Waste is a Design Flaw

ENGR 1501 FALL 2023 - Week 8

Attendance

DIY Version of the Plastic Scanner
Visual model from thesis Jerry

Commercial Version of the Plastic Scanner
Visual model by AED student team

Overview
Introduction
How it works
Development Board
DB 2.3
Build instructions
Firmware installation
Software usage
Handheld scanner
Handheld Scanner 1.0
Revision history
Research
Contribute

Build instructions

Before you begin

Please know the current status of the project.
Currently we are working hard to make new developments for the Plastic Scanner. The first item we are releasing is a development board, this needs to be taken quite literally, it is for developing purpose. With this board you can help develop the Plastic Scanner further and do tests to see if it fits your usecase.

Tools required

In order to replicate the development board you need the following tools:

- Flush cutters
- Forceps
- Screwdriver
- Solder

Today's Agenda

1. TEAR DOWN DISCUSSION
2. WHAT ARE THESE PIECES
3. EXTRACTING COMPONENTS
4. COMPONENT USE

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

Hobbyist Teardown Analysis

Due Tonight

Find a teardown of your selected e-waste (or a product like it)
Discuss the

- Expertise needed
- Tools needed
- Time and effort
- Parts of interest
- General list of parts you see extracted

Identify an aspect of the design that made the disassembly more difficult for the user

E-waste Disassembly and Parts List

Due Tonight

Please reflect on your hands-on disassembly and how it compared to the one you found online

List out all components that are recovered (more specific the better, can be for a specific model)

Tools required

Expertise needed

Briefly note any design areas that created difficulty or added ease to your teardown

Component(s) of Interest Identification

Due Next Week

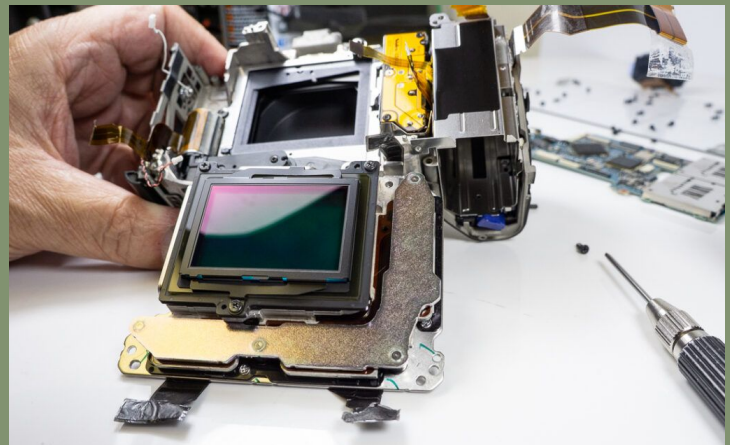
Identify component(s) from your teardown that are of interest to you

What is the name/part name for the component?

- What is the cost of the component?
- Does it need any refinement to be used? If so what?
- What are examples of uses for the component?
- How do you use the component? (coding, circuitry, power needs, etc.)
- Anything else of interest?

What HAVE you found interesting about your disassembly?

- Is it easier/harder than it looked?
- Could you put it back together after?
- Any cool components you wanna use?
- Are you confused about the tear down in any way?

