Summary

Global plastic pollution is an ecological crisis. Any earnest assessment of the enormous scope of the problem, the incalculable harm it imposes on the planet's essential ecosystems (particularly the oceans), and the rate at which the problem is expanding must be approached with at least the same posture as we treat climate change. By recognizing the urgency of the issue, we can act accordingly, and at a scale that is commensurate with the existential challenge humanity is facing.

The purpose of this article is to set the stage for Diatom's tactical plan to remediate plastic waste through a proposed tokenized Plastic Removal Credit (PRC) framework. The framework's intended goals are to leverage the capabilities of DeFi to build a reliable, verifiable, and efficient plastic removal supply chain that increases recycling, reduces use, funds high-leverage removal projects, establishes new channels of circularity and drives innovation in new materials.

Ample research and framing already exists framing the concept of plastic credits, (major acknowledgements to organizations like WWF, OBP, SYSTEMIQ, and the Ellen MacArthur Foundation). Diatom intends to integrate the existing knowledge base into a cohesive and actionable plan for global plastic pollution remediation.

We're on track to have more plastic than fish in the sea by 2050 by weight (*).

That's a lot of plastic, considering there are an estimated 3.5 trillion fish in the sea. But it's not hard to imagine when armed with the knowledge that we dump a garbage truck's worth of plastic into the ocean *every minute***(*)**.

Unlike fish--who will die and reintegrate back into the oceanic ecosystem--all of that plastic will stick around for roughly 450 years, breaking down slowly into microplastics (pieces smaller than 5mm in size). Since ocean life curiously taste-tests everything, those microplastics contaminate fish, water and even evaporate and become airborne(*)(*).

Even diatoms and other phytoplankton are unwittingly ingesting or binding with microplastic. The health of phytoplankton is the health of the ocean. Phytoplankton are responsible for sequestering nearly half of the C02 emissions on the planet, and produce nearly half of all oxygen. For an overview of the importance of diatoms and their symbiotic relationship with whales, see our Diatom manifesto.

It's now estimated that the average human being consumes 1 credit card worth of microplastic every week (*). While the research is still early on the health effects--it's not good. The toxicity from plastic has been linked with sexual function, fertility complications, and cancer(*). One recent study even found microplastics present in 4 out of 6 human placentas that were tested(*).

Since plastic was invented in 1907, its adoption has exploded. And to be fair, the benefits of plastic cannot be understated. Plastics have been enormously beneficial to everything from medicine and computing to reduced food waste and lower fuel use in transportation. And yet, this byproduct of the fossil fuel industry is too successful for our own good.

As humanity hurdles into the 21st century, we realize that there is no new continent to explore, no vast unknown ‘worlds’ across the sea to discover--rich with resources. That age-old feeling of exploring the *vast unknown* lands no longer exists on earth. Our big world is now smaller, and the illusion of throwing something “away” is disintegrating as we see our own waste coming back around like a boomerang to hit us in the face.

We now have a legitimately scary mess on our hands, one that with no exaggeration threatens our very existence. And while climate change eats up much of the global dialogue, scientists are warning that plastic pollution and climate change are not separate issues.

A paper from the Zoological Society of London and Bangor University says the two issues are intertwined, and each makes the other worse(*). Since plastic is a fossil fuel product, its creation leads to greater greenhouse gas emissions, and increasingly aggressive weather due to climate change disperses plastics--worsening plastic pollution at sea. Furthermore, coral reefs--essential to life in the ocean--are doubly hit. As the ocean acts as a carbon absorbing sponge, water is acidified and warmed, which leads to coral bleaching and weaker coral skeletons(*). Meanwhile, “ghost net” plastic fishing gear attaches to coral reefs and rakes back and forth with the tides--destroying already weakened reefs, while killing or injuring 650,000 marine animals annually through entanglement(*)(*).

It’s time to acknowledge that plastic pollution and climate change are two sides of the same coin, both rooted in fossil fuel production and consumption.

“Our study shows that changes are already occurring from both plastic pollution and climate change that are affecting marine organisms across marine ecosystems and food webs, from the smallest plankton to the largest whale.”
- Helen Ford, Bangor University

Who is to blame?

We all know the *easy* answer to this. The fossil fuel and natural gas industries have thrived off of an economy that is hungry for energy. Plastic is a byproduct of the refining crude oil and natural gas. It’s a clever way to maximize returns by squeezing those extracted resources for a few more pennies, while providing real utility across many industrial and consumer sectors.

Furthermore, while the fossil fuel industry may like to pretend that they are not the same as the plastic industry when speaking to the masses, they tell the opposite narrative to stakeholders. In fact, big oil is betting that their growth over the next few decades will be *driven* by none other than: plastic production. It’s worth noting a fantastic article published by Vox that not only explains this narrative, but succinctly summarizes the economic dynamics of plastic at play.

With that said, solely pointing the finger at the big bad oil boogeyman is not the *real* answer. A truly ecologically informed perspective is far more constructive--this is a problem *created by humanity*. If you are human, you are in one form or another part of a symbiotic relationship with an industry that pulled human civilization out of the dark ages, but is now choking our very life support systems.

The fact is that companies can only grow commensurate with the energy (money) that is put into them. Civilization was hungry for power sources in the early 20th century, and the industrial revolution met the demand. While this is by no means intended to excuse an industry rife with faults, it's ultimately more valuable to look at this from a historical perspective rather than that of an angry teenager. That is, *in the early 21st century, confronting ecological devastation, humanity shifted away from fossil fuels--both for energy and materials--and toward renewable sources of energy.* This is a markedly different stance from, *down with those evil oil companies.* When we look at this not through the lens of warring political or ideological factions, but as fellow members of the same species, we will solve the challenge faster.

Let's not forget, when the fossil fuel industry came into existence, it was lauded as a vast improvement over whaling for oil, and plastics were initially conceived to reduce the ivory trade that devastated threatened elephant populations.

How do we fix this? Part One.

If there were as many ants on the planet as there were humans by weight, ants would still not have a waste problem (in fact, a survey indicated that Americans are more concerned with plastic pollution than climate change).

Why? Because ants have evolved to create an incredibly symbiotic, albeit complex civilization. Their waste is not *wasted*--it either becomes a part of another local species' essential needs, or is used for another purpose internally. Some ant colonies have even evolved to have what can only be described by scientists as *toilets(***)*. Fecal waste is kept here where it may be mined for nutrients, used to build, or to fertilize fungus crops (a favorite farmed food for ants).

Humanity, on the other hand, is not so circular. If extraterrestrials observed humanity from space alongside every other species on the planet, they might remark, "those creatures poop plastic." When we de-anthropomorphize our human perspective and look at humanity from a purely biological perspective, this statement would not be far from the truth. Every species--in order to survive--must extract resources and, therefore must also produce waste. Generally speaking, this cycle works harmoniously. One man's waste is another man's treasure *and all tha*t. But *one* particular form of human waste does not serve the wellbeing of nearly *any* other species. In fact, it does exactly the opposite. It poisons, chokes and contaminates life wherever it is found. That waste is plastic.

“We cannot solve our problems with the same thinking we used when we created them.”

- Albert Einstein.

Solving humanity’s plastic crisis is not just about incredible innovation or strict policies adopted by governments around the world. It’s about re-integrating a biodynamic philosophy back into human civilization. That is, making civilization itself sustainable (as a start). It’s time to take a step back, gaze upon the vast achievements of the past 100 years and infuse the next 100 years of innovation with nature’s circular wisdom. Diatom DAO is taking a practical step forward toward this vision.

How do we fix this? Part Two.

This article will now shift from the philosophical and ethological to the practical and concrete.

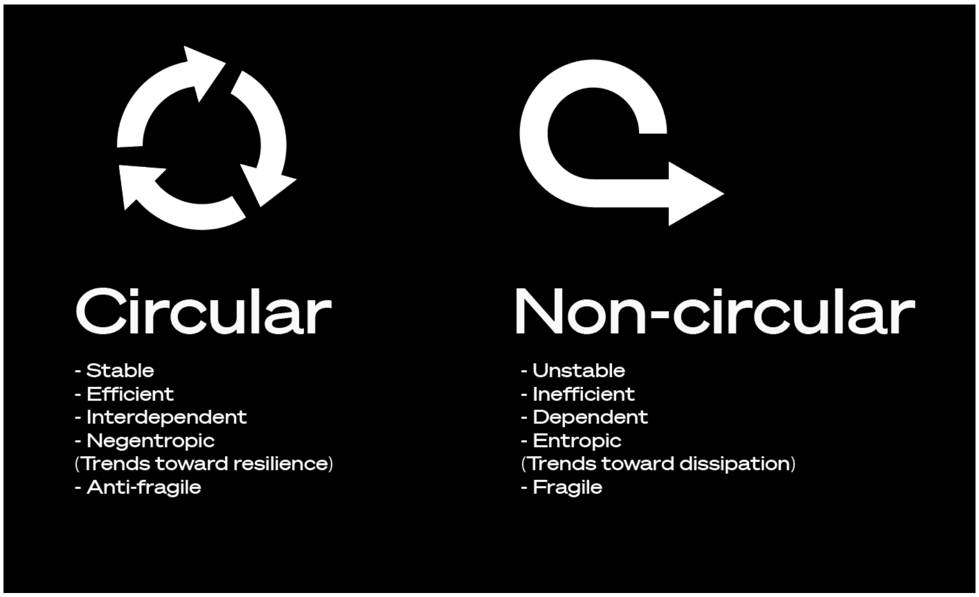
Humanity has established a highly salient awareness that a plastic waste problem exists. At the same time, economic incentives do not currently align with remediating the problem. What follows is a proposed framework for realigning incentives that are healthy for economic stakeholders as well as the global ecosystem that supports all life. This framework is not intended to make obsolete many other well-reasoned approaches, but to build upon them, and contribute to the aggregate body of knowledge in a true spirit of collaboration.

Diatom stands for a world where making profit is the *same* behavior-set as regenerating and protecting life support systems (ecological apparatus). This requires those participating in Diatom to make a conscious decision to shift their thinking away from the outdated mentality that “doing good” is solely reserved for the philanthropic space (a statement that implies that business is therefore a space for *not* doing good). It is worth noting here that “profit” comes from the Latin word for “progress.” Non-profit quite literally means “non-progress” etymologically. Rather, we believe that “making profit,” or progress, ought to be exactly one and the same as intelligent evolutionary decision making, driving species’ resilience. In fact, the most productive contributors in any ecosystem generate an *overflow* (profit) of resources that replenish life in proximity. We would not ask a 2,000 year old tree to stop generating the profit of carbon sequestration or oxygen production, because the economics of trees are aligned with the greater benefit of the ecosystem. In human economics, we’ve stigmatized profit negatively only as a result of economic misalignment with nature’s principles.

Circularity

Exceptionally adapted organisms interact and collaborate with the environment around them. They waste as little as possible, establishing as close of a closed loop as possible in their economic cycle. Materials are maximised to their full potential before being relegated to external waste. Furthermore, “waste” is expressed in such a way as to provide benefit to a neighboring organism. Circularity is characterized by its stability, efficiency, interdependence (collaboration with other organisms), Negentropy (non-dissipation of energy, giving rise to higher order), and antifragility (increasing capability to thrive).

Humanity is currently non-circular, and has a high degree of negative externalities that not only exert harm upon neighboring organisms, but also do not take full advantage of the materials being used. Non-circularity is characterized by: instability, inefficiency, dependence (constant and excessive extraction from other aspects of the ecosystem), Entropy (trending toward dissipation of energy and disorder), and fragility (negative response to external stressors, decreasing ability to thrive).

