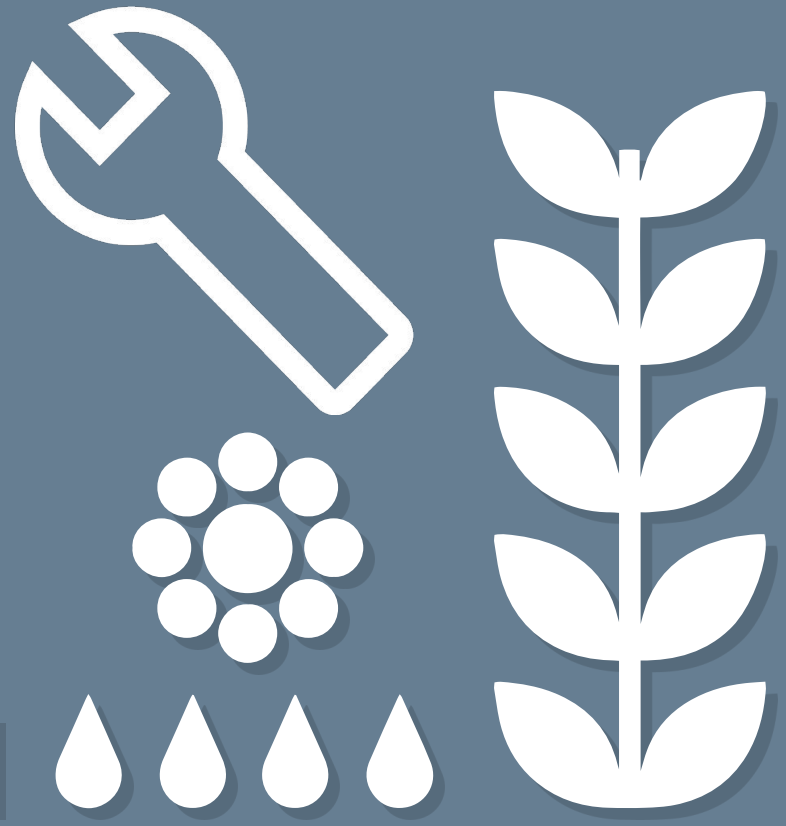
Waste is a Design Flaw

ENGR 1501 FALL 2023 - Week 4



Attendance

We launched Glass Half Full in a backyard...

where we began collecting and hand-crushing our friends' glass with no real expectation for what this project would become. As word spread, participation and support grew, and soon we obtained the resources to move to a location uptown. After quickly running out of storage space (a good problem to have, in our opinion!), our supporters rallied to help us expand into a new processing facility on Louisa St, where we would have the ability to scale up our operations and accept more glass. From there, it was history– we are now backed by a growing team of staff, volunteers, and community members who pitch in daily to divert tens of thousands of pounds of glass from NOLA's landfills every single week.

Distributing our sustainable, recycled glass sand.

Finally, we allocate the sand and cullet for a myriad of applications. From coastal restoration and disaster relief to flooring and new glass products, we work to creatively integrate our recycled materials into every day life.

The possibilites for recycled glass sand are truly endless!

Today's Agenda

1. WHERE CAN E-WASTE GO
2. WHERE DOES E-WASTE GOES
3. E-WASTE RECYCLING
4. DESIGNING OUT E-WASTE

Course Objectives

- Learn how waste creation is designed into our linear economy
- Understand engineering frameworks for designing “out” waste and designing with waste
- Explore what main components make up electronics and how to work them
- Create a Circular Engineering outline for an E-waste product

How your e-waste is currently disposed of/recycled

Research and describe what happens to your e-waste when it is discarded?
How can a consumer recycle your e-waste?