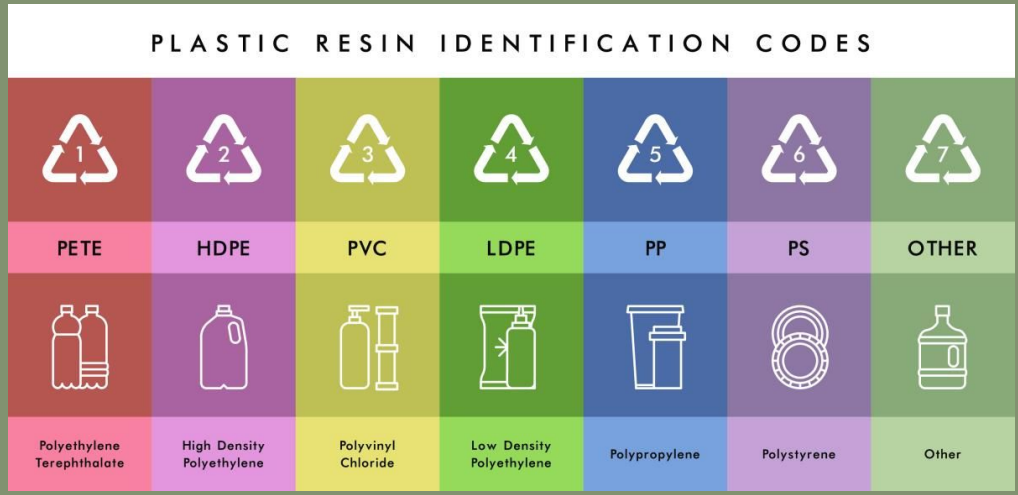


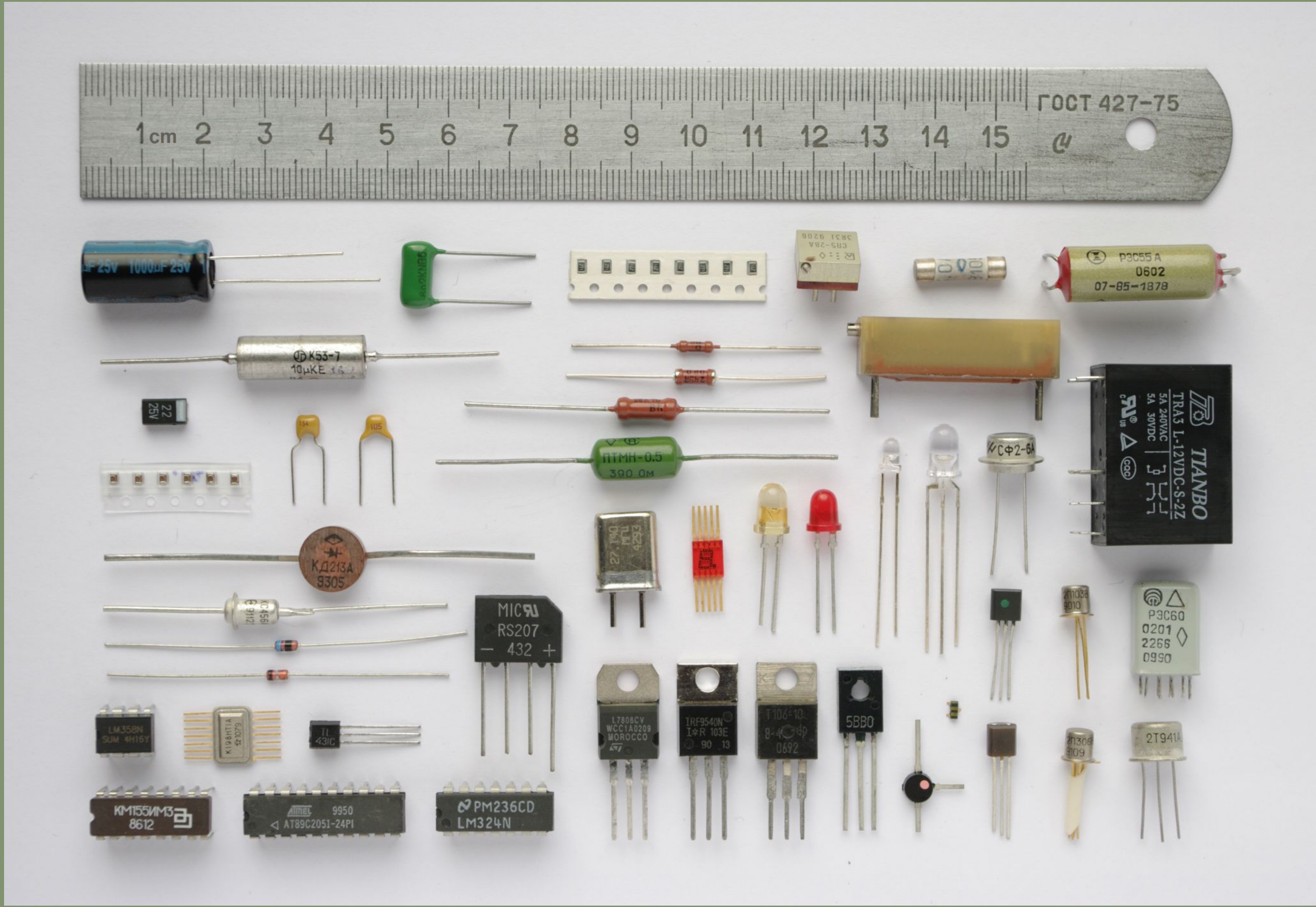
Disassembly Safety

1. Glasses
    a. ALWAYS.
2. Gloves
    a. Recommended when prying, handling devices with ink/oil, generally a good call
3. Masks
    a. Needed for soldering, recommended for devices with ink/oil
4. Electricity
    a. Products may hold a charge for weeks after they are unplugged. Gloves assist in reducing risk of shock. Let products sit for a month to de-charge
5. Breaking
    a. Many pieces are glued, mechanically connected, or stuck. You may need to break an item so aim to limit destruction with prying tools (flat head screwdriver)
    b. You may (not today) need to melt/saw a product

What are these pieces?

1. Plastic
    a. Resin identification code (NOT AN INDICATOR IT CAN BE RECYCLED)
    b. Issues with this system?
        i. Hard to find, what if it breaks/degrades the label?
    c. Do we trust the number?
        i. How do we test?

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TIANBO
TRA3 L-12VDC-S-2Z
5A 240VAC
5A 30VDC
СФ2-6А
РЭС60
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2266
0990
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RS207
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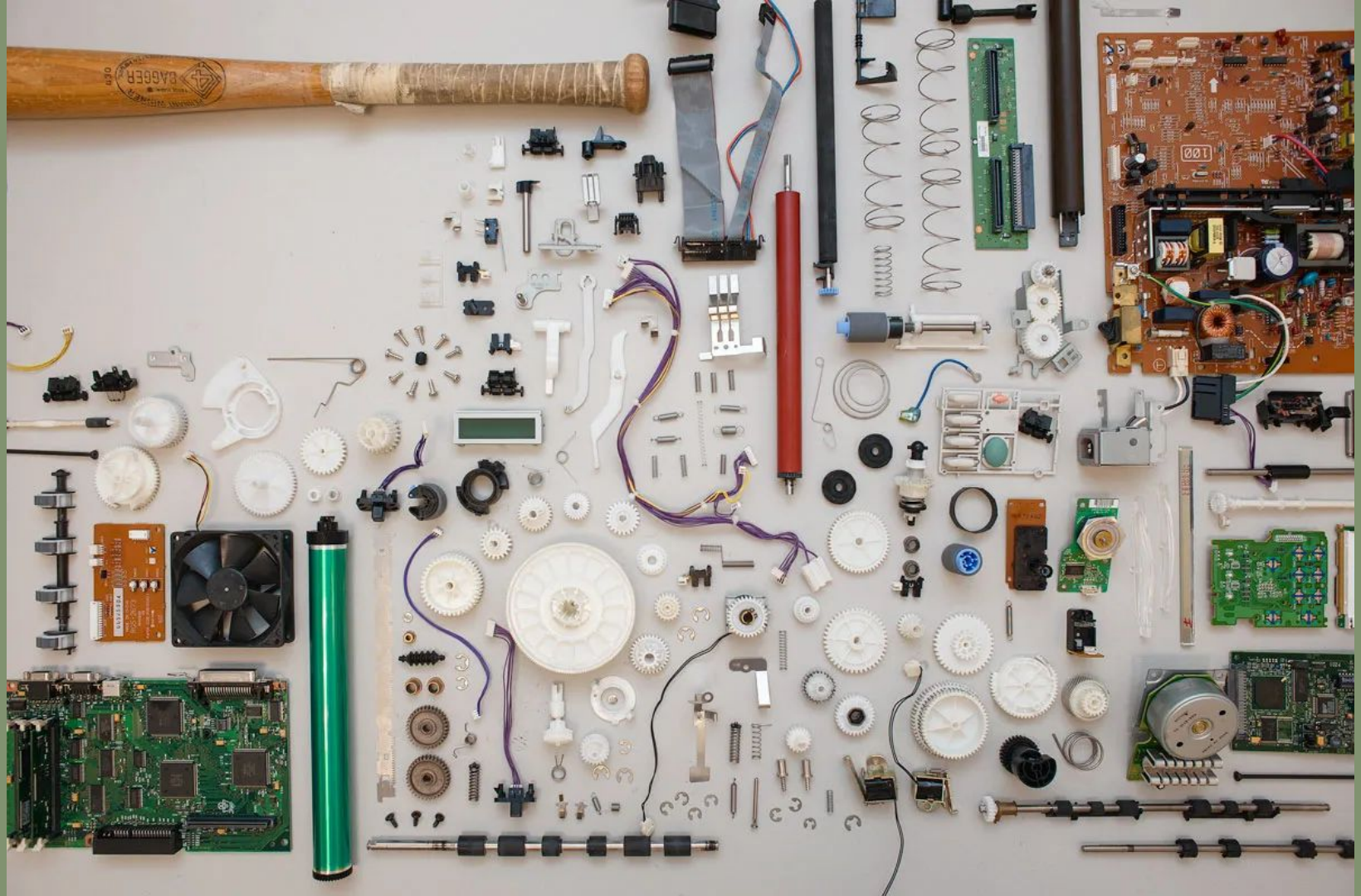
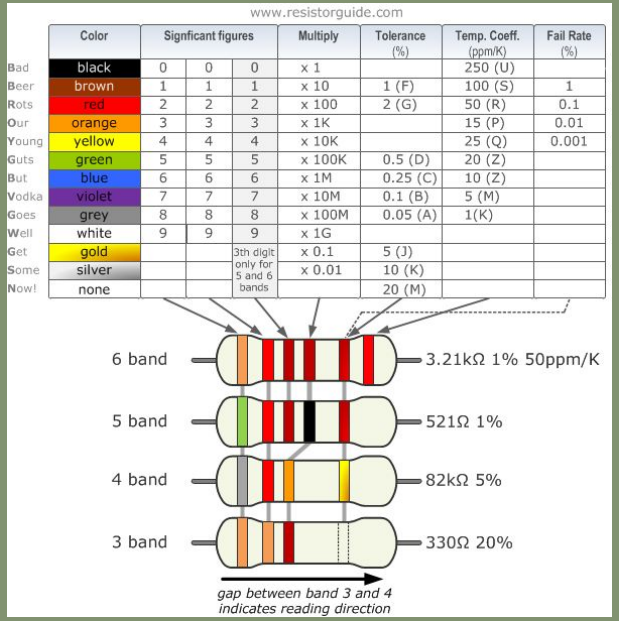
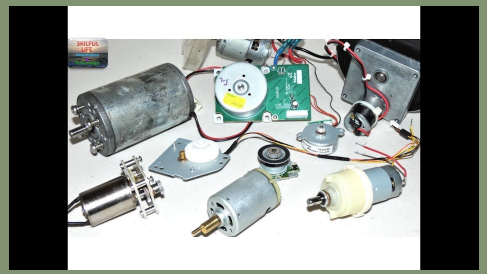
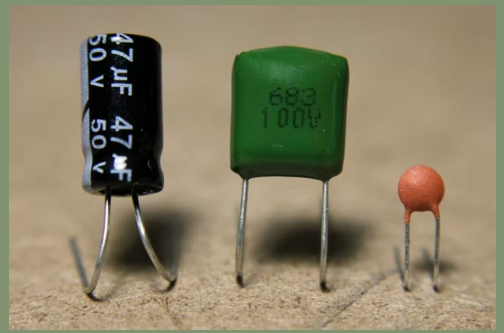

BAGGER

What are these pieces?

