Trash Matters

Material Strategies for Prolonging the Life of Single-use Plastic

Zixin Li

MLA Landscape Architecture, RISD

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Thesis Book was written and designed by Zixin Li.

Printed and bound by Printer Company Name.
Typeface: Helvetica Neue by Max Miedinger,
Mergenthaler Linotype Company, 1983.

A thesis submitted in partial fulfillment of the requirements for the Master of Landscape Architecture Degree in the Department of Landscape Architecture of the Rhode Island School of Design, Providence, Rhode Island.

By Zixin Li
May 28, 2022

Approved by Masters Examination Committee:

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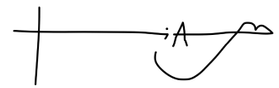

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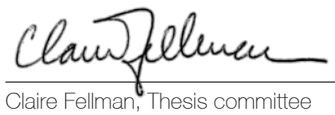

Claire Fellman, Thesis committee

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KEY TERMS

SLOW VIOLENCE

a violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space, an attritional violence that is typically not viewed as violence at all. (Slow Violence and the Environmentalism of the Poor P17)

COVID-19 PANDEMIC

COVID-19 pandemic, also known as the coronavirus pandemic, is an ongoing global pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Transmission of COVID-19 occurs when people breathe in air contaminated by droplets and small airborne particles.

STRUCTUAL VIOLENCE

The term was coined by Norwegian sociologist Johan Galtung, who introduced it in his 1969 article "Violence, Peace, and Peace Research". Some examples of structural violence as proposed by Galtung include institutionalized racism, sexism, and classism, among others. Structural violence and direct violence are said to be highly interdependent, including family violence, gender violence, hate crimes, racial violence, police violence, state violence, terrorism, and war. It is very closely linked to social injustice insofar as it affects people differently in various social structures.

PPE

Personal protective equipment (PPE) is protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter.

SOLID WASTE

Solid waste is any discarded or abandoned element, which may be solid, liquid, semi-solid or containerized gaseous material. In the thesis words as garbage, trash, residue and waste are used as substitute for the term 'solid waste'.

POLYMER

A molecule has a group of atoms which have strong bonds among themselves but relatively weak bonds toadjacent molecules. (Manas Chanda. Plastics Technology Handbook. CRC Press, 2018.)

LANDFILL

"A landfill is a carefully designed structure built into or on top of the ground, in which trash is separated from the area around it. Landfills contain garbage and serve to prevent contamination between the waste and the surrounding environment, especially groundwater."(Advanced Disposal 2016)

MICROPLASTIC

Microplastics are fragments of any type of plastic less than 5 mm (0.20 in) in length, according to the U.S. National Oceanic and Atmospheric Administration (NOAA) and the European Chemicals Agency. They cause pollution by entering natural ecosystems from a variety of sources, including cosmetics, clothing, food packaging, and industrial processes.

"Covid will eventually go away, plastic waste won't, it's here forever."[1]

1 Flint, Rachel. "Covid-19: Single-Use Plastic Impact 'Will Last Forever'." BBC News, BBC, 26 Sept. 2020, https://www.bbc.com/news/uk-wales-54265590.
Figure 1 Creagh, Ben. "Recycling Sector Gets a $1.1 Million Boost from Victorian Government." Food & Beverage Industry News, 15 Aug. 2018, https://www.foodmag.com.au/recycling-sector-funding/.

ABSTRACT

Plastic pollution has become one of the most pressing environmental issues. Communities worldwide have addressed the importance of facing the problem of plastic pollution control and issues relevant policies to effectively reduce the use of plastic products. The sudden outbreak of Covid-19 has made the urgency of the problem less significant. Nevertheless, the use of disposable plastics to comply with public health protocols has hugely increased making plastic pollution all the more severe.

Through material experimentation, this thesis reappraises different types of single-use plastic waste and attempts to transform them into longer-lasting reused solutions. It focuses on finding alternative materials while, at the same time, proposing find more efficient methods of decomposition.

“We’re all downwinders now, some sooner than others.”

—Nixon, Rob. Slow Violence and the Environmentalism of the Poor

INTRODUCTION

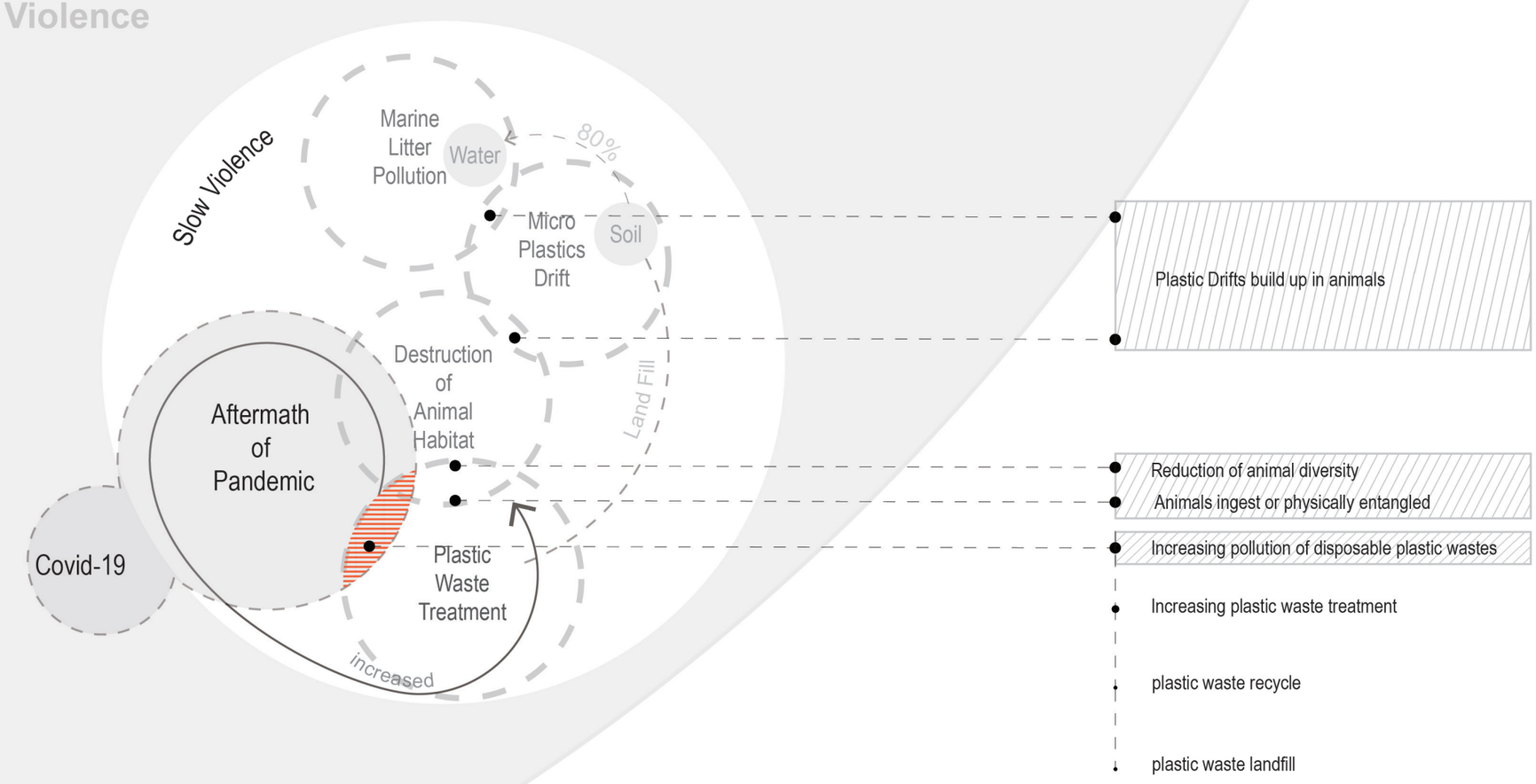
Slow violence defined by Rob Nixon in “Slow Violence and the Environmentalism of the Poor” as a type of “violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space, an attritional violence that is typically not viewed as violence at all.”[2]. Catastrophes like war, earthquakes, volcanoes, and floods can be understood as immediate and explosive violence, their impacts are strong and can be quickly counted and recorded so we can respond in time. But boundaries of slow violence in time and space are very vague and casualties of such violence are most likely not to be seen, not to be counted, making them simplified and underestimated.

The Covid-19 was a sudden outbreak of violence, but the aftermath of the pandemic is unpredictable and will affects our lives for a long time. Prior to the pandemic, plastic pollution was already a global issue. We were producing over three hundred and eighty million tons of plastic every year, and some reports indicate that up to 50% of that is for single-use purposes. After the pandemic, there was an upsurge of disposable plastic products. It is estimated one hundred and twenty-nine billion single-use face masks are used monthly around the world. Considering public health, not only personal protective equipment, but also other disposable plastics are increasing. Plastic waste that we are already producing and the time it takes to decompose becomes a long-term issue.

Unfortunately, it will requires from 100 to 400 years to break down the surge in plastic production at the landfill.[3]Plastic waste doesn’t break down completely instead it will photo-degrade in the form of microplastics that absorb toxins. And 80% of plastic waste will eventually go into the ocean. The aggravation of plastic waste pollution and side effects needs to be taken seriously.

2 Nixon, Rob. Slow Violence and the Environmentalism of the Poor. Harvard University Press, 2013. P17
3 United States Environmental Protection Agency. “Environmental Factoids.” Accessed Jan. 16, 2021.

Violence



STATEMENT

The pandemic outbreak not only increased plastic wastes but also negatively impacted slow violence. Environmental issues such as marine litter pollution, destruction of animal habitats and soil pollution caused by waste leakage are gradually devastating our living environment. Landscape architects have a responsibility to participate in responses to the global plastic crisis. Through material experimentation, this thesis reappraises different types of single-use plastic waste and attempts to transform them into longer-lasting reused solutions. It focuses on finding alternative materials while, at the same time, proposing to find more efficient methods of decomposition methods.

Plastic Crisis

+ World Plastic Pollution Crisis
+ Plastic Crisis is a Form of Slow Violence
+ US Plastic Waste Flow
+ Plastic Waste Issue Accelerated by Pandemic

World Plastic Pollution Crisis

1. Daily use of plastic

(1) Everything comes with plastic packaging, discarded within seconds after purchase.

