

Micro Plastics: Global & Local Strategies for Environmental Management

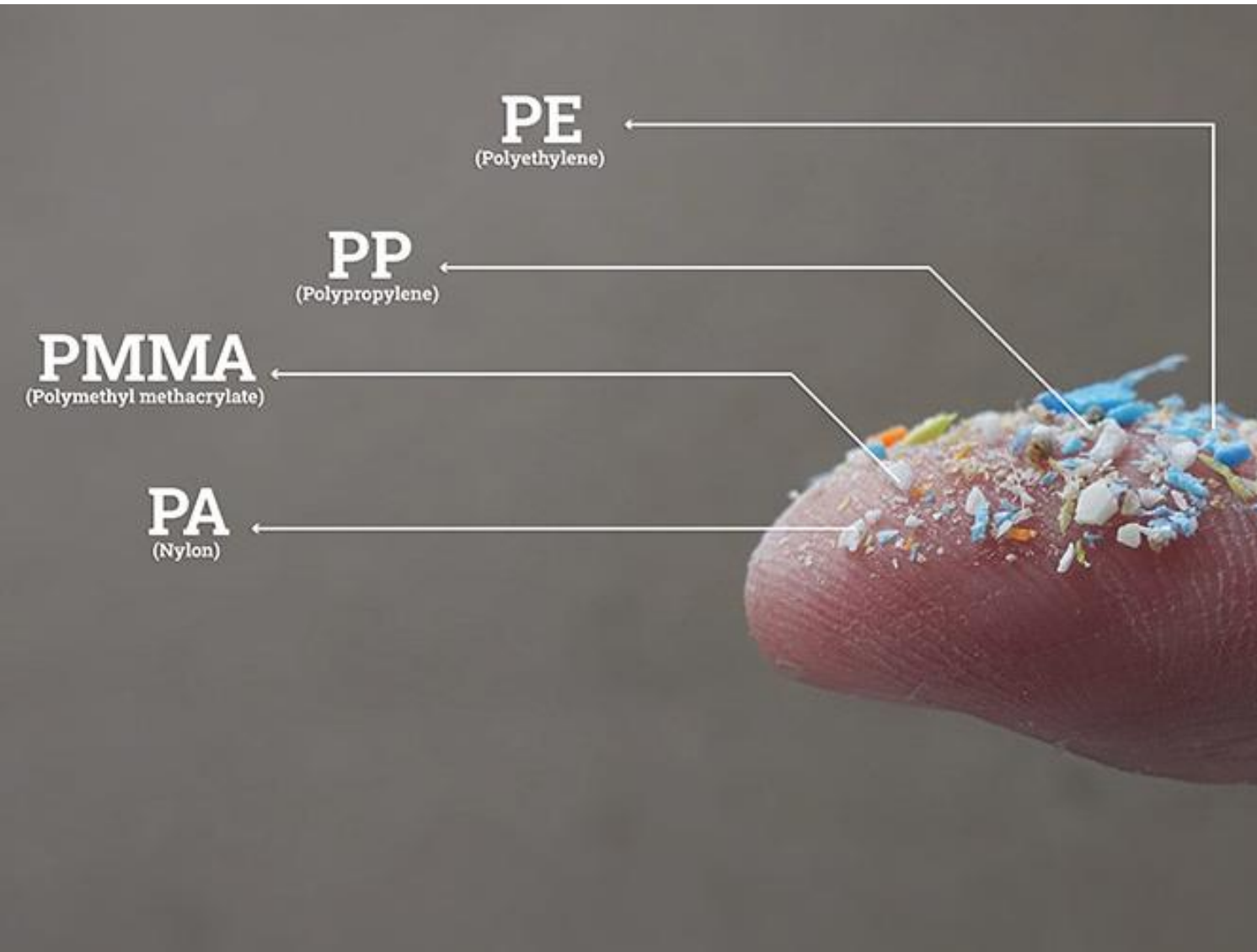
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PASSION FOR CHEMISTRY

The **M**ega Problem:



- Microplastics are in air, water, sediment, sludge and soil > End up in food chain/air/water > End up in our bodies.
- Microplastics can contain/leach toxic chemicals (BPA)
- Microplastics adsorb POP's and other CEC's
- A lot we don't know about them

Plastics Labelling

Generally, most recyclers accept plastics #1 and #2. Plastics #3 to #6 are more difficult to recycle, and some recycling centres do not process them. Plastics #7 are even more challenging to recycle and are almost always excluded.