1. Electrical Components
    a. Identify broad category
        i. Resistor, transistor, capacitor, motor, etc.
        ii. Stuck?
            1. Use google reverse image search
    b. Part number
        i. Resistor Stripes, capacitor parameters,
        ii. Part numbers





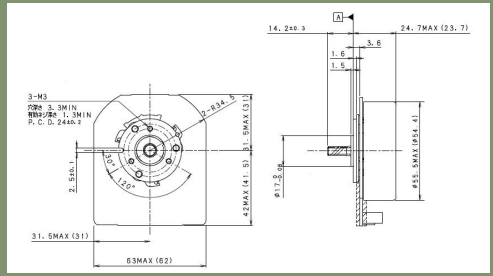


What are these pieces?

The brushless motor ensures long life and high efficiency.

Brushless DC motors do not require commutators and brushes, which are the disadvantages of brush motors. Brushless DC motors are an energy-efficient direct-current drive with long life, noise levels, quietness, and high efficiency. Because the rotor is on the outside, this has high drive torque, and excels at low-speed applications.Extensive customization in accordance with usage application, required pricing and quantities is possible. This includes inclusion of mounting plates, use of neodymium, and sleeve bearings.

characteristics: Low noise,Low vibration,Energy saving,Long life,Stability,REACH support,RoHs support

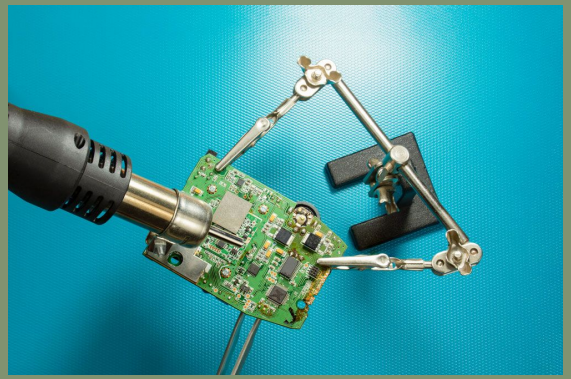


Input

Rated voltage	24 V	21.6 ~ 26.4 V
Frequency	1174.9875 Hz	
Operating current		~ 2 A
Rated input	48 W	

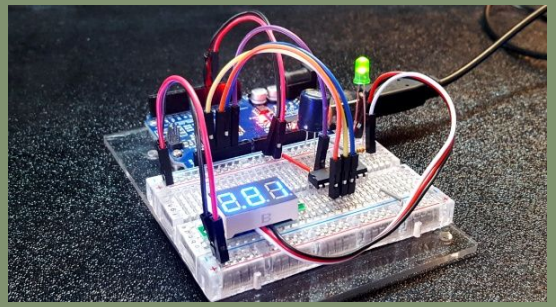
Part Extraction?

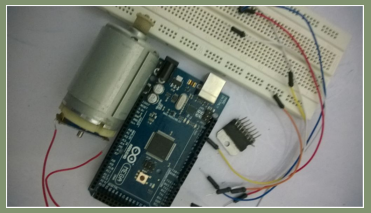
1. Screws
2. Solder
    a. Desoldering parts can be difficult as it is
        i. Tiny, sometimes poorly soldered, and awkward mechanically
        ii. Printed component boards have gotten smaller and smaller
            1. <u>Heating in mass to remove pieces at expense of the board</u>
                a. Theory: great
                b. Practice: difficult to not burn board (fumes, flames, no fun)
3. Mechanical (Cut/Rip)
    a. Clipping at the base of components can also work... but

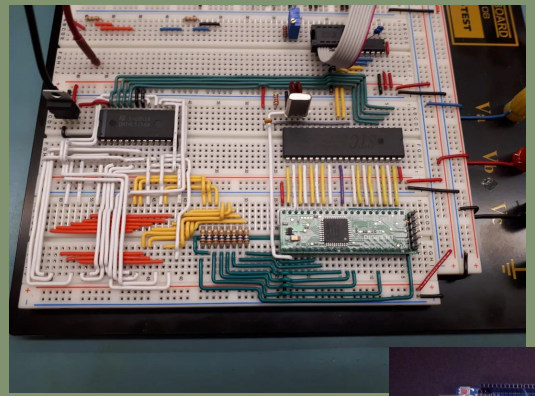


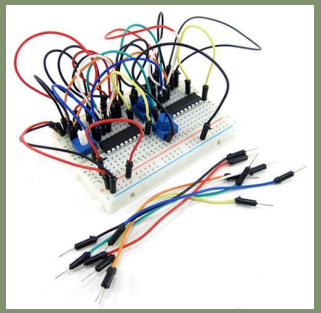
Part Use (Practice)

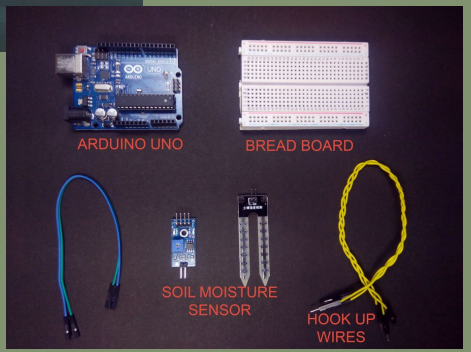
1. Breadboard
    a. Allows for non-permanent connections
    b. Connect in series and parallel
2. Clip/Slot connectors
    a. Used in tandem with breadboard, the wiring system of clip/slot connectors
    b. Lego mentality (universal connection)
3. Solder
    a. Melting tin to hold two metal connections together
    b. “reversible”











Part Use (Purpose)

1. Designing with a goal function in mind
    a. How do you find purpose?
        i. Goal definition
        ii. Problem brainstorming
        iii. Solution Convergence
2. **<u>Designing with a list of parts</u>**
    a. What can I do with what I have?
        i. Search part projects
        ii. Detail part uses and think of application
3. Designing to learn
    a. Pick a skill you'd like and find interesting projects

List of material used in this project:

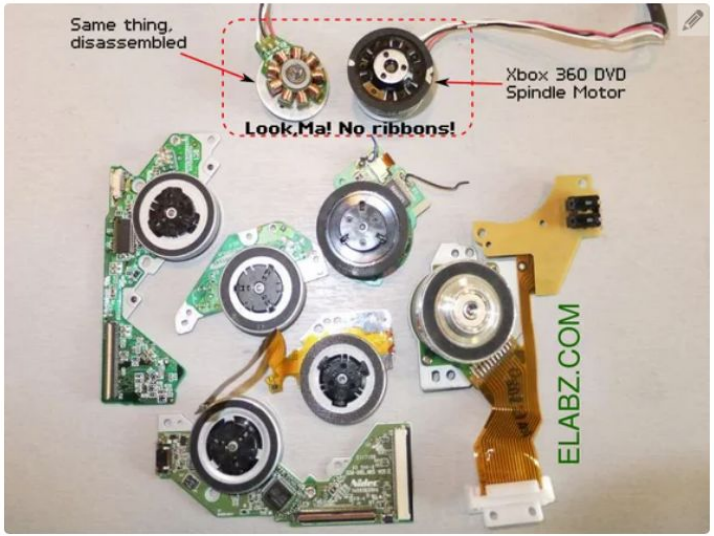
- Old hoverboard
- 6 inch PVC pipe
- 5mm round metal platees
- 1 inch metal strips
- Ply wood
- Nut and bolts
- 2 inch galvanize pipe

What do you do with ___?

