End of Life Options, Bioplastics and Compostability

Martin Markotsis

Outline

- Plastic Waste
- End of Life options for bioplastics
- Recycling
- Biodegradable vs. Compostable
- Composting
- Standards and Labelling
- Scion’s new Biodegradation Test Facility

Plastics are everywhere

SCION
forests · products · innovation

Highly visible waste issue

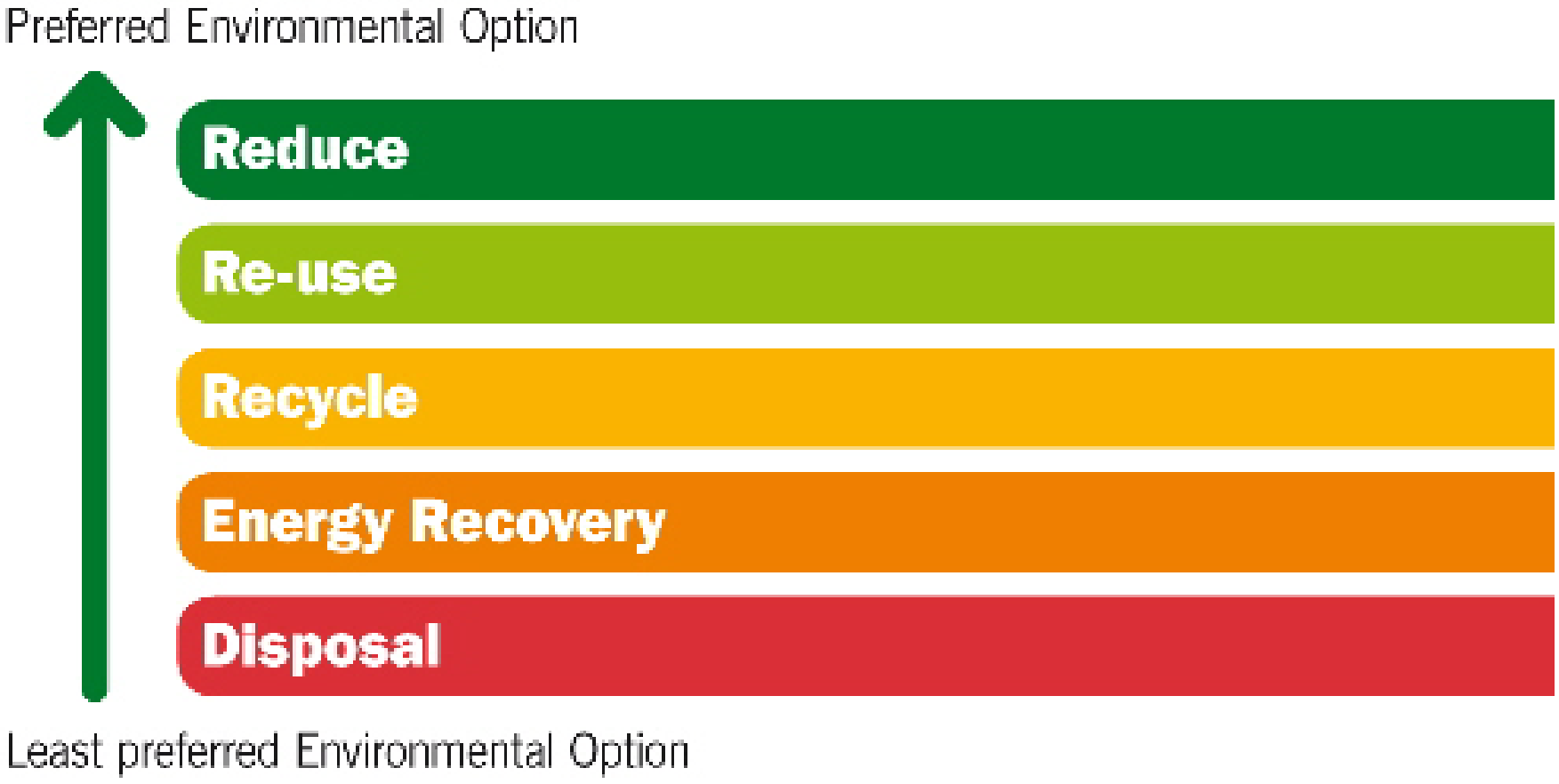
Packaging Waste Globally

- 72 million tons in USA (2009) (29.5% total MSW)
- 56.3 million tons in Europe (2005) (25% total MSW)
- 3.3 million tons in Australia (2004) (10% of MSW)

