Potential human and environmental health implications of the proposed EU-Mercosur trade agreement in relation to selected plastic items

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This research was undertaken by Dr Arturo Castillo Castillo based at Utrecht University as commissioned by Greenpeace Germany. The report has been produced during the period of international trade negotiations as of beginning of 2023. It is intended to provide background for the work of Greenpeace in the subject of plastic pollution.

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Abstract

Greenpeace has conducted preliminary research on the types of plastic inputs, intermediate products, products and wastes that may be included in a new trade agreement between the **European Union and the Mercosur** trading block. Greenpeace requested Dr Arturo Castillo Castillo to provide scientific insight and expertise into the potential impacts of these plastic types included in the trade arrangement being discussed between the two blocks. The research is relevant because several monomers and polymers with or without their additives can be made into dozens of different products. Such materials can be traded in primary forms (before manufacturing into products), in components of products or in whole items. Each one of these states is associated with a different probability of becoming pollution. Human and environmental health can be affected through different pathways. Two important distinctions about harm to human and environmental health must be made. Firstly, pathways and effects are different for **mechanically or chemically induced damage**. Mechanical damage can occur when macro-plastic harms human or animal tissue. For example by puncturing tissue or blocking organs of the digestive system but also via external injury to skin and muscle tissue. Micro- and nano-plastics can lodge themselves in different tissues causing inflammation and in some cases cross membranes such as the blood-brain barrier. Chemical damage, is primarily caused by degradation products during the production and use stages as well as emission of chemicals during (uncontrolled) combustion. Another important pathway for chemical harm is the migration of chemical additives, monomers, oligomers, fragments and degradation products from packaging materials to foodstuffs, which regularly ingress and egress the body, resulting in a potential constant stock. These chemicals can, amongst others, mimic or block the functions of hormones and contribute to inflammation, diabetes, obesity and impaired fertility.

Secondly, it is important to distinguish the ability of pollutants and chemicals within the human or animal body to represent **hazards as opposed to risks**. A hazard is posed by a substance that can contribute to a harmful reaction. The risk is the probability that the harm will actually occur depending on the frequency and severity of the hazardous events that collectively can cause harm. In reality, chemicals do not take turns to enter an idealised pristine body. Instead, many chemicals enter the already contaminated body at various times in different combinations. It would therefore lack rigour and scientific validity to attribute a particular harm to a single chemical through a single route of ingress to the body at a specific time.

There are several **dependencies** that must be considered in the analysis of potential categories of concern included in the trade negotiations between the EU and Mercosur. (i) the potential to become plastic pollution or to cause toxicity will vary greatly depending on the final product that is ultimately manufactured, as two products with a common original polymer can vary in value, use, disposal route and chances of recovery; (ii) the combination of chemical additives will greatly influence how toxic a product could potentially be in use, what quality it would yield in recycling and the toxicity at end of life; (iii) there is also variability in price competitiveness across product groups and, in some cases, European polymers, parts or products might be able to undercut prices of Asian imports but in other cases they may not, even without tariffs, given the difference in cost base; (iv) it is important to know whether products, and eventually waste, are subject to regulations different from those stipulated for polymers; (v) dominant behaviours and civic practices will have decisive influence on the probability of littering, wrong disposal, fraction separation and length of use of products; (vi) the variety of chemicals and pollutants that consumers are in any case exposed to from other sources will significantly influence the final toxicity of the entire mix over time in each immediate geographical location; this is called *exposome*; and (vii) the effectiveness of reuse and substitution policies,

recycling infrastructure and the waste management system in each country will be key drivers of the impacts at the end of life of products.

The **red flags** to watch closely during the negotiations between the European Union and Mercosur include some polymers in primary forms, products and some product groups, all of which will have some of the dependencies mentioned. Full details are explained in the *Red flag items* and *Watching brief* sections.

Polystyrene

The polystyrene items included as primary forms in the EU-Mercosur tariff reduction schedule, i.e. the planned reduction of tariffs of plastics exports from the EU to Mercosur countries, can, once expanded, break up easily leading to significant pollution on land and in aquatic environments. Due to its low density it is difficult to recycle, unattractive to recover and can be in most cases only downcycled.