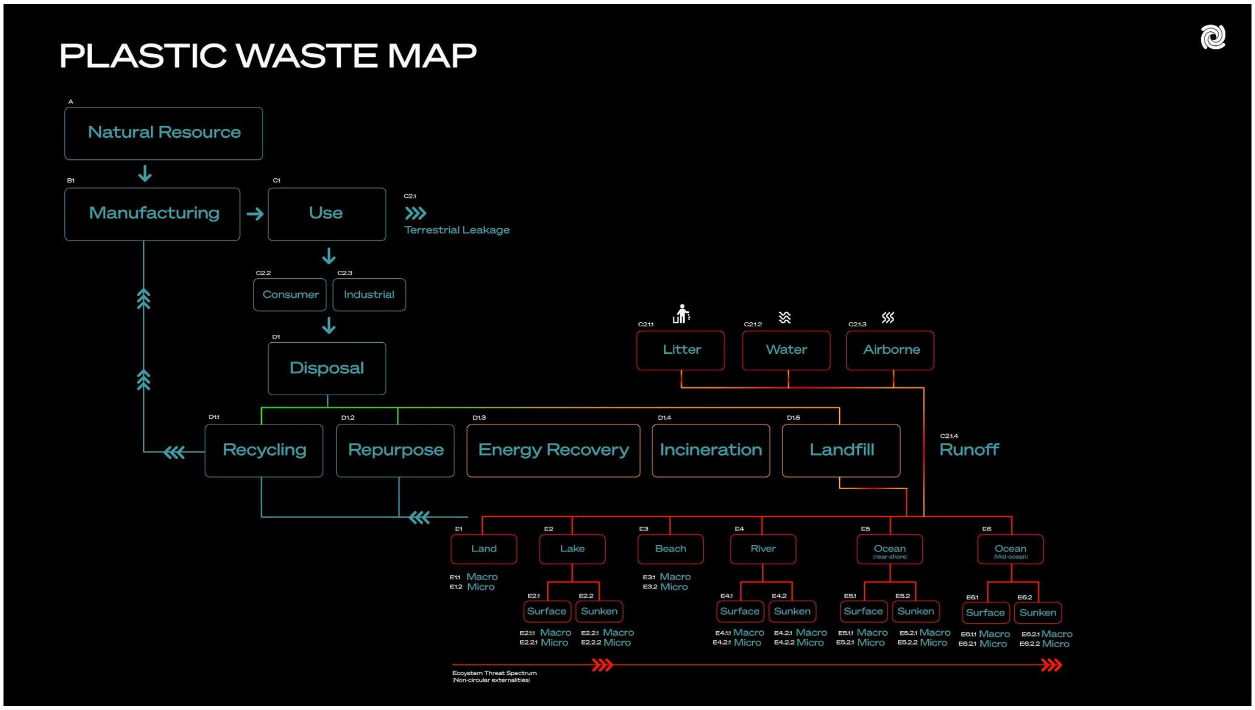


All plastic must be remediated as part of the transformation to a circular system. Diatom aligns with [WWF's call to action] for a "plastic free nature." This means that a priority is placed on activities that capture as much plastic as possible before it becomes more difficult to remediate later. Every piece of macro plastic should be viewed as a slow-release drug that has entered the belly of the ocean, slowly unleashing its full potential for toxicity over time. Micro plastic is the ultimate enemy, as no scalable methods for remediation currently exist, especially once ocean-based.

Diatom DAO intends to help bend the errant arrow of humanity's non-circular tendencies toward circularity, with Plastic Removal Credits (PRC) as one of many important contributions in this effort. Humanity must reckon with its non-circular tendencies not just to survive, but to thrive.

Plastic Cartography

To properly address the complex issue of global plastic waste remediation, we must zoom out and look at the landscape of the problem topographically. That is, we need a map that serves as a useful (albeit imperfect) representation of the plastic waste problem-set from a perspective that is comprehensive enough to see the whole playing field, but detailed enough to be tactically useful. Without a map, no battle plan has relevance. Without a map, no game layer can be applied to solving the problem.



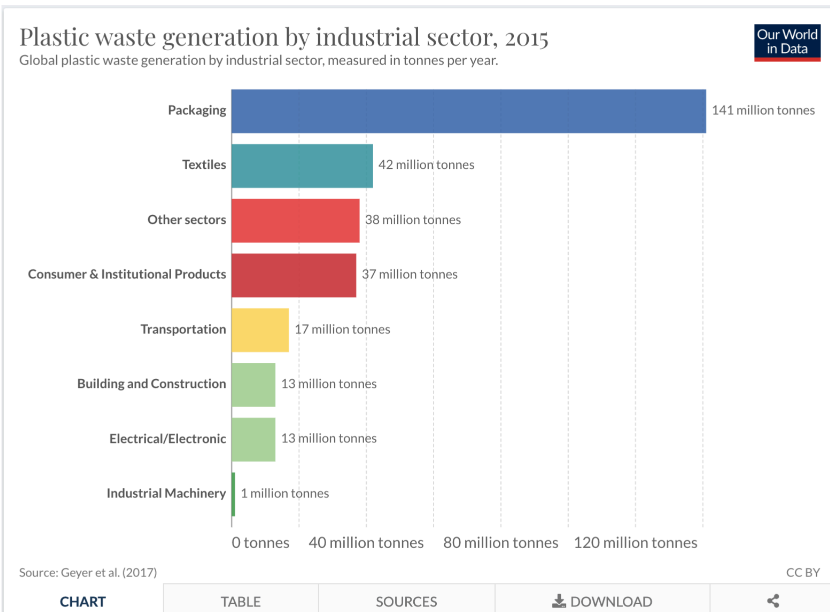
Let's define the playing field:

A: Natural Resources
This category requires little explanation. Fossil fuels and natural gas are extracted from ecosystems primarily for energy production.

B1: Manufacturing
The traditional energy industry has evolved to maximize the utility of those extracted resources through the creation of cheap plastic that is strong, durable and extremely cheap. Plastics are produced for a vast array of industries, including medicine, consumer packaged goods, textiles and beyond. If you simply look around you at any given time, you are likely to observe a multitude of objects that utilize plastic.

Plastic is created through the fossil fuel refining process, where naphthalene is distilled to manufacture plastic pellets.

Plastic is extremely cheap to produce. A 50 lb bag of plastic pellets costs about $70. At roughly 50 plastic bottles per pound, that's approximately 2,500 plastic bottles produced for $70. On the other hand, the externalities of plastic are much higher. That is, the true cost is actually *much* higher, but the manufacturers don't pay it. The commonly accepted rule of thumb is that 1 ton of plastic has the additional cost of around $1,000, and 1 ton of plastic in the ocean has an estimated cost of up to $33,000 in terms of reduced marine natural capital(*). These costs are assumed through carbon emissions, effects on tourism, air pollution, collection and sorting, and ocean cleanup. It's worth noting that Diatom firmly believes that the true cost of ocean cleanup has not even been fully assessed yet (primarily because very little funding has actually been given to ocean cleanup projects, but deep analysis will likely find this to be the biggest cost), given that the ocean has an estimated value of $24 Trillion (*), yet we are pouring 11 million tons of plastic into it every year. We are only now at the early stages of realizing how much plastic proliferation is destroying the value of the ocean.



C1: Use

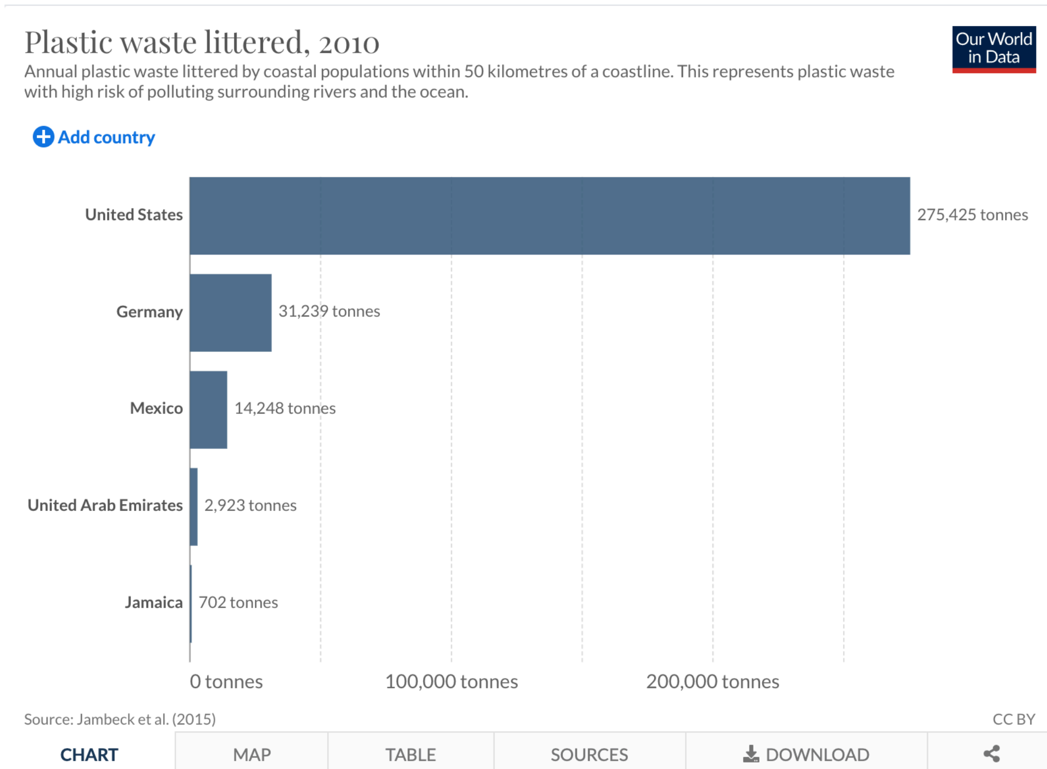
Plastic is used in almost every sector of society--including construction, packaging, textiles, consumer products, computing, medicine and industrial machinery.

C2.1: Terrestrial Leakage

During regular use, plastic can exit the chain of circularity in many ways. We represent 3 broad categories--Litter, Water, and Airborne plastics. What follows is a very brief summary of each that is not intended to be comprehensive, but rather to establish baseline framing.

