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## Introduction to the Field Actions Science Reports Special Issue 19 (2019): Reinventing Plastics

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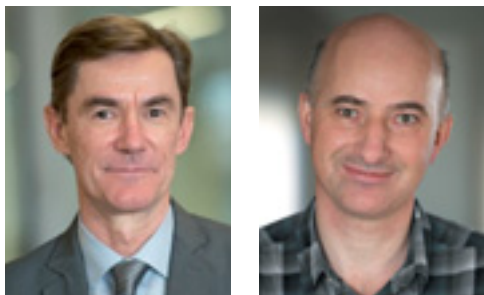
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# INTRODUCTION

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Plastics are yesterday's hero and today's villain – their fall from grace precipitated by their success. As with many materials, plastics were perfectly acceptable as long as their use remained marginal. But now that plastics have conquered the planet, their use has become a problem. After cement and steel, plastics are the third most-widely manufactured material in the world. And production of plastics will continue to grow in the decades ahead, driven by demand from emerging and developed economies alike.

This is bad news for the environment, unless we find ways to improve the management of end-of-life plastics, which generate high volumes of waste that degrade extremely slowly in nature. A symbol of modernity, plastics have become ticking time bombs that threaten human and environmental health. A major factor is the paradox of the life cycle of plastics: designed to last for a very long time but used only briefly, almost half of all plastics are turned into packaging that is discarded almost immediately after the product is purchased.

Plastics are all around us: in toys, household appliances, sports equipment, classroom supplies, medical equipment, as well as every trash can, every outdoor space and every sea and ocean. The challenge is how to remove the scourge of plastics from the economy and the environment. We cannot do without plastics completely, but we can restrict their use to vital applications for which no substitute exists. Many countries are already implementing legislation to curtail the use of single-use plastics.

But the real solution lies in the circular economy, which converts waste into a valuable resource. Despite the omnipresence of plastics, very few plastics are recycled. Worldwide, no more than 9% of plastics are recycled; compared to 80% of ferrous metals, 60% of paper and 50% of glass that are recycled. And yet the potential benefits of recycling are immense: by reducing waste of raw materials,

overexploitation of nature and environmental pollution as well as limiting global warming. This is because recycling plastics can dramatically reduce greenhouse gas emissions, with five barrels of oil saved for every metric ton of plastic recycled.

Which raises the obvious questions: why are plastics so under-recycled, why do so many plastics end up in nature? The answers: a lack of infrastructure for collecting and processing plastics, particularly in developing economies; limitations of current technologies; consumer reluctance to use recycled plastics, especially when used in the food industry; the supply of inexpensive crude oil, which makes it cheaper to manufacture plastics than to recycle them; and the difficulty in meeting the demands of consumers in terms of quality, availability and price. All this means that recycling cannot progress unless we find ways to scale up collection and reprocessing of plastics to offset the high cost of recycling installations, coupled with regulatory or financial mechanisms to incentivize manufacturers to use regenerated resins.

Recycling also requires appropriate eco-design as products can only be recycled if they are designed to be recyclable! This goal is not helped by the plastic industry's sheer creativity: plastics are formed from a wide variety of resins, additives and mixtures for a seemingly limitless list of uses, all of which makes recycling a complicated affair. This means that while eco-design remains voluntary, many plastics cannot be recycled cost-effectively. Combatting this 21<sup>st</sup> century pollution will require a major paradigm shift. In the past, plastics were made to last – in the future, we need polymers that biodegrade quickly or can be recycled. It is by examining the whole life cycle of plastics that we can extend their usefulness as a resource, and reduce the time they spend as waste.

Thus, acting upstream and on land, we can conquer the overabundance of plastics afflicting the planet's waterways and oceans. The task is titanic, but it is achievable in the long term, since only 10 rivers account for 90% of plastic waste entering the world's oceans.

A final point can be made when considering the turbulent history of this material, which represents one of the 20<sup>th</sup> century's main industrial revolutions. If people were to stop throwing away plastics as litter, the plastics would not make their way to the sea. Plastic pollution is also a consequence of our behavior as individuals. Whether through our day-to-day actions or initiatives led by non-profits and business, we must all play our part in deplastifying our lives.

*The plastic life cycle is paradoxical. Plastics are designed to last but are used only briefly.*