TECHNICAL AND ENVIRONMENTAL PERFORMANCES OF ALTERNATIVE THERMOCHEMICAL TREATMENTS FOR MIXED PLASTICS WASTE

Filomena Ardolino, University of Campania “Luigi Vanvitelli”, Italy
filomena.ardolino@unicampania.it
Francesco Parrillo, University of Campania “Luigi Vanvitelli”, Via Vivaldi, Italy
Umberto Arena, University of Campania “Luigi Vanvitelli”, Via Vivaldi, Italy

Key Words: Mixed Waste Plastics; Combustion; Gasification; Pyrolysis; Technological readiness level

There is a general and important effort to increase circularity of plastics, by proposing new behaviours and styles of life (“how to use and reuse plastics”), new eco-design criteria (“design for recycling” and “design from recycling”), innovative recycling processes able to increase the quantity and quality of recovered resources (“Plastics-to-Plastics” but also “to-Chemicals”, and “to-Fuels”). The attention in mainly focused on mixed plastics waste (MPW) whose treatment shows the major technical difficulties, due to the co-presence of various and generally non-compatible, polymers, with different kinds of additives, pigments and fillers. A very small fraction of these plastics can be treated in conventional recycling facilities, and the recovered resources are often characterised by a low quality, which complicates the reintroduction into the market. Some promising treatments, such as the new processes of supercritical fluid extraction and dissolution/precipitation (Nontox, 2021), have been recently proposed and could be suitable for some of these plastics waste streams in a close future. On the other hand, advanced thermochemical treatments (TT) seem to acquire a new and interesting role in the framework of circular economy agenda, due to their high or rather high technology readiness level (TRL) but also for their sustainable environmental and economic performances (Fellner and Brunner, 2021; Voss et al., 2021). The paper describes the technical characteristics of some of these TTs: plastics-to-energy by combustion, combustion with carbon capture and sequestration (CCS), and autothermal gasification; plastics-to-fuels by allothemal gasification or catalytic pyrolysis; plastics-to-oil by catalytic pyrolysis. An attributional environmental life cycle assessment (LCA) quantifies and compares the related environmental performances, by taking into account the substitutability factor of obtained resources and TRL of the recovery processes (Figure 1). The results highlight the promising performances of some of these thermal processes, particularly those occurring in waste-to-energy units with CCS and in advanced gasification technologies.

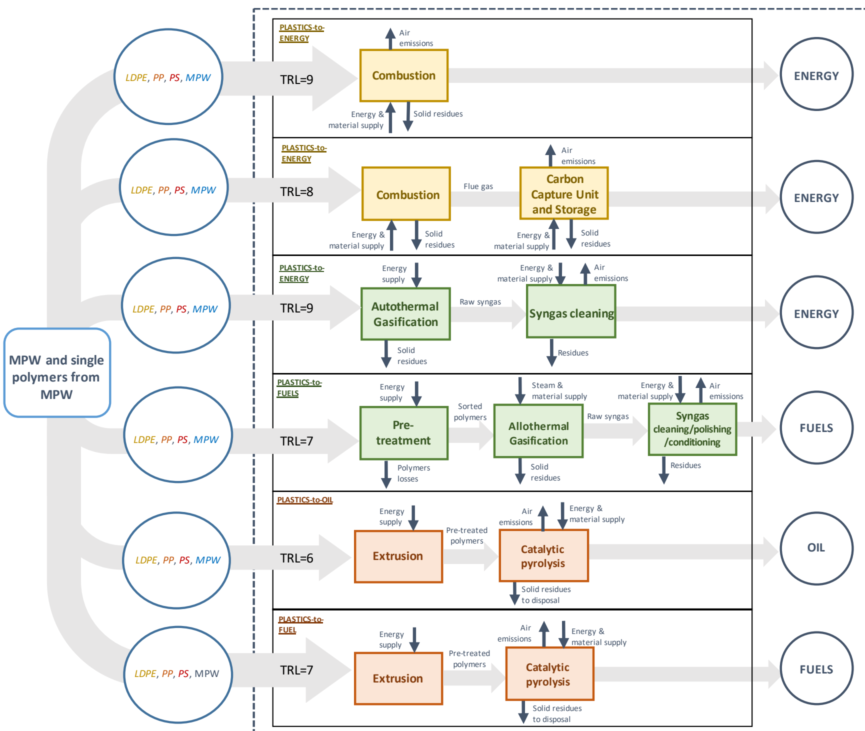

Figure 1 – System boundaries of the LCA study, with the indication of the alternative thermochemical options for specific types of mixed plastics waste.

REFERENCES:
Fellner, J., Brunner, P.H., 2021. Plastic waste management: is circular economy really the best solution? J. Mater. Cycles Waste Manag. 24: 1–3. DOI: 10.1007/s10163-021-01340-2.
NONTOX Project, 2021. http://nontox-project.eu/
Voss, R., Lee, R.P., Seidl, L., Keller, F., Frohling, M., 2021. Global warming potential and economic performance of gasification-based chemical recycling and incineration pathways for residual municipal solid waste treatment in Germany. Waste Manage. 134, 206-219