Fraunhofer IMWS

PRESS RELEASE

Today's waste becomes tomorrow's resource: "Waste4Future" paves new ways for plastics recycling

A sustainable society with climate-neutral processes requires significant adjustments in the value chains, which are only possible through innovations. Seven Fraunhofer Institutes are pooling their expertise in the lighthouse project "Waste4Future" to develop new solutions for this goal, from the raw material base to material flows and process engineering right to the end of a product's life cycle. In particular, they want to increase energy and resource efficiency in the use of plastics and thus pave the way for a chemical industry that requires fewer fossil raw materials and produces fewer emissions

Plastics such as polyethylene (PE), polypropylene (PP) or polystyrene (PS), which are currently produced almost entirely from fossil raw materials, are fundamental to many everyday products and modern technologies. The carbon contained in plastics is an important resource for the chemical industry. If it is possible to better identify such carbon-containing components in waste, to recycle them more effectively, and to use them again to produce high-quality raw materials for industry, the carbon can be kept in the cycle. This not only reduces the need for fossil resources, but also pollution with CO_2 emissions and plastic waste. At the same time, the security of supply for industry is improved because an additional source of carbon is tapped.

The "Waste4Future" lighthouse project therefore aims to create new opportunities for recycling plastics in order to make the carbon they contain available as a "green" resource for the chemical industry. "We are thus paving the way for a carbon circular economy in which valuable new base molecules are obtained from plastic waste and emissions are largely avoided: Today's waste becomes tomorrow's resource," says Dr.-Ing. Sylvia Schattauer, deputy director of the Fraunhofer Institute for Microstructure of Materials and Systems IMWS, which is heading the project. "With the know-how of the participating institutes, we want to show how the comprehensive recycling of waste containing plastics without loss of carbon is possible and ultimately economical through interlocking, networked processes." The outcome of the project, which will run until the end of 2023, is expected to be innovative recycling technologies for complex waste that can be used to obtain high-quality recyclates.

Specifically, the development of a holistic, entropy-based assessment model is planned (entropy = measure of the disorder of a system), which will reorganize the recycling chain from process-guided to material-guided. A new type of sorting identifies which materials and in particular which plastic fractions are contained in the waste. Based on this analysis, the total stream is separated and a targeted decision is then made for the resulting sub-streams as to which recycling route is the most technically, ecologically

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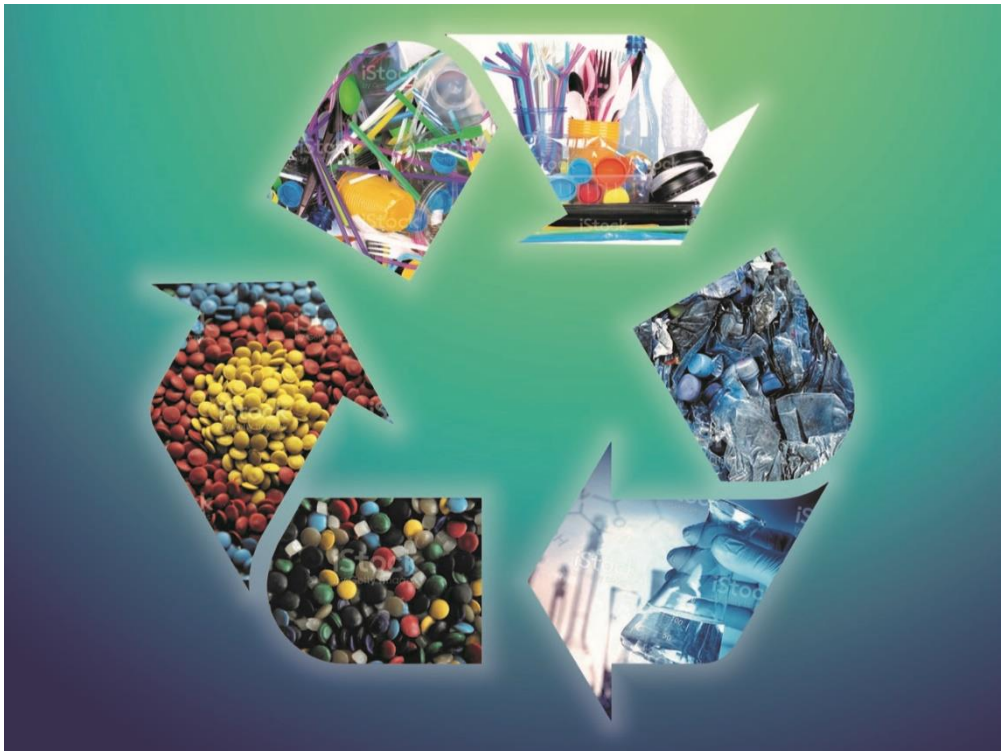
and economically sensible for this specific waste quantity. What cannot be further utilized by means of mechanical recycling is available for chemical recycling, always with the aim of preserving the maximum possible amount of carbon compounds. Burning waste containing plastics at the end of the chain is thus eliminated.

The challenges for research and development are considerable. These include the complex evaluation of both input materials and recyclates according to ecological, economic and technical criteria. Mechanical recycling must be optimized, and processes and technologies must be established for the key points in the material utilization of plastic fractions. In addition, suitable sensor technology must be developed that can reliably identify materials in the sorting system. Machine learning methods will also be used, and the aim is to link them to a digital twin that represents the properties of the processed materials.

Another goal of the project is the automated optimization of the formulation development of recyclates from different material streams. Last but not least, an economic evaluation of the new recycling process chain will be carried out, for example with regard to the effects of rising prices for CO_2 certificates or new regulatory requirements. The project consortium will also conduct comprehensive life cycle analysis (LCA) studies for the individual recycling technologies to identify potential environmental risks and opportunities.

For the development of the corresponding solutions, the participating institutes are in close exchange with companies from the chemical industry and plastics processing, waste management, recycling plant construction and recycling plant operation, in order to consider the needs of industry in a targeted manner and thus increase the chances of rapid application of the results achieved.

The following Institutes are involved in the Fraunhofer lighthouse project "Waste4Future":
- Fraunhofer Institute for Microstructure of Materials and Systems IMWS (lead)
- Fraunhofer Institute for Non-Destructive Testing IZFP
- Fraunhofer Institute for Materials Recycling and Resource Strategy IWKS
- Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB
- Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR
- Fraunhofer Institute for Structural Durability and System Reliability LBF
- Fraunhofer Institute for Process Engineering and Packaging IVV



Keeping carbon in the cycle, thus avoiding plastic waste and emissions: That is the goal of the "Waste4Future" lighthouse project. © Fraunhofer IMWS

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About the Fraunhofer Institute for Microstructure of Materials and Systems IMWS

The Fraunhofer Institute for Microstructure of Materials and Systems IMWS offers microstructure-based diagnostics and technology development for innovative materials, components and systems. Building on its core competencies in high-performance microstructure analysis and microstructure-based materials design, the Institute investigates questions of functionality and application performance as well as the reliability, safety and service life of materials used in various market and business areas with major importance for social and economic development. For its partners in industry and the public sector, Fraunhofer IMWS enables the accelerated development of new materials, increases material efficiency and cost-effectiveness, and helps to conserve

resources. In doing so, the Institute contributes to ensuring the innovative capacity of key future fields and to sustainability as the greatest challenge of the 21st century.

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