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University of Strathclyde

Optimising the Circular Economy of Beverage Packaging

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T009b.3

Current state of Beverage Packaging Industry

- Have **you** bought a single use beverage container this week?
- **Circular Economy** is the idea that you can Reduce, Reuse and Recycle the product again and again
- The aim of this project is to **promote and encourage** the optimization of circular economy of beverage packaging by comparing processes of popular material choices – PET and Al
- Create process flows and compare data

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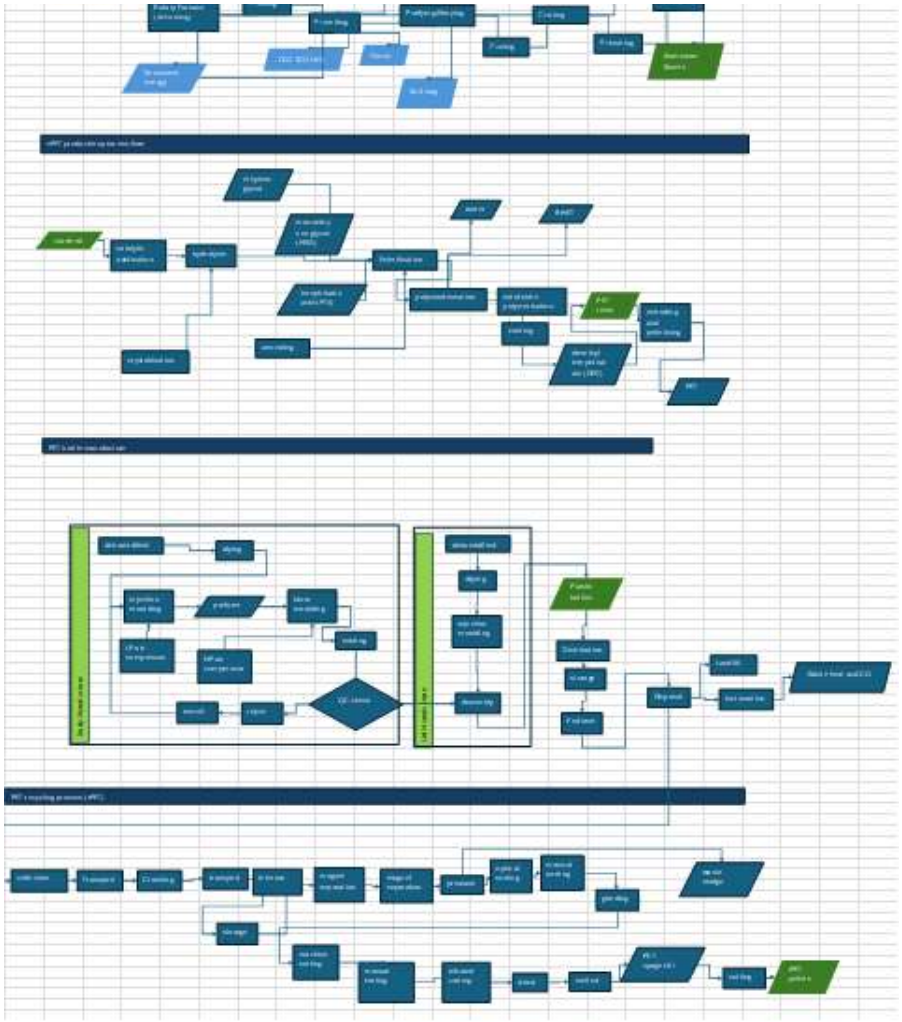