PETE



HDPE



PVC



LDPE



PP



PS



OTHER

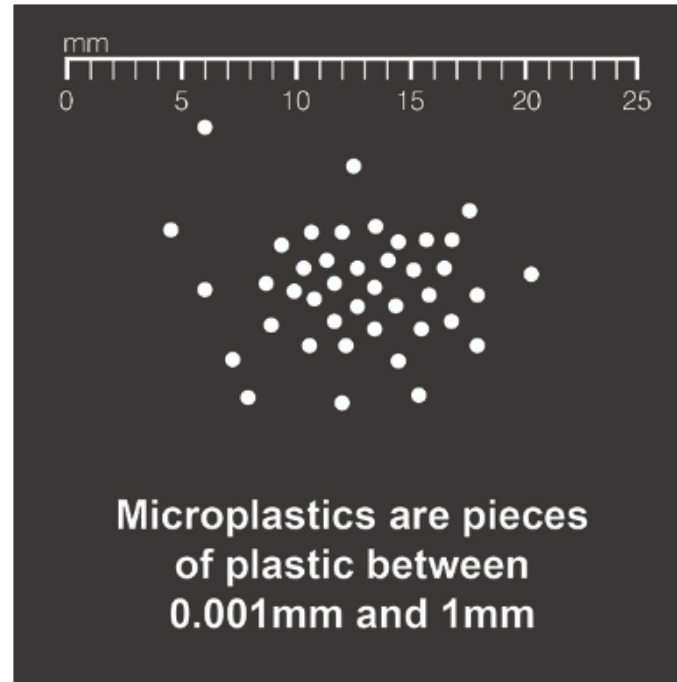
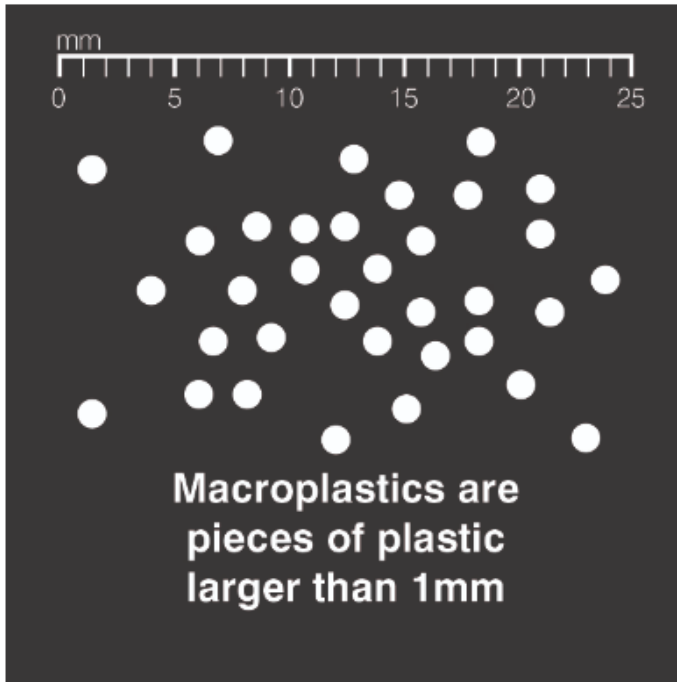
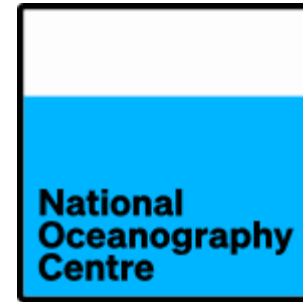


compostable

- 1 - Polyethylene Terephthalate
- 2 - High Density Polyethylene
- 3 - Polyvinyl Chloride (PVC / Vinyl)
- 4 - Low Density Polyethylene
- 5 - Polypropylene
- 6 - Polystyrene
- 7 - Polycarbonate - other plastics
- 8 - Plain - Doesn't fit elsewhere
- 9 - Plant Based

OTHER = MDPE, PU, PA, PVDF, Silicone

Info Graphic from NOC:



1 mm – 1000 Microns
Human hair = 50 microns

HOW LONG UNTIL IT'S GONE?