According to the United States Environmental Protection Agency data, and estimated 14.5 million tons of plastic containers and packaging were generated in 2018. In Western Europe, approximately 92 kilograms of plastic per capita are consumed annually, and this quantity is increasing. Worldwide use per capita stands at about 35 kilograms. The largest amount of plastic waste comes from the packaging industry: two-thirds is generated by households and one-third by industry and commerce.[4]

(2) Plastic is cheap and easy to mold into any shape, it has been widely used to replace other materials. It has been used for containers to replace glass because of the low possibility of breakage in transportation; used for food wraps to replace paper bags because of the flexibility of shape; used for cars and plane parts to replace metal because of the much more lightweight. In one of their early applications, they saved wildlife. In the mid-1800s, piano keys, billiard balls, combs, and all manner of trinkets were made of a scarce natural material: elephant ivory.[5]

2. The globe is a whole, if one country is polluted, the world is polluted. 'No homeland can be secure if a country or a region is still in danger.'[6]

Before the 2018 Basel Convention revision, the developed countries led by the United States generally treated plastic waste by exporting it to developing countries. This once again confirms the environmental injustice of the poor. Even if they are overwhelmed and do not have a sound recycling industrial chain and qualified landfill sites, those countries provide cheap labor and sell environmental resources to "recycle" waste. However, the fact is that no one can escape this slow violence. "We're all downwinders now, some sooner than others."[7] Exporting the problem is not a sustained solution for solving the problem, it still exists. Countries have boundaries, but environmental issues do not.

3. We are not only coping with the amount of plastic on our planet but also the number of plastics that continues to be produced.

Plastic is a genius invention; it exists among us. It has become indispensable, and we rely too much on it before we could effectively manage it, our production speed far exceeds the speed of recycling and reuse. Plastic permeates every detail of our living system, and we don't even realize there are too many of them. Withdrawal response is painful, but it is necessary.

4 "Plastic in the Daily Life." Plastic Garbage Project, https://www.plasticgarbageproject.org/en/plastic-life.
5 Parker, Laura. "We Made It. We Depend on It. We're Drowning in It. Plastic." The Best American Magazine Writing 2019, 2019, pp. 201–214., https://doi.org/10.7312/asme19001-009.
6 Nixon, Rob. Slow Violence and the Environmentalism of the Poor. Harvard University Press, 2013. P252
7 Nixon, Rob. Slow Violence and the Environmentalism of the Poor. Harvard University Press, 2013. P52

Figure 2 "Global Plastic Trade 40% Bigger than Previously Thought, Study Finds." UNCTAD, 3 Mar. 2021, https://unctad.org/news/global-plastic-trade-40-bigger-previously-thought-study-finds.

4. The existing plastic management model is a failure. Most of the plastic waste is landfilled, it needs dumpsites, it takes a long time to decompose (over 400 years), and it causes other side effects (other worldwide pollution).

(1) Over 80% of the landfilled plastic ends up in the ocean as microplastic. Each year, approximately eight million tons of plastic end in our oceans. Some researchers predict that this figure could double by 2025, while others suggest there could be more plastic than fish in our oceans by 2050.

(2) Plastic waste affects marine life. According to the United Nations, at least 800 species worldwide are affected by marine debris, and as much as 80 percent of that litter is plastic.' In the waters, animals and seabirds may die because of plastic ingestion. They are attracted by the movement and colors of plastic waste, ingesting them believing it is food. Ocean plastic is estimated to kill millions of marine animals every year. Nearly 700 species, including endangered ones, are known to have been affected by it. Some are harmed and visibly strangled by abandoned fishing nets or discarded six-pack rings. Many more are probably harmed invisibly. Marine species of all sizes, from zooplankton to whales, now eat microplastics, the bits smaller than one-fifth of an inch across.[8]

(3) Microplastics degrade into nano plastics, build up in animals then enter the food chain.

(4) Reduction of animal diversity.

8 Parker, Laura. "We Made It. We Depend on It. We'Re Drowning in It. Plastic." The Best American Magazine Writing 2019, 2019, pp. 201–214., https://doi.org/10.7312/asme19001-009.

Plastic Crisis is a Form of Slow Violence

We tend to deal with immediate emergencies first before forms of slow violence; slow violence can wait. The paradox of slow violence is that long-term emergency is not static; it builds up. While we are waiting for the right time to address the long-term emergencies, they become more and more drastic. Covid-19, on the other hand, is an immediate emergency, long term slow violence can wait.

Slow violence like this is basically invisible, permeating every detail of life. It is hard to notice the negligible damage by every single life detail. People walking on the street, simply don't realize the negative impact of the coffee cap after they discarded it into the garbage can.

What is more, the consequence appears through too many processes, resulting in the underestimation of the aftereffect by direct behavior. Slow violence like the plastic crisis is not a priority. It will not cause a significant impact today, or tomorrow, but that day is slowly approaching. The coffee cups will be transported to the waste center, packed, and shipped by the ocean to Malaysia for landfill, decomposed into microplastics, leaked into the soil to contaminate groundwater, and then enter the marine system through the water cycle, ingested by marine animals, and become the body of the animals we eat Accumulation of nano plastics. We eat it into the stomach, not die immediately, it becomes another slow violence story of a killing.

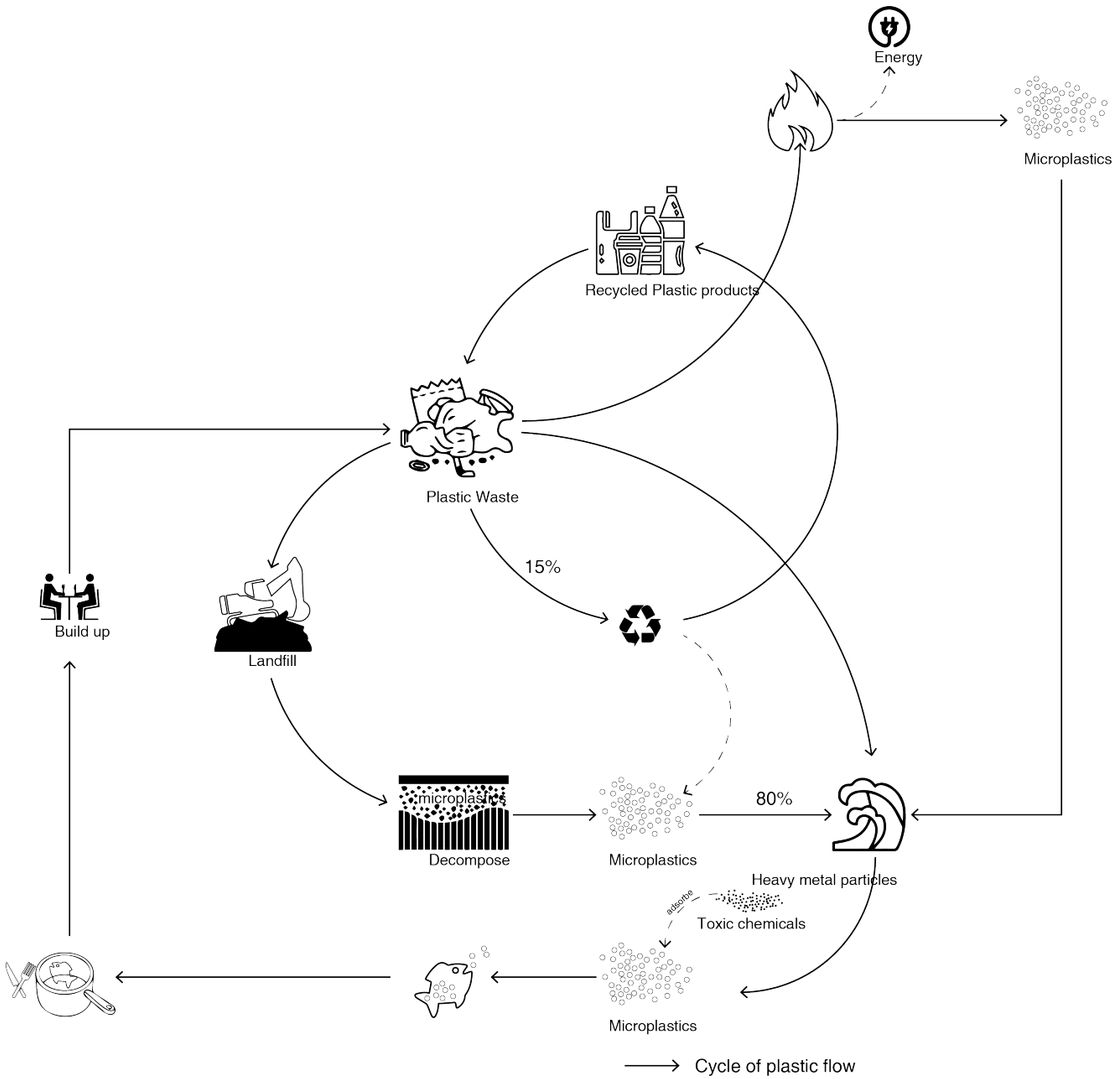
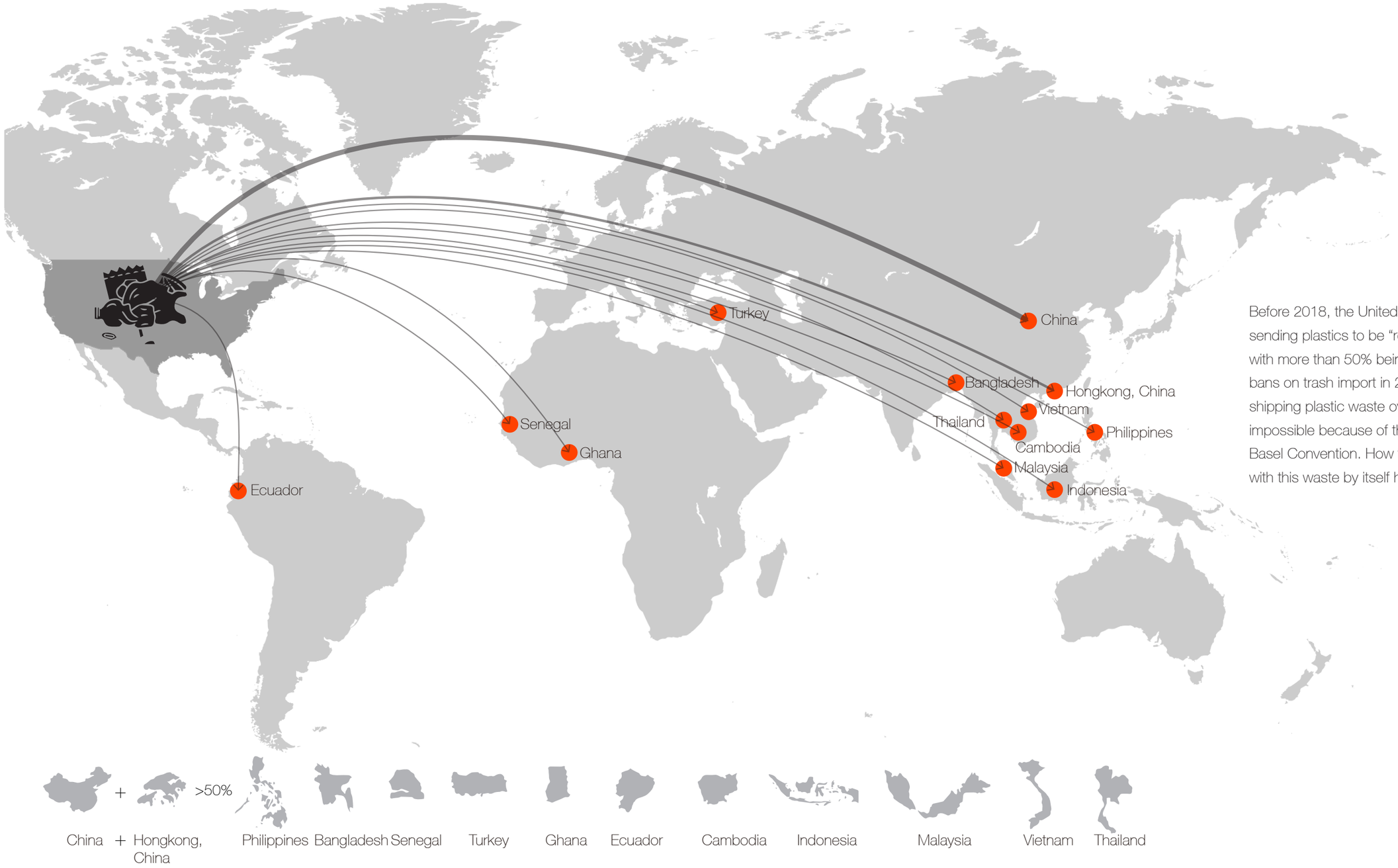


