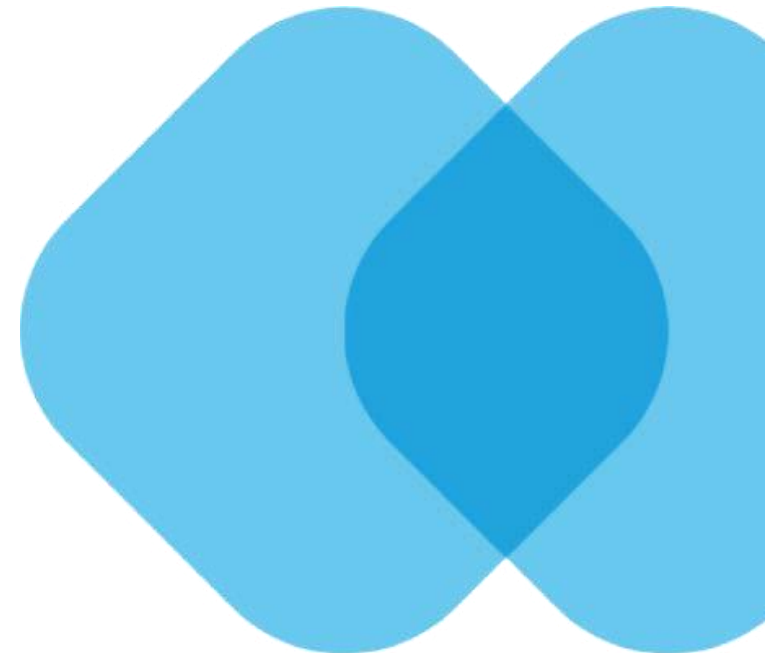


Addressing the Elephant

Future of Plastics Conference

Athens February 2023

Kevin Ross



Why Me?

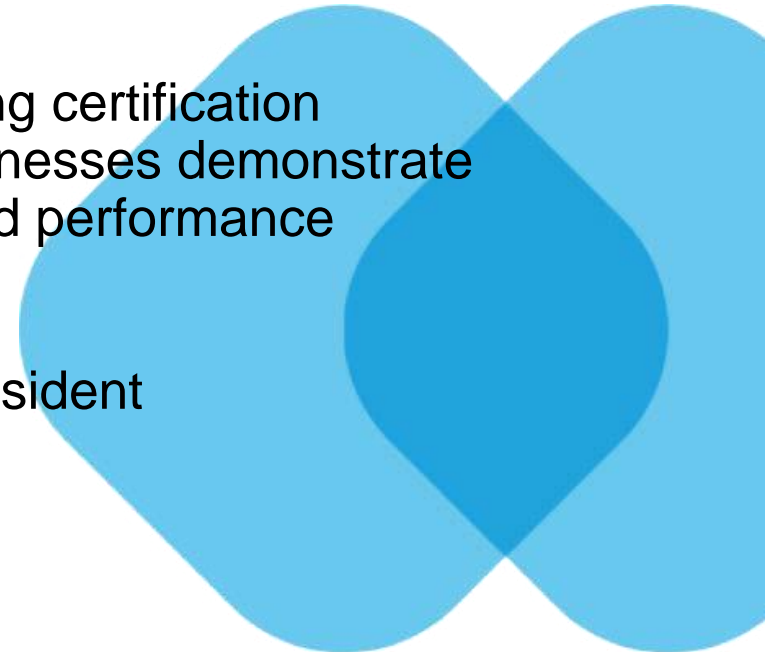
Impact Solutions – Global polymer R&D centre and 17025 accredited test laboratory

Impact Recycling – Recycling company using our Patented BOSS Technology separating plastics

Reventas – Currently commissioning a pilot plant that provides a low cost method of removing colour from a recycled plastic.

Sustainable Certifications Group www.scgroupuk.org providing certification schemes that ratify the sustainability of products, to help businesses demonstrate compliance with customer requirements, fiscal conditions, and performance standards.

Scottish Plastics & Rubber Association – Immediate Past President



Future of Plastics?



