Using a range of technologies can drive up recycling rates

LAUREN KJELDSEN: 'From a policy perspective, there are additional levers that would be hugely important in supporting recycling.'

Plastics recycling will play a key role in the transition to a circular economy, and chemical companies in Europe and the rest of the world are developing a variety of process technologies and plants to transform plastic waste into high-quality plastics. The circularity drive is supported by the European Commission and national governments as they seek to reach their environmental and sustainability objectives.

However, plastics recycling rates remain low in Europe. According to Lauren Kjeldsen, president/smart materials at Evonik Industries AG and an EPCA board member, chemical recycling and mechanical recycling technologies each have a part to play in raising plastics recycling rates in the region, depending on the type of waste stream or the application of the final product.

"To achieve more circular value chains, we need every available technology with each playing a specific role," she said. "Mechanical and chemical recycling are complementary technologies. Due to its more advantageous energy balance, mechanical recycling should be the preferred option whenever possible. However, for waste streams that cannot be processed by mechanical recycling or if the final application requires very high-quality materials, chemical recycling comes into play."

Certain adjustments to the EU policy framework would boost plastics recycling, Kjeldsen said.

"From a policy perspective, there are additional levers that would be hugely important in supporting recycling," she said. "My top three are the inclusion of chemical recycling to count towards mandatory recycled content, acceptance of the mass-balance approach with the fuel-use exempt model, as a reliable chain-of-custody procedure, and finally we urgently need clarity on the end-of-waste status—a definition of the requirements for waste to become a product again. In terms of policy support, we also see a general need to make bureaucratic processes more accurate, but at the same time as practical as possible. Legislation should follow the MECE principle: Mutually Exclusive and Collectively Exhaustive."

According to Kjeldsen, stronger EU backing for innovation would also boost circularity and accelerate the development of new materials.

"Beyond technology and policy aspects, a supportive environment for innovation would help to scale recycling rates," said Kjeldsen. "This could include for example joint test space, dedicated funding – especially investment in collection and sorting, common interfaces for exchange of data or transparency in claims for consumer guidance."

To meet the demands of the materials transition, it is vital that chemical manufacturers build circularity into their innovation and business strategies, according to Kjeldsen.

Evonik aims to invest more than $3 billion in "next generation solutions" —products with superior sustainability benefits — by 2030 and an additional $700 million in "next generation technologies" to optimize production processes and infrastructure, and to avoid CO_2 emissions.

"The first step is to make sure everyone speaks the same language. In that sense, sustainability and circularity are closely related but not the same," Kjeldsen said. "The transition from linear to circular value chains of course also leads to improved sustainability, but circularity has rather well-defined levers, which first and foremost aim to decouple economic activities from the consumption of finite resources, to keep resources for as long as possible in the loop and to close value-chain loops. This means, among other things, that every participant in these value chains can contribute by rethinking their business models – very likely the circular economy requires other ways of doing business, for example leasing instead of owning."

For Kjeldsen, it is "a prerequisite" for a company to know its own capabilities and be aware of other players in the value chain that could complement the company's know-how. "To know your own position in the chain and which elements you can act on, you need to identify the largest levers, which requires high-quality data about your business and its impact on the environment," she said.

Specialty chemical companies such as Evonik — through their R&D, technologies and products

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— are well positioned to drive the transition to plastics circularity, develop sustainable materials and help meet the goals of the EU Green Deal.

"Also here, it is important to define success," Kjeldsen said. "At Evonik, we focus particularly on generating the most beneficial outcome for the environment while staying economically viable across the diverse value chains we're part of. We do not regard our products as a standalone solution — we take a more holistic perspective on supportive technologies and services. For example, we have gained great experience with our specialties to enable more efficient recycling, both mechanical and chemical recycling. Today, we offer additives for more efficient cleaning processes, such as deinking of plastics, or additives to make recyclates suitable for high-performance applications. We also provide technologies for upgrading pyrolysis oil, e.g. through contaminant removal or pour-point depressants."

Evonik has established a portfolio of mass-balance products based on circular raw materials with reduced carbon footprint, such as its high-performance polyamide polymers. "We established a highly efficient process for polyurethane recycling, which is already running at pilot scale," Kjeldsen said. "This is not just a good example for chemical recycling but also highlights our complementary approach where we support all technologies that help close the loop. Besides recycling, we are also working on technologies to support defossilation. Here our innovative Rhamnolipid platform offers biobased and biodegradable alternatives for the cosmetics or detergent markets."