Figure 3 Water, Path. "Plastic vs. Aluminum: People Are Debating Whether Plastic Can Be Part of a Circular Economy." PathWater, 8 July 2019, https://drinkpathwater.com/blogs/news/aluminum-reusable-bottles-are-required-for-the-beverage-industry-to-claim-any-place-in-a-circular-economy.

US Plastic Waste Flow before China Pastic Import Ban



Before 2018, the United States exported the problem by sending plastics to be “recycled” in other 13 countries, with more than 50% being sent to China. However, China bans on trash import in 2018. Especially after May 2019, shipping plastic waste overseas has become nearly impossible because of the new amendment under the Basel Convention. How the United States should deal with this waste by itself has become an urgent problem.

Plastic Waste Issue Accelerated by Pandemic

Plastic pollution has become one of the most pressing environmental issues. Since the majority of plastic materials take centuries to degrade, all of the plastic that has been sent to landfills still exists — and yet we're still producing and consuming more of it. Plastic pollution control has been a global focus topic in recent years. A lot of progress was made before the pandemic to reduce single-use plastic, but the outbreak of COVID-19 made the use frequency of disposable plastic products once again increased world-wide.

A seagull carries a protective face mask at the port of Dover in Britain.

Figure 4 "These Heartbreaking Images Show How Covid Waste Is Hurting Animals." IndiaTimes, 20 Aug. 2020, https://www.indiatimes.com/trending/environment/images-covid-waste-hurting-animals-520790.html.

1. Because of the three main forms of COVID-19 transmission, from person-to-person; air-borne transmission; and fomite, the massive use of face masks by the world's population was recommended by the World Health Organization (WHO) to slow down the transmission rate of the virus. According to the WHO (2020), PPEs include gloves, medical/surgical face masks, goggles, face shields, gowns, respirators (N95 or FFP2 or FFP3 standard or equivalent), and aprons being made, primarily, of single-use plastics.

The International Solid Waste Association estimated an additional 250 to 300% consumption single-use plastic compared to the pre-pandemic period. Approximately 130 billion face masks and 65 billion gloves are used globally every month nowadays (Vasil 2020). In 2020, China produced 116 million masks a day, or about 12 times what was produced before the pandemic (Bradsher and Swanson 2020). The number of face masks used daily in the world is estimated to reach over 7 billion (Hantoko et al. 2021). During the COVID-19 pandemic, the packaging materials and others (which include medical supplies) are projected to increase (44.8 and 13.2%, respectively) due to the demand for PPEs, food delivery services, and online groceries (Hantoko et al. 2021).[9]

2. Because post-used PPEs should be handled as infectious materials, such waste needs to be properly handled as clinical/hospital waste. The amount of these dangerous wastes causes more stress for management on collection and recycling.

In Brazil alone, an estimate shows that more than 85 million face masks might be disposed of per day (Urban and Nakada 2021). Preventive measures such as the use of face masks were imposed on the population, but no clear instructions and disposing mechanisms were provided. Plastic is both a protector and polluter.[10]

3. The pandemic outbreak has also changed people's plastic usage habits. Plastic products that have the possibility of multiple uses have also had a shorter service life to reduce the possibility of virus spread; the use of unnecessary plastic has increased.

Due to the social isolation imposed by the pandemic, buying over the Internet and apps has been a safe and viable option. However, all items need to be packed to facilitate transportation and maintain the product quality, which has caused a significant increase in packaging production, both in the productive sector and as residues. (Kalina et al 2021; Tilley and Kalina 2020).[11]

9 De Sousa, Fabiula Danielli. "Plastic and Its Consequences during the COVID-19 Pandemic." Environmental Science and Pollution Research, vol. 28, no. 33, 2021, pp. 46067–46078., https://doi.org/10.1007/s11356-021-15425-w.
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Story of Plastic

PLASTIC

+ What is Plastic
+ History of Plastic
+ Plastic Classification & Characteristics

PLASTIC WASTE

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+ Personal Production of Plastic Waste
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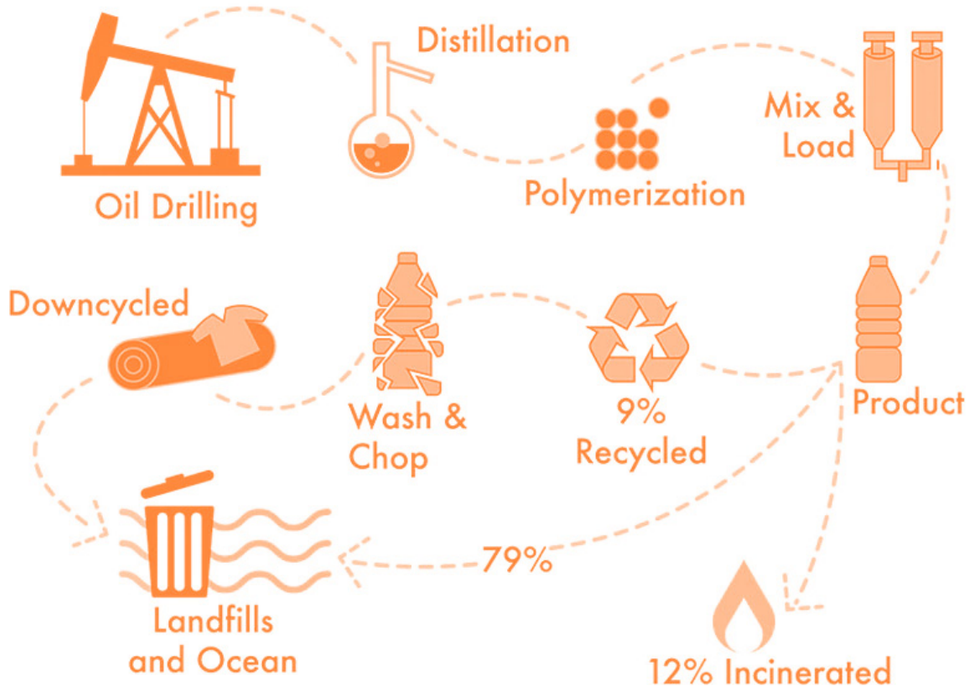
+ Plastic Products Serving & Decompose time

PLASTIC WASTE MANAGEMENT

+ The Social Benefits of Recycle Plastic
+ The Reason of Low Recycling Percentage
+ The World without Plastic
+ The Current Plastic Waste Management

What is Plastic



According to Wikipedia, "Plastics are a wide range of synthetic or semi-synthetic materials that use polymer as a main ingredient." The flexibility and low manufacturing cost led to its widespread use. Humans have benefited from the use of plastics, particularly in the fields of medicine, building technology, and aircraft and automobile manufacturing.

Figure 5 Water, Path. "Plastic vs. Aluminum: People Are Debating Whether Plastic Can Be Part of a Circular Economy." PathWater, 8 July 2019, https://drinkpathwater.com/blogs/news/aluminum-reusable-bottles-are-required-for-the-beverage-industry-to-claim-any-place-in-a-circular-economy.

History of Plastic

Alexander Parkes introduced the world's first-ever man-made plastic in 1862, at the London International Exhibition. "Parkesine," as it was called, was marketed as an alternative to ivory and horn that Parks discovered while trying to develop a synthetic substitute for shellac for waterproofing. That was not the plastic we are using today, but Parkesine represented an important first step in the development of man-made plastic. In the period surrounding World War, plastic innovations had a huge development, and plastic manufacturers turned to making consumer products in the 1950s. Polyester and polypropylene are becoming the most used polymers today.[12]

This group includes PP and PE. Polypropylene was discovered in 1954 by Giulio Natta, and commercial production of the resin began in 1957. It is the single most widely used thermoplastic globally. It is a very useful cost-effective polymer and can be injection-molded, blow-molded, thermoformed, blown film extruder or extruded into a variety of products.

Polyethylene was discovered in March 1933 by Reginald Gibson and Eric Fawcett, two research chemists at ICI's Winnington Laboratory in the UK, and it was first synthesized as a low-density resin (LDPE) in 1935. Polyethylene manufacturing processes have since become more sophisticated and cost-effective. Polyethylene is presently the second most widely used class of resin globally.

About a half of the 35 million tons of PE resin produced is used to make the plastic film, followed by 13–14% in injection-molded and blow-molded products. North American, western European, and Asian markets each consume approximately 25–30% of the PE film produced globally. Typical applications of PE are in blow-molded containers. Polyethylene is also widely used as a dielectric insulator in electrical cables.

