Overcoming Plastic Pollution: Challenges Faced by Brazilian Policies and Perspectives for Stakeholder Engagement and Global Governance Opportunities

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https://doi.org/10.38126/JSPG220204
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Keywords: public policies; solid waste; single-use plastics; microplastics; plastics circular economy; environment and social governance; international collaboration

Executive Summary: This policy position paper begins with a historical overview of the invention and uses of various plastic types, particularly polyethylene, which has become the most widely used plastic commercially. It highlights the rapid growth of our dependence on plastics and the subsequent mismanagement, which has led to their omnipresent and pervasive presence as pollutants, threatening biodiversity, climate change, ocean health, economic sustainability, and human health. The paper also provides an overview of plastic draft laws proposed by lawmakers at the Brazilian Houses of Representatives, emphasizing the importance of delivering effective policies, setting targets and priorities, and aligning with global trends to address the plastic pollution crisis and transition towards a circular economy. The section on governance opportunities examines a practical recommendation specific to Brazil, and subsequently presents ambitious pathways for global standardization and implementation of Environment and Social Governance (ESG). Additionally, a policy roadmap is suggested to incorporate existing approaches, promising strategies, UN Ocean Decade targets, and address concerns identified during the negotiations among UN Member States for a binding legal agreement by 2024 (Plastic Pollution INC1). In the last section, I present practices for adapting ocean literacy and scientific knowledge for different audiences, such as lawmakers and waste pickers, to support informed decision-making processes. Additionally, I present an overview of the benefits that transitioning to a new plastic economy can bring, ranging from global to local social justice associated with the triple planetary crisis: pollution, climate change, and biodiversity loss. Science diplomacy and stakeholder involvement are strongly recommended to find solutions to the plastic pollution problem and towards transforming the circular plastics economy.

I. Introduction

i. The rise of plastics: From a genius solution to the world's most significant global environmental crisis.
The development of Bakelite in 1907, the pioneering synthetic plastic, was a turning point for modern plastics (PIA 2023). This discovery triggered numerous innovations in synthetic plastic production, most notably making waves in fossil fuel (specifically petroleum)-derived synthetic plastics to meet the demands of World War II (1939-1945). Among these advancements stands the invention of polyethylene in 1933, followed by the introductions of expanded polystyrene and polyethylene terephthalate (PET), both in 1941. After the war ended, the excess of petroleum resources and production capacity was shifted to the mass consumer market, allowing plastics to become increasingly prevalent in many spheres of daily life. Although it is vital to regulate the use and lifecycle of all plastics, this policy position paper will focus mostly on polyethylene, which is the most common plastic in everyday items.

Two British scientists created polyethylene only 90 years ago, but it has quickly become the most prevalent material for creating single-use plastic products and disposable plastic packaging (UNEP 2018). One example of a prominent plastic item made from polyethylene is the plastic bag. The first patent for a plastic bag made from polyethylene was issued to a Swedish engineer in 1965 (Figure 1). This design was then licensed to a petrochemical company in the USA, which began producing plastic bags in 1977. In 1982, plastic bags were introduced into grocery stores and quickly became popular in the United States, replacing paper bags in supermarkets and other retail stores. During the following decades, plastic bag producers, sellers, and consumers grew exponentially worldwide, and in the 1990s, they became widespread in Brazil (which will be a focus of this policy position paper), as they were, and still are, inexpensive to produce (Geyer et al. 2017).

