ABSTRACT

Relatively high and continuously increasing CO_2 emissions have intensified the global energy transition agenda. However, energy transition efforts remain constrained because decarbonizing the industrial sector is particularly challenging, especially in hard-to-abate industries whose high-temperature production processes still depend heavily on fossil fuels. Green hydrogen innovation offers a potential low-carbon solution to overcome the limitations of direct electrification in these sectors. Nevertheless, advances in green hydrogen innovation have not yet been matched by widespread technological commercialization, and their effectiveness therefore requires further examination. This study aims to analyze the effect of green hydrogen innovation on CO_2 emissions from industrial combustion in ten developed OECD member countries during the 2000–2022 period.

Through an annual panel-data approach with a total of 230 observations, through first differences cause current period and one-periode lag using 220 observations, and two-period of lag using 210 observations. This study employs CO_2 emissions from industrial combustion as the dependent variable. Green hydrogen innovation and its interactions with specific low-carbon hydrogen policy as the main independent variables. The analytical framework is based on the Extended STIRPAT approach and Ecological Modernization Theory. The model is estimated using the two-way fixed-effects method.

The results show that green hydrogen innovation has a negative but statistically insignificant effect on emissions. This finding indicates that an increase in the number of patents has not yet demonstrated a measurable reduction in industrial energy combustion emissions. However, the interaction with specific hydrogen policy has a statistically significant effect to the value of green hydrogen innovation to reducing industrial emissions within first and second model. Also, the combination of policy support and innovation can influence the effect of green hydrogen technologies and generate output which statistically significants based on the Wald test of first and second model. Among the control variables, broad hydrogen policy has a negative and significant effect, while changes fossil fuel consumption share and GDP per capita have positive and significant effects. Meanwhile, changes in the renewable energy consumption share do not demonstrate a statistically significant causal relationship.

Keywords: *green hydrogen innovation, CO_2 industrial combustion, clean energy policy, renewable energy, two-ways fixed effect model.*