Polyvinyl chloride was first created by Eugen Baumann in 1872, but it was not until the late 1920s that the first commercial production of PVC took place in the USA. Large-scale production in Europe followed during the next two decades. Most commodity plastics have carbon and hydrogen as their main component elements, but PVC differs by containing chlorine (around 57% by weight) as well as carbon and hydrogen. PVC as produced is in the form of a white powder. This powder is not used by itself but blended with other ingredients to give formulations that are suitable for use in a wide range of products. PVC is used in buildings and furniture, including window shutters, piping, and upholstery. It is also used as cling films for both household and various industrial applications.

Commercial production of PS was started in the 1930s by the German company BASF (I G Farben) and was introduced into the USA in 1937. Polystyrene is available in two main forms: a general-purpose grade and a high-impact grade in which the PS is modified with polybutadiene.

Chemists Whinfield and Dickson produced the first polyester films and in the early 1970s the first polyester bottle resins in the 1950s. Of the few polymers that are potentially suitable for bottles, PET is the only plastic with a balance of properties such as transparency (near 100% light transmission in a bottle), gloss, lightweight, and resistance to carbon dioxide permeation.[13]

12 Admin, Client. "History of Plastics." Plastics Industry Association, 12 Feb. 2021, https://www.plasticsindustry.org/history-plastics.

13 Andrady, Anthony L., and Mike A. Neal. "Applications and Societal Benefits of Plastics." Philosophical Transactions of the Royal Society B: Biological Sciences, vol. 364, no. 1526, 2009, pp. 1977–1984., https://doi.org/10.1098/rstb.2008.0304.

Plastic Classification & Characteristics

In 1988, the Society of the Plastics Industry introduced the Resin Identification Code (RIC) system which divided plastic resins into 7 different categories.
The purpose was to “provide a consistent national system to facilitate recycling of post-consumer plastics.” Since then, after undergoing some minor variations, the RIC has been recognized as the worldwide standard plastic classification.[14]

	1	2	3		4	5	6	7
	PET	HDPE	PVC		LDPE	PP	PS	OTHER
	POLYETHYLENE TEREPHTHALATE	HIGH-DENSITY POLYETHYLENE	POLYNINYL CHLORIDE		LOW-DENSITY POLYETHYLENE	POLYPROPYLENE	POLYSTYRENE	OTHER
Percentage Recycled Annually	36%	30%	<1%		6%	3%	34%	Low
How Long to Decompose Under Perfect Conditions	5-10 years	100 years	more than100 years		500-1000 years	20-30 years	50 years	more than 1000 years

14 Ferrario, Matteo. “The 7 Different Types of Plastic.” Plastics For Change, Plastics For Change, 7 June 2021, https://www.plasticsforchange.org/blog/different-types-of-plastic.

What is Plastic Waste

Plastic waste, or plastic pollution, is 'the accumulation of plastic objects (e.g.: plastic bottles and much more) in the Earth's environment that adversely affects wildlife, wildlife habitat, and humans.'

It also refers to the significant amount of plastic that isn't recycled and ends up in landfills, polluting the soil and ocean.

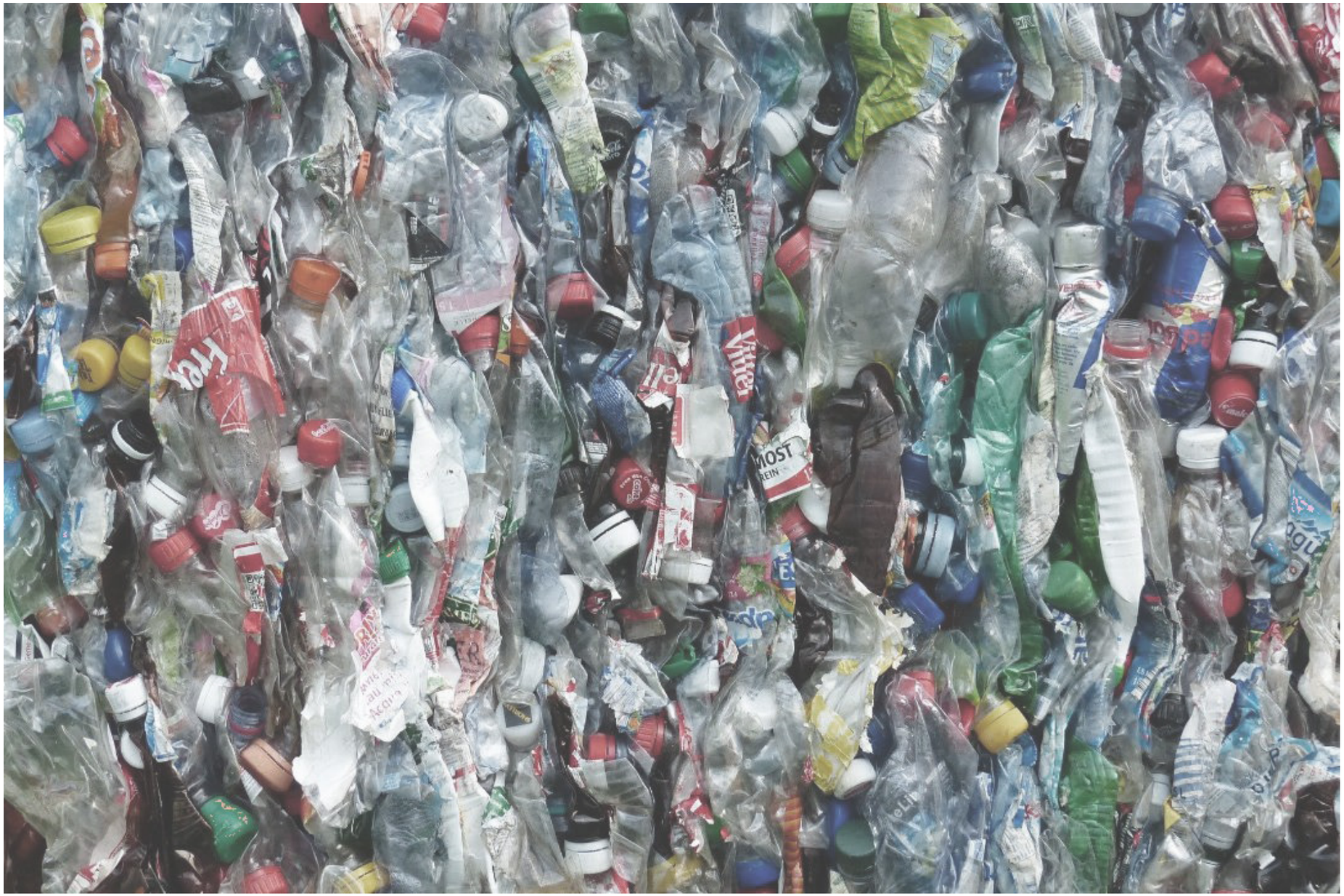
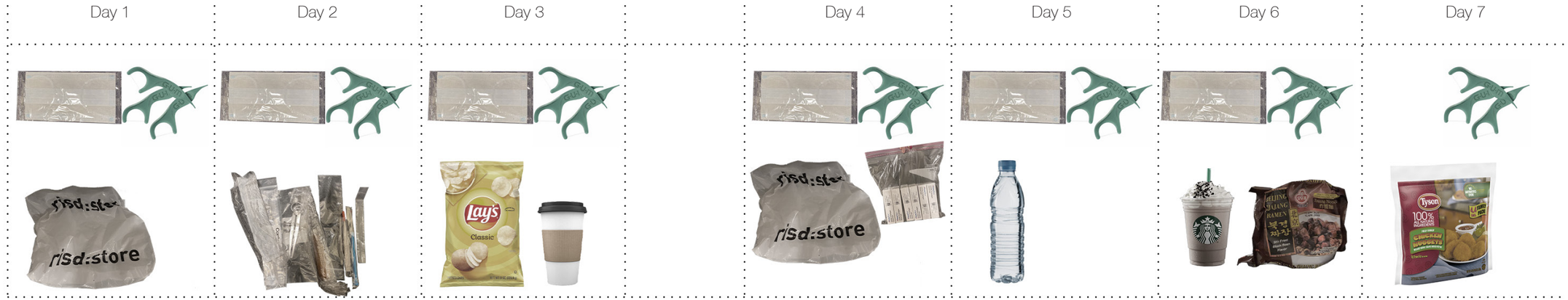


Figure 6 Creagh, Ben. "Recycling Sector Gets a $1.1 Million Boost from Victorian Government." Food & Beverage Industry News, 15 Aug. 2018, https://www.foodmag.com.au/recycling-sector-funding/.

Plastic in Daily life (per person per week)



I document the plastic I used in one week. There are things I use every day and things I use for a very long term. But in any circumstance, plastic appears commonly in my daily life but seems invisible before.

The amount of plastic waste I generated shocked me. Usually I pay attention to avoid actively using plastic disposable products, but still passively obtain a lot of plastic that I cannot avoid to use.
It makes me wonder, are we already addicted to plastic? What is the cause of plastic? Are we unable to turn back? How would life be affected by returning to a world without plastic?

