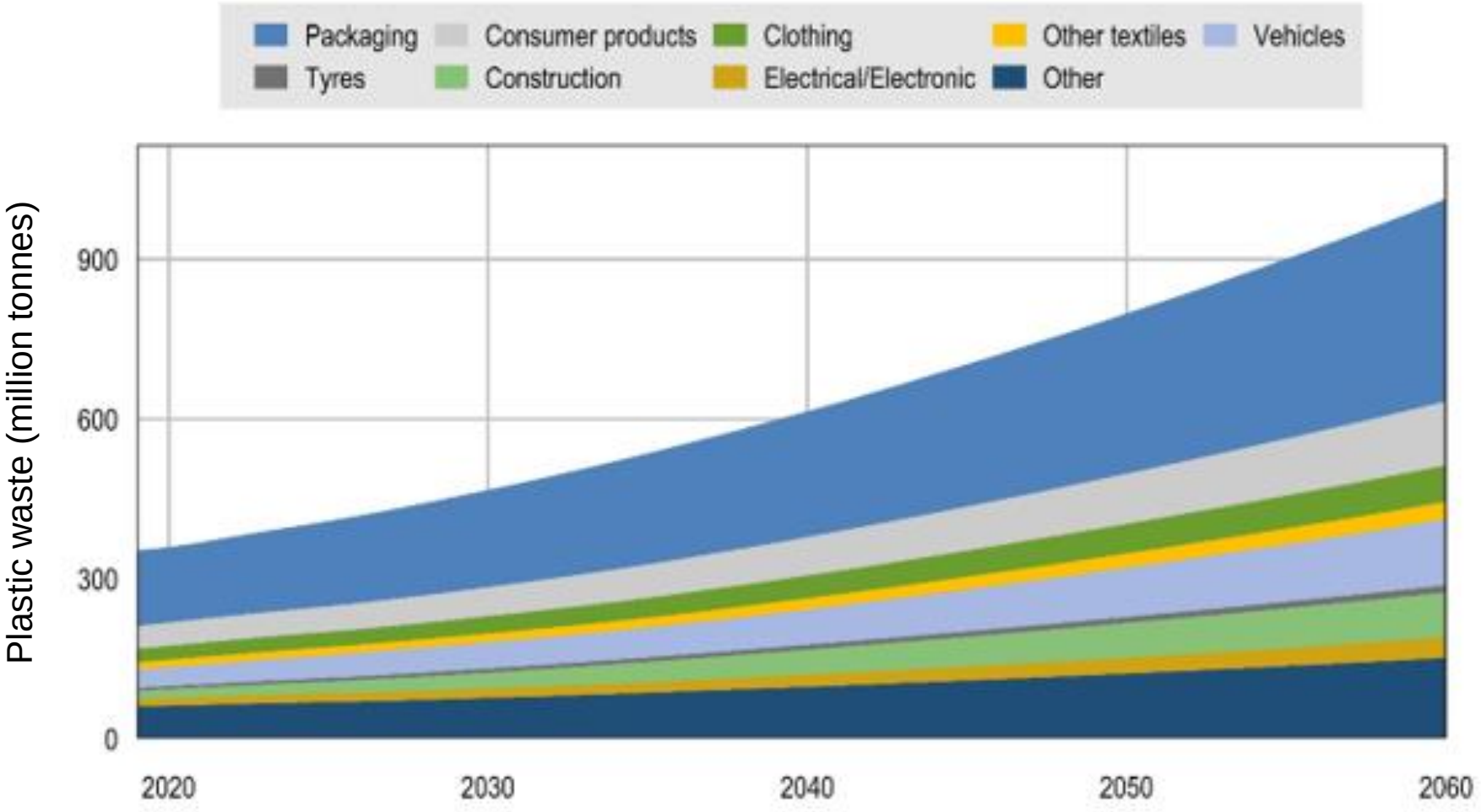
The Transport of Microplastic Contamination into Soil:

Pathways, Problems and Prevention

Erina Brown

AtkinsRéalis and University of Birmingham

A quick intro to plastic waste...



Source: OECD ENV-Linkages model.

