Nature is objectively beautifully cyclical. As organisms move through existence, their excess can be of use to another entity. Humans have coined the idea that once we have finished with an item we consider it waste. But when we choose to dispose of something, can it be recovered?

At a granular level, we could pick that object back out of a bin and find a way to reuse it. We could put a biscuit wrapper on our head and call it a hat. On a global scale, how we define and deal with waste varies geographically, temporally and culturally making optimising recovery of material an inconsistent behemoth to tackle. Many pinch points of irreversibility can be considered in the waste industry; incineration reducing an object to ash; landfill containing well mixed materials that are currently unrecoverable; and recycling systems creating increasingly limited outputs with decreasingly homogeneous materials. Irreversibility can come down to costs, technological capabilities, sortation and perception of value.

As the Earths' natural resources are finite, it typically becomes more expensive to discover, access and extract them and increasingly important to use them as many times as possible maximising circularity. So at what point does it become 'worth' recovering material previously classified as waste, in effect reversing our action of disposal?

This will vary between commodities and products with supply and demand over time, depending on how they have been treated once classified as waste. Just as the value of raw or recycled materials fluctuate, so could landfill content depending on extraction capabilities as considered below.

GONE !

Incineration is irreversible – essentially products and components in the state they once existed are, for the most part, gone. Waste-to-energy plants are a move to capture a 'value' from the action of burning waste in the form of energy, a tidy solution as seen in regions such as The Nordics, diverting huge amounts of waste from landfill (c.99% in Sweden[1]) and contributing power to homes and businesses. However in the frame of irreversibility, resources in their original formats at point of disposal are lost to the process and can only contribute once to this system. Demand for incineration is driven amongst other things by; reduced landfill capacity (places like the UK); establishing basic sanitation through rudimentary waste practices (open fires to reduce volume of rubbish); and ease of dealing with waste locally to reduce transportation costs and impacts. The balance between the societal benefits of dealing with waste this way versus burning material irrecoverably dances between the realities and ideals of tackling the huge volume of waste we continue to churn out – an estimated 2.24 billion tonnes of solid waste globally in 2020, a footprint of at least 0.79 kilograms per person per day.[2]

1. Avfall Sverige, *Swedish Waste Management 2021*, August 2023, https://www.avfallsverige.se/media/lbdg3vcp/svensk_avfallshantering_2021_en.pdf

2. SilpaKaza, Lisa Yao, Perinaz Bhada-Tata, and Frank Van Woerden, *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050* (Washington: International Bank for Reconstruction and Development, 2018).

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GONE... FOR A WHILE!

The practice of landfilling traditionally means waste is buried or heaped and then covered. Globally, there is wide ranging variation in regulation, structure and monitoring of landfills, with formal landfill engineering only a relatively recent concept. Challenges to recovering resources once landfilled include: locating them; breakdown of product under anaerobic conditions that change their state; interactions between waste types that are mixed together; technology available to physically retrieve it; and the human and environmental risks of disturbing a landfill due to ground gas and contamination. If you knew or could detect that a landfill cell contained a significant amount of gold, how far would you go to extract it? Ultimately it comes down to the price of gold versus the cost to extract it and at some point that breaks even to be of value for someone somewhere. In many countries where formal waste collection systems are unstructured, individuals may find value in collecting littered items like aluminium cans or scaling rubbish mounds to effectively backwards-mine them, because they can find a way to recover cost from doing so.

DONE THAT

GONE...AS WE KNOW IT!

In places where robust recycling collection and material recovery systems are established, when we throw something like a plastic bottle into that recycling stream, we hope that material is used again and again. In countries where sorting, transporting and processing technology costs allow for specific materials, the more pure a stream of material collected the more likely it is that it could be processed into a 'like-for-like' end use. Within the recycling industry items that contain highly mixed materials become increasingly complex to separate into clean streams, driving up the cost to do so and decreasing the likelihood of it being scalable to recycle them. The quality of the output from the recycling process may reduce to a point where there is no further way (using current technology) to use it. For many naturally occurring resources (e.g. asbestos) or man-man substances (e.g. silicones) recycling or reuse can be restricted due to potential hazards or scientific limitations. So whilst recycling tries its best to reverse the negative environmental impacts of throwing something away, it is not always straightforward.

So how should we tackle the Irreverse in the world of waste? Only use or manufacture resources or products that have a recovery solution? Reduce incineration of anything non-hazardous to close to zero? Plan landfill cells to be so well categorised that we can easily access that deemed worthless now, in the future, when we need it back?

Whilst these are idealistic scenarios, multiple effective tools already exist throughout the waste hierarchy, are tried, tested and scalable to rise to the challenge. In the frame of the Irreverse, humans have undertaken many irreparable actions to waste resources, yet it is within our ability to make significant positive changes for our future. This will take the effort of individuals, regulatory bodies and businesses alike. Recognising that there are complexities from an economic growth perspective with a call to rethink consumerism, individuals can consider the resource demand their purchasing choices drive and apply pressure on businesses around packaging. Human and environmental health should be protected by waste management regulations which iterate to be better monitored and enforced. Those extracting resources, creating products and packaging must do so in a way that takes responsibility for their end-of-life. As organisations such as the Ellen McArthur Foundation are driving, the circular economy should be steered to work so that businesses are empowered to plan, create and remake products in a way that eliminates waste and pollution. Well regulated, accessible recycling systems, that are supported to run as the commodity business that they typically are, should continue to try to retain material in circulation where robust life cycle analysis show their benefit. Creative solutions to reuse and recycle material outside of the typical commodity model should be explored, seeking value other than recovering profit from the process. We collectively need to swiftly and continuously explore, attempt and scale numerous solutions until there are few irreversible disposal decisions left.