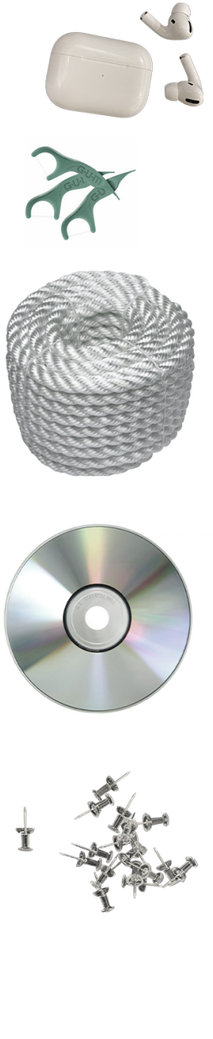
Daliy used plastic classification

1	2	3	4	5	6	7
PET	HDPE	PVC	LDPE	PP	PS	OTHER
POLYETHYLENE TEREPHTHALATE	HIGH-DENSITY POLYETHYLENE	POLYNINYL CHLORIDE	LOW-DENSITY POLYETHYLENE	POLYPROPYLENE	POLYSTYRENE	OTHER









Personal production of plastic waste

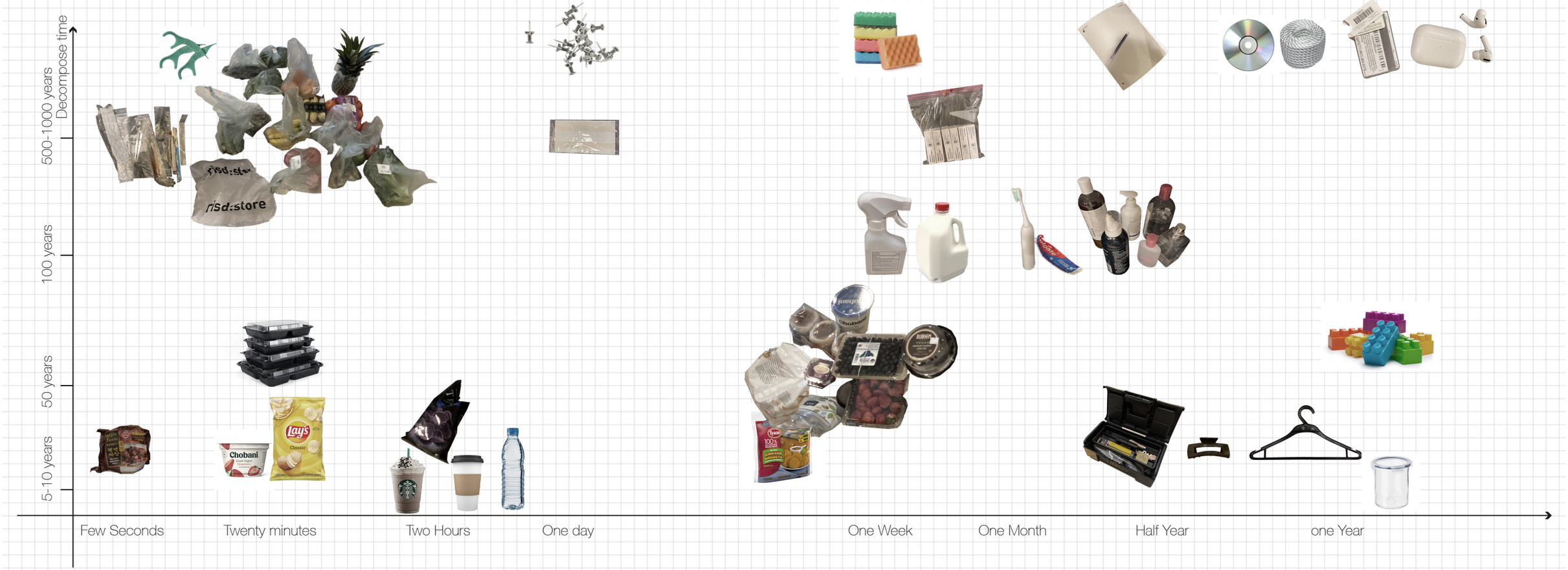
Geology of plastic landfill

The volume of the plastic waste I produce in 4 weeks relates to my body volume. The base of the boxes is 9 inches by 9 inches equal to my feet area. So, the volume of plastic waste I generate in one month is around the volume of myself.

The plastic waste in the left boxes shows the way when it has been abandoned in the trash can. But when plastic waste is landfilled, it is packed and compressed.

To show the geology of plastic landfills, I made another box to show the volume of compressed plastic waste, Compressed plastic wastes collect from 5 people in two weeks.

Plastic Products Serving & Decompose time



The single-use plastic products only use a few seconds yet take hundreds of years to decompose.

"This isn't a problem where we don't know what the solution is, we know how to pick up garbage. Anyone can do it. We know how to dispose of it. We know how to recycle." It's a matter of building the necessary institutions and systems.

—We Made Plastic. We Depend on It. Now We're Drowning in It

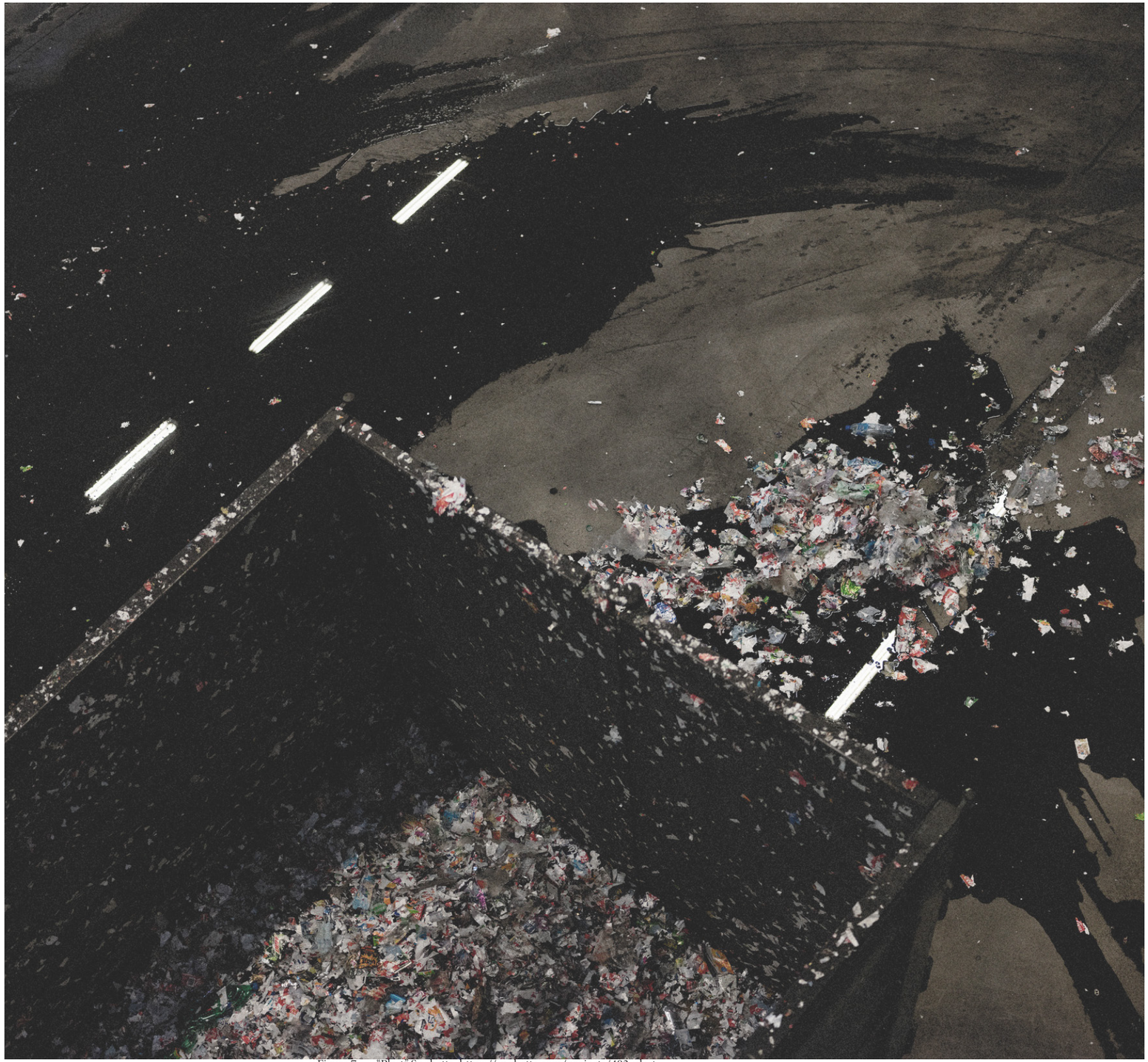


Figure 7 "Plast. Snøhetta, https://snohetta.com/projects/403-plast.

The Social Benefits of Recycle Plastic

Improved consumer health and safety: Plastics contribute to the health and safety of consumers in food and water packaging applications.[15] Especially under the current circumstance of Covid-19, public health became the priority of everything.

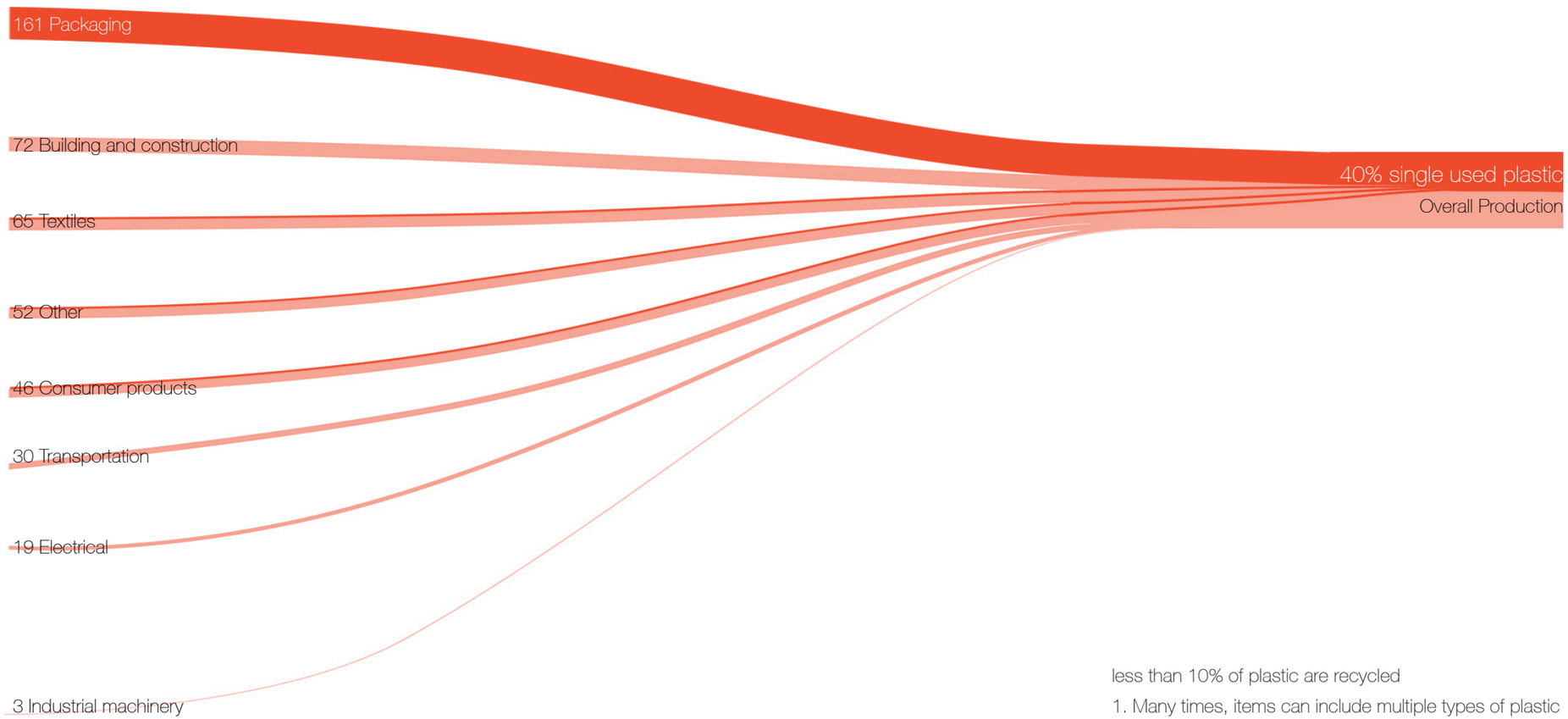
Energy savings: Owing to their light weight, plastics reduce transportation costs and, therefore, atmospheric carbon dioxide emissions.[16]

Material conservation: As reported by PlasticsEurope (2008), plastics can be made from any feedstock containing carbon and hydrogen. Currently, fossil fuels are the preferred feedstock, but plastics are also made from renewable resources such as sugar and corn. Around 4 percent of global oil and gas production is used as the raw material for plastics production and a similar amount is used as energy in the process. However, plastics by their very nature store carbon, and this energy is retained by reusing and recycling plastics. Plastics capture around half of the carbon that is used to produce them, and this is a valuable resource. (Applications and societal benefits of plastics).[17]

Recycle plastic is reducing pollution, and producing a resource opportunity.