Estimated decomposition rates of common marine debris items



Estimated individual item timelines depend on product composition and environmental conditions.

Source: NOAA (National Oceanic and Atmospheric Administration), US / Woods Hole Sea Grant, US
Graphics: Oliver Lude / Museum für Gestaltung Zürich, ZHdK

Plasti>Centa

- In the study, [published in the journal Environment International](#) in 2021, researchers found: “the presence of potentially harmful plastic particles in the placenta is a matter of great concern... Need to assess if the presence of microplastics may trigger immune responses or may lead to the release of toxic contaminants, resulting in harm.”
- <https://www.theguardian.com/environment/2020/dec/22/microplastics-revealed-in-placentas-unborn-babies>
- <https://www.sciencedirect.com/science/article/pii/S0160412020322297>

Microplastics revealed in the placentas of unborn babies

Health impact is unknown but scientists say particles may cause long-term damage to foetuses



One charity said: 'Babies are being born pre-polluted.' Photograph: Zffoto/Getty Images/iStockphoto

Microplastic particles have been revealed in the placentas of unborn babies for the first time, which the researchers said was “a matter of great concern”.

Micro>Plastics in Breast Milk:

- <https://www.theguardian.com/environment/2022/oct/07/microplastics-human-breast-milk-first-time>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9269371/>

Microplastics found in human breast milk for the first time

Exclusive: Researchers concerned over potential health impacts of chemical contaminants on babies



📷 The breast milk samples were taken from 34 healthy mothers, a week after giving birth.
Photograph: michellegibson/Getty Images

Microplastics have been detected in human breast milk for the first time, with researchers greatly concerned over the potential health impacts on babies.

Management Strategies: Local and Global

1. **Cutting off the source** is one strategy to eliminate microplastics.
2. **Biodegradable alternatives:** cotton, hemp, flax, jute, wool, silk) are one possible solution. Switzerland is a world leader in so called Eko-Tex textiles/certification. Bio-polymers is another one. Biodegradable/compostable plastic bags are already out there.
3. **Zero waste** supermarkets can eliminate plastics food/drink packaging. They already exist in countries like Germany/UK where all food is bought/sold in re-usable packaging.
4. The **top three polluters** of the oceans when it comes to micro plastics are poor/developing Asian countries that cannot afford proper waste management/ wastewater treatment. Poverty elimination/Infrastructure Development should be part of the strategy.



Solutions For Developed Countries

1. Installing Ultra or Micro filters on washing machines can help. Silt traps should be part of road run off treatment strategies.
2. Car Tyres are a source of PM in the air and water as tyre wear ends up in the air as dust or in the rivers from road run off. Better tyres are needed.
3. Plastics Recycling is good and bad: it diverts plastics waste from landfill but in itself generates wastewater and consumes a lot of chemicals/energy.
4. Energy from Waste is another dirty form of waste valorisation. Incinerating plastic waste should be the last option.
5. Chemical recycling is also another strategy – turning plastic waste back into its building blocks through pyrolysis. But it costs a lot of energy.



