

Economically Rational CO₂ Reduction Potential in the Japanese Hot Water Sector considering Lock-in Issues: Future Analysis using Micro Data of Survey on Carbon Dioxide Emissions from Residential Sector

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Abstract

Water heating accounts for approximately 20% of carbon dioxide (CO₂) emissions in the residential sector in Japan, and the importance of reducing CO₂ emissions has been suggested through the spread of high-efficiency water heaters such as heat pump water heaters. However, differentiating services for water heaters is difficult, and cost tends to be the most important factor. To promote the reduction of CO₂ emissions, the viewpoint of economic rationality is indispensable. Therefore, this study analyzes the changes in the market share of water heaters required to reduce CO₂ emissions at low costs in the Japanese residential sector.

The following three points were considered to ensure a realistic analysis. First, installation costs were included to reflect the fact that replacement with heat pump water heaters would require foundation work and other costs in addition to the high unit cost of the appliance. Second, the limitation that replacing other appliances with heat pump water heaters in existing multi-family homes was difficult owing to the installation space and other limitations, was considered. Third, the micro data of survey on CO₂ emissions from the residential sector were used to account for different household characteristics and the variations in hot water demands even among the same number of household members. The analysis compared the changes in the water heater shares, emissions, and costs between 2020 and 2050 among the three cases. The CO₂ emission factor for electricity was assumed to gradually decrease and reach zero in 2050.

Consequently, the cases, in order from the lowest to the highest cost, were as follows: the “economic case” in which the least expensive appliances were selected, the “80% reduction case” in which appliances were selected to reduce CO₂ emissions by 80% in 2050 compared with that in 2020 while maintaining costs low, and the “business as usual case” in which the current appliances continued to be selected. To reduce CO₂ emissions by 80% in 2050 compared with that in 2020 at low cost, (1) the lock-in problem where types of water heaters become fixed must be solved, and a closer examination by building type shows that (2) for single-family homes, the immediate steady adoption of high-efficiency appliances and accelerated adoption of heat pump water heaters starting in the second half of 2030 are necessary, and (3) for multi-family homes, the adoption of heat pump water heaters for new constructions must be accelerated immediately.

note: This document will be opened to the participants on IERE website before the Forum and opened to the public afterward.