Consistency Verification of the 2035 NDC: Effects of the IPCC Guidelines Transition on the Reduction-Rate Calculation

Joo Hyung Moon*, Youngwoo Lee, Jai Oan Cho
Korea Atomic Energy Research Institute
111, Daedeok-daero 989beon-gil, Yuseong-gu, Daejeon, 34057, Republic of Korea
**Corresponding author: moonjooh@kaeri.re.kr*

***Keywords :** 2035 NDC, IPCC, Greenhouse Gas, Carbon-Neutrality, Net-Zero*

1. Introduction

The Government of the Republic of Korea announced its 2035 Nationally Determined Contribution (NDC) as a 53–61% reduction relative to 2018[1], expressed on a ***net*** emissions basis, thereby establishing a major interim milestone toward the 2050 carbon-neutrality goal. The 2035 NDC involves not only a change in the level of ambition but also important shifts in the statistical and accounting foundations used for target setting. Specifically, Korea's national greenhouse gas (GHG) inventory guideline framework has transitioned from the Intergovernmental Panel on Climate Change (IPCC) 1996 Guidelines[2] to the IPCC 2006 Guidelines[3], and the target-setting narrative increasingly emphasizes harmonization around ***net*** emissions, minimizing the prior practice of mixing "***total*** emissions" and "***net*** emissions."

These changes are not limited to technical updates. They can directly affect: (1) the baseline-year emissions level (i.e., the denominator in reduction-rate calculations), (2) the calculated reduction rate itself, (3) consistency with the statutory target (a 40% reduction by 2030), and (4) clarity in domestic and international communication. Accordingly, under the guideline transition, it is essential to verify whether the 2035 target is logically and quantitatively consistent with the existing pathway (the 2030 target and its associated measures). In particular, the Constitutional Court Decision [4] has underscored the importance of predictability and clarity in mid- to long-term mitigation target-setting and implementation pathways, highlighting the importance of clarity and predictability in accounting conventions.

Building on this motivation, the present study systematically reviews how the transition of IPCC inventory guidelines affects reduction-rate calculations, examines structural consistency issues that may arise in the 2035 NDC framework, and proposes practical and institutional directions to address these issues.

2. Understanding National GHG Statistics

The Greenhouse Gas Inventory and Research Center of Korea (GIR), under the Ministry of Climate, Energy and Environment, annually estimates and discloses national GHG emissions in accordance with the *Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis*. National GHG statistics have been compiled since 1990, and, in general, the latest official inventory is finalized at the end of year Y for data up to year Y–2. For example, the inventory finalized in December 2024 provides statistics from 1990 through 2022.

However, revisions to previously finalized estimates occur frequently. GIR publishes an annual National GHG Inventory Document (NID)[5] and notes that discrepancies between the current report and the prior year's report can arise because of improvements in activity data and/or changes in estimation methodologies that trigger recalculation for relevant years.

According to the NID [5], the estimated national GHG emissions for the NDC base year (2018) under the 2030/2035 NDC framework are summarized in Table 1. Beginning with the 2023 NID, Korea applies the updated statistical basis (IPCC 2006 Guidelines[3]) while providing estimates under both the previous and updated guidelines to maintain continuity with earlier publications (see Section 3.1 for details). Under the updated guideline basis, the 2018 ***total*** GHG emissions for the 2030/2035 NDC base year increase to 783.9 million tCO_2eq in the 2024 calculation.

Table 1. GHG emissions for the NDC base year†(2018)

(Unit: million tCO_2eq)

Emission		2020	2021	2022	2023	2024
IPCC 1996	Total	**727.6***	727.0	727.0	725.0	723.9
	Net	686.3	685.0	686.6	684.7	692.5
IPCC 2006	Total	-	-	-	773.0	**783.9**
	Net	-	-	-	732.5	**742.3****

* 2030 NDC base year (2018) ***Total*** Emission
** 2035 NDC base year (2018) ***Net*** Emission
† Note that revisions reflect activity data/method updates and recalculations across years

Here, "***net*** emissions" refer to ***total*** emissions excluding removals from sinks. Article 2(3) of the *Framework Act* defines ***net*** emissions as the quantity remaining after offsetting the amount of GHG absorbed by sinks from the amount emitted, released, or leaked into the atmosphere. Accordingly, even for the same NDC base year (2018), the reported emissions level may differ depending on the year of compilation, the applicable guideline basis, and whether ***total*** or ***net*** emissions are used. Therefore, when establishing an NDC baseline and calculating reduction rates, it is