The Reason of Low Recycling Percentage

Global plastic production by industry
in million of tons



less than 10% of plastic are recycled

1. Many times, items can include multiple types of plastic and different layers which are hard to separate and make recyclability difficult and costly.

2.Plastics can often be contaminated by food and other substances, making the resins not clean enough to be reused.

3. Recycling facilities cost millions of dollars to build and operate can only be profitable when a huge amount of plastic is treated every day.

Small quantities of plastics can therefore make recycling non-economical and non-beneficial, due to low efficiencies and high costs.

15 Andrady, Anthony L., and Mike A. Neal. "Applications and Societal Benefits of Plastics." Philosophical Transactions of the Royal Society B: Biological Sciences, vol. 364, no. 1526, 2009, pp. 1977–1984., https://doi.org/10.1098/rstb.2008.0304.

16

17

The World without Plastic

Imagine a world without plastic, the changes in life are huge. Starting from many daily necessities closest to life, packaging bags, coffee cups, milk jugs, and many containers will change; lifestyles, seats, computers, mobile phones, and Wi-Fi will be affected; transportation, aircraft parts, auto parts, underground Pipelines; of course the natural environment will also change.

The World without Plastic

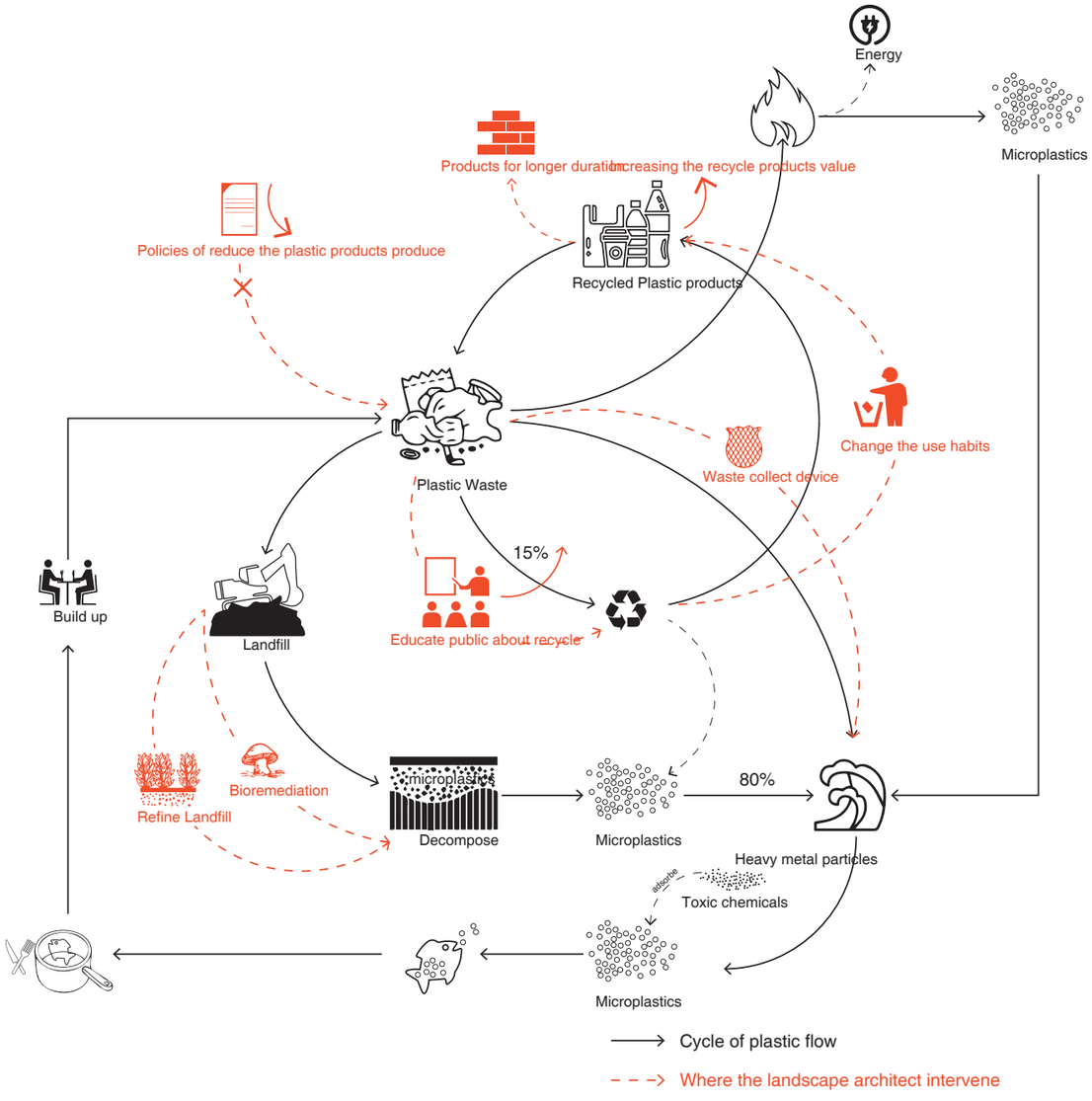
Plastic Waste Management

The most common waste management we have is landfill. The impact of solid waste is varies. First, it directly affects the region of landfill sites: unpleasant odors, dust, noise or damage to the infrastructure caused by heavy vehicles used for transportation of waste materials. It also causes indirect effects on various levels of environmental pollution (methane and leachate generated on waste sites during decomposition of organic material and percolation of water through garbage). Therefore, the traditional waste disposal reliance on landfills has to be changed. *The Landscape Architect's Guide to the World of Solid Waste* classifie eight design approaches of transformation of waste sites:[18]

(1) Camouflage: disguise and blend new structures into the surrounding landscape, due to visual and/or practical aspects.
(2) Restoration: The strategy seeks to reconstruct a waste site, returning it to its former state and condition.
(3) Recycling: The method aims to strengthen economic or social benefits.
(4) Mitigation: This strategy seeks to weaken the impacts of infected land or water in the surrounding environment through natural processes.
(5) Sustainability: This approach centers around economics, resource conservation and self-sufficiency of waste sites.
(6) Education: The educative approach seeks to raise awareness and change attitudes towards waste.
(7) Integration: The strategy is a combination of all the above-mentioned approaches. Its interdisciplinary perspective results in a diverse and versatile way of managing waste.
(8) Celebration: In this approach waste or its management is highlighted, dramatized and used as a metaphor of refuse, excess and resource management.

I think this reading The Landscape Architect's Guide to the World of Solid Waste is only a one-sided understanding of the role of landscape architects in the problem of solid waste.

In the whole process of waste management, there are many aspects we can intervene in but have not yet explored much, not just refining existing landfill sites. Of course, landfill is an important method, and it has many spatial dimensions and intervention potentials, which seems to be the obvious intervention point of landscape architects, but this method itself is the product of the failure of recycling management. Refine landfill is a placebo, not a fixer. More ideally, we find other choices to reduce or replace the landfill. Because transforming wasteland with new purposes is addressing problems caused by existing waste but new landfill sites will be created that will cause new problems or exacerbate existing problems.

