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Life-cycle assessment of hydrogen production *via* catalytic gasification of wheat straw in the presence of straw derived biochar catalyst

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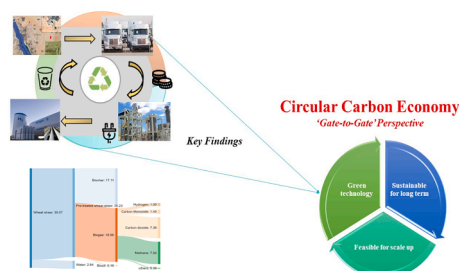
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HIGHLIGHTS

- The environmental impacts based on P5 unit are found to be negligible.
- P4 unit poses the highest environmental impact, especially on human health category.
- The whole process environmental impact is found to be 93.4017 mPt.
- “Wheat straw loading” parameter contributes the most to global warming potential.
- Straw biochar catalysts offer competitive H₂ yield and lower environmental impact.

GRAPHICAL ABSTRACT



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ABSTRACT

The environmental footprints of H₂ production *via* catalytic gasification of wheat straw using straw-derived biochar catalysts were examined. The functional unit of 1 kg of H₂ was adopted in the system boundaries, which includes 5 processes namely biomass collection and pre-treatment units (P1), biochar catalyst preparation using fast pyrolysis unit (P2), two-stage pyrolysis-gasification unit (P3), products separation unit (P4), and H₂ distribution to downstream plants (P5). Based on the life-cycle assessment, the hot spots in this process were identified, the sequence was as follows: P4 > P2 > P1 > P3 > P5. The end-point impacts score for the process was found to be 93.4017 mPt. From benchmarking analysis, the proposed straw-derived biochar catalyst was capable of offering almost similar catalytic performance with other metal-based catalysts with a lower environmental impact.

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