EPA http://www.epa.gov/ & Kale, G., T. Kijchavengkul et al Macromolecular Bioscience 2007, **7**, 255-277

SCION forests · products · innovation

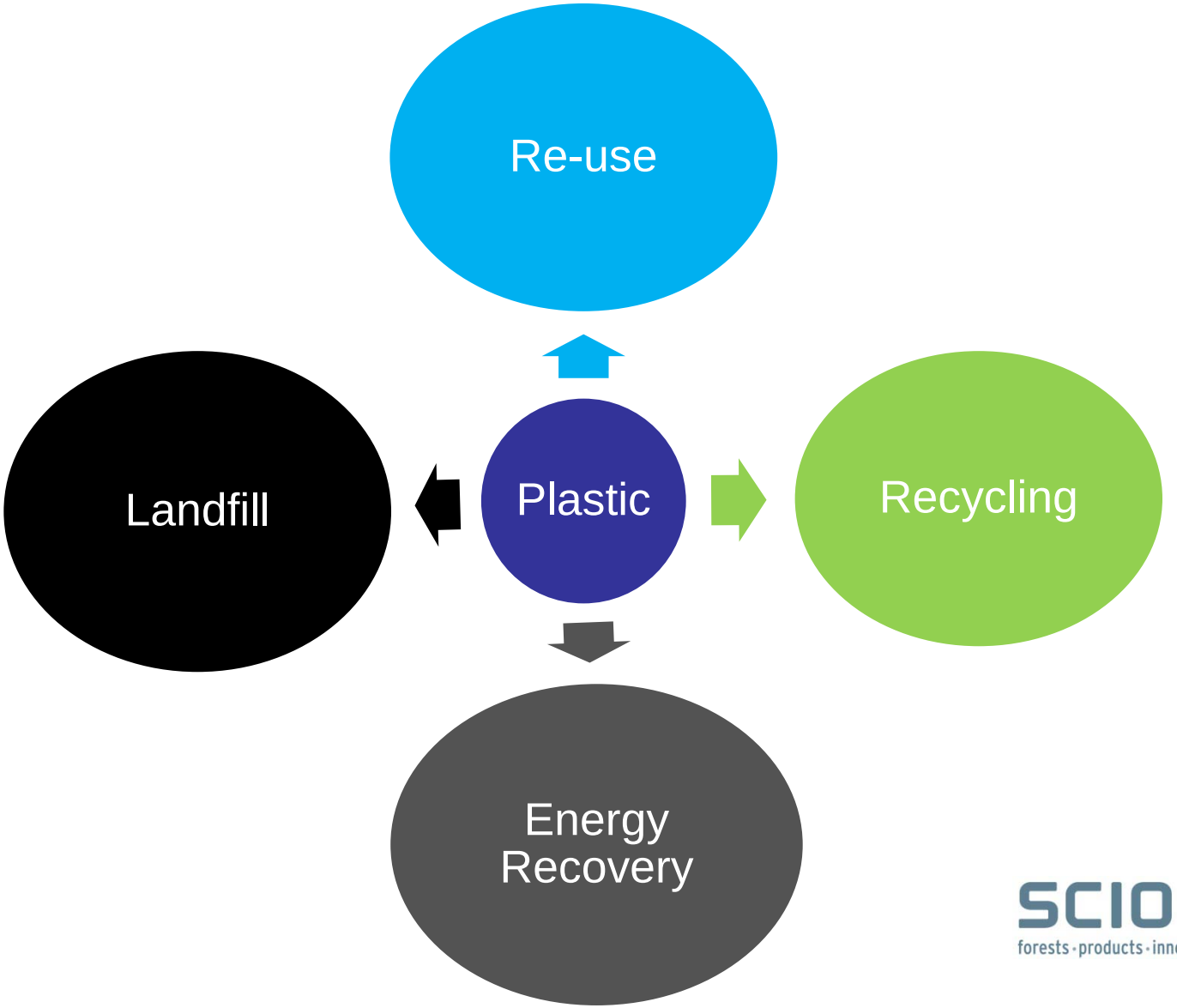
The Waste Hierarchy



http://www.cravendc.gov.uk

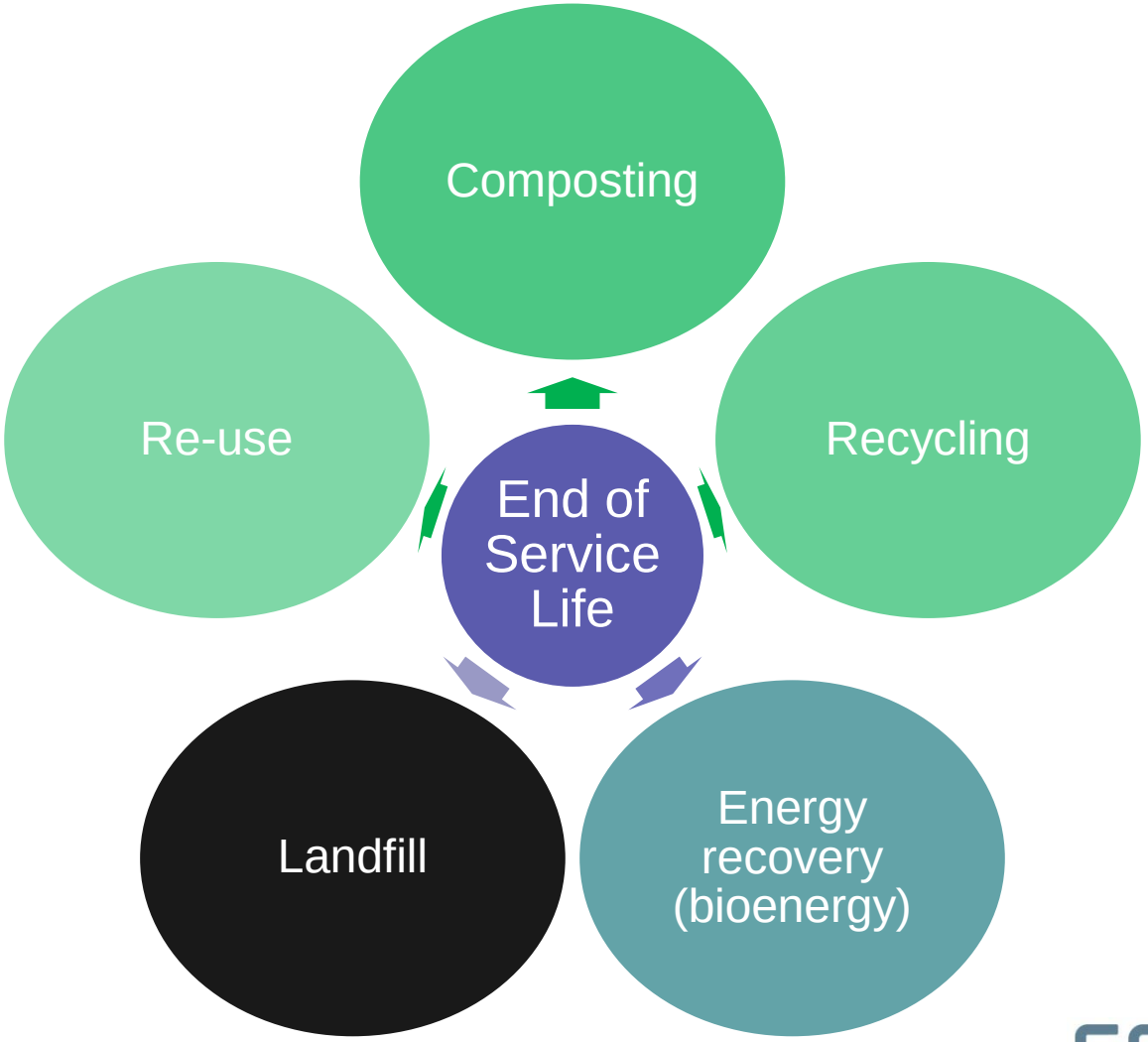
SCION
forests · products · innovation

End of Life Options for Conventional Plastics



SCION
forests · products · innovation

End of Life Options for Compostable Bioplastics

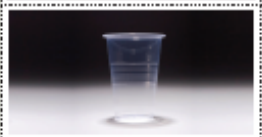


SCION
forests · products · innovation

Recycling

- 97% of New Zealanders have access to recycling
- Plastics recycling in NZ has more than doubled in the past 5 years.
- Approximately 252,000 tonnes of plastic still going to landfill each year.

SCION
forests · products · innovation

SYMBOL	TYPE OF PLASTIC	PROPERTIES	COMMON USES	RECYCLED IN	PACKAGING	NON PACKAGING
1 PET	**PET** Polyethylene Terephthalate	Clear, tough, solvent resistant, barrier to gas and moisture, softens at 70°C	**Soft drink and water bottles**, salad domes, biscuit trays, salad dressing and peanut butter containers, **fleece clothing** and geo-textiles	Pillow and sleeping bag filling, clothing, soft drink bottles, carpet		