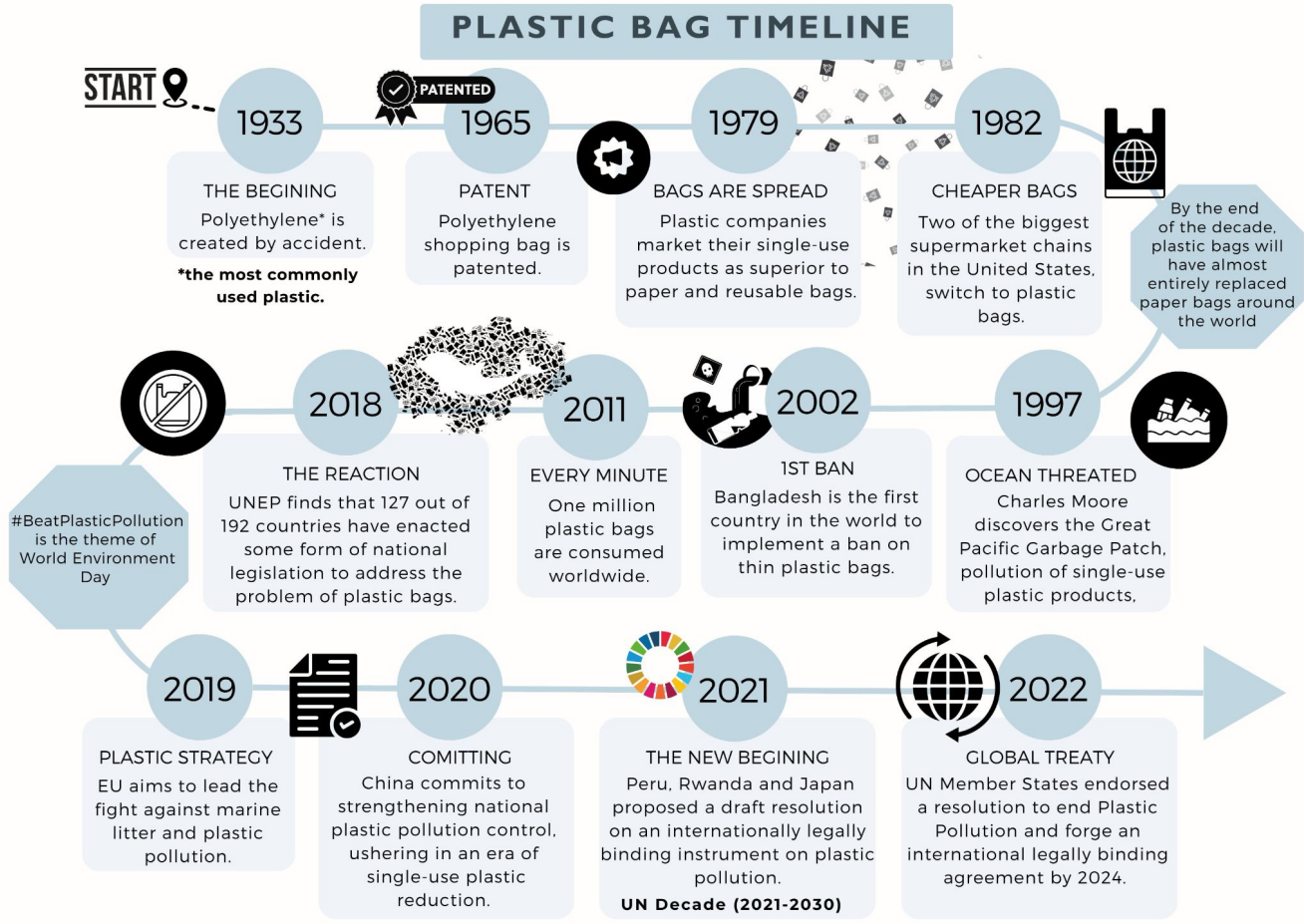

Figure 1: The timeline of the history of plastic bags made of polyethylene shows the year of their creation, market adoption, increasing popularity worldwide, pollution caused by their use, restrictions implemented in some countries, and the beginning of the UN Ocean Decade and UN Restoration Decade (2021-2030), and global treaty as international initiatives to combat plastic pollution. (Adapted and modified from UNEP 2018).

In general, plastics are convenient and cost-effective, which has led humanity to depend on them for a wide range of applications such as packaging, household products, cosmetics, transportation, technology, medical devices, baby products, toys, construction, etc. However, the growing awareness of plastics' negative impacts on biodiversity, climate, humans, and planetary health reveals a Trojan horse. For instance, global plastic production leads to the emission of greenhouse gasses equivalent to 1.96 gigatons of carbon dioxide each year. Also, for the year 2015, in the United States, it was estimated that the healthcare costs from diseases and disabilities caused by plastic-related chemicals exceeded $920 billion (Landrigan et al. 2023). The science-based evidence and multilateral collaboration surrounding plastics resulted in a global consensus at the fifth United Nations Environment Assembly in March 2022, where the historical groundbreaking decision to put an end to plastic pollution was made by all 193 UN member states.

Plastics are typically sorted into seven categories based on their polymer composition (Figure 2) and recyclability. When recycled, plastic polymers lose their quality and are not suitable for manufacturing similar, original products. As a result, recycled plastics generally become parts of other products with inferior quality. Moreover, recycled plastics often cannot be recycled again due to decreases in quality. The design of plastic items plays a crucial role in their recyclability, and certain types pose significant challenges to recycling, hindering the transition to a circular economy for plastics. Examples of such plastics include laminated packaging, thin plastic films, expanded polystyrene foam (commonly known as styrofoam), and items that combine different plastic polymers. It is estimated that only 21% of plastics in short-lived items can be economically recycled, leaving little motivation to collect and recycle these items (UNEP 2023). Consequently, the unrecyclable plastics often end up polluting the environment.