Polyvinylchloride (PVC)

PVC products can contain 10%-60% phthalates by weight, which can leach into the environment during manufacturing, use and disposal. Unwanted migration of plasticiser additives such as short-chain chlorinated paraffins (SCCPs) from toys made of PVC has been identified previously. This poses a hazard to vulnerable groups such as children. Exposure of children to persistent organic pollutants (POPs) has been detected as coming from toys made with abundant SCCPs in soft PVC toys (UNEP, 2018). Uncontrolled combustion of halogen-rich PVC can emit dioxins and significant POPs.

Tableware, kitchenware, other household articles, of plastic

They can be made from different polymers and different additives. Dominant polymers are melamine, unexpanded polystyrene and polypropylene. Melamine in particular can lead to leaching of chemical additives during use. Disposable cutlery is one of the most common items found in field counts along coastlines and at sea.

Waste parings of polyethylene, styrene and PVC

Closed loop recycling seems unlikely since waste parings come from different products and brands. Even if they consist of the same polymer, the unknowable mix of additives would yield low quality recyclate. The toxicity of recycled products is likely to be high. They can end up as mismanaged waste depending on how developed the recycling market is. If they leak to the environment, as they are already fragmented, they can lead to mechanical damage to biota, most typically birds, amphibians and fish. In the case of repurposing, it is often overlooked that some of the compositions of the plastic might not be suitable for the new purpose.

Garments made of mesh fabrics with plastic/rubber and articles of apparel/accessories, of plastics

Micro- and nano-fibres and plastics are produced during the use and washing of all synthetic garments. At the end of life, chemicals are released while burning plastic such as benzo(a)pyrene (BAP) and polyaromatic hydrocarbons (PAHs), which are both potentially carcinogenic. It is worth considering that in the places were indigenous communities have widespread access to polymer fibres but not to waste management, there may be increased impacts of open burning on air quality as well as pollution of surface water and soil through the ashes.

To be able to prevent undesirable developments it is advised that civic society and the international community monitor national developments through questions on fundamental aspects such as:

- Do governments have strategies to foster recycling, reuse, the sharing economy and the right to repair?
- Are there fiscal or other mechanisms to internalise value chain external costs?

- Are there deliberately limited ambitions regarding better use of plastics (e.g. early versions of the UK and the Dutch Plastic Pacts) with significant industrial involvement that mainly concentrate on recycling and neglect reuse and other parts of the resource efficient and healthy economy?

Combining these questions, the red flags and the dependencies outlined in this report can provide a good basis for evaluating the potential impacts of the planned EU-Mercosur trade agreement in relation to some plastic items and plastic waste in the Mercosur countries.

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1. Introduction

1.1 Plastic trade can contribute to pollution

Important changes have taken place in the last ten years regarding international trade in plastic and particularly in waste plastic. In principle, most of the international shipments of plastic waste are meant for recycling. In reality, complications arise in receiving countries when the quality of the shipments is inconsistent or controls of quality and quantity are not guaranteed. Consequently, recycling sectors of receiving countries are unable or disinclined to process all sub-standard material leading to stockpiling, dumping, burning or otherwise dispersing the waste. China eventually banned imports of plastic waste for several reasons, not least because of the abundant plastic waste available in the domestic market. The ban was reflected in overburdened waste management systems in many other receiving countries, which have gradually introduced their own bans. However, bans are not universal and there are different definitions and management practices around them.

In future, it is important to ensure that all international instruments are used and observed. In cases where they are not, additional action from civic society stakeholders is required. There are at least two basic instruments to consider.

The **Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade** ("The Rotterdam Convention") .calls on exporters of hazardous chemicals to include directions on safe handling, and inform purchasers of any known restrictions or bans. Signatories decide whether to allow the importation of listed chemicals and exporting countries are obliged to ensure that producers within their jurisdiction comply. It is not automatically clear which plastic waste shipments can be applicable on the basis of their degree of contamination or the quantity and combination of toxic additives contained in the waste fraction being traded. In any case, waste shipments should all be based on an analogous prior informed consent mechanism.

The **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal** ("the Basel Convention"), aims to prevent transfer of hazardous waste from high- to low-income countries, except for radioactive waste covered in another treaty. It is intended to minimise the rate and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source and to assist developing countries in environmentally sound management of hazardous wastes they generate. It has established a Partnership on Waste Plastic, which manages pilot projects expected to benefit low- and middle-income countries through four project types: (i) Plastic waste prevention and minimisation; (ii) Plastic waste collection, recycling and other recovery including financing and related markets; (iii) Transboundary movements of plastic waste; and (iv) Outreach, education and awareness-raising.