Addressing the Elephant

Burn it

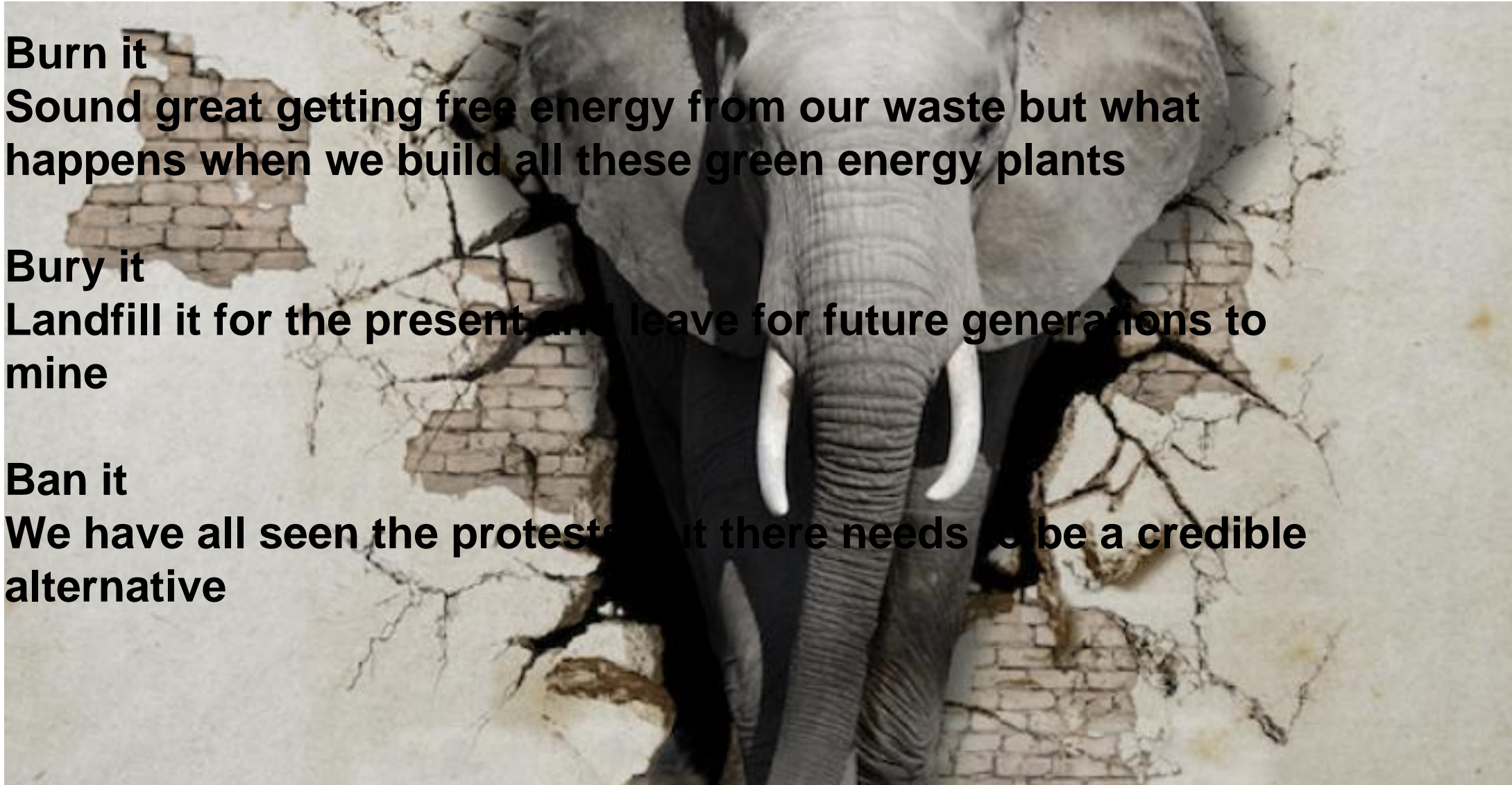
Sound great getting free energy from our waste but what happens when we build all these green energy plants

Bury it

Landfill it for the present and leave for future generations to mine

Ban it

We have all seen the protests but there needs to be a credible alternative



External Drivers in Plastic Recycling

Government Policies through:

- Plastic Packaging Tax
- Plastic Bans
- Deposit Returns Schemes



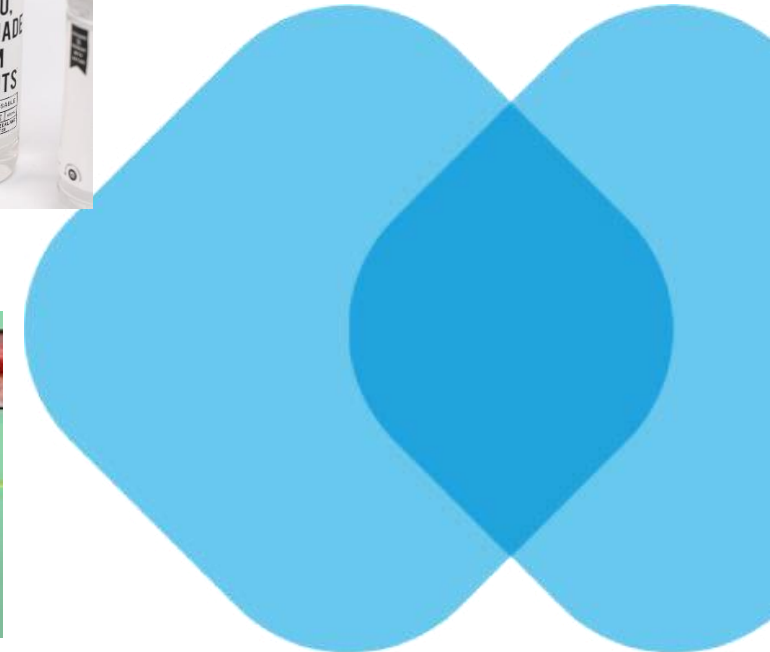
Brand Marketing through:

- Green & Sustainability Credentials
- Pressure and requests from consumers
- Light weight but non recyclable packaging
- Alternative materials ie Glass & Paper



A TOY STORY

Lego wants to solve the world's plastics problem with a biomaterial that can survive generations of play