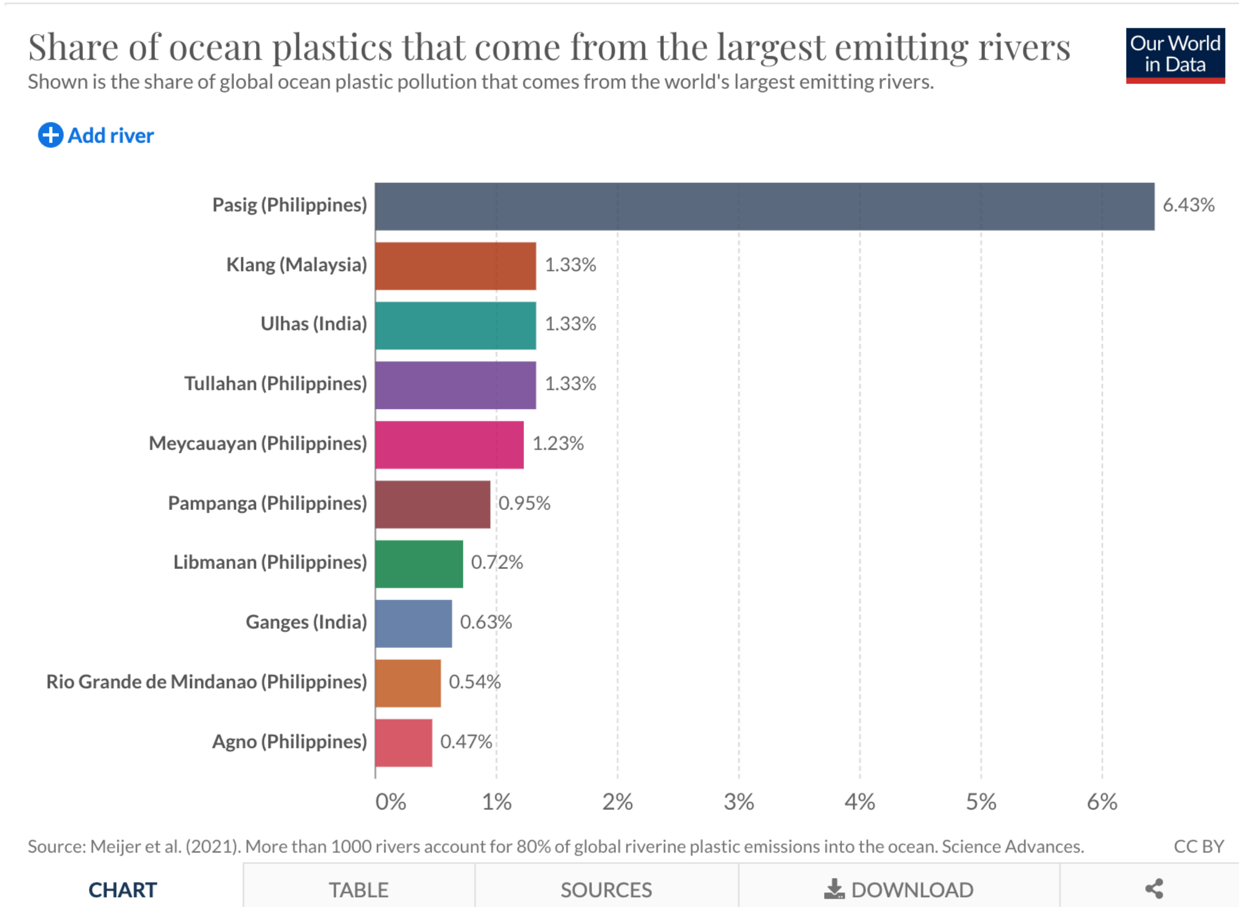
Litter (C2.1.1)

Refers to consumer or industrial litter that is either intentional or unintentional, and is restricted to land-based loss. While western countries like the United States have the most effective waste management, they also tend to consume more plastic and litter more.



Water (C2.1.2)
Refers to macro and microplastic waste that travels via water into higher threat zones (Category E). Water is the primary mechanism by which plastic waste works its way into the most harmful categories of the Plastic Waste Map. It is estimated that 80% of all ocean plastic enters via rivers and coastlines (*) (this makes rivers an excellent choke-point of focus for maximum impact interventions).

It is estimated that 91% of all primary microplastic loss occurs through water systems as well: 66% via road runoff, and 25% via wastewater (*). The single largest source of microplastic loss is from synthetic textiles (clothing made from sources like nylon, polyester, acrylic and other synthetic fibers), which escapes laundry machines that are not outfitted with microplastic filters (35%). Laundry machines must be recognized as a major chokepoint for microplastic proliferation, and can be remediated with the addition of filters that already exist.

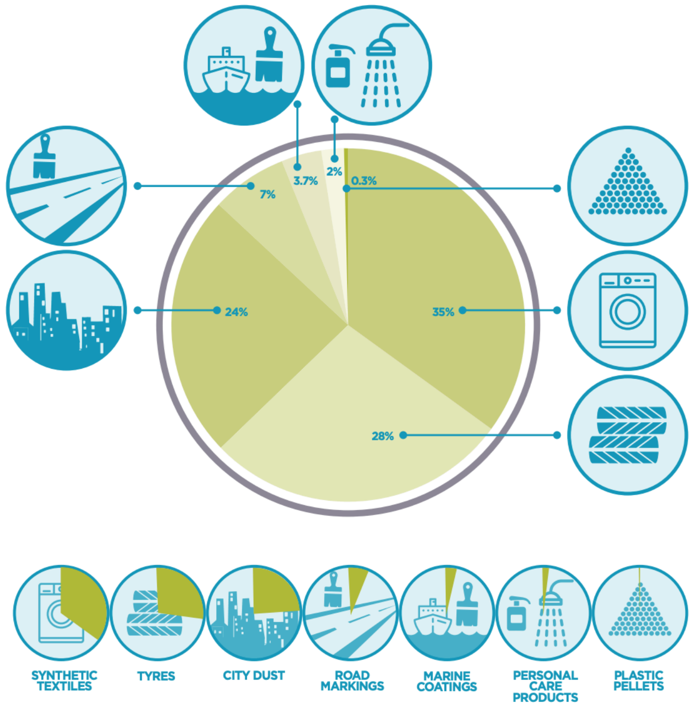


Airborne (C2.1.3)
Refers to microplastic pollution that travels through the air and into higher threat zones (Category E). Tires are the second-largest source of microplastic loss (28%) and contribute heavily to Airborne plastics (*). Abrasion from the friction created as a tire rolls over the surface of roads generates microplastic pollution that becomes airborne, and either travels to higher threat categories (lakes, rivers, oceans), or is carried by road runoff (water). Following closely behind tires is “City Dust.”

“City Dust includes losses from the abrasion of objects (synthetic soles of footwear, synthetic cooking utensils), the abrasion of infrastructure (household dust, city dust, artificial turfs, harbours and marina, building coating) as well as from the blasting of abrasives and intentional pouring (detergents).”
- Primary Microplastics in the Oceans, IUCN

Other sources of airborne plastics include the ocean (microplastics in the ocean are ousted into the atmosphere as trapped air bubbles are burst by crashing waves), and soil dust.

It must be noted here that Airborne microplastics are estimated to be the largest single source of human ingestion, and therefore may pose the largest threat to human health of all plastics.(*)



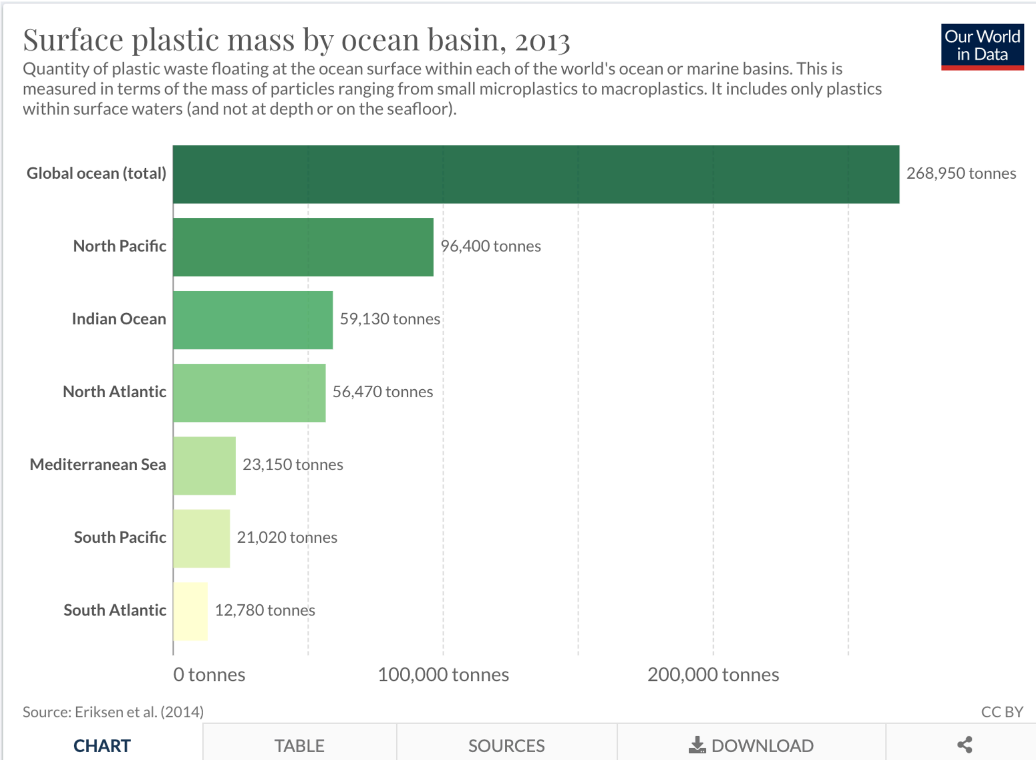
C2.2 Consumer Use

This category refers to plastic materials used broadly by general consumers, and includes food wrappers and containers, bottle caps, straws and stirrers, plastic bags, beverage bottles and takeout containers as primary culprits.

C2.3 Industrial Use

This category refers to plastic materials used broadly by the industrial sector and includes transportation, fishing, building and construction materials, medicine, electronics, and industrial machinery as heavy contributors.

Of particular note for Diatom is abandoned fishing equipment. Fishing gear is estimated to make up roughly 10% of all ocean plastic, though some estimates suggest this number is much higher. A topographical survey of the North Pacific Trash Gyre (often referred to as the ‘Great Pacific Garbage Patch’) found that 46% was fishing related macroplastics (*). This is noteworthy, particular because the North Pacific is by far the largest accumulation of ocean plastic, as indicated below:



If the North Pacific is a broad indication of the total trend, then researchers may have vastly underestimated the scale of derelict fishing gear.

In addition to the scale of the problem, it is important to underscore the negative effects of fishing gear, otherwise known as "ghost nets." Ghost nets, abandoned, lost, discarded fishing nets, are estimated to be four times more deadly to marine life than any other type of plastic. Ghost nets can be as large as a football field, take up to 800 years to break down, kill marine life through entanglement (often resulting in death by starvation or unnatural predation), and destroy coral reefs by entangling and raking with the tides. It's also worth noting that ghost nets can transmit diseases from one reef ecosystem to another. It is estimated that ghost nets are responsible for killing and injuring 650,000 marine animals annually--including whales, dolphins, turtles, fish and a myriad of other marine animals (*)

D1. Disposal

This category refers to the broad category of "Methods for Intentional Waste Management," and is broadly divided into four sub-categories:

D1.1 Recycling

This category refers to attempts to apply industrial methods that reconstitute the base material of plastic back into raw plastic stock that can be used for new plastic material production. This should be contrasted with virgin plastic--which is raw materials used for the first time to create plastic.

D1.2 Repurpose
This category refers to transforming plastic material/waste into products that have utility beyond the original purpose of the plastic. Repurposing is distinct from recycling in that it does not occur through breaking the plastic down into its raw materials, such as plastic pellets. The term "repurpose" is often used to describe creative ways that consumers may "repurpose" items, for example taking a plastic water bottle and cutting it in half to create a funnel. While we encourage this type of creativity, it is not what is intended by "Repurpose" in this framework. A better example of Repurposing in this context would be melting waste into construction materials.

D1.3 Energy Recovery
This category refers to disposing of plastic waste through controlled incineration as a means of generating energy. The term "energy recovery" is used as a recognition that plastic is already an extracted resource (often a byproduct of fossil fuel refining).

Plastic waste that is non-recyclable (due to a variety of factors) may be used to burn and produce energy. This is almost certainly the least glamorous solution to plastic waste, but its merits need to be understood in the greater context of the limited set of options at hand.

Plastic is, after all, the result of fossil fuel extraction (Category A). Many types of plastic cannot be recycled (composite, multi-layer laminates), and many plastics that are further downstream (category E) are often impossible to recycle or repurpose due to degradation from the environment or the accumulation of algaes, bacterias or other organic matter that is extremely energy intensive to clean (if possible at all).

The question is, what do with these plastics? They can be sent to a landfill, incinerated purely as a disposal method, or they can be incinerated to produce energy, which offsets the need for additional fossil fuel extraction. While carbon credits and market demands push industries toward renewable energy, incineration provides a transitional solution that de-risks physical plastic waste re-entering the ocean, while offsetting additional fossil fuel and natural gas extraction.