Stroboscope (zoetrope) Using Arduino and a Broken Xbox 360 DVD Drive by elabz Follow

Add Tip Ask Question Comment Download

Step 1: Gather the Parts

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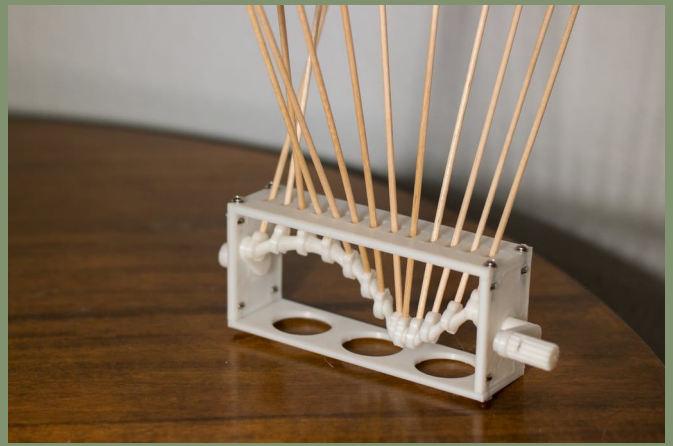


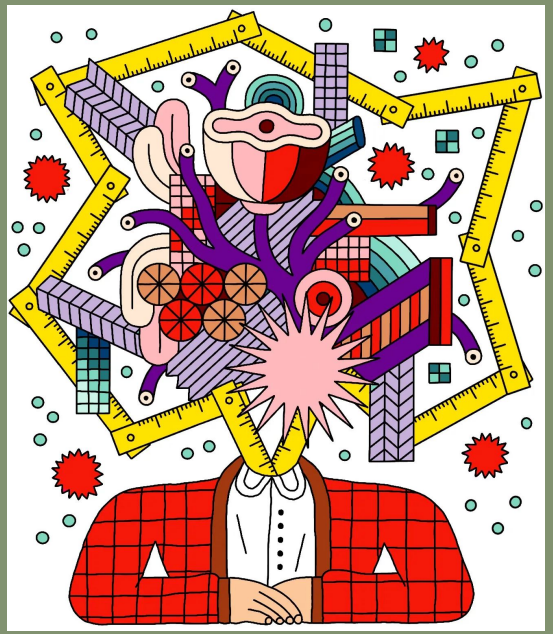

glücklich
verwundert
neugierig

Disassembly Documentation!

- Take pics of the pieces you separate
- Take pics of difficult disassembly areas
- Documentation allows for others to save time and compare notes!!

Finding the Purpose!

- Let’s combine recipe constraint design (work with what you have) with purpose design
  - How to find purpose? Pick problems!
  - Next class we will be doing a creativity workshop!



Thought for the class:

"Never Just Remember How to Do Something, Understand How It Works"

If you simply remember how to do something, then all you can do is use it the same way over and over, but if you understand how it works, you can reason about it. Once you can reason about something in your mind you can contemplate why it is the way it is, you can apply your entire creative mind to making the most of it, and you can implement and question improvement – you own it intellectually. - Martin Rue

Recommended Media:

Electronic basics (https://www.youtube.com/watch?v=6Maq5lyHSuc)
Look out list (https://www.instructables.com/What-to-Keep-When-Taking-Apart-Electronic-Devices-/)
Computer parts (https://edu.gcfglobal.org/en/computerbasics/inside-a-computer/1/)
VCR example (https://electronics.howstuffworks.com/vcr3.htm)

Appendix Slides

Sustainable Design (Pre-Waste)

Hardware

Software

System

What is your process of identifying a principle of sustainable design?

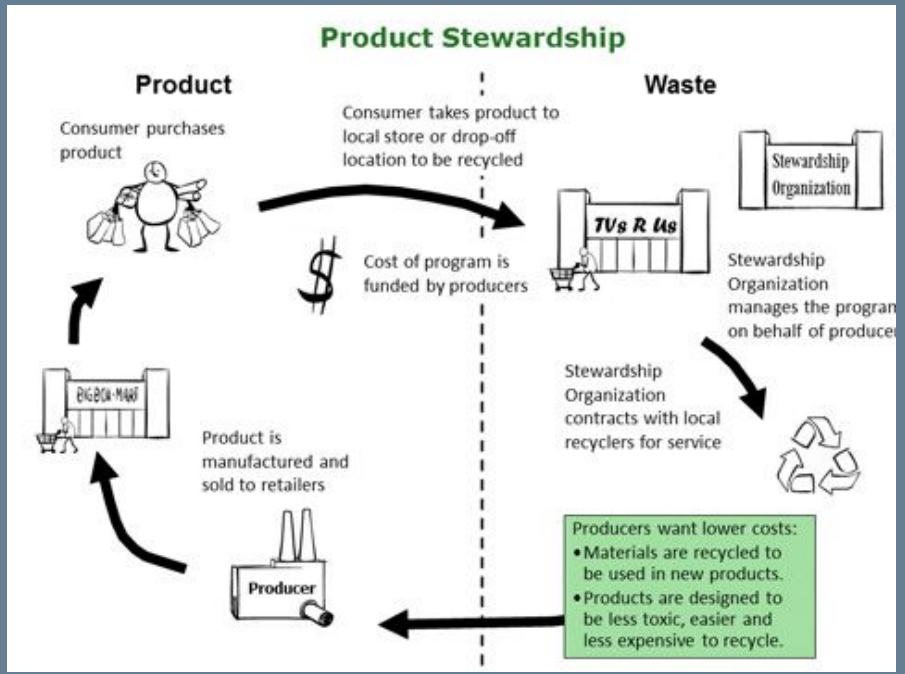
Sustainable Design

[sə-ˈstā-nə-bəl di-ˈzīn]