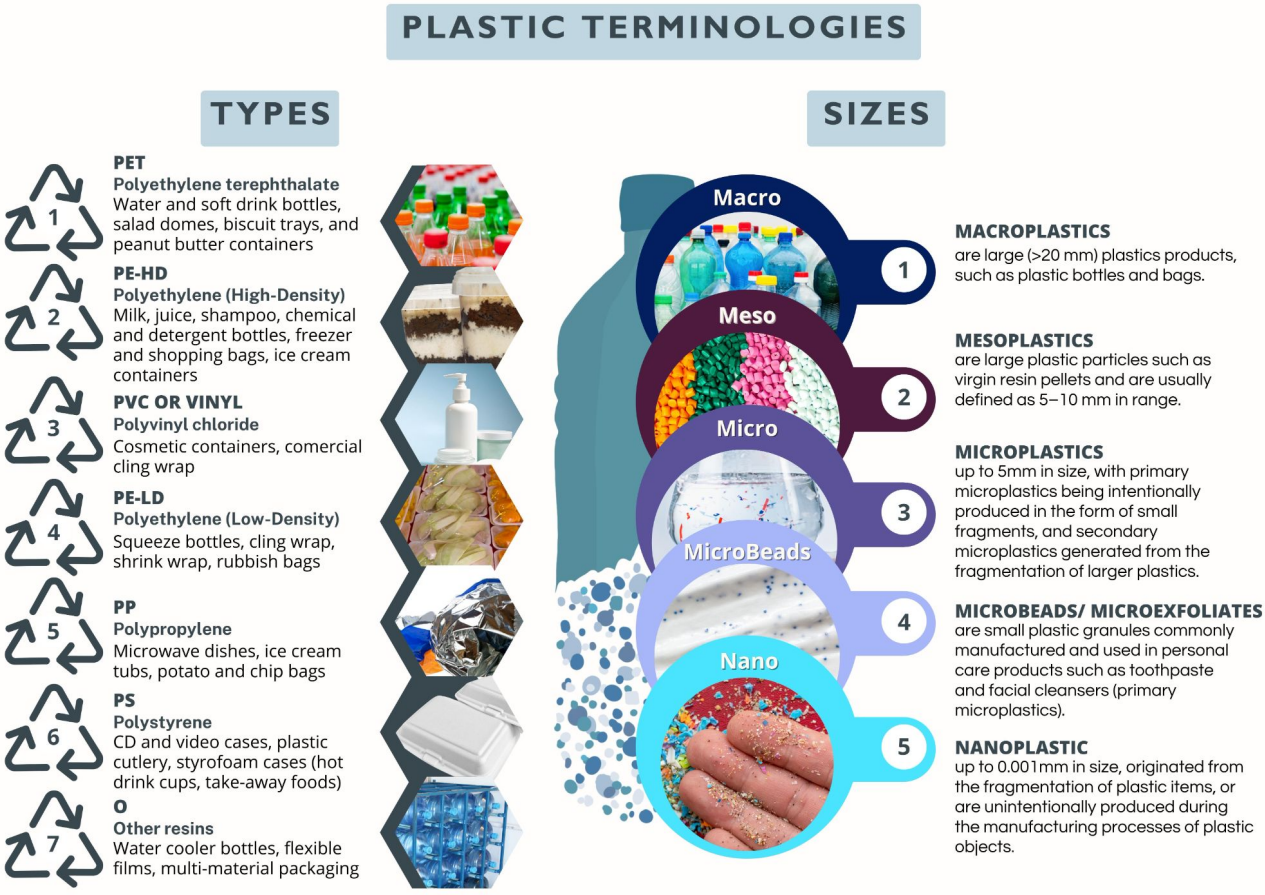

Figure 2: The seven plastic categories, according to the Resin Identification Code (left). The plastics labeled with codes 1-PET (Polyethylene Terephthalate) and 2-PE-HD (High-Density Polyethylene), are the most commonly recycled. The plastic sizes (right), adopted in marine litter studies, are macroplastics and microplastics, which are divided into two categories according to their source. Regular products are known as primary microplastics (e.g., plastic added in cosmetics and fibers from clothes), while those fragmented from larger plastics are known as secondary microplastics (e.g. pieces from single-use plastics and vehicle tires). Additionally, there are nanoplastics and microbeads.

These nuances of plastic recycling have made it difficult to balance plastic production and recycling, which humanity has thus far failed to efficiently do. The consequences of this failure have a cumulative effect. Global plastic production rates have steadily increased, doubling from 2000 to 2019, while less than 10% of the world's plastic waste has been recycled (OECD 2022). Most plastic is either incinerated, ending up in landfills, or leaks into the environment. Moreover, plastics have a large carbon footprint and account for 3.4% of global greenhouse gas emissions (OECD 2022), surpassing Brazil's contribution. This creates a negative feedback loop as climate change can exacerbate the consequences of plastic pollution, and vice-versa. For example, under extreme rain

events, plastics can prevent water from draining properly, leading to an increased risk of flooding. Additionally, disposing of plastics through incineration and landfilling also releases greenhouse gasses, such as carbon dioxide, methane, and other pollutants.

Plastic pollution is so prominent in our daily lives that it has even infiltrated how we talk about it. The word "Plasticene" was coined to refer to the overwhelming amount of plastic pollution in modern life, although it is not a geological epoch (Haram et al. 2020; Rangel-Buitrago et al. 2022). Similarly, the terms "plastic pandemic" and "plastic tsunami" have been used as a parallelism to the COVID-19 virus pandemic to denote the size and seriousness of the problem (Subramanian 2022). Single-use plastic products and disposable plastic packaging items might be practical, but they are a serious pollution threat to the environment.

ii. Plastics: A threat to the health of you, me, and the food we eat.

Plastic waste that is not adequately managed and disposed of leaks into nature, which with winds and water runoff, among other factors, ultimately leads to the ocean. The ocean shapes the planetary weather and climate patterns, absorbs about 30% of the carbon dioxide emitted, and its photosynthetic biodiversity produces at least 50% of the oxygen on Earth. Not only does it play crucial roles in environmental health, but it also has roles in global trade and transport. The global trade in ocean-based goods and services was about 2.5% of the global GDP in 2010 and is estimated to double in size by 2030 (OECD 2016). However, plastic pollution's negative impacts on ocean health threaten all benefits provided by the ocean.

Once in the ocean, currents can carry plastics over long distances, eventually forming large patches of plastic waste known as "garbage patches" in the gyres and deposited on the seabed. As plastics float in the ocean, environmental factors such as UV light, heat, and wave actions can cause plastics to disintegrate into smaller particles known as micro- and nanoplastics (Figure 2). Microplastics are "synthetic solid particles or polymeric matrices, with regular or irregular shape and with size ranging from 1 μm to 5 mm, of either primary or secondary manufacturing origin, which are insoluble in water" (Frias and Nash 2019). Primary microplastics are intentionally produced plastic particles in reduced sizes that are added to products, typically everyday consumer goods such as cosmetics, personal care products, cleaning products, and synthetic textile fibers. On the other hand, secondary microplastics originate from the unintentional fragmentation of larger plastic items. Nanoplastics are even smaller than microplastics, generally within the size range of 1 to 1000 nm, and are either formed from the fragmentation of larger plastic items or unintentionally produced during the manufacturing processes of plastic objects (Gigault et al. 2018).

Both microplastics and nanoplastics can be colonized by the microbial community, creating what is known as the plastisphere. Several pathogens, including *Vibrio spp., Aeromonas salmonicida*, and *Arcobacter spp*., which are among the most common pathogens affecting fish and shellfish in aquaculture, have been found in the plastisphere. The plastisphere represents a significant threat to food security as these pathogens can cause substantial losses to commercial aquaculture species (Amaral-Zettler et al. 2020; Cholewinska et al. 2022; Marathe et al. 2022). The presence of *Vibrio spp.* in floating microplastics raises concerns as it is associated with the emergence of antimicrobial resistance, which accelerates the spread of drug-resistant microbial populations, particularly during the summer months when they flourish in response to elevated water temperatures (Amaral-Zettler et al. 2020). Also, while many species of *Vibrio spp.* are harmless to humans, certain strains can lead to diseases in both wildlife and humans. Furthermore, the discharge of microplastics by wastewater treatment systems into rivers is another potential source of human infections. For example, higher concentrations of the family Campylobacteraceae, a pathogen known to cause gastrointestinal diseases in humans, have been found on microplastics downstream of sewage treatment plants (McCormick et al. 2014).

