우리들의미래
Coalition for
Our Common Future

Strategic Direction for Phase Four of South Korea's Emission Trading Scheme

Final Report

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List of Abbreviations

NCE	Next-generation Climate Expert
ETS	Emission Trading Scheme
EV	Electric Vehicle
CBAM	Carbon Border Adjustment Mechanism
RPS	Renewable Portfolio Standards
IMO	International Maritime Organization
MEPC	Marine Environment Protection Committee
IPCC	Intergovernmental Panel on Climate Change
IF	Innovation Fund
NER	New Entrant's Reserve
MAC	Marginal Abatement cost
MSC	Marginal social cost
MSR	Market Stability Reserve
TNAC	Total Number of Allowances in Circulation
SAM	Supply Adjustment Mechanism
CCM	Cost Containment Mechanism
CCR	Cost Containment Reserve
APCR	Allowance Price Containment Reserve
ECR	Emission Containment Reserve

Summary

This report provides a deep dive into South Korea's Emissions Trading Scheme (ETS), with a focus on preparing for its Phase Four. The study encompasses a broad range of aspects, including operational efficiency, market dynamics, comparative analysis with other ETS markets, and a set of targeted recommendations for enhancing the system's effectiveness.

Operational Efficiency and Market Dynamics: The report assesses the operational efficiency of South Korea's ETS, noting challenges in fund utilization and governance. It highlights the need for improved transparency and effectiveness, especially in the use of the Climate Response Fund.

Price Cap and Floor Mechanisms: The study thoroughly examines the need for and implementation of price stabilization mechanisms, recognizing their importance in managing market volatility and ensuring long-term stability.

Comparative Global ETS Analysis: A detailed comparison of ETS markets in Korea, the EU, California, Quebec, and New Zealand is presented. This analysis provides insights into different approaches, sectoral coverage, pricing mechanisms, and the overall effectiveness of these systems.

Recommendations for South Korea's ETS Phase Four

Cap Setting and Allocation: Adjust the cap to reflect updated National Greenhouse Gas Reduction Roadmaps and consider a more ambitious reduction target.

Trading and Auction Mechanisms: Encouraging broader participation in auctions, particularly from financial institutions, and considering mandatory exchange trading for certain allowances.

Emission Coverage: Enhancing regulations on free allocation, aligning more closely with EU standards to minimize the impact of the Carbon Border Adjustment Mechanism (CBAM).

Market Stabilization: Implement more responsive and effective price control measures, including price ceilings and floors, to address market uncertainties and guide medium- to long-term trends.

Climate Response Fund: Strengthening the linkage between the fund and the ETS by allocating

a portion specifically for supporting companies involved in ETS auctions.

Governance and Stakeholder Insights: The report includes diverse perspectives from stakeholders, emphasizing the need for inclusive approaches in ETS policymaking and implementation.

The report concludes that as South Korea approaches its Phase Four of ETS, strategic improvements in cap setting, allocation mechanisms, market stabilization, and stakeholder engagement are essential. By adopting these recommendations, South Korea can enhance the effectiveness of its ETS, contributing significantly to global climate change mitigation efforts.

Ch. I. Introduction

I-1. Background and Objective

i. Significance and Objectives of the Research

Climate change is recognized as a paramount global challenge, demanding immediate, science-based action. The urgency of the situation is underscored by the need to bridge the communication gap among experts, policymakers, and the public. This gap not only impedes the acceleration of climate action but also frustrates a burgeoning cohort of climate-invested youth deeply concerned about the planet's future.

Next-generation Climate Experts (NCEs) Program: In response to this critical need for enhanced communication and collaboration, the NCE initiative has been proposed. The initiative aims to facilitate constructive discussions and actionable outcomes among NCEs, seasoned expert groups, and policymakers.

Objectives of the NCE Initiative: The primary objective of the NCE initiative is to empower young climate advocates. This empowerment involves providing the knowledge and tools necessary to participate meaningfully in decision-making. Throughout the project, NCEs gain a comprehensive understanding of the processes and steps involved in policymaking. Additionally, they acquire the skills to build transparent communication channels between policymakers and field experts.

Focus on South Korea's Emission Trading Scheme (K-ETS): The NCE initiative mainly focuses on phase four of K-ETS. This scheme is a pivotal component of the national efforts to combat climate change. Despite significant progress with the current K-ETS policy based on free allocation, experts have identified the need for a more comprehensive strategy to upgrade the K-ETS in preparation for phase four. The NCEs thoroughly assess South Korea, the first nationwide ETS market in East Asia, examining both its successes and areas of improvement. Valuable lessons are drawn from leading ETS frameworks worldwide,

culminating in proposed recommendations and critical changes that should be reflected in phase four of K-ETS.

South Korea's Commitment to International Climate Action: The ETS, being a focal point in this paper, plays a pivotal role in South Korea's commitment to international climate action. Driven by ambitious goals such as achieving net-zero greenhouse gas (GHG) emissions by 2050 and a substantial 40 percent reduction in GHG emissions by 2030 compared to 2018, South Korea is poised for a significant transformation towards a carbon-neutral energy landscape. This transformation includes a decarbonized industrial sector, widespread adoption of electric vehicles (EVs), and the construction of zero-emission buildings. A cornerstone of this strategy is the robust allocation of climate financing to facilitate these critical changes.

Role of ETS in the Comprehensive Approach: The ETS plays an essential role in this comprehensive approach, serving as a mechanism to regulate emissions and secure crucial financial resources. These resources underpin the country's green growth and sustainable development. By assigning monetary value to carbon and providing incentives for emission reductions, the ETS drives progress towards environmental goals. Simultaneously, it generates funds that can be strategically channeled into developing and implementing green technologies, further advancing South Korea's ambitions for carbon neutrality.

Key Objective of this Research: A key objective of this research is to ensure a steadfast commitment to the 'auctioning' of emissions allowances and to increase its portion in the upcoming phase, identifying the need for implementing price stabilization mechanisms and effective Climate Response Fund. To achieve this, the NCEs compile a strategic policy report outlining the necessary upgrades to K-ETS. This report results from a comprehensive analysis and stakeholder engagement through interviews with experts and policymakers. The NCEs gain valuable insights and perspectives through the research and the interviews.

Creating Consensus Among Domestic Stakeholders: To create a consensus among domestic stakeholders and decision-makers, the NCEs research the ideal components of a booming ETS market. This research draws from a vast literature on the subject, both domestically and internationally. Through effective communication, the NCEs aim to

reinforce the “no treat” philosophy regarding the portion of auctioned ETS, further strengthening South Korea’s carbon neutrality goals.

Establishing a Lasting Communication Pipeline: Ultimately, the NCE initiative seeks to establish a lasting communication pipeline between climate experts and decision-makers. This is crucial to ensuring continuous collaboration beyond the present and throughout the journey to 2050. During this period, multiple administrations may come into power with varying positions on carbon neutrality. By actively involving a passionate and ambitious cohort of climate-conscious emerging experts in the decision-making process, the initiative endeavors to test and solidify South Korea’s commitment to achieving its carbon neutrality targets, both domestically and on the international stage.

The NCE initiative presents a unique opportunity to bridge the information gap, engage young climate advocates, and create a pathway for effective climate action. By critically evaluating current K-ETS, this paper aims to provide policy recommendations for the upcoming Phase Four, as well as promote active engagement of the NCEs in the policymaking process. It is expected to steer the country towards a more sustainable and climate-resilient future.

Ch. II Current Status and Evaluation of Korea's ETS

II-1. Overview of Korea's ETS

Carbon Pricing: The carbon pricing mechanism is a strategic approach to reduce carbon emissions by assigning a monetary value to carbon output. This system has gained prominence with the growing focus on carbon neutrality and climate change mitigation in various industries. Essentially, it imposes a cost on carbon emissions exceeding a specified limit, with the primary aim of encouraging emission reduction. This approach helps in allocating the economic burden of GHG missions between producers and consumers, ensuring a shared responsibility for environmental impact.

- **Carbon Tax and Emissions Trading System**

  The carbon pricing system, primarily categorized into carbon taxes and ETS, addresses climate change by monetizing carbon emissions. Carbon taxes ensure stable revenue through fixed pricing per unit of GHG emissions, but risk cost pass-through to consumers, potentially raising prices. On the other hand, ETS sets a national emissions cap, distributing tradeable KAU[1] to emitters. It fosters industry growth by incentivizing carbon reduction technologies and creating jobs. However, ETS faces challenges like price volatility for permits due to supply and demand dynamics, and challenging companies to strategize long-term plans. Predicting tax revenue from emissions trading is complex. Initial methods of allocating permits or pricing can disproportionately impact specific industries or regions economically, raising social fairness concerns. Robust monitoring and regulation are crucial for ETS effectiveness, with insufficient oversight or lack of transparency leading to potentially fraudulent activities.

[1] KAU refers to Korean Allowance Unit.

- **K-ETS**

South Korea opted for the ETS over carbon taxation to foster technological innovation and flexibility for businesses, resulting in job growth linked to this system. Act on the Allocation and Trading of Greenhouse Gas Emissions Allowances was enacted by the National Assembly on May 2, 2012, and came into force on November 15, 2012. The law's formal implementation began in 2015, marking the commencement of the country's structured approach to emissions trading and GHG management.

II-2. Evaluation of the Korea's ETS

i. Initial allocation of allowances

(i-1) Current Status

ETS in South Korea, a key tool for achieving the "2030 Greenhouse Gas Reduction Roadmap," establishes a total emissions cap aligned with the roadmap. Industries must either internally reduce emissions or trade it to comply with the cap. ETS was established under Article 46 of the "Framework Act on Low Carbon, Green Growth" (enacted in January 2010) and is governed by the "Act on Allocation and Trading of Greenhouse Gas Emissions" (enacted in May 2012). This system has been in operation since January 1, 2015. It involves the annual allocation of KAU to GHG-emitting businesses, allowing emissions within allocated limits. The system is designed to facilitate the trading of KAU among businesses to address any surplus or deficit in their emissions relative to the allocated permits.

- **Allocation Plan for KAU**

The allocation of KAU is a key element of the system, with goals set for each phase. For the phase one, 100% of the allocations were free. In the phase two, 3% of the KAU allocated to companies in certain sectors[2] were subject to auction. The phase three (2021.1.1. - 2025.12.31) aims for aggressive GHG reduction based on market mechanisms, including expanding auction to 10% and allowing third-party trading. During the phase three, the coverage of K-ETS increased from 70.2% in the phase two to 73.5%, with additional sectors such as transportation and construction included. The

[2] Criteria for sectors eligible for free allocation include 1) sectors where the product of cost incidence and trade intensity is 0.002 (0.2%) or higher, 2) local governments, schools, hospitals, and public transport operators, 28 of the 69 sectors in the phase three met these criteria.

Number of entities expanded to 62 sectors and 589 companies.

[Table 1] Allocation Plan

	PHASE ONE (2015-2017)	PHASE TWO (2018-2020)	PHASE THREE (2021-2025)
Purpose	Accumulation of Experience and Establishment of the Trading System	Substantial reduction of GHGs.	Proactive GHG reduction.
Operation	Enhancing the system's flexibility, such as expanding the range of recognized offsets and building infrastructure for accurate Monitoring, Reporting, and Verification implementation.	Expanding the scope of the trading system and raising targets, refining various standards such as emission reporting and verification.	Inducing voluntary reductions in preparation for the new climate regime, expanding liquidity supply through domestic financial intermediaries and other thrid parties.
Allocation	Utilizing experience from the strategic free allocation and Target Management System	Starting auction *Free allocation: 97%, auctioning: 3%, and advancing allocation methods through benchmarking.	Expanding the ratio of auction *Free: 90%, Auction: 10%, establishing advanced allocation methods."

- **The Entities Subject to the ETS**

The scope of K-ETS encompasses companies and facilities with an average annual GHG emission over recent years exceeding specific thresholds: companies emitting more than 125,000 tons or facilities emitting over 25,000 tons. Additionally, companies that voluntarily apply to be designated as emission allocation entities are included. The regulated GHGs under this system cover six categories: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).

- **Free Allocation**

The allocation of free KAU follows two main approaches: based on historical emissions, known as Grandfathering (GF), and on emissions efficiency, known as Benchmarking (BM). The BM method, favoring entities with efficient emission processes, is increasingly applied to enhance equity and encourage reduction investments.

Conversely, the GF method faces structural limitations in recognizing emission reductions, while BM is advantageous due to its ease of acknowledging reductions. During the phase three, 65% of the allocations are based on emission efficiency standards.

Phase One	Phase Two	Phase Three
(3) Grey clinker, Oil refining, Aviation	(Existing 3) + Power Generation, District Energy, Industrial Complex, Waste Management	(Existing 7) + Steel, Petrochemicals, Buildings, Paper, Wood Processing

[Figure 1] Industries for BM Application

- **The composition of the total KAU**

The total allowable emissions for K-ETS represent the cumulative GHG emissions permitted for ETS-regulated entities within the nation during the designated phase. These emissions are calculated in alignment with the national reduction targets, post-adjustment for targeted emission reductions. This consists of the sum of the 'allocated quota ('pre-quota')' that the government allocates to target entities before the start of the phase and the 'reserve' as per Article 18 of the Act.

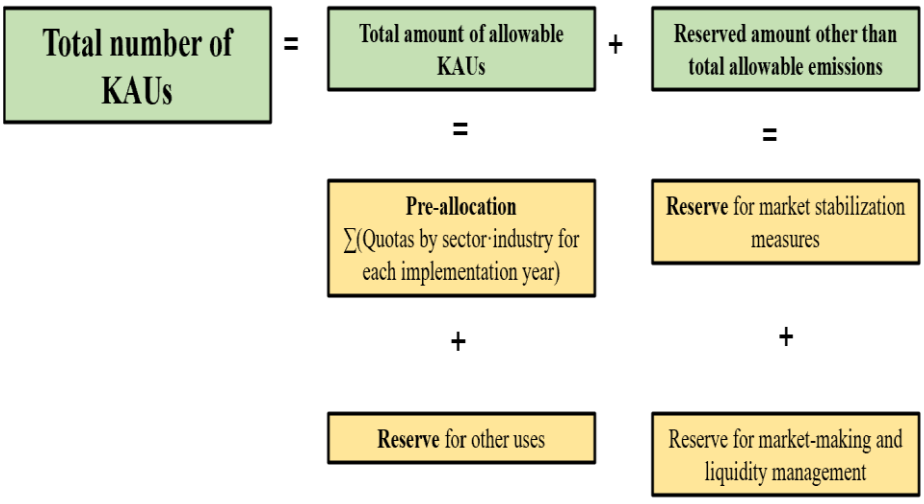


Figure 2 The composition of the total KAUs

The total emission allowance for the phase three is approximately 3,082,259 thousand Korean Allowance Units (KAUs), with the emission allowance set at around 3,048,259 thousand KAUs.

[Table 2] Total Emission Allowance for the Phase Three

(unit: KAU)

		Allocated amount by Implementation year					Total
		2021	2022	2023	2024	2025	
Total number of emission permits							3,082,258,880
Reserve	Market Stabilization Measures						14,000,000
	Market-making and liquidity management						20,000,000
	ETCs Transition						72,696,520
	ETCs Other then transition						73,465,992
Pre-allocation		589,316,246	589,316,246	589,316,246	567,073,815	567,073,815	2,902,096,368
Transition		215,075,407	215,075,407	215,075,407	197,926,538	197,926,538	1,041,079,297
Other then transition		5,043,379	5,043,379	5,043,379	4,718,222	4,718,222	24,566,581
Industrial Complex		14,865,128	14,865,128	14,865,128	14,335,488	14,335,488	73,266,360
Industrial Sector		328,488,017	328,488,017	328,488,017	325,411,477	325,411,477	1,636,287,005
Building Sector		4,784,993	4,784,993	4,784,993	4,651,249	4,651,249	23,657,477
Transportation Sector		8,323,449	8,323,449	8,323,449	8,014,890	8,014,890	41,000,127
Waste Management Sector		11,970,563	11,970,563	11,970,563	11,273,387	11,273,387	58,458,463
Public · Other Sector		765,310	765,310	765,310	742,564	742,564	3,781,058

- **Auctioning**

During the phase two, an auction market was launched on January 23, 2019. The auction market operated a system where auction purchased KAU through 3% auctions during phase two, which expanded to 10% in phase three. The expected effects of the auction include 1. price discovery function from a fuel conversion cost perspective, 2. liquidity supply to address supply-demand imbalance, 3. reduction in carbon emissions permit price volatility through the lowest bid method, 4. enhanced market transparency with multiple auction participants, and 5. reinvestment of auction proceeds. The criteria for selecting auctioning sectors are based on trade intensity and additional production costs. Sectors meeting any of the following criteria: 1) Production cost occurrence over 5% and trade intensity over 10%, 2) Production cost occurrence over 30%, 3) Trade intensity over 30% receive 100% free allocation, while the rest are subject to auction.

Additional Production Cost: An indicator to determine the extent to which production costs increase due to the greenhouse gas emissions trading system, calculated using the formula below.
(Annual average GHG emissions during base year X Average market price of allowances during base year) / Annual average value-added production during base year
Trade intensity: It is calculated relative to the base year
(Annual average exports + Annual average imports) / (Annual average sales + Annual average imports)

[Figure 3] Additional Production Cost and Trade Intensity

- **Flexibility Mechanisms**

Banking: If emissions are less than the allocated amount, the surplus is carried over to the next compliance year within the current phase or to the first compliance year of the next phase. The purpose of Banking is a response strategy based on the anticipation of future increases in carbon credit prices.

Institutional Change

- Initially, unlimited banking between compliance years and phases were allowed, but prices soared as sales disappeared due to the sentiment of holding emissions rights.
- In December 2017, the system was changed to allow banking of up to 10% of the average annual allocation of the phase one plus 20,000 tons.
- In July 2018, the criterion was changed to the larger of the average annual net sales volume during the phase two or 25,000 tons.

- Banking limitations were enforced even within the compliance period, based on net sales volume.
- Market conditions dominated by carbon credit supply formed due to changes in the Nationally Determined Contributions (NDC), economic downturns from COVID-19, and natural disasters, leading to record low prices since market opening.

- In September 2023, banking restrictions were eased, allowing three times the net sales volume for banking.

Borrowing: If emissions exceed the allocated amount, a portion of the KAU from other years within the phase can be borrowed. This strategy is effective when a decrease in carbon credit prices is anticipated. Initially, it was up to 10% of the required submission amount. It expanded to 20% of the required submission amount in May 2016. It was reduced to 15% of the required submission amount in August 2017.

Offsetting: It is a system for accrediting reduction amounts through external reduction projects. It was 10% of the submission amount (5% domestic, 5% international) but reduced to 5% during the phase three. However, the distinction between domestic and international offsets has been removed.

(i-2) Achievements and Limitations of Phase One and Two

- Phase One (2015 – 2017)

  - Total Allocation: A total of 1,691 million tons of KAU were allocated, accounting for 77% of the projected emissions. The actual emissions by the end of 2017 were recorded at 1,669 million tons.
  - Free Allocation: As this was the initial implementation phase of the emissions trading system, all KAUs were allocated free of charge. This approach aimed to minimize the economic and industrial impact.
  - BM Allocation: The BM method was applied to allocate permits for only certain facilities (approximately 6% of total emissions). In contrast, most allocations were carried out using the GF method. Facilities that received allocations via the BM method included oil refining (refinery + utility), cement (gray clinker firing facility), and domestic civil aviation sectors.

[Table 3] Phase One (2015~2017)

(Unit: million tons)

		2015	2016	2017	
				2020 Roadmap	2030 Roadmap
Roadmap	BAU	709	721	733	749
	Emissions after reduction (reduction rate, %)	637.8 (△10.0)	621.2 (△13.8)	614.3 (△16.2)	701.2
Allocation Plan	Total Amount of Allowable Emissions	1,673			17.6*
		1,691 (1,673 + 17.6)			

*Following the revision of the 2030 roadmap, the total allowable emissions in 2017 increased by 17.6 million tons compared to the 2020 roadmap.

