Rethinking of the future sustainable paradigm roadmap for plastic waste management: A multi-nation scale outlook compendium

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HIGHLIGHTS

- Plastic wastes have caused undeniable sustainability impacts at a multi-nation scale.
- P-graph tool is applied to generate a feasible global plastic wastes treatment scheme.
- The optimal scheme is determined using TOPSIS with consideration of three criteria.
- Significant environmental impact is still non-negligible even after optimization.
- Strategy and recommendation for future improvements are outlined via PESTLE analysis.

GRAPHICAL ABSTRACT
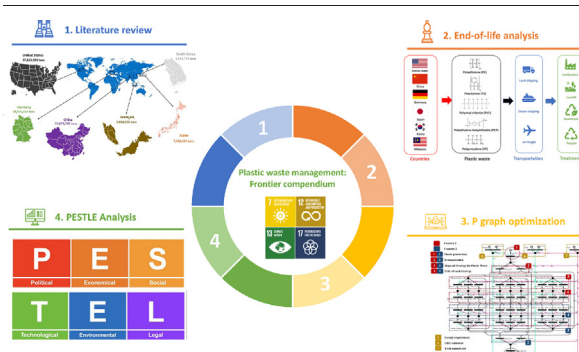
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ABSTRACT

The myriad consumption of plastic regularly, environmental impact and health disquietude of humans are at high risk. Along the line, international cooperation on a global scale is epitomized to mitigate the environmental threats from plastic usage, not limited to implementing international cooperation strategies and policies. Here, this study aims to provide explicit insight into possible cooperation strategies between countries on the post-treatment and management of plastic. First, a thorough cradle-to-grave assessment in terms of economic, environmental, and energy requirements is conducted on the entire life cycle across different types of plastic polymers in 6 main countries, namely the United States of America, China, Germany, Japan, South Korea, and Malaysia. Subsequently, P-graph is introduced to identify the integrative plastic waste treatment scheme that minimizes the economic, environmental, and energy criteria (1000 sets of solutions are found). Furthermore, TOPSIS analysis is also being adapted to search for a propitious solution with optimal balance between the dominant configuration of economic, environmental, and energy nexus. The most sustainable configuration (i.e., integrated downcycle and reuse routes in a closed loop system except in South Korea, which proposed another alternative to treat the plastic waste using landfill given the cheaper cost) is reported with