Of course, "energy recovery" is not a category that intends to imply that all methods of recovery are equal, as not all recycling or repurposing solutions are equal. Energy recovery must be done in such a way to ensure no airborne plastic toxicity is created, and that the process minimizes carbon production.

D1.4 Incineration
This category refers to disposing of plastic waste through controlled incineration (and is not inclusive of open-burning, which is considered terrestrial leakage).

As with Energy Recovery (D1.3), incineration is not an ideal method of disposal, but in some cases is better than sending it to a landfill (for example, for areas with poor waste-management practices that are also within 50 kilometers of a water source). Additionally, incineration methods must be controlled to avoid airborne toxicity.

D1.5 Landfill
This category refers to all plastic waste that is sent to a landfill as its final destination. Landfills are a last resort waste management solution for plastic waste, as they still pose a minimal, but non-zero risk of re-entering ecosystems (either through water runoff, degradation leading to airborne microplastics, or by blowing away as fragments of plastic become smaller and more easily carried by the wind). Additionally, plastic sitting in landfills can lead to additional greenhouse gas emissions when hit by UV light (*)

It is worth noting that landfills within 50 kilometers of a water source pose an additional risk of re-entry into ecosystems, and should be considered as an entirely different category of landfill.

Category E
This category refers to any plastic waste that has left the intentional circularity of waste management and resource maximization. Category E is a spectrum that runs from *generally lowest threat* to *generally highest threat* to ecosystem integrity. This threat spectrum is not intended to be an absolute and certainly has exceptions that must be assessed on a case by case basis, but is intended to give a broad rule of thumb of which types of plastic waste are most harmful to the environment, neighboring species, and humanity itself.

Every category within E can be divided into microplastic (inclusive of nanoplastics) and macroplastic, with the general rule of thumb being that microplastic poses a higher threat based on a) much higher cost to remediate, b) much higher difficulty to remediate, c) significant negative effects on wildlife and human health. There are, however, some exceptions to this rule of thumb that will be clarified.

Additionally, any water-based E-class plastic waste is divided into two additional categories: *Surface* or *Sunken*.

E1 Land
This category refers to any plastic waste that has intentionally or unintentionally exited the circular loop of waste management and resource maximization, and is currently land-based. Land-based litter that is within 50 kilometers of a water source pose significantly higher risk or re-entry into downstream categories that pose higher levels of threat to ecosystems. Macro plastic waste (E1.1)--larger than 5mm--degrades over time into microplastic (E1.2) that is smaller than 5mm. Land-based microplastic waste poses the highest threat of category E1, as it is the most difficult to re-integrate in meaningful ways, is the most likely to travel into higher threat categories, and may pose the highest threat to human health.

E2 Lake
This category refers to any plastic waste that has intentionally or unintentionally exited the circular loop of waste management and resource maximization, and is currently within a lake--a large body of water surrounded by land.

Lakes provide a significant source of freshwater on the planet. While lakes are contained by land, they still make up a large portion of wildlife habitats. Marine life is more likely to mistake plastic waste for food than land-based wildlife. Plastic waste in Lakes is also significantly more difficult and expensive to remediate once in a body of water. Furthermore, there is evidence that airborne microplastic can proliferate from lakes in a similar way that oceanic waves can expel microplastic into the atmosphere.

Lake-based plastic waste has the additional subcategory of *Surface* or *Sunken* waste. Sunken waste is notably more complex and therefore expensive to remediate compared to surface waste. As with E1, lake-based microplastics (E2.2) pose a higher threat than lake-based macroplastics (E2.1) due to their ever-increasing difficulty to remediate.

E3 Beach

This category refers to any plastic waste that has intentionally or unintentionally exited the circular loop of waste management and resource maximization, is land-based, and is currently within 500 meters of a shore line.

Plastic waste on beaches pose an immediate risk of entry into the oceans, where environmental impact is greater, and threat to the integrity of ecosystems is greater. As with category E1 and E2, microplastics (E3.2) pose the largest threat to ecosystems with few exceptions, due to the extreme difficulty of remediation.

E4 River

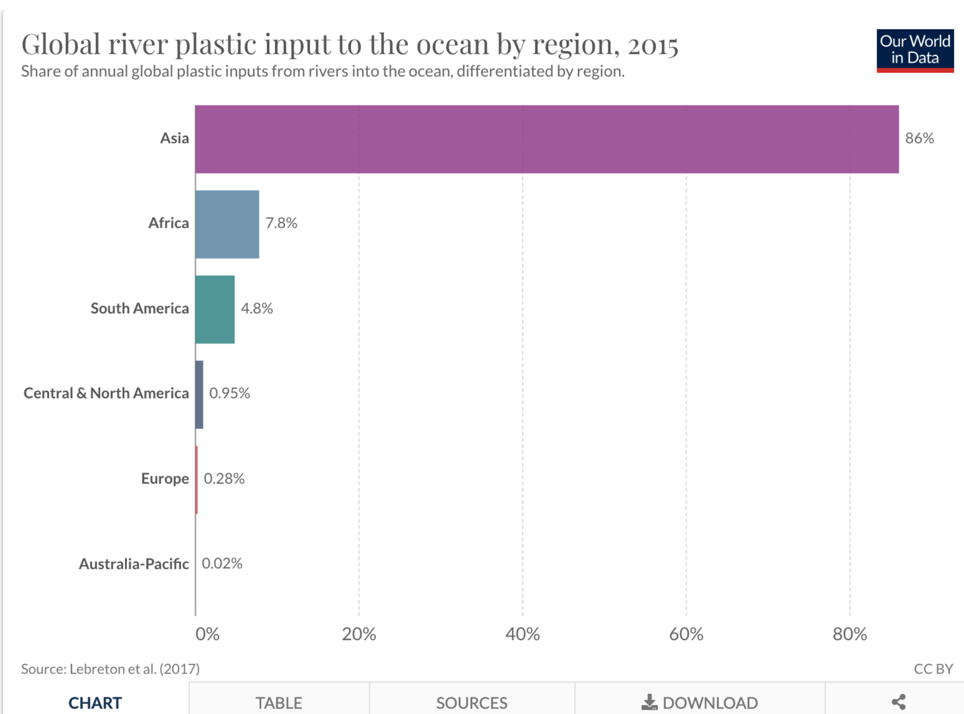
This category refers to any plastic waste that has intentionally or unintentionally exited the circular loop of waste management and resource maximization, and is currently within a river--a well-defined, ‘permanent’ path of flowing water.

Rivers have been identified as a primary transportation channel for ocean-bound plastic. It is estimated that 80% of all ocean plastic comes from rivers. It was previously thought that up to 90% of river-based ocean plastic was coming from only 10 of the worst offending rivers, but this data has since been updated. The current picture painted by the latest mapping indicates that 80% of plastic entering the ocean is accounted for by around 1,600 rivers.

River	Share of global plastics emitted to the ocean percent
Pasig (Philippines)	6.43%
Tullahan (Philippines)	1.33%
Ulhas (India)	1.33%
Klang (Malaysia)	1.33%
Meycauayan (Philippines)	1.23%
Pampanga (Philippines)	0.95%
Libmanan (Philippines)	0.72%
Ganges (India)	0.63%
Rio Grande de Mindanao (Philippines)	0.54%
Agno (Philippines)	0.47%
Agusan (Philippines)	0.47%
Paranaque (Philippines)	0.45%
Iloilo (Philippines)	0.43%
Soai Rap (Vietnam)	0.42%
Chao Phraya (Thailand)	0.41%
Lagos Harbour (Nigeria)	0.41%
Hugli (India)	0.40%
Huangpu (China)	0.37%
Pazundaung Creek (Myamnar)	0.37%
Bharathappuzha (India)	0.36%
Ebrie Lagoon / Komoe (Cote d'Ivoire)	0.34%

CHART | TABLE | SOURCES | DOWNLOAD

The regions of the world that are the highest polluters by river are highly correlated with a lack of mature waste management practices. As of 2015, it's been estimated that more than 80% of ocean-bound river pollution stems from Asia, making it an excellent area of focus for remediation efforts.



As with Lakes, river-based plastic is divided into surface and sunken categories, and additionally into microplastic or macroplastic, conveying a scale of relative difficulty and threat.

River-based ocean plastic waste is divided into surface (E4.1), surface-macroplastic (E.4.1.1), surface-microplastic (E4.1.2) and sunken (E4.2), sunken-macroplastic (E4.2.1), sunken-microplastic (E4.2.2). That is, E4.2.2 (River > Sunken > Microplastic) is considered to have the current highest level of difficulty in this class.

E5 Ocean (near-shore)

This category refers to any plastic waste that has intentionally or unintentionally exited the circular loop of waste management and resource maximization, and is currently ocean-based, but within 50 kilometers of a shoreline.

The purpose of distinguishing between near-shore ocean plastic waste and mid-ocean is based on the marked differences in complexity to remediate each. Near-shore plastic waste can be addressed with a much lower level of difficulty, cost and complexity than mid-ocean. For example, near-shore ocean plastic can be cleaned by individuals equipped with snorkels or scuba gear (as demonstrated by the 2019 Guiness World Record for the largest underwater cleanup set by 633 scuba divers off the coast of Florida). Additionally, smaller vessels that need not be equipped or trained for long mid-ocean voyages can participate in near-shore removal operations that remediate plastic waste from coral reefs.

Near-shore ocean plastic waste is divided into surface (E5.1), surface-macroplastic (E.5.1.1), surface-microplastic (E5.1.2) and sunken (E5.2), sunken-macroplastic (E5.2.1), sunken-microplastic (E5.2.2).

E6 Ocean (mid-ocean)

This category refers to any plastic waste that has intentionally or unintentionally exited the circular loop of waste management and resource maximization, and is currently ocean-based, but beyond 50 kilometers from a shoreline.

Mid-ocean plastic provides the highest level of complexity and cost for removal currently, and is additionally considered by Diatom to be the highest level of threat to marine life and ecosystem integrity. Mid-ocean plastics are consumed by diverse marine animals, from fish to turtles, dolphins, whales and everything in between, permeating throughout the entire food chain of ocean life. One study found that 1 in 3 fish sampled contained toxic microplastic (*).

Mid-ocean plastic has proven to be the most difficult to remove, and requires veteran maritime experience and long voyages at sea, adding additional costs and often coming with a higher carbon footprint. To date there are only a small handful of organizations who have been successful in mid-ocean removals, as the difficulty and unpredictability of the ocean has been frequently underestimated.

Many of the larger (and potentially more essential) organisms are under threat from plastic waste in mid-ocean, including whales (~$2 Million per whale) (*) and sharks (some estimates as high as $1.9 Million per living shark) (*). These essential ocean animals are particularly vulnerable to abandoned fishing gear (ghost nets), which kill by entanglement.

Mid-ocean microplastics proliferate throughout the food chain, but perhaps more dangerous is the risk they pose to the most essential organism of the ocean (*): plankton. Phytoplankton, like diatoms, form the foundation of the entire food chain of the ocean. They are the basis of all life in the ocean. Plankton attach themselves to microplastic particles, resulting in de-oxygenation. The plastic particles block sunlight and photosynthesis, the essential process that results in carbon storage and global oxygen production by plankton(*). Furthermore, since plankton are themselves food for other marine animals, plankton attached to microplastic expedite the consumption of microplastics throughout the entire food chain.

Unfortunately, the vast majority of plastics in the ocean appears to be of the most difficult and complex to remediate: Mid-ocean > Sunken > macroplastics/microplastics. It is currently estimated that more than 99% of all ocean plastic is hiding beneath the surface (*). Scientists do not yet fully understand how a buoyant material is sinking in the ocean, but theories are emerging. Two kinds of creatures have been identified in this process-- red crabs and giant larvaceans. Red crabs consume plastic and expel it as waste at lower depths, and larvaceans coat plastic in a mucus that makes it heavy enough to sink. Another theory is that plastic is deposited at lower depths by all types of marine organisms who have unwittingly consumed plastic over their lifetime, sinking to the depths upon death and releasing it there. One thing is clear, surface cleanup technologies alone will not be able to solve the vast majority of this problem(*).