- Overview of the Transaction
  - **Trade Volume**: There was a substantial increase in trade volume over the years, from 1.91 million tons in KAU15 to 13.57 million tons in KAU16, reaching 39.98 million tons in KAU17, and then slightly decreasing to 33.19 million tons in KAU18.
  - **Average Annual Transaction Price**: The price per ton showed a significant rise, from KRW 11,007 in 2015 to KRW 28,155 in 2018. This indicates a 20-fold increase in trading volume and a 90% increase in the average annual emissions price.
  - **Transaction Patterns**: Market observations reveal a trend where liquidity in the emissions permit market drops significantly as the emission permit settlement period (end of June) approaches, leading to a spike in emission permit prices.
  - **Banking and Borrowing Limitations**: In March 2017, due to an imbalance in supply and demand, banking in the phase two was restricted to the range of the company's annual average net sales of KAU during the phase one. Initially, borrowing within the phase was limited to 10% of the allocation. However, this limit was adjusted to 20% in May 2016 and then to 15% in August 2017 to reflect the changing supply and demand dynamics of KAU.

- Phase Two (2018 – 2020)

[Table 4] Phase Two (2018~2020)

(Unit: million tons)

		2018	2019	2020
Revised 2030 Roadmap	BAU (3years average)	779	779	779
	Emissions (3years average) after reduction (reduction rate, %)	691 (△11.3)	691 (△11.3)	691 (△11.3)
Allocation Plan	Total Amount of Allowable Emissions	1,777		

Total Allocated Amount: The allocation of emission permits adhered to the revised 「2030 Greenhouse Gas Reduction Roadmap」 as of July 2018. A total of 1,643 million tons of KAU were pre-allocated, accounting for 76% of the projected emissions out of the total allowable emissions of 1,777 million tons.

Auction: Auction was introduced during this period. 3% of the KAU for companies under this category were deducted at the pre-allocation stage and subsequently supplied through monthly auctions starting from January 2019. The inclusion of exporters and large companies in the 100% free allocation category, while domestic demand and small and medium-sized companies were subject to auction, sparked debates over the fairness in emission responsibilities.

BM Allocation: The application of the BM method was expanded to cover a total of seven industries (oil refining, cement, aviation + power generation, integrated energy, industrial complexes, waste), which comprised approximately 50% of the total emissions. This method was designed to allocate KAU based on specific benchmarks tailored to each industry, reflecting a more equitable and efficiency-driven approach to emissions management.

[Table 5] Overview of the Transaction

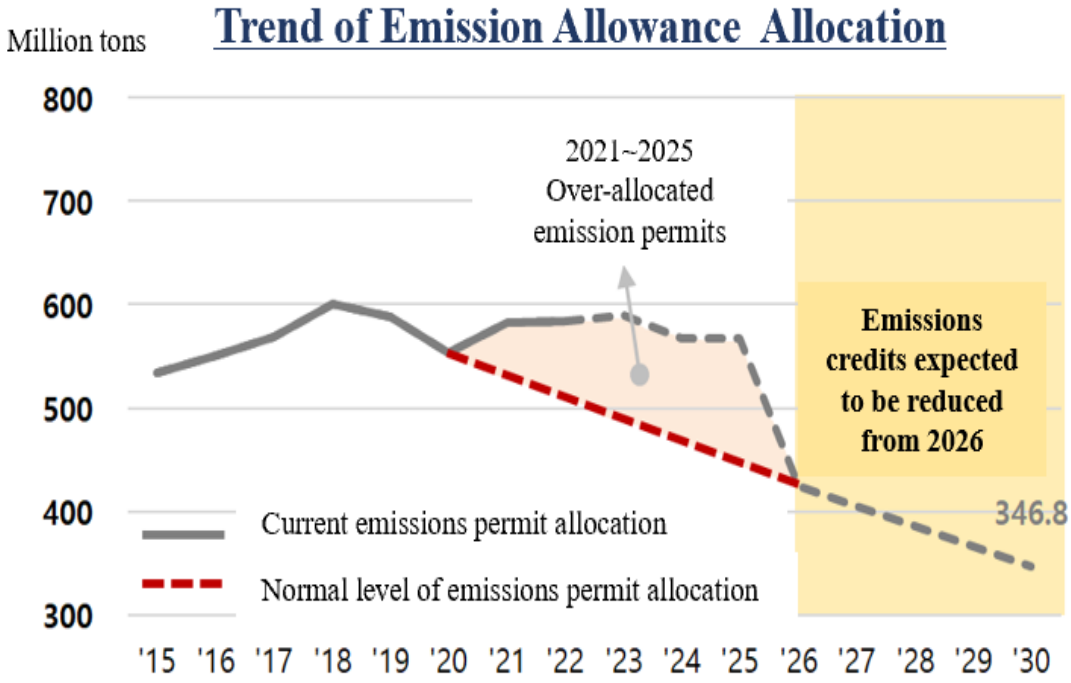
(Unit: thousand ton)

	Exchange (a)				Over - the - Counter (b)		Total (a+b)
	Competitive bidding, auction	Request For Quote (RFQ)	Market Stabilization	Auction	Regular transaction	SWAP and Others	
KAU15	336	1,010	274		286		1,906
KAU16	2,450	6,543			4,573		13,567
KAU17	6,338	10,752	4,665		8,794	9,430	39,978
KAU18	3,229	4,291		4,650	7,105	13,916	33,192
KAU19 (~SEP 19)	719	448		1,650	968	6,000	9,785

- Overview of the Transaction
  - **Increase in Over-the-counter Trading**: Since 2017, there has been a notable increase in over-the-counter trading in the emissions market. This shift indicates a diversification in trading practices beyond the formal exchange mechanisms.
  - **Banking Limitations**: To address the tendency of companies with surplus KAU to hold, restrictions on banking within the phase were implemented. The permissible banking amount is now determined based on the net sales volume, a policy enacted in June 2019. It aimed to encourage more active trading and efficient use of KAU.
  - **Participation of Public Financial Institutions as Market Makers**: In June 2019, major public financial institutions like the Korea Development Bank and the Industrial Bank of Korea entered the emissions market as market makers.
  - **Impact on KAU Prices**: The combined effect of banking limitations and the introduction of a market-maker system has contributed to a gradual rise in the price of KAU. This approach has helped maintain stable price fluctuations, ensuring a more predictable and reliable emissions trading market.

(i-3) Shortfalls and Limitations of Phase Three

- **Quota**
  - The NDCs towards the 2030 GHG reduction roadmap, initially submitted to the UNFCCC in 2020, were requested for enhancement and subsequently updated in 2021. However, when the total quantity of phase three was decided, it was based on the 2020 NDCs, so it was inevitable that it would be over-allocated from the beginning.



[Figure 4] Trend of Emission Allowance Allocation

- **Banking and Borrowing**
  - Banking and borrowing part, which is the flexibility mechanism of the emissions trading system, is becoming a problem as there are restrictions on the banking part. Due to concerns about price uncertainty among allocating companies, prices skyrocketed due to continuous banking. To prevent this, restrictions on banking measures were implemented, resulting in the loss of the price discovery function that identifies the appropriate price.

ii. Emission Coverage

(ii-1) Current Status

- **Emissions by Sector in Korea**

From 1990 to 2018, South Korea's cumulative GHG emissions have seen an upward trend driven by rapid industrialization and economic growth. There has been a noticeable decline in emissions from the peak figures of 2018, which registered at 632.6 million tons of CO2 equivalent (MtCO2eq). In 2020, a substantial decrease to 569.9 MtCO2eq was observed, largely attributed to the impact of the COVID-19 pandemic. Nonetheless, the 2020 emissions still reflect an approximate 124.7% rise from the baseline year of 1990. Sectoral analysis reveals that the energy sector is the predominant emitter, contributing to 86.8% of total emissions. Industrial processes follow with 7.4%, while agriculture accounts for 3.2%. A detailed breakdown of the national GHG emissions inventory is presented in [Table 6].

[Table 6] Annual Emissions Data from National GHG Inventories

MtCO2eq	1990	2000	2010	2015	2016	2017	2018	2019	2020
Energy	240.3	411.6	565.7	600.3	602.2	615.6	632.6	611.6	569.9
Industrial process	20.4	50.9	53.0	54.5	53.5	56.5	55.8	52.2	48.5
Agriculture	21.0	21.4	22.1	21.0	20.8	21.0	21.1	21.0	21.1
LULUCF	-37.9	-60.1	-56.1	-46.6	-46.9	-41.7	-40.3	-37.7	-37.9
Waste management	10.4	18.9	15.4	16.9	17.2	17.6	17.4	16.5	16.7
ETCs	0	0.1	0.3	0.6	0.7	0.7	0.8	0.8	0.8
Total	292.1	502.7	656.1	692.6	693.7	710.6	727.0	701.2	656.2

Examining the extensive national GHG inventory data, it's evident that over the last three decades, South Korea's emissions have escalated, while the absorption figures have remained constant.

- **Emissions**: Specifically, until 2018, emissions from the energy sector have surged to approximately 2.37 times their earlier levels, the industrial processes sector has expanded to about 2.38 times, and the waste sector has seen a rise of around 1.61 times.
- **Offset**: The amount of offset was subsequently declined, returning to levels like those in 1990 starting from 2019.

- **South Korea’s NDCs**

South Korea aims to reduce emissions to 436.6 million tons of CO2 equivalent by 2030, which represents a 40% decrease from the levels recorded in 2018. There have been minor variations in the specific sectoral reduction targets between the revisions of October 2021 and March 2023.

- **Transition**: The reduction target was intensified from 149.9Mt (44.4%) to 145.9Mt (45.9%). This includes a planned additional cutback of 4 MtCO2eq to account for the rise in clean energy utilization, such as solar and hydrogen.
- **Industry:** The reduction target was slightly eased from 222.6 Mt (14.5%) to 230.7 Mt (11.4%).
- **Hydrogen:** The reduction target was strengthened from 7.6Mt to 8.4Mt. This adjustment reflects updated projections for hydrogen demand.
- **Internationally transferred mitigation outcomes (ITMOs):** The ITMOs target was also increased, from a decrease of 33.5Mt to 37.5Mt. This expansion is due to the identification of joint public-private projects and an increase in blended finance measures.

South Korea's strategic direction for reducing emissions focuses on alleviating the emissions levels from the industrial sector while intensifying the targets for the transition sector and ITMOs.

- **Overview of Sectoral Certified Emissions**

In the emissions trading scheme, emissions are managed distinctly across various sectors, including energy, industry, buildings, domestic transportation, waste, and the public sector. During the phase three, the application scope of the ETS was broadened, as detailed in [Table 7].

[Table 7] Expansion of ETS Target During the Phase Three

Application			Final Quota (proportion)	Certified Emissions (proportion)
New Industry	**Transportation**	Freight, Railroad, Passenger, Shipping	6.0Mt (1.0%)	4.9Mt (0.8%)
	Industry	Construction		
New Company	Transition (5), Industry (10), Building (2), Waste (5)		7.3Mt (1.2%)	7.2Mt (1.2%)
Emissions Activities	**Refining industry**	Hydrogen production and catalyst process	9.7Mt (1.6%)	11.1Mt (1.9%)
Others	All sectors		2.6Mt (0.4%)	3.8Mt (0.6%)

Source: 2022 ETS Operation Results Report

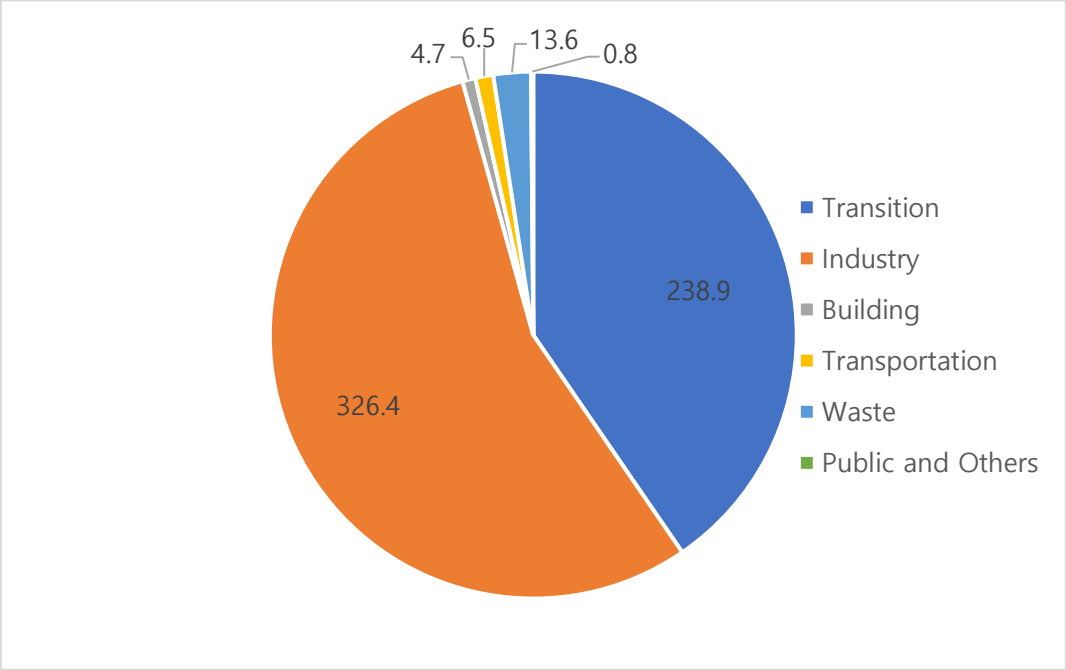
The 2021 performance of South Korea's ETS overall indicates an increase compared to 2020 across various sectors.

- **Transition:** The power sector, constituting 40.4% of total emissions, recorded certified emissions of 238.9Mt. This marks an increase of 22.8Mt (10.5%) from the previous year. This significant rise is attributed to an increase in the number of allocated companies from 36 to 58. Due to the change in industrial classification, 16 allocated companies in the industrial complex industry were moved to the transition sector and 6 companies were newly included. The top 10 industries in this sector showed a larger buying volume compared to selling, with a net purchase volume of approximately 6.1 Mt.
- **Industry:** Representing 55.2% of total emissions, the industrial sector emitted 326.4Mt, an increase of 12.4 Mt (4.0%) from the previous year. Factors contributing to this rise include new construction and expansion of facilities, the addition of emissions from the petrochemical industry during production, and a short-term rebound effect due to economic recovery. Despite this increase, the overall economic performance had not returned to pre-COVID levels, resulting in a higher selling volume than buying volume in this sector.
- **Buildings:** In 2021, the certified emissions of the 39 allocated companies were calculated to be 4.7Mt. This is an increase of 0.5Mt (13.1%) compared to the previous year. The easing of various response regulations in the post-

COVID era, along with the operation of accommodation facilities, hospitals, and educational institutions, contributed to a slight increase in emissions in this sector.

- **Transportation:** This sector saw an emission of 6.5 Mt as the number of companies included in the ETS increased. Notably, the sector has expanded to include not only air transport but also railway, land passenger, maritime passenger, and road freight industries, starting from the phase three. Consequently, the number of companies in the transport sector has significantly increased from 6 to 62.

(unit: Mt)



[Figure 5] Sectoral Certified Emissions in 2021

Source: 2022 ETS Operation Results Report

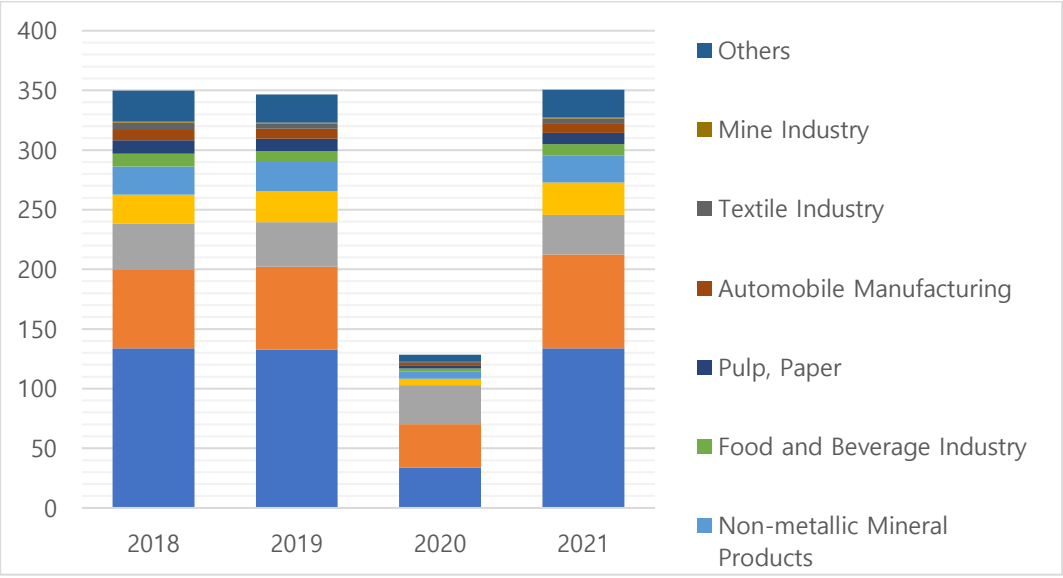
- **Certified Emissions by Industry**
  - **Overview**
    - The industrial sector is the largest contributor to GHG emissions. The certified emissions can be analyzed in detail by subdividing into specific industry categories.

[Table 8] Certified Emissions by Industrial Sector in 2021

Industry	Emissions (Mt)	Proportions (%)
Steel	116.7	35.8
Petrochemical	59.7	18.3
Cement	43.1	13.2
Refining	33.6	10.3
Semiconductor	21.8	6.7
Display	9.5	2.9
Electrical and Electronic	4.2	1.3
ETCs	37.8	11.6
Total	326.4	100.0

Source: 2022 ETS Operation Results Report

- In terms of certified emissions, the steel, petrochemical, cement, and refining sectors are at the top, with net selling volumes exceeding net buying volumes by 1.2Mt, 1.6Mt, 2.1Mt, and 0.1Mt, respectively. In the industrial sector, steel accounts for 35% and refining and petrochemicals for 27% of total emissions, collectively representing over half of the sector's emissions. As shown in [Figure 6] below, the industrial sector includes various sectors such as steel, which is energy-intensive, and semiconductor, display, and electrical and electronics industries, which have high process emissions.

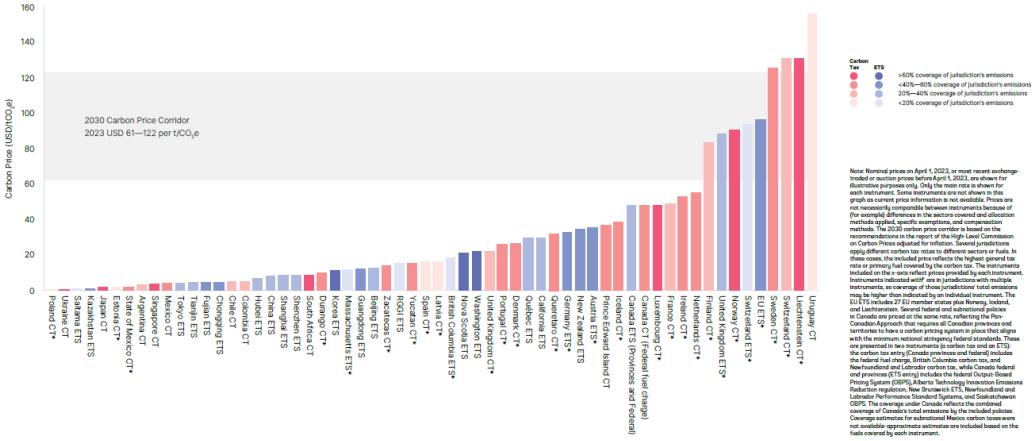


[Figure 6] Emissions by Industry Sector

Source: Korea Energy Agency

- **Steel:** Certified emissions increased by 4.1 Mt to 116.7 Mt compared to the previous year. Despite a reduction in the number of allocated companies compared to the previous year, increased production due to the recovery of demand industries such as automobiles and ships led to an increase in emissions. With the rise in LNG prices, the consumption of LNG in steelmaking and primary and secondary rolling decreased, while coal consumption and electricity usage increased.
- **Petrochemical:** Emissions increased by 4.1Mt to 59.7Mt due to increased production following economic recovery. A decrease in coal consumption and an increase in LNG consumption seem to have improved the emissions per unit.
- **Cement:** Emissions increased by 4.5 Mt to 43.1 Mt compared to the previous year. Two companies previously classified under the 'Ceramics and Glass Industry' during the phase two were incorporated into the cement sector, contributing to an increase of 3.0Mt. Although emissions from kiln facilities increased due to increased production, the use of biomass is showing a yearly increase.
- **Refining:** Exhibited the largest increase in the industrial sector with a rise of 13.3Mt compared to the previous year. This increase is due to the expansion of the application scope to include 'hydrogen manufacturing and catalyst regeneration processes' for consistency with national GHG emissions.
- **Semiconductor, Display, Electrical/Electronic:** All witnessed an increase in emissions due to increased production over the previous year. Fluorinated GHGs are emitted during etching and deposition processes**.**
- **CO2 Capture and Transfer:** First reported in 2021, with 0.7Mt and 0.5Mt ultimately recognized.