2 HDPE	**HDPE** High Density Polyethylene	Hard to semi-flexible, resistant to chemicals and moisture, waxy surface, opaque, softens at 135°C, easily coloured, processed and formed	Crinkly shopping bags, freezer bags, **milk bottles**, ice cream containers, juice bottles, shampoo, chemical and detergent bottles, buckets, rigid agricultural pipe, **milk crates**	Recycling bins, compost bins, buckets, detergent containers, posts, fencing, pipes		
3 PVC	**PVC** Unplasticised Polyvinyl Chloride PVC-U Plasticised Polyvinyl Chloride PVC-P	Strong, tough, can be clear, can be solvent welded, softens at 75°C Flexible, clear, elastic, can be solvent welded	**Cosmetic containers**, electrical conduit, **plumbing pipes** and fittings, blister packs, wall cladding, roof sheeting, bottles Garden hose, shoe soles, cable sheathing, blood bags and tubing, watch straps, commercial cling wrap	Flooring, film and sheets, cables, speed bumps, packaging, binders, mud flaps and mats		
4 LDPE	**LDPE** Low density Polyethylene **LLDPE** Linear low density Polyethylene	Soft, flexible, waxy surface, translucent, softens at 80°C, scratches easily	**Cling wrap**, rubbish bags, squeeze bottles, black irrigation tube, black mulch film, rubbish bins, **shrink wrap**	Rubbish bin liners, pallet sheets, slip sheets		
