Reducing Plastic Waste

Emily Pollitt

The introduction of plastic

1862
First manmade plastic

1907
First synthetic lab made plastic: 'Bakelite'

1946
Tupperware

Today:
- 300 million tonnes produced annually
- 50 % is single use

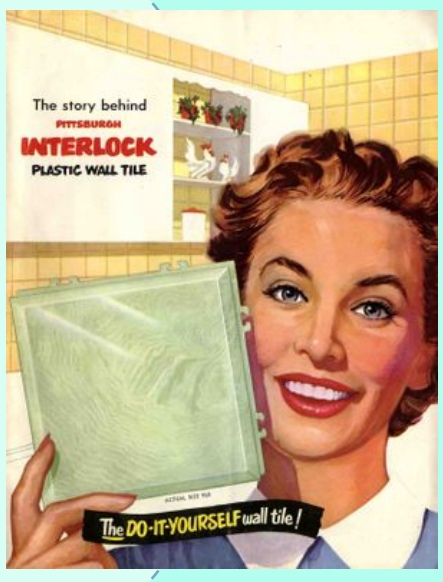
1900s
Cellophane

1939
First polythene factory in Britain

1950
The polythene bag is introduced

1950s

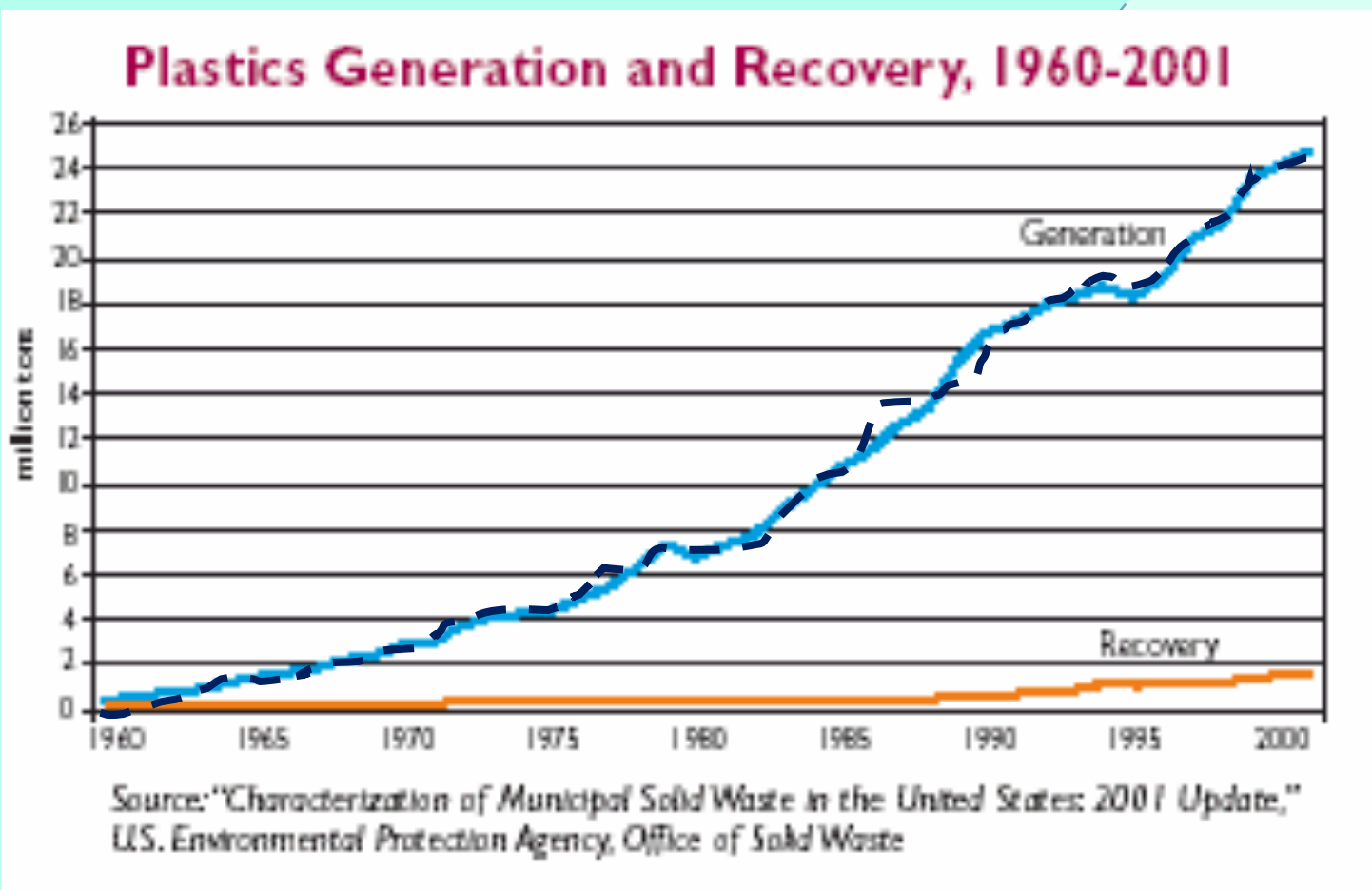
1.5 million tonnes produced annually



Today

Over 300 million tonnes produced annually

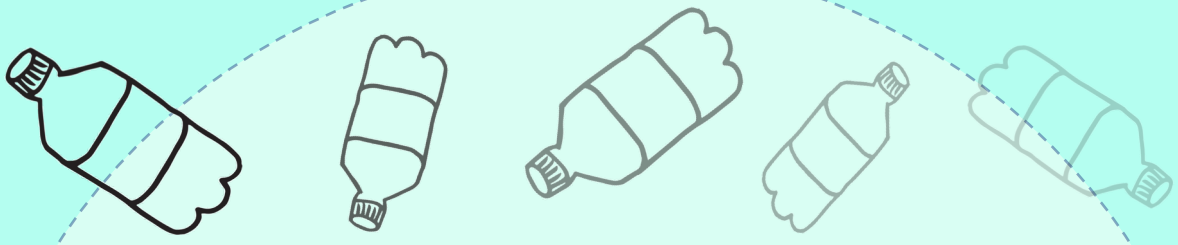
Finite Source



Liu, 2006

Petroleum is a **non- renewable resource** with diminishing quantities

Plastic : the problem



BENEFITS

- Persistence
- Strength
- Longevity
- Flexibility
- Low cost

DISADVANTAGES

= High environmental footprint

- Finite source
- Toxic waste release

Animals

People

The environment

Single use plastics : Avoidable plastics

50 % of plastic produced is for single use plastics

- Not easily recycled
- Not biodegradable
- Breaks down into hazardous chemicals
- Or finds its way into ecosystems….