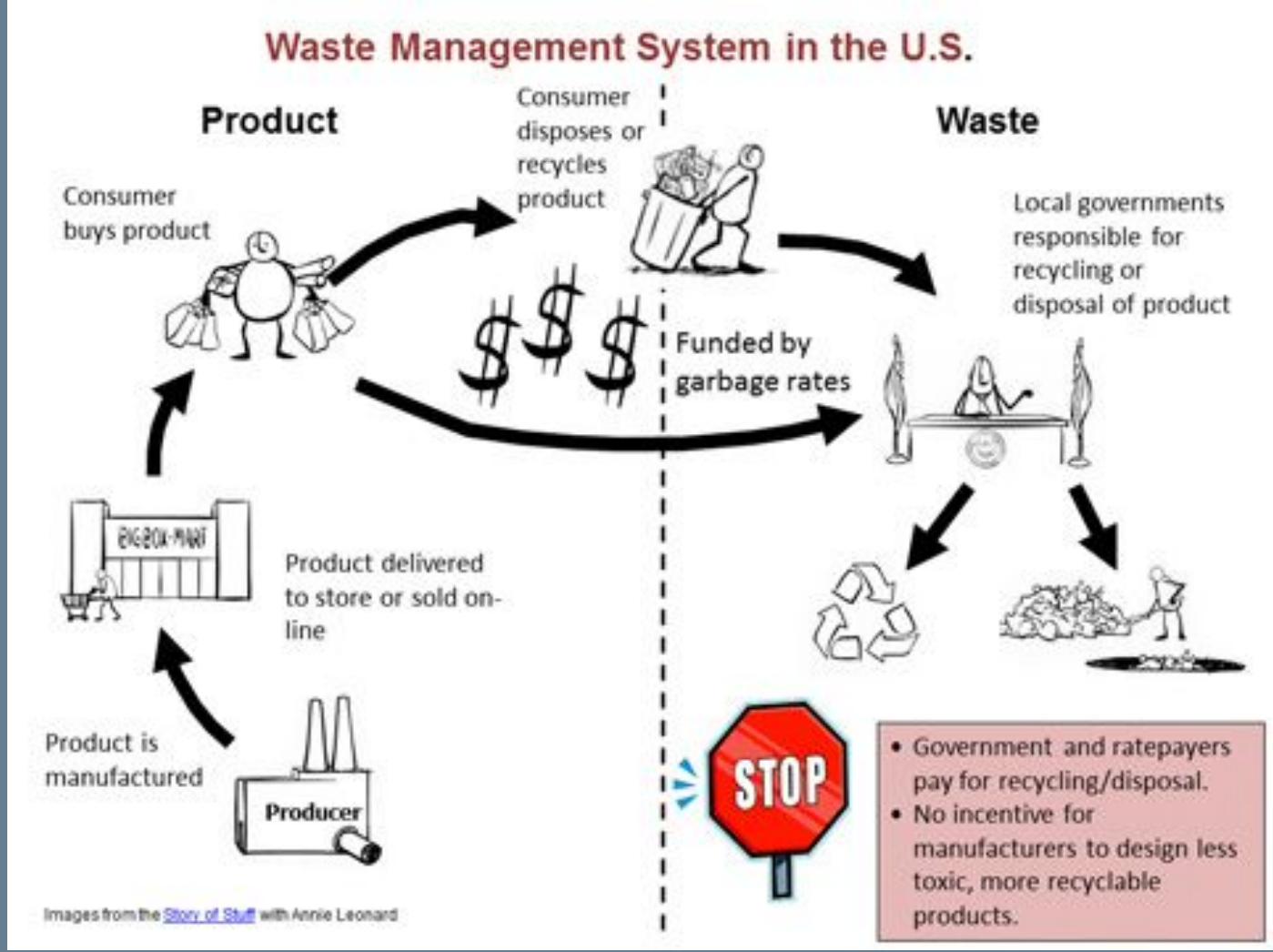
A design approach that seeks to minimize negative environmental, social, and economic impacts.

Sustainable Design

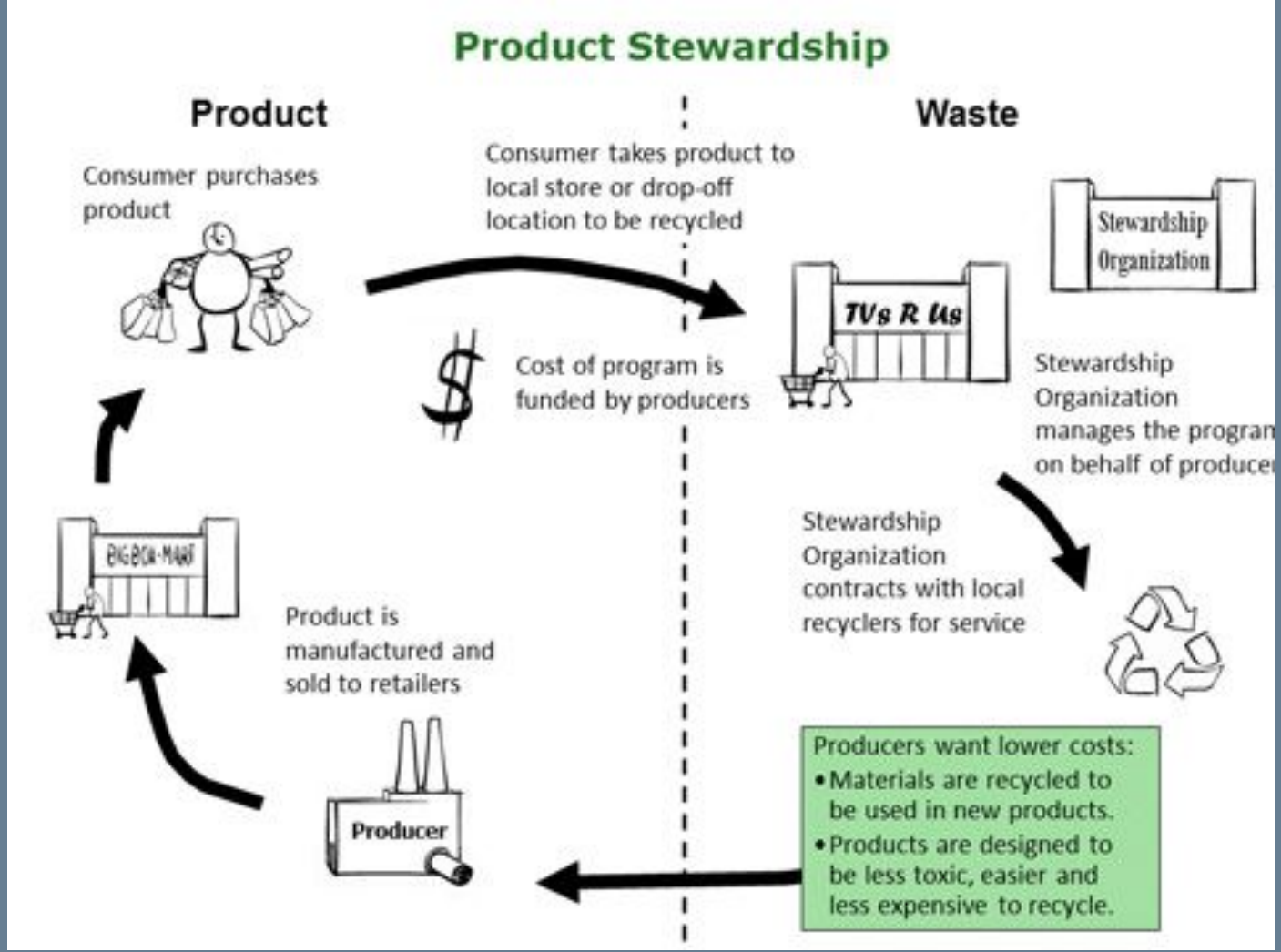
Product Stewardship



Waste Management System in the U.S.



Product Stewardship



Product Stewardship

Companies design products WITH an end-of-life plan.

How?