Mid-shore ocean plastic waste is divided into surface (E6.1), surface-macroplastic (E.6.1.1), surface-microplastic (E6.1.2) and sunken (E6.2), sunken-macroplastic (E6.2.1), sunken-microplastic (E6.2.2).

Plastic Waste Map Analysis

The Plastic Waste Map gives us a tool to conceptualize precise remediation efforts in an ecosystem-relevant context. To the degree that humanity can shift toward completely eliminating terrestrial leakage (Class C2.1) and all stages at D.3 or later represents the ideal image of circularity for the problem-set of plastic waste. These should both be the ultimate goal of any remediation efforts--to transform practices toward this end.

But ideal pictures of reality are only useful insofar as they inform a relevant and practical plan of action. What follows is a proposed strategy for mass remediation that aims to mitigate the most immediately threatening symptoms of the plastic crisis, while working toward real transformation at the root of the problem, slowly but surely bending the broken loop back into itself, rendering humanity a much more resilient and integrated member of the global ecosystem.

Prioritization of Plastic Remediation

Diatom recommends approaching this problem-set as a doctor might approach a sick patient. The patient’s being poisoned consistently, and the symptoms are so bad that they cannot be ignored, but the problem will not be completely solved until the poison is no longer being ingested. In fact, if some form of poison remediation does not happen, the patient could die. Therefore, efforts must be made to clean the body from the poison, while simultaneously identifying the source of the poison and preventing further ingestion.

In the context of plastic waste, we are poisoning our environment and ourselves at a rate of about 30,000 tons of plastic waste entering the oceans per day. Those plastics can be accurately viewed as a time-release poison capsule that will slowly dissipate into the ocean ecosystem. Given that there is currently nothing remotely resembling a closed loop system, we must do everything in our power to curb the use of plastics while building capacity to close the loop. At the same time, we cannot ignore the plastic that is already in E-class. It poses an immediate and potentially apocalyptic threat to humanity's survival. Based on greatest efficiencies and proven methods, we must also invest in E-class removals, and mechanisms that prevent the flow toward the later stages of E-class.

Beyond the negative externalities, research by the Ellen MacArthur Foundation estimated that $80 - $120 billion in economic value is lost in discarded plastics, a sum that could be recovered if new mechanisms to recover and repurpose that waste are applied and scaled.

Those who say that we must focus all our energy on cleaning up ocean plastic are equally as misinformed as those saying, "there's no point cleaning it up until we turn off the tap." If we are serious about nature without plastic, we cannot ignore the fact that this means we will still need to clean up what is already out there wreaking havoc on ecosystems. We cannot wait until the "tap" has been turned off. Every ton of plastic removed from the ocean is one less slow-release time bomb that will need to be removed eventually. Simultaneously, immediate and substantial pressure must be applied at the root cause--plastic production and improper waste management.

Here is a short-list of high level priorities that inform Diatom's approach to global plastic waste remediation:

1. Increase recycling (D1.1)
2. Reduce overall use (C1)
3. Removals in E-class, priority to Rivers (E4) and Mid-ocean (E6), with consideration given to C2.1.4 (runoff).
4. Establish new channels from E-class to recycling (D1.1), longterm repurposing (D1.2), or transformation back into natural resources (A).
5. Establish new materials (A).

Priority #1 | Increase Recycling (D1.1)
Programs that increase recycling are likely to have the highest efficiencies, but are dealing with waste that is less threatening to ecosystems. However, effective recycling and waste management is critically important to reduce the amount of plastic waste that is reaching downstream, E-class plastic waste.

Priority #2 | Reduce overall use (C1)
Per PRC requirements, organizations who purchase PRCs must demonstrate that they have reached a reasonable threshold criteria for their *ceiling of change*. This includes an assessment on reductions of plastic use.

Priority #3 | Removals in E-class, priority to Rivers (E4) and Mid-ocean (E6), with consideration given to C2.1.4 (runoff).
Along with priority #1, priority #2 is a major focus of investment for Diatom, establishing a supply chain that is attempting to remove plastic waste that is either a) at highly concentrated choke-points in the flow of plastic waste from land to sea (rivers, road runoff), and at the same time, b) removing the most immediately threatening types of plastic waste (mid-ocean).

The logic behind attacking E6 is that the longer humanity waits to address mid-ocean plastics, the more difficult the task is to accomplish. For example, removing Ocean (mid-ocean) > surface > macro plastics (E6.1.1) is removing an immediate threat before it becomes much more difficult and expensive to remove later (e.g. degrading into sunken, and/or microplastic). Oceanic microlastic, having no currently tenable proven solution may at this time be best considered unmitigatable damage--a “lost cause” as it were. That is, for all we currently know, there may never be a viable remediation tactic (though we should persist in fervently seeking one). In all likelihood those forms of plastic may only be dealt with through adaptation by oceanic life, not removed. Avoiding plastic reaching the state of microplastic while it is still possible must be a top priority.

Priority # 4 | Establish new channels from E-class to recycling (D1.1), repurposing (D1.2), or transformation back into natural resources (A).
During the process of priority #3, ensuring that the end-destination of those removal efforts are harnessing the current best practices for processing the plastic. Sometimes the best choice is energy recovery, as is often the case with mid-ocean plastic, but wherever possible plastic waste should be recycled or repurposed to maximize efficiency while keeping it out of nature.

There is one important point to be made here regarding recycling and replacing. While the idea of turning millions of tons of plastic waste into consumer products such as bracelets, sunglasses or clothing may seem appealing initially, deeper analysis uncovers serious flaws with this approach. By recycling or repurposing plastic back into items that have a small lifespan, we simply re-enter more flawed materials into the consumer marketplace when they should be removed as much as possible. Rather, the priority should be placed upon re-using these materials to a) create maximum utility, b) maximum lifespan, c) maximum unit mass, and d) ease of recycling/repurposing again.

For example, categories of product use such as *Building and Construction* produce products that can last +35 years, perform a foundational utility to society, and are typically not taking the form of tiny objects that are easily lost, and are therefore more contained and easier to recycle once again at the end of their lifespan. Contrast this with sunglasses, which have an estimated lifespan of 1-3 years (5 if we are being extremely generous) before they once again become waste. This also assumes that they are not otherwise lost or discarded, being that they are inherently designed for outdoor use, where loss in nature is possible. Synthetic plastic clothing--even that made from recycled/recovered plastic waste--is also an equally unscalable solution, primarily due to the threats of microplastic from such textiles (the current largest single contributor of microplastic pollution). Such fabrics should only be put into laundry machines fitted with a microplastic filter (a filter that Diatom believes ought to be standard on all new machines).

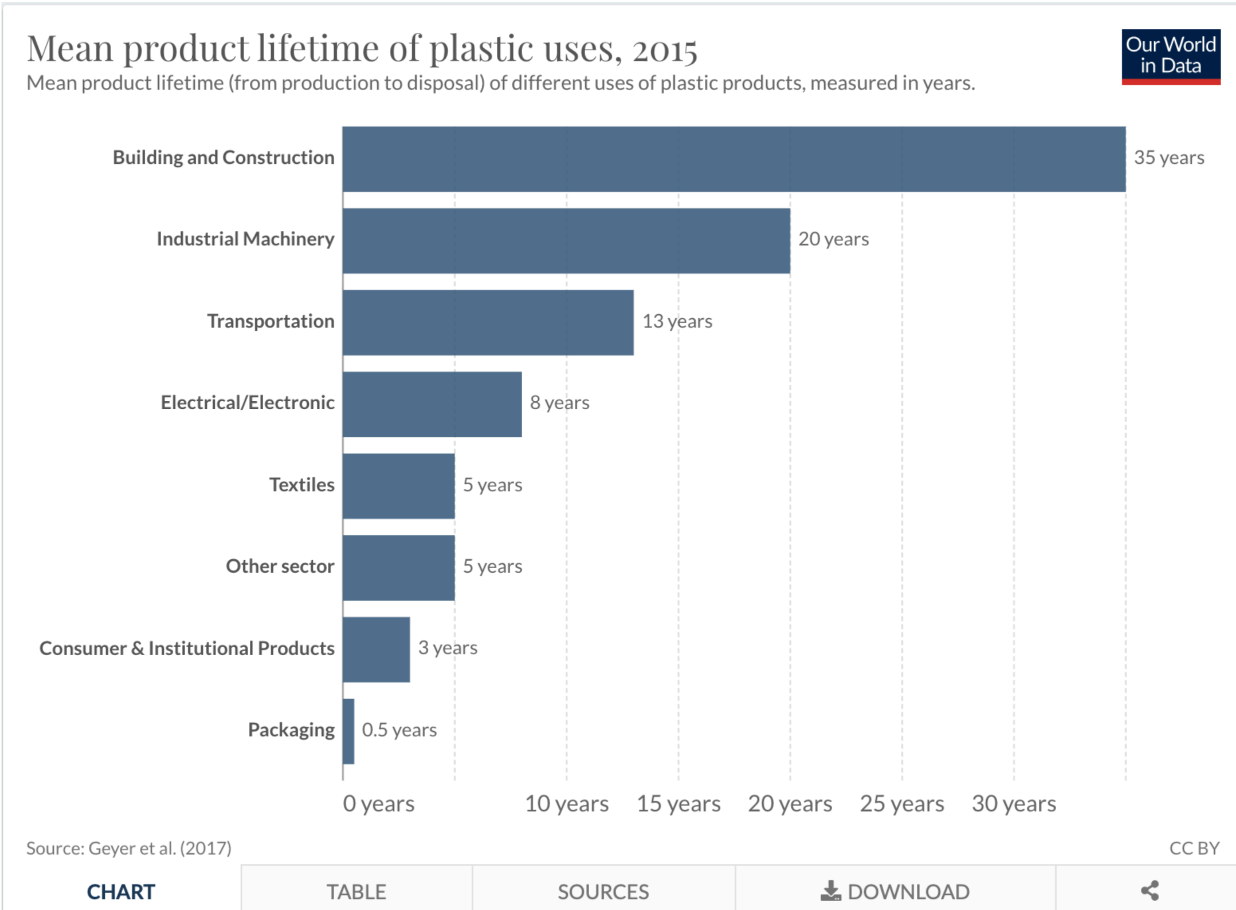
Furthermore, we do not intend here to completely demonize projects that are creating consumer products out of plastic waste. It is perhaps contributing some additional benefits in engaging the public, pop-culture, and fashion in the conversation in ways that have an added economic benefit to the overall problem of plastic waste, which is in part related to cultural saliency of the issue. With that said, it must be seen as a method for the emerging circular movement, who is still getting their feet under them, but is by no means a realistic or practical approach to the depth of transformation required in the mid or long term.

With any type of product made from plastic waste, challenges still exist connected to human health--namely, toxicity and off-gassing. More research and development is needed to understand the overall health impact of any recycled/repurposed plastic material.

In general, we must focus on and reward those projects that are maximizing the utility, lifespan and end-of-life predictability of recycled/repurposed plastic waste as much as possible. See the table below, which can be seen as an excellent guide for the ideal prioritization of products for recycling and repurposing, slowly working plastic completely out of the consumer supply chain and replacing it with more circular materials.