- Doesn’t break down in water = entanglement or ingestion

Hopewell *et al.*, 2009

Packaging

40 % of plastic usage is in **packaging**

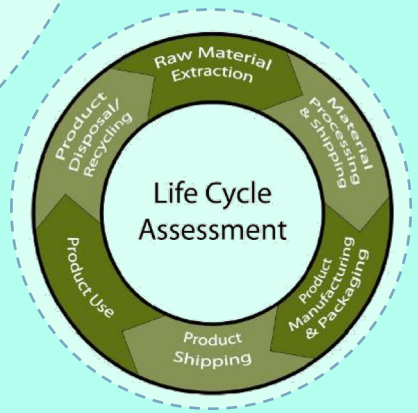
Al-Salem *et* al., 2009

Unnecessary packaging…

Packaging

Barlow & Morgan, 2013, Wikstrom *et al.*, 2013

- Certain foods require packaging
  (e.g. cheese and meat)
- Wastage of these foods would give **higher environmental implications** than the packaging produced for it
- **Avoiding food wastage is a critical packaging issue**



End of Life…Current disposal methods

Recycling

Incineration

Landfill

However…

Landfill

- 'Convenient'
- Space restraints
- Leaching of chemicals and toxins
- Negatively impact wildlife and the environment

Recycling

- Can relieve pressures to landfill, reduce Co2 emissions and use of fossil fuels
- **30%** of plastic packaging may never be eligible for recycling
- Combined plastic types hard to separate and recycle

Incineration

- Can relieve pressures to landfill
- Can create energy from burning waste
- Expensive
- Dangerous : can release hazardous substances to atmosphere