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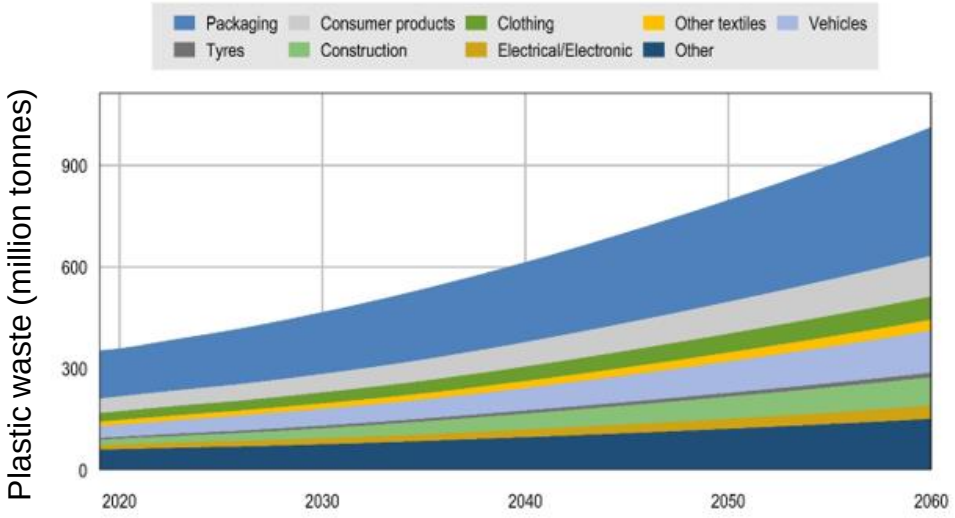

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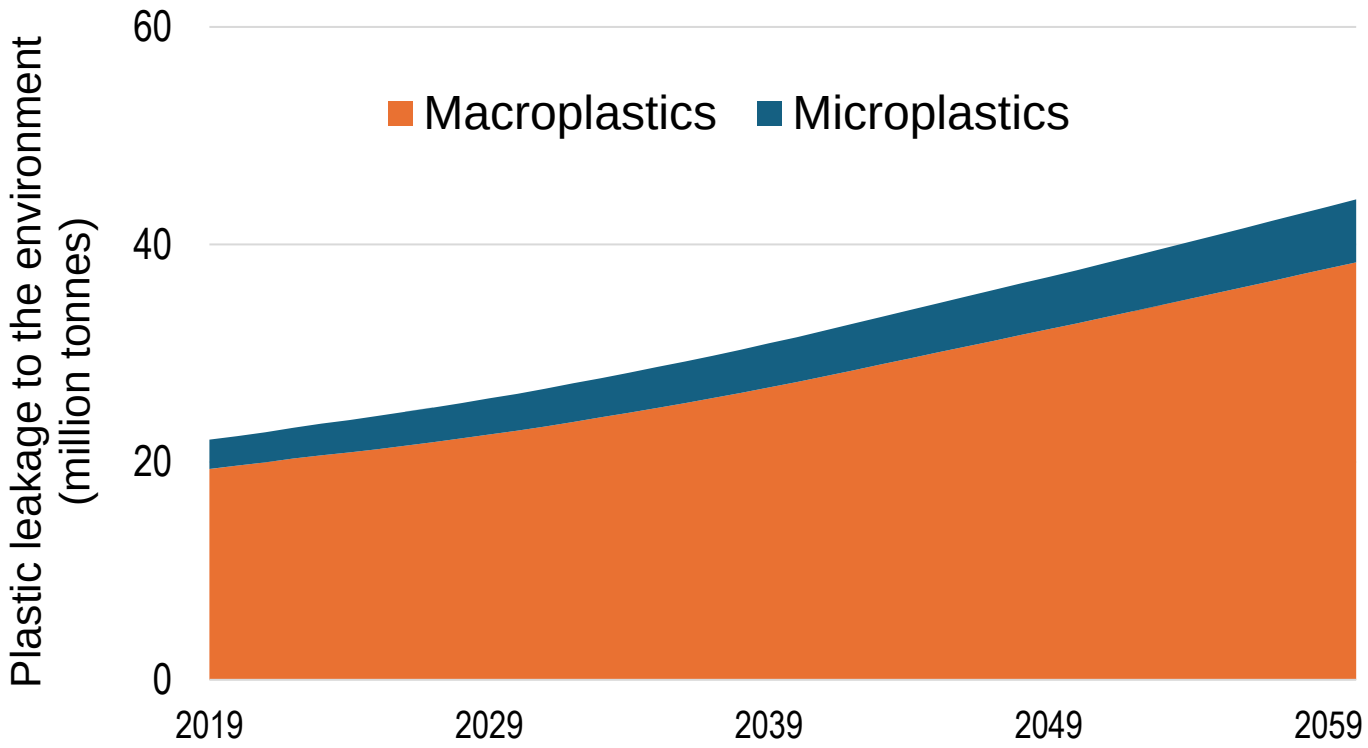