Product Stewardship

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

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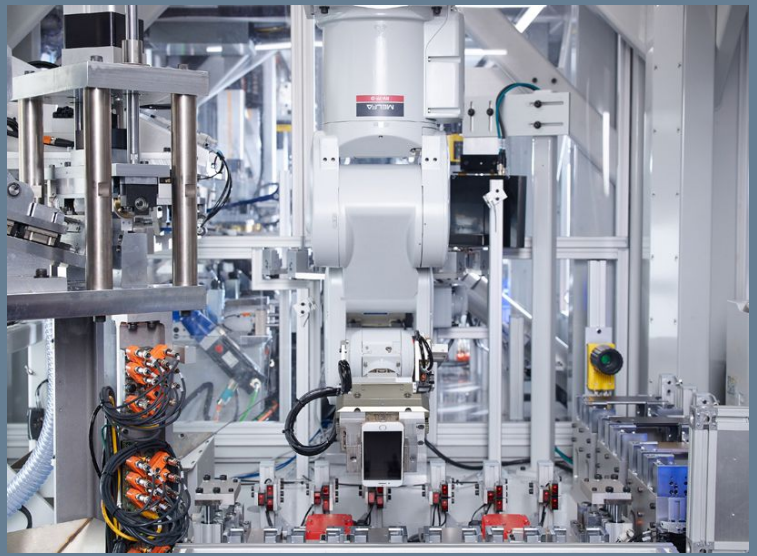
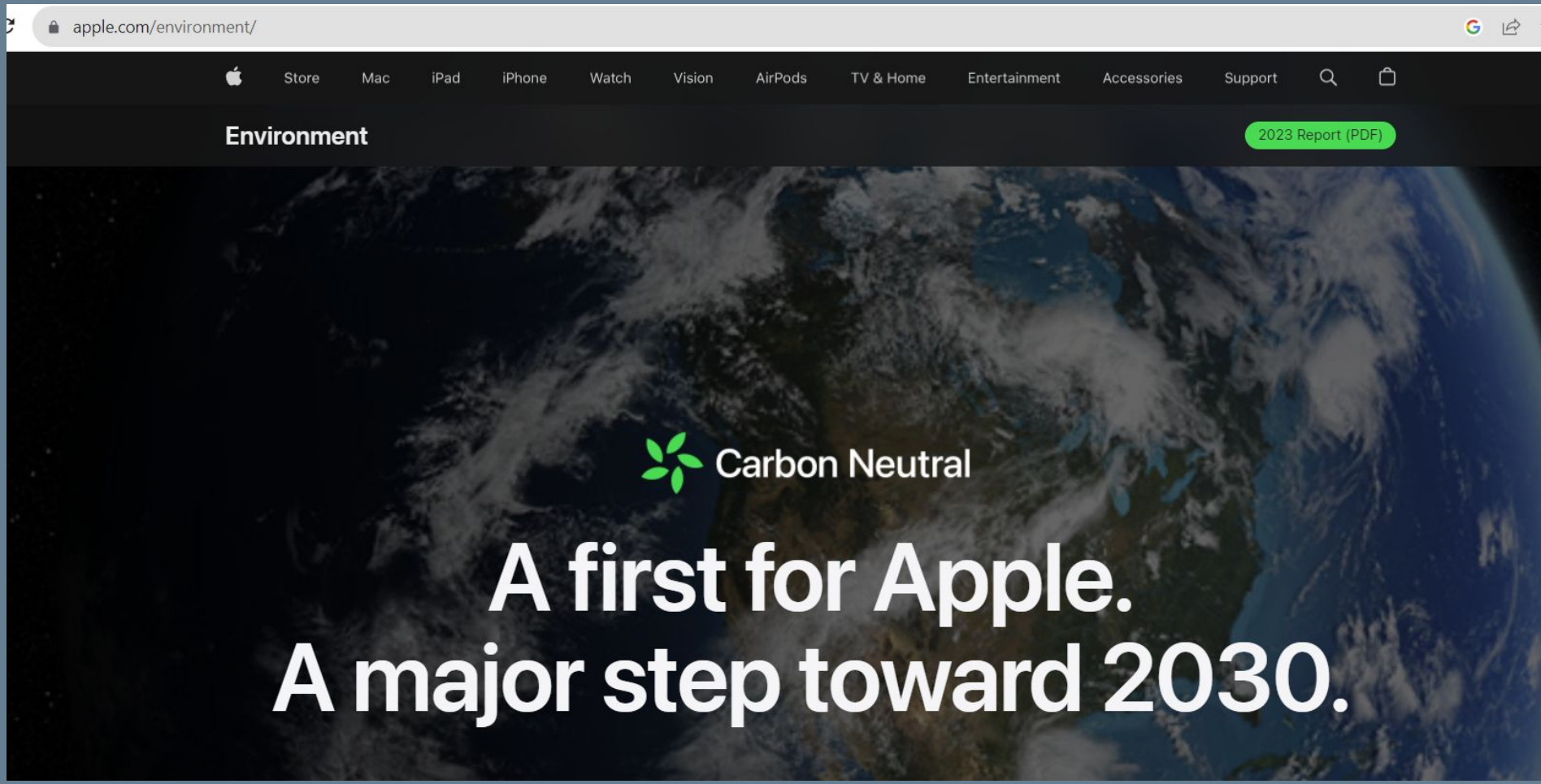
Examples of Product Stewardship

Apple Recycling their Own Phones

- How? What is the success rate?
  - What defines success?
  - What feels fishy?
  - What would you want to see?




apple.com/environment/
Store
Mac
iPad
iPhone
Watch
Vision
AirPods
TV & Home
Entertainment
Accessories
Support
Environment
2023 Report (PDF)
Carbon Neutral
A first for Apple.
A major step toward 2030.


ORIGINAL
ORIGINAL TASTE
16 FL OZ
(1 PT)
473 mL
190

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Refill Products

Modular Products

Recyclable Products (?)

Sustainable Design with Waste (Post)

Input pushed design.

Sustainable Design with Waste (Post)

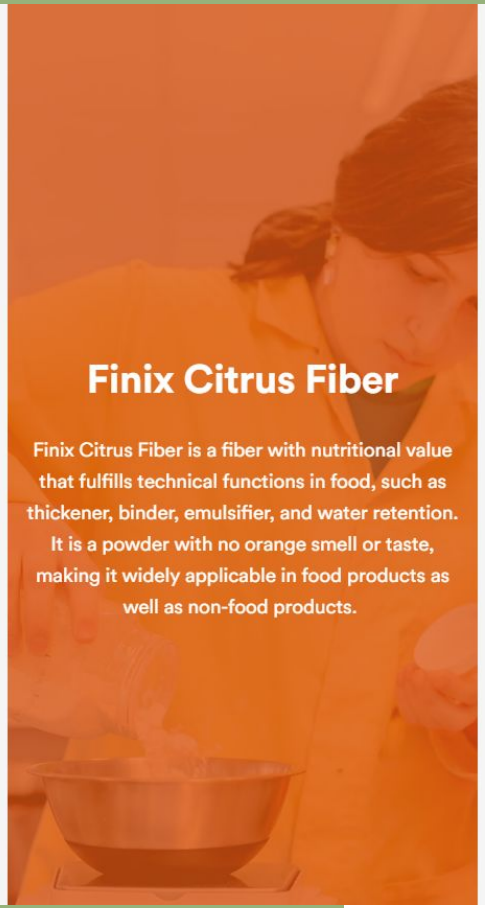
Input pushed design.

We can identify waste streams and reorient them so the “waste” becomes a material input for a new product/process!

Sustainable Design with Waste (Post)

Simone Post - Post Adidas

The age of waste: five designers modelling a 'circular economy'



Finix Citrus Fiber

Finix Citrus Fiber is a fiber with nutritional value that fulfills technical functions in food, such as thickener, binder, emulsifier, and water retention. It is a powder with no orange smell or taste, making it widely applicable in food products as well as non-food products.