Pathogens that colonize on plastic are not the only plastic-related risks to human health. In fact, plastics themselves can be a major problem for humans. During the production of plastic products, over one hundred chemicals known to threaten human health are incorporated. This makes plastics pervasive sources of endocrine-disrupting chemicals (EDCs), which can cause various health problems such as cancer, diabetes, neurological impairments in babies and children, and reproductive disorders (Flaws et al. 2020). Plastics can also absorb organic pollutants and heavy metals from the environment, which can be inhaled, ingested, and absorbed via the skin. As a

result, microplastics and hazardous chemicals can accumulate in the body and have been found in humans' blood (Çobanoğlu et al. 2021; Leslie et al. 2022), lungs (Amato-Lourenço et al. 2021), placenta (Ragusa et al. 2021), feces (Liu et al. 2023), liver (Horvatits et al. 2022) and breast milk (Ragusa et al. 2022; Liu et al. 2023), resulting in nearly all people already having EDCs in their bodies (Flaws et al. 2020).

II. Current policies and challenges

i. A brief look at global policies against plastic pollution.

The scientific evidence is clear that plastic pollution is a severe problem that negatively impacts human and planetary health, and neglecting the plastic crisis is not an option. Moreover, the transition to a transformed plastics economy will generate significant economic benefits, creating new business opportunities, particularly for those who are quick to adapt and embrace the changes (UNEP 2023).

There is a global trend aimed at mitigating the negative impacts of plastic and reducing plastic litter in the ocean. Over 120 countries have implemented bans or taxes on single-use plastics, such as plastic bags, cutlery, straws, beverage cups, and food containers. In Asia, Bangladesh took a pioneering step by becoming the first country to ban plastic bags in 2002, setting an example for others to follow. However, when it comes to significant policy action, Europe has emerged as a leader. Since 2021, the European Union has prohibited certain single-use plastic items from being placed on Member States' markets and has acted against the ten most commonly found single-use plastic items on European beaches. These items include plastic food containers, beverage cups, packets, wrappers, cigarette butts, cotton bud sticks, cutlery, plates, straws, and balloon sticks.

Before implementing these policies or allocating public funds, policymakers can predict how businesses and households will respond to various plastic policy instruments by using the Plastics Policy Simulator (PPS) of the World Bank, which is a cutting-edge technology-financial model. It also allows policymakers to estimate the costs, revenues, and other effects associated with these policies. The PPS can project comprehensive results, including target accomplishments, expenses, employment consequences, and environmental implications such as plastic waste and greenhouse gas emissions. This makes it possible to recognize potential trade-offs and put effective solutions in place to deal with them. UNEP (2023) recommends using the PPS to evaluate the long-term effects of enacting plastic policies.

ii. The impact of plastic on the Blue Amazon (aka the Brazilian marine space) and Brazilian policies to try and mitigate these effects.

Brazil is both one of the world's most significant producers and consumers of plastic, and pollutes the ocean with at least 325,000 metric tons of plastic each year, resulting in beaches polluted with plastics from north to south (Zamora et al. 2020; Oceana 2022). Concerning the amount of materials produced and placed on the market by the industries and the volume of material recovered, the country registers a recovery rate of nearly 3% for dry residues; of these, all plastic types represent 16.8% in the urban solid residues. Brazil has not yet implemented a ban on single-use plastics, but some municipalities have laws regulating plastic bags and straws.

In Brazil, other policies/programs related to solid waste and beyond the topic of plastic pollution include The National Solid Waste Policy and the Reverse Logistics Program. The National Solid Waste Policy (PNRS, Law 12.305/2010), which took 19 years of discussion and debate to be approved, is the basic legislation for waste that sets the concepts, objectives, tools, and directions for integrated and solid waste management, as well as the duties of waste producers and the government.

The implementation of PNRS policy is progressing slowly, highlighting the challenges faced by the country in waste management, particularly in cases where there is limited political interest in finding a solution. For instance, the article 54 of the Law required the closure of dumpsites by August 2, 2014. However, in that same year, 489 new dumps began operating, which is plausibly related to a global sporting event that took place in the country (i.e., the FIFA World Cup). In 2018, a total of 1,037 dumps were reported to the Federal Government, but only thirty-one had an environmental operating license, demonstrating that most dumpsites were unauthorized by local governments (Faroni-Perez 2020). Also, the closing of dumps and uncontrolled landfills was delayed by the Law 14.026/2020 with some municipalities

having the option of extending the deadline until 2024. These unfavorable waste management conditions and decisions have potentially contributed to the increase in plastic pollution and its subsequent release into the environment.
Furthermore, the program integrating reverse logistics circular economy packing was approved over a decade later (Decree 10.936/2022), and recently, another decree (Decree 11.413/2023) was published to institute it. Reverse logistics and recycling are key pillars in achieving a circular economy by ensuring the reuse and efficient return of goods and materials to industries and manufacturing processes. These approaches promote resource efficiency, reduce waste, and minimize reliance on dumpsites or landfills and the extraction of virgin materials by maintaining materials in the economic chain. By enhancing the stability and profitability of plastic recycling, the potential to reduce pollution is estimated to be an additional 20%, which can be achieved by increasing the proportion of economically recyclable plastics from the current 21% to 50% by the year 2040 (UNEP 2023).