E-waste lifecycle

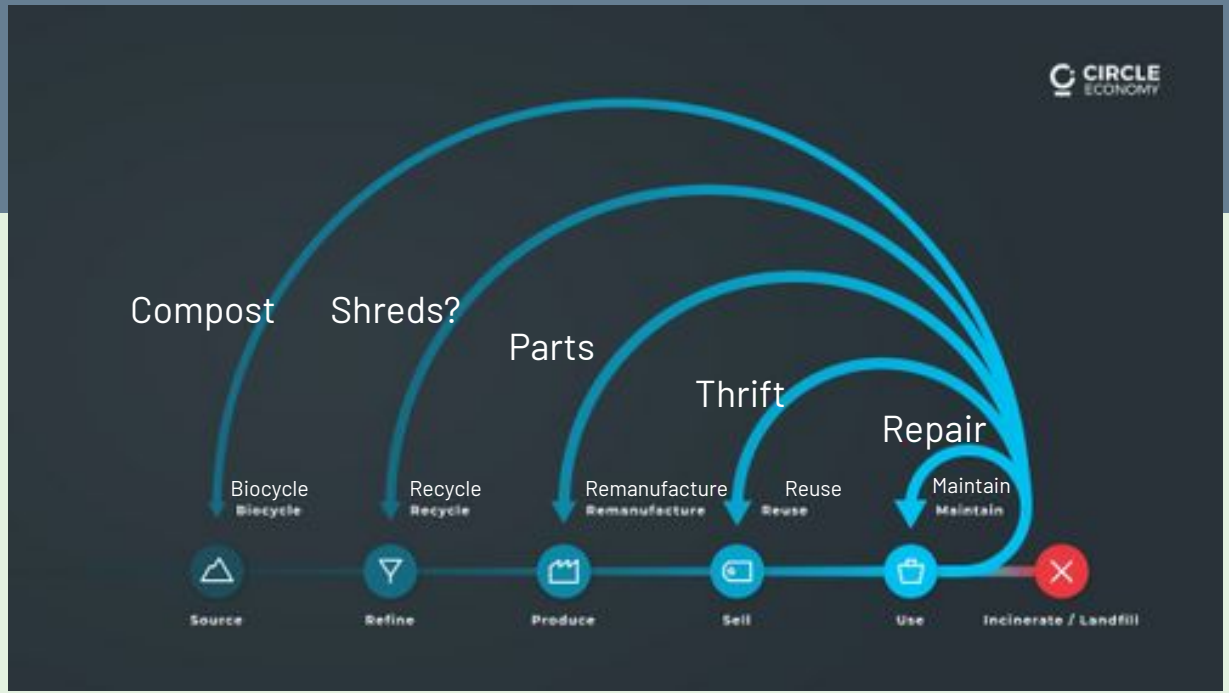
1. When a device becomes waste
2. How a device becomes waste
3. **Available waste streams**

Review: E-waste lifecycle

When DOES a device become waste?

CIRCULAR ECONOMY

Common Language for reintegration process



Where can E-waste Go

- Repaired
- Resold
- Unused
- Recycled
- Trashed

How can you recycle E-waste?

- Drop off
  - Bestbuy, Staples, Manufacturer, Rivanna E-waste days
- Donate
  - Goodwill “recycles” unsold electronics
- DIY

E-waste Path

How Can I Recycle My Old Electronics?

There are a number of recycling opportunities, depending on where you live.

Donating your equipment to second-hand stores or thrift stores is a popular choice since you're not just recycling your e-waste but you're also helping other people who may not be able to afford new electronics.

If your e-waste is broken and unusable, you can track down your nearest BestBuy or electronic waste disposal center. For management of e-waste in San Francisco, I Got E-Waste offers convenient pick-up services that are fast and simple. I Got E-Waste accepts a wide-variety of recycled items that are processed and dealt with responsibly and effectively.

Sound awesome?