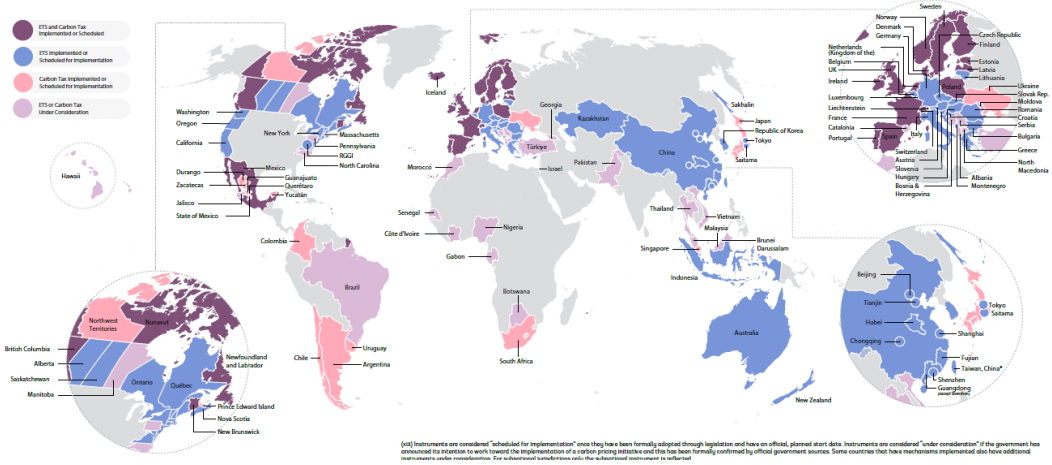
- **Status of Overseas ETS**
  - According to 'State and Trends of Carbon Pricing 2023' published by the World Bank, 73 carbon pricing policies are in operation. Approximately 23% of GHG emissions are under the carbon pricing system.



[Figure 7] Prices and Application Scope of ETS and Carbon Tax by Country

Source: State and Trends of Carbon Pricing 2023

- Although high-income countries are still dominant, there is a growing trend of emerging economies adopting emissions trading schemes and carbon taxes.



[Figure 8] Status of the Adoption of Carbon Tax and ETS

Source: State and Trends of Carbon Pricing 2023

- **EU**: As the first to implement an ETS, the EU is currently in phase four, managing about 39% of total EU emissions. It covers sectors like power generation, industry, and aviation, targeting CO2, N2O, and PFCs among the six major GHGs.
- **USA**: Regional ETS are operational in states like California, Massachusetts, Oregon, and Washington and under the Regional Greenhouse Gas Initiative (RGGI). California's system, for instance, covers 74% of total emissions, targeting facilities in the power generation, industry, transportation, and buildings sectors with annual emissions of over 25,000 tons. These regions

account for seven major GHGs (CO2, N2O, CH4, SF6, HFCs, PFCs, NF3) and other fluorinated gases.

- **Canada**: Regional systems are also in place in Quebec and Nova Scotia. Quebec manages 78% of its total emissions. Facilities emitting over 25,000 tons annually or supplying more than 200 liters of fuel are eligible. Target companies calculate and report the seven major GHGs and other fluorinated gases.
- **Mexico**: Mexico started its ETS in 2023, targeting direct CO2 emissions in the industry and power sectors, which account for about 40% of the national total.
- **China**: After piloting regional trading systems since 2013, China launched a nationwide scheme in July 2021. It targets facilities in the power sector with annual emissions of over 26,000 tons, managing 44% of total emissions, focusing solely on CO2.
- **Japan**: Japan began its emissions trading in Tokyo (2010) and Saitama (2011). Tokyo's ETS only covers CO2 emissions from buildings and industry, accounting for 20% of Tokyo's total emissions.
- **Kazakhstan**: The only Central Asian country with an ETS, Kazakhstan has been focusing on CO2 emissions in the power and industry sectors since 2013, covering about 50% of national emissions as of 2020.
- **UK**: Post-Brexit, the UK ETS started in January 2021, is managed by various environmental and governmental agencies: UK's Environment Agency, Scotland's Environmental Protection Agency, Natural Resources Wales, Northern Ireland's Environment Agency together with the Department for Business, Energy and Industrial Strategy. Initially covering the power and aviation sectors, the UK plans to lower the cap on carbon emissions from energy-intensive industries. Also, the UK plans to expand to maritime by 2026 and waste by 2028. UK ETS involves about 1,000 institutions, accounting for 25% of the UK's GHG emissions.
- **New Zealand**: Following the 2002 Climate Change Response Act, over 50% of GHG emissions are managed in the mandatory market. Forestry, agriculture, waste, synthetic gas, Industrial processes (steel, etc.), liquid fossil fuels (e.g., diesel and diesel suppliers), power generation (electricity production, industrial heating, etc.) departments are being managed.
- **Australia**: As of July 2023, over 200 large facilities are eligible for credit

trading under the Safeguard Mechanism, covering about 60% of total emissions. This applies mainly to industrial emitters like steel, mining, and manufacturing, excluding power, buildings, transportation, and agricultural sectors, thus being a comparatively lenient policy compared to other countries.

[Table 9] Comparison of ETS Coverage by Major Countries

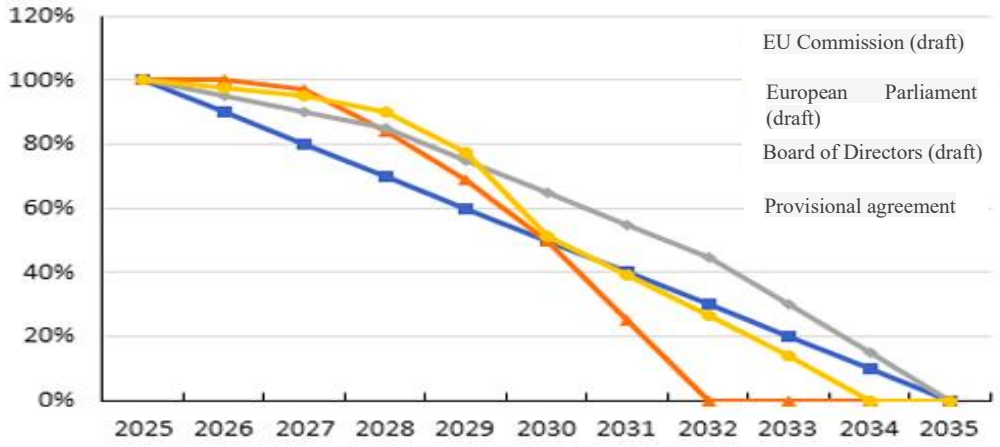
Country	Emission Rate (%)	Sector	GHG
EU	39	Power generation, Industry, Aviation	CO2, N2O, PFCs
USA (California)	74	Power generation, Industry, Transportation, Building	CO2, N2O, CH4, SF6, HFCs, PFCs, NF3, HCFCs
Canada (Quebec)	78	Power generation, Industry, Transportation, Building	CO2, N2O, CH4, SF6, HFCs, PFCs, NF3
China	44	Power generation	CO2
Japan	20	Industry, Building	CO2
Kazakhstan	50	Power generation, Industry	CO2
UK	25	Power generation, Industry, Aviation	CO2, N2O, PFCs
New Zealand	50 or more	Power generation, Industry, Aviation, Transportation, Building, Waste, Forestry	CO2, N2O, CH4, SF6, HFCs, PFCs
Australia	60	Power generation, Industry, Transportation, Building	CO2, N2O, CH4

(ii-2) Shortfalls and limitations

Although South Korea's ETS covers a broad range of sectors compared to ETS in other countries, its carbon prices are significantly lower on a global scale. It encompasses 70% of total emissions, including the six major GHGs (CO2, CH4, N2O, PFCs, HFCs, SF6), and includes sectors like power generation, industry, aviation, transportation, buildings, and waste. Despite an average market price of KRW 20,633 (USD 15.97) in 2022, prices have recently plummeted to below KRW 10,000, indicating a rapid decrease.

- **EU Carbon Border Adjustment Mechanism (CBAM)**

The European Union's CBAM tends to consider the pricing level of South Korea's ETS rather than its coverage scope, potentially increasing the burden on South Korean companies. This aims to supplement the phase-out of free allocations for imports of goods produced outside the EU in sectors at risk of carbon leakage. This mechanism recognizes that free allocations might distort ETS price signals and serves as a complementary measure to address carbon leakage in sectors with imports from outside the EU.



[Figure 9] EU Commission (draft), European Parliament (draft), Board of Directors (draft), CBAM coefficient of the provisional agreement

Source: Inseong Son & Donggu Kim (2023). Policy implications of the revision of the EU emissions trading system and the introduction of the carbon border adjustment system. Energy economic research.

- **Pricing Setting Structure**

The CBAM obligates the purchase of CBAM certificates linked to the ETS, proportionate to the 'embedded emissions' produced during manufacturing. South Korea can utilize Method 2, as shown in the [Table 10] below. Method 2 is a temporary methodology available until the end of 2024. While the formula for K-ETS calculation is the same as Method 1, there are differences in the scope of calculation and emission factors, necessitating adjustments to the calculation scope from 2025 onwards.

[Table 10] CBAM Register How to Measure Embodied Emissions

	Method 1	Method 2	Method 3
Legal Grounds	Regulation (EU) 2023/956 Article 4 Paragraph 1	Regulation (EU) 2023/956 Article 4 Paragraph 2	Regulation (EU) 2023/956 Article 4 Paragraph 3
Date of Use	continue	~ 24.12.31	~ 24.07.31
Explanation	Estimating GHG Emissions Based on Measurement Data Estimation-Based Approach - Deriving parameters from measurement data to determine emissions. Measurement-Based Approach	Estimation of GHG emissions in the following cases, which can provide emissions data with a similar scope of application and accuracy to Method 1: A carbon pricing system in the region where the facility is located. A mandatory emissions monitoring system in the	In cases where GHG emission estimation information is lacking, the Executive Committee will use default values provided during the transition period for estimating GHG emissions. [Implementation Regulation Annex VIII] Emission factors related to the net calorific value of fuels, process emissions, and the global warming potential of

		region where the facility is located. A facility's internal emissions monitoring system that can include verification by a recognized verifier.	GHG. [Implementation Regulation Annex IX] Efficiency factors for electricity and heat production

- **Applicable Industry**

Only six industries are classified as target industries under the scheme, which are cement, electricity, fertilizers, steel, aluminum, and hydrogen. Specifically, the list of target products is indicated using the Combined Nomenclature (CN) code, which is the EU's product classification method.

[Table 11] The Companies with Goods Subject to Export to the EU (more than 50 as of 2022)

Product Group	CN code	Number of target companies (As of 2022)
Steel	72	260
	7304	80
	7306	110
	7307	330
	7308	140
	7310	85
	7318	610
	7326	790
Aluminum	7606	70
	7607	50
	7616	300

- **Application Period**

The EU CBAM, as a transitional institution, will be in effect from October 2023 to the end of 2025, with various reporting methodologies and grace periods under consideration. The full implementation is scheduled to begin in 2026. As of September 2023, the price of South Korean ETS (K-ETS) is significantly lower than that of the EU, about 15 times less, which could lead to increased trade burdens for South Korea in trade with the EU upon the full adoption of CBAM. As of that point, the K-ETS price is around 8,000 KRW, compared to over 120,000 KRW for EU-ETS.

Despite K-ETS covering a broader range of emissions, it is not fully recognized under the CBAM framework. If precursors are involved, it necessitates the calculation of unique embedded emissions, including the subcontracting process of the target precursor, thereby including some scope of Scope 3 in the regulatory framework. South Korea applies six GHGs (CO2, CH4, N2O, PFCs, HFCs, SF6), while the EU applies only three (CO2, N2O, PFCs), highlighting a difference in approach. Under EU CBAM calculations, the scope of the substance is more than 100% of the actual system but is calculated as only 100%.

K-ETS accounts for emissions from 41 emission activities, including stationary and mobile combustion, process emissions, waste treatment, fugitive and indirect emissions, and carbon capture, whereas EU-ETS includes only 29 activities like combustion, process emissions, aviation, and carbon capture. Despite South Korea having a wider scope, it is simply measured as 100% under the EU framework. The carbon price of domestically produced products in South Korea includes not only K-ETS but also the climate-environment charge in electricity tariffs, individual consumption taxes on various fuels, and transportation, energy, and environmental taxes. However, free allocation quantities of K-ETS designated sites are excluded.

[Table 12] CBAM Carbon Pricing Calculation Method

$$CP = \frac{(Emission_{CBAM} \times CoverageK-ETS) + \sum(Fuel \times tax_{Fuel})}{Emission_{CBAM}}$$

factor	*explanation*	*unit*
CP	CBAM Product Production Process Contributory Emission Amount Paid for Carbon Pricing	KRW /t CO2e
$Emission_{CBAM}$	CBAM Product Production Process Contributory Emission Amount Calculated by the EU CBAM GHG Emission Estimation Guidelines	tCO2e _
$Coverage_{K-ETS}$	Proportion of Emissions in CBAM Product Production Process Contributory Emission Amount Corresponding to K-ETS (100% or 0%)	%
$price_{K-ETS}$	K-ETS Emission Permit Price	KRW /tCO2e
$Fuel$	Fuel and Energy Usage Utilized in Calculating CBAM Product Production Process Contributory Emission Amount	kWh, kg, L
tax_{Fuel}	Taxes, Levies, or Fees in the Form of Carbon Pricing Imposed on Each Fuel and Energy Type	KRW/ kWh, KRW/kg , KRW/L

- **Emission Permit Price**: The average annual price of emission permits from the product's country of origin's emissions trading system is applied. This considers all emission permits traded during the period (allocated emission permits, offset emission permits), including those traded through competitive and negotiated sales, as well as auctioned emission permits.

- **Electricity**: The climate and environment fees are imposed in proportion to electricity consumption. Costs related to the implementation of the Renewable Portfolio Standards (RPS), ETS compliance costs, and coal power reduction costs are included.

[Table 13] The Climate Environment Fee Unit Price (As of 2023)

Cost Classification	RPS	ETS	Reduction in coal power generation	Total
Unit price (KRW/ kWh)	7.7	1.1	0.2	9.0

- **Fuel:** Individual consumption taxes and transportation, energy, and environment taxes are imposed on fuels such as anthracite, LNG, heavy oil, kerosene, propane, butane, gasoline, and diesel. The individual consumption tax is levied at the time of removal from the manufacturing site or upon import declaration for goods like gasoline, diesel, LPG (butane, propane), indoor kerosene, heavy oil (B-C), LNG, and anthracite. The tax rate varies depending on the purpose of fuel use and the application of a flexible tariff. Notably, if gasoline and diesel are primarily taxed under the transportation, energy, and environment tax, they are not subject to the individual consumption tax.

[Table 14] Basic rates of transportation, energy, and environmental taxes and flexible rates

(As of 2023)

Fuel Classification		Gasoline		Diesel
Unit		KRW/L		
Transportation, energy, and environmental taxes	Base rate	475		340
	Flexible rates	529		375

However, in the CBAM, vehicle emissions within business premises are excluded from the calculation range. Consequently, taxes on gasoline and diesel used in vehicles do not contribute to the final carbon pricing. For individual consumption tax on anthracite, it only applies to coal power plants under the Electricity Business Act, meaning it is not taxed on anthracite used by the general industrial sector. In the case of LNG, the tax rate varies depending on the usage, such as for power generation and non-power generation purposes, and individual consumption tax is also levied on the fuel of LNG power plants owned by the industrial sector.

- **Rebates:** Rebates are calculated based on the free allocation quantities assigned to the CBAM product manufacturing processes. In this case, any additional allocations or cancellations that occur in addition to the pre-allocated quantities should also be considered. If not confirmed, the calculation is based on the pre-allocated quantities.

- **Expansion of Maritime Sector Regulations:** With the EU's 'Fit for 55' and the IMO's 2050 carbon-neutral goals, South Korean companies are anticipated to face dual pressures from both K-ETS and international regulations. Trends in International Environmental Regulations for the Maritime Sector At the 80th session of the IMO in July 2023, targets were revised upwards to achieve zero international maritime emissions by 2050. To ensure feasibility and as part of an interim review, it was agreed to reduce emissions by at least 20% by 2030 and by at least 70% by 2040, compared to total emissions in 2008. This implies that by 2030, the use of low-carbon and zero-carbon fuel technologies should reach a level of 5-10%. Additionally, an agreement was reached on the introduction of the Basket measure, which combines Quantity-based regulation and Price-based regulation. The specific implementation plan is yet to be determined, but it's scheduled to commence in 2027.
  - The European Commission, as part of its 'Fit for 55' package, has proposed incorporating maritime transport into the EU ETS.
    - **Scope of Calculation**: The plan targets vessels emitting over 5,000t of CO2, applying to all emissions from EU navigation, 50% of emissions from non-EU navigation, and all emissions from anchoring at EU ports.
    - **Submission Deadlines:** The obligation to submit emission permits starts in 2023 with 20% of verified emissions, increasing to 45% in 2024, 70%

in 2025, and 100% from 2026 onwards.

- **The Scope of GHG Application**: From 2026, the scheme will also include CH4 and N2O, in line with the existing EU-ETS.
- **Price Submission**: Differing from other ETS, there's no set cap on emissions; instead, it's based on the polluter pays principle, requiring the purchase of emission permits corresponding to emissions during docking at EU ports and submitting to the competent authority.
- **Penalties**: Failure to submit permits incurs a fine of £100/t for unsubmitted emissions, and submission is required in the following year. For continuous non-compliance, vessels that have failed to submit their documents more than twice in a row can face expulsion orders.

- Additionally, from 2025, the EU plans to progressively strengthen GHG intensity limits for vessels docking at EU ports until 2050 under the FuelEU Maritime initiative.
  - **Intensity Calculation**: The GHG emission ratio is calculated based on the complete lifecycle emissions of fuel (Well-to-Walk, WtW), including emissions from production to supply (Well-to-Tank, WtT) and emissions during fuel usage (Tank-to-Walk, TtW).
  - **Application Method**: If the fuel used has a higher intensity than the standard, penalties are calculated based on the difference between the standard and the calculated intensity for each type of fuel used, multiplied by the quantity of fuel used.
  - **Implementation Period**: The GHG intensity standards will be progressively tightened every five years, starting from 2025.
- According to research by Kim Hanna et al. (2022)3, the financial burden from carbon tax implementation can range from a maximum of over 4 trillion KRW to a minimum of 1.7 trillion KRW, whereas the burden from ETS implementation ranges from a maximum of 830.7 billion KRW to a minimum of 216.3 billion KRW. This is attributed to the fact that the only way to reduce the financial burden of a carbon tax is through direct carbon emission reduction activities. In contrast, ETS allows for a variety of strategies through ETS.

[3] Hanna Kim et al (2022). Impact of the introduction of IMO market-based measures on domestic shipping companies. Korea Maritime and Fisheries Development Institute.

- While the recognition and methods of regulations from other countries have not been thoroughly discussed in EU or IMO contexts, like CBAM, a financial burden increase is expected, proportional to the price difference between EU ETS and K-ETS.