5 PP	**PP** Polypropylene	Hard but still flexible, waxy surface, softens at 145°C, translucent, withstands solvents, versatile	**Dip pottles** and ice cream tubs, potato chip bags, straws, microwave dishes, kettles, garden furniture, lunch boxes, blue packing tape, **automotive parts**	Pegs, bins, pipes, pallet sheets, oil funnels, car battery cases, trays		
6 PS	**PS** Polystyrene	Clear, glassy, rigid, brittle, opaque, semi-tough, softens at 95°C. Affected by fats and solvents	CD cases, plastic cutlery, imitation 'crystal glassware', low cost brittle toys, video cases, **water station cup, safety helmets**	Coat hangers, coasters, white ware components, stationery trays and accessories		
6 EPS	**EPS** Expanded Polystyrene	Foamed, light weight, energy absorbing, heat insulating	Foamed polystyrene hot drink cups, hamburger take-away clamshells, **foamed meat trays**, protective packaging for fragile items, insulation, **insulation panels**	Car parts, concrete aggregate, plastic timber		
7 OTHER	**OTHER** Letters below indicate ISO code for plastic type including SAN (styrene, acrylonitrile), ABS (Acrylonitrile butadiene styrene), PC (polycarbonate), Nylon, degradable plastic e.g. PLA	Includes all other resins, multi materials (e.g. laminates) and degradable plastics. Properties dependent on plastic or combination of plastics	**Packaging**, car parts, appliance parts, **computers**, electronics, water cooler bottles, medical devices,	Car parts, concrete aggregate, plastic timber		