Kjeldsen recognizes that for the chemical industry, collaboration and partnerships — with customer industries such as automotive and energy, with academic institutions or with governments, or even with competitors—is vital to tackling global challenges.

"Partnerships are essential to achieve the transformation to a circular economy and eventually more sustainable markets," she said. "There is not one company that can solve the challenge alone. Only the joint work of all stakeholders will create an impact."

Because of Evonik's position in the value chain as a specialty chemicals company with extensive integrated technologies and process know-how, both upstream and downstream, "we are well equipped to enable our partners to reach their circularity and sustainability goals and eventually contribute to the industry's transformation," Kjeldsen said. "We are all tasked with rethinking our way of doing business and this explicitly requires factoring in mid- and long-term impacts much more than before," she said.

INNOVATION: Pilot plant at Hanau, Germany, where Evonik is testing its hydrolysis process to recover the main components of polyurethane foam and reuse them as building blocks to produce new mattresses.

Evonik in 2021 launched a Circular Plastics Program, which aims to generate additional sales of more than €350 million per year by 2030 with solutions for circular plastics.

"With our Circular Plastics Program, we started our journey to enable circularity in plastic-related end markets," said Kjeldsen. "We have learned a lot about partnership development, providing guidance and developing technical solutions that are starting to transform parts of our portfolio. Today, we already see great progress, not just from the perspective of Evonik but also in terms of the growth of entire circular ecosystems, such as the recently announced partnership with BMW that Evonik is part of."

The program will eventually enable circularity in other markets, according to Kjeldsen. "As the path and requirements for the industry's transformation become clearer, we'll see that we can also support circularity and address challenges in markets beyond plastics, which will be part of the next phase," she said.

Recycled, biobased, biodegradable and compostable plastics will help Europe achieve a circular economy

FRANCO MEROPIALI: 'The use of renewable and sustainable resources can help decouple economic growth from the consumption of finite resources.'

According to industry association Plastics Europe, 65% of post-consumer plastics were incinerated or sent to landfill in Europe during 2021. In the same year, just 12.4% of Europe's plastics production consisted of circular plastics and only 9.8% of global plastics production was circular plastics. These figures will have changed in the last two years, but plastics recycling rates remain low despite the EU's 2030 circularity targets.

Franco Meropiali, head of Versalis's polyethylene and intermediates business, and an EPCA board member, said an improvement in plastics recycling rates in Europe requires "comprehensive strategies" that include chemical as well as mechanical recycling technologies.

"To achieve the real recycling potential of plastics, it is important to leverage all the available technologies, adopting a complementary approach in order to make the most of the strengths of each one," Meropiali said. "Based on this principle, both mechanical and chemical recycling play a crucial role as complementary technologies: mechanical recycling is a widely used technology for sorted waste streams, today providing the highest quantities of recycled plastics with end-applications that not always require virgin-like quality; chemical recycling is a new array of recycling technologies that can manage streams of mixed plastic waste that cannot be mechanically recycled, generating virgin-like recycled plastics suitable for all market applications, even ones not always directly accessible by mechanical recycling, such as food contact and pharma products."

According to Meropiali, the EU should provide tax breaks, grants or other financial incentives to boost private investments in recycling infrastructure and advanced recycling technologies. "This support would promote the expansion of recycling capacities and encourage innovation in this sector," he said. "By adopting a multi-faceted approach, Europe will be a front-runner towards a more sustainable and circular plastics economy."

Chemical recycling also needs "official recognition" in EU legislation, Meropiali said. "Since many files are currently being updated at EU level, we believe there is room to include this recognition along with the mass-balance calculation methodology. This would highlight the numerous benefits of this technology and therefore keep EU regulation up to date with advances made by the industry."

Biobased plastics will also play an important role in achieving the EU's climate objectives, Meropiali said. "Plastics obtained by feedstock made from biomass offer a promising way to drive decarbonization efforts, reducing overall GHG emissions thanks to the use of biogenic rather than fossil carbon," he said. "The use of renewable and sustainable resources can help decouple economic growth from the consumption of finite resources and reduce the EU's dependence on imported fossil fuels."