Where E-waste Goes. But what happens (bestbuy)

The products are removed from our stores, consolidated, and then delivered directly to one of our contracted recycling partners. From there, the recyclers determine if the product can be repaired, repurposed or recycled. To ensure all products collected for recycling through Best Buy are handled and processed responsibly, we partner directly with qualified and respected recycling companies. The recyclers recover ozone-depleting chemicals and other waste streams from discarded refrigerators and freezers. PCBs, mercury, used oil, refrigerants and insulating foam are properly dealt with through the best environmental practices available. Using various technologies, our recyclers dismantle the units, separating out the commodities (metals, plastics, glass, etc.). The recyclers ensure the reclaimed commodities are recycled and repurposed into new products.

How do we measure success in recycling?

With 50 million tons of e-waste thrown away each year, we make it easy and convenient to repurpose all of your old tech. In fact, we've collected 2.7 billion pounds of electronics and appliances for recycling since 2009, making us the largest retail collector of e-waste in the United States.

Mar 20, 2023

What is a goal of E-waste recycling?

How would you measure the success of this goal?

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Mar 20, 2023

Best Buy's e-cycle program is ambitious, successful and financially unsustainable

Where does collected e-waste go? (Where should it go)

https://www.rivanna.org/ewaste/

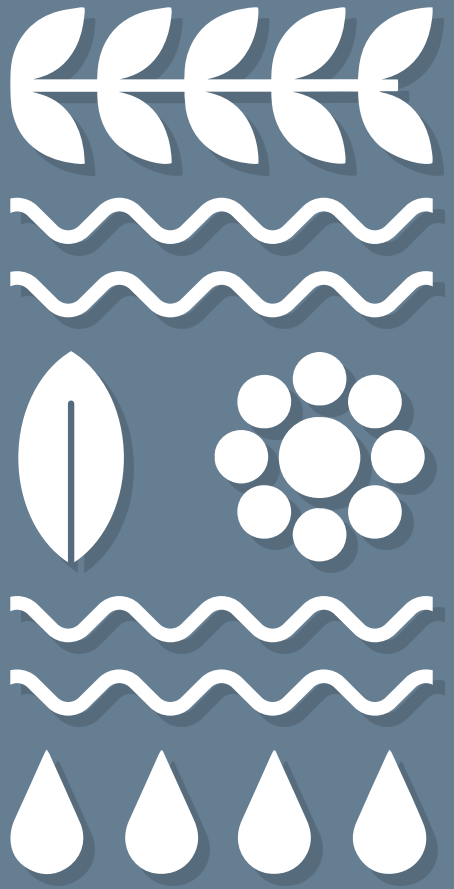
E-waste collection centers have limited days with heavy limits.

http://sustainableit.virginia.edu/Resources/E-WasteOverview

UVA sends our E-waste to North Carolina recycling centers, once all information from computers has been wiped.

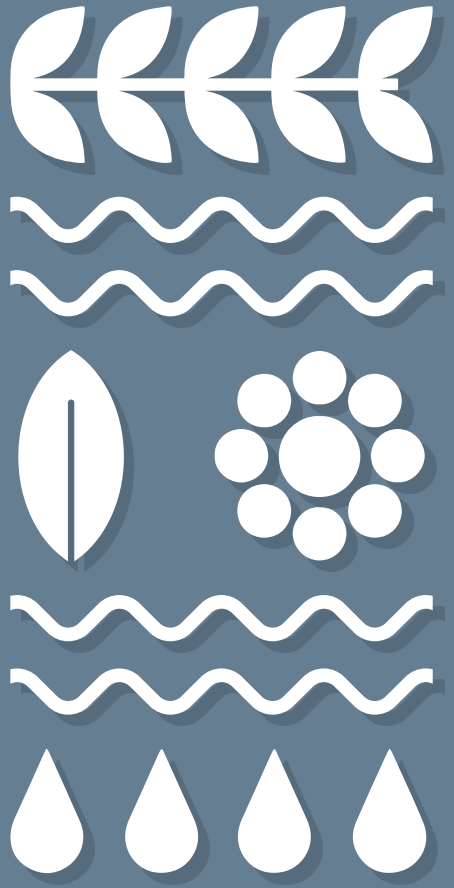
E-waste -> Collection -> De-sensitized ->Recycling centers -> ???