PLASTICS NEW ZEALAND

SCION forests · products · innovation

Recycling

- BioHDPE and BioPET bottles

SCION
forests · products · innovation

up to 30% plant-based plastic
(PET)

up to 100% plant-based plastic
(HDPE)

plantbottle®

Still a 100% recyclable bottle

redesigned plastic, recyclable as ever

Recycling - PLA

- Chemical recycling easy.
- Optical sorting works.
- Separation an issue at MRFs.
- Low volumes in use.

biocor.org

SCION
forests · products · innovation

Definitions

- Biodegradability
  - The ability of organic substances to be broken down by micro-organisms in the presence of oxygen (aerobic) to CO_2, water , biomass and mineral salts or any other elements that are present (mineralization). Alternatively, the breakdown of organic substances by micro-organisms without the presence of oxygen (anaerobic) to CO_2, methane, water and biomass.

- Composting
  - The aerobic and thermophilic degradation of organic matter to make compost.
  - Compost must be non-toxic and support plant life.

– AS 4736-2006

SCION
forests · products · innovation

Composting

- Enriches soils
- Reduces fertiliser and water use
- Can remediate soil
- Keeps organics out of landfill

Ideal disposal route for food contaminated compostable bioplastics

SCION
forests · products · innovation

False Claims

MISLEADING CLAIM

Bags challenged

A PLASTIC bag manufacturer has been accused of being misleading over the biodegradability of its product.

The Australian Competition & Consumer Commission has started legal proceedings against Goody Environment Pty Ltd and Nupak Australia Pty Ltd relating to the Australian Standard for toxic or hazardous substances.

Adelaide Advertiser 8 July 2010

'Biodegradable' plastic bags may not be as eco-friendly as thought

"Biodegradable" plastic bags used by major supermarkets do not break down as quickly as believed and may not be as environmentally-friendly as they sound, according to Government-funded research.

The Telegraph 11 March 2010

SCION
forests · products · innovation

Composting Standards

- ISO 14855
- ASTM 6400
- EN13432
- AS 4736

SCION
forests · products · innovation

Example Standards

- **EN 13432**
  - 90% biodegradation of materials within 180 days.: determined by measuring the actual metabolic conversion of the compostable material into carbon dioxide.
  - Disintegrability: fragmentation and loss of visibility in the final compost (absence of visual contamination). After 3 months in compost less than 10% by weight shall be bigger than 2mm.
  - Low levels of heavy metals (below predefined maximum values), and absence of negative effects on the quality of compost.
  - Plant growth test.

- **ASTM 6400**
  - 60% biodegradation within 180 days,

- All within commercial composting conditions.

SCION
forests · products · innovation

AS 4736 – Key Aspects

- The presence of heavy metals and other toxic and hazardous substances shall be determined and recorded.
- AS 4736-2006 is based is ISO 14855 which outlines the appropriate methods for determining aerobic biodegradability.
- Maximum of 6 months / material shall degrade at least 90% w/w (dry weight) in total or of the maximum degradation of a suitable reference substance.
- Disintegration in AS 4736-2006 is defined as the physical falling apart into minute fragments of the test material: must disintegrate by over 90% into fragments < 2 mm in size in a 12 week pilot-scale composter under aerobic conditions.
- Compost Quality and Ecotoxicology : Plants and Earthworms