[Table 15] Cost Burden of ETS for 95 Domestic Companies

(Unit: billion KRW)

	EU-ETS	K-ETS	Difference
2024	89.9	28.7	61.2
2025	522.9	167.0	355.9
2026	1,036.0	330.8	705.2
2027	1,060.7	338.7	722.0

Source: Hanna Kim et al. (2022)

iii. Climate Response Fund

(iii-1) Current Status

- **Introduction of Climate Response Fund**

To combat climate change effectively, prompt carbon reduction and adaptation investments are crucial. The IPCC warns that delays in addressing climate change will lead to increased mitigation costs, lock-in effects for carbon-emitting infrastructure, stranded assets, and reduced future policy options.[4] Globally, various means are being utilized to secure budgets for climate change mitigation and adaptation. The establishment of a dedicated Climate Response Fund is increasingly recognized as vital for addressing social issues caused by climate change.[5] In 2020, the South Korean government formalized the establishment of the Climate Response Fund as part of its '2050 Carbon Neutrality Promotion Strategy'. As stipulated in the " Framework Act on Carbon Neutrality and Green Growth," the fund's purpose is “to secure resources necessary for effectively responding to the climate crisis and facilitating the transition

[4] IPCC (2018) IPCC Special Report on the impacts of global warming of 1.5°C

[5] The fund is legally required to be “established when there is a need to flexibly manage specific funds for a specific purpose,” so it meets the purpose of establishment.

to a carbon-neutral and green growth society."[6] Consequently, a fund of 250 million KRW was established in 2022 to serve as a primary resource for supporting green new technologies and industries. The importance and proportion of South Korea's Climate Response Fund have progressively increased. In 2023, it accounted for 20% of the total carbon neutrality budget, making it a key financial tool for GHG reduction. Notably, in terms of budget size for GHG reduction in 2023, the Climate Response Fund is the second largest after the Energy and Resources Special Account and the largest among funds.

- **Climate Response Fund Resources**

The Climate Response Fund in South Korea is financed through government contributions, transfers from general and special accounts, and income from the auction of emission allowances. A significant portion of its funding comes from the Transportation Energy Environmental Tax (44%) and the revenue from the auction of emission allowances (17%). In 2023, the total operational size of the fund was approximately 2.49 trillion KRW, which decreased to about 2.42 trillion KRW in the 2024 budget (a 2.9% decrease). The fund's resources are supplemented with various general and special account transfers, as well as transfers from the Electricity and Public Funds, to compensate for the shortfall compared to the previous year.

[Table 16] Climate Response Fund Financial Structure

(Unit: 100 million KRW)	Revised 2022	Revised 2023	2024 plan	22-23 increase/decrease amount	23-24 increase/decrease amount
Proceeds from emission permit sales.	7,306	4,009	4,009	-3,298 (-45.1%)	-
Transfers from the general account (Transportation Tax).	7,631	12,222	10,728	4,591 (60.2%)	-1,494 (-12.2%)
Surplus funds from the special account for educational expenses	3,000	3,000	3,000	-	-
Surplus funds from the Electric Power Fund	2,000	2,000	2,000	-	-

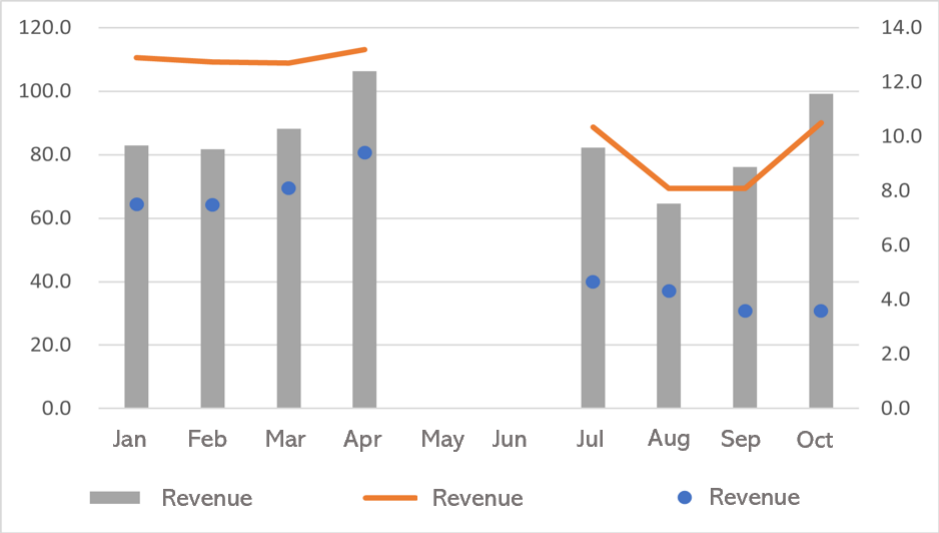
[6] 『Framework Act on Carbon Neutrality and Green Growth』Chapter 10 Article 69 Establishment of Climate Response Fund

Surplus funds from the Lottery Fund.	-	957	1,100	957 (net increase)	114 (15.8%)
Deposits from the Public Capital Management Fund.	3,709	2,726	3,199	-983 (-26.5%)	473 (17.4%)
Recovery of deposits from non-monetary financial institutions.	-	-	122	-	122 (net increase)
Total	23,646	24,914	24,158	1,268 (5.4%)	-756 (-3.0%)

Note: The transfer of funds from the Lottery Fund has been recommended for deletion in the review by the National Assembly Standing Committee, so this may be subject to change.

The most significant change in funding sources for 2022 compared to the previous year was the decrease in proceeds from the sale of emission permits. Forecasts for emission permits sales proceeds are made by multiplying the 'expected auction for the relevant year' by the 'expected success rate' and 'expected unit price' and then calculating the market creation reserve. It is calculated by adding up the repayment fees. However, at the time, the price of emission permits fell, the bid rate decreased, and the sale price decreased by about 45%. For 2024, it is assumed that the situation will remain like 2023[7]. However, considering the recent decline in bid rates and emission permit prices, actual revenue is expected to fall short. Analysis of auction results from January to October indicates a drop in bid rates from 70-80% to around 30% in October and a decrease in bid prices from around 13,000 KRW to 8,000-10,000 KRW. There is a lot of room for both the expected success rate and the expected unit price, which are assumed in the composition of the budget, to decline, so there is also a lot of room for significant volatility in the finances for the 2024 emission permit sale proceeds.

[7] While the assumptions varied, it was projected that the scale would remain the same. For 2023, based on the average auction (20.6 million tons) during the phase three, phase one and the average auction price in 2021 (27,000 KRW), plus the market formation reserve repayment fee, the revenue was estimated at 400.9 billion KRW. For 2024, considering the predicted volume of canceled auctions in 2023 (24.3 million tons) and the average auction price from 2019 to 2022 (24,000 KRW), plus the repayment fee, a similar revenue of 400.9 billion KRW was anticipated.



[Figure 10] 2023 Emission Allowance Auction Results

Note: Revenue (in billion KRW) and the bid acceptance rate (%) follow the left-hand legend, while the bid price (in thousand KRW) follows the right-hand legend.

Source: Ministry of Economy and Finance, Preliminary Review Report of the 2024 Fund Operation Plan

The transportation tax transfer also exhibits significant annual volatility. The Transportation Energy Environmental Tax, levied on gasoline and diesel, is influenced by various factors, including economic activities and travel distances during the period. In the current financial structure of the Climate Response Fund, 7% of this tax revenue is allocated as a transfer to the fund. Hence, fluctuations in tax revenue directly impact the fund's resources. Additionally, since the transportation tax constitutes 44% of the total fund, changes in this tax revenue significantly affect the fund's financial stability.

- **Utilization of Climate Response Fund**

The primary investment focus of the Climate Response Fund aligns with supporting the achievement of the 2030 NDC, as well as the Carbon Neutrality and Green Growth basic plans. The fund is utilized for various purposes, including support for industrial, labor, and regional economic transitions, GHG reduction activities in businesses, job transition and creation in economically and socially vulnerable areas, green technology research and development, workforce training, financial support for climate crisis response, education, promotion, and international cooperation. The uses of the fund are detailed in Article 70 of the "Framework Act on Carbon Neutrality and Green Growth" and in the Fund Operation Plan.[8]

[8] 2024 Fund Operation Plan, p.98

Purpose of Climate Response Fund

※In accordance with Article 70 of the Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis, support is provided to four key areas to realize carbon neutrality by 2050.

1. **GHG Reduction**: Supports corporate GHG reduction activities and urban/land energy efficiency, along with the creation and expansion of carbon sinks like forests and wetlands.
2. **Promising Low-Carbon Ecosystem**: Aids in developing carbon-neutral promising companies and workforce, green finance, and circular economy to establish a low-carbon ecosystem.
3. **Just Transition**: Supports industrial, labor, and regional economic transitions, assists vulnerable groups in climate crisis response and raises public awareness of carbon neutrality.
4. **Carbon Neutrality Infrastructure**: Backs critical technology development for carbon neutrality and policy foundations for GHG reduction, including system operation support.

Based on this, the current expenditure on specific project items is as follows [Table 17]. Actual project expenses increased by 8.8% in 2023 but decreased by 7.1% in 2024, returning to levels similar to 2022. Examining the specific areas of expenditure, the budget for 'Promising Low-Carbon Ecosystem' shows a continuous upward trend, while funding for 'Carbon Neutrality Infrastructure' is set to decrease in 2024.

[Table 17] Expenditure Structure of Climate Response Fund

(Unit: 100 Million KRW)	Revised 2022	Revised 2023	2024 plan	22-23 increase/decrease amount	23-24 increase/decrease amount
Project Expenses	22,592	24,591	22,842	1,999 (8.8%)	-1,749 (-7.1%)
GHG Reduction	9,498	9,866	9,756	368 (3.9%)	-110 (-1.1%)
Promising Low-Carbon Ecosystem	5,488	6,364	6,604	876 (16.0%)	240 (3.8%)
Just Transition	1,837	2,085	1,973	248 (13.5%)	-112 (-5.4%)
Carbon Neutrality Infrastructure	5,769	6,276	4,509	507 (8.8%)	-1,767 (-28.2%)
Fund Operating Expenses	22	27	27	5 (22.7%)	-
Repayment of Interest on Deposits from the Public Capital Management Fund.	20	174	286	154 (770%)	112 (64.4%)

Deposits from Non-monetary Financial Institutions.	1,013	122	1,003	-891 (-88.0%)	881 (722.1%)
Total	23,646	24,914	24,158	1,268 (5.4%)	-756 (-3.0%)

In the 2024 plan, a total of 146 projects are included in the expenditure plan. The ministries with the highest proportion of project expenditures are the Ministry of Trade, Industry and Energy and the Ministry of Environment, accounting for 36% and 35% of the total project budget, respectively. Notably, the Ministry of Trade, Industry and Energy has recorded the largest increase among the 17 ministries, with an increase of 135 billion KRW. Approximately 40.2% of the total budget is allocated to R&D investments, with around 65% of R&D projects being conducted by the Ministry of Trade, Industry and Energy.

[Table 18] 2023 Climate Response Fund R&D Support Project Budget by Ministry

Ministry	Number of Projects	2023 R&D Support Project Budget
Ministry of Trade, Industry and Energy	59	651,329
Ministry of Science and ICT	12	116,484
Ministry of Environment	12	67,759
Ministry of Land, Infrastructure and Transport	13	57,826
Ministry of SMEs and Startups	4	54,152
Ministry of Oceans and Fisheries	5	32,784
Korea Forest Service	1	8,075
Total	106	988,409

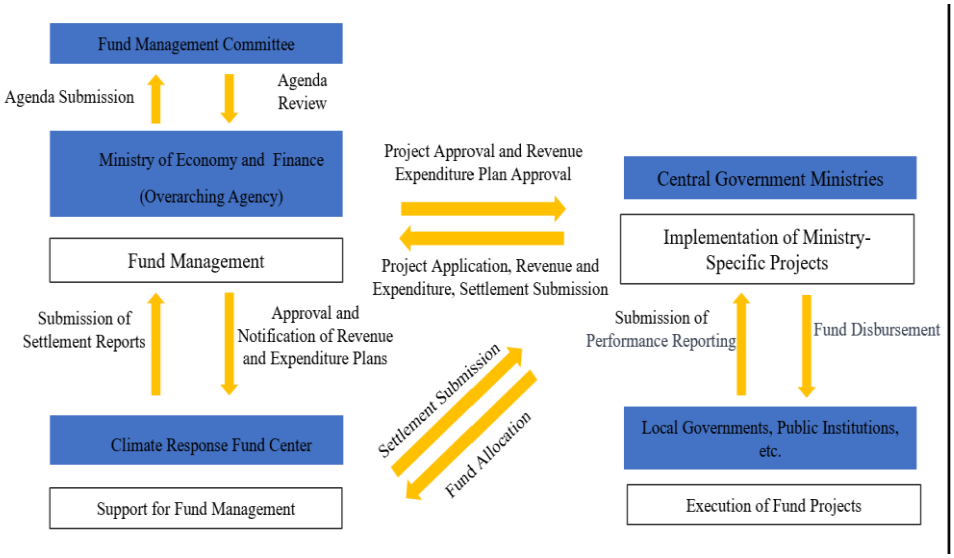
Note: KRW Unit of million

Source: Jihoon Lim, Hyunsuk Jang (October 2023), p.36

- **Climate Response Fund Governance**

The Climate Response Fund operates in a multi-ministerial fund structure, overseen by the Ministry of Economy and Finance, which sets the overall project direction and composition. The Ministry manages the overall support areas of the fund, adjusting the distribution of resources across fields. Sixteen individual ministries, including the Ministry of Environment, Ministry of Trade, Industry and Energy, and Ministry of Land, Infrastructure and Transport, apply to the Ministry of Economy and Finance to carry out their respective fund projects and report detailed operation plans and results. A designated Climate Response Fund Center supports the fund management, based on the

notice of the, and preparing financial statements. There is also a Fund Operation Deliberation Committee, chaired by the first Vice Minister of the Ministry of Economy and Finance and comprising government and private members, which deliberates on key issues in fund operation. The Climate Response Fund Center, designated to support the fund operation of the Ministry of Economy and Finance, prepares fund-related accounting and settlement reports based on the 'Entrustment of Operation and Management of Climate Response Fund' and performs other administrative tasks. At the same time, a fund management deliberation Council is formed to deliberate on major matters in the fund management process. The Council is chaired by the First Ministry of Economy and Finance and is composed of government and private members.[9]



[Figure 11] Domestic Climate Response Fund Governance System

Source: Jihoon Lim, Hyunsook Jang (October 2023), p.35

- **Current Status of International Climate Response Fund Composition and Utilization**

Globally, governments are actively supporting the low-carbon restructuring of industries and the transition to carbon neutrality, notably through the reallocation of exogenous resources such as funds for long-term GHG reduction. This section focuses on the EU's approach, analyzing and comparing it to domestic operations and drawing implications.

9 『ENFORCEMENT DECREE OF THE FRAMEWORK ACT ON CARBON NEUTRALITY AND GREEN GROWTH FOR COPING WITH CLIMATE CRISIS』 Chapter 10 Article 66 Composition and Operation of Fund Management Deliberation Council

The EU operates the Innovation Fund (IF), Modernization Fund (MF), and Social Climate Fund (SCF) based on the revenues from its ETS[10]. The EU's fund operation financial structure is shown in the following [Figure 12][11] The fundamental resource for IF, MF, and SCF is the auction revenue from the ETS. Specifically, the IF utilizes resources from ETS1 and ETS2. In the case of ETS1, 365 million tons of the free allocation and 85 million tons of the auction quantity are used as innovation fund resources. Additionally, additional quotas resulting from the closure of air carriers and free quotas replaced by CBAM are also used as resources for the IF. Unused in MSR and NER300 Emissions revenue (50 million tons) is also used for the IF. Lastly, revenue generated through the Fuel EU Maritime initiative[12] is also used as a resource for the IF.

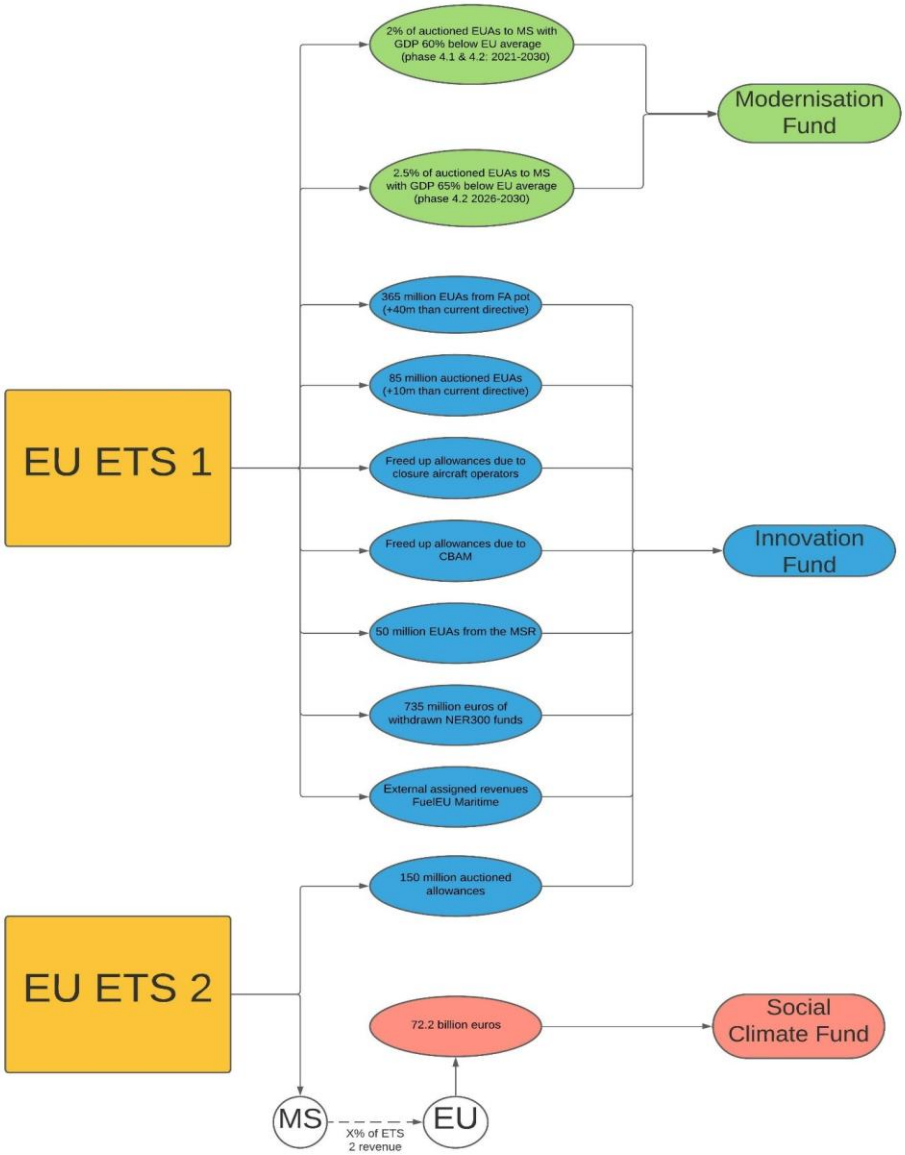
The MF is made up of 2% of ETS1 auction revenue as its main source of funding and is used for energy modernization in countries with an average GDP of less than 60% of the EU. From 2026 onwards, an additional 2.5% will be incorporated into the MF, and additional amounts will be paid to countries with GDP per capita below 65% of the EU average during 2016-18.

Lastly, the SCF was proposed to reduce the side effects of ETS being introduced in the building and transportation sectors. The total financial resources of the SCF are planned to be around 72.2 billion euros, with 23.7 billion euros in 2025-27 and 48.5 billion euros in 28-32. For each member country, the upper limit is determined based on GNI per capita, population, number of poor people in rural areas, household fuel combustion CO2 emissions, and proportion of delinquent electricity bills.

