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Opportunities for chemical recycling to benefit from waste policy changes in the United Kingdom

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ABSTRACT

Increased awareness in the United Kingdom around the issues of dealing with plastic waste, particularly non-recyclable plastics, has created political pressure to find new ways to manage this waste stream. As a result, the UK government recently convened consultations around adapting the national plastic waste management strategy in light of curtailed overseas plastic recycling. In this work, we consider the potential role that chemical recycling, such as gasification and pyrolysis, may have to play in the context of plastic waste valorization, and assess the policies and market conditions that would be required to make chemical recycling a feasible means by which to manage difficult to recycle plastic waste in the UK.

In December 2017, China implemented the National Sword programme, which dramatically curtailed its plastic waste imports, over 2.7 M tonnes of which came from the UK. Other countries like Malaysia have also started turning away waste plastics. These bans have forced policy makers and scholars to examine with fresh eyes how the UK is going to cope with its own plastic waste, and above all to recast the situation from a problem into an opportunity for change.

At present, 67% of plastic waste generated in the UK is difficult to recycle packaging, and research has found low recycling rates (Hahladakis et al., 2018). Additionally, 40% of domestic waste is incinerated in the U.K., with some London councils burning over 80% of their collected rubbish. There is a lack of solutions for sustainably dealing with non-recyclable plastics (NRPs) such as films and other food packaging. As a result, landfill and/or incineration is currently the only economically viable approach to NRPs in the UK, despite their detrimental environmental impacts.

The rising awareness of the problems of plastic wastes has created political pressure to implement solutions to decrease the plastic waste output of the UK. In response, the UK government has convened consultations on changing its plastic waste management strategy. Two of these policy changes in particular could have an effect on the handling of NRPs, and are an opportunity to consider alternatives to landfilling and incineration, such as chemical recycling. The policy landscape has changed considerably since chemical recycling first began being considered as a waste treatment option for the UK (Fichtner Consulting Engineers, 2004).

In particular, the Packaging Recovery Note (PRN) scheme is undergoing reconsideration given the criticism that the existing system only covers 10% of plastic packaging recycling costs, and is vulnerable to fraud. There is also a growing problem around the Packaging Waste Export Recovery Notes (PERNs), with an increasing number of countries, such as China and Malaysia, closing their borders against accepting plastic waste from other countries and some Members of Parliament now calling for an end to plastic waste exports. In tandem with changes to the PRN scheme, the UK Government is also proposing a new plastics tax on packaging that does not include at least 30% recycled material, which would be enacted from 2022 if the measure is enacted. These policies, combined with increasing difficulties in exporting plastic waste, could potentially create an economic landscape where chemical recycling could play a larger role in the waste management systems in place in the UK.

Against this background, it may be time to consider the role that chemical recycling processes can play in plastic waste processing in the UK, and assess the policies and market conditions that would be required to make chemical recycling an economically feasible solution for dealing with NRPs. Chemical recycling processes such as pyrolysis and gasification are being considered as potential methods for reducing in plastic waste because it is capable of processing many forms of NRPs to convert them into useable feedstocks, which can be in turn be used to create virgin plastics or refined into other petrochemicals such as diesel and aviation fuel.

From a sustainability perspective, converting waste plastics into

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petrochemical feedstocks can help decrease consumption of fossil fuels by offsetting them with chemically-recovered feedstocks from NRPs (Wong et al., 2015). However, there are many caveats around this process, not least from the perspective of the high-temperature energy requirements needed to convert the plastic waste into refined petrochemicals (Rollinson and Oladejo, 2019), in addition to transport and storage requirements, and the fact that the production of plastics needs to be curtailed.

For chemical recycling to prove to be an effective solution, it must fulfill some basic criteria. First of all, it must be a profitable solution to the NRP problem when compared with the current baseline solution, incineration, which has gate fees of about £90/tonne as of 2018, compared with £100/tonne for landfill. Secondly, it must also have less of an environmental impact than incineration, particularly in terms of carbon footprint and release of toxins. In particular, as stated by Chemical Recycling Europe in 2019, "Lack of structured and harmonized approach to waste collection and recycling causes constraints on companies that can create new value-added products from this waste."

These two consultations directly interact with the chemical recycling industry in the following ways. There is frustration in the waste industry around the fact that the revenues from the PRN scheme are not passed down effectively to local authorities for reinvestment into waste infrastructure. A revised PRN scheme should be an earmarked tax in order to directly contribute the revenues from issuing PRNs towards improving waste sorting and recycling systems. A key question is whether chemical recycling facilities would qualify as beneficiaries from the PRN scheme, so that they would be included in the range of potential solutions to be invested in.

When considering the taxation of plastic packaging producers based on the recycled content of their packaging products, a point that will need clarity is whether plastics produced from feedstocks resulting from chemical recycling will qualify as "recycled" or not. This is related to a larger question about the carbon footprint of chemical recycling and more work needs to be done involving life cycle assessment (LCA) to measure the true energetic impacts of chemical recycling compared with incineration and conventional recycling (Benavides et al., 2017). However, if chemical recycling can be competitive on an emissions basis with incumbent methods of plastic waste management, then the categorization of the end products of chemical recycling is crucial to also helping these technologies become competitive on an economic basis. The classification of plastics produced from feedstocks arising from chemical recycling as eligible for the 30% recycled content policy would be pivotal to establishing a circular economy for plastics in the UK. A large part of making pyrolysis and gasification economically viable is by creating a marketplace for their end products, namely the feedstocks they produce and their char, and making them eligible for inclusion as recycled plastics would stimulate market demand.

We argue that implementing both of these policy decisions could help lead to the development of a policy environment where chemical recycling plays a role in transitioning to a more circular economy in the UK. While the consultations have the objectives of increasing recycling and reducing difficult to recycle packaging by encouraging design changes, this still leaves a gap in waste infrastructure for dealing with common NRPs, especially plastic films and laminates.

There is also a role for considering compostable bioplastics within these policy frameworks, because they also require extensive investment in sorting and industrial composting infrastructure. At present these types of plastics are proving to be problematic contaminants to the conventional plastic recycling streams with no clear waste management pathway.

There are many valid questions that still arise around the overall sustainability of chemical recycling as an approach to plastic waste. However, as pressures on waste management infrastructure increase given growing export constraints, alternative solutions need to be explored. Given the current state of waste management in the UK, pyrolysis and gasification need not be perfect solutions to the plastic waste problem in order to make progress, but rather merely be competitive with incineration on an ecological and economic basis. By implementing these policies, a new plastic waste processing market in the UK could be created by stimulating private investment for industrial research and development.

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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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