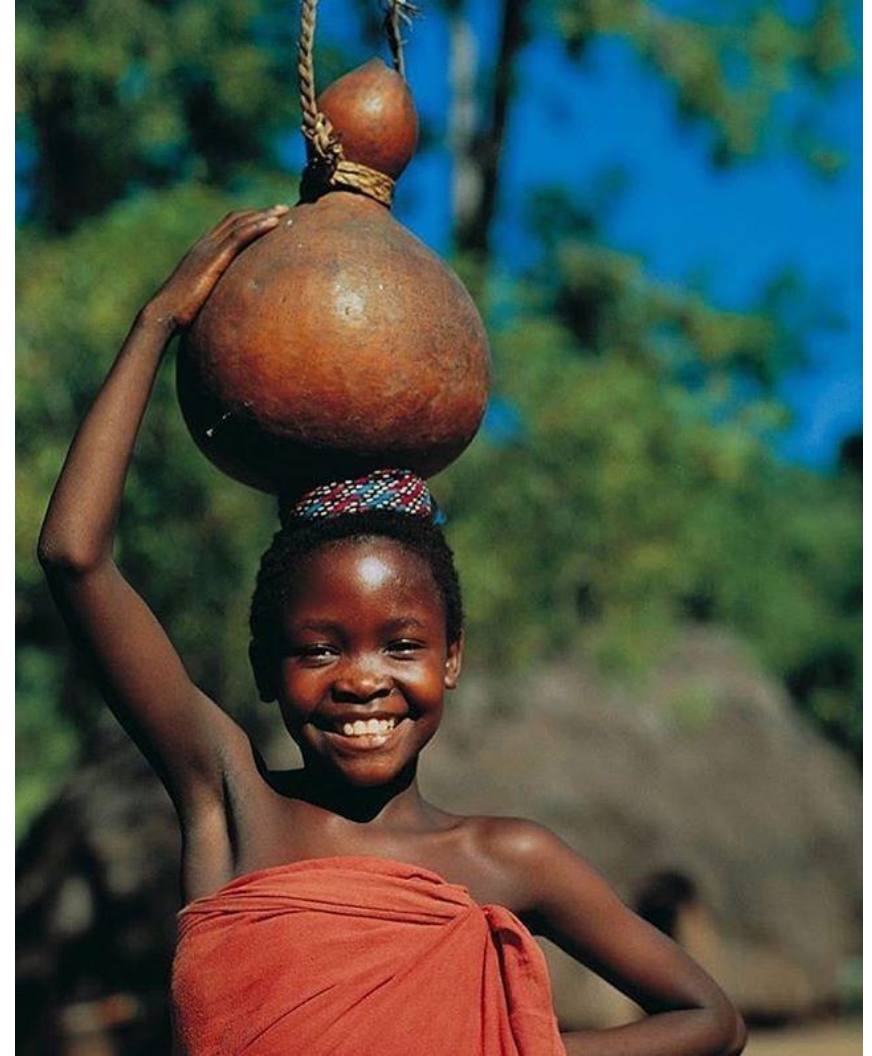
Solutions For Developed Countries

1. Micro beads in some cosmetic products and toothpastes are being slowly phased out which is good news.
2. All consumer electronics are also a source of plastics and some of them are non-recyclable.
3. Some Carpets are composite materials and very difficult to recycle.
4. Car panels/bumpers are usually non-recyclable
5. Childrens Toys, Food Packaging > make wood toys/paper and cardboard packaging
6. Upgrade Sewage Treatment/Recovery Plants



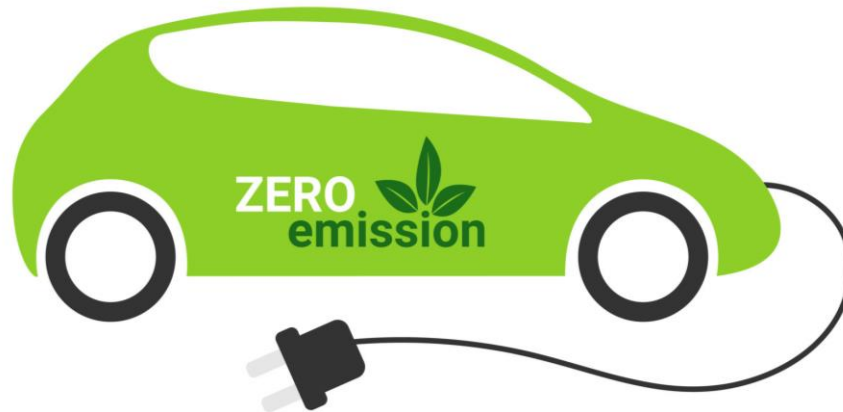
Solutions for Developing Countries

- Don't imitate the West or North !
- Valorise resources
- Keep it simple and natural
- Decentralize
- Think Differently
- Be Proud
- Be Happy
- Awareness/Governance/Bureaucracy
- More Data? More stories?