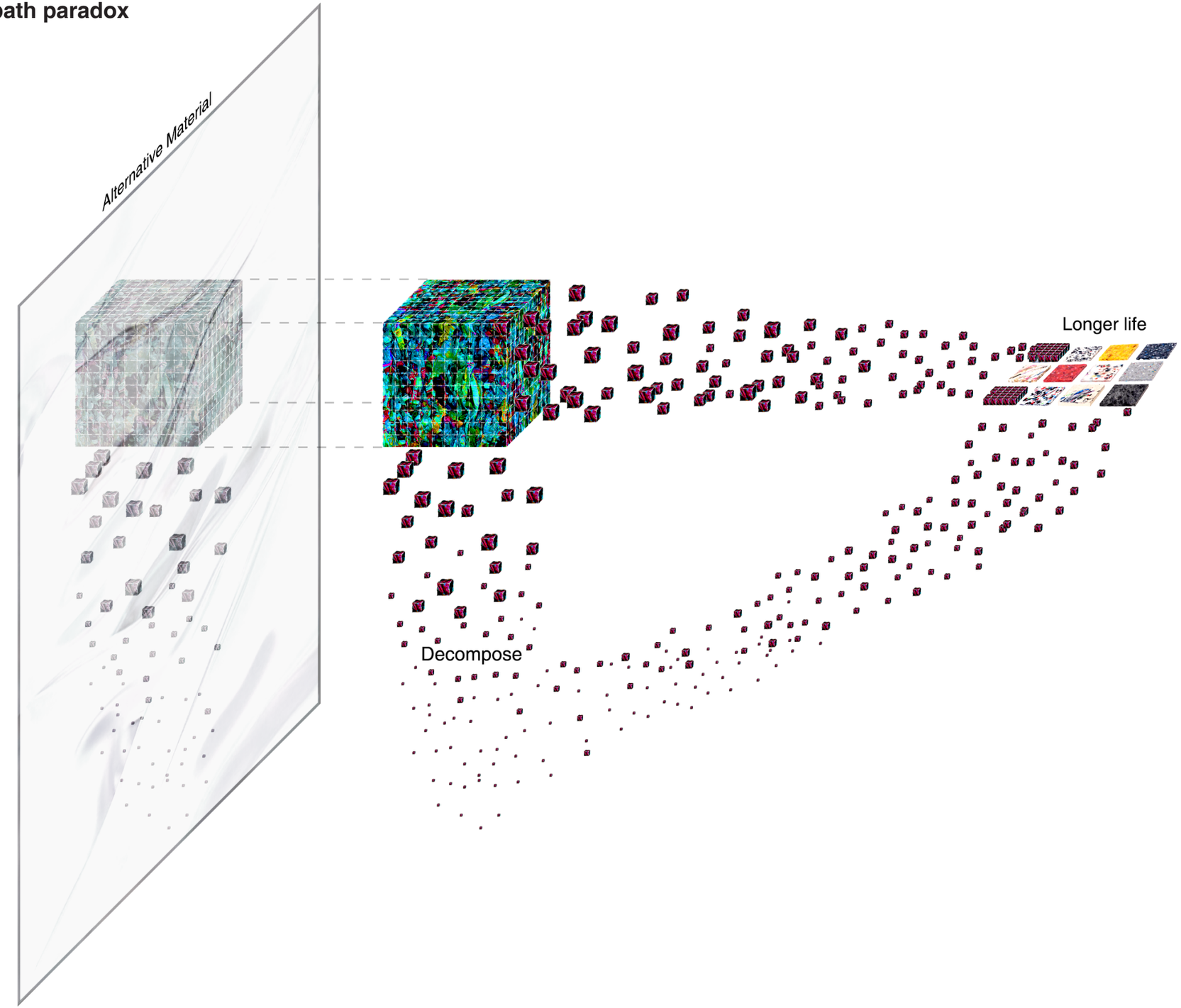


18 The Landscape Architect's Guide to the World of Solid Waste. SLU/Department of Landscape Architecture, Planning and Management (from 130101), 2016.

MATERIAL TESTING

+ The 3-path Paradox
+ Other Thoughts of Prolonging life of Single-use Plastic

The 3-path paradox



1. Find alternative Material
Plastic emerged as a substitute for other materials. Using alternative materials to plastic may cause other issues too.

2. Decompose
Plastic decomposition does not mean that it disappears, rather, it degrades into micro and nano plastics, which continuously pollute the hydrological systems such as ocean and are digested by marine animals. Plastic accumulates in the ecosystems.

3.Prolonging life
Prolonging the life of plastic begs the questions: how to define the value of the products? What if the recycled plastic products are even harder to handle after they have been discarded?

Other thoughts of Prolonging life of single-use Plastic

Precious Plastic Spaces

Machines

Shredder

Extrusion

Injection

Compression

Products

Bricks

Furniture

Modular Structures

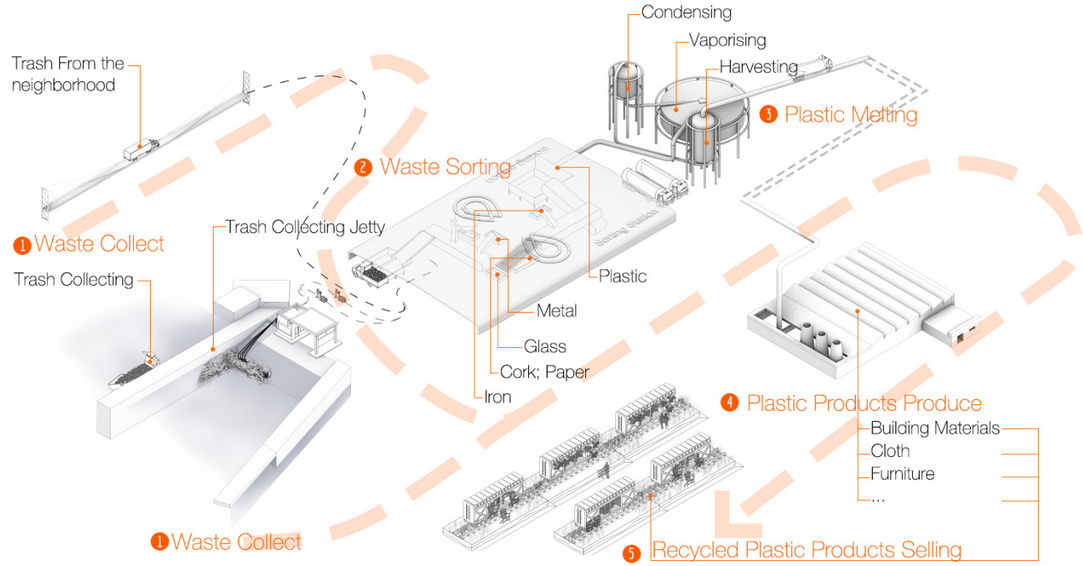
Jewelry

Precious Plastic is an organization that approaches counting on people as the element to fix the plastic mess, providing a platform of machines and the technics to the public to create an alternative global recycling system.

Figure 8 "Precious Plastic Spaces." Precious Plastic Spaces, https://preciousplastic.com/universe/recycling-spaces.html.
Figure 9
Figure 10
Figure 11
Figure 12
Figure 13
Figure 14
Figure 15
"Precious Plastic Spaces." Precious Plastic Spaces, https://preciousplastic.com/universe/recycling-spaces.html.

Plastic Energy

Waste management process assumption based on Plastic Energy Techenology



Plastic Energy Offer a global and sustainable solution to help prevent plastic pollution, by transforming previously unrecyclable plastic waste into a valuable resource.

Based on the research on what Plastic Energy can do with its technology, I start to think about how it can be planted in with landscape design. The image shows the waste management process, which begins with trash collecting from adjacent neighborhoods and rivers, then sorting, transporting pure plastic for melting, and then mode into new products.

"Technology." Plastic Energy, 16 May 2022, https://plasticenergy.com/technology/#patented-technology.

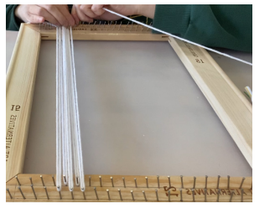
EXPERIIMENTATION

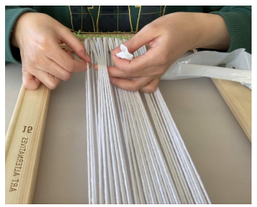
+ Plastic-textile Samples
+ Samples Flexibility Chart
+ Plastic-textile Experiment
+ Potential Application

Plastic Textile Samples

Wave

Process





Crochet

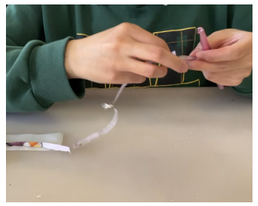
Process

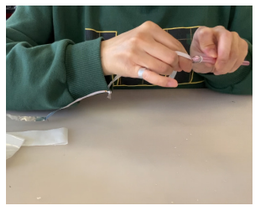
Other Technologies

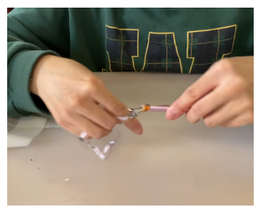
Shred

Crochet

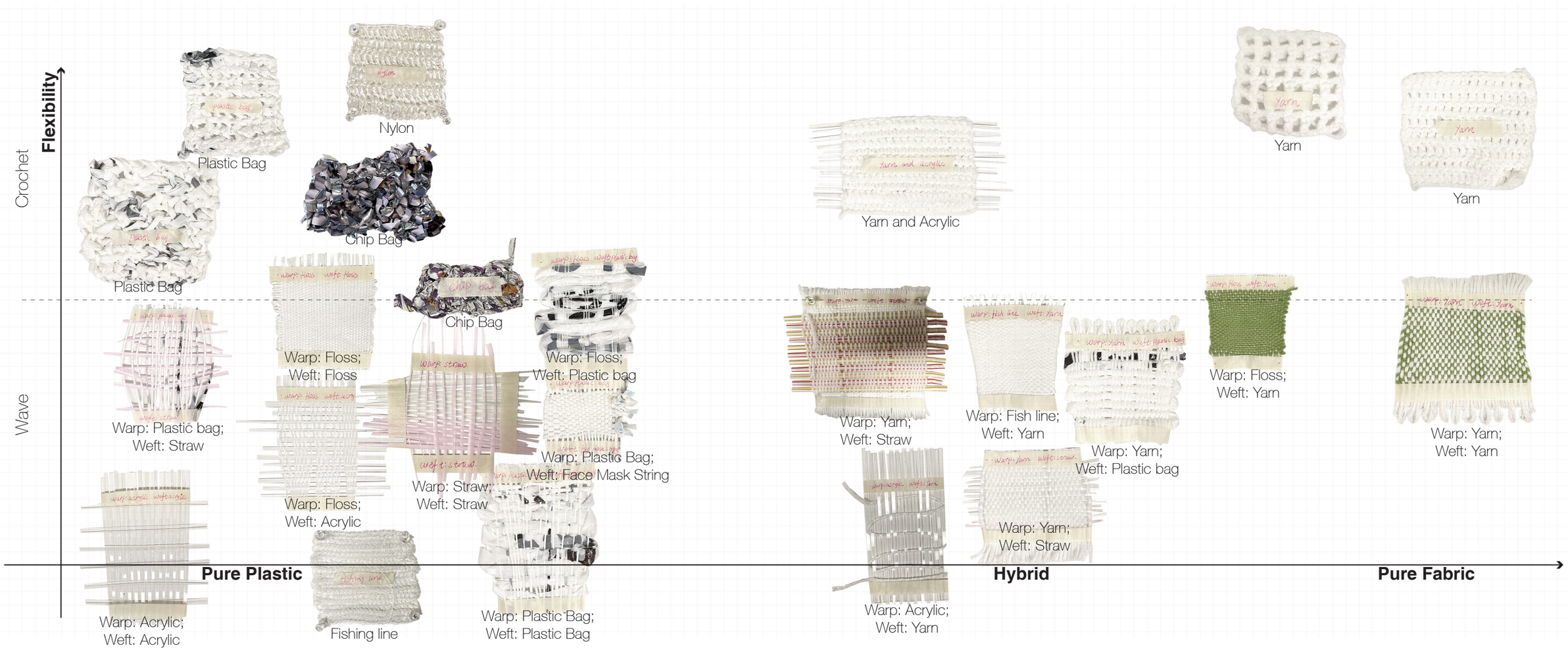
Compress







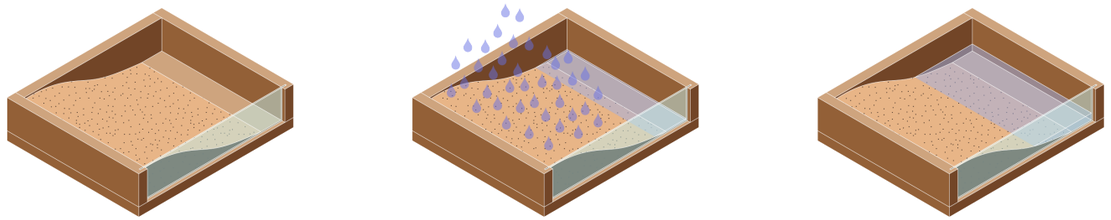
Sample Flexibility Chart



Plastic-textile Experiment

With the samples I made from single-use plastic, I start to explore my sample applications. It got me thinking about geotextiles increasing soil stability, providing erosion control, or helping with drainage, and start questioning the same possibility of the plastic blanket I made could offer. For testing, I made a model and put my different wave densities on plastic blankets and insets and simulated how it would respond to two different types of soil erosion.