Ellen MacArthur Foundation, 2017 Chidambarampadmavathy *et al.*, 2017

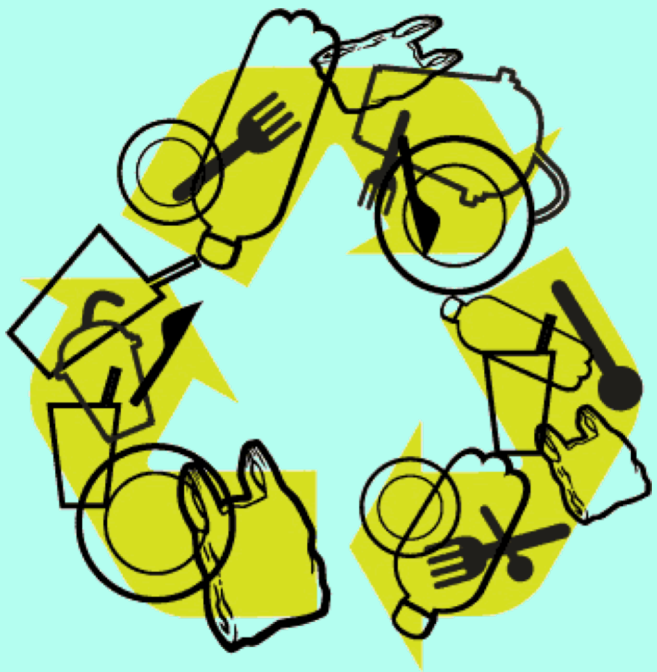
Hopewell *et al.*, 2009; Song *et al.*, 2009

Eriksson and Finnveden, 2009 Gilpin *et al,* 2003

The Solution…

While many believe a more sufficient system of waste management is needed… it is evident that the rate plastics are produced is fast overtaking finite disposal systems…

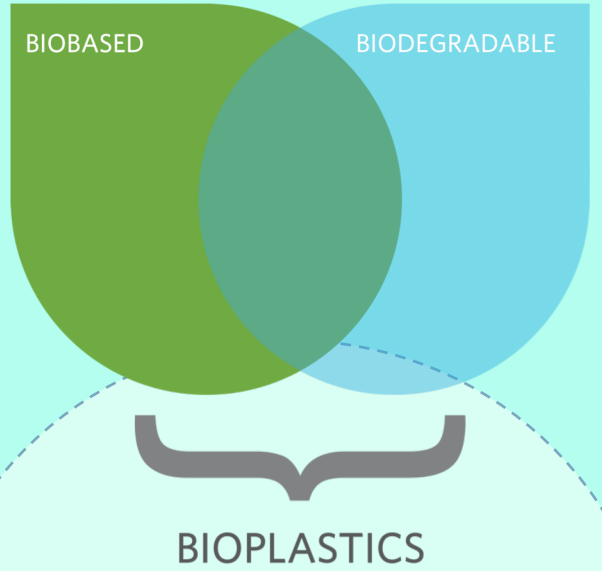
Knight, 2014



Alternatives..

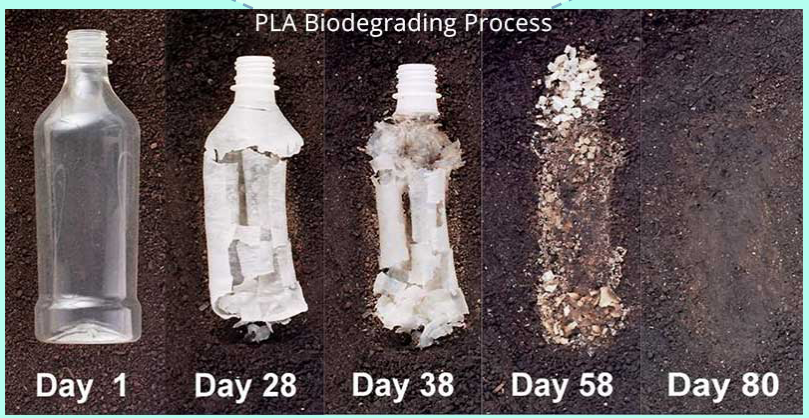
- Past 40 years, research has focused on alternatives: **renewable** materials.
- ‘**Environmentally friendly**’ plastics fall into three categories:

Woodford, 2017



Bioplastics

Biodegradable plastics



Eco/Recycled plastics

Bioplastics

- Made from natural materials (renewable biomass sources)
- Can be **biodegradable** or **non - biodegradable**

e.g.

vegetable fats

corn starch

straw

food waste

- Inclusion of additives that enable them to break down more rapidly
- No specified time restriction

Biodegradable plastics

- Plastics that can be decomposed by living organisms (such as bacteria)
- Can be **bio-based** or **petrochemical** based

Recycled plastics

- Recycle old materials into new ones
- Often lower grade items
- High energy use and emission output

e.g.

milk bottles to clothing

Outdoor furniture

Building blocks

Biodegradability: ability of organic substance to be processed through biological processing

Green Plastics, 2012

Compostability: capacity for organic material to be wholly converted through the composting process

EN 13432 standard ; AFOR, 2011

…… Confusing jargon!