Data source: OECD iLibrary: Plastic leakage to the environment - projections

UNIVERSITY OF BIRMINGHAM AtkinsRéalis

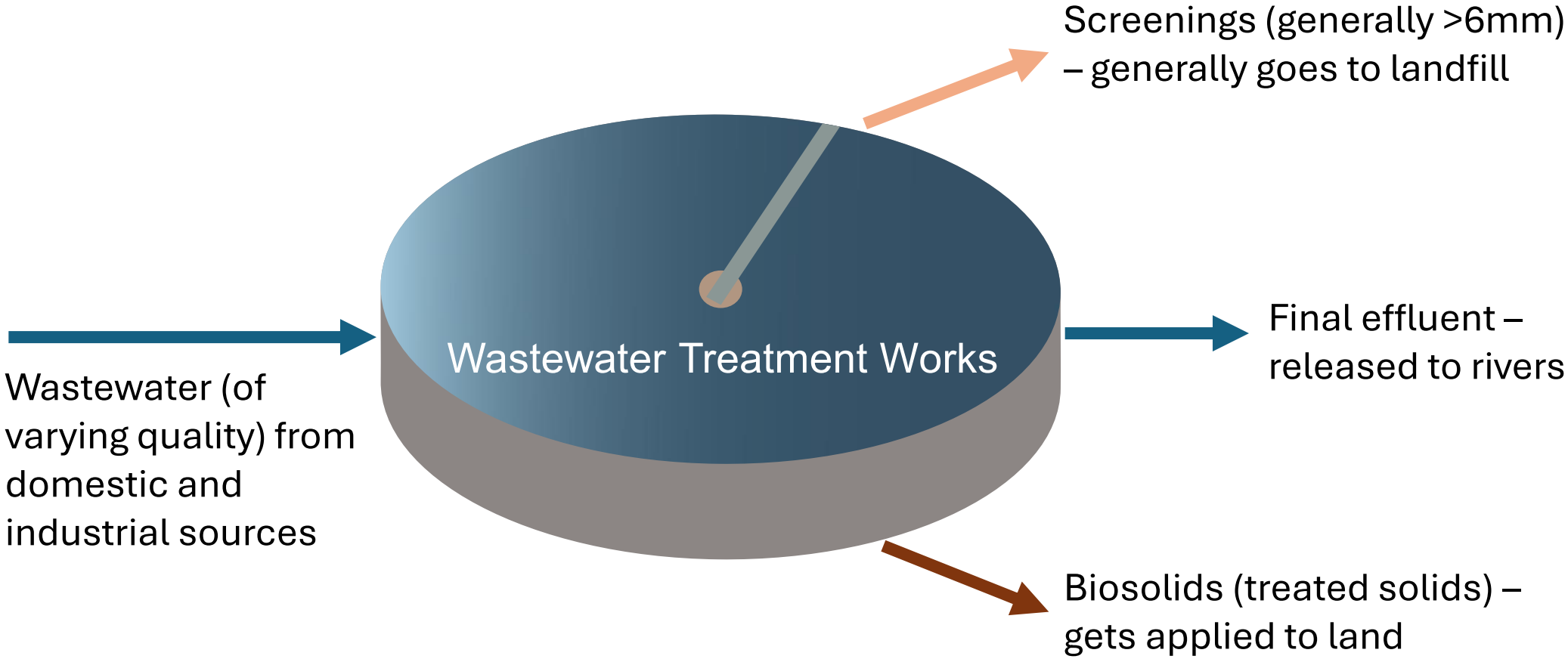
Pathways

What are the major potential routes that microplastics take into soils?