Five Fold Oil

Five Fold Oil is concentrated orange oil that can provide food and personal care products with a delicious orange aroma.

Cold Pressed Oil

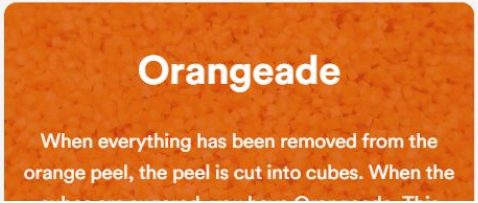
Cold Pressed Oil is pressed directly from the orange peel and purified with minimal further processing.

D-Limonene

D-Limonene is a degreasing and natural solvent that is used to make cleaning products, among other things.

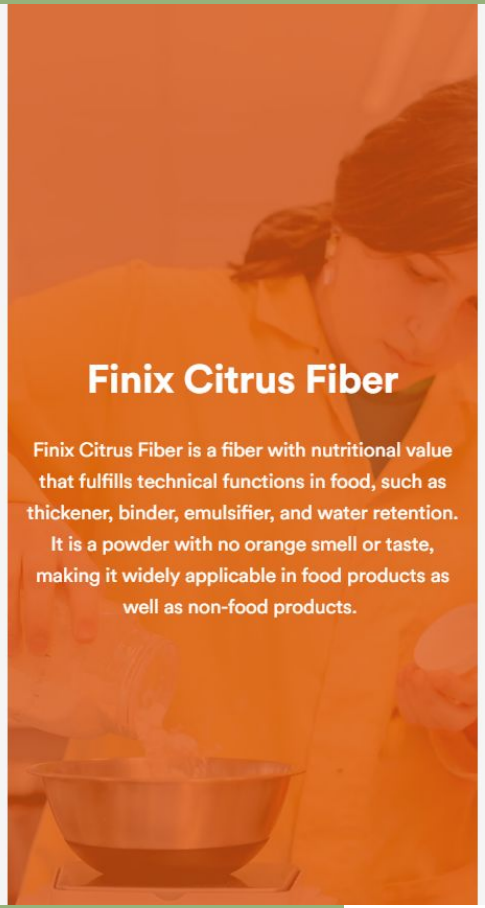
We keep developing

In our (in-house) innovation lab we are constantly doing research on what more ingredients we can extract from citrus peel. In addition, we also carry out various tests to build knowledge on the functionality of our ingredients in the different applications. There is still so much potential! We continue to develop together with our partners.



Orangeade

When everything has been removed from the orange peel, the peel is cut into cubes. When the



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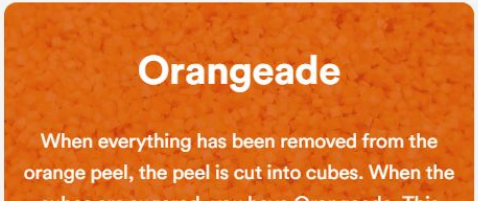

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Sustainable Design with Waste (Post)

Input pushed design...

AND output pulled.

Recycling with a purpose vs. making to use. We should design products to serve a purpose.

The designed proc

life-cycle should b

What to make with waste?

Ship of theseus

- Aluminum cans, glass bottles, clothing, etc.

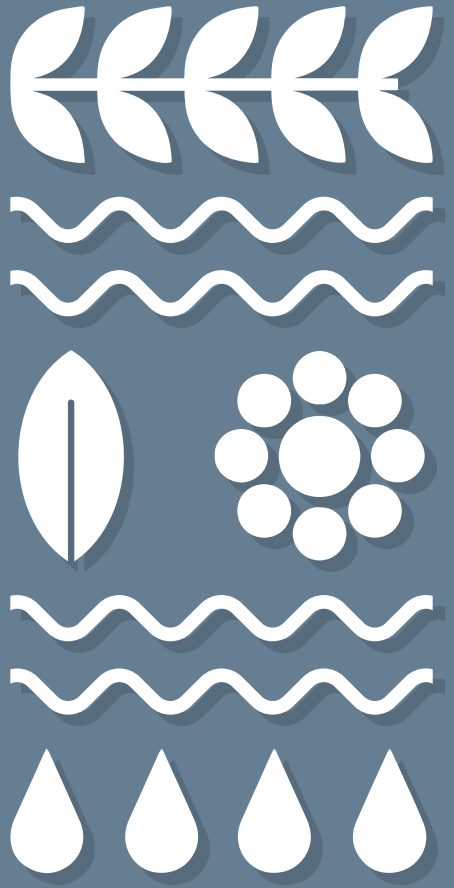
New products!

- Creating an existing product out of sustainable materials (cheaper and sustainably sourced)
- Identifying community need
- Fun!

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?



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

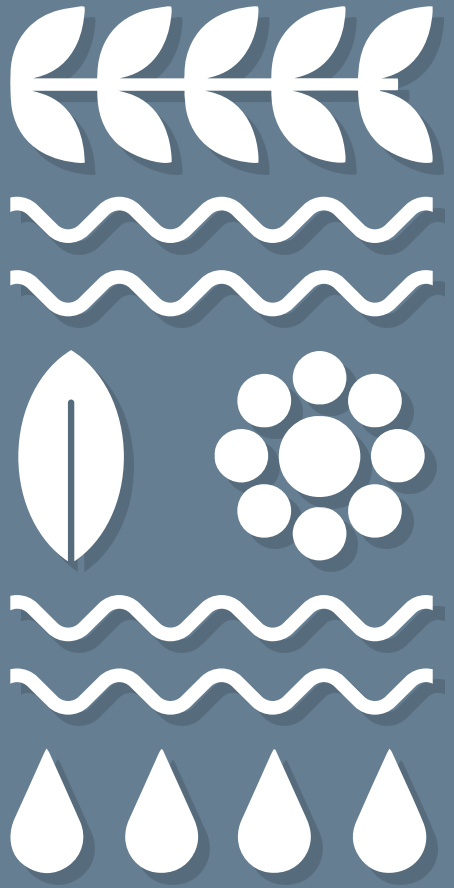
We will also go through any questions you all have on the principles for how to implement and what they mean.

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.

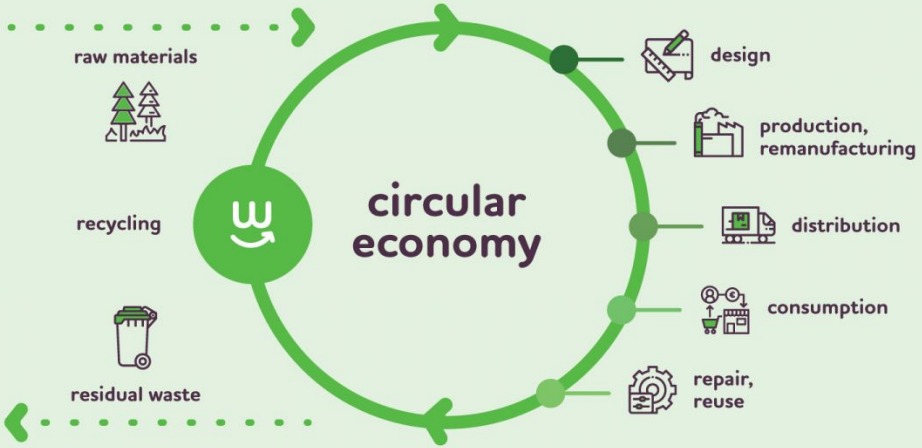
The current dominant economy is linear in its processes: it takes resources, makes goods, and quickly wastes them.

-CIRCLE REPORT, 2021



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.

