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Perspective

Plastics recycling after the global pandemic: resurgence or regression?

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With its promise to invest a trillion euros over the next 10 years, the European Union has set forth the European Green Deal as a unique opportunity to reinforce its economic base. (European Commission, 2019) The transition to a circular economy constitutes an important pillar of the Green Deal. In particular, the recycling of plastic packaging is a central theme, in terms of resource conservation and waste reduction, marine litter in particular (European Commission, 2020).

In recent years, plastic recycling has been on an upswing, with Europe setting stringent targets and recycling schemes generally emerging around the world. However, the current COVID-19 crisis has hit the industry on several fronts. (Muruges, 2020) At the household level, the supply of recyclable material in varying qualities is fluctuating: While curbside collection of mixed waste has increased, return levels in deposit systems have temporarily fallen due to limited mobility and fear of contagion. Cutbacks in industrial production have significantly reduced the supply of high-value material from post-industrial waste. Social distancing measures have restricted collection and sorting capacities. For example, France has had to switch from separate to mixed collection of all household waste to adjust pickups to the reduced workforce available, resulting in a waste stream that is more difficult to recycle and a larger share of the valuable material dumped in landfill or incinerated. In Spain, Italy, and Eastern Europe collection has come to a complete standstill due to the severity of the outbreak. (Tudball, 2020) Over the months to come, these developments are likely to make recycle, which was already in high demand before the crisis, even more expensive. With virgin prices ranging below those of recycled material, converters are switching back wherever technically feasible. This increases the pressure on recyclers, since at a price of 60 USD per barrel of oil, there are only a few types of plastic

that can be recycled at a profit. (Gao et al., 2020) At the same time, single-use plastics are in higher demand, while reusable alternatives are cut back to prevent viral contagion.

The public sector is set to offer financial support to help firms and industries deal with the crisis, aiming to avert a long-lasting recession. However, this places the plastics industry at a crossroads. We believe that the spectrum of possible developments stretches between these two contrasting scenarios:

Regression portrays a scenario in which the plastics industry is governed by a paradigm of cheap, multi-functional packaging. Any financial aid goes towards restoring the version of the industry before it was hit by COVID-19, without taking efficiencies or investments in new technologies into account. For recyclers, this means financial incentives to keep depreciated plants running and marginally increase capacity where possible. A surge in the use of food packaging consisting of multiple polymers, even long after the pandemic, results in hard-to-separate waste streams and lower recycle quality, which cannot be treated properly due to lacking investments into the respective technologies. This questions the brand owners' concept towards circularity in plastic packaging, and they will look to alternatives such as bioplastics or paper to at least partially achieve their circular economy goals. However, these alternatives are not necessarily superior from a sustainability perspective. The plastics value chain becomes even more scattered, and hence developments towards a design for recycling are reversed, and investment into new recycling technologies and R&D grinds to a halt. When the economy has recovered from the COVID-19 shock, however, the general public will revive the debate around circular solutions for plastic packaging and may be less tolerant about the progress that will have been made. Measures as drastic as today's

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Single-Use Plastics Directive would be looming and may put the license to operate of an entire industry at risk.

In a **resurgence** scenario, industry developments are determined by policy and industry goals formulated before COVID-19. In light of small margins especially in recycling, financial aid from governments is keeping stronger firms afloat, while at the same time consolidation takes place across the industry. Vertical and horizontal integration along the value chain leads to a pooling of influence while allowing recyclers to harness economies of scale. This enables the more resilient recyclers to continue investing into latest technologies on the sorting and recycling level, and the entire industry to commit to investments into more disruptive technologies, such as chemical recycling or automation and digitalization. Furthermore, consolidation gives industry the opportunity to define necessary standards more easily. For instance, packaging companies could be compelled to synchronize their new product designs with recyclers before bringing them to market. To fuel recovery and safeguard resources, there is an effort to inform the general public about the value of recycling. This results in a higher quota and availability of recyclate, enabling brand owners to move away from virgin material as they originally planned.

Hence, the future of plastics recycling – a prime example of the circular economy – could be determined by the path society takes in combating the economic aftermath of COVID-19. For this reason, we urge policymakers to include the long-term targets of the European Green Deal in their decision processes on short-term measures to alleviate the crisis. Assuming plastics upholds its important role as a packaging material, this will require the EU to emphasize the message that aspiring ambitions must not be scaled back and recycling targets should not be postponed. Instead, financial aid could incentivize and hence accelerate a transition towards the Green Deal goal of a sustainable industry. This may include a re-evaluation of the resilience of current and future value chains, potentially making them less global. Standardizing product specifications and harmonizing relevant national law could bolster this resilience further. For example, the convergence of currently separate waste collection systems would foster cross-country collaboration and provide greater flexibility in future crises while improving value-add at the local level.

With a clear signal from regulators reaffirming that the long-term requirements for the recycling industry have not changed, leaders in the sector will regain confidence to continue on their pre-pandemic course. The industry has formed many collaborations to develop breakthrough innovations, and it is vital that these fragile setups are not jeopardized. Brand owners' pledges on the future use of recyclate in their products represent a powerful pull towards change, and we encourage the entire industry to work together to make these pledges real. This is especially important as the use of recycled plastic in high-value applications instead of park benches and flowerpots remains a niche application that must be fostered to reach the mass-market. At the same time, policy

should carefully consider if and possibly where it creates lock-ins or path dependencies. In the long term, industry and society have to make sure to keep material in the loop as long as possible. By now, we hope that sustainability has been encoded into the strategic DNA of all firms across the industry, and many will see this crisis as an opportunity to reposition their business in a greener way. On no account should long-term prospects be compromised for a one-dimensional focus on safeguarding the status quo of the industry.

Research can help industry to stay on course, and continue to provide factual support. We need both research accompanying industries' lighthouse projects in the field, and comparative studies on the different ways of closing loops – especially given the diverse and sometimes conflicting goals that need to be achieved. Under this paradigm shift, how do value chains make the transition from linear to circular, and how quickly can that transition take place? Who will try to prevent this change and how can incentives be set to accelerate a regime switch? Academia should inform society, industry, and policymakers alike to help them make decisions that are both deliberate and responsible.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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