Could potentially hamper public understanding, making it hard to make pro-environmental choices ☹

Woodford, 2017

Alternative and **Sustainable** materials for packaging

Potato Starch

Post consumer waste

Plant fibres

Wood

Corn Starch

Edible packaging

Alternative materials for packaging

Starch
PLAs, PHAs

Tharanathan, 2003
Cannarsi *et al*., 2005
Pei *et al*., 2011

Cellulose

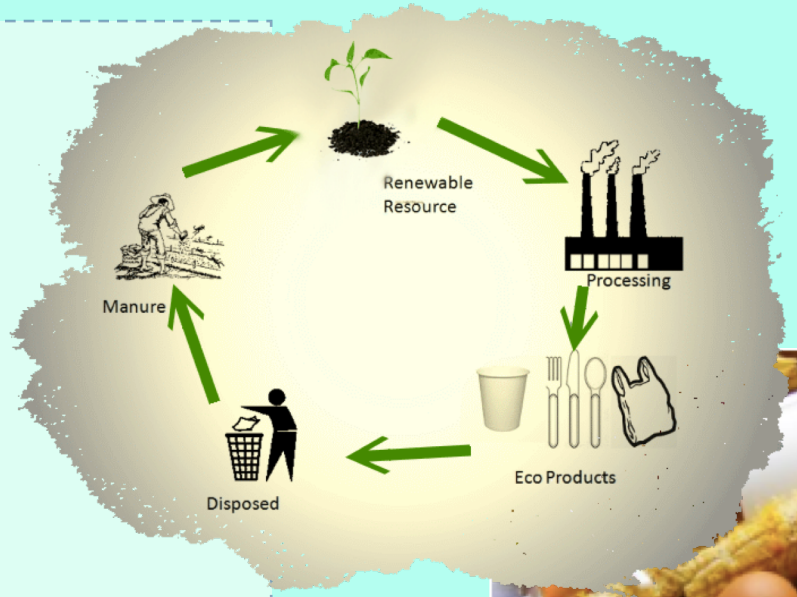
Liu, 2006; Peelman et al., 2013

Tharanathan, 2003; Hu et al., 2009

Edible packaging

Benefits and Limitations of Alternatives

- Lower environmental footprint
- Abundant
- Capitalises natural resource conservation
- Return nutrients to soil in carbon cycle



Limitations of Alternatives

- Costly
- Technology not advanced yet
- Infrastructure does not yet exist = industrial composters
- Undermine current disposal systems
- Cannot be recycled
- Monoculture croplands = intensive agriculture
- Plants used for bioplastics over food = moral dilemma

Weber, 2000; Barnes, 2002; Knight, 2014

Energy costs for Production

Bioplastics

- Use more carbon in the manufacturing process
- Release methane and other greenhouse gases in anaerobic landfill.
- currently more energy costly process
- Wont degrade in landfill – require industrial composters
- Toxic leftovers
- However, wont release toxic fumes if incinerated

Traditional petrochemicals

- Lock carbon in the plastic
- Less energy costly production
- Don’t degrade in landfill

Both petrochemical plastics and bio-based plastics use fossil fuel energy equivalents

The future?

- Long term plans seek to depend on agricultural waste (e.g. stalks and stems) for production
- Bioplastic advocates argue that in time, **energy** and **financial** costs will go down, while petroleum based plastics will fluctuate, due to unstable production and limited resources.
- Bioplastic manufacturers hold events where they will take back and compost correctly their products – e.g. sports games and events

Government policies and backing

- The plastic bag levy success
- 83% reduction of bags in 2016 to 2017 compared to 2014
- Over £66 million donated to good causes