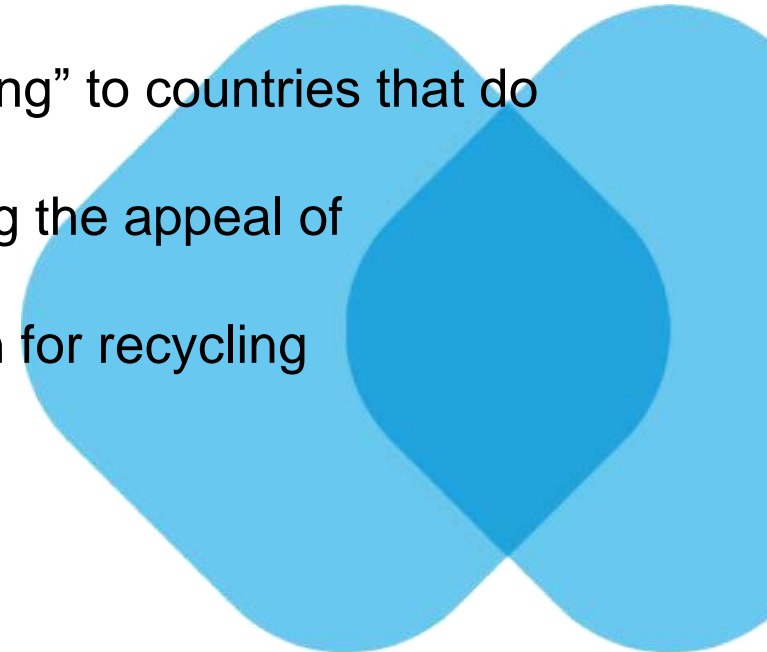
Unintended Consequences

Regulations

Packaging Recovery Note (PRN) a UK system Packaging Recovery Notes generate income for reprocessors. This money is invested back into recycling projects, ensuring that the UK's recycling and recovery industry continues to grow, and enabling the UK to meet its obligations under the European Regulations

The unintended consequence however is

- Encourages UK recyclers to export their “plastic packaging” to countries that do not have the infrastructure to deal with this material
- Increases the difficulties in attracting investment reducing the appeal of investing in domestic recycling
- Light weighting of products taking preference to a design for recycling



Unintended Consequences

Greenwashing
False claims

- Recycled content
- Biodegradability
- Sustainable

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Huge backwards steps are being taken producing carbon intensive products that are replacing perfectly satisfactory and recyclable products.

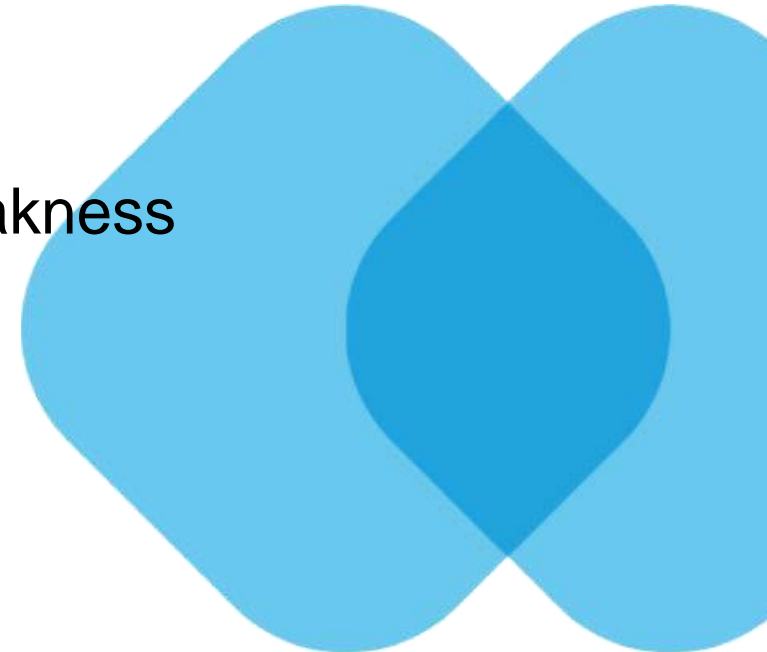
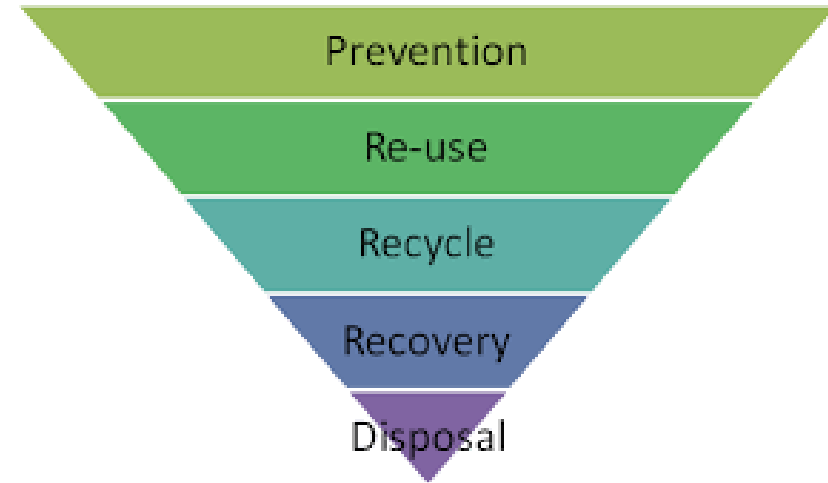
Plastic Recycling.

There is no one solution for Plastic Recycling

Mechanical
Chemical
Additive
Degradation

Each recycling method has its own strength & weakness

So what's new?