Sources	→	Routes to soil
Widespread general litter	→	Degradation of macroplastics to secondary microplastics
Landfill	→	Degradation of macroplastics and leaching of microplastics from improper landfill dumping or escaping leachate
Plastic mulching	→	Application to land and degradation of mulching
Atmospheric microplastics	→	Deposition from airborne contaminants
Compost	→	Application to land
Biosolids (treated sewage sludge from domestic and industrial wastewater and stormwater)	→	Spreading to land
Stormwater	→	Splashing and run-off
		And many more…?

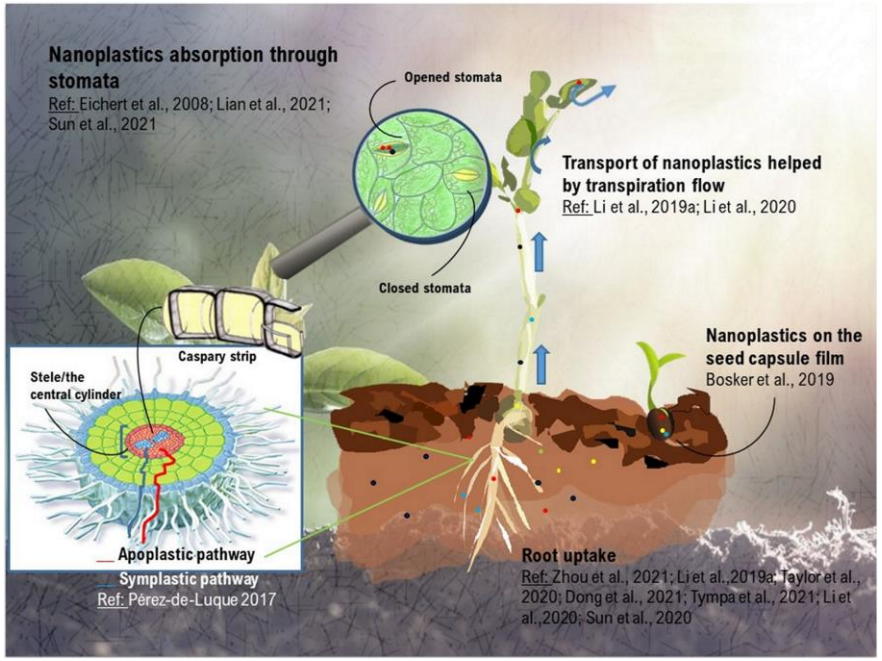
Pathways

Why is there concern about biosolids?



Problems

What impacts on the soil health can these microplastics have?

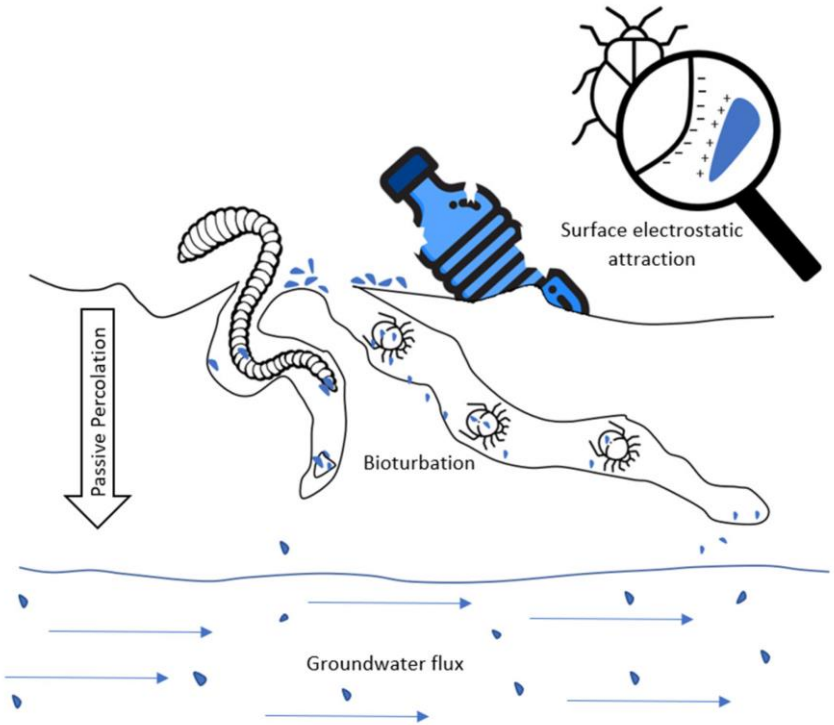


Source: Campanale et al., 2022, https://doi.org/10.1016/j.scitotenv.2021.150431

- Uptake by plants
- Impacts to soil ecosystem

Problems

What further transport can microplastics in soil undergo?



