Marine fuels via plastic waste valorisation: a path to sustainability

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The conversion of plastic waste into marine fuels represents a promising and sustainable approach to addressing the global plastic pollution crisis while simultaneously providing cleaner, renewable energy for the maritime industry. By embracing the concept of plastic waste valorisation, the loop on plastic waste can be reduced promoting in parallel sustainable energy solutions under the circular economy concept.

In this context the Plastic2Fuels project aims to develop an innovative technology for producing renewable maritime fuels by utilizing plastic waste through advanced thermochemical processes, with the goal of reducing emissions and enhancing sustainability in maritime transportation.

It is important to evaluate the environmental profile of these fuels towards the identification of sustainable fuels production processes in order to discern the optimal sustainable pathway. Life Cycle Assessment (LCA) is an internationally standardized methodology that quantifies the environmental potential impacts associated with a product by collecting the inputs and outputs of the examined production process and evaluating the associated impacts by interpreting the results obtained in the inventory analysis based on the impact assessment categories.
This LCA study evaluated the environmental impacts of the examined production process targeting to marine fuels. In particular, the system boundaries involve the plastic waste pyrolysis to py-oil, that is further upgraded via catalytic hydrotreatment to marine fuels, under a well-to-tank approach, integrating the whole process of the fuels production (Figure 1).

The life-cycle impacts are quantified in terms of variant categories, emphasizing on Global Warming Potential (GWP), as an agent of climate change that is a key link between fuels production and environmental impacts. The accumulative emissions for fuels production are generally determined by the emissions of each process including energy (i.e., electricity, natural gas, and petroleum) production, materials (i.e., chemicals) production and energy recovery (i.e., the combustion of by-products).

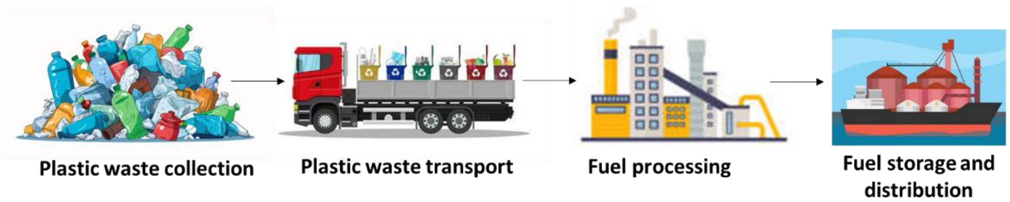

Figure 1. System boundaries of the examined production process

Table 1 depicts the preliminary calculated accumulative GHG emissions attributed to marine fuels production.

Table 1. GWP (g CO_2eq/MJ) of the examined production process

Month	GWP *
Plastic waste pyrolysis	82
Py-oil catalytic hydrotreatment	20
Total	102

*The unit of GWP g CO_2eq/MJ

Based on the initial results, the examined production pathway can potentially lead to sustainable alternative fuels. The next steps of this study involve data further elaboration, quantification of the environmental impacts associated with the jet fuel production and the comparison with biofuels originated from vegetable oils, etc.

The results of this study are preliminary, since data are being collected and processed but they are indicative of the favourable environmental profile of the investigated technological pathway. Furthermore, it is evident that processes utilizing plastic waste targeting to marine fuels contribute towards sustainable production pathways.

Conclusively, the valorisation of plastic waste into marine fuels is an emerging and promising solution to two major environmental issues: plastic pollution and the necessity for cleaner energy in the maritime, driving the transition toward sustainable energy sources for shipping.

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