Mechanical Recycling

3 Main technologies

Spectroscopy: Most common method ie Infra Red separation

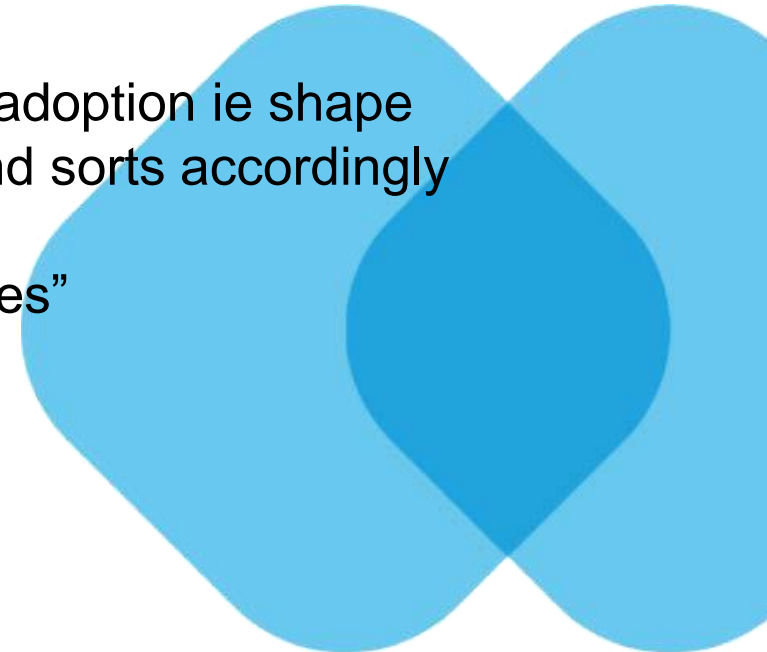
Density: eg Impact Recycling BOSS technology <https://impact-recycling.com/boss/>

Electrostatic: Starting to mature with choice of suppliers

<https://en.hamos.com/produkte/elektrostatische-kunststoff-kunststoff-separatoren-hamos-eks>

Other technologies are becoming available but have limited adoption ie shape sorting which “sees” a milk bottle or a detergent container and sorts accordingly

All the Technology are maturing with new entrants and “copies”



Chemical Recycling

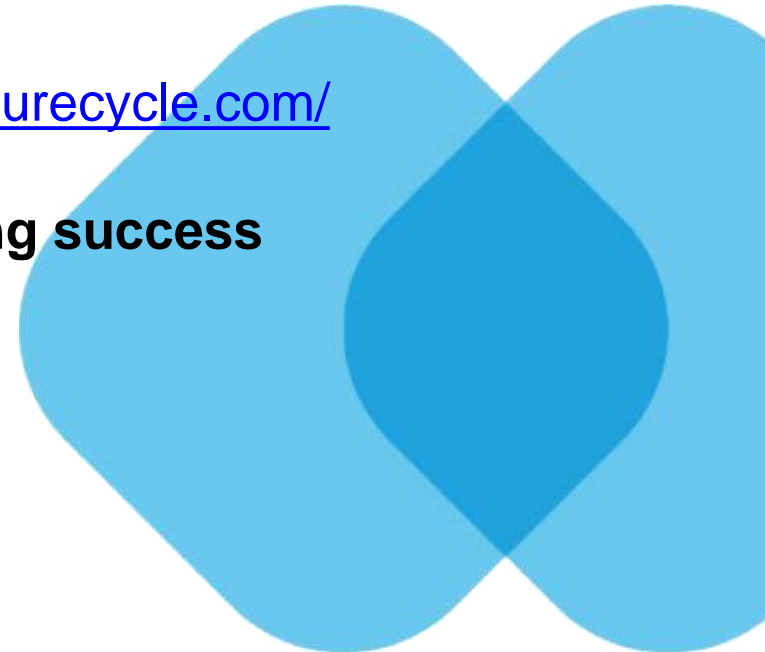
Chemical recycling has come a long way from the small scale plastic to oil production.

Market is splitting into two distinct technologies and can be operated at scale.

Plastic to “intermediate feed” is a Oil, cracker feed or Naptha substitute
<https://plasticenergy.com/technology/>

Plastic to Plastic is the Purecycle technology <https://www.purecycle.com/>

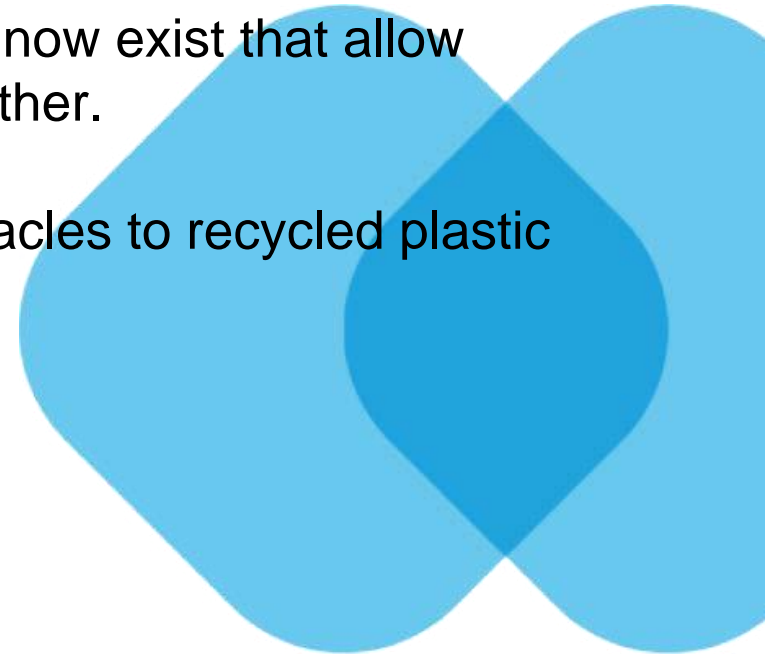
Scale is they key driver for chemical recycling success