Source: Pompermayer de Almeida et al., 2023, https://doi.org/10.3390/microplastics2010005

- Downward transport through bioturbation and percolation into groundwater
- Run-off to rivers

Prevention

What are we doing to try to manage these pathways?

- **Source control!**
- Research to improve knowledge and awareness of pathways and consequences
- Potential changes to regulation of biosolids spreading
- Developing alternative methods and technologies for sludge treatment

Glitter is used in many products, including face/body stickers, clothing, makeup, toys etc.

- “Approx 4,500 tonnes were purchased in the US between 1989-2009”
- “Approx. 9,000 tonnes are manufactured globally per year”

Glitter is made of common polymers such as PET and PVC

Contents lists available at ScienceDirect

Water Research

journal homepage: www.elsevier.com/locate/watres

Improved methodology to determine the fate and transport of microplastics in a secondary wastewater treatment plant

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ABSTRACT

Wastewater treatment plants are a significant pathway of microplastics (MPs) to aquatic environments. To develop suitable management options and reduce microplastic emissions in treated effluent and sludge, we must first develop a reliable method to understand their transport and fate throughout the treatment process. An improved methodology was applied to determine the size, shape, polymer type and partitioning behaviour of MPs using a combination of oxidation treatment, fluorescent staining and Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy (ATR-FTIR) to detect small MPs ≤20 μm in wastewater. The mean number of MPs (<5 mm) detected using this methodology was 11.80 ± 1.10 MP/L in raw sewage, 5.23 ± 0.25 MP/L in degritted wastewater, 7.91 ± 0.44 MP/L in waste activated sludge and 2.76 ± 0.11 MP/L in the final treated effluent. An increase in MPs following primary screening suggests that WAS is a sink for several stealth microplastics, including glitter, which is returned to the effluent during the treatment process. The estimated MP removal efficiency for the studied WWTP is relatively poor compared with global data for secondary WWTPs, which is likely due to the release of partially treated effluent into the Pacific Ocean via a second discharge point. The information generated through this study can be useful to; firstly, inform on-site wastewater management practices, and secondly, reduce MP concentrations in final treated effluents discharged to the marine environment.

Glitter comprised approx. 25% of the microplastics found in the waste activated sludge (WAS)