Lastly, a note about opportunities to transform plastic waste back into A-class (natural resources). Bacteria may play a critical role in plastic waste remediation, and may perhaps open up a channel to bring plastic waste into circularity but transforming it back into natural resources. Scientists have recently discovered new forms of bacteria that have evolved in landfills to consume plastic. It’s worth noting that a long time ago, trees were also *not* biodegradable. Fallen trees would fill forests until wildfires cleared them out. Eventually fungal and bacterial adaptations learned how to consume and break down the materials. In the same way, nature is already seeking ways to remediate the massive influx of this material. New polymers and bacterial cocktails may yet be discovered, hiding away in a landfill somewhere right now. If these bacteria can be discovered, understood, and safely scaled, it may provide a new set of solutions for returning plastic back into a naturally integrated material.

Projects like Poliloop have shown early promise for their ability to use bacterial cocktails to biodegrade plastic within a few weeks, transforming almost any type of plastic waste into a sludge that can improve soil health. This space is nascent, but extremely promising.



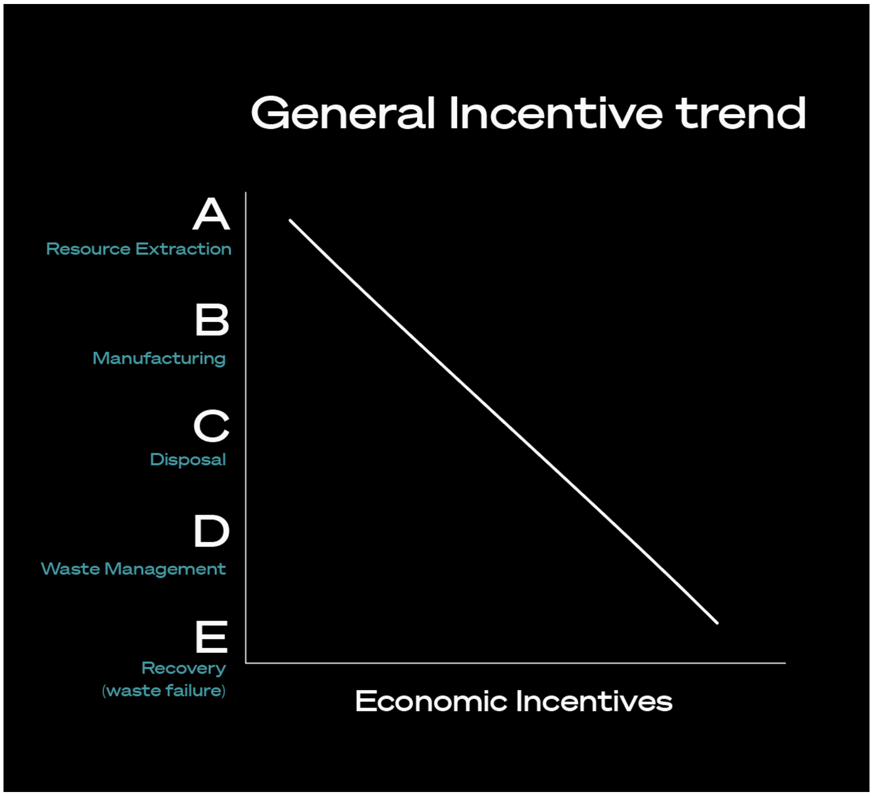
Priority #5 | Establish New Materials

It is imperative that industries shift toward scalable new materials that are circular and integrate the overall costs of waste management into their design. Materials that, at the very least, are compostable and genuinely biodegradable within short timespans. Many of the apparent solutions already exist, but have not yet proven to be cost-effective enough to drive scalability. Bioplastics, for example, make up roughly 1% of all plastic production today. Emerging solutions include hemp plastics and other bioplastics made from olive pits, sunflower hulls, fish waste, algae or mushrooms just to name a few.

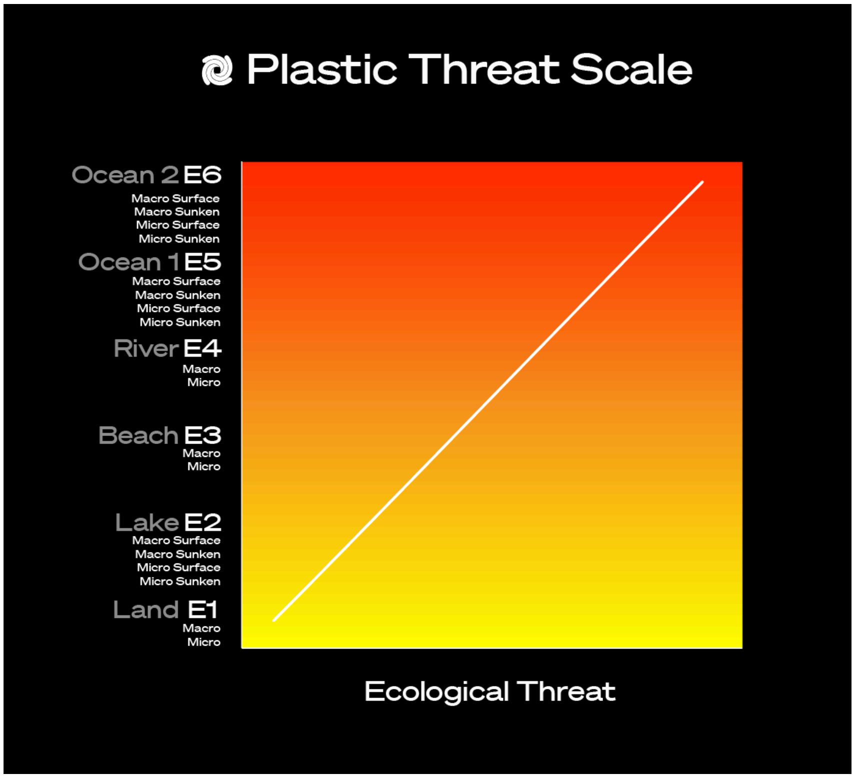
If the real costs of plastic were assessed and exerted onto manufacturers, this could rapidly change the supply/demand dynamics for better materials. For this reason, Diatom believes that a true cost plastic tax is a sensible solution for any nation that is experiencing the drastic costs of plastic pollution and poor waste management, ultimately paid for by taxpayers.

Obstacles to Global Plastic Waste Remediation

Perhaps the primary challenge facing the urgent task of global plastic waste remediation is the misallocation of the true cost of plastics. As previously mentioned, the true cost of plastic is not paid by the manufacturers, or even purchasers. It is paid by local municipalities who must deal with the waste, the loss of critical species and ecosystems, or those who pay to remediate that waste. Furthermore, as plastic waste enters increasingly threatening Classes, the economic incentives to remediate it drop off significantly, as indicated in the figure below.



This is the opposite of what a healthy economic expression ought to look like, where the most threatening externalities represent the highest priority for a resilient species. One of the primary aims of Diatom is to invert this trend, to align it with the reality of plastic threats.



In order to execute the proposed priorities above, several enabling factors are proposed:

- Genuine economic incentive for plastic remediation
- A credible standard for waste removal
- Transparent verification of removal
- An effective and consistent supply chain of removal partners
- Funding to scale the supply chain

Diatom intends to directly offer contributions to bringing about a recognized economic incentive for plastic waste remediation, and to bring to bear the funding necessary to actually solve the problem. Diatom will work with partners building credible standards, transparent verification, and a network of efficient removal partners. Removal partners will be prioritized based on how effectively and efficiently they can deploy projects that hit priority #1 (increase recycling and waste management) and priority #4 (Removals at E-class, priority on rivers and mid-oceans, and runoff), with consideration given to auxiliary projects.

The initial primary mechanism for addressing these priorities is with Diatom's Plastic Reduction Credits (PRC). PRC's provide an on-chain verification of plastic waste reduction in collaboration with a network of plastic waste remediation projects around the world. PRC is a first step toward a cleaner ocean and a more resilient human expression on earth.

Plastic Removal Credits as a Viable Tactic

Plastic Credits have been proposed as one of many viable tools to address the non-circular nature of humanity's plastic waste crisis. Broadly, plastic credits are generated when verified plastic waste removal occurs. After a credit is created, it can be purchased and "retired" by organizations seeking to meet CSR and ESG goalst. A credit may be exchanged before being retired, but any claims attached to social impact can only be made through proof of retired credits, not by purchasing the credits alone. Diatom harnesses the latest in DeFi and blockchain technologies to create a plastic credit model that is effective, transformational, and verifiable.

We do not intend to deeply debate the benefits and potential pitfalls of plastic credit systems in this document (for that, we recommend an excellent analysis by the WWF). Many informed bodies of literature have already outlined what a good plastic credit ought to be. Our intention is to propose how Diatom will play a role in the healthy development of a much-needed economic model to drive plastic waste remediation through a credible and effective plastic credit framework.

How Plastic Credits Work

Plastic credits offer major contributors to plastic waste a mechanism to "invest in waste management infrastructure" while making meaningful changes to their operations that reduce use, establish more ecologically sound materials, and increase recycling of the plastic waste they generate. That is, organizations must individually assess how they themselves can reduce use and close their own loop, while mitigating the harm that materials going outside of their individual loop can create.

When an organization purchases a plastic credit, they must "retire" the credit in order to demonstrate that they have funded real plastic removal. Once foundational changes are made to minimize use and maximize new materials and recycling efforts, then the plastic credit is a tool for organizations to remediate the negative externalities that their products create, which they do not directly pay for (prior to the use of a plastic credit.

Plastic credits must prove "additionality." That is, the activities of plastic waste removal must prove to go above and beyond typical collection, recycling and repurposing activities in a given region. Credits cannot be awarded without proving additionality.

Diatom's Plastic Removal Credit (PRC) is designed to:

- Bring the necessary funding toward global plastic waste removal efforts.
- Apply ample pressure on organizations that continue to proliferate plastic waste to shift practices.
- Be part of an equitable development system for waste pickers.
- Redirect E-class waste back into the value chain (A, B, and C-class), or at the very least into contained landfills posing minimal threat to ecosystems.
- Drive innovation in new materials (A).

Risks and Objections to Plastic Credits

If not designed properly, plastic credits can do harm. They can be used as a platform for greenwashing, offsetting genuine transformational changes that need to be made to become more circular. That is, plastic credits *could* have the unintended effect of relieving many symptoms (plastic waste in E-class, or D-class insufficiencies), while delaying addressing the root of the issue (B-class).

Plastic credits must prove "additionality." That is, the activities of plastic waste removal must prove to go above and beyond typical collection, recycling and repurposing activities in a given region. Credits cannot be awarded without proving additionality.

- Some of several risks inherent to a plastic credit system:Organizations may continue to pollute without making necessary internal changes.
- Lack of a credible standard
- Disregard of other waste types
- Use for greenwashing claims
- Priced inadequately to motivate-fundamental change
- Geographical disparity - That plastic credit activities would occur in vastly different geographies than where a company may be polluting
- Mismatch of plastic type - That plastic credit activities would remove a different, potentially less threatening type of plastic than what is being produced
- Risk of incorrectly assessing additionality
- Mismanaged final destination of plastics

Conversely, Diatom's PRC is designed with the following properties:

- Requires demonstrable transformational internal change of the company
- Works with and integrates the most credible existing standards
- Gives consideration to other types of waste and overall environmental impact
- Effective pricing
- Proves additionality
- Assurance of optimal end destination
- Verification of end destination

Diatom's PRC intends to go beyond what has been proposed until now, while integrating and building upon many components of existing frameworks.

Additionally, there is one point of departure from Diatom's plastic credit philosophy from some other proposed frameworks, and that is the emphasis on geographic disparity.