Sadly,
At present, some 50% to 80% of e-waste collected by recyclers is “exported.”



1. EPA: An undetermined amount of used electronics is shipped from the United States and other developed countries to developing countries that lack the capacity to reject imports or to handle these materials appropriately. Without proper standards and enforcement, improper practices may result in public health and environmental concerns, even in countries where processing facilities exist.

2. **The United Nations estimates that 10-40% of the US's e-waste is exported,** even though there are international laws forbidding the transnational movement of electronic wastes.

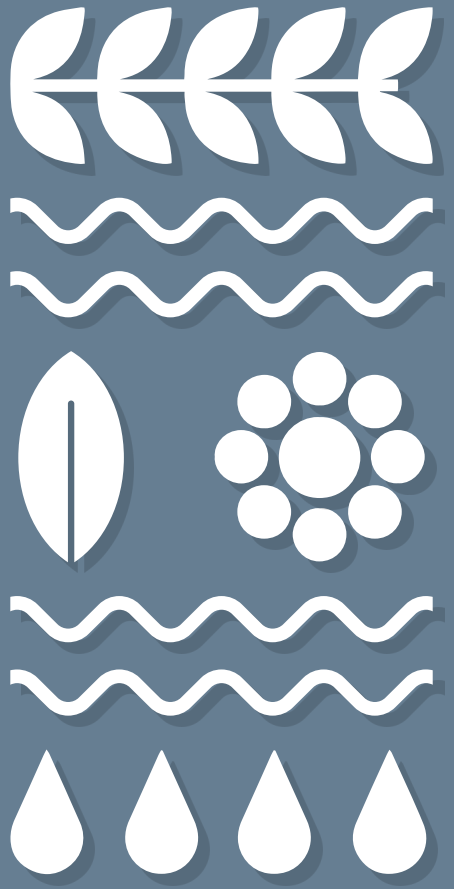



TRACKING DISCARDED ELECTRONICS
Courtesy: Basel Action Network
& MIT Senseable City Lab

He teams up with a Chinese journalist and translator, Dongxia Su, and a local driver, who will help navigate the region. They follow a set of GPS coordinates for one of the tracked electronics. Paved streets become rutted dirt roads. They pass a steady stream of trucks carrying shipping containers from the port.

Inside, workers are dismantling LCD TVs. The ground at their feet is littered with broken white tubes. These fluorescent lamps were made to light up flat-screens. When they break they release invisible mercury vapor. Even a minuscule amount of mercury can be a neurotoxin.

Many U.S. consumers got their first glimpse of what happens to their discarded electronics in Puckett's 2001 film "**Exporting Harm: The High-Tech Trashing of Asia**." It captured the crude recycling methods taking place in Guiyu, a cluster of villages in southeastern China that has since become known as the world's biggest graveyard for America's electronic junk.



Why is Electronic Recycling difficult?

What happens to properly collected E-waste:

Currently E-waste is:

Pitfalls of recycling e-waste

What issues do you see with this process?

Shredding

- Motors, gears, rollers, cases, buttons, LEDs, resistors, capacitors, transistors, screens, all WASTED

What is a benefit of this process?

To process the large amount of material received, most of it is shredded, losing almost all of its value.

What base materials are in electronics?

What base components are in electronics?

What specialized components are in electronics?

How do we salvage each?

Then what do we do with the salvage?

Recycling Intro for materials

Metal recycling: Can be repeated endlessly with no degradation of material properties. Involves sorting, melting, skimming

At the turn of the twentieth century, Elmore writes, soft-drink and brewing companies sold beverages in glass bottles that could be used repeatedly. Customers returned their empties to retail stores, sometimes in exchange for the return of a one- or two-cent deposit. While some bottles inevitably got broken, a 1948 study found that about 96 percent of soda bottles ended up back at their manufacturers.