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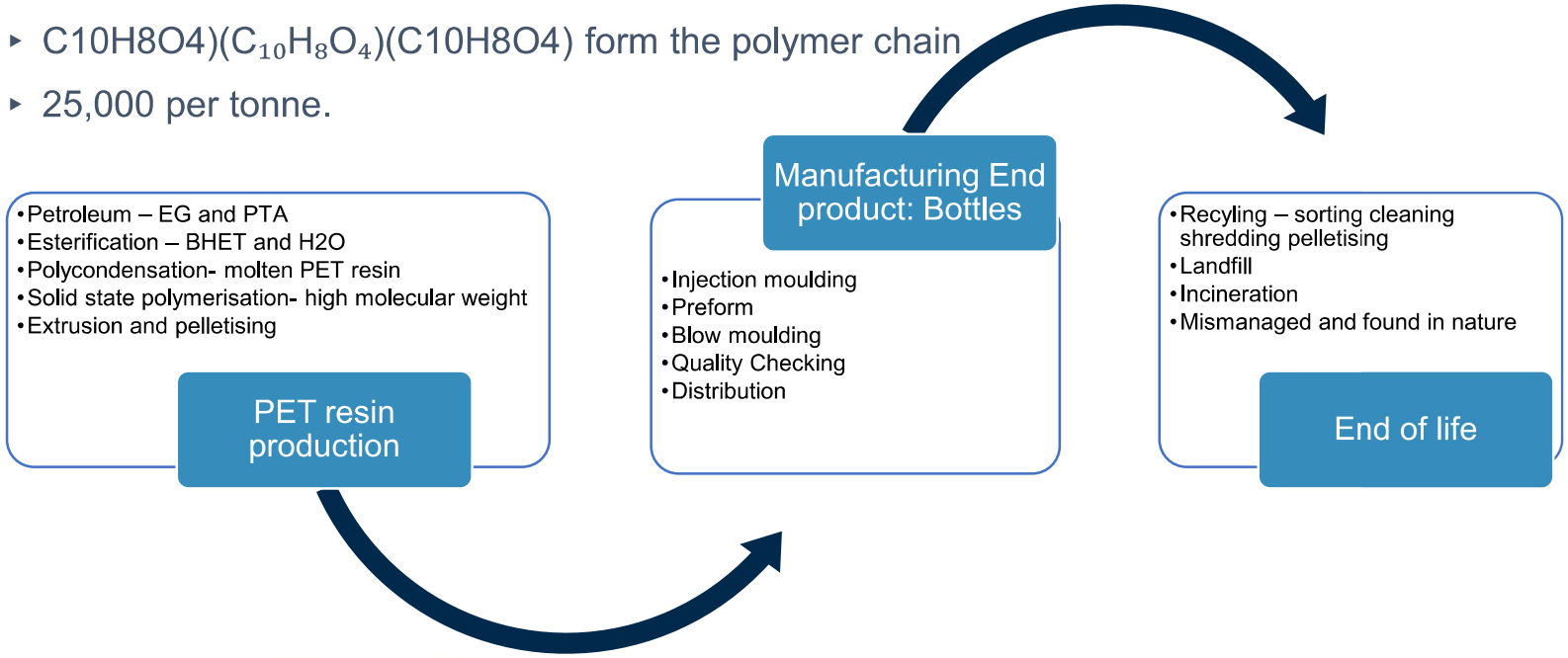
Life of a Plastic Bottle

- What is PET? thermoplastic polymer resin of the polyester family, characterized by its high strength-to-weight ratio, excellent chemical resistance
- Production consists of the Buhler process
- C10H8O4)($C_{10}H_8O_4$)(C10H8O4) form the polymer chain
- 25,000 per tonne.



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PET resin production

- Petroleum – EG and PTA
- Esterification – BHET and H2O
- Polycondensation- molten PET resin
- Solid state polymerisation- high molecular weight
- Extrusion and pelletising

Manufacturing End product: Bottles

- Injection moulding
- Preform
- Blow moulding
- Quality Checking
- Distribution

End of life

- Recyling – sorting cleaning shredding pelletising
- Landfill
- Incineration
- Mismanaged and found in nature

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Life of an Al Can

- Bauxite grinding – caustic soda
- Pressure digestion
- Clarification – red mud
- Filtering
- Precipitation – Seed separation
- Calcinating – Kiln
- Electrolysis – cryolite
- Melting - ingots

Aluminium Production

Manufacturing End product: Cans

- Rolling – Coil
- Drawing-incremental
- Necking
- Curing
- Lid - seaming

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End of life

- Aluminium is extracted from bauxite ore through the Bayer–Hall Heroult process
- Roughly 58,000 cans per tonne