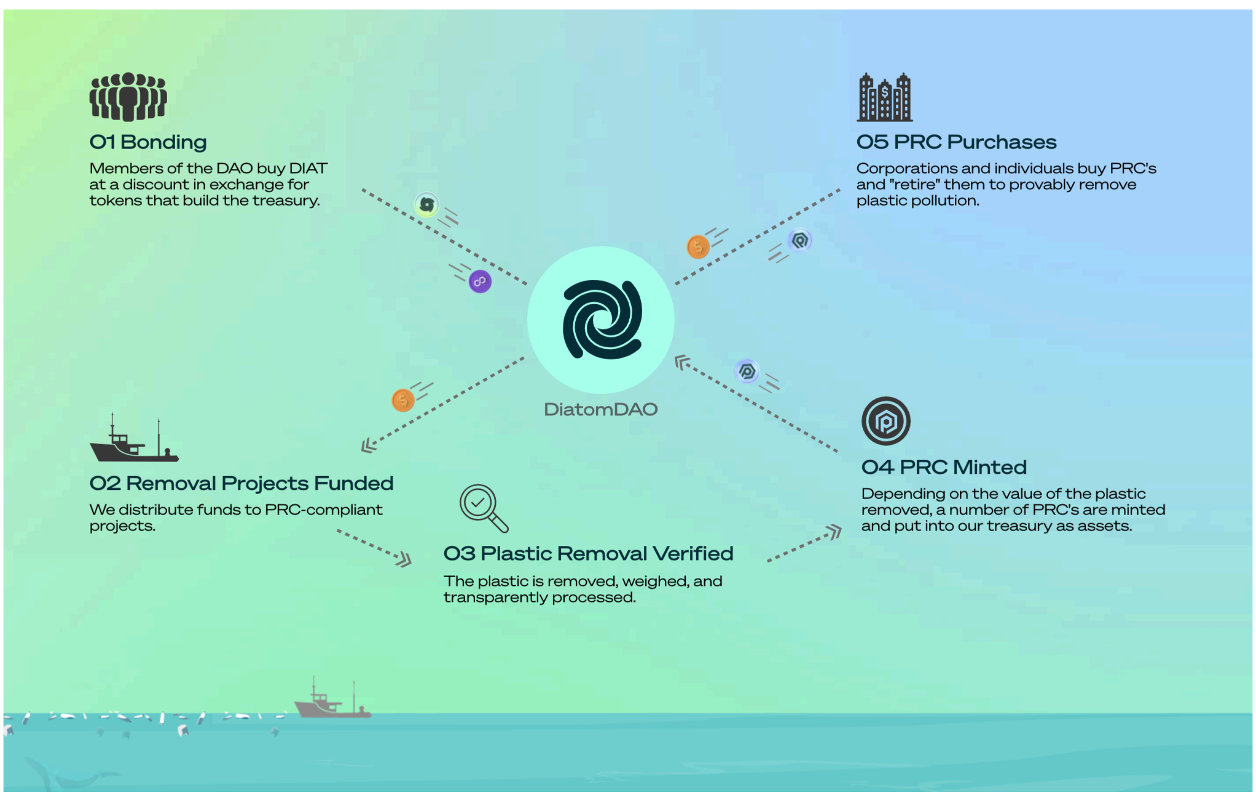
Some other frameworks have emphasized the importance for plastic credit purchasers to be constrained to funding only plastic removal efforts in the same exact regions that they are assessed to directly impact. While this is a logical principle, we maintain that this makes more sense in theory than in practice. As plastic waste is shipped all over the world, used prolifically, and enters E-class, it is bound to disperse wildly from that geographic location. Waste that enters the ocean in the United States can wash ashore in Japan, and vice versa. It is often not feasible to accurately track exactly where an organization's plastic waste impact has hit the hardest. For this reason, we believe that less focus on geographic parity is necessary, especially if it delays the necessary funding being awarded to a scalable solution in another region. We propose a more holistic, planet-level perspective to the plastic waste problem. Priority should be given to the projects that provide the most efficient and effective use of resources to remove or prevent as much plastic waste from sliding down the scale of E-class as possible.

Diatom's PRC Tokenomics

The Diatom DAO treasury builds liquidity through Bonding, PRC Minted, and PRC Purchases, and then funds PRC-compliant projects.

PRC can be understood broadly in 5 stages:

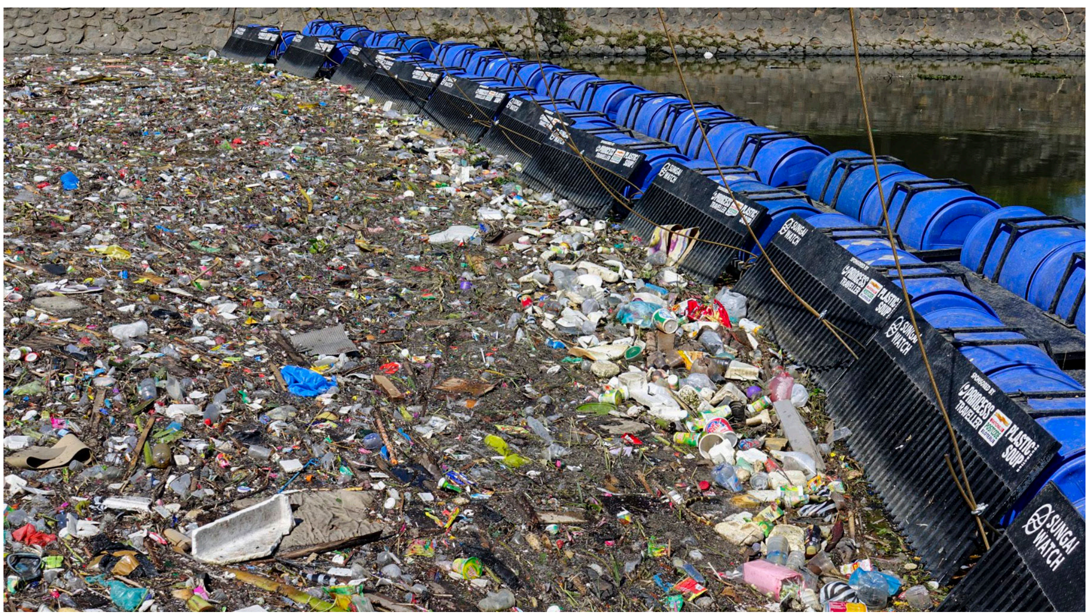
1. **Bonding -** We sell bonds to Diatom DAO members for DIAT at a variable discount in exchange for specific tokens that we want to have in our treasury.
2. **Removal Projects Funded -** Our treasury distributes funds to PRC-compliant projects.
3. **Plastic Removal Verified -** The gathered plastic is removed, weighted, and transparently processed.
4. **PRC Minting -** Successful plastic waste removal immediately triggers minting of PRC's, which are deposited into the Diatom treasury as assets.
5. **PRC Purchases -** Anyone can purchase DIAT (Diatom's governance token) at a discount in exchange for tokens that build the treasury.



1. Bonding
Members of Diatom Dao have the benefit of buying DIAT at a discount, in exchange for tokens that build the treasury. This leads to the protocol owning its own liquidity pools on decentralized exchanges.

2. Removal Projects Funded
The treasury (initially 65% of it) is allocated directly to fund highly vetted plastic waste removal projects**.** Projects are selected for their proven and measurable ability to remove plastic waste, primarily at various stages of E-class, in keeping with Priority #1 and #3. Projects are initially assessed by Diatom advisors (a credible cross-section of renowned oceanographers, scientists and innovators), and then renewed based on performance (verified on-chain), as decided by the DAO. Particular attention is paid to how well the projects integrate into local economies and cultures, de-risk unintended negative consequences and produce maximum impact per dollar.

Diatom does not intend to establish itself as *the* standard setter, but rather applies the highest set of standards that are downward compatible with the highest bar of emerging industry standards, such as Verra.



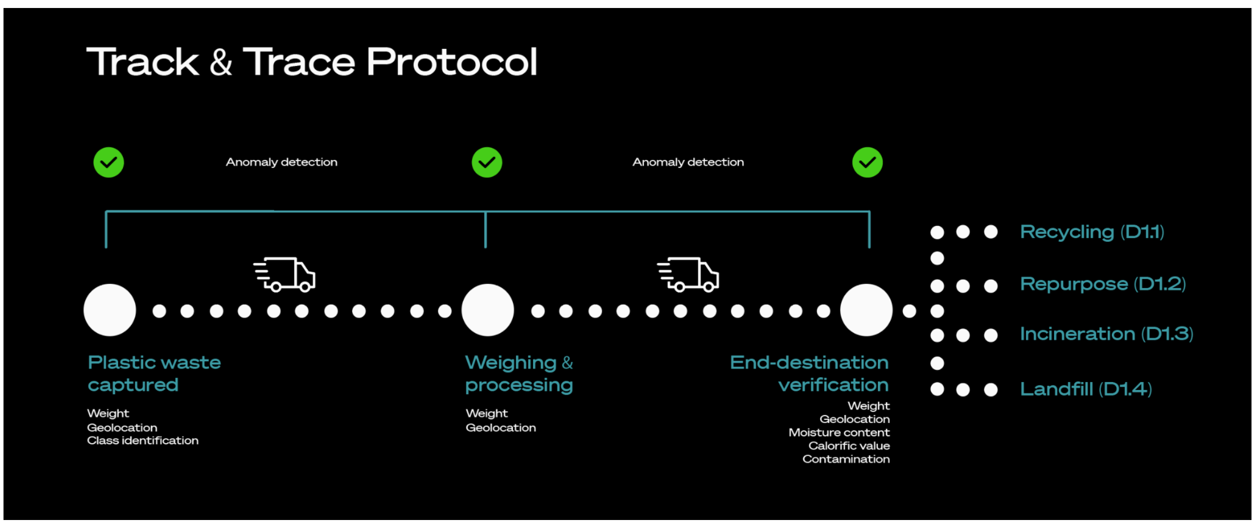
Example of a river barrier system by Sungai Watch

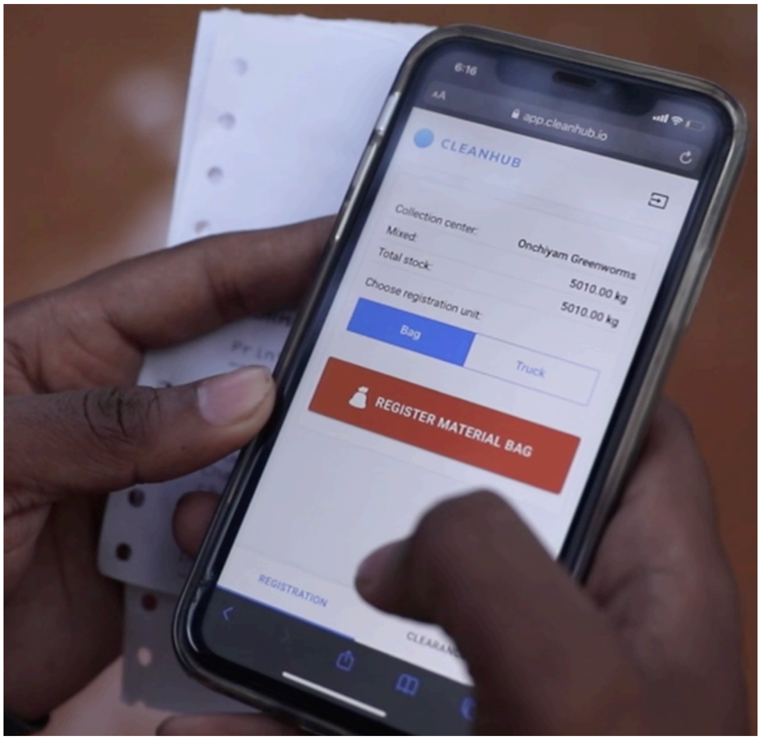
3. Plastic Removal Verified
As plastic waste is removed, it is verified on-chain, providing clear and transparent data about the class of waste and the total mass removed.

Diatom has partnered with Cleanhub to implement their “track and trace” protocol as a third party verification mechanism for PRC. Diatom is establishing the on-chain bridge to this already fully digital tracing tool, making plastic removal activity verifiable in real-time.