3D printing as the process of recycling and 3D printing are very similar. What issues do you see for plastic recycling?

Stopping E-waste at the Start

So far we have looked at how E-waste is a design flaw

How so?

By designing products with sustainable foundations, we can eliminate waste.

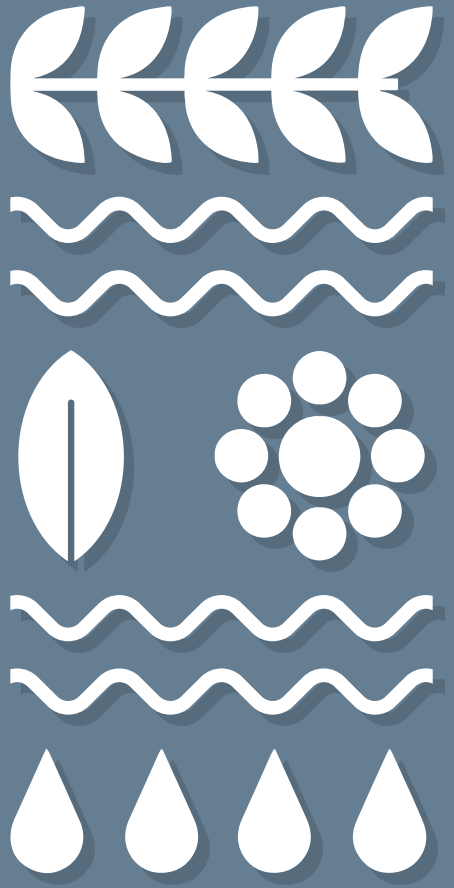
How would you design a sustainable electronic?

(Opposite of how e-waste is designed)

How do you envision how your product can be reused/refurbished rather than recycled in this “grinding” technique?

What limits do you see?

How could you see your product redesigned so it is more easily repaired, reused, recycled?



Thought for the class:

"There is no such thing as 'away'. When we throw anything away it must go somewhere."
– Annie Leonard, Proponent of Sustainability

Recommended Media:
Precious Plastics (amazing website and social media on plastic recycling)

The 12 Principles of Green Engineering

Principle 1: Designers need to strive to ensure that all material and energy inputs and outputs are as inherently nonhazardous as possible.

Principle 2: It is better to prevent waste than to treat or clean up waste after it is formed.

Principle 3: Separation and purification operations should be designed to minimize energy consumption and materials use.

Principle 4: Products, processes, and systems should be designed to maximize mass, energy, space, and time efficiency.

Principle 5: Products, processes, and systems should be "output pulled" rather than "input pushed" through the use of energy and materials.

Principle 6: Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse, or beneficial disposition.

Principle 7: Targeted durability, not immortality, should be a design goal.

Principle 8: Design for unnecessary capacity or capability (e.g., "one size fits all") solutions should be considered a design flaw.

Principle 9: Material diversity in multicomponent products should be minimized to promote disassembly and value retention.

Principle 10: Design of products, processes, and systems must include integration and interconnectivity with available energy and materials flows.

Principle 11: Products, processes, and systems should be designed for performance in a commercial "afterlife".

Principle 12: Material and energy inputs should be renewable rather than depleting.

Through *the* 12 Principles GREEN *Engineering*

Let's make a memorable summary phrase/word for each principle so they can be easily referenced