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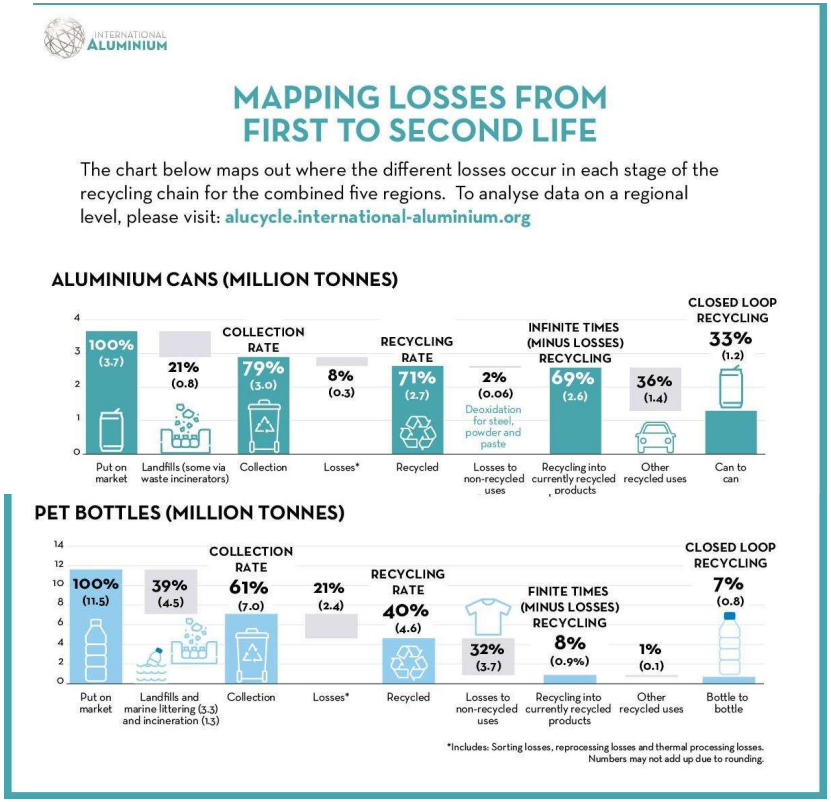
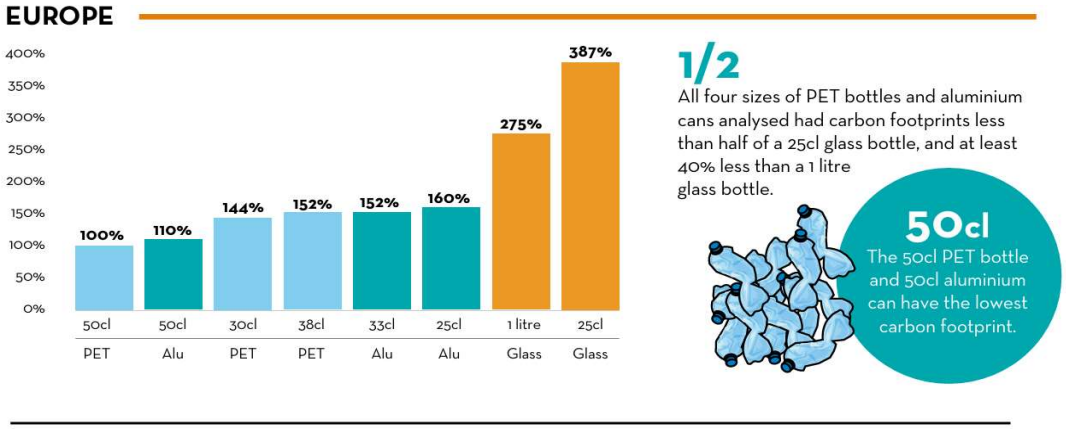
How do they compare economically and sustainably?



- Embodied Energy and Cost of Energy in the UK can be found online and in literature
- LCA results can vary depending on functional units and commonly only consider the first lifecycle
- Hazards of burning and extraction include PAHs and PM10 – carcinogenic micro-particles, ingestion, plastiglomerates while red mud ponds are toxic residue that includes radioactive elements from the process of refining bauxite.
- For both processes, the highest impacts derive from raw materials extraction and processing, followed by manufacturing



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Process	Electricity consumed (MWh/metric tonne)		Price of Electricity (GDP)	
	PET	Al	PET	Al
Primary material production from raw	23.33	15.5	1,866.40	1,240
End product manufacture	2.73	0.72	218.40	57.6
Recycling to same grade r-material	9.72	0.78	777.6	62.4
			£2862.4	£1,360

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Solutions and Conclusions

- Advanced forming involving incremental gas forming of Aluminium in theory can be investigated for cost and energy savings
- Ability to combine drawing and similar to quick plastic forming that integrates processes reducing labour, resources, time etc and maintains structural integrityand complexity
- Industry agrees that material choice has the largest environmental impact
- LCA s and data can be manipulated – difficult to come to conclusion
- PET is cheaper to buy vPET than rPET so the trend will continue if there isn't incentive for NPD
- Open – ended?

- Global Metals Network
- PetStar
- resilience industries limited
- Ampulla
- One water
- Rio Tinto
- Vedanta Aluminium
- South32
- Kaiser aluminium
- Alpek polyester
- JBF Industries
- Nan Ya Plastics
- Amcor
- Crown Holdings
- Tetra Pak
- DS Smith
- Ardagh Group
- Owens Illinois inc
- Open water
- Novelis
- Hydro Aluminium
- TRIMET Aluminium SE
- Vanden Recycling
- Evergreen
- Association of plastics recyclers
- Real Alloy
- Highland Spring
- Cano
- Wellwater company - purely scottish
- Re:water
- Altwater
- Shepleyspring
- Path

Both multimillion pound companies agree that material choice has the largest impact on the environment for companies involved with beverage packaging

Cano Water

Novelis

"*A focus on Circular material and product cycles is necessary. This is likely to be progressed through the increasing usage of Deposit Return Schemes but will ultimately need to be driven by packaging manufacturers and brands.*" – *Alupro*

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Thank you for listening!