CleanHub's protocol applies a data-centric approach to verification, which is essential to a plastic credit supply chain's ability to scale. Plastic is weighed and geo-tagged at every step in the process, and any inconsistencies trigger a deeper audit (e.g. an audit is triggered if weight data-entries do not match within an acceptable margin of error at any step in the process). Verification goes all the way through end-destination, which is essential to ensuring that plastic is properly processed so that it is never counted twice, and does not end up in the environment again as a result of mismanaged processing. Before reaching the end-destination, all materials are lab tested for moisture, calorific value and contamination. Moisture is weighed and deducted from the overall mass (so plastic credits are not being awarded for water trapped inside the plastic). Calorific value is essential for end-destination processors to know the type of plastic and the optimal way to process it. Contamination tests identify the presence of foreign substances that could hinder the ability to process the waste. For example, a high presence of chlorine may rule out the waste for processing by incineration due to toxicity and damage to the kiln.

An average of 59 data points is collected for every ton of plastic removed, all analyzed for anomalies that might signal fraud or negligence in the process. More information about the CleanHub protocol can be found [here].





Cleanhub's web-app data entry as plastic waste is collected.

Real-time feed of plastic waste removal.

4. PRC Minting

Successful plastic waste removal immediately triggers the minting of PRC's, which are deposited into the Diatom treasury.

One major departure from previously proposed plastic credit frameworks is in how plastic credits are assessed and awarded. Many plastic credits to date are founded on the idea of credits being awarded based on the total mass of plastic removed.

Not all plastic waste has the same negative impact on ecosystems--Mass alone does not represent actual value of plastic waste removal.

Whereas in the carbon credit market, 1 ton of carbon removed is 1 ton of carbon removed, it is not as simple with plastic waste. For example, 1 ton of plastic that is recycled on land does not remove the same level of threat to ecosystems that a ghost net does in mid-ocean. The plastic waste on land poses a latent threat, but is less difficult and costly to remediate, whereas the ghost net mid-ocean poses an immediate threat to marine life and is far more complex and costly to remediate. This is a nuance of the nascent plastic credit market that must be recognized, and is markedly different from a carbon credit market. One of the reasons that plastic waste is so prolific in the ocean is because there have been little to no economic incentives to retrieve it. It is essential that a mechanism reflects the actual cost (and therefore value) of the most egregious forms of plastic waste.

As such, PRC's will not be awarded based on raw mass, but will be assessed to reflect as accurately as possible the total value of the plastic removed. The number of PRC's awarded is based on mass, multiplied by a class-score, which reflects the difficulty, complexity and relative threat to ecosystems. Mass is calculated in metric tons, and the class is scored according to the following table in PRC version 01.01.01:

Class	**Score**
Recycling Programs (D1.1)	1
Land (E1)	1
Runoff Prevention (C2.1.4)	1.2
Beach (E2)	1.3
Lake (E3)	1.3
River (E4)	1.5
Ocean (near-shore) (E5)	1.7
Ocean (Mid-ocean) (E6)	2

[Mass (metric tons)] x [Class Score] = PRC's generated.

Example calculation
1 ton of **E5 Ocean (near-shore)** plastic was removed. [1] x [1.7] = 1.7 PRC's generated.

Our intention is to create the urgent and immediate economic incentives that reflect the true costs of the destruction to nature that plastic waste conveys, accounting for the increasing difficulty to remove it as it moves deeper into E-class.

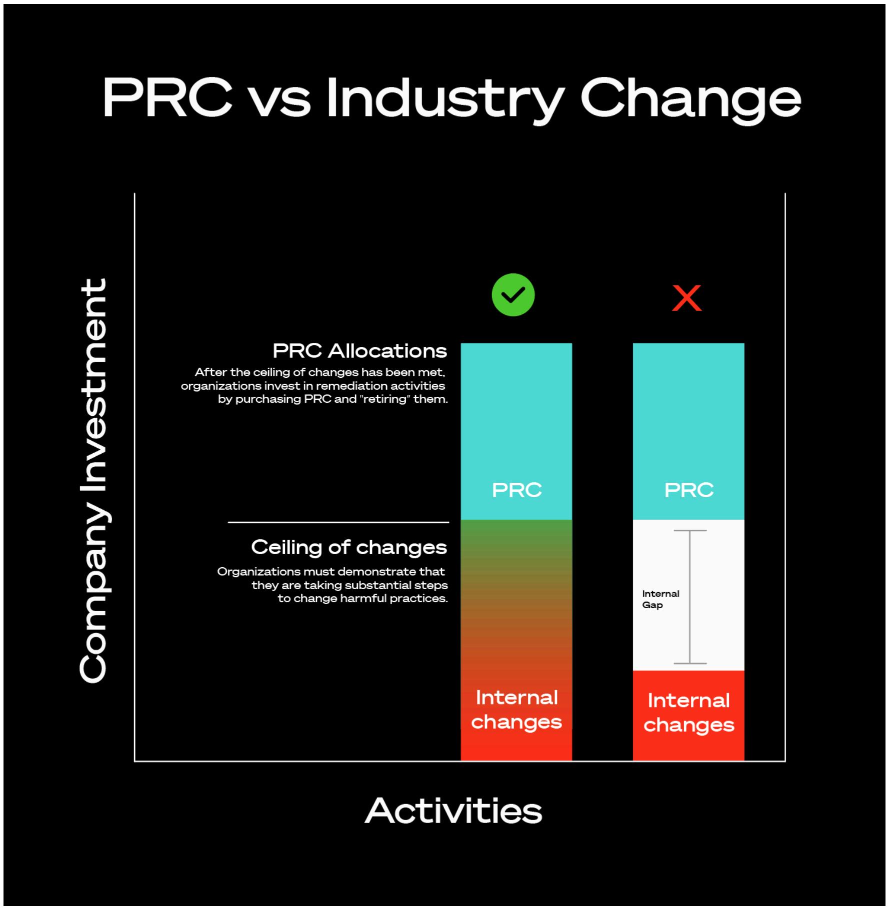
Further evolutions of PRC will aim to add more granularity to the distinctions of each E-class, and the scoring assessment may fluctuate as better data emerges to accurately map the level of threat, difficulty and cost. For example, note that E6.2.2 (Ocean (mid-ocean) > sunken > microplastic) is considered by this scale to be the most difficult to remediate and therefore the most challenging enemy to contend with. Since there are no known remediation tactics for this class, there is no current purpose for including it in the scale. As the PRC supply chain capabilities evolve, this scale will evolve to reflect the current tools at hand.

There are some obvious ways that this system could be abused, and careful measures are taken to de-risk gaming this system. The most glaring risk is creating an unnatural incentive for the worst types of plastic waste to be created so that they can then be removed by waste pickers. This underscores the need for a credible vetting process, including audits that ensure that PRC's are only sourced by high quality, highly vetted projects. Furthermore, the track and trace protocol's heavy emphasis on data entry, anomaly detection, and lab analysis make the system extremely difficult to game.

5. PRC Purchases

Organizations or individuals can purchase PRC's and "retire" them to provably remove plastic pollution. Currently the plastic credit market is voluntary based, driven by CSR and ESG goals to achieve "plastic neutrality," or to offset current waste outputs. As we have already covered, this area is vulnerable to greenwashing, where companies may delay making fundamental changes to their non-circular operating practices if they perceive that they can simply "offset" that waste.

Organizations must demonstrate that they are taking substantial steps toward transformational change within their operations before they can become candidates for PRC purchase and retirement. Diatom calls this threshold the *Ceiling of Change* within an organization. The organization must demonstrate to PRC partners how they are making practical and substantial steps to reduce use (including eliminating unnecessary plastic), establish new materials and increase recycling in order to meet the threshold. See figure below.



PRC Evolution

In keeping with Diatom DAO's overall ethos of realigning human organizational systems with nature, PRC itself will also be established in such a way that it can learn and evolve over time. PRC's first evolution will not be perfect, but will apply the best known practices to date. As practices improve, they will be applied. As plastic waste remediation efforts gain more funding, they will also gain more experience and insights. A cycle of rapid learning will begin, resulting in highly evolved practices over time. The task of global plastic waste remediation is urgent. As such, one of the biggest threats to scaling plastic waste removal efforts is allowing the *perfect* to be the enemy of the *good.* There are many excellent plastic removal projects around the world that are proven, measurable and scalable, and yet lacking funding. We intend to accelerate these heroes to scale their much needed efforts.

As PRC criteria evolves, previously awarded PRC's will be honored as a timestamp on best known practices at the time. This design principle acknowledges that ecosystems are built on consistent adaptation and are not static. As such, PRC evolutions will be treated like software updates (e.g. PRC 01.01.01).

Conclusion

Diatom DAO is a community-driven effort to protect the ocean that gives life to all on earth. Our first major effort is to unleash the power of DeFi for its most regenerative purpose (ReFi) through the creation of a credible Plastic Removal Credit that provides ample economic incentives for cleaning and protecting our ocean, while building out a robust supply chain of removal partners.

At its core, Diatom is more than just a new form of enterprise with an environmental twist. It is a revolution in the concept of an organization itself, inviting all participants in the DAO to embody a more circular, resilient and thriving capacity for humanity. One that *works* for all of life, not just the few.

References below (these will be organized properly):

https://www3.weforum.org/docs/WEF_The_New_Plastics_Economy.pdf

Sharks worth $1.9M alive: https://reefbuilders.com/2011/05/02/million-dollar-sharks/

Most ocean plastic is hiding beneath the surface:

https://www.nature.com/articles/s41598-019-44117-2
https://www.theguardian.com/us-news/2019/dec/31/ocean-plastic-we-cant-see

WWF Stance on Plastic Credits
https://c402277.ssl.cf1.rackcdn.com/publications/1429/files/original/newWWF_Position_on_Plastic_Crediting_and_Plastic_Neutrality_.pdf?1611957221

“The purchase of plastic credits must be transformational, meaning they catalyze the creation of a more sustainable plastic management system with the end goal to stop the flow of plastic into nature and, in so doing, ultimately render the crediting mechanism to clean up plastic pollution unnecessary in the future.” - WWF

Cost of plastic externalities: Adding up all those costs, drawing on the latest research, the report comes up with a total externalities cost of between $800 and $1,400 per tonne, with “at least $1,000” used as a reasonable rule of thumb.
https://www.vox.com/energy-and-environment/21419505/oil-gas-price-plastics-peak-climate-change

https://www.science.org/doi/full/10.1126/science.aba9475

Primary microplastics in the ocean:
https://portals.iucn.org/library/sites/library/files/documents/2017-002-En.pdf

We estimate that between 1.15 and 2.41 million tonnes of plastic waste currently enters the ocean every year from rivers, with over 74% of emissions occurring between May and October. The top 20 polluting rivers, mostly located in Asia, account for 67% of the global total.
https://www.nature.com/articles/ncomms15611

https://www.sciencedirect.com/science/article/pii/S2211339821000125

https://www.sciencedirect.com/science/article/pii/S0025326X19302905

The most important organism in the ocean:

https://oceanfirsteducation.blue/node/174

Surface cleanup solutions can't solve the plastic waste problem
https://www.sciencedaily.com/releases/2020/08/200804085923.htm

Systemiq
https://www.science.org/doi/full/10.1126/science.aba9475

Our World in Data
https://ourworldindata.org/plastic-pollution

Types of consumer plastic:
https://www.treehugger.com/most-common-sources-plastic-pollution-4859259

⅓ of fish contain microplastic:
https://theconversation.com/hundreds-of-fish-species-including-many-that-humans-eat-are-consuming-plastic-154634

References:

- Study showing 4 out of 6 placentas with microplastics
- Ants have toilets