[10] SCF is scheduled to be implemented from 2025

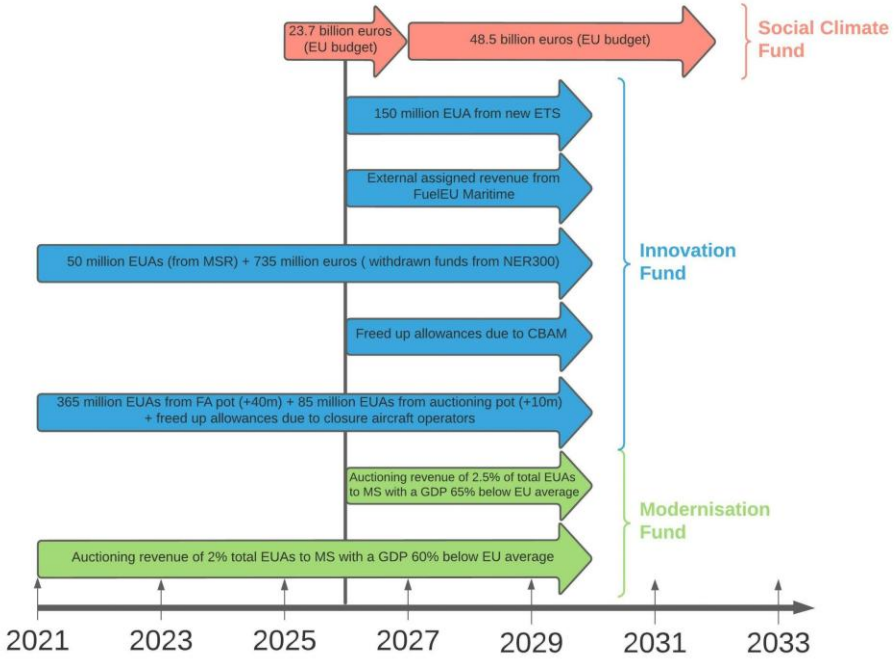
[11] https://bellona.org/news/eu/2021-09-financing-the-fit-for-2030-package-modernisation-innovation-and-social-funds-spell-the-eus-recipe-for-the- future

[12]As a policy to reduce greenhouse gases in the shipping industry, it is a mandatory system to purchase greenhouse gas emissions rights for 50% of ships of 5,000 tons or more docked in EU ports, operated within the EU, and operated outside the EU.



[Figure 12] Fund Types and Financial Structure

Source: Bellona

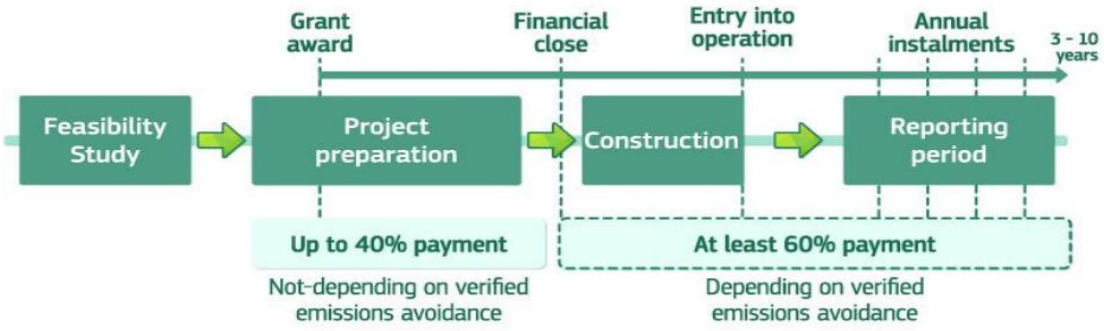


[Figure 13] Financial Resource Structure by Point in Time

Source: Bellona

- **Innovation Fund**

First, the Innovation Fund (IF) is a fund established to finance technology development projects that can innovatively reduce GHGs. The Fund was established in 2017 and is a follow-up program to the NER300 Fund, which has been operated by the European Commission and the European Investment Bank since 2012. It provides funding for low-carbon technologies, processes, and innovative eco-friendly energy production technologies with an estimated size of about 40 billion euros in 2020-30 (assuming 75 euros per ton). The main purpose of the IF is to support the rapid commercialization of low-carbon innovative technologies that are still in the pilot stage, offering proactive support, such as providing up to 40% of the support costs at the pre-project start stage, regardless of reduction performance. (see [Figure 14]).



[Figure 14] Innovation Fund Investment System

Source: EU Commission. Innovation Fund Progress Report, 2022.08

The EU Innovation Fund targets five specific technology categories, providing funding support following an evaluation process. The detailed support areas are categorized into (1) energy-intensive industries, (2) carbon capture utilization, (3) carbon capture storage, (4) renewable energy, and (5) energy storage. The European Commission operates an expert group that oversees the project selection process, which involves evaluating projects based on five key criteria.

[Table 19] Project Evaluation Criteria for the EU Innovation Fund

Criteria	The details
Effectiveness of GHG emissions avoidance	The project's ability to reduce GHGs is evaluated in terms of both absolute and relative numbers. Each of these calculations is assessed separately.
Degree of innovation	The technological innovation and maturity indicating readiness for market launch and commercialization soon. Highly versatility of the technology that can be applied to other industries
Maturity	Technology maturity (feasibility, scope of expansion, development details) Financial structure (business model, expected revenue and costs, financial structure, financing plan, etc.) Project execution capabilities (goals and execution plan, supply/demand analysis, performance, etc.)
Scalability	Short-term and long-term impacts on the local and the overall economy Analysis and evaluation of the project's impact on related and other industries, including its potential for market expansion
Cost efficiency	Evaluate the cost per unit of technical performance The evaluation involves deducting self-financing, public support, and external investment funds from the related costs and then dividing this amount by the absolute figures of GHG reduction to assess cost-effectiveness.

Source: Jihoon Lim, Hyunsook Jang (October 2023)

The EU IF operates a dual funding system, distinguishing between large and small-scale projects. Large projects exceeding 7.5 million euros in capital can receive up to 60% support for both capital and operational costs. Small-scale projects (strictly between 2.5 and 7.5 million euros) receive up to 60% capital cost support, focusing on areas lacking carbon reduction infrastructure.

The status of projects by phase is detailed in the following table [Table 20], showing the annual selection of IF projects with gradually increasing budgets. Existing projects can receive additional funding if ETS profitability improves. For instance, the first phase of large projects received an additional 100 million euros, and the second phase of large projects, an additional 300 million euros.

[Table 20] Innovation Fund Execution Budget and The Number of Projects

Phase	Scale	Budget	The number of applications	The number of selections	The details
Phase one (`20)	Large-scale	€ 1 billion (€ 1.1 billion executed)	311	15	Ultimately supported for 7 projects
	Small scale	€100 million	232	30	
Phase two (`21~22)	Large-scale	€1.5 billion (€1.8 billion executed)	139	17	Ultimately, 16 projects were supported
	Small scale	€100 million (€620 million executed)	66	17	
Phase three (`22~23)	Large-scale	€3 billion	239		Budget increase due to improved ETS profitability
	Small scale	€100 million	Recruiting		

As indicated in the table below [Table 21], the projects are primarily focused on developing carbon reduction technologies in high-carbon emitting industries and enhancing the economic viability of renewable energy sectors.

[Table 21] Project Details of EU Innovation Fund Phase two

Project Area	Purpose and Details of the Project
Cement/Lime (4)	Deployment of carbon capture process in cement factory (capture more than 1 million tons of carbon per year and then synthesize methanol) Developing technology for permanent storage of CO2 in marine geological layers
Hydrogen (3)	Building a 400MW water electrolysis facility in the Netherlands for green hydrogen production. (~2025) Implementing solid waste treatment and hydrogen conversion facilities, development of carbon capture technology
Chemicals (3)	Commercialization of technology to convert plastics and waste into reusable high-quality chemical raw materials (target to process more than 1 million tons per year from 2030) Build a 200,000-ton methanol plant per year and supply renewable hydrogen to nearby water electrolysis facilities.
Manufacturing (3)	Construction of a battery recycling plant (aiming to recycle/process 50,000 tons of black mass per year) Construction of a solar module manufacturing plant with an annual capacity of 2GW.
Refining (2)	Construction of sustainable synthetic aviation fuel facilities and conversion of waste to energy Establishment of the world's first commercial-scale second-generation bio contact production facility
Wind Power (1)	Build a 450MW offshore wind farm and an integrated water electrolysis facility to supply fuel to ships and provide emergency power. Enhancing the proportion of renewable energy and achieving energy cost-effectiveness through a reduction in the LCEO
Others (1)	Construction of a terminal capable of storing 880 million tons of carbon dioxide.

(iii-2) Shortfalls and Limitations

- **Securing Financial Resources**

The Climate Response Fund has faced challenges in securing funds since its inception. The Climate Response Fund operation plan was prepared with the expectation of 730.6 billion KRW in proceeds from the sale of emission permits in 2022, but the amount was limited to 318.6 billion KRW in 2022, making it difficult to secure financial resources. Alternatively, to secure financial resources, expanding the proportion and scope of auctioning is being considered. This requires a review of funding strategies for the Climate Response Fund, considering carbon neutrality goals and emissions trading market forecasts.

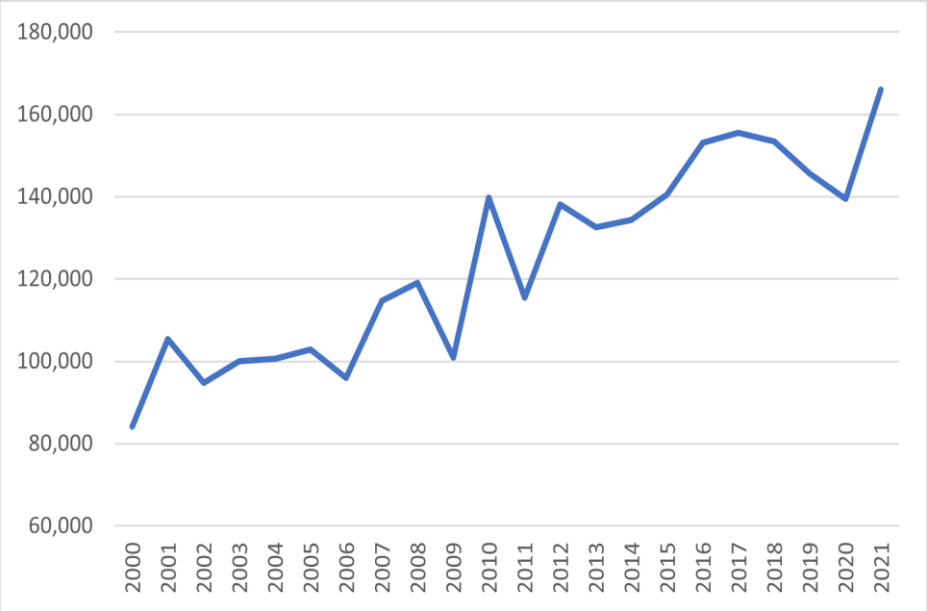
[Table 22] Status of the Climate Response Fund Resources

Budget	2022	2023	Change
Other Ordinary Transfer Income (Emissions Trading Revenue)	7,305.84	4,008.96	-3,296.88
General Account Transfer (Transportation Energy Environmental Tax)	10,766,35	12,222.55	1,456.20
Special Account Transfer	3,000	3,000	-
Fund Transfer	2,000	2,909.75	909.75
Fund Deposit	1,522,04	2,725.97	1,203.93

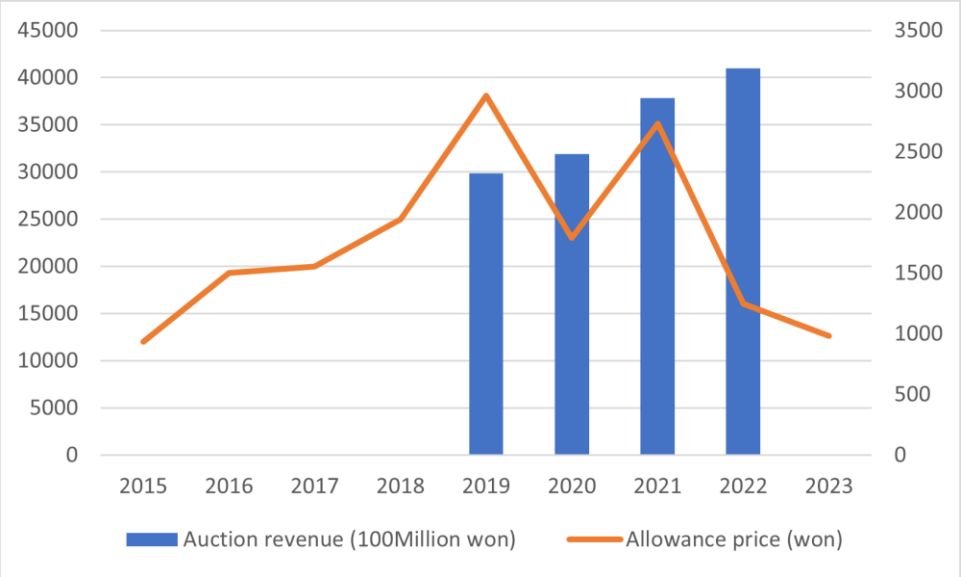
- **Volatility in Size of Financial Resources**

The Climate Response Fund's revenue sources, emissions trading auction proceeds, and transportation energy environmental tax, exhibit annual variability, making stable fund size maintenance challenging. While the transportation energy environmental tax shows a rising trend, its stability is hindered by tax rates and economic fluctuations. For instance, there was a significant 19% increase in 2021 compared to 2020. Emissions auction revenue proceeds grew from 232.2 billion KRW in 2019 to 318.6 billion KRW in 2022, but future revenue could vary significantly due to price volatility and potential increases in the proportion of auctions.

(Unit: 100 million KRW)



[Figure 15] Change in Transportation Energy and Environmental Tax Revenue



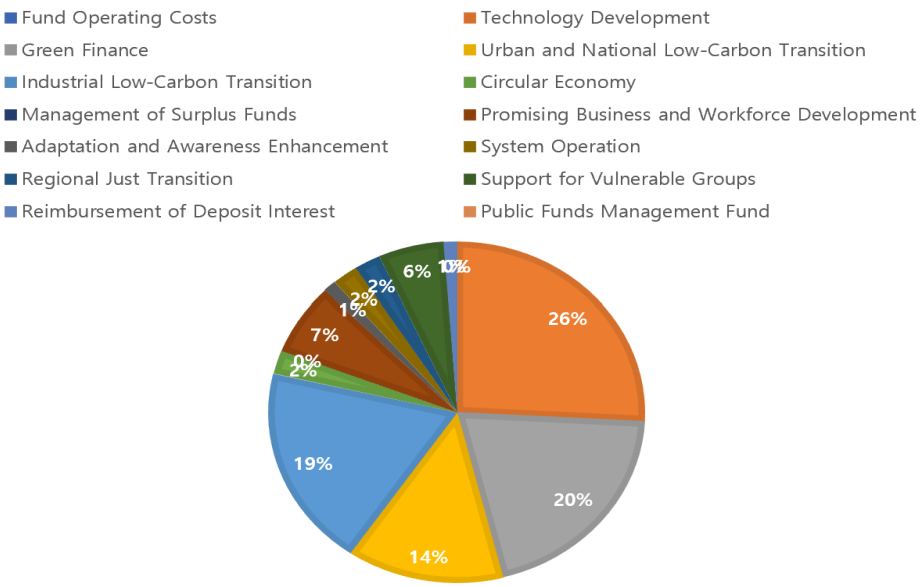
[Figure 16] Emissions trading price (left) and auction revenue (right)

In the case of overseas, measures are being implemented to maintain a stable fund size. In the USA, a stable financial size is maintained by securing the necessary financial size from each session's budget. In the EU, a policy structure is in place that allows borrowing from future finances if additional funding is needed.

- **Operational Efficiency**

In terms of utilization of the Climate Response Fund, fund projects are decentralized across ministries, and the target of support and the reduction effect from budget execution are unclear, raising the issue of fund operation efficiency and the unclear reduction effects relative to the support targets and budget execution. The Climate Response Fund's utilization has issues with its operation efficiency, stemming from the dispersion of fund projects across various departments and the unclear reduction effects relative to the support targets and budget execution. While the Ministry of Economy and Finance oversees the Climate Response Fund, the budget is divided among 13 departments, leading to problems of overlapping expenditures and inefficiencies (NABO, 2023).

  - The Climate Response Fund's budget is distributed for GHG reduction (40%), promising low-carbon ecosystem development (27%), just transition (8%), and system/infrastructure building (25%). Criticisms exist regarding the inclusion of projects in the Climate Response Fund that are either redundant or not clearly aligned with the fund's objectives and purposes.



[Figure 17] Climate Response Fund Utilization Status (%)

Source: Ministry of Economy and Finance

The future proportion of auction revenues in the Climate Response Fund is expected to increase. However, the criteria for supported projects under the fund are not clear, and the fund is not sufficiently utilized for reduction projects in sectors participating in the ETS. Criticisms exist that the fund, unlike the European Innovation Fund, focuses more on small-scale projects across various fields than on large-scale projects targeting high-emission industries. In the case of the European Innovation Fund, it is divided into large-scale projects and small-scale projects and is operated in a dual manner.

- **Governance**

While the Ministry of Economy and Finance oversees the fund, the execution of projects is divided among 16 ministries, making performance management difficult and selection criteria inconsistent. The criteria for selecting recipients are unclear. Project implementation performance management is difficult due to the lack of a governance system. Since it was selected as an exclusion from performance management in the early stages, the performance of the project is not evaluated.

  - In the case of the Climate Response Fund, since it is a project carried out by each ministry, performance management centered on the Ministry of Economy and Finance is not being implemented (Ministry of Economy and Finance Preliminary Review Report, p.234)

- **Unclear Role**

The role of the Climate Response Fund in Korea is viewed as overly extensive relative to its size. The fund represents just 0.12% of GDP, while in the EU, the IF alone accounts for a similar percentage, and combined with the MF and SCF, it reaches 2-3% of GDP. The broad scope of the fund, covering various industries, technological development, and just transition, leads to diluted focus and effectiveness, given its relatively small scale.

- **Flexibility**

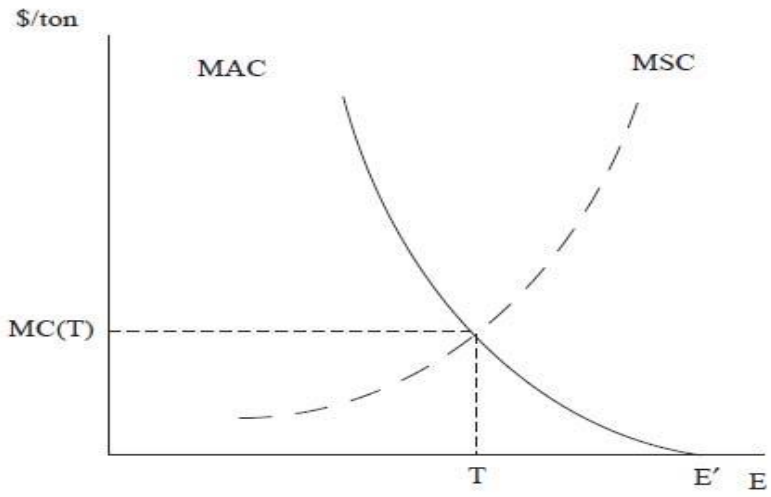
The fund needs to support the development and demonstration stages of new technologies for carbon neutrality. The current focus is on existing technologies, with less emphasis on new innovations. The European Union, conversely, actively supports the introduction and demonstration of new technologies right from the initial stages of a project, including funding for operational costs. The EU also differentiates between large-scale and small-scale projects, offering financial support for both capital and operational costs in large-scale projects.

iv. Price Cap and Floor

(iv-1) Current Status

- **Need for a Device to Stabilize Emissions Price**

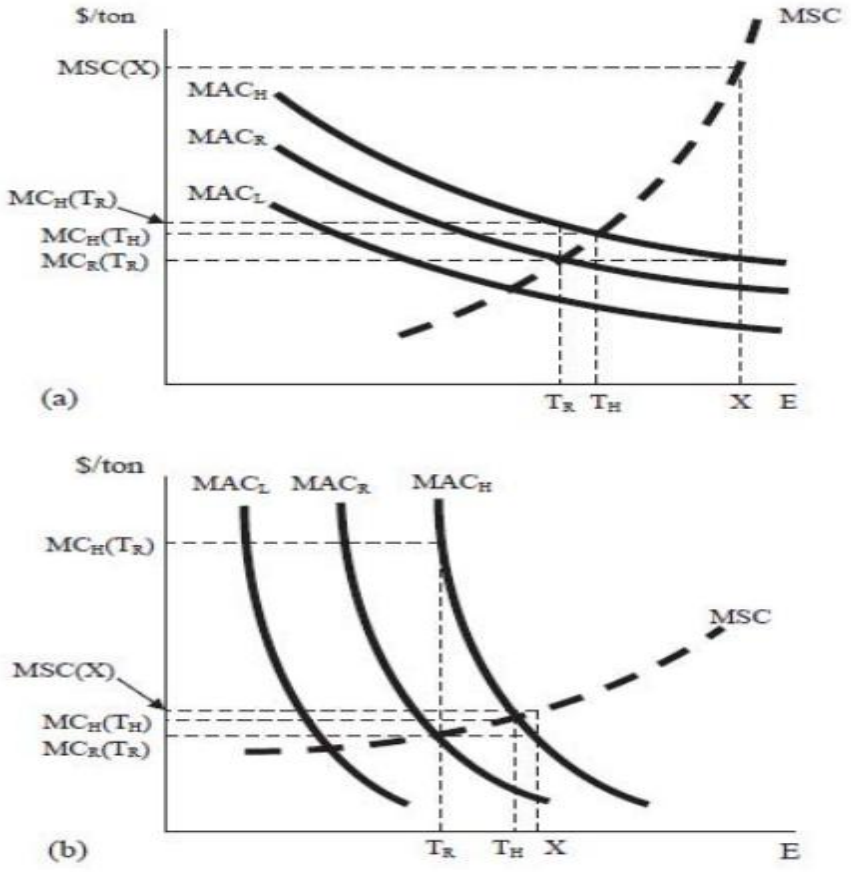
The quantity of emissions and the corresponding price (cost) of emission are determined by the balance between the demand for emission permits (the marginal abatement cost of carbon, MAC) and the supply of emission permits (the marginal social cost of emissions, MSC). When there is certainty in both the MAC and the social marginal cost, The ETS (with the quantity of emission permits set as T) and the carbon tax (with the carbon price set as MC(T)) lead to the same outcomes.