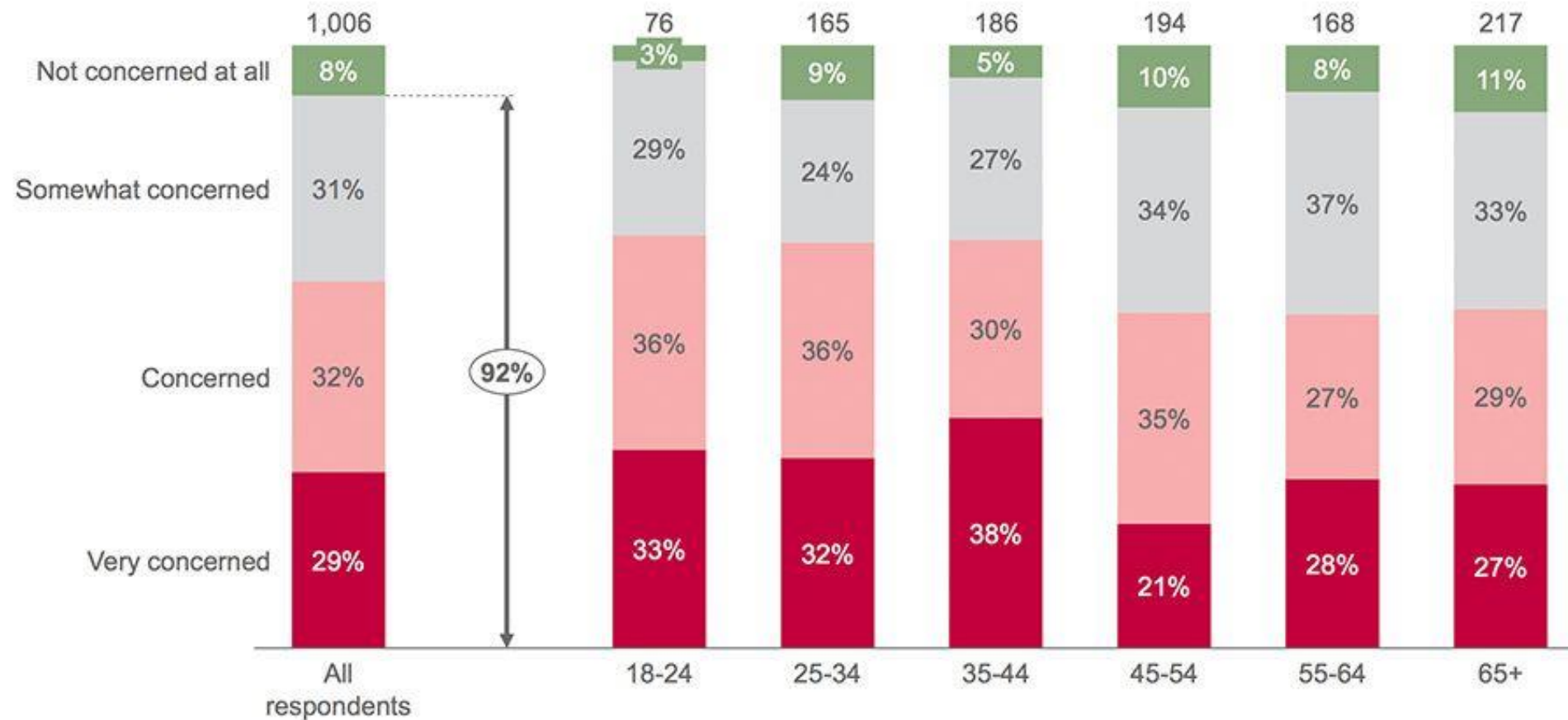
Consumer Awareness/Trends

- Consumer awareness about environmental issues is increasing
- Demand for environmentally friendly alternatives is increasing pressure on suppliers/producers to come up with innovative alternatives
- Eco labels are almost on everything.