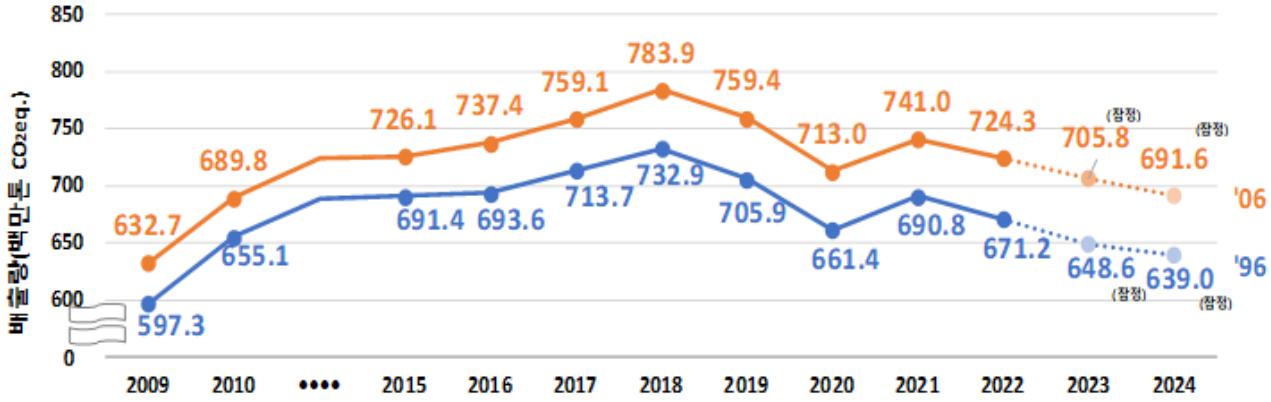

Fig. 1. Increase of national ***total*** GHG emissions by transition from 1996 to 2006 IPCC guidelines[6]

necessary to explicitly state which inventory statistics and accounting conventions are applied.

3. What Has Changed in the 2035 NDC?

3.1 Revision of the Inventory Guidelines

The IPCC National GHG Inventory Guidelines[2, 3] provide standardized methodologies for estimating national emissions and removals. Compared to the 1996 Guidelines, the 2006 Guidelines advanced toward improved comparability and transparency by refining sectoral and activity-data classification, elaborating source-category structures, and expanding the coverage and precision of estimates for certain gases (particularly fluorinated gases) and industrial process emissions. This transition is consistent with international methodological developments and also serves as a foundation for more accurately reflecting technological progress and changes in industrial structure in Korea (e.g., the growing relevance of F-gas-related industries such as semiconductors and displays, and increased refrigerant use).

Figure 1[6] illustrates changes in national ***total*** GHG emissions under different IPCC guideline bases. Relative to the 1996 Guidelines, applying the 2006 Guidelines increases estimated ***total*** emissions by approximately 50 million tCO_2eq. Therefore, even for the same underlying real-world emissions, the guideline transition can result in a recalculated baseline-year emissions level. Because this change affects the denominator of the reduction-rate calculation, the nominal expression of a target (e.g., "40% reduction relative to 2018") may be preserved while the implied implementation burden or calculated reduction rate may shift. In this sense, the guideline transition is not only an update to statistics but also calls for verification of consistency between legal-policy targets and the sufficiency of the implementation pathway.

*3.2 From a "**Total** Base to **Net** Target" Convention to a "**Net** to **Net**" Convention*

Historically, Korea has presented mitigation targets using a convention in which the base year is expressed in terms of ***total*** emissions, while the target year is expressed in terms of ***net*** emissions. In this context, the Constitutional Court has issued opinions[4]—split between majority and minority views—emphasizing the importance of predictability in mid- to long-term mitigation targets and clarity in the accounting basis used for such targets. Subsequently, the Government indicated that the 2035 NDC would align both the base year and target year on a "***net***" emissions basis in response to broader calls for clarity[1]. As a result, the emissions levels for the 2030 NDC and the 2035 NDC have been set differently, as shown in Table 2.

Table 2. 2030/2035 NDC Target Emissions [1]

(Unit: million tCO_2eq)

Target Emissions		2018	2030	2035
2030 NDC	Total	727.6	-	-
	Net	686.3	436.6	-
2035 NDC	Total	783.9	-	-
	Net	742.3	470.3	289.5 ~348.9

The Constitutional Court's decision suggests that the institutional design of mid- to long-term national mitigation targets is linked to the government's duty to protect fundamental rights, and that not only the numerical level of targets but also the predictability of target setting and implementation pathways and the clarity of institutional arrangements are important. Accordingly, this study reaffirms that: (1) mixing baselines and metrics can make the substantive meaning of the target unclear to the public, and (2) an ambiguous long-term pathway may weaken policy credibility and implementation feasibility.

4. Structural Consistency Issues in the 2035 NDC

The present study identifies two structural issues that may arise in connection with the 2035 NDC during the

transition to the IPCC 2006 Guidelines and the alignment toward ***net*** emissions accounting.

First, there is a need to manage consistency with the statutory 2030 target (a 40% reduction). The Act and its Enforcement Decree specify a mid-term national mitigation target of a 40% reduction by 2030 relative to 2018. If the base-year (2018) emissions are recalculated under the IPCC 2006 Guidelines and the reduction-rate calculation aligns both the base year and the target year on a ***net*** emissions basis, it becomes necessary to re-examine whether the same set of policy measures that has been associated with the "40%" target continues to yield an equivalent reduction rate under the updated accounting basis.