[Figure 18] Emission Permits Price Structure

Source: Jacoy and Ellerman (2004)

However, when uncertainty exists in the MAC, both ETS and the carbon tax result in price fluctuations (or emissions fluctuation). In case of uncertainty in the MAC, there is a possibility that it may change to MACH or MACL rather than MACR. In this case, MACR is expected under the ETS, emission prices are predicted at the MCR(TR) level, and emission permits are allocated equally. If the MAC is higher than MACH, the gap between the target value and the actual value under the ETS is as large as MCH(TR)-MCR(TR). In the given scenario (a), there is relatively less change in prices, resulting in lower welfare loss. Consequently, compared to a carbon tax that fixes prices, an ETS is more suitable.



[Figure 19] Emission Permits Prices under Uncertainty

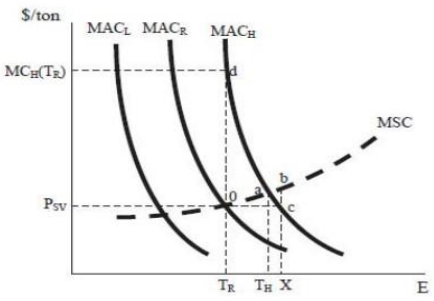
Source: Jacoy and Ellerman (2004)

However, as seen earlier, in situations where there is uncertainty in the MAC and if the MAC is steep (as in the example of scenario (b)), fixing the total amount of emission permits s can lead to drastic price changes. Consequently, it becomes necessary to equip a price stabilization mechanism.

- The types of price stabilization mechanisms are as follows (Han Hyun-ok, 2014)
  - Regulation of Emission Permits Supply
    - This includes methods such as banking, borrowing, allocation of reserve permits, and offsets. These methods flexibly adjust the total emission volume, mitigating price fluctuations. In particular, the reserve permit allocation involves setting aside a portion of the total emission permits as a reserve and supplying it to the market when prices surge, thereby stabilizing market prices.

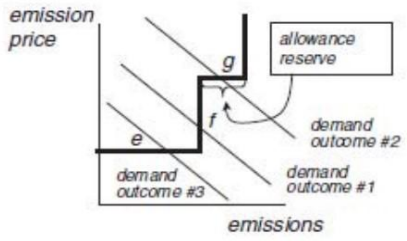
- Price Control
  - There are ceiling, floor, and collar approaches to the price of emission permits. The ceiling limits the rise in prices, ensuring that even if the MAC becomes high (MACH), the price level is capped. However, this does not meet the goal of ETS (reducing GHGs by limiting emissions) because it requires the supply of additional emission permits equal to X-TR. Price Floor prevents the emission permit prices from falling too low, ensuring that incentives for GHG reduction and technological investment are not hindered. Price collar mechanism in emissions trading systems involves constraining emission permit prices within a predetermined upper and lower limit. Particularly in situations where additional permit supply is required due to the upper price limit being reached, a reserve (g) can be prepared in advance to address this need.

Case with Price Ceiling (P_{SV}) Exists



Source: Jacoy and Ellerman (2004)

Case with Price Ceiling and Floor+ Reserve Exists



Source: Murray et al. (2009)

[Figure 20] Theoretical Discussion on Price Ceiling and Floor Mechanism

- **Domestic emission permit price stabilization system**

In South Korea, the Emission Permits Allocation Committee (Allocation Committee) has the authority to implement measures for stabilizing emission permit prices. The activation conditions of measures for market stabilization measures are as follows, and upon meeting these conditions, the system is implemented after deliberation by the Allocation Committee under Article 23 of the Act on the Allocation and Trading of Greenhouse Gas Emission Allowances**.** Among these, 1) and 2) are measures for the price ceiling, and 3)-① pertains to the price floor measures.

1.) If the price of emission permits is three times higher than the average price of the previous two years for six consecutive months
2.) If there is a short-term significant increase in the volume of transactions due to a surge in demand for emission permits, such that the average volume of transactions in the most recent month is more than double that of the highest monthly average in the previous two years, and the average price of emission permits in the most recent month is more than double the average price of the previous two years.
3.) If it is deemed necessary to implement market stabilization measures to maintain the order of the ETS market or to protect the public interest:
    ① The average price of emission permits over the most recent month is below 60% of the average price over the previous two years.
    ② There are a significant shortage of emission permits available in the trading market compared to the demand due to entities covered by the allocation not trading their emission permits, resulting in difficulties in the transaction of permits among these entities.

The method of stabilizing the price of emission permits is as follows (Article 23 of the Act on the Allocation and Trading of Greenhouse Gas Emission Allowances). Among these, 1) and 2) are measures to increase the supply of emission permits in the market as actions for the price ceiling, and 3) is a measure to directly set the price ceiling and floor.

1.) Additional allocation of up to 25% of the reserve portion of emission permits: During phase three, 14,000 thousand KAU are held as a reserve, and following deliberation by the Allocation Committee, additional allocations are carried out to entities covered by the allocation through auctions or other means from the respective reserve account in the emission permit registry.
2.) Setting minimum (not less than 70% of the emission permits for the respective compliance year) and maximum holding limits (not exceeding 150%) for emission permits.
3.) Temporary setting of highest and lowest trading prices.

So far, the implementation of emission permit price stabilization measures has been limited. In 2018, due to the perceived shortage of emission permits for the 2017 compliance period, 5.5 million emission permit reserves were provided to the market

through auctions, with 4.7 million of these being sold. There have been no further cases of using reserves since then. In 2021, due to the continuous decline in emission permit prices, a minimum emission permit price was set at 12,900 KRW in April (phase one) and then at 9,450 KRW in June (phase two). On July 26, 2023, the third minimum transaction price was set at KRW 7,020 per ton. This was determined after the price remained at the lowest level for five consecutive business days (July 19 to 25), resulting in a revision of the minimum transaction price and its calculation method. The fourth instance of implementing the minimum transaction price occurred on November 29, at KRW 7,750 per ton. Notably, three out of these four instances have been activated during phase three of the emissions trading system.

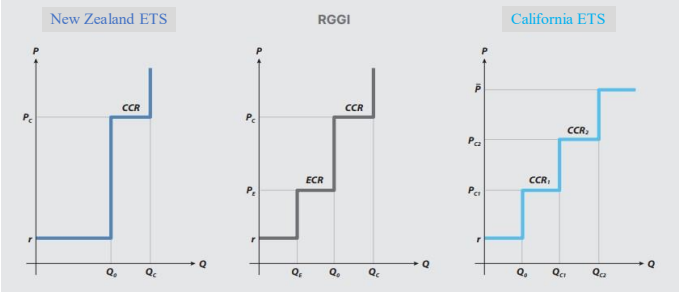
- Emission Permit Price Stabilization System in the EU and Other European countries
  - **EU**: The EU induces appropriate price stability by regulating the quantity of emission permits rather than direct price controls. Since 2015, the EU has established the Market Stability Reserve (MSR) system. If pre-set standards are met, auction volumes are adjusted to stabilize the supply and demand in the emissions market. The Allocation Committee uses the Total Number of Allowances in Circulation (TNAC) as a benchmark. 1) If the TNAC is above 833 million, 24% of future auction volumes are reserved, and supply is limited; 2) if the TNAC is below 400 million, 100 million additional emission permits are supplied as auction volumes. However, because these systems adjust the market based on transaction volume, the price stabilization effect is relatively limited. Additionally, operating the MSR based on the accumulated volume in circulation can result in temporal delays, potentially hindering immediate market stabilization measures (Yoon Yeochang, 2023).

  - **Germany:** Germany has adopted fixed prices until 2025 and will introduce a price ceiling and floor system in 2026. The German Emissions Trading System, introduced in 2021 for heating and transportation fuels, due to the market stability, auction allocation is made at fixed prices between 2021 and 2025 (25 euros in 2021, 30 euros in 2022 and 2023, 35 euros in 2024, and 45 euros in 2025). In 2026, auction prices will have a price range constraint of a minimum of 55 euros/tCO2 and a maximum of 65 euros/tCO2.

- **UK:** The UK has implemented systems for price stabilization based on the quantity of emission permits, including the Supply Adjustment Mechanism (SAM) and Cost Containment Mechanism (CCM). The UK ETS has been in effect since January 2021 following Brexit, with phase one extending until 2030. The UK ETS adjusts the supply of emission permits in the market through reserves using the SAM (this has a similar role to the MSR of EU-ETS) To mitigate sudden fluctuations in emission prices, the UK operates the CCM.
  - Activation Criteria: Triggered when the price of emission permits rises more than double the average of the past two years for three consecutive months.
  - Operating Method: The system allows for i) redistribution of auction quantities within the year; ii) advancing future auction quantities; iii) sourcing from the MSMA; iv) auctioning an additional 25% of the remaining emission allowances.

- Emission Permit Price Stabilization System in the U.S and New Zealand

New Zealand, the Regional Greenhouse Gas Initiative (RGGI), and the California ETS operate markets where the total supply of emission permits is adjusted based on their prices. If the price of emission permits rises above a certain level, planned reserves are additionally supplied to the market. If prices fall below a certain threshold, auctions are canceled, or the government buys back allowances to secure reserves. The existing multi-unit auction system, where a single price is set for multiple units, makes it challenging to separate bidders from winning prices, creating an incentive to bid at lower prices (Milgrom, 1989). This weakens the price discovery function of auctions. On the other hand, if the supply of emission permits is proportional to their price, bidding at lower prices would result in receiving fewer allowances, creating a penalty and incentivizing bidding according to the actual value of the permits.



[Figure 21] Market Stabilization Strategies of New Zealand, RGGI, and California's Emissions Trading System

Source: Yoon Yeochang, (2023)

- **New Zealand**: The New Zealand ETS employs the Cost Containment Reserve (CCR) and a price floor system to stabilize the market. The CCR mechanism limits price increases by introducing additional auction volumes from the reserve when the benchmark price is reached. The benchmark price for 2021 was set at NZD 50 (USD 31.65), with an annual increase of 2% planned. At the end of 2022, the New Zealand government announced plans to raise the CCR benchmark price to NZD 80.64 (USD 51.13) in 2023 and NZD 129.97 (USD 82.42) by 2027. The price floor was set at NZD 20 (USD 12.68) in 2021, with a planned annual increase of 2%. As of 2023, the floor price is NZD 33.06 (USD 20.96), projected to rise to NZD 44.35 (USD 28.12) by 2027.

- **California**: California ETS pursues price stabilization through an auction reserve price and the Allowance Price Containment Reserve (APCR). Starting in 2012 with a reserve price of USD 10 per emission permit, the minimum bid price increases annually by the rate of inflation plus 5%. As of 2023, the reserve price is set at USD 22.21 per emission permit. Each year, a portion of the total allowable emissions is stored in the APCR. The emission permit cap price is divided into two reserve tiers, and permits from the reserve are added to the auction when conditions for each tier are met. Additionally, a cap price is provided to eliminate non-compliance concerns within the compliance period. If the quarterly auction settlement price is more than 60% of the lowest

tier price, additional allowances from the reserve are provided. As of 2023, these are set at USD 51.92 and USD 66.71 per emission permits. If one or more businesses cannot submit the required permits by the end of the compliance period and there are no remaining permits in the APCR, permits are provided at the cap price. Revenues from sales at the cap price are used to purchase additional GHG reductions that are real, permanent, measurable, verifiable, and enforceable.

- **RGGI**: RGGI applies total emission allowance quantity control and a price floor mechanism. The Emission Containment Reserve (ECR) system reduces the total emission allowance quantity when prices are low to induce a price increase. Additionally, the price floor is preserved by reflecting the rate of inflation in the minimum price. The minimum auction price for emission permits in 2023 is USD 2.5 per permit, increasing annually by 2.5% to account for inflation. The Cost Containment Reserve (CCR) was introduced in 2014, and the ECR in 2021, to stabilize prices.
  - The CCR acts as a reserve to suppress price increases, supplying permits from the reserve to the market when the benchmark price is reached. The quantity supplied is approximately 10% of the regional total emission allowance. The CCR benchmark price started at USD US10 in 2017 and is at USD 14.88 in 2023. The CCR was activated in 2014 and 2015, with a total of 15 million allowances sold. The most recent activation was in the fourth quarter of 2021, with 3.9 million allowances sold.
  - The ECR cancels up to 10% of regional total emission allowances in auctions if prices fall below the benchmark. Canceled permits are not used in the future, leading to a reduction in the total emission allowance. As of 2023, the ECR benchmark price is USD 6.87, increasing by 7% annually. It issues with the Domestic Price Stabilization System.

(iv-2) Shortfalls and Limitations

- Complex and Stringent Activation Conditions

The current domestic price stabilization system in South Korea involves both price and quantity adjustments. In a period of price rise, the maximum price is set, and the auction quantity is expanded, and in a price decline period, the minimum price is set, and the auction quantity is reduced. The implementation of maximum and minimum price

mechanisms is one of the inevitable measures in a situation where auction volumes within the Emissions Trading System are limited. However, the activation conditions, such as 'prices being three times higher than the average of the previous two years for six consecutive months' during price increases or 'the average price of the most recent month being below 60% of the average price of the previous two years' during price decreases, are complex and make it difficult for market participants to clearly understand the activation timing and conditions. Additionally, due to the stringent nature of the activation conditions, there have been few actual instances of implementation (a total of 4 times).

- Low Sensitivity of Price Ceilings and Floors

The conditions for triggering the price increase period consist of stand conditions that are difficult to implement as the average price of the past two years for six consecutive months is more than three times higher. During price decreases, the condition requires that low prices must be maintained for more than one month, as it is based on the average price of the most recent month. The UK's CCM system has a more responsive activation criterion, 'prices exceedingly double the average of the past two years for three consecutive months,' allowing for quicker suppression of emission permit price increases. While the current domestic system in South Korea has the advantage of minimizing frequent market interventions, its low sensitivity means it may not respond effectively to significant market volatility. There is a need to consider revising the criteria to be more sensitive to market fluctuations, drawing from examples like the UK, where stabilization measures are triggered more responsively.

- Lack of Clear Principles and Standards Leading to Exceptional Applications

The lowest trading price over five days in which the criteria for setting the minimum trading price are met is discounted by 10% and applied on the following day. The third stabilization measure in 2023 was activated as prices fell below the market's lowest trading price on July 19, 20, 21, 24, and 25. According to the principle, the price on July 27 should have been set at 6,320 KRW, which is 10% less than the lowest price on July 24 (7,020 KRW). However, the third minimum trading price was set on July 26, and the price level was not discounted by 10%, remaining at 7,020 KRW. Such exceptions undermine the reliability of standards within the market and can increase uncertainty about the adoption of future policies.

- Absence of Measures for Price Normalization After Stabilization Actions

The purpose of price stabilization measures is to mitigate temporary volatility and provide a safety mechanism for market normalization. Given domestic conditions, with limited reserves and a small quantity of auctioned allowances, stabilization measures primarily rely on price ceilings and floors. In such cases, especially during periods of price decline, there are a few factors that can drive price increases. For instance, in 2021, after the minimum price was set in April, another price stabilization measure was implemented in June. Similarly, in 2023, there was not a significant increase in prices after the minimum price setting in July. Due to the structure of the system, it is possible to allocate additional reserves during price increases, the only method to address price declines is to reduce the total auction volume. Consequently, after the implementation of a minimum price scheme during a price decline period, there is a lack of policy tools to normalize prices.

- Absence of a Clear Direction for Minimum Prices

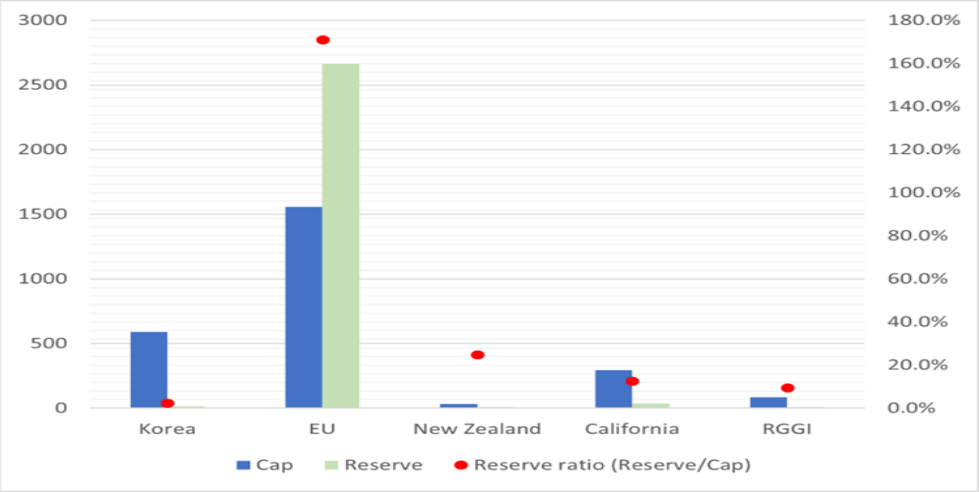
Most countries that have implemented a minimum price policy have introduced a standard increase rate for the minimum price, creating a structure where the minimum price gradually rises. For instance, California has codified an annual price increase of the inflation rate plus 5%, RGGI opts for a 2.5% annual increase, and New Zealand proposes a 2% annual rise. This approach signifies the need to consider at least the inflation rate, even for a minimum price. In South Korea, the standard for the minimum price is '60% of the average price of emission permits over the past two years', which leads to a progressive decline in the minimum price during periods of price drops. In practice, this has resulted in a gradual decrease in the minimum price: from 12,900 KRW in April 2021 to 9,450 KRW in June 2021 and down to 7,020 KRW in July 2023.

- Insufficient Reserve

The purpose of the ETS is to induce GHG reduction by limiting the number of emission permits. Therefore, direct price regulation methods like price ceiling and floor systems do not align with the intent of the system. In the case of the EU, instead of price regulation, the ETS stabilizes the market by adjusting the quantity of emission permits using reserves. This approach requires a sufficient amount of reserves to have a substantial impact on market stabilization. However, compared to other ETSs, South Korea has a significantly lower proportion of reserves.

  - The proportion of the reserve in relation to the total emission permits in Korea

is about 2.4%, which is much lower than that of the EU-ETS (171%), as well as New Zealand (25%), California (13%), and RGGI (10%).



[Figure 22] Reserve Proportion

Source: ICAP

II-3. Comparison between ETS Markets

ETS has emerged as a pivotal tool in the global effort to combat climate change. By setting a cap on the total level of GHG emissions and allowing industries with lower emissions to sell their excess capacity to more significant emitters, ETS creates a financial incentive for reducing emissions. This part of the paper aims to compare various ETS markets, including those in Korea, the European Union (EU), California (CALI), Quebec, and New Zealand. We have chosen these specific countries, the EU, CALI, Quebec, and New Zealand, based on the observation and identification of their commendable performance in implementing effective ETS. Through this analysis, we seek to understand the different approaches and mechanisms each system employs, the effectiveness of these strategies in reducing emissions, and their broader economic and environmental impacts.