Innovation in Recycling

Rather than spectacular new technologies being released the most excitement developments have been in support areas:

- Food contact identifying and separating this is a large market, Technologies such as Fluorescent or Ultraviolet Markers eg <https://www.nextloopp.com/> aim to close this.
- Process Aids/ Compatibilizers has come a long way and now exist that allow mixed PE eg LLDPE, MDPE & HDPE to be recycled together.
- Colour removal – Removing colour is one of the key obstacles to recycled plastic eg <https://reventas.co.uk/>



Degradation

When considering any Recycling Option using a compostable product for a food contaminated products makes a lot of sense but what is meant by compostable?

Home Compostable:

Industrial Compostable:

However a lot of the compostable packaging are only compostable in industrial composters and a lot of the industrial composters do not accept plastic

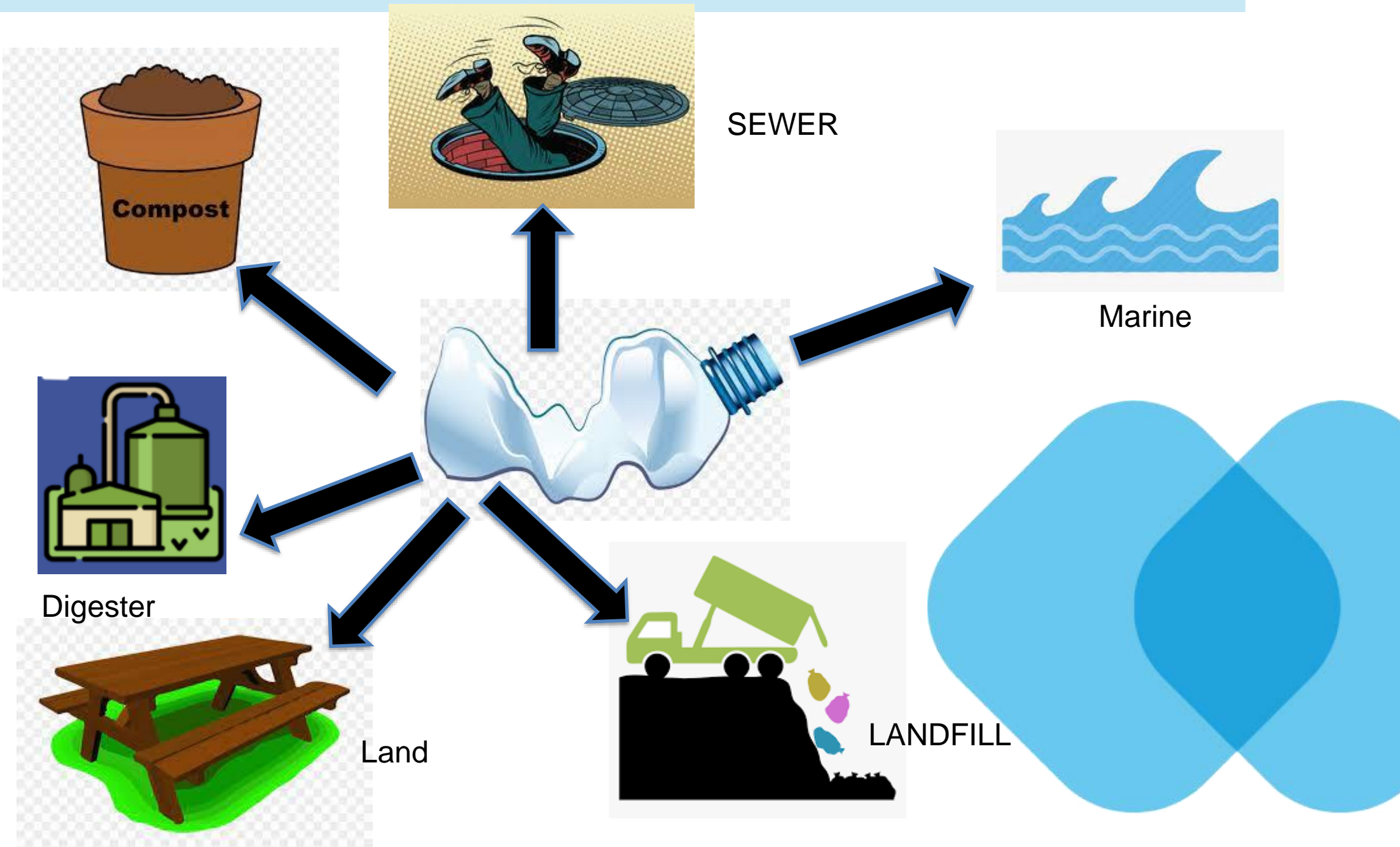
So what happens to some of the expensive compostable product?

yes we burn it or bury it

A collection and compostable infrastructure is required to support their introduction.