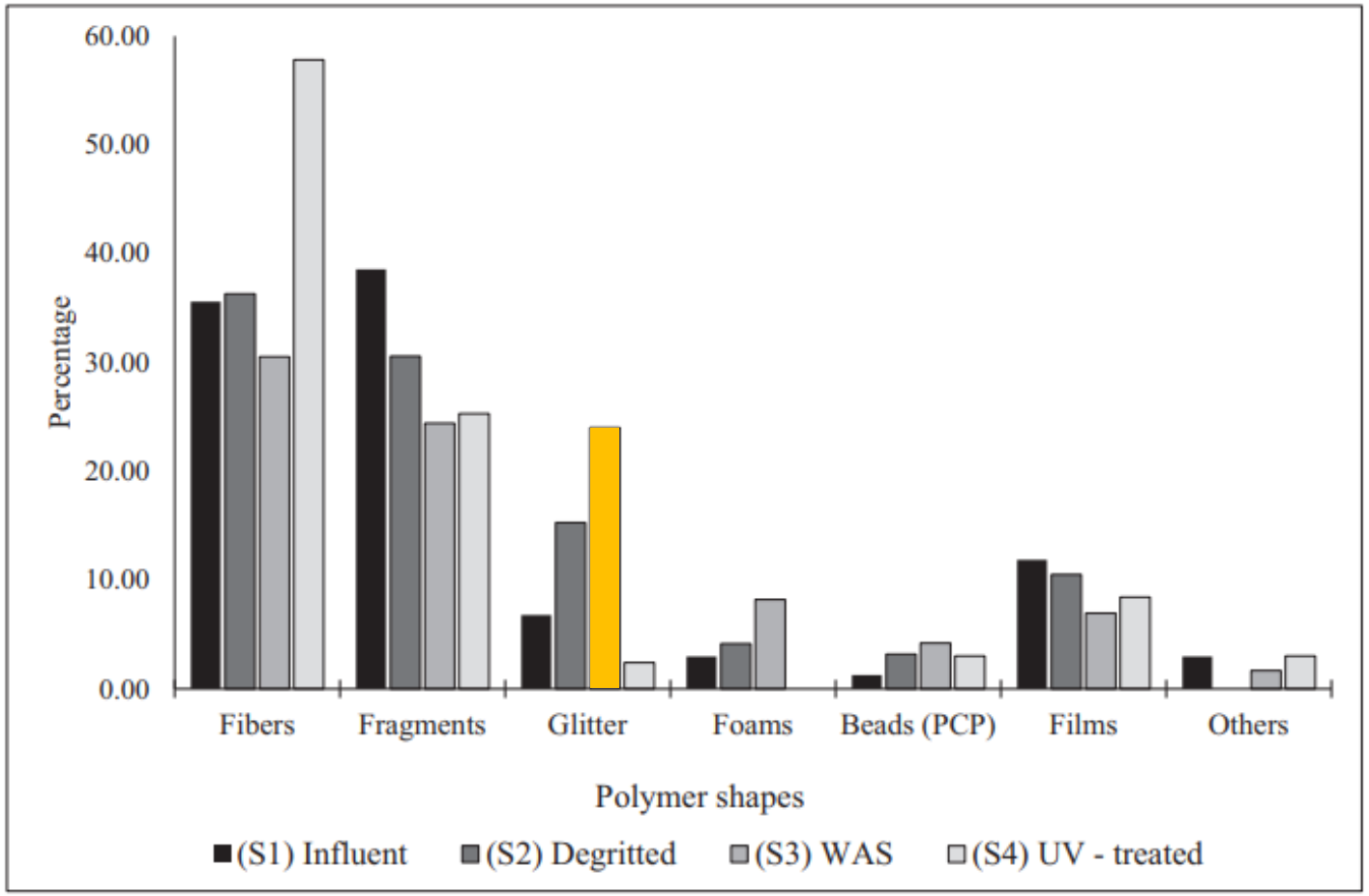

Fig. 3. Proportion of MP particles (%) by shape and treatment stage. The microplastics (MPs) from wastewater treatment samples were classified into fibers, fragments, glitter, foams, beads (PCP), films, and others.

PRESS RELEASE | 25 September 2023 | Brussels | 2 min read

Protecting environment and health: Commission adopts measures to restrict intentionally added microplastics

Page contents

Today, the Commission takes another **major step to protect the environment** by adopting measures that **restrict microplastics intentionally added to products** under the EU chemical legislation REACH. The new rules will **prevent** the release to the environment of about **half a million tonnes of microplastics.** They will prohibit the sale of microplastics as such, and of products to which microplastics have been added on purpose and that release those microplastics when used. When duly justified, derogations and transition periods for the affected parties to adjust to the new rules apply.

The adopted restriction uses a broad definition of microplastics – it **covers all synthetic polymer particles below five millimetres that are organic, insoluble and resist degradation**. The purpose is to reduce emissions of intentional microplastics from as many products as possible. Some examples of common products in the scope of the restriction are:

- The granular infill material used on artificial sport surfaces – the largest source of intentional microplastics in the environment;
- Cosmetics, where microplastics is used for multiple purposes, such as exfoliation (microbeads) or obtaining a specific texture, fragrance or colour;
- Detergents, fabric softeners, glitter, fertilisers, plant protection products, toys, medicines and medical devices, just to name a few.

The Standard

61 UK music festivals are banning glitter. Here's why it's time to switch to biodegradable sparkle

It's time to make the switch to guilt-free glitter

A FESTIVAL-GOER HAS HER FACE PAINTED WITH GLITTER AT GLASTONBURY 2017

AFP/GETTY IMAGES

CHLOE STREET
6 AUGUST 2018

Prevention

What are we doing to try to manage these pathways?