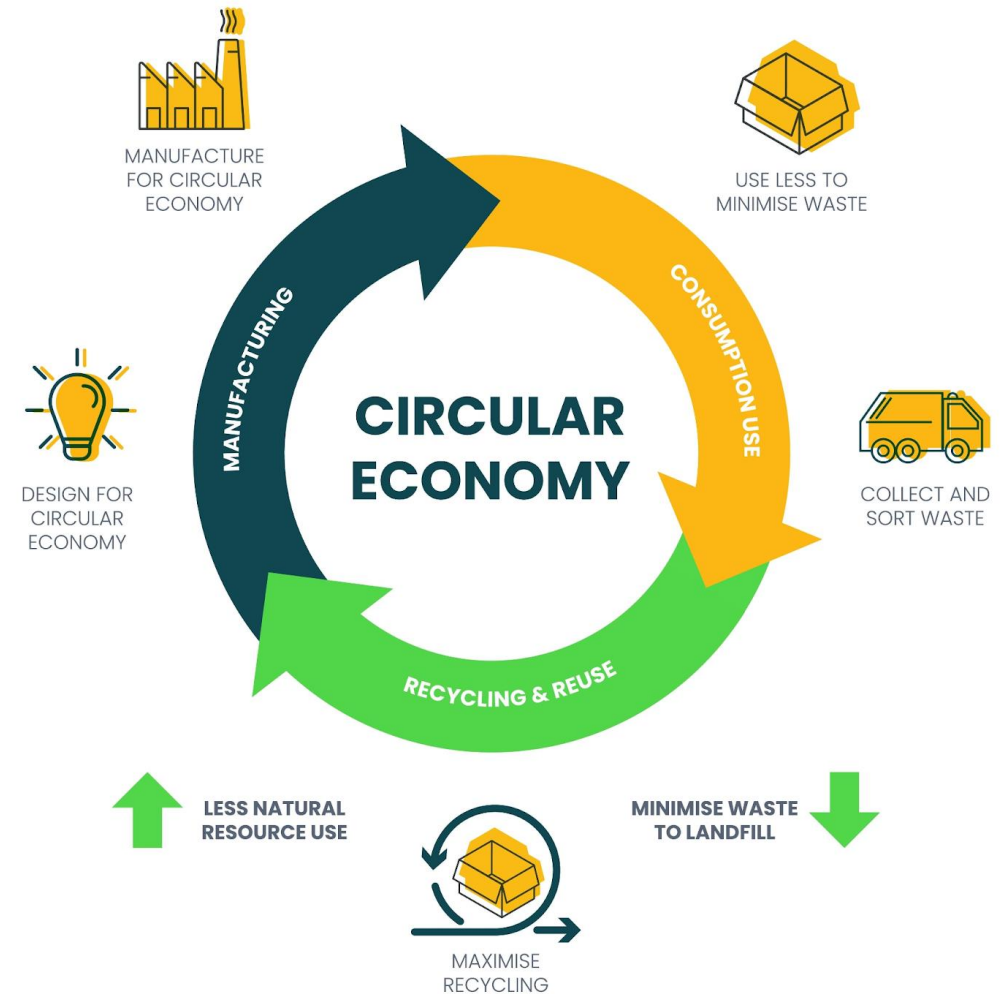
Consumer Awareness Trends:

UK ENVIRONMENTAL SUSTAINABILITY: ENVIRONMENTAL CONCERN



Circular “O” Economy

- Plastic parts can be manufactured so that they are modular with Right to Repair designs that eliminate waste.
- Plastics can be recycled chemically using Pyrolysis, but it requires energy.
- Caveat: Due to the law of entropy, plastics cannot be recycled indefinitely (Georgescu-Roegen)
- As the Hydrogen economy catches on, we can synthesize monomers from H₂ and CO₂.



Circular economy introduction

[Overview](#)[Key ideas](#)[Case studies](#)[Glossary](#)

Explore the circular economy by topic



Biodiversity and the circular economy

This topic area examines how the circular economy can help shape a nature-positive future.



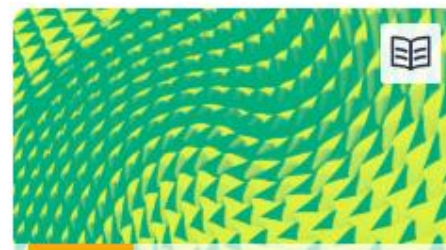
Built environment and the circular economy

In a circular economy our built environment can be a force for good



Cities and the circular economy

This topic area looks at the role cities play in the transition to a circular economy.