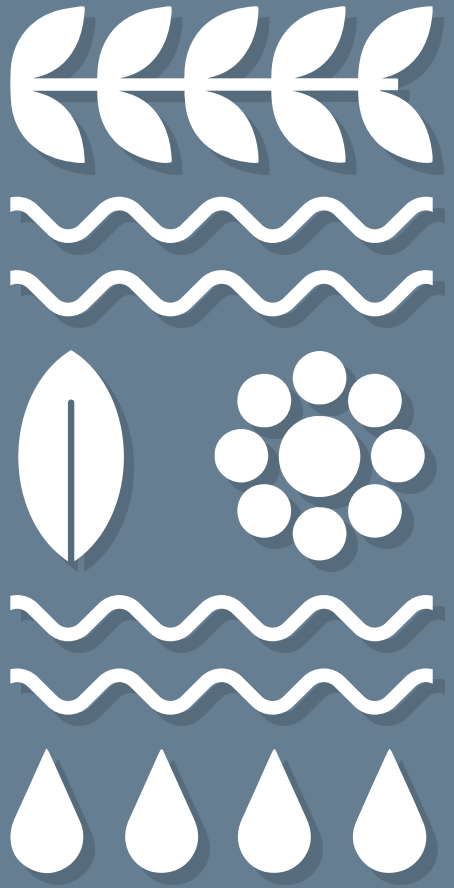
We will also go through any questions you all have on the principles for how to implement and what they mean.

We will be testing Miro for this, so please go to the announcements page on Collab

That means each year we waste 90 billion tons of resources. This also means that we create 90 billion tons of potential resources.

The current dominant economy is linear in its processes: it takes resources, makes goods, and quickly wastes them.

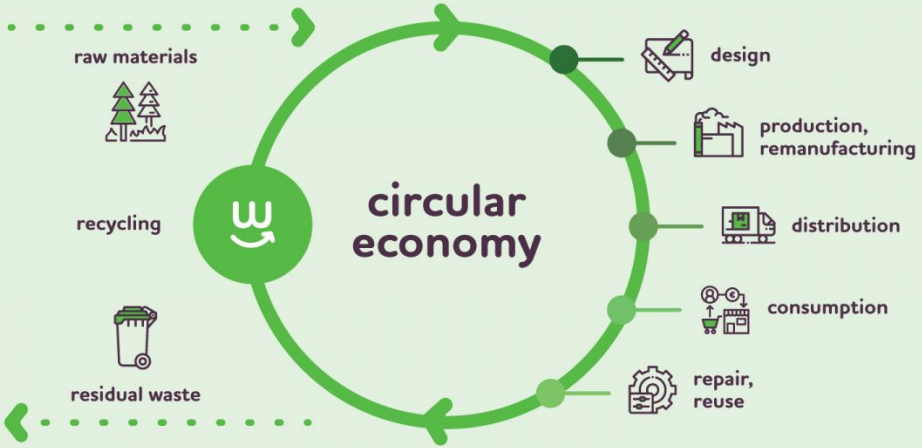
-CIRCLE REPORT, 2021



Appendix Slides

CIRCLE ECONOMY

The circular economy is an economic system where waste is designed out, everything is used at its highest possible value for as long as possible and natural systems are regenerated.



These 2 will be our main focus

USE **WASTE** AS A RESOURCE

Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling.