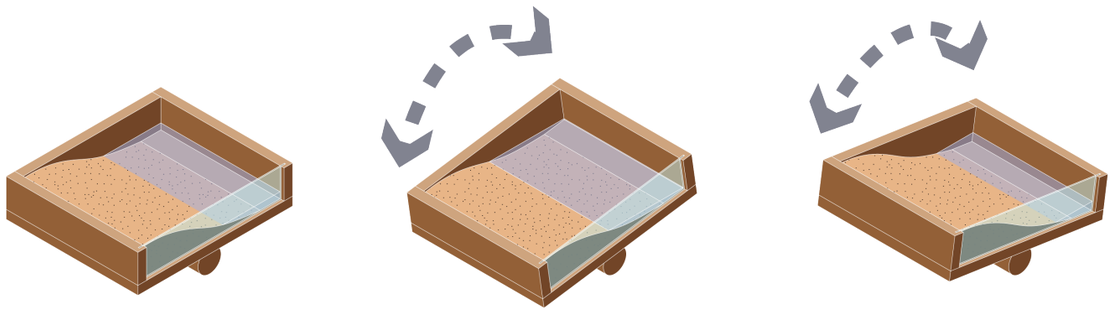
Rain



Process

Spray water from the top of the model to imitate the rain and watch how the surface reacts to it. Calculate the accumulated soil runoff on the right side of the model.

Tidal Change

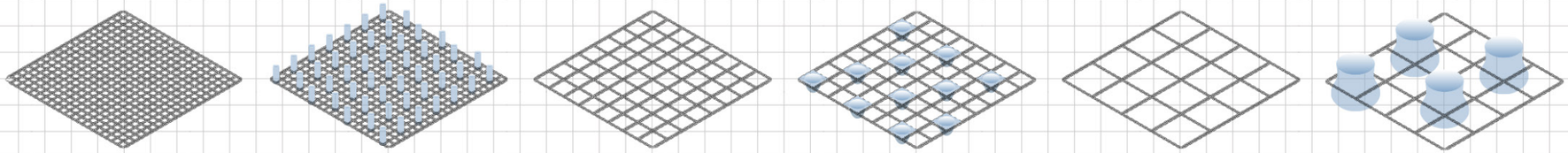


Process

Put water into the model and shake it gently from left to right to mimic tidal changes and watch the topsoil react to it. Calculate the cumulative soil loss in water.

Rain

Density



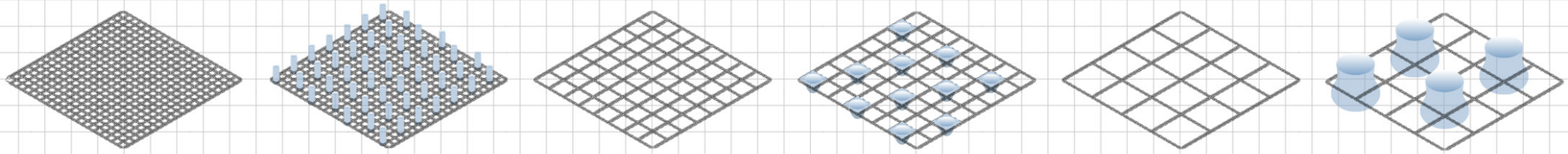
Before

After

Soil loss

Tidal Change

Density



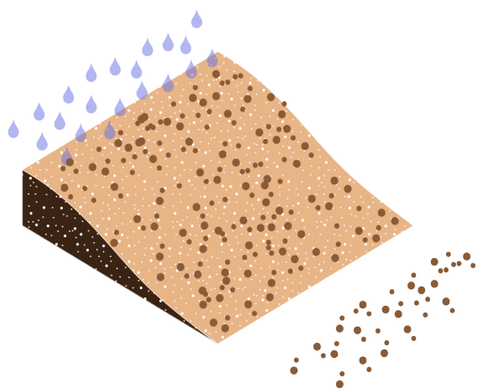
Before

After

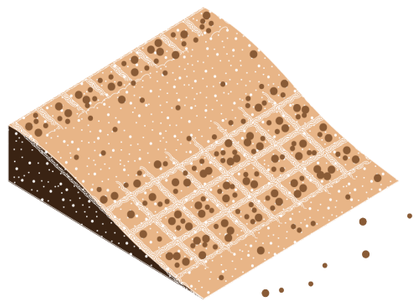
Soil loss

Potential Applications

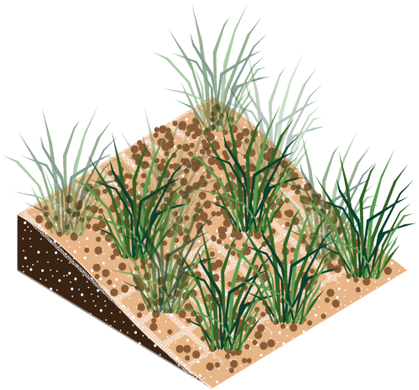
Timeline



Surface Runoff



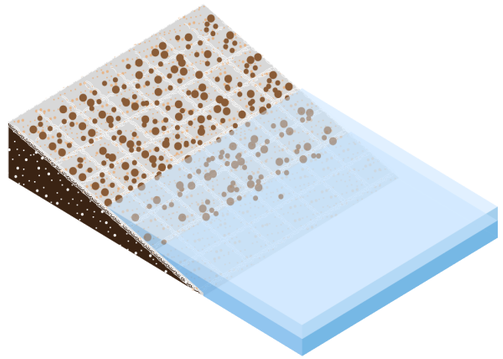
Soil Fixation



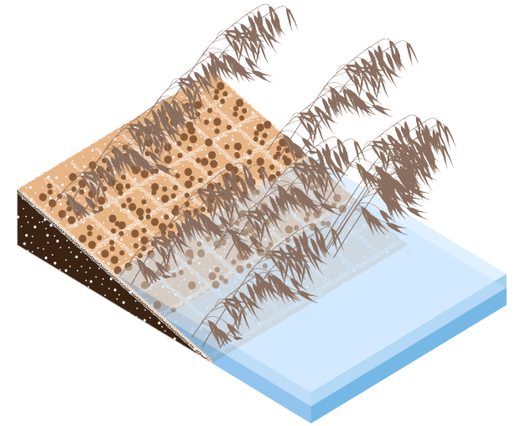
Vegetation Solidified soil

Application in Sand Control and Soil Fixation

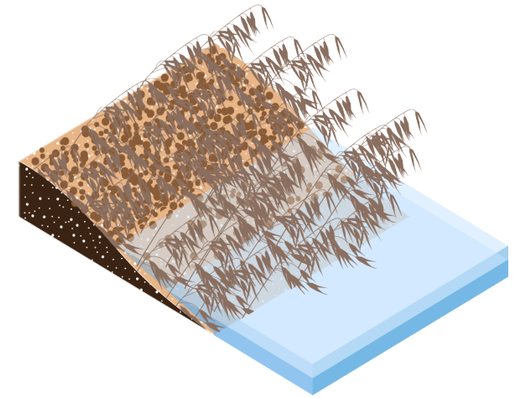
Surface Runoff



Soil Accumulation



Vegetation Growth



Plants Further Fix Soil

Applications in Riverside Habitat Restoration

Application

The plastic blanket can be used on the real site to prevent soil erosion and habitat restoration. Help trap soil and slug along the river and provide the possibility for vegetation to grow and aquatic animals to rest.

REFLECTION

REFLECTION

This thesis departs from an analysis of the current situation under Covid-19, the changes it forced globally, and the slow violence it has caused and aggravated. Psychological trauma, unknown sequelae, economic recession, and changes in the use of public spaces, among others, can all be considered as forms of slow violence. But what is special about the plastic problem is that it already existed before the pandemic, yet it hugely increased the usage of plastic, which can be quantified. All plastic products, from their invention to the present global condition, should be considered because most plastics still exist and have not yet been decomposed. This thesis' initial ambition was to manage the use of plastic in specific regions of the world and to design a mechanism to encourage people to collect and recycle their plastic. But to better understand the amount of plastic used and to avoid the obvious possibility of sending it for disposal, I decided to begin with a more personal scale; I collected the plastic waste that I generated and tried to transform it into a way I am familiar with. The thesis then expanded from this personal scale into the different scales we deal with in landscape architecture. This required different experimental stages to I could refine where the study was gesturing towards.

As the study I progressed, I gradually learned the elements that I can and cannot control, starting from the samples I made with single-use plastic, which made me think more deeply about their applicability and potential. During the process of the thesis, I stepped out of my comfort zone, away from my computer and regional planning, and tried to immerse myself in the personal scales required for this type of material exploration.

Of course, the experimental direction I choose is not the only direction this study could have been taken to. I focused on ways to prolong the life of single-use plastic, yet, and because of the equipment limitation and considerations around my safety, I did not try to melt or compress the plastic. As a result, the application methods used in this study do not attempt to provide the perfect solution to a given problem. Instead, they try to tease out different possibilities. But due to the type of experimentation, many other paths could have been followed.

This thesis departs from a broad approach to plastic recycling. The case of centralized sorting is much higher than the plastic products themselves. Because of the low value of recycled products, people's willingness to recycle is low. It then focuses on increasing the value of recycled plastic products, providing other values in addition to the original value, and encouraging people to recycle plastic to hopefully, make recycling plastic a trend. It also explores further directions, such as community-based plastic recycling and other technologies to transform plastic waste into other recycled products, while attempting to take plastic-textile to other types of applications.

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IMAGE LIST

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