Certification and Logos

グリーンプラ®

COMPOSTABLE
Biodegradable
Produces Institute
COMPOSTING COUNCIL

compostable

compostable
AS4736
Licence # XXXX

Bioplastics organisations

- USA

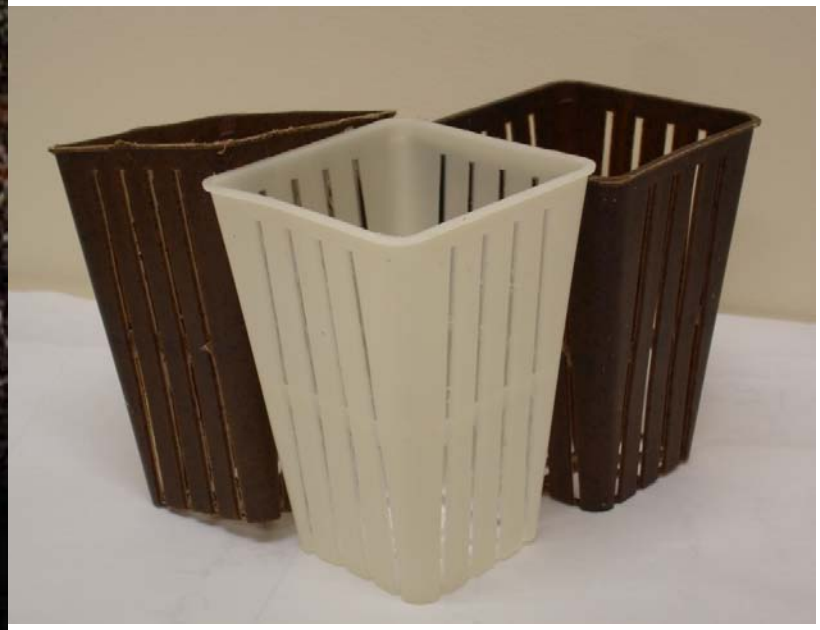
- Japan

- Europe

- Australia/
  New Zealand

SCION
forests · products · innovation

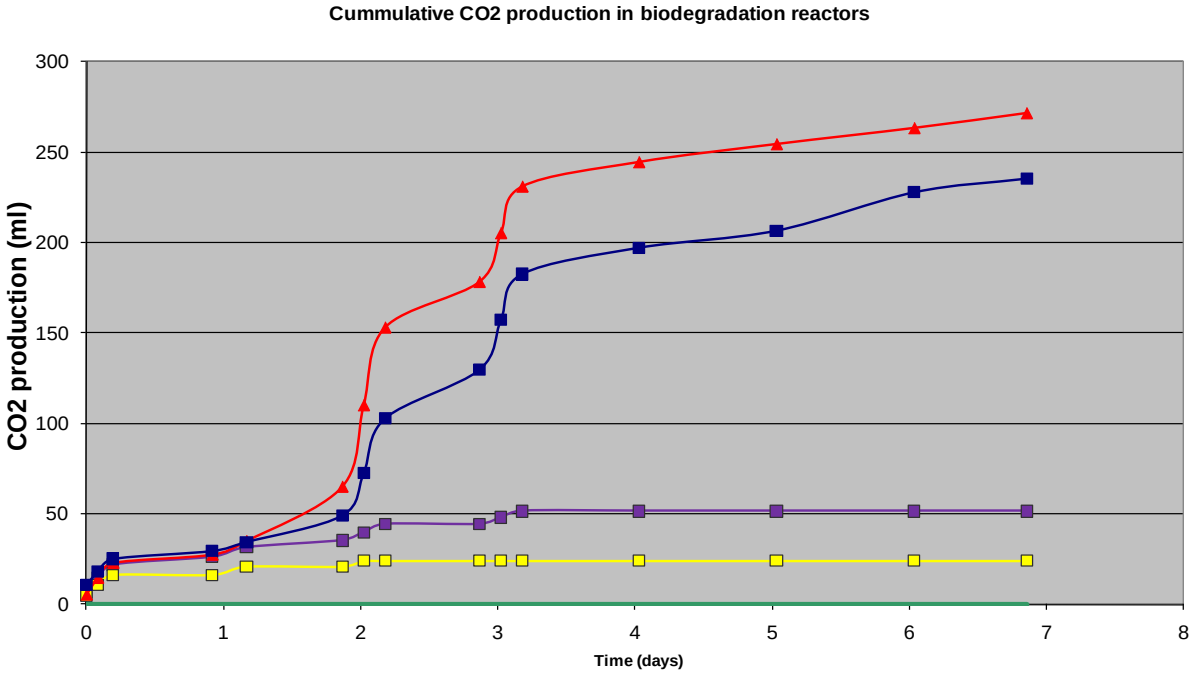
How long do these take to breakdown?