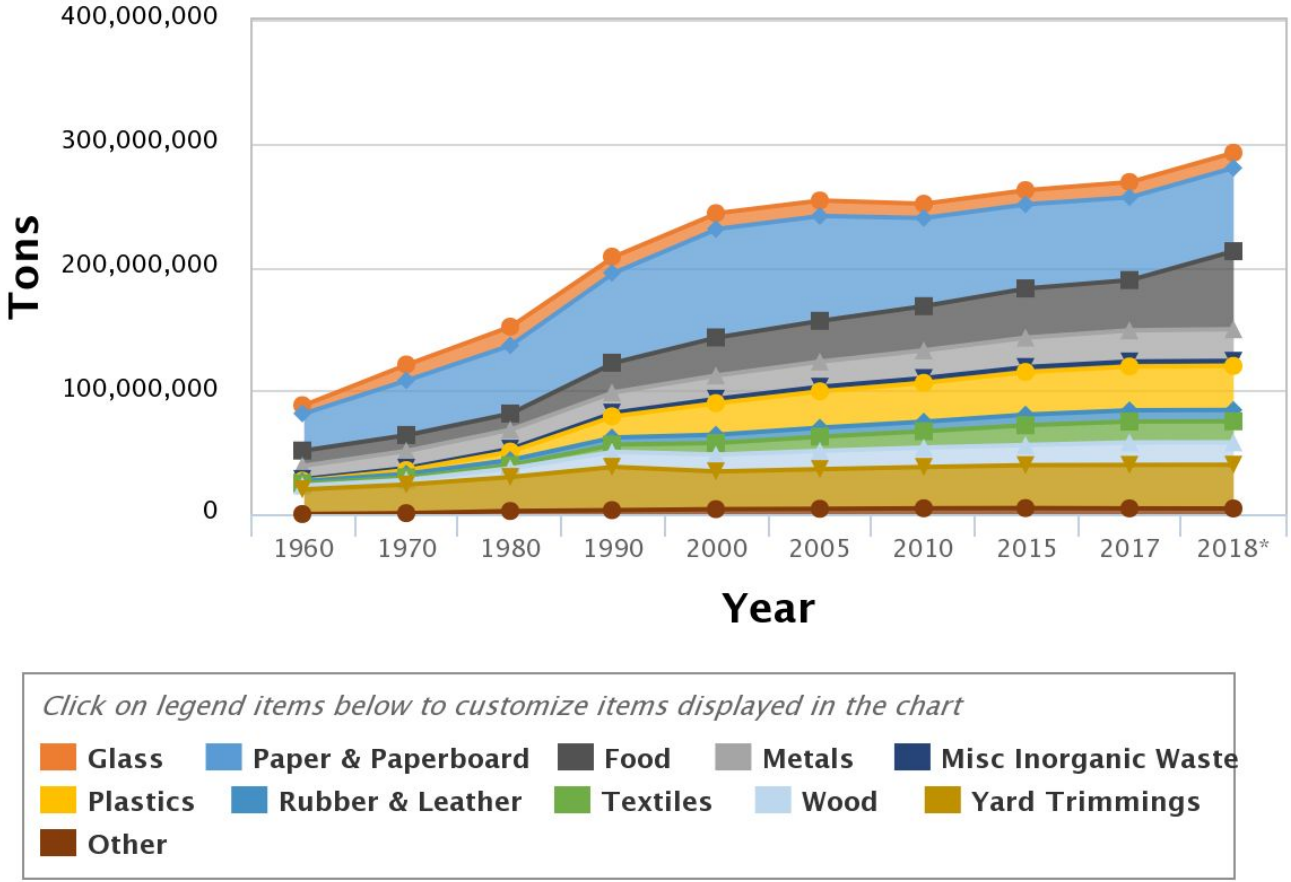
STRETCH THE LIFETIME

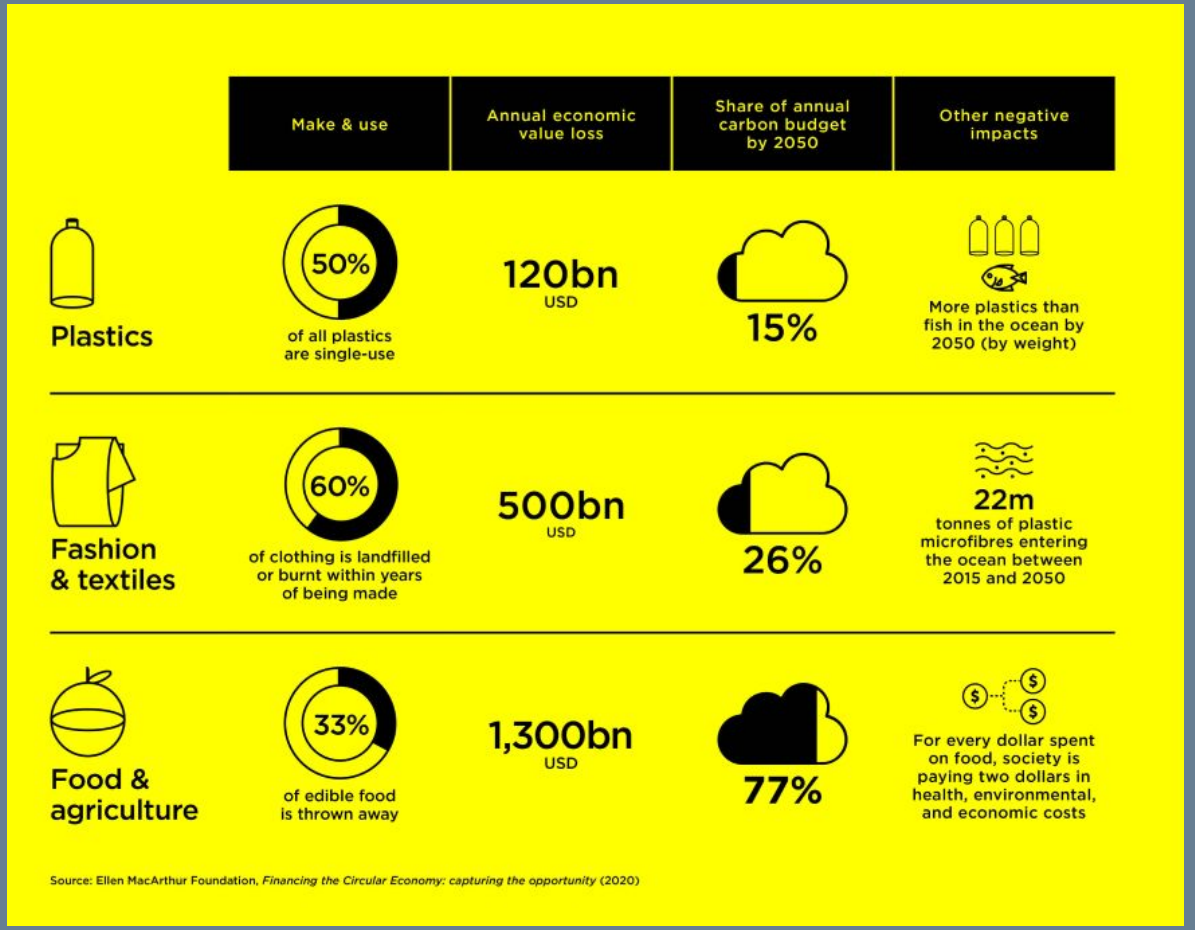
While resources are in-use, maintain, repair and upgrade them to maximise their lifetime and give them a second life through take back strategies when applicable.

Class Naming Convention of 12 Principles

1. Safety First
2. Prevention
3. Low resource separation and purification
4. Optimization
5. Limit Extraneous thinking
6. Hard Work to Salvage Gold
7. Realistic Design Goals (Durability)
8. Necessary design
9. Minimize material diversity
10. Integration and interconnectivity of resources
11. Long-term designing
12. Renewable sources

- Average U.S. person produces 4.9 pounds of waste per day
- That's 1,788.5 pounds a year. Almost a full TON per person.




Make & use
Annual economic value loss
Share of annual carbon budget by 2050
Other negative impacts
Plastics
50%
of all plastics are single-use
120bn
USD
15%
More plastics than fish in the ocean by 2050 (by weight)
Fashion & textiles
60%
of clothing is landfilled or burnt within years of being made
500bn
USD
26%
22m
tonnes of plastic microfibres entering the ocean between 2015 and 2050
Food & agriculture
33%
of edible food is thrown away
1,300bn
USD
77%
For every dollar spent on food, society is paying two dollars in health, environmental, and economic costs
Source: Ellen MacArthur Foundation, Financing the Circular Economy: capturing the opportunity (2020)

CIRCLE ECONOMY

Common Language for reintegration process