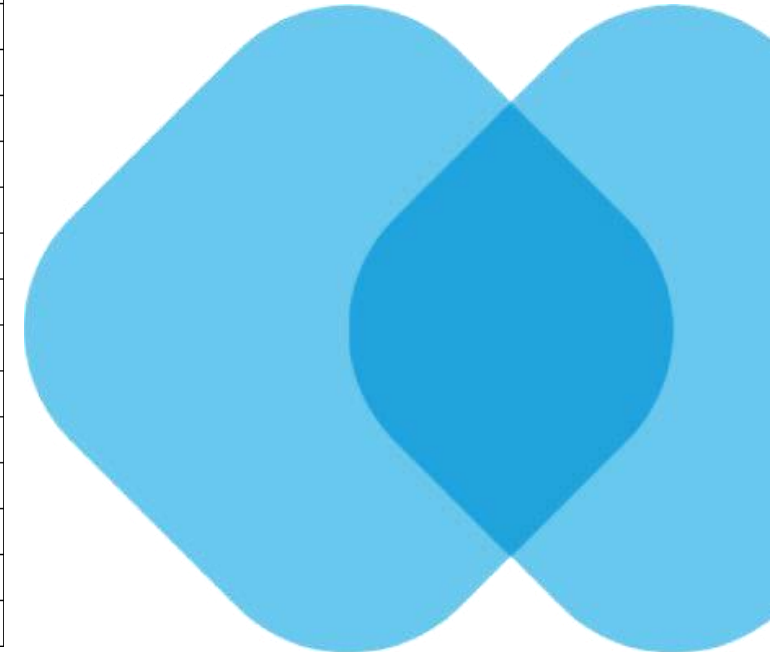


Degradation – Final Destination



Degradation –Labelling & Standards

| | Standard | |
|--|------------------|-------------|
| | BS EN | ASTM |
| Packaging – Compostability | 13432 | D6868/D2020 |
| Plastics – Compostability | 14995 | |
| Disintegration under defined composting conditions | 14045 | |
| Disposability in wastewater treatment plants | 14987 | |
| Plastics - Biodegradable mulch films for use in agriculture and horticulture - Requirements and test methods | 17033 | |
| Packaging - Requirements and test scheme for carrier bags suitable for treatment in well-managed home composting installations | 17427 | |
| Packaging - Determination of the degree of disintegration under simulated home composting conditions | 17428 | |
| ISO | | |
| Aerobic Biodegradation Water | 14851/14852/7827 | |
| Anaerobic Biodegradation in Water | 14853 | |
| Aerobic Biodegradation Soil | 17556 | D5988 |
| Soil biodegradable materials for mulch films for use in agriculture and horticulture | 23517 | |
| Aerobic Biodegradation seawater/sandy sediment interface | 18830 | |
| Aerobic Biodegradation Marine | 23977 | D6691 |
| Aerobic Biodegradation Industrial Composting | 14855 | D5338 |
| Aerobic Biodegradation Landfill | | D5526 |
| Anaerobic Biodegradation under high-solids anaerobic digestion | 15985 | D5511 |
| Anaerobic Biodegradation in controlled slurry digestion systems | 13975 | |
| Disintegration under simulated composting conditions – lab scale | 20200 | |
| Disintegration under defined composting conditions – pilot scale | 16929 | |
| Leather - Determination of degradability by micro-organisms | 20136 | |
| Biodegradation of polyolefins in an open-air terrestrial environment | PAS 9017 | |



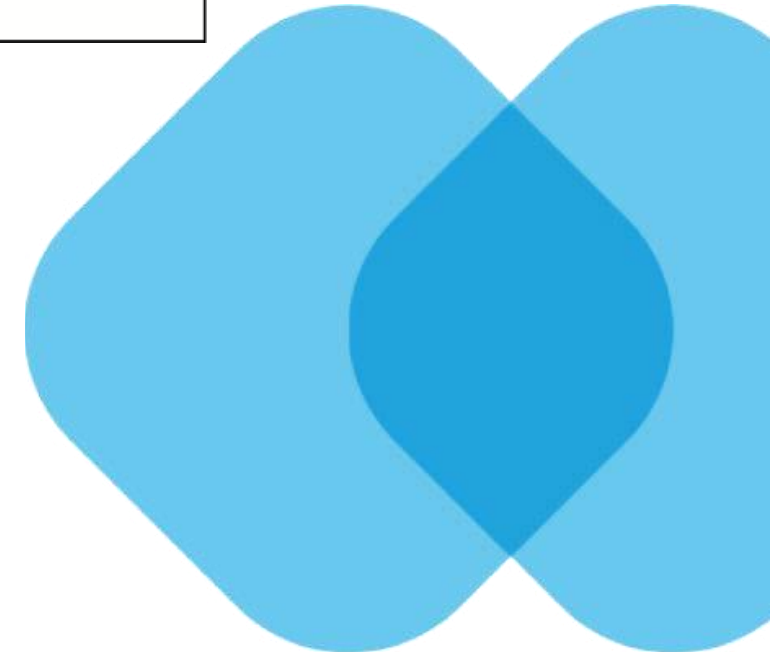
Degradation – Labelling & Standards



BPI®

COMPOSTABLE
IN INDUSTRIAL FACILITIES

Check locally, as these do not exist in many communities. **Not suitable for backyard composting.** CERT # SAMPLE



Bio!!!!

One of the biggest source of confusion in the Market!