In the Brazilian House of Representatives, between 1997 and 2021, seventy proposals on plastic bags were presented, of which thirty-one were presented from 2018 onwards. Since the presentation of these proposals, sixty-five have been attached to draft legislation PL N° 612/2007, which provides instructions for using biodegradable plastic bags for packaging products and goods used nationwide in commercial establishments. Other draft legislations focused on banning or limiting the use and commercialization of plastics, with varying degrees of restriction on different products and raw materials. Although the drafts can reduce plastic consumption, none so far involves changes to manufacturing or marketing of non/least-recyclable plastics (e.g., laminated snacks bags and blister packaging), despite their adverse effects and their social and environmental liabilities.

In 2018 and 2021, the term single-use plastics appeared in seven drafts of legislation, with two being 'Nationals Day to Combat' and 'Awareness Against Plastic Use and Plastic Pollution.' The draft legislation, PL N° 10.504/2018, which intends to set the National Program for the Ban of Single-Use Plastics until 2030 is the most developed and promising avenue. By shifting the market towards reusable and refillable products instead of single-use plastics, it can strengthen the business case for the reuse market. This strategic shift, combined with effective interventions such as eliminating unnecessary and non-recycled plastics, promoting reuse, and adopting new delivery options, has the potential to achieve a significant 30% reduction in plastic pollution by 2040 (UNEP 2023).

The term microplastics has appeared in the content of eleven draft legislations since 2015. A debate on the topic started in 2016 but has been halted, and none of the bills have been passed to date. The intentional addition of microplastics in manufacturing of personal care products and cosmetics has been widely questioned, and there are suggestions to ban these products (MMA 2019; UNEP 2023). Everyday items such as toothpaste, exfoliants, nail polish, and shower gel can contain up to 90% primary microplastics in their composition, becoming a source of environmental pollution when they are discarded and leak into nature (UNEP 2015; IUCN 2017). A prohibitive law that bans the intentional addition of microplastics to products can prevent further contamination and help reduce existing pollution, which is an environmental liability. Brazil can take an important step towards banning the intentional use of microplastics in personal care products by fostering harmonized collaboration with the business sector to facilitate policy acceptance and implementation.

The Brazilian National Law N° 9.605/1988 on criminal and administrative penalties relating to behavior and activities harmful to the environment is clear in its definition of environmental crime in article 54 defining it as, "causing pollution of any nature at levels that result or may result in harm to human health, or which cause the death of animals or significant destruction of plants." Considering this scope, the pollution caused by plastic can be encompassed within its definition. Moreover, article 72 establishes administrative sanctions for environmental liabilities, including fines, seizure of goods, and suspension of activities. These measures, aligned with articles 74 and 75, which establish the baselines for the application of fines related to the damages caused, and determine the minimum and maximum value of the fines, provide a framework to address plastic pollution towards environmental compliance and safeguarding human and ecological well-being, as provided in article 225 of the Federal Constitution.

These policies represent necessary steps towards more sustainable waste management practices, but there is still much political will and work to be done to achieve the reduction of single-use plastics and to reduce plastic leakage into the ocean. Brazilian legislators and decision-makers need to make the country an active player in the global fight against plastic pollution. In the coming years, the federal government of Brazil is expected to lead in the global environmental and social efforts with a governance horizon ranging from the 'Amazon Forest to the Blue Amazon'. This term, Blue Amazon, was coined by the Brazilian Navy to refer to Brazil's exclusive economic zone and continental platform, and to emphasize its biodiversity and importance. To illustrate, the Blue Amazon contributes approximately 20% to the country's GDP, employs around one million artisanal fishermen, and possesses the second-largest extension of the mangrove forest with a high potential for carbon storage, all of which may be threatened by plastic pollution (Faroni-Perez 2023).

There are ongoing initiatives including Brazil's participation in the United Nations Clean Seas campaign, the launch of the National Plan to Combat Marine Litter in 2019, and the introduction of financial incentives by the Brazilian Ministry of Science, Technology, and Innovation in 2022 to promote science and technology. However, it is crucial to accelerate actions and implement effective policies to address the magnitude and nature of plastic pollution and shape the necessary changes addressing the plastics circular economy and eliminating unnecessary pollutants, such as primary microplastics. Considering Brazil is one of the world's largest producers and consumers of plastic and significantly contributes to plastic pollution, it is essential to prioritize political and stakeholder commitment when finding innovative solutions.

Plastic pollution threatens the ocean, which is essential for the sustenance, oxygen supply, livelihood, and overall well-being of humanity. In order to achieve the necessary transition from a linear to a circular plastic economy, it is imperative to take systemic steps, such as ensuring the effective implementation of existing laws and developing common policies. For instance, the development and implementation of policies mandating the prohibition of intentionally manufactured microplastics, the regulation of single-use plastics, and the establishment of a circular economy serves as a blueprint for strengthening national efforts to combat plastic pollution.

iii. Global policy challenges to overcoming plastic pollution.

Plastic pollution has negative transboundary impacts and can affect marine areas beyond national jurisdictions, also called the high seas. Global governance of plastic pollution requires joint actions from science diplomacy and stakeholders to overcome plastic pollution. It also requires cooperation between governments, non-governmental organizations, and the private sector to create effective and sustainable solutions to reduce plastic pollution. After nearly twenty years of work and decisions, the United Nations has recently achieved a high seas treaty, which is the first international agreement to provide protection for the two-thirds of the ocean outside of state jurisdiction. Beyond that, the treaty is a significant accomplishment in terms of safeguarding against pollution, besides addressing overfishing and habitat degradation, and fostering the potential for scientific collaboration (Nature 2023).

Lessons must be learned from the COVID-19 pandemic, when science diplomacy practices, including agreements between governments and companies as well as the work of international organizations, have demonstrated the potential to solve a shared crisis. International cooperation, data, technology sharing, disclaimer of intellectual property, stakeholder engagement, and increasing funding helped COVID-19 vaccine development relatively quickly compared to other vaccines. Therefore, it can foster solutions to the "Plasticene"/"Plastic Pandemic", which is as complex and challenging an issue as the COVID-19 pandemic.