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- **Increasing research to improve knowledge and awareness of pathways and consequences**
- Potential changes to regulation of biosolids spreading
- Developing alternative methods and technologies for sludge treatment

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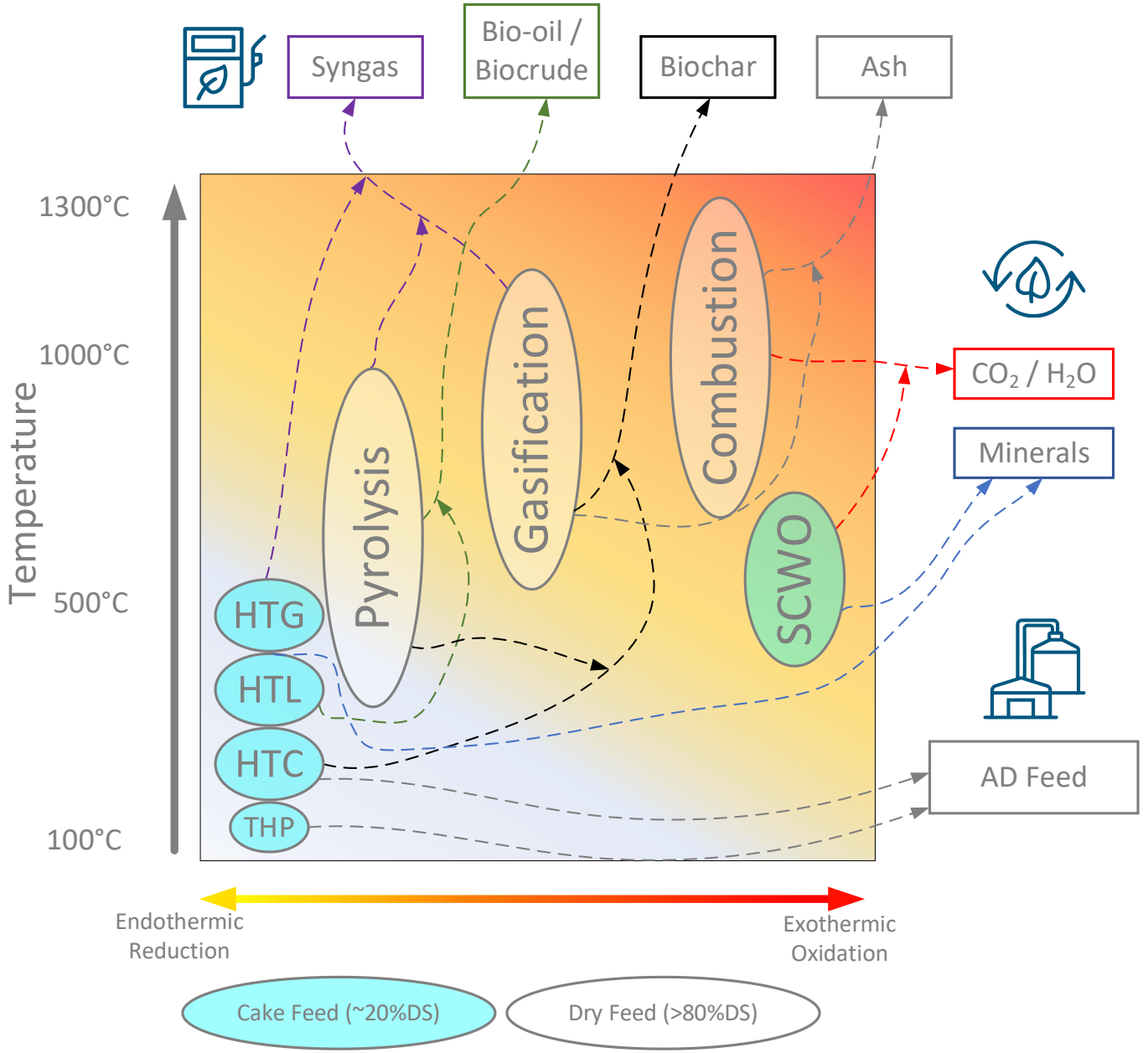

Source: AtkinsRéalis Bioresources Team, UKWIR

To conclude…

- Transport through many pathways
- More knowledge required
- Lots going on!

Thank you for listening!

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