[Table 23] Comparison Between ETS Markets

	Korea	EU	CALI	Quebec	New Zealand
Average Price	Average Auction Price				
	KRW 23,243 (USD 17.99)	EUR78.91 (USD 83.10)	USD 28.08	CAD36.29 (USD 28.08)	NZD 75.88 (USD 48.11)
	Average Secondary Market Price				
	KRW 20,633 (USD 15.97)	EUR 80.82 (USD 85.11)	-	-	NZD 78.97 (USD 50.07)
Total Revenue	Since the Beginning (EU: Since 2013)				
	In 2022				
	KRW 317.1 billion (USD 245.4million)	EUR 38.8 billion (USD 40.8 billion)	USD 4.03 billion	CAD 1.34 billion (USD 1.03 billion)	NZD 2 billion (USD 1.3 billion)
Sectoral Coverage	Waste/Aviation/Transport/Buildings/Industry/Power	Aviation/Industry/Power	Transport/Buildings/Industry/Power	Transport/Buildings/Industry/Power	Forestry/Waste/Aviation/Transport/Buildings/Industry/Power
GHG Coverage	CO2, CH4, N2O, HFCs, PFCs, SF6	CO2, N2O, PFCs	CO2, CH4, N2O, SF6, HFCs, PFCs,	CO2, CH4, N2O, SF6, HFCs, PFCS, NF3	CO2, CH4, N2O, SF6, HFCs, PFCs

			NF3, other fluorinated GHGs		
Number of entities	684 (at the start of the Phase 3) (2021)	8,757 stationary installations 371 aircraft operators	~330covered/opt-in entities represent 400 emitting sources/facilities	127 covered entities represent 165 facilities (2021)	2,887 entities registered (2,809 have surrender obligations)
Allowance Allocation (current phase)	Free Allocation				
	90%	43%	35%	35%	-
	Auctioning				
	10%	57%	65%	65%	-
Banking and Borrowing	(‘21~’23) Can bank up to 2 times the net amount of KAUs and offsets sold on secondary markets. (‘23~’24) Banking limits are equal to the net amount of allowances and offsets sold.	(‘08~) Unlimited banking allowed / Borrowing not allowed	Banking is allowed, subject to a holding limit, which is based on the year’s cap and decreases annually. Borrowing is not allowed.	Banking is allowed, subject to a general holding limit. The holding limit declines based on the annual allowance budget. Borrowing is not allowed.	Banking is allowed, except for the units purchased under the fixed price option. Borrowing is not allowed.
Market Stability Measure	Additional auctioning (up to 25% of allowances from MSR (Market Stability Reserve)) Limitation of the number of allowances entities can hold Increase/decrease of borrowing/offset limit Setting up a price	(MSR) adjusts auction volumes according to pre-defined thresholds of TNAC (Total number of allowances in circulation) Thresholds: (TNAC above 833m) 24% is withdrawn from future auctions and placed into MSR over 12 months.	(Auction reserve price) ‘23: USD22.21 Annually increase by 5% plus inflation. (Reserve account) (APCR) some allowances from each annual cap are placed here. tier(CCR)1: USD51.92 tier(CCR)2: USD66.71 tier(CCR)3(price	(Auction reserve price) ‘23: CAD20.83 Annually increase by 5% plus inflation. (Reserve account) To sell to entities that do not have enough allowance. 2021~: 4% (set portions) of the annual cap. tier 1: CAD49.66 tier 2: CAD63.81 tier 3: CAD77.97	(Cost Containment Reserve (CCR)) when it reaches a predetermined trigger price (set at NZD50 in 2021 and updated every year-NZD80.64 in 2023) -> a certain number of allowances from CCR is released for auction. (Price floor) ‘23: NZD33.06 ‘27: NZD44.35 (latest update)

	ceiling/floor	(TNAC less than 400m) 100m are released from the reserve and auctioned	ceiling): USD81.50		
Climate-Related Fund (Use of Auction Revenues)	Major Climate-Related Fund & Composition of the Source				
	Climate Response Fund (17% Auction Revenue) (44% Transportation Energy Environmental Tax)	Innovation Fund (IF) Modernization Fund (MF) Social Climate Fund (SCF) (All based on auction revenue)	Greenhouse Gas Reduction Fund California Climate Investment (All from the auction revenue of Cali-owned allowances)	Electrification and Climate Change Fund (All from auction revenue, and all auction revenues go here)	Climate Emergency Response Fund (CERF)
	Operational Scale				
	2023 2.49 trillion KRW (0.12% of GDP)	IF: EUR 40b MF: EUR 48.2b SCF: EUR 72.2b (total 2~3% of GDP)	GHG Reduction Fund: USD 5.4b (reached disadvantaged/low-income community) CCI: USD11.4b (invested in 560,000 projects)	CAD 7b (since the beginning of the program) (carbon market generated revenues of more than CAD4.3b during the period '13-'20)	NZD4.5b (USD 2.9b) (initial funding)
	Use of the Fund				
	1 GHG Mitigation 2 Creation of a new promising/Low carbon Ecosystem 3 Just Transition 4 Building a Basis for Carbon Neutrality	IF: Energy-intense industry/carbon-capture/CCS/renewable energy/energy storage MF: Support 10 lower-income EU member states to modernize energy system and	GHG Reduction Fund: at least 35% benefit disadvantaged/low-income communities CCI: supports environmental, economic, and public health-related projects.	ECCF: Climate action (mitigation/adaptation measures contained in the '30 Green Economy Plan)	Support immediate emissions reductions, future reductions and removals, climate change adaptation.

		improve energy efficiency SCF:			
	Governance				
	Multi-department Overall management: Ministry of Economy and Finance Fund management support: Climate Response Fund center Implementation of concerned business: central ministry	(IF) EC: overall management CINEA: implementing body EIB: PDA (project development assistance-financial and technical advice), monetizing funds from ETS, reporting. Participating countries: participating in implementation (MF) Beneficiary states: implementing the fund EIB: auctioning the allowances, confirming investment, managing the assets IC: annual report, issuing recommendations for financing.	-	Minister of the Environment, the Fight Against Climate Change, Wildlife and Parks ensures the Plan's implementation and coordinates its execution. Each ministry and agency is responsible for the performance of the action it implements	Treasury: CERF recipients are required to provide regular monitoring/reporting updates to the Treasury (financial reporting: quarterly basis, non-financial information: annually required)

- Comparative Analysis

  - **Operational Scale and Market Dynamics**: The ETS markets vary significantly in their operational scale, with the EU having the largest system in terms of total emissions covered and the number of entities participating. This scale influences market dynamics, such as price volatility and liquidity. New Zealand's ETS is notable for its integration with global carbon markets, demonstrating a more open-market approach compared to others.
  - **Pricing Mechanisms and Stability:** Price stability mechanisms, such as market stability reserves in the EU, differ across systems and are crucial in managing market volatility. California and Quebec, for instance, operate under a joint auction mechanism, providing a unique example of cross-border carbon market collaboration. This joint approach aids in maintaining price stability and consistency in market signals. Meanwhile, EU ETS employs a Market Stability Reserve (MSR) to adjust the supply of allowances and stabilize prices, a critical feature in managing market volatility and ensuring long-term price signals.
  - **Sectoral and GHG Coverage:** The breadth of sectoral coverage and the types of GHGs included vary. While Korea's ETS covers a wide range of industries, the EU's system focuses more on power and heavy industries, reflecting the region's industrial composition and its focus on climate policy. In the case of New Zealand, ETS notably includes the forestry sector, which is unique among the compared ETS. This inclusion reflects New Zealand's specific environmental and economic contexts.
  - **Allocation and Trading Mechanisms:** The allocation of allowances (free allocation vs. auctioning) and the provisions for banking and borrowing allowances are critical components. For example, New Zealand's system allows banking but limits borrowing, affecting the flexibility available to entities. Meanwhile, Korea ETS initially relied heavily on free allocation, which was intended to ease the transition for industries. However, this can potentially lead to windfall profits and reduced incentives for emissions reduction. EU ETS has progressively moved towards auctioning as the primary mode of allocation, which promotes market efficiency and reduces the risk of windfall profits.

- **Environmental Impact and Emission Reduction**: The effectiveness of each ETS in reducing emissions and its contribution to national or regional climate goals is a vital measure of success. The EU ETS has shown substantial progress in reducing emissions, with a notable decrease in power generation and heavy industry emissions, setting a benchmark for others. Also, California ETS demonstrates a reduction in emissions, with the added benefit of revenue generation for climate and clean energy projects.
- **Economic Impact and Market Efficiency:** The economic impact, including industry competitiveness and market efficiency, is crucial. With its revenue-recycling and climate-related funds, California's ETS demonstrates an approach that balances environmental goals with economic considerations. It generates significant revenue through its auctioning process, part of which is invested back into climate-related projects and initiatives, showcasing a model of balancing environmental and economic goals. In comparison, the effectiveness of EU ETS in reducing emissions has faced criticisms regarding its impact on the competitiveness of certain industries.
- **Governance and Compliance:** Governance structures, compliance mechanisms, and penalties for non-compliance play a significant role in the effectiveness of ETS. The rigorous compliance mechanism in the EU ETS has been a critical factor in its success. It features a robust compliance mechanism, including stringent MRV requirements and penalties for non-compliance, contributing to its overall effectiveness. Korea ETS has faced challenges in this area, particularly regarding the allocation process and the engagement of smaller entities in the system.
- **Innovation and Development:** The role of ETS in driving technological innovation and sustainable development is increasingly recognized. Markets like those in California have spurred innovation in green technologies, with a portion of the auction revenue dedicated to supporting clean technology development. Also, the EU ETS drives innovation as well, particularly in the energy sector, as companies seek cost-effective ways to reduce emissions.

This comparison of ETS markets across various regions highlights the diversity in approaches and mechanisms employed to combat climate change. While there are commonalities, such as the goal of reducing GHG emissions, each system reflects the unique economic, environmental, and political contexts in which it operates. Understanding these differences is crucial for

policymakers and stakeholders in designing and refining ETS to effectively balance environmental objectives with economic realities, ultimately contributing to the global fight against climate change.

Ch. III Designing an Effective K-ETS; Recommendations for Optimal Performance For Phase Four

i. Cap and allocation

- **Free Allocations Inconsistent with Updated NDCs**

The K-ETS market currently utilizes the GF method, where allocations are based on historical emissions, inherently leading to an excess supply. This is particularly pronounced during periods of low economic growth or recession, resulting in inevitable overallocation. During the phase one in 2017, the ETS cap was promptly updated to reflect the amended National Greenhouse Gas Reduction Roadmap (December 2016), increasing the 2017 CAP by 17.6 million tons. At the end of 2021, during the phase three, the NDCs were revised, setting a more ambitious reduction target of 40%. However, this was not immediately incorporated into the CAP for phase three. Instead, an adjustment of 12.7 million tons was declared in September 2023 through other reserves. Nonetheless, adjustments through other reserves have limited efficacy.

- **Halting Auctions or Introducing Third-Party Participation**

With the current oversupply of KAUs, auctions serve as a primary channel for acquiring permits during liquidity shortfalls in the trading market and also facilitate the distribution of reserves for market stabilization. Given this context, continuous auctioning of permits is not advisable. As the share of auctions grows, KAU auctions, unlike international practices, are restricted solely to companies engaged in auctions. Persisting with auctions under these conditions will lead to the absorption of market supply by increasing the range of auction participants. There's a need to broaden the spectrum of entities eligible for auction participation. Expanding this group should initially focus on increasing the involvement of financial institutions in the market to offset participation challenges faced by small and medium-sized enterprises, which may struggle due to limited resources and operational costs.

- **Mandatory trading on an exchange**

Consists of 56.1% of over-the-counter transactions, 10.8% of auctions, and 33.2% of exchanges. Over-the-counter trading is preferred because bulk transactions can be made at a single price, trading costs are low, and the price is not disclosed. However, it is mandatory to strengthen liquidity in the spot market and improve transparent pricing. Particularly, KAUs granted free of charge should be mandatorily traded on the exchange. The introduction of derivatives could be considered for the phase four, but only after ensuring sufficient liquidity and transparency in the spot market.

[Table 24] Proportion of Traded Volume Relative to Verified Emissions

		2015	2016	2017	2018	2019	2020	2021	2022
Exchange Transactions	TOTAL (1,000 tons)	1,242	5,107	14,734	17,829	16,959	20,953	25,869	25,935
	Daily Average (1,000 tons)	5	20	60	73	68	84	104	105
	Auction (1,000 tons)	0	0	0	0	7,949	8,171	11,177	19,641
Proportion of Exchange Transactions Compared to Actual Emissions		0	1	3	3	3	4	4	4
Proportion of Over-The-Counter Transactions Compared to Actual Emissions		1	2	5	8	6	8	9	7

Source: Korea Capital Market Institute

ii. Emission Coverage

- To respond effectively to CBAM, strengthening the regulation of free allocation and upward price signaling is necessary.
  - Considering the current industries that are regulated by the CBAM, industries with a high dependency on EU exports are quite limited to the steel industry.

[Table 25] Proportion of Exports in EU-CBAM Target Sectors

Sectors	EU Export Proportion ('18-'20)	
	Ton (%)	USD (%)
Cement	0.0	0.0
Fertilizer	0.3	0.3
Steel	9.8	10.3
Aluminum	6.2	6.7

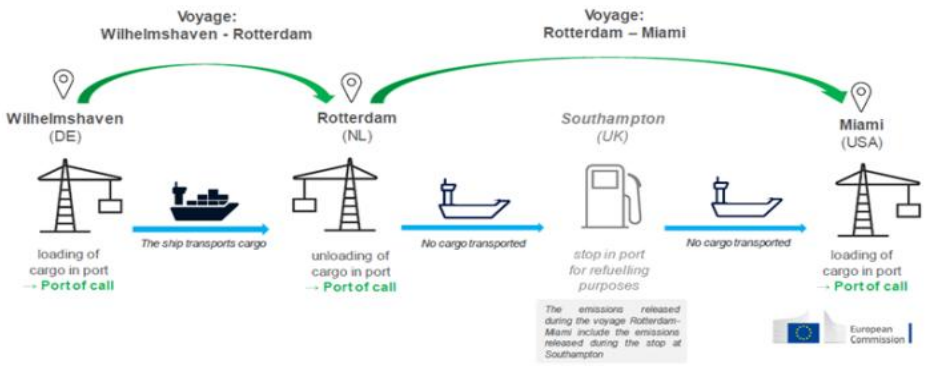
Source: Customs Office, Trade Statistics of Import/Export

- There is a need for correction due to the differences in the inclusion of indirect emissions in the steel sector between K-ETS and EU-ETS. The EU's calculation method is relatively lenient compared to Korea's, as it includes indirect emissions only in the electric furnace while excluding emissions associated with the general steelmaking process. Therefore, it is not cost-effective for K-ETS to reform its calculation methods to EU-ETS.
- However, from a regulatory perspective, maintaining or strengthening Korea's free allocation regulations, at least to the level of the EU's, can minimize the impact of CBAM and enable to internalize the carbon cost into the domestic regulatory system. Approaches to strengthening the regulations on free allocation involve directly increasing the rate of free allocation to minimize the benefit of 100% free allocation.
- Currently, the K-ETS is based on an average BM coefficient, but there is also a strategy to align it with the EU by enhancing it to the top 10% level. Additionally, in order to align with the EU-ETS price levels, efforts should be made to change the price of K-ETS upward. Eliminating banking restrictions is one measure. However, this is a short-term solution and has limited effects in providing long-term upward price signals. Some suggest that the current decline in the price of K-ETS may be due to a decrease in emissions caused by lower economic growth rates 13 and consumption slowdowns compared to previous years.
- To alleviate the double administrative burden on domestic companies caused by different emission methods, there will be a way for the government to support using the benefits from the implementation of ETS for EU-CBAM certificates.

[13] Economic Growth Rate: 4.1% (2021) → 2.6% (2022) → 1.5% (2023, OECD forecast)

- Activating compliance with reduction obligations for specific sectors by expanding the foundation of the voluntary carbon market

  - With global carbon regulations from international organizations such as IMO and ICAO, there is a need to expand carbon reduction efforts outside the compliance market. One of the ways to establish domestic implementation foundations for sector-specific carbon reduction obligations is to revitalize the domestic voluntary carbon market and strive to raise global recognition for it.
  - In this regard, the top priority would be to create an MRV system that takes environmental soundness into consideration, similar to certification systems such as Gold Standard and Verra. For instance, in the MRV system of the shipping sector, based on the distance between ports, it is challenging to calculate increased emissions due to additional travel distances for refueling purposes. Therefore, the most reliable method is to attach measuring devices to the point of emission sources of shipping and develop a system that can check this in real-time.



[Figure 23] The MRV calculation scope in the EU system

iii. Price Cap and Floor / Climate Response Fund

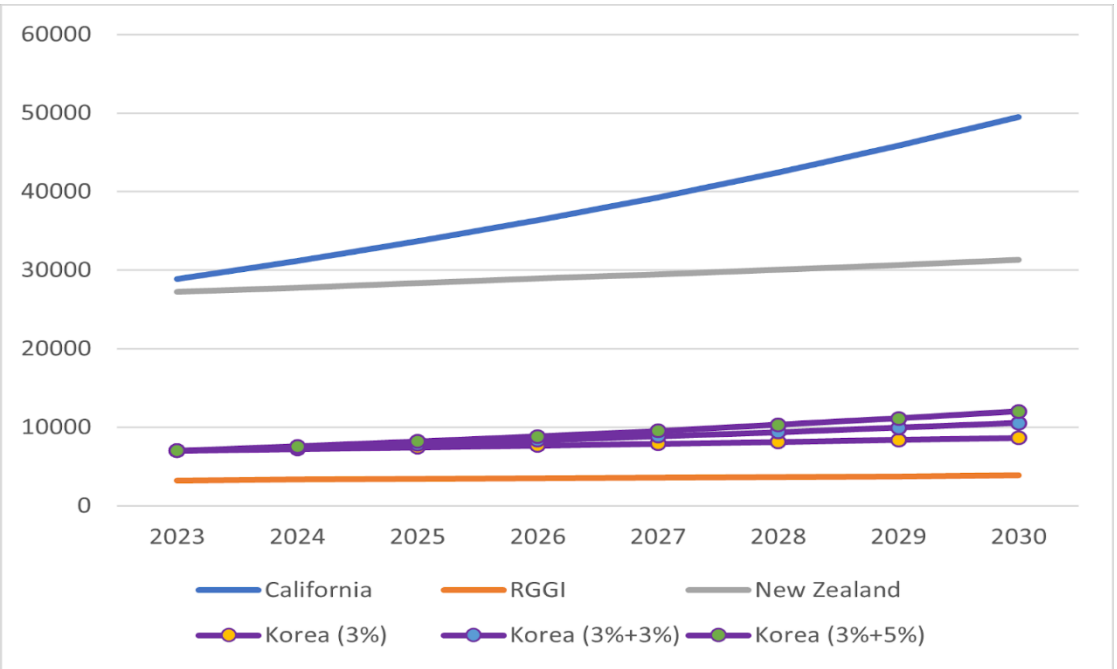
- Directions for Improvement in Market Stabilization

  - Focus on stabilizing the market through quantity control, but concurrent measures for price regulation are necessary.

    - Given the concept and purpose of the ETS, market stabilization through the control of emission permit quantity is crucial. The ETS aims for efficient resource distribution within a given quantity; thus, intervention in the market is appropriately done through quantity control.
    - However, due to the structure of the domestic ETS market, where the

reserve is small, and the proportion of free allocation is high, simply adjusting auction quantities may not achieve the desired market stabilization. Therefore, while quantity control should be the fundamental measure, it is necessary to cooperate it with price control measures. Price ceilings and floors can mitigate market uncertainties and provide direction for the medium to long-term market trend.

