Targeted Decomposition Analysis for healthcareâ€™s carbon footprint in Japan

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Healthcare services have become an increasingly significant source of greenhouse gas (GHG) emissions, driven by rising demand associated with global population growth and rapid aging in developed countries. The sector is estimated to account for approximately 5% of total global GHG emissions. Following the 2015 Lancet Commissionâ€™s proposal of â€œPlanetary Health,â€• which emphasizes the interdependence between human health and the Earthâ€™s natural systems, efforts to quantify healthcare-related emissions and promote decarbonization have accelerated worldwide. In 2022, the World Health Organization launched the Alliance for Transformative Action on Climate and Health (ATACH) to foster climate-resilient and low-carbon health systems; more than 100 countries now participate. Japan joined ATACH in 2024, and in July 2025 the government adopted a cabinet decision committing to a net-zero target for the healthcare sector. Healthcare-related emissions account for roughly 6% of Japanâ€™s total GHG emissions. Although decarbonization measures are urgently required, their relative mitigation potential within the healthcare carbon footprint has not been sufficiently quantified, making policy prioritization challenging.

This study quantifies the emissions associated with 30 decarbonization options identified from precedents in the UK National Health Service (NHS). Using Japanâ€™s 2020 Input-Output Table, we construct an environmentally extended input-output (EEIO) model with endogenous capital formation. Sectoral GHG emissions are derived from the 3EID database.

To attribute emissions to specific mitigation options, we develop Targeted Decomposition Analysis (TDA), a novel decomposition approach that allows us to define selected element groups within the input coefficient matrix and/or the emission vector and to quantify their contribution to the overall carbon footprint. Compared with conventional decomposition methods, TDA provides a flexible framework for focusing on specific supply-chain components while avoiding double counting of emissions across components.

By defining each of the 30 mitigation options as a target element group, we identify option-specific emissions within Japanâ€™s healthcare carbon footprint. The results indicate that establishing decarbonization standards for pharmaceuticals, nationwide electricity decarbonization, energy-efficiency improvements in healthcare facilities, and extending the service life of medical capital stock are among the highest-impact options.

The proposed method enables us to quantitatively assess the influence of any selected group of elements within the supply chain, thereby enhancing the policy relevance and interpretability of input-outputâ€“based carbon footprint analysis.