In 2022, the United Nations Environment Assembly (UNEA) adopted a historical resolution to address the issue of plastic pollution, recognizing the need for a comprehensive and coordinated global approach. Furthermore, the global treaty on plastic pollution is ongoing, with the ambition of completing an international legally binding instrument (ILBI) on plastic pollution by the end of 2024. The agreement promotes international cooperation and coordination to reduce plastic pollution and its impacts while addressing the entire lifecycle of plastic, from

production to design to disposal. It would establish a framework for countries to set targets and take action to reduce the production and consumption of single-use plastics, improve waste management, and enhance research and monitoring of plastic pollution. The first intergovernmental negotiating committee (INC) met in Punta del Este, Uruguay, with delegates and stakeholder groups from 160 countries. The Brazilian government participated in the INC-1 and stressed the significance of creating implementation strategies as ambitious as the suggested obligations and implementation measures. Also, Brazil emphasized the need to specify the scope, objectives, and implementation methods of a future ILBI and called for a balance between socio-economic and environmental concerns (IISD 2022). This upcoming agreement, expected to be concluded next year, presents a significant challenge, as it requires timely actions and international collaboration to achieve a consensus. If the necessary shifts to overcome plastic pollution are delayed by five years, it will result in increased costs and an additional eighty million metric tons of plastic pollution by 2040 (UNEP 2023).

III. Governance opportunities: Collaboration and synergies

The International Organization for Standardization (ISO) is a non-governmental international organization with a membership of 167 national standards parties. It plays a crucial role in the global economy and international trade by developing and publishing several standards, which are reviewed every five years. An example of a sustainable action by ISO is the approval in 2021 of the London Declaration by members representing 165 countries, which is a commitment to achieving the climate agenda by 2050 by establishing international standards relevant to climate change. This commitment is important as the climate crisis stands with the ocean crisis, both of which, as previously mentioned, are impacted heavily by plastic pollution.

ISO also formed a technical committee on "Sustainable Finance" to develop new standards towards aligning global financial systems with sustainability. This underpins the credibility, integrity, and scalability of sustainable finance activities and guides financial institutions to better integrate Environmental, Social, and Governance (ESG) considerations into investment and finance practices while preventing "sustainability washing". Sustainability washing, also known as greenwashing, involves the use of ambiguous or deceptive claims to make products or practices appear more sustainable than they truly are to mislead investors and consumers. This practice undermines genuine sustainability efforts and can mislead stakeholders, leading to a perception of sustainability as a mere marketing tactic rather than a genuine commitment to environmental responsibility. International Standards could guide national laws and the global agreement on plastic pollution and vice-versa. ESG considerations present a significant opportunity for implementing Sustainable Development Goals (SDGs). The SDGs are seventeen goals adopted by the United Nations in 2015 as a universal call to action toward sustainable development that are integrated and indivisible and balance the three dimensions of sustainable development: economic, social, and environmental. These are aligned into five pillars: people, prosperity, planet, peace, and partnership.

Private sector financial investment to achieve an end to plastic pollution is consistent with multiple SDGs and the five pillars and can play a crucial role in reducing liabilities, risks, and litigation associated with the damage caused by plastic pollution in the ocean. Moreover, ESG standardization and practices have the potential to become the private institutions' forerunner to reverse the cycle of decline in ocean health at both the United Nations Decade of Ocean Science for Sustainable Development and the United Nations Decade on Ecosystem Restoration (2021-2030). Therefore, the organizations responsible for developing the standards could devote more attention to this promising opportunity to include ocean targets related to the challenges and goals of the UN Ocean Decade. For example, more than 80% of goods traded internationally pass through ports in coastal areas and are transported by sea, and this proportion is even higher for most developing nations. These activities cause pollution and greenhouse gas emissions that impact marine ecosystems, biodiversity, and the benefits provided by the ocean. Furthermore, microplastics can enter the ship's engine cooling system and damage pumps, filters, and other components. Plastic debris can also get caught in a ship's propellers or intakes, harming, or even taking the engine out of commission. Many corporations, if not all, have a direct or indirect connection to the ocean through their business activities and can make ESG commitments to improve its sustainability and health.

The Brazilian National Standards Organization (ABNT) published an ESG Recommended Practice (ABNT/PR 2030) in 2022, highlighting a growing trend towards sustainable development. The document guides the measuring and reporting of ESG data, helps companies improve their sustainability performance, increases transparency and accountability, and meets the growing demand from investors, consumers, and other stakeholders. It has instruments on dimension E (environment) that explicitly mention land, air, climate, freshwater, pollution, biodiversity, and ecosystem services. However, the document does not explicitly mention the ocean and its agenda for sustainability. Therefore, it is strongly recommended that ABNT takes the next step to include ocean targets in the PR 2030 during its review process. This inclusion could become a model for the business sector taking action to reverse the cycle of ocean sustainability decline due to plastic pollution. Depending on the scope, priorities, or needs of the business, several attainable goals and steps that establish accountability can be taken, such as developing corporate policies to reduce or eliminate the use of single-use plastics, develop technologies and programs to remove plastics and microplastics from waterways, support innovative initiatives for alternative materials, allocate resources to promote awareness-raising campaigns in collaboration with stakeholders, such as government and NGOs, and to foster projects focused on restoring and conserving marine biodiversity and ecosystems.

Furthermore, the ABNT/PR 2030 encompasses the biodiversity and ecosystem services dimension (ABNT/PR 2030, 19), but there is a need for indicators and metrics. Brazil has the Brazilian Platform on Biodiversity and Ecosystem Services (BPBES), which develops assessments by gathering and compiling scientific data and existing knowledge in a language understood by decision makers from both public and private institutions with the aim of connecting scientific knowledge and policy making. It is also in the final stages of preparing the Exotic Species and the Marine-Coastal on Biodiversity and Ecosystems Services Assessments, which encompasses technical and scientific approaches along with perspectives of indigenous people and traditional communities. It is recommended that ABNT partners with BPBES to receive substantial and expert support in the areas of environment and ocean interface, utilizing science-based approaches on biodiversity and ecosystem services. This partnership will contribute to the advancement of PR 2030 in its subsequent phases.