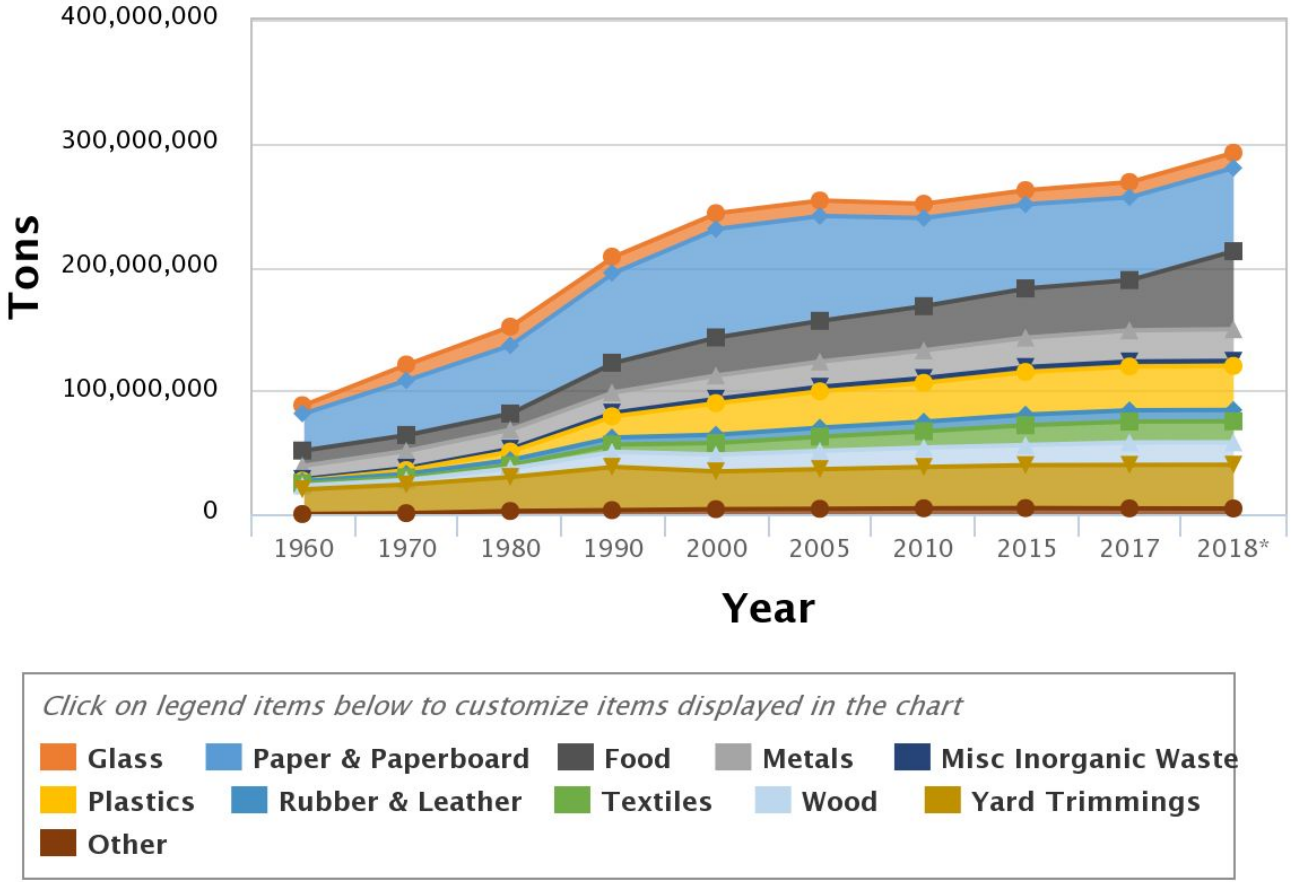
STRETCH THE LIFETIME

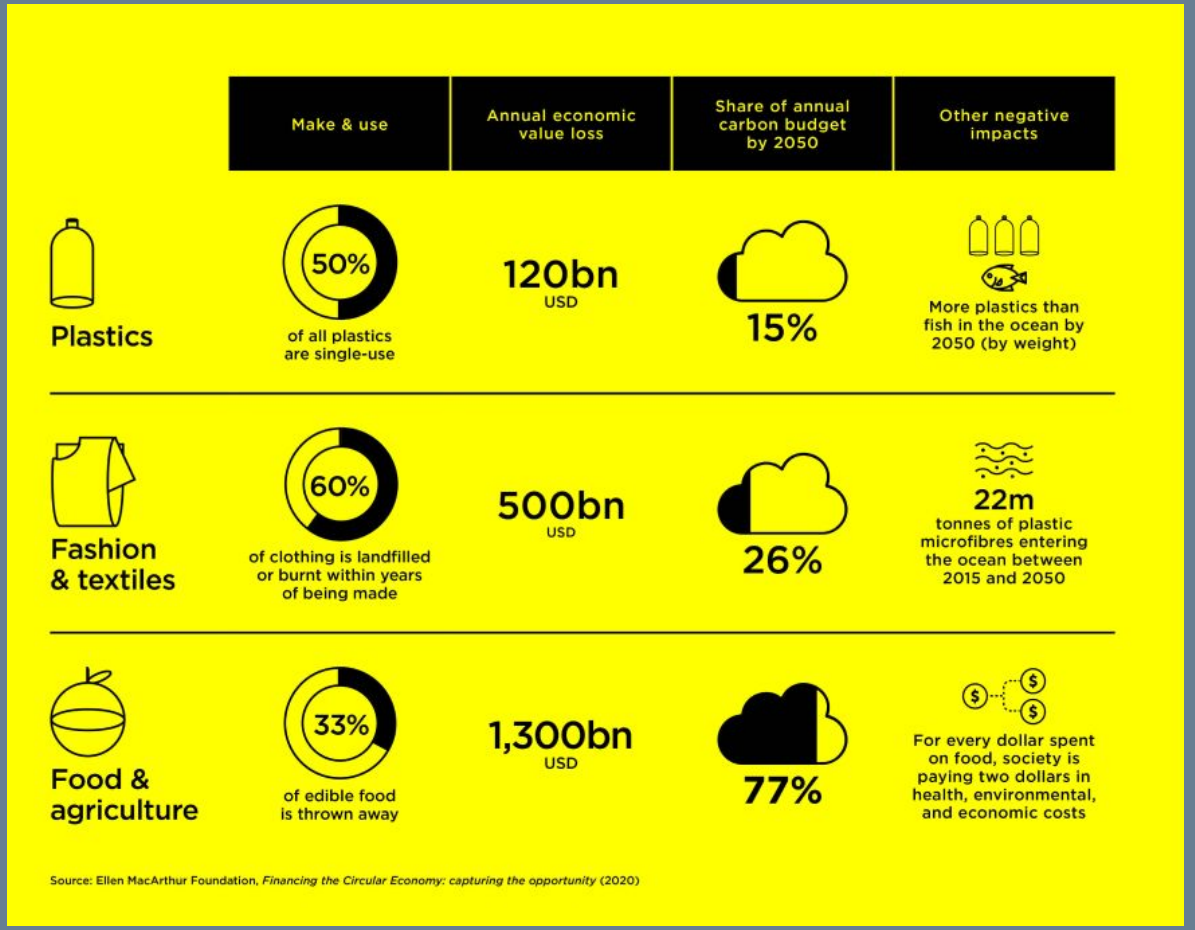
While resources are in-use, maintain, repair and upgrade them to maximise their lifetime and give them a second life through take back strategies when applicable.

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