Bio Polymers can be plant based eg PLA from corn

Bio Based Polymers can be produced from plant derived ethanol eg PE from sugar cain

Bio Polymers can be a polymer produced bio synthesis from amino acids obtained from fish waste

If it's a Bio Plastic -Does that mean that its Compostable & Biodegrades – No!!!!!!!



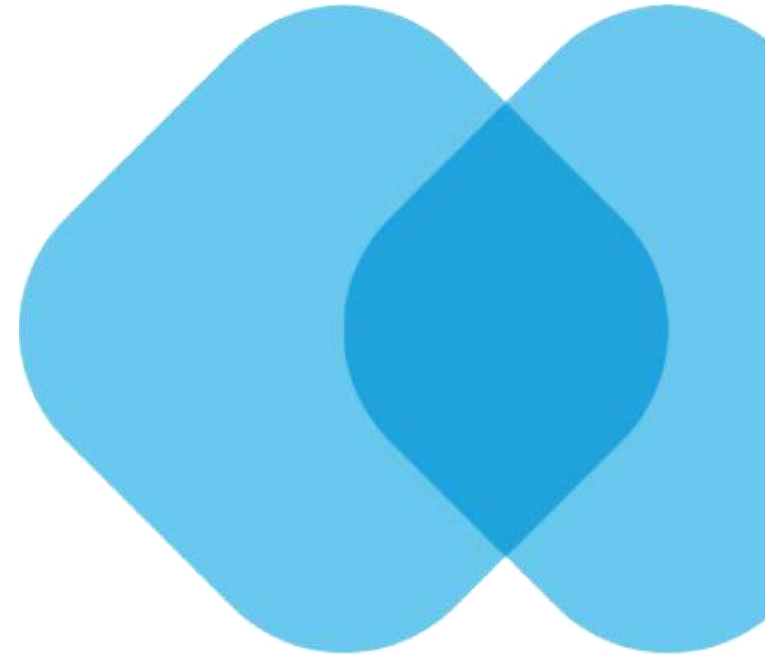
Biodegradable or Compostable?

Biodegradable (Adj) : capable of being decomposed by bacteria or other living organisms and thereby avoiding pollution.

Compostable (Adj): (of organic matter, especially kitchen waste) able to be made into compost.

Biodegradation is a chemical process that happens naturally. Materials are broken down by micro-organisms into CO₂, Water & Biomass.

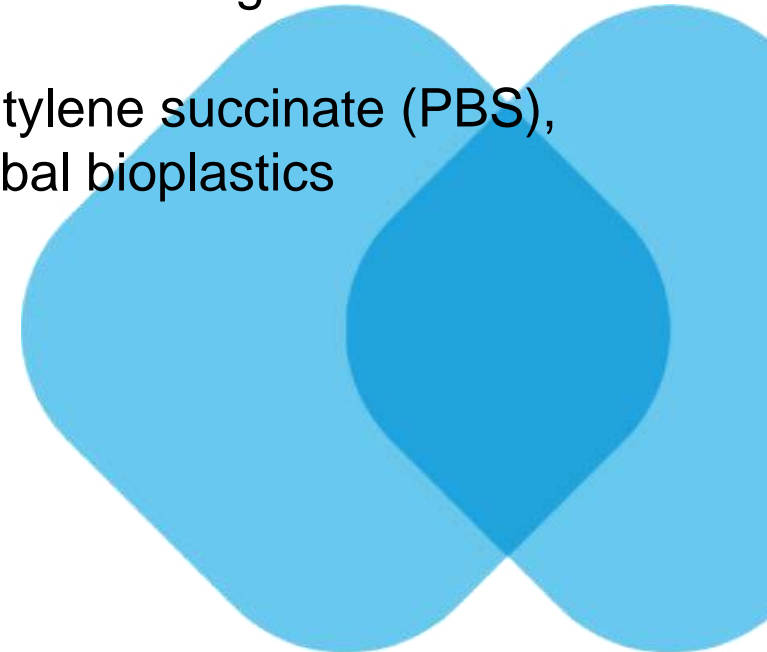
- Standards only exist to confirm production of CO₂.



Scale

When discussing recycling its worth putting some things into scale

- QatarEnergy and Chevron are looking to build the world's largest integrated polymer facility with a combined capacity of 2 million tonnes per year of PO
- In 2021, the market volume of polyethylene amounted to 107 MT¹
- Impact Recycling Newcastle plant produces 6K tonnes per year of PO
- 88–95% of plastic in the ocean comes from just 10 rivers with the Yangtze River in china puts as much plastic in the ocean each year as Ineos Grangemouth produces
- Biodegradable plastics, including PBAT, PLA, and polybutylene succinate (PBS), currently account for slightly over 64% (1.5 MT) of the global bioplastics production capacities.²



Industry Clusters

Recycling Clusters eg Project Beacon <https://www.zerowastescotland.org.uk/case-study/project-beacon>

- Different polymer recycling technologies working together on a single site sharing feedstock and waste materials.

Industrial Biotechnology Innovation Centres <https://www.ibioic.com/about>

- Scottish Government funding a Bioeconomy Cluster Builder to supports the development of new products and services using biotechnology.

Several Biorefinery's are now operating commercially eg

<https://www.celtic-renewables.com/production-facility/> producing Acetone, Butanol and Ethanol adjacent to the Ineos refinery in Grangemouth from waste products from the whiskey industry.