Similarly, ISO is strongly recommended to partner with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and the scientific committee of the UN Ocean Decade. This partnership will ensure the integration of best practices for ESG standardization, with a particular focus on promoting ocean health and sustainability. These efforts are crucial, as they underpin the well-being of humanity and the sustainability of economic activities. It would also benefit both institutions, ABNT and ISO, to form a partnership with the Science, Technology, Policy (STeP) Fellowship Program from Inter-American Institute for Global Change Research (IAI). STeP is a cutting-edge program that promotes the provision of expert scientific advice to decision-makers to develop public policies that are responsive to climate change. The program also helps to train future Latin American and Caribbean leaders to participate in the science-policy interface through hands-on learning supported by professional development and mentorship, giving these fellows the potential to interface with science and the capacity to help develop instruments and measures. This combination of an international network and workplace cooperation provides the opportunities for resource sharing and integrating distinct knowledge and expertise across many sectors and nations.

IV. Policy roadmap to evidence-based and fast-tracked approaches

The Organization for Economic Cooperation and Development (OECD) is an international forum that develops policy standards to promote sustainable economic growth. OECD has developed several policy approaches encompassing plastic waste and pollution. These policies are directives for responsible production, consumption, and disposal of plastics to minimize the negative impacts. Rather than starting a policy from scratch, national-level draft legislation could incorporate policy approaches and instruments evaluated and recommended by the OECD. This practice can save decision-makers and legislators time and public resources and ensure that the policy approaches and tools used are evidence-based and effective.

In the book ‘Global Plastics Outlook: Economic Drivers, Environmental Impacts and Policy

Options,' OECD (2022) describes the policy blueprint to address pressures from the production, consumption, and end-of-life management of plastics. It also provides a policy roadmap with a toolkit of five policy approaches: 1) Restrain demand, 2) Design for circularity, 3) Enhance recycling, 4) Close leakage pathways, and 5) Clean up. Additionally, I hereby propose the inclusion of three additional policy approaches and instruments (Figure 3), adapted from the World Economic Forum's circular plastics economy initiative (Shaping the Future of Trade and Investment), Intergovernmental Negotiating Committee, Plastic Pollution INC-1 (IISD 2022), and UNEP (2023), to further support the development and implementation of effective plastics policies. The additional policy approaches and instruments are:

1. Raise awareness: promote awareness through the implementation of a continuous, widespread, and accessible communication plan that effectively disseminates scientific information, encourages ocean literacy for all, and fosters behavior change interventions.

2. Incentives: promote scientific and technological advancements to enhance knowledge, materials, and indicators necessary for achieving targets outlined in the plastic circular economy strategy. Provide incentives to support sustainable practices while discouraging unsustainable trade. Additionally, ensure sufficient financial resources for prioritized actions and establish a sustainable implementation strategy by revenue-generating policies, adjustments to financial incentives, attraction of private-sector investments, and promotion of international cooperation.

3. Transparency: promote responsibility and commitment by establishing a monitoring system with indicators that are aligned with the initial baseline. This transparent system should be open and accessible to the public, empowering society to exercise control.

The set of eight policy approaches presented herein strengthens the framework for improving the global treaty on plastic pollution by offering a comprehensive toolbox of instruments to be adopted in the international legally binding instrument. These approaches and instruments, outlined in Figure 3, also address some of the concerns expressed during the Plastic Pollution INC-1(IISD 2022). Furthermore, it can help in the development of policies, including the improvement of the Brazilian draft legislation mentioned earlier. The most comprehensive Brazilian draft legislation to close the intention-action gap on plastic policy, including aspects such as chained stakeholder investment facilitation and a data monitoring system, is PL 10.504/2018, which sets the National Program for the Ban of Single-Use Plastics until 2030. There is room for enhancement to ensure greater effectiveness, efficiency, and relevance, as well as to align the goals of the draft with its potential impact if it is enacted into law (Awasthi et al. *in press*). Furthermore, involving multiple stakeholders, such as business representatives, environmental NGOs, and consumers, in the drafting process and debates is helpful to ensure a more acceptable and successful law.

