operation conditions among its overall policy tools.
 - o To encourage a smooth supply of funds to the eco-friendly sector, Bank of Korea will seek ways to utilize lending, payment and settlement systems, and open market operations.

- In managing foreign exchange reserves, Bank of Korea will seek ways to expand the share of investment in the eco-friendly sector by increasing the weight applied to climate change.

Ⓐ **Lending systems**

- (Broaden the range of eligible collateral)** Bank of Korea is considering including Green Bonds as eligible collateral.
 - o The addition of Green Bonds as eligible collateral is expected to help increase demand for the bonds and improve issuance conditions.
- (Support green growth companies through bank intermediation support facility)** Bank of Korea is also considering expanding the supply of green funds to SMEs through its bank intermediation support facility.
 - o Support for green growth companies through the bank intermediation support facility is expected to support the strengthening of new growth engines for the post-COVID-19 era and to increase the supply of green funds to SMEs with limited access to green finance.

[Constraints and Considerations]

- (Expansion of the scope of securities eligible as collateral)** It is expected to take time for banks to secure and utilize green bonds to use them as collateral for loans extended by the BOK, due to the recent increase in investment demand for them from pension funds and asset management companies.

- (Support for green growth companies through the Financial Intermediated Lending Support Facility)** Given that there are a limited number of SMEs subject to the Financial Intermediated Lending Support Facility, and a lack of any authentication process related to the use of funds or follow-up controls, caution should be exercised in making decisions as to the subject and size of support.

㉔ Payment and Settlement System

- (Expansion of the scope of securities eligible as collateral for net settlements)** When green bonds are added to the scope of securities eligible as collateral for loans extended by the BOK, Bank of Korea will consider the expansion of the scope of securities eligible as collateral for net settlements to the same extent.
 - o If the scope of green bonds included in securities eligible as collateral for net settlements is expanded to include bonds issued by public institutions, the collateral posting burden of participants, stemming from the increased ratio of collateral for guaranteeing net settlements, is expected to be lessened.

[Constraints and Considerations]

- It is expected to take time for banks to secure and utilize green bonds to use them as collateral for net settlements, due to the recent increase in investment demand for them from pension funds and asset management companies.

© Open Market Operations

- (Expansion of the scope of securities eligible as collateral for RP transactions and securities lending)** Bank of Korea plans to add green bonds to the scope of securities eligible for RP transactions and securities lending.
 - o If green bonds issued by specialized banks and public institutions are included in the securities eligible as collateral, it is expected that they will be used more widely and thus it will be possible to issue them without difficulty.

[Constraints and Considerations]

- However, since the volume of green bond issuance is currently not large, the impact of any expansion of the securities may be limited.

① FX Reserve Management

- (Sustained expansion of investment in ESG equities and bonds)**
From the perspective of portfolio asset diversification, Bank of Korea invests part of its FX assets (\$7.12 billion as of end-June 2021) in ESG assets associated with responses to climate change and plans to continually expand such investment going forward.
- (Expansion of the application of a negative screening strategy)**
The current level of investment in ESG products for FX asset diversification will be upgraded to cover the broad application of ESG components to the entire range of FX assets.

(Considering adoption of ESG integration strategy in the long run) Bank of Korea is considering ways to adopt an ESG integration strategy according to which financial and non-financial analysis would be integrated into the entire management process.

(Future ESG FX asset management action plan) With respect to ESG bonds, Bank of Korea plans to continually purchase green bonds, social bonds, and sustainable bonds included in the current index for direct and trust management.

Concerning negative screening, the Bank plans to make use of a negative screening index from an outside supplier in the initial stages, in consideration of limitations on its staff and systems, but ultimately to set up its screening framework.

3. Organization and Internal Management

(Establishing a separate unit responsible for climate change) To maintain continuity in its response to climate change, Bank of Korea plans to set up a team or a section responsible for responding to climate change. If there is a need for cooperation among departments, an “agile” cross-departmental group will be operated.

(Reducing carbon emissions and disclosing relevant information) Bank of Korea plans to conduct research into carbon emission status and reduction, and establish a carbon reduction target and action plans in various areas based on research results.

o Bank of Korea is set to establish its action plan by the end of 2022, implement it starting in 2023, and disclose all relevant achievements through, for instance, the Annual Report.

4. External Cooperation and Communications

- Bank of Korea will strengthen the gathering of information on climate change-related research and policy directions in the international community by expanding its participation in climate-related global consultation bodies.

- Bank of Korea will form a consultation body made up of staff who are in charge of climate change at financial institutions, listen to the opinions of market participants by holding regular conferences, and identify industry trends.

- Bank of Korea's website will have a section devoted to climate change and disclose to the public its achievements in terms of research and studies on climate change to contribute to raising awareness of climate change risk among economic entities