Preparing for the application of the new IPCC methodology reports on SLCFs and CDR/CCUS

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Abstract

In preparation for its seventh assessment cycle (AR7), the Intergovernmental Panel on Climate Change (IPCC) is developing two supplements to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories — one on Short-Lived Climate Forcers (SLCFs) and one on Carbon Dioxide Capture, Utilization and Storage and Carbon Dioxide Removal (CDR/CCUS) — both scheduled for publication in 2027. The SLCF supplement responds to mounting evidence that pollutants such as black carbon, methane and tropospheric-ozone precursors exert a strong near-term warming effect; quantifying them therefore enables integrated climate–air-quality assessment and captures the co-benefits of joint mitigation. The CDR/CCUS supplement, in turn, formalizes accounting for what the IEA and IPCC AR6 identify as an indispensable mechanism for reaching net-zero, and both documents are expected to serve as central references for national climate policy. The Republic of Korea (ROK) — which has legislated a 2050 carbon-neutrality target and a 40% reduction from 2018 levels by 2030 — carried out a study to assess how readily its National GHG Inventory can accommodate these forthcoming rules. For SLCFs, we mapped Korea's air-pollutant emission inventory and calculated precursor emissions to prepare for future reporting in the tranportation sector ; for CDR/CCUS, we reviewed how other countries currently report these emissions internationally.

For the SLCFs, we mapped Korea's national air-pollutant inventory (CAPSS) onto the IPCC GHG inventory categories and computed precursor emissions (NOx, SOx, CO, NMVOC) in the transportation sector for 2016–2023, comparing their trajectories with those of CO_2 and CH_4. Nationally, CO_2 emissions declined by only 6%, whereas precursor emissions fell far more steeply — SOx by 58%, NOx by 38%, and NMVOC by 13%. This divergence arises because precursor reductions were driven mainly by the diffusion of advanced end-of-pipe abatement and after-treatment technologies (e.g., flue-gas desulfurization and catalytic converters), whereas lowering CO_2 depends less on technology than on the sheer volume of fuel combusted and therefore requires an absolute reduction in fuel use. A detailed analysis of the road-transport sector (7 vehicle types × 7 fuel types) revealed the same pattern: CO_2 fell by just 1.6%, while NOx and CO fell by 50.3% and 54.8%, respectively. An LMDI decomposition attributes this asymmetry to rising vehicle registrations (+16.5%, +9,884 kt), which nearly offset the CO_2 savings from lower per-vehicle activity (−10.8%) and improved fuel efficiency (fuel economy) (−5.3%), whereas precursor reductions were dominated by technology-driven emission-intensity effects. By vehicle type, diesel trucks and diesel recreational vehicles (RVs) showed simultaneous declines in both precursor and CO_2 emissions, whereas gasoline RVs and gasoline hybrids showed falling precursor emissions but rising CO_2 emissions as their registered fleets expanded.

For the CDR/CCUS, we analyzed the reporting status of 42 Annex I countries that submitted National Inventory Documents (NIDs) and Common Reporting Tables (CRTs) to the UNFCCC under the Paris Agreement's Enhanced Transparency Framework. Only 24 of the 42 reported any CCUS activity, and captured CO_2 amounted to just 0.16% of their total emissions. Oil- and gas-producing countries — Russia, Canada, Australia and Norway — reported the largest

capture volumes, reflecting their established EOR and geological-storage infrastructure. Case studies of Japan, Canada, Switzerland and the United States revealed wide cross-country differences in how transport and storage emissions are estimated, how CO_2 transferred across borders is tracked, and how enhanced oil/gas recovery (EOR/EGR) is treated.

Building on the transport-sector SLCF analysis and the review of international CDR/CCUS practices, ROK is conducting foundational research to reflect both elements in its National GHG Inventory, and plans to progressively broaden the scope of this work. Drawing on these findings and on consultations with domestic experts, we will prepare a National GHG Inventory consistent with the IPCC guidelines once they are finalized in 2027, and submit it to the UNFCCC accordingly.