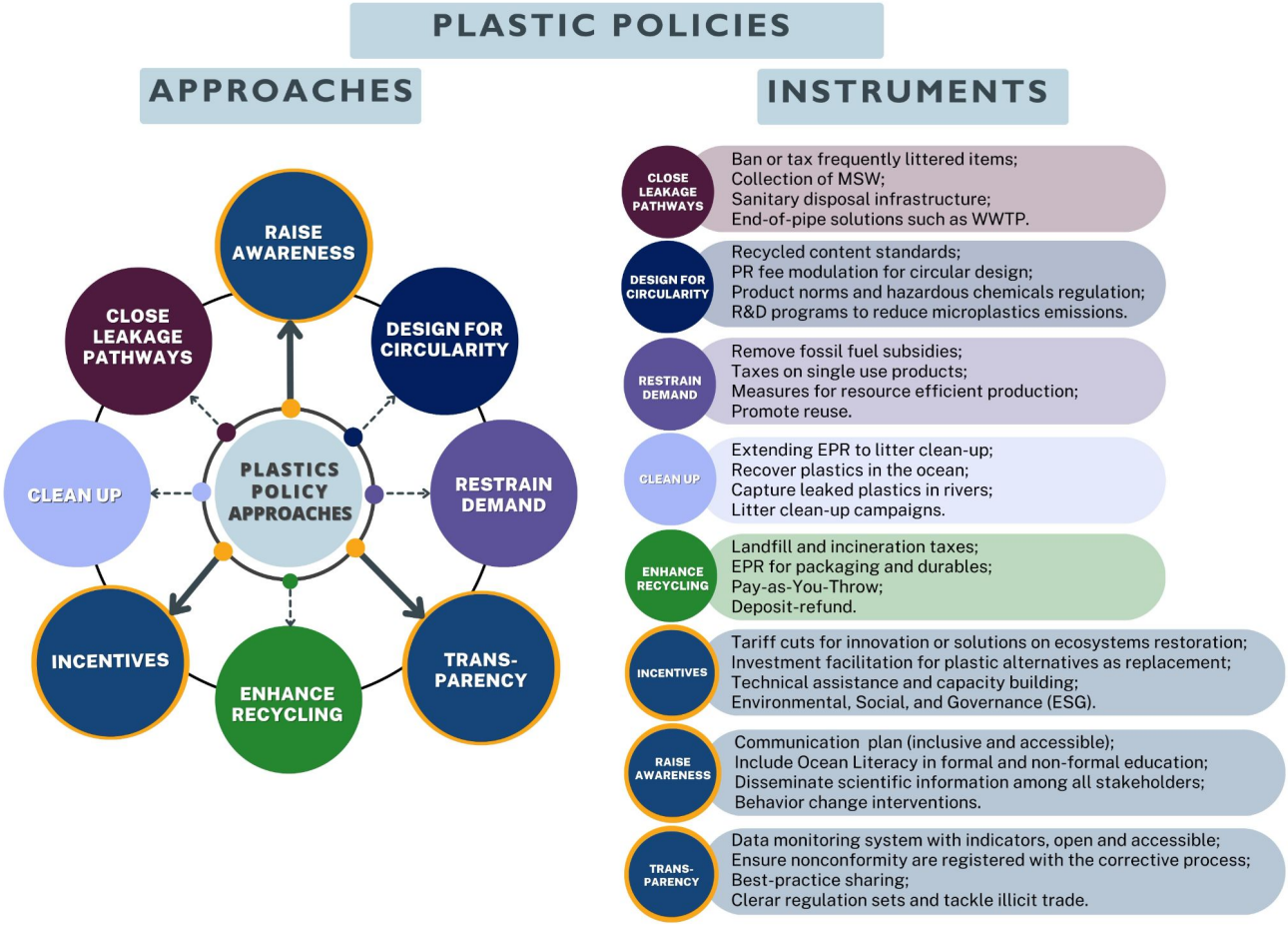

Figure 3: The five policy approaches suggested by the OECD (dashed arrows) and the three approaches (solid long arrows, highlighted circles in yellow) that I propose are shown, along with examples of instruments (small arrows). The three approaches proposed are adapted and modified from the World Economic Forum. Legends: EPR: extended producer responsibility; MSW: municipal solid waste; WWTP: wastewater treatment plant, ESG: environmental, social, and governance. (Modified and adapted from OECD 2022, WEF 2020, INC-1(IISD 2022) and UNEP 2023).

In addition to implementing systemic regulatory interventions to address plastic pollution and promote socioeconomic and environmental benefits, it is crucial to innovate and raise awareness in society to drive behavior change. Ocean literacy, defined as "an understanding of the ocean's influence on you and your influence on the ocean" is grounded in scientific knowledge and applicable in diverse settings beyond taught schools. It plays a crucial role in plastic policy campaigns by shaping and transforming people's attitudes and emotions, while fostering a deep connection between individuals and nature. Adapting ocean literacy principles and concepts for different audiences, such as policymakers and waste pickers, has supported recycling initiatives and the development of policies aimed at reducing plastic waste and its impacts (ALES 2022). Plastic pollution in the ocean is an environmental crisis that humanity is currently confronting, necessitating informed decision-making processes. By incorporating scientific knowledge and integrating it with the challenges of the plastic economy, it is possible to effectively support these decision-making processes.

The primary plastics industry, which generates earnings of about $600-700 billion a year, imposes a severe social and environmental cost, as stated in the latest UNEP report (UNEP 2023). Based on reasonable estimates, the costs associated with environmental and human health damages range from $300-600 billion annually. The transition to a new plastic economy holds considerable advantages. Apart from reducing costs and harm, this shift has the potential to create approximately 700,000 jobs, primarily in developing nations. Furthermore, by achieving an 80% decrease in plastic pollution between 2021 and 2040, it is projected that over $4.5 trillion in direct, environmental, and societal savings could be realized. This reduction in plastic pollution would also lead to the prevention of 0.5 Gt of CO2-equivalent greenhouse gas emissions

annually, resulting in an additional savings of $3.3 trillion in environmental and socioeconomic costs. Additionally, this transition would alleviate responsibilities, risks, and legal challenges associated with plastic pollution damages. The triple planetary crisis encompasses pollution, climate change, and biodiversity loss. The information provided in this policy position article demonstrates the significance and potential of implementing global and local plastic policies to overcome these crises. Therefore, adjusting to a new plastic economy is an essential step as it can promote job creation and build a more just, equitable, inclusive, and sustainable future.

The plastics crisis is complex and global, and the solution will be equally complex. Each country is unique, having its own culture and economy around plastics. To go even further, individual cities within each country have nuanced differences in the way they use and recycle plastics. Therefore, policy models will need to be adjusted to these local realities while also following a larger global policy that ensures that all cities are positively contributing to the solution. No one person can change the global plastic crisis, and overcoming plastic pollution will require the commitment of all countries, governments, institutions, and people.

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Acknowledgements

The author would like to acknowledge the Science Technology and Policy (STeP) program at the Inter-American Institute for Global Change Research (IAI) and the Brazilian Platform of Biodiversity and Ecosystem Services (BPBES), where she is a fellow, for their valuable support. Additionally, the author would like to express her gratitude to the editors for their insightful comments and suggestions, which have greatly contributed to enhancing the quality and clarity of this article.