Design and the circular economy

Design is a force for change. From innovative products or disruptive business models to entire...



Climate and the circular economy

This topic area looks at how fixing the economy can help fix climate change.



Fashion and the circular economy

This topic area explores how the circular economy works for the fashion industry.



Finance and the circular economy

This topic area looks at the role of the financial sector in the shift to a circular economy.



Food and the circular economy

This topic area shows how moving to a circular economy for food will help people and nature thrive.



Plastics and the circular economy

This topic area shows how the circular economy can help keep plastic in the economy and out of the...



Government and policy for a circular economy

The circular economy provides a framework which allows governments and cities to realise many of...

Sustainable Goods?

- Bioplastics and Bio-polymers are becoming more and more prominent
- Waste is a commodity
- Nature has **no waste** it recycles everything
- Cardboard plates and wood cutlery
- Biofuel/Biodiesel



Biodegradation by Mushrooms/Plastic Eating Worms

Some edible mushrooms can biodegrade plastics >>>



<<< Larvae of the darkling beetle can survive on a diet of plastic, pointing to new methods of processing the planet's tide of garbage.

Plastics that can't/difficult to be recycled

- Crisp packets aka Metallized film (plastic coated with Aluminium)
- Chocolate wrappers (Metallized film)
- Salad bags (Low-density polyethylene LDPE)
- Film lids (Metallized film)
- CD and DVD cases.
- Fruit netting.
- Polystyrene/PVC/Poly Carbonate
- Disposable razors (hybrid of polypropylene, polystyrene, and phenylene oxide, also known as PPO.)
- Cling film/Blister Packaging (PVC or PVDC)
- Composite Plastic Materials



Other Solutions/Success Stories

1. Turning CO₂ gas from power station/Oil and Gas emitting plants into something useful is the Holy Grail of chemical engineers. Of course, trees do this beautifully, but the process is slow and requires land/time.
2. Metal Organic Frameworks are a potentially emerging game changer in CO₂ capture/valorisation. Startups like NovoMOF are already in the commercial market. BASF is also looking into MOF's. A MOF could potentially be invented that can turn CO₂ into a bio-polymer. Some MOF's could potentially replace expensive catalysts in the oil and gas industry.
3. Treating the oceans using robots is one proposed solution but obviously limited by the sheer volume of the oceans.
4. A true minimalist decentralized model of living is another strategy which however conflicts with growth-based economic models. Subsistence organic farming – Leo Tolstoy
5. Small success stories: plastic straws have been eliminated in the UK and replaced almost ubiquitously with paper bio-degradable/recyclable straws.
6. Waste fabric/textiles are being recycled/upcycled.
7. Upcycling/Repair fad

