The iCAREPLAST project
Results and conclusions

Welcome to the **iCAREPLAST** newsletter!

This is the seventh edition of our newsletter series.

This SPIRE project started in October 2018 and has received funding from the European Union's Horizon 2020 research and innovation programme (G.A. Nº 820770).

iCAREPLAST addresses the cost and energy-efficient recycling of a large fraction of today's non-recyclable plastics and multi-layered films. The process combines chemical routes (pyrolysis, catalytic and separation steps) to produce valuable chemicals.

Please, visit the website in order to learn more about the **iCAREPLAST** project in general, as well as find more detailed information on upcoming activities: https://www.icareplast.eu/

*Your **iCAREPLAST** Team*

This project has received European Union's Horizon 2020 research and innovation funding under grant agreement Nº 820770.

SPIRE
Sustainable Process Industry through Resource and Energy Efficiency

iCAREPLAST: results and conclusions

We are excited to share the remarkable achievements of the iCAREPLAST project after 54 months of dedicated work. iCAREPLAST, an initiative focused on revolutionizing plastic waste management, has achieved significant milestones in the efficient and cost-effective recycling and recovery of non-recyclable plastics in municipal waste and compounds.

The project, which combines pyrolysis, catalytic treatment, and membrane separation processes, has demonstrated a substantial increase in plastic upcycling efficiency. Notable accomplishments include a 12% rise in pyrolysis liquid yield, a 45% reduction in energy requirements, and an astonishing 95% reduction in residues. These achievements are projected to result in a potential economic yield boost of up to 200%.

Technological development

The iCAREPLAST project has successfully converted solid plastic waste into aromatic molecules through a series of thermocatalytic and separation processes.

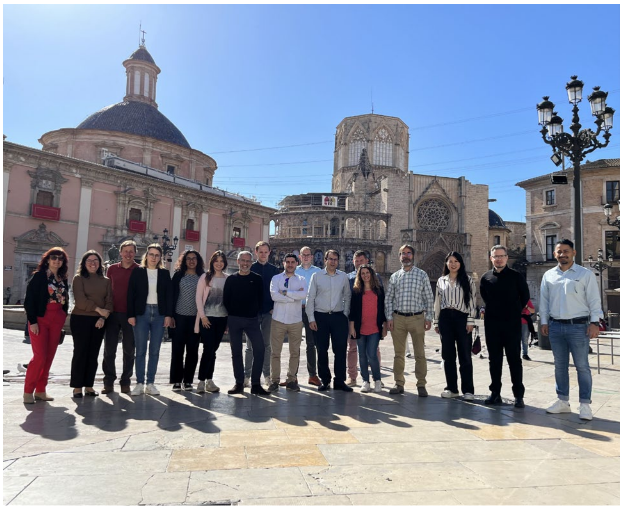
Real plastic waste mixtures were extensively characterised, which served as a guide for tailor-made pre-treatment. Optimal plastic mixtures were selected for maximum pyrolysis liquid yield and molecular composition. Various pyrolysis tests achieved high liquid yields and improved product content. Efficient hydrocarbon separation membranes were identified and showed promise in laboratory-scale models. Alkylation, aromatisation and oxycombustion tests guided the selection of materials, catalysts and electrochemical stack configuration. Integration of newly-developed pre-treatment of complex plastic mixtures, solids removal, and reactor modifications went smoothly and consolidated as a solid pyrolysis technology. Durability tests confirmed the stability and quality of the pyrolysis fluids. Pilot-scale aromatisation validated the reactor design using an industrial zeolitic catalyst, and a steady-state model encapsulates the iCAREPLAST process, ensuring accurate representation. Comprehensive LCA modelling and Life Cycle Cost (LCC) assessments were carried out for environmental and economic evaluation. Detailed market and techno-economic analyses were carried out investigating the production of linear alkylbenzenes, aromatics and the potential commercialisation of by-products (CO2 and char).

Thus, with the work carried out, iCAREPLAST has produced nine pivotal Key Exploitable Results, including 1) Novel pre-treatment for post-consumer plastic blends; 2) Cutting-edge char extraction system; 3) Product Sustainability tools, enabling real-time ecological performance analysis for plant managers; 4) Innovative unit for separating aromatic products; 5) Ground-breaking carbon-capture-enabling oxycombustion unit for side stream gases; 6) Novel alkylation catalyst formulation; 7) Catalytic processes in plastic-mixture pyrolysis; 8) Control architecture optimising liquid pyrolysis yield through temperature and composition manipulation; 9) Real-time monitoring LCA application.

CONCLUSIONS

iCAREPLAST contributes to the reuse and recycling of plastic waste materials by increasing the efficiency in the chemical recycling process and upcycling the quality of the secondary materials to virgin quality, thus contributing to the economic viability of the process. Besides, thanks to the real-time control and LCA monitoring, optimal use of the energy and material resources is achieved. The reuse of by-products for energy valorisation (with CO_2 capture) increases the energy efficiency of the process and reduces the amount of residues. Moreover, all the process units can be operated using electricity, which makes the process ready for the upcoming renewable energy landscape. Altogether, it contributes to the energy and materials efficiency of the process industries (in particular plastic waste management), unlocking an economically effective business model based on the chemical upcycling of plastic materials to virgin-quality chemicals.

We extend our sincere gratitude to the iCAREPLAST consortium for their continued dedication and innovative contributions. Their collaborative efforts have not only driven the project forward, but also laid new foundations for the sustainable management of plastic waste. The innovations achieved through this effort serve as a model for continuing the fight against plastic pollution.



Learning material

Several videos were prepared as learning resources, about the different technologies involved in the iCAREPLAST project. Stay tuned on our website!

Visit iCAREPLAST Training Material

This project has received European Union's Horizon 2020 research and innovation funding under grant agreement Nº 820770.