<https://oceanium.world/> producing chemical products from harvested sea weed

<https://www.ingenza.com/> engineer biological systems to make everything from therapeutics to enzymes and consumer products

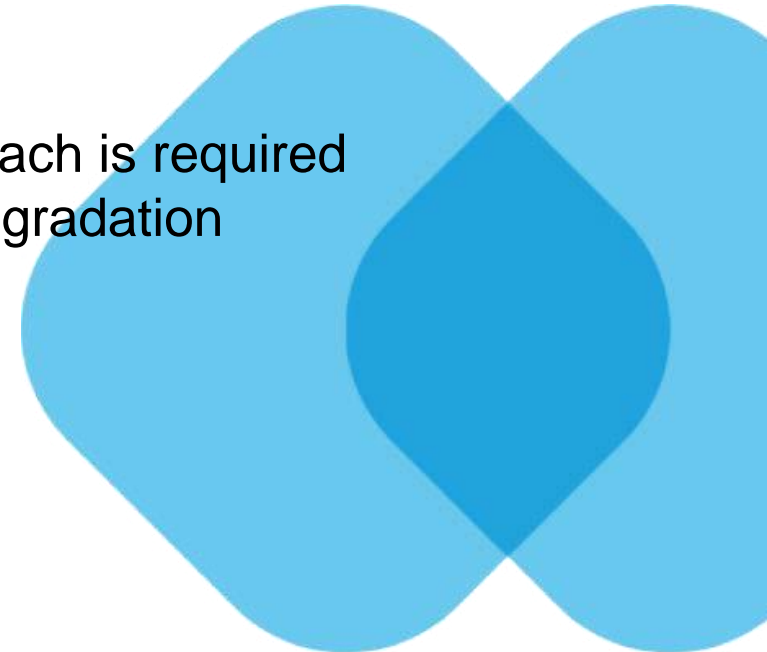
<https://www.cuantec.com/> Producing packaging material from shell food waste

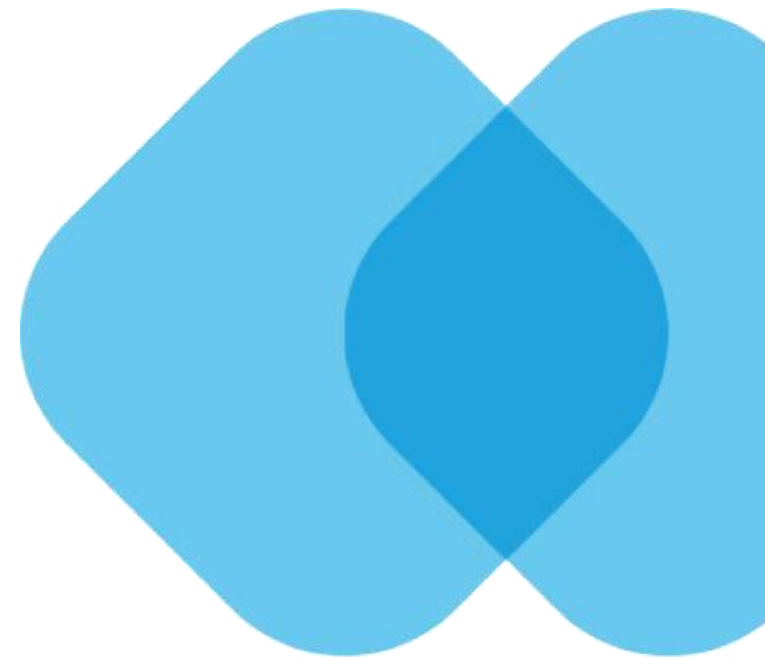
Clusters are a method to overcome the challenge of scale facing innovation.



Summary

- The plastics industry is operating in challenging but exiting times
- Market & Regulation are changing how we are doing things.
 - The polymers we use
 - Sustainability is a much higher focus
- All that is green is not necessary good for the environment
 - Unintended consequences
 - Greenwashing
 - Higher Carbon Products
- Polymer recycling is booming
 - No single solution and a collaborative approach is required
- The importance of considering the final destination for Degradation
- The importance of Scale & the use of Industry clusters





1 -<https://www.statista.com/statistics/1245162/polyethylene-market-volume-worldwide/#:~:text=Global%20market%20volume%20of%20polyethylene%202015%2D2029&text=In%202021%2C%20the%20market%20volume,107%20million%20metric%20tons%20worldwide>.

2. https://www.google.com/search?q=global+production+of+PLA&rlz=1C1CHBF_en-GBGB907GB907&ei=oLHbY4bAJ46XhbIPIOaKiAU&ved=0ahUKEwiGklaZ8Pb8AhWOS0EAHRSzAIEQ4dUDCA8&uact=5&oq=global+production+of+PLA&gs_lcp=Cgxnd3Mtd2l6LXNlc nAAZIECAAQzIFCAAQgAQyBQgAEIAEMgYIABAWEB4yBggAEBYQHjIGCAAQFhAeMgYIABAWEB4yBggAEBYQHjIGCAAQFhAeMgYIABAWEB46CggAEEcQ1gQQsAM6BQguEIAESg QIQRgASgQIRhgAULoJWJoOYL4TaAFwAHgAgAFHiAG-AZIBATOYAQCgAQHIAQjAAQE&sclient=gws-wiz-serp