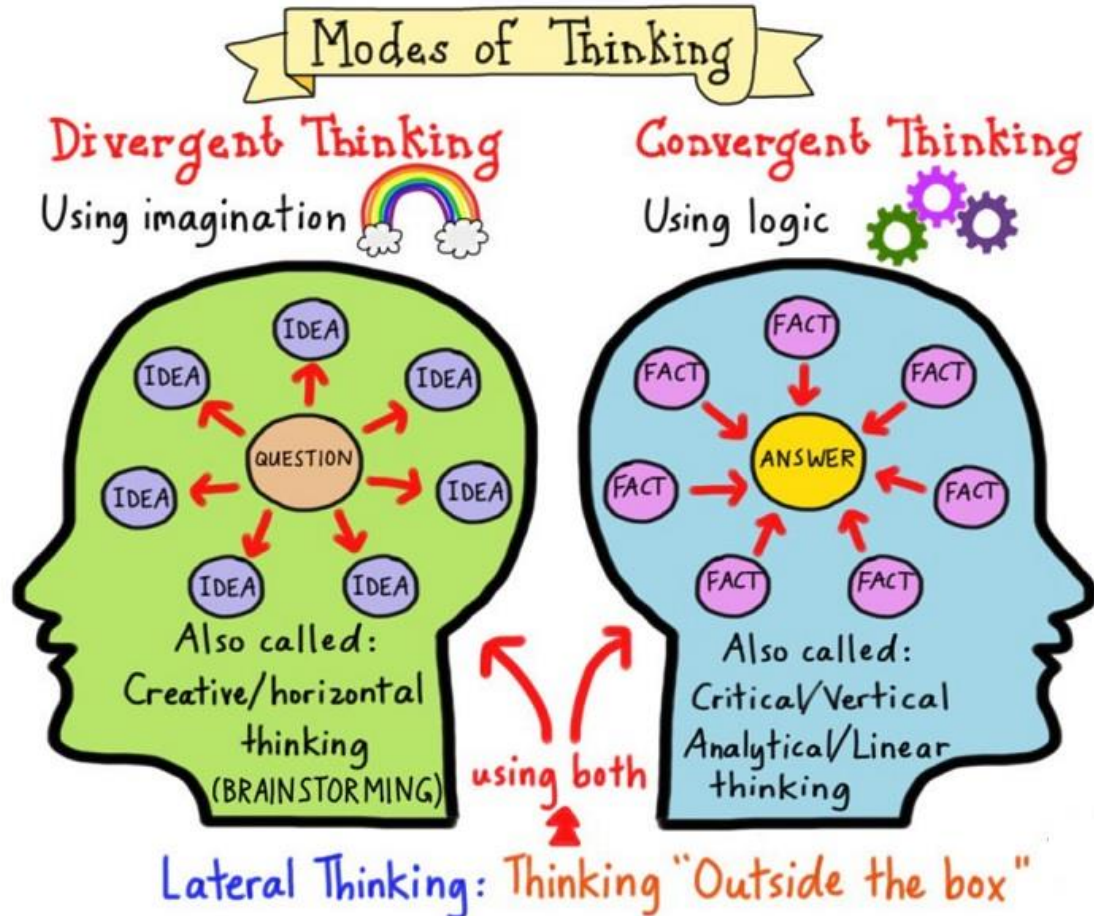


Inner Pollution: Engineering vs Poetry

“The pollution of the planet is only an outward reflection of an inner psychic pollution: millions of unconscious individuals not taking responsibility for their inner space.”

— Eckhart Tolle, [The Power of Now: A Guide to Spiritual Enlightenment](#)

Different Modes of Thinking



A Bit of History – Cause for Cautious Optimism

In 1977, Commercial production of [PCBs](#) ended because of its toxic health effects.

In 1987 The [Montreal](#) Protocol was signed, ultimately enforcing the regulation of nearly one hundred [ozone](#)-depleting chemicals as well as [Acid rain](#) producing emissions.

[Leaded](#) gas was banned in 1996, but exposure to the poison cost people born before that date several IQ points on average, researchers estimated.

[Greenhouse](#) gas emissions were found to be rising faster than ever in 2006.

In 2009, perfluoro-octane sulfonic acid and its derivatives ([#PFOS](#)) were included in the international [Stockholm Convention](#) to eliminate their use.

2016 was the hottest year in history due to [GHG](#) emissions... Also [microplastics](#) were discovered in human placentas and breast milk around the same time...

Cause for cautious [optimism](#) or should we expect more bad news in 2026?

The Fifth Industrial Revolution (5IR/Y2Q)

The Fifth Industrial Revolution:

Smart Materials?

Clean Energy?

Clean-up The Environment

Quantum Computing

Bespoke Medicine

Happiness Index

Green Cities/World Peace



References/Further Reading

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- <https://edition.cnn.com/2024/03/06/health/nanoplastics-heart-attack-study-wellness/index.html>
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- <https://www.bloomberg.com/news/articles/2022-06-09/plastic-eating-superworms-could-fight-world-s-garbage-crisis>

Author Mini Biography

Rami Elias Kremesti is a UK CIWEM chartered water treatment specialist and environmentalist. He has a Master's degree in chemistry from the USA. Rami has worked in the water treatment field for over 18 years and has travelled the world. He is the author of three books on philosophical topics, his other passion. Proud father of two teenage girls, he loves to cook, play guitar and never stops reading and seeking new ideas and experiences.