However, EU policies and legislation need "a consistent approach" in areas such as labeling, use and disposal of plastics derived from biomass, Meropiali said. "This means that a full alignment between applications in this sector and the ambitions enshrined in the EU Green Deal policies is needed, as highlighted by the EU Commission in the 2022 EU policy framework on biobased, biodegradable and compostable plastics," he said.

Biodegradable and compostable plastics "can play a significant role in helping achieve a circular economy in Europe, especially when made from sustainable biomass such as organic waste or residues," Meropiali said. "The characteristics of these plastics offer tangible advantages in specific applications, for example in organic waste collection and sorting, as shown by Italy, which has already successfully implemented separate organic waste collection, and in other applications such as mulch film for agriculture, where biodegradability can be a key factor. Meanwhile, universal standards have been implemented and authorities and industries will continue to promote research and innovation on these plastics to address the persisting technical challenges related to their production, use and disposal."

Collaboration for Impact

For the chemical industry, collaboration with other stakeholders is vital to tackling global challenges including circularity and reaching net zero, and the industry has a major part to play in these partnerships, according to Meropiali.

"Building collaboration and partnerships along the supply chain is the most effective way to address the challenge towards sustainable transition and decarbonization," he said. "We are moving from an 'old' linear model, where the chemical industry was just one of the players along the value chain, to a highly interconnected system, where cooperation between each and every single player will make the real difference in developing the multiple solutions we need to address the global challenges. It is here that the chemical industry can play a central and strategic role as the 'catalyst for change,' thanks to its own technological competence and capabilities."

Meropiali notes that in recent years, "we have already seen this change of perspective to some extent; all the major chemical players in Europe and overseas have embarked on a road paved with partnerships and cooperation with various stakeholders, especially producers of recycled materials and producers of renewable raw materials, in order to offer to the market more and more sustainable products."

In the future, as targets and standards are set to support the circular economy, Meropiali expects to see "increasing involvement" from major brand owners as well as leading manufacturing companies in different application areas, "which will need the cooperation and support of the chemical industry to meet their decarbonization targets, and above all to provide consumers with increasingly sustainable products and services."

Versalis has announced a number of ambitious targets to increase the recycled content of its polymers and cut emissions.

"In line with Eni's strategy, Versalis's commitment is embodied in a decarbonization plan with defined short-, medium- and long-term emission-reduction targets, and it is supported by decarbonization levers and a solid dedicated governance structure," Meropiali said. "Our decarbonization strategy is based on the development of complementary products and solutions that work in a synergistic manner to achieve our goals."

The circular economy is a key driver of Versalis's strategy. "We are committed to increasing the use of certified sustainable feedstocks as alternatives to conventional ones, to also developing complementary recycling technologies for rubber and plastic waste with the aim of increasing the amount of recycled content and to achieve full circularity of plastics," said Meropiali.

CIRCULAR PRODUCT: Versalis, together with The Flo Group, has developed R-Hybrid, the first vending cup made from post-consumer recycled polystyrene.

He cites the example of the company's innovative recycling technology Hoop, a proprietary process for the chemical recycling of mixed plastics waste. The Hoop project — a first demonstration plant with 6,000 metric tons per year of capacity being developed at Mantua, Italy —was selected in July by the European Commission among the winners of a tender for the EU Innovation Fund. As a result, the project will receive financing through the fund, which is dedicated to innovative technologies with low carbon emissions. Out of 41 projects securing a total of €3.6 billion in funding, it was the only selected technology in Italy.

Versalis plans eventually to roll out the Hoop technology to commercial-scale plants. "Afterwards, we plan to build up further chemical recycling units of higher capacity," Meropiali said.

Versalis is also active in the business of chemistry from renewables, aiming to offer a wide range of decarbonized products. The company recently announced that it had signed an agreement to acquire the entire share package of Novamont SpA, a leading player in the circular bioeconomy and the market for biobased, biodegradable and compostable plastics and biochemicals. The timing of the closing is subject to approval by the competent authorities.

"We confirm the commitment to increasing the use of renewable energy sources and to improving energy efficiency on the manufacturing front," Meropiali said. "Versalis aims to develop competitive and innovative technological solutions to implement new, increasingly efficient production processes and, in this field, is willing to collaborate with strategic partners."