- Establish Clear and Effective Principles for Price Standards
  - Current criteria for activation are stringent and insensitive, making immediate market intervention challenging. This results in prolonged periods of low (or high) prices, potentially harming market stability. Moreover, the complexity of the price-setting criteria makes it difficult for market participants to predict the price floor/ceiling for the following year. For the phase four, it's necessary to revisit and clarify the current criteria, Especially the 6-month criteria for price surge periods and the 1-month criteria for price drop periods, to enhance sensitivity.
- Provide Long-Term Direction for Minimum Price Levels in Price Regulation
  - Domestic minimum prices are continuously declining, failing to incentivize participating companies in the ETS to reduce emissions. Like the USA and New Zealand, a pre-determined annual increase rate for the minimum price should be set to ensure that carbon prices are aligned with carbon neutrality goals. As seen in leading examples, a minimum inflation rate consideration (2-3%) is necessary, and an additional increase rate (like in California's case) should be applied to strengthen the impact of carbon neutrality through minimum pricing.
  - Based on the 2023 minimum price of KRW 7,020 in the K-ETS, the inflation rate (assuming 3% in the [Figure]) as in New Zealand or the inflation rate + x % as in California is applied as shown in the following [Figure 24]. The projected prices for 2030 would be around KRW 8,600 with only inflation applied and about KRW 12,000 with inflation plus an additional 5%, as illustrated in [Figure 24] below.



[Figure 24] Patterns of Minimum Price Change

Note: The KRW/USD exchange rate is assumed to be 1,300 KRW/USD, assuming a 3% inflation rate in the US and Korea

Note: California, RGGI, and New Zealand are estimated by applying the average annual growth rate based on the 2023 floor price.

- Directions for Improvement in the Climate Response Fund
  - Strengthening the Linkage between the Climate Response Fund and the ETS
    - Revenue from emissions trading auctions is a primary source for the Climate Response Fund, and its significance is expected to increase as more entities are included in the auction. However, there is a lack of support systems for companies participating in the ETS auctions that contribute to these revenues. Currently, all auction proceeds are transferred to the fund, and project selection is conducted by different departments, resulting in a lack of a feedback process for the participating companies. It is necessary to strengthen the linkage between the ETS and the fund by allocating a certain proportion of the Climate Response Fund specifically for supporting companies involved in the ETS auctions. This could involve setting aside a dedicated segment of the fund for these companies, ensuring a more direct and beneficial connection between auction participation and fund allocation.

Ch. IV Conclusion

IV-1. Summary of the main findings and insights

As the K-ETS approaches its Phase Four, this report has provided an in-depth analysis of its operational dynamics, efficiency, and comparative performance with global ETS markets. Based on the insights gathered, it outlines critical policy recommendations that will guide South Korea in optimizing the K-ETS for the upcoming phase, ensuring it continues to be a pivotal component in the nation's climate change mitigation strategy.

Key Policy Recommendations

- **Robust Cap Setting and Allocation Strategy**

  Adjustment of Caps: Align the cap setting with South Korea's updated National Greenhouse Gas Reduction Roadmaps, considering more ambitious reduction targets in line with international commitments.

  Strategic Allocation: Improve allocation mechanisms to encourage emission reductions, particularly in high-emitting sectors. This includes refining the criteria for free allocation and gradually transitioning to auction-based allocations.

- **Enhanced Market Mechanisms**

  Trading System Improvements: Facilitate broader participation in ETS auctions, especially by financial institutions, and explore mandatory exchange trading for certain allowances to enhance market liquidity.

  Price Stabilization Measures: Implement more responsive price control measures, such as dynamic price ceilings and floors, to stabilize the market and guide medium to long-term price trends.

- **Expanded Emission Coverage**

  Revise regulations on free allocation, aligning closer to EU standards. This adjustment is vital to minimize the impact of the EU's Carbon Border Adjustment Mechanism (CBAM) and to encourage more effective emission reductions.

- **Strengthening the Climate Response Fund**

  Allocate a specific portion of the Climate Response Fund to support companies actively participating in ETS auctions, thereby strengthening the linkage between the fund and the ETS.

  Enhance transparency and governance of the fund to ensure its effective utilization in climate mitigation and adaptation projects.

- **Governance and Stakeholder Engagement**

  Foster a more inclusive approach in policy-making, incorporating feedback from diverse stakeholders. This includes industry participants, environmental groups, and the public to ensure a balanced and effective ETS.

- **Continuous Monitoring and Adaptation**

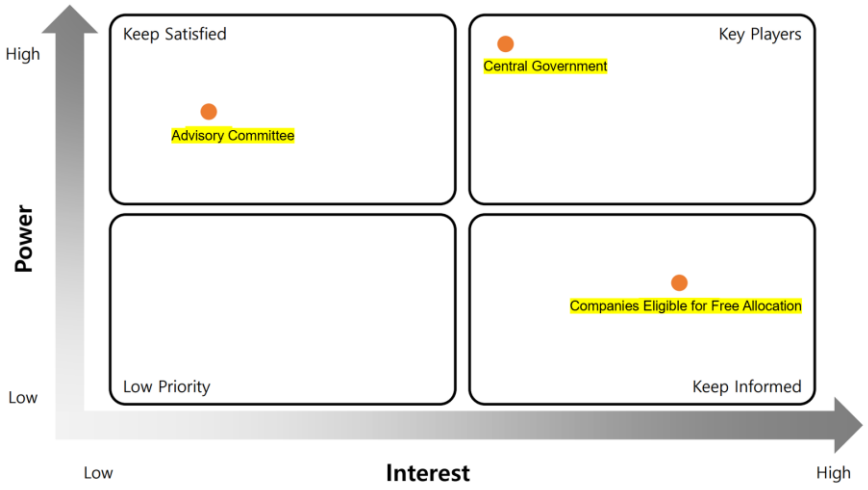
  Establish robust mechanisms for continuous monitoring of the K-ETS, enabling adaptive management in response to changing economic, environmental, and technological landscapes.

In conclusion, as South Korea is soon to embark on Phase Four of the K-ETS, these recommendations provide a strategic framework for enhancing the system's effectiveness. By adopting these measures, South Korea can not only achieve its emission reduction targets but also drive sustainable economic growth and environmental resilience. The success of Phase Four will hinge on the nation's ability to implement these policies effectively, fostering innovation and collaboration across all sectors. This will solidify South Korea's position as a leader in climate change mitigation and as a model for effective emissions trading systems globally.

APPENDIX

Stakeholder Interviews

In systematically identifying suitable interviewees for our research, the research team delineated the distribution of decision-making authority within the ETS framework and analysed the varied interests stemming from its implementation. Stakeholder analysis identified three key categories: the advisory committee, a high-power entity with a nuanced yet comparatively restrained level of interest; the central government, wielding significant influence and demonstrating moderate but potentially evolving interest aligned with K-ETS advancements; and companies eligible for free allocation, characterized by their limited decision-making power but high-interest levels. This detailed analysis not only guided our interviewee selection but also provided critical insights, shaping our research methodology and contributing to a nuanced understanding of stakeholder dynamics in the ETS.



[Figure 25] Stakeholder Analysis

i. Advisory Committee

Q. I understand there is an over-allocation following the initial allocation of emission permits due to adjustments in the NDC. What are your thoughts on this?

A. All excess emission permits were recouped from the reserve. The current state of over-allocation is due to other factors. Over time, there has been an accumulation, and a surplus of allowances remains due to the economic downturn caused by COVID-19 in 2021 and 2022. Fundamentally, it is true that the allocation to companies is excessive compared to their activities. There is a need to change the allocation method itself. The ETS covers 72% of the national emission volume in South Korea. It is 72%, but in the actual ETS scope, it can be higher. For instance, if the reduction rate is 10% in Europe, the ETS applies a reduction rate of about 12-13%. To lead effectively in emissions trading, it is essential to strengthen reduction efforts and limit allocations.

Q. If so, is it impossible to resolve this issue by 2025?

A. The issue could have been resolved if the government had reduced the quantity of allowances allocated rather than recouping from the reserve. The legal basis for doing this can be determined through deliberation by the Committee. The Committee determines the total amount and then allocates part of it, setting aside the rest as a reserve. While reducing the reserve is effectively the same as reducing the total amount, the impact is different. The reserve is held by the state, while companies hold the allocated amount. Therefore, adjusting the allocation is what truly makes an impact. However, this has not been done due to concerns about resistance from the industrial sector. (Adjusting the reserve and allocation are different matters.) Reducing the reserve does not affect the companies.

Q. Is there a way to prevent the widespread practice of companies selling emission allowances just before closing down to cover deficits, possibly through early reclamation or legal actions?

A. It can be challenging to anticipate such issues at the beginning, leading to mistakes. However, legal measures (civil actions) can be taken afterward. When submitting emission allowances, a fine of 100,000 KRW per ton (or three times the market price) is imposed if a company submits fewer than its actual emissions. However, no system is in place for recouping allowances after paying the fine. It is unclear whether paying the fine exempts a company from the obligation to submit the required allowances. The Ministry of Environment needs to refine the rules based on identified loopholes. Rule setting can be done through notifications or legal measures.

** The Ministry of Environment does not have the power to adjust the reserve; the Ministry of Trade, Industry and Energy does it **

Q. What do you think about transferring all authority related to emissions permits to the Ministry of Economy and Finance?

A. The Ministry of Economy and Finance (MOEF) is the only ministry that can influence the Ministry of Trade, Industry, and Energy, so it has power in that respect. However, it is currently struggling even to raise electricity prices. Personally, I do not view MOEF as a ministry that is friendly towards GHG reduction efforts.

Q. What kind of work do you do on the Committee?

A. Regarding the recent adjustment of reserves, the Committee did not make that decision. I participated in the deliberation committee when the lowest price market stabilization measure was invoked last time. According to the regulations, the lowest price should have been activated in May, but it was not, which became an issue.

Q. As far as I know, the Ministry of Environment granted additional emission permits to all applying companies this year, and upon checking, I found that the additional allocation was more than double compared to last year. What are your thoughts on this? I am also wondering if it is appropriate to continue releasing auction quantity in addition to granting additional allocations to entities with over-allocation.

A. As I mentioned earlier, the lack of clear rules is a major issue, and there seems to be no party genuinely hoping for the normalization (increase) of emission allowance prices. This absence of a clear objective for price stabilization is the biggest problem in the current system.

Q. Regarding the Carbon Border Adjustment Mechanism (CBAM), there is an opinion that it might be better for South Korea to pay the costs domestically now rather than to the EU starting from 2026. It's also said that since the designated sectors (excluding power generation) like steel are already decided, it would be better to impose taxes only on steel exported to Europe and communicate to the EU that these taxes have already been paid. What do you think about this matter?

A. Even if the EU plans to apply the carbon border tax across all sectors by 2034, currently, only a few sectors, like steel, are affected. Therefore, many hold the view that imposing a tax due to this is not rational. However, I think it is time for advanced countries like ours to face this challenge head-on. Apart from the issue of whether the allocation is excessive or insufficient, the quantitative national target itself is too lax. When the national emission

allowance targets were set in 2020, the target price was 50,000 KRW, and it was 100,000 KRW for 2030. The implication was that we must reach 100,000 KRW to reduce emissions effectively. The IPCC reports also predict a 50% reduction compared to 2018-2019 if the price of emission allowances reaches about 100 dollars. During COVID-19, the EU reduced its allocation rate and recouped a lot from the MSR. They also started reducing overseas reduction shares in 2018. These factors, which do not operate in South Korea, hinder the rise in the price of emission allowances.

Q. I've heard that from the corporate perspective, emission allowance prices are unpredictable, and even achieving reduction targets does not significantly benefit them, leading many to conceal reduction technologies. The industry claims a lack of technology for reduction, but when meeting, it is often found that they have the technology but choose to keep it hidden.

A. That is true. National policymakers need to continuously signal the importance of will and goal achievement. From a corporate standpoint, their approach is understandable, and it is not the fault of the businesses but rather the government, which needs to provide clear signals and consistently drive policy. My argument is for the implementation of a price ceiling and floor for emission allowances. For instance, if the floor is 50,000 KRW and the ceiling is 100,000 KRW by 2030, the government is effectively signaling an ideal price of around 75,000 KRW. The IPCC reports can be used as a reference to determine these limits. Or, considering the price was 40,000 KRW in 2019, the limits can be set based on a certain rate of increase. I believe next year will see the formation of the 4th plan starting from 2024, and the allocation for 2030 will significantly decrease. This accumulation of effects might lead to a slight increase in prices from next year. It seems that even in phase four, there is an ongoing discussion of just using the MSR for volume adjustment instead of a price floor. When quantity regulation is implemented, it makes price prediction challenging, so minimizing price uncertainty is essential, which, in this case, would be a price ceiling and floor system. In that perspective, California operates its ETS market in the most textbook manner.

Q. I am interested in the possibility of a multi-unit auction system where the supply of emission allowances moves in proportion to their price.

A. In California, there is a system called the allocation price containment reserve, APCR, which is similar to what you're describing. Even with a cap of 65 dollars, there are intermediate control points at 35 and 45 dollars to prevent sudden sharp price increases. This system operates under the premise of implementing a price ceiling and floor. However, as previously mentioned, South Korea is discussing adopting the European-style MSR instead. For the MSR to be successful, a high ratio of auction is necessary.

Q. Considering this year's agenda includes items like tripling energy efficiency, which is viewed favorably, is there a possibility that the NDC might change again if this is decided?

A. It is unlikely to change. As South Korea is not a rapidly growing country, it is not easy to alter the denominator in the energy efficiency equation.

ii. Central government

Q. Could you explain your Ministry's specific responsibilities regarding the emissions trading system?

A. The concept of 'emissions trading' is implemented with the objective of fostering cost-effective reductions in GHGs. It is a framework enabling enterprises to trade surplus emissions achieved through GHG mitigation efforts. The Ministry establishes a basic plan, a legislative framework guiding the emissions trading process. This involves developing and administrating a comprehensive system for emissions trading centered around an allocation strategy that determines the distribution of emission allowances to various GHG-emitting entities. Continuous refinements and enhancements to this system are also part of the Ministry's responsibilities.

Q. Do you think rotating positions among policymakers could impede the ability and understanding of work related to the emissions trading system? What do you think is the correlation between position rotation and task comprehension?

A. Among emissions trading, especially the emissions trading market, there are many differences in nature from other tasks of the Ministry. Its distinct nature, comparable to financial markets, especially those observed in the EU, demands specialized skills and knowledge. Consequently, the focus should be less on rotating roles and more on ensuring a profound comprehension of the market's complexities.

Q. Is there a possibility that the auction will be stopped due to the current over-allocation of emission permits?

A. It is not accurate to describe the emission permits as being over-allocated; they have been allocated in accordance with the Nationally Determined Contributions (NDC). However, a surplus of emission allowances has emerged due to a reduction in corporate emissions, influenced by factors like COVID-19 and changes in economic conditions. In the past, there have been instances where the auction was suspended due to heightened price volatility. However, the decision to suspend auctions should be based on continuous monitoring of the market conditions. If a critical need for quantity adjustment arises, the suspension of auctions may be considered following a thorough review.

Q. Is there a plan to allow third-party participation in the auction? If not, what are the reasons?

A. Allowing third-party participation in auctions is a mid - to long-term basic direction. Currently, auctions are conducted to enable companies with auctions to purchase the

necessary amount of emission permits efficiently. However, expanding participation requires ongoing review, considering social consensus and market conditions.

Q. What if the winning bid is lower than the bidding price?

A. The current auction system operates in a structure where the highest bids purchase the available quantities, and bids below the minimum are invalid. The winning bid price is determined by the lowest of these valid bid prices. Therefore, even if bids are placed at higher prices, the winning bid can be lower.

Q. Is there any mechanism to penalize selling auctioned emission allowances at higher prices in the market after winning a bid at a low price? Is the Ministry aware of this case?

A. The trading exchange continuously monitors for unfair trade practices, and the auction and market prices generally form at similar levels. So far, there have been no instances of such trading activities identified.

Q. I would like to ask about plans for expanding auctions, particularly the overall direction for phase four. I am curious whether there is a focus on increasing the percentage of auctions among the current auction target industries or if there are discussions about transitioning completely free allocation industries to auction.

A. The direction for phase four is currently under internal review. Phase four, as per the legal deadline, needs to be established by the end of 2024, so a draft is expected to be released in the first half of 2024. Therefore, the public can learn about this through the published draft or public hearings. At present, the direction for the 4th plan can only be ascertained to the extent outlined in the 3rd basic plan and allocation plan.

iii. Companies Eligible for Free Allocation

Q. Given that companies like yours are among Korea's top GHG emitters, I am curious if they tend to have a shortage or surplus of allowances in actual operation.

A. Power generation and electric power group companies are always experiencing an allowance shortage. Due to their high generation share, electric power groups are always in a buying position.

Q. From the perspective of purchasing emission permits, how significant is the purchase cost in financial terms?

A. For power generation companies, which are base industries, most of the costs are fuel expenses. In this context, though substantial, the cost of purchasing emission permits may be relatively lower compared to other general companies. It accounts for about 2-3% of the total costs, which is a figure close to the average.

Q. With the implementation of an integrated BM, it is expected that the economics of coal power will worsen, and costs will align with LNG prices. Do you anticipate that the financial impact of carbon emission allowances will lead to a change in the proportion of coal power generation?

A. The purpose of the single BM implementation is to strengthen environmental protection. It is about supplying power considering economy, environment, and stability beyond cost-effectiveness. Even if the single BM for coal power strengthens and the price and auction ratio of emission allowances increase, ideally, dispatch can change. However, practical factors like energy security must be considered when designing the system.

Q. In the industrial sector, there was a surplus in 2020-2021 due to reduced production from COVID-19. What changes have occurred in the transition sector due to COVID-19? Did it also experience a surplus like the industrial sector, or did household electricity usage maintain previous levels?

A. In the transition sector, there was some impact due to reduced power demand following the economic downturn, but it did not significantly influence the excess supply of emission allowances. Coal power is being replaced with LNG and renewable energy. While other sectors might have triggered a price crash due to excess supply against allocation, the transition sector was less affected by COVID-19 than the industrial sector. However, as mentioned earlier, we are always in a buying position; no surplus occurred.

Q. Do you make predictions about the ETS market?

A. Since we do not purchase emission allowances daily, market forecasting is necessary to determine the appropriate time to buy. We explore cost-effective and economical ways to trade emission allowances while operating facilities, and if no viable option is apparent, alternative strategies must be prepared. Although predicting market prices is challenging due to their high impact, we are developing our own forecasting system, which will be made public once it is well-developed.

Q. Are there any plans for additional power plant construction? Does the ETS play a significant role in investment decisions for power plant expansion?

A. As evidenced by the EU and other data, we need to consider the policy role of the ETS. Although South Korea operates the ETS as a key reduction policy, the damage (cost) is significant, and the technology and maturity of the market are lacking, making it challenging to close or expand power plants due to the ETS. Also, due to the special nature of energy, power companies operate according to the Basic Plan for Electricity Supply and Demand, so it is not an issue a company can decide independently.

Q. Do you have any expectations or anything you would like to reflect on designing the 4th ETS?

A. The goal is to set rational reduction targets. Assigning excessive targets with inadequate sectoral carbon reduction technology can undermine industrial competitiveness, as everything is based on electricity. Assigning targets considering each sector's capacity and technology would be ideal.

Q. I am curious about the number of staff dedicated to managing emission allowances. I'm asking to gauge how seriously the company takes this area.

A. If you look at the 'transaction' of emission allowances, it's about four people, and considering the reporting line under the premise of in-house trading, it's five. However, it is not an issue that can only be seen as a pure transaction; it must also be responsible for business reduction activities, long-term technology development accordingly, and an overall energy transition roadmap. The headquarters is quite large, considering the emissions management, calculation, and reduction guidance departments.

Q. If an allocation is insufficient, are you considering engaging in external projects?

A. The three primary implementation methods are self-reduction, technology utilization, and offsetting. ETS is the most economical, but we are still working to expand offsetting activities. Non-ETS also needs to be addressed, so we strive for reduction activities linked

to business characteristics. Overseas, decisions on items like ITMO at COP28 will inform project planning, but international projects are on hold due to policy uncertainty.

Q. I heard that your company reduced its compensation for emission allowance costs to its power generation subsidiaries. Has there been any change in internal strategy since then?

A. Before answering, I would like to clarify that while the term 'compensation' is used, it is more appropriate to view it as a rational accounting and inclusion of environmental costs incurred in operating power generation facilities into the wholesale price. It is challenging to detail the impact of environmental dispatch, but as it strengthens, the mix of generation facilities has shifted, leading to financial impacts as well.