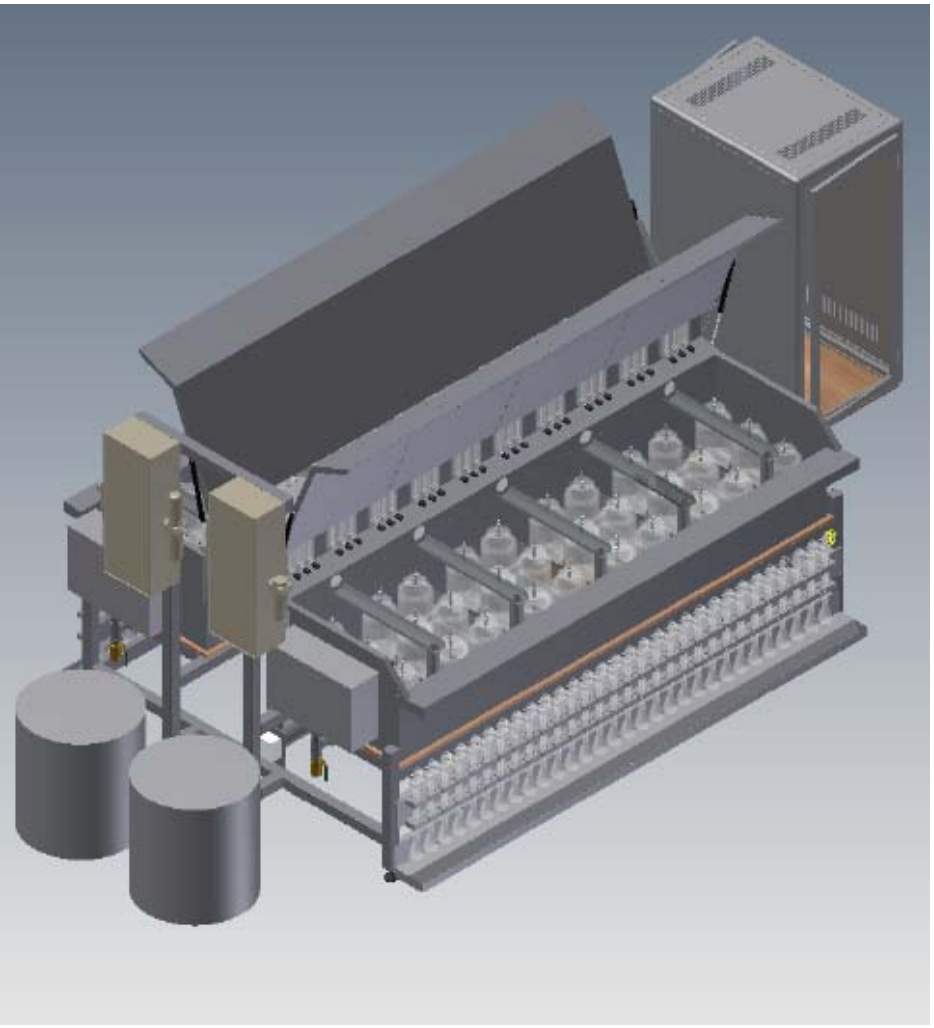


SCION
forests · products · innovation

Scion's new facility

- Designed to measure the composting of bioplastics under ISO 14855 conditions.
- 17 samples in triplicate


Cummulative CO2 production in biodegradation reactors
CO2 production (ml)
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
Time (days)



- Biodegradation measured by CO_2 output.
- Product development tool.
- Can study the degradation of almost any material in a range of environments.

SCION
forests · products · innovation

Summary

- Recycling – a viable end of life solution for bioplastics.
- Composting is an extra option for some bioplastics
- Composting – Ideal for food contaminated compostable bioplastics.
- Standards and logos exist to ensure compostability.

- Scion has a new test facility for compostable materials.

SCION
forests · products · innovation