Plastics

Plastic tax: coffee cups and food packaging could face levy

Phllip Hammond accused of delaying action after he announces consultation

Adam Vaughan *Energy correspondent*

@adamvaughan_uk

Tue 13 Mar 2018 19.23 GMT

This article is over 1 month old

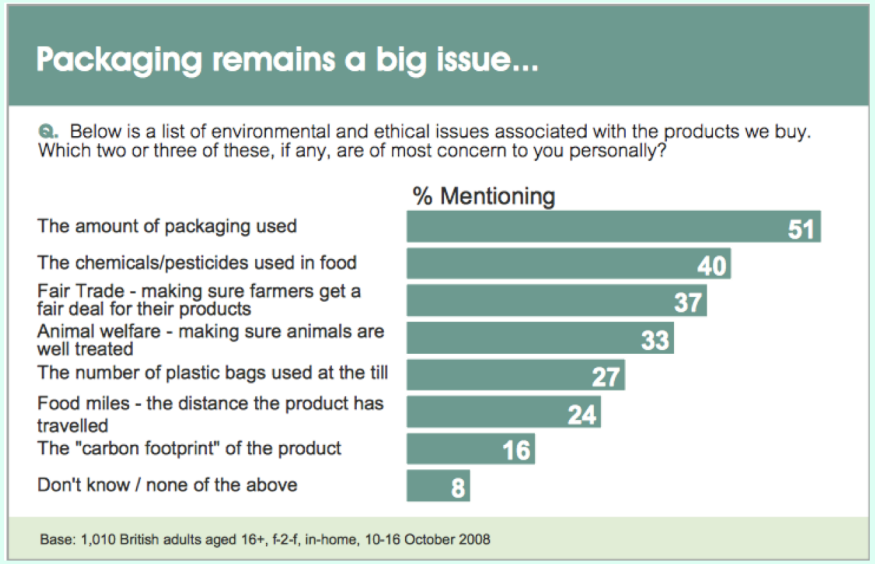
170 94

- Other levies to come into place?
- **However** latte levy refused…
- **Need more government backing**

Public attitudes

Public perception of packaging thought to be dominated by the '**end of life**' phase

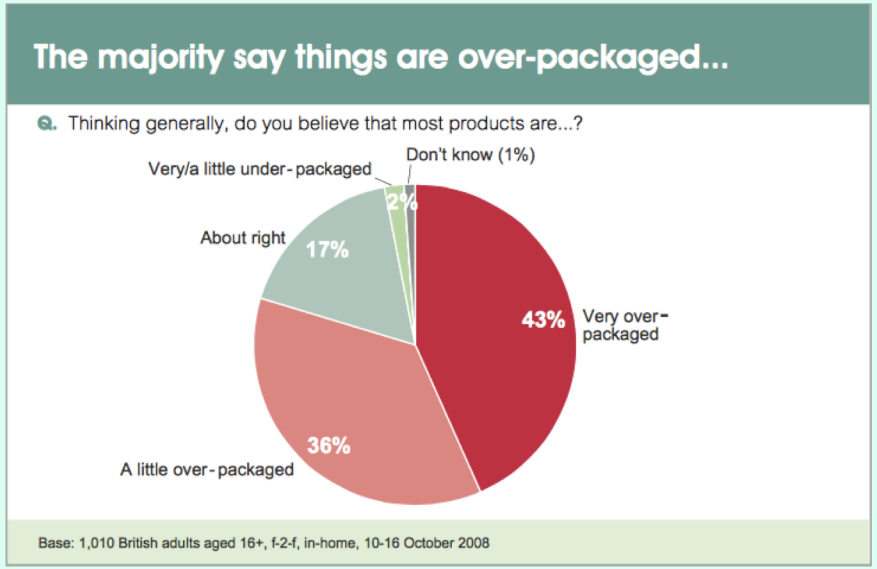
Peterson *et* al., 1999; Williams and Wisktrom, 2011



51%: the amount of packaging is an environmental issue

43% say very over packaged

But...



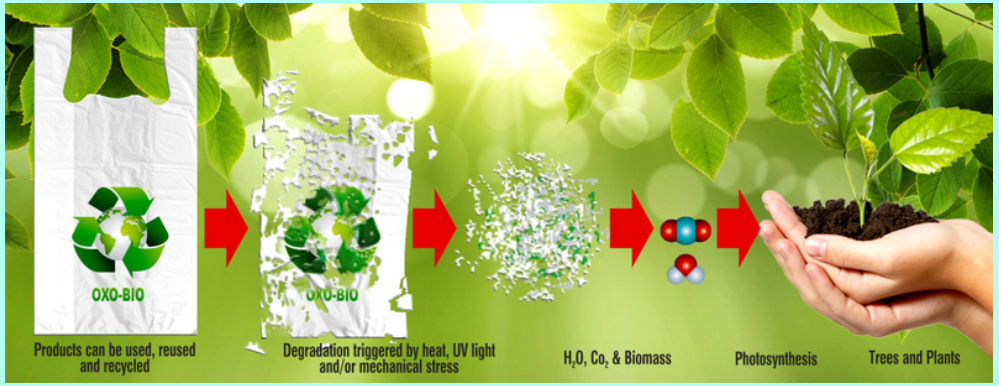
Incpen & Valpack, 2008

Consumer attitude is considered more influential to business decisions

Through this awareness consumers have increasingly targeted food companies to improve their environmental performances (Liu, 2006).

Executive Summary…

- Plastic is a large percentage of municipal waste: **packaging and single use plastics**
- Current disposal systems and resources = **fast depleting** and cause **environmental problems**



- Contemporary development **of Alterative plastics** made from **natural, renewable resources**
- However a **change in infrastructure** is also very important, as well as suitable disposal methods
- **Public and government support** is needed to efficiently make and keep these changes

However… exciting time with lots of attention and encouraging progress!