Second, the guideline transition and metric alignment may reveal a need for additional mitigation beyond the existing 2030 implementation pathway, and thus highlight the importance of concretizing subsequent policy discussions. When the existing mitigation package is "translated" into the updated accounting framework, a quantitative discrepancy may emerge. If the same set of measures yields a lower reduction rate under the updated basis, additional mitigation measures (or strengthened instruments) may be required to maintain equivalence with the statutory target. In this context, the key issue is not merely whether additional mitigation is needed, but whether discussions clearly specify how any additional requirement would be addressed—namely, in which sectors, by which instruments, on what timeline, and with what cost and institutional readiness. Because the 2035 NDC is largely designed on the assumption of a pathway for the 2030–2035 period, leaving a consistency "gap" unresolved at the 2030 stage may increase the implementation burden for the 2035 stage.

If the existing 2030 mitigation package is converted to the IPCC 2006 Guidelines and a ***net*** emissions basis without additional adjustments, the 2030 ***net*** emissions are estimated at approximately 490.3 million tCO_2eq, as reported by Ahn [7]. However, it is set to 470.3 million tCO_2eq as shown in Table 2. Therefore, to maintain equivalence with the statutory target level, it is necessary to identify and explain additional mitigation measures on the difference of 20 million tCO_2eq. However, based on publicly available materials, it is difficult to confirm quantitative evidence that explicitly explains this gap.

5. Recommendations for Improving the 2035 NDC

5.1 Transparent Disclosure of the Guideline-Transition Effects

To explain the effects of the guideline transition and metric alignment transparently, the Government should present a table that clearly summarizes: baseline-year emissions under both the 1996 and 2006 Guidelines; the stepwise conversion structure from ***total*** emissions to ***net*** emissions (including sinks, CCUS, and international mitigation, where applicable); and the official formula/definition used for calculating the reduction rate. Such a table could serve not only as explanatory material but also as an "*official reference*" that can be repeatedly used in future target adjustments and implementation assessments.

5.2 Establish a Standardized Metric Rule Connecting Statutory Targets and NDC Communication

To manage the 2030 target and the subsequent 2035 target along a consistent pathway, a standardized rule is needed that clarifies: (1) the metrics used for base and target years (definitions of ***total*** vs. ***net***), (2) the basis for applying the 2006 inventory guidelines, and (3) the treatment of sinks/removals and international mitigation. Rather than abruptly rejecting prior conventions (e.g., ***total*** base / ***net*** target), it would be beneficial to specify both the official rule and the relationship between the official rule and prior conventions (e.g., through conversion and equivalence explanations) to reduce confusion.

5.3 Explicitly Design an Additional Mitigation Measures Portfolio

If additional mitigation is required under the guideline transition, it is preferable to present the response as a portfolio. Measures with high implementability (energy efficiency improvements, strengthened methane and F-gas management, demand-side measures, etc.) should be prioritized, while measures requiring regulatory reforms, permitting, and investment preparation should be staged over time with clear milestones. Moreover, performance should be tracked not only by "annual abatement" but also by implementation indicators such as completion of regulatory arrangements, permitting progress, and investment execution, which can improve policy stability.

6. Conclusions

The transition to the IPCC 2006 Guidelines and the alignment toward ***net*** emissions accounting are consistent with international best practices and can enhance the precision of national statistics and policy transparency over the long term. Nevertheless, these changes affect baseline-year emissions levels and reduction-rate calculations, thereby introducing new tasks for managing consistency between the statutory 2030 target (40%) and the 2035 NDC, as well as for explaining the implementation pathway. This study frames these issues not as a question of policy direction, but as a challenge of strengthening consistency and verifiability accompanying an accounting-system update. Disclosure of bridging information, establishment of a standardized metric rule, and the design of an additional mitigation portfolio constitute practical measures that can simultaneously improve credibility and implement-ability. Moving forward, achieving carbon neutrality will require not only ambitious numerical targets but also a

transparent explanation clarifying how targets are calculated and how those calculations link to legal requirements and implementation instruments.

ACKNOWLEDGEMENT

This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (No. RS-2024-00430408).

REFERENCES

[1] The Presidential Commission on Carbon Neutrality and Green Growth, the 2035 Nationally Determined Contribution, Nov. 10, 2025.
[2] IPCC, the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, 1996.
[3] IPCC, the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2006.
[4] Constitutional Court Decision 2020HeonMa389 et al., Aug. 29, 2024.
[5] GIR, National Greenhouse Gas Inventory Document of Republic of Korea, 2021/2022/2023/2024/2025.
[6] Ministry of Environment, Press Release on National Greenhouse Gas Provisional Emissions of 691.58 million tCO_2eq in 2024, Aug. 19, 2025.
[7] Y.H. Ahn, Meaning of 2035 NDC and Net Zero Promotion Plan, Korea Carbon Forum, Nov. 24, 2025