In addition, it is important to highlight the Global Plastic Treaty that is currently being negotiated by the Intergovernmental Negotiating Committee (INC) convened by resolution 5/14 of the resumed fifth session of the UN Environment Assembly (UNEP, n/d). The treaty is meant to be based on a comprehensive approach that addresses the full life cycle of plastic, including its production, design and disposal.

1.2 Objective and process of this report

Greenpeace Germany has commissioned Dr Arturo Castillo at Utrecht University to assess the items that may become problematic as a result of the elimination of import tariffs within the framework of the Trade Agreement Negotiations between the European Union and the MERCOSUR block. Potential concerns arise where specific categories of polymers, chemical additives or finished plastic articles are imported into countries where use of plastic and waste generation already surpass the capabilities of waste collection and treatment systems. Traded items can be problematic in several ways including:

- Being mostly intended for single-use
- Being low-value, and often low-density, articles susceptible to become plastic pollution
- Being materials or finished articles that can generate human or environmental toxicity during the use or end-of-life stages
- Being materials that can easily become toxic on their own
- Being materials used in the manufacture of the kinds of articles mentioned above
- Materials that are already traded as (pre-treated) waste

The further up-stream the traded item is in the life cycle of plastic articles, the more complex the combination of conditions becomes, which may cause human and environmental health problems. This makes the direct attribution of risk of damage to particular items increasingly difficult.

1.3 Approach

Utrecht University was commissioned to carry out a short assessment of the items included in the trade negotiations mentioned above that were considered to meet some of the problematic preconditions. The aim is to identify items that can be considered as "**red flags**" because they meet one or more of the conditions and have any kind of tariff reduction or elimination. Background work by Greenpeace Germany identified some items that seemed most likely to be problematic and that are already traded in large tonnages. This subset included polymers in primary forms, some chemical additives and some items of waste.

Each potentially problematic item was analysed from the perspectives of (i) human toxicity, (ii) environmental harmfulness, and (iii) sustainability to clarify the reasons why they could become a red flag. Several components of each perspective were collectively referred to as assessments. The following criteria were used as **guiding questions** for the analysis.

Human toxicity assessment:

- Toxic at product use stage
- Toxic at end-of-life waste management stage

Environmental harmfulness assessment:

- Harmfulness to biota via chemical or mechanical damage
- Ecotoxicity for pristine soil and aquatic environments

Sustainability assessment:

- Application in single use
- Feasibility of reuse or other product-service systems
- Feasibility of recycling and downcycling

- Likely to become plastic pollution
- Dependence on fossil (or sensitive bio-) feedstock

The assessment of whether there are low, medium, moderate or high risks associated with the items analysed is based on a qualitative analysis and judgement based on existing studies and scientific knowledge. For the first two assessments, when the answer to the guiding questions or criteria was "high toxicity" the items are more likely to be classified as red flags. The sustainability assessment is more complex as there are some criteria that would reduce the likelihood of items becoming plastic pollution either through littering, waste management leakage or difficulty to reuse, and some criteria related to increasing dependence on fossil hydrocarbons or sensitive bio-feedstocks. In this way,. Greenpeace Germany can evaluate where the problems may arise or what conditions must be met before they arise.

2 Overarching conditions for human and environmental harm

2.1 Pathways to harm

Plastic pollution and plastic use itself can affect human and environmental health through different pathways. It is important to distinguish between mechanisms of mechanically induced harm and those of chemically induced harm (Liboiron, 2015). A second important distinction helps explain the difference between hazards and risks of causing human or environmental health.

Mechanical damage can occur, firstly, when macro-plastic harms human or animal organ tissue. For example by puncturing organ tissue or by blocking organs such as the digestive tract but also via injury to muscle tissue (Barboza et al., 2020; Battaglia et al., 2020). Micro- and nano-plastics can lodge themselves in different organ tissues causing inflammatory reactions and in some cases cross membranes such as the blood-brain barrier (Kopatz et al., 2023). Potentially toxic chemicals can reach organisms that ingest or are in contact with plastic. These can be Intentionally Added Substances (IAS) such as additives (e.g. plasticisers) and processing aids (e.g. anti-slip agents) (García Ibarra et al., 2019; Groh et al., 2019) as well as Non-Intentionally Added Substances (NIAS) such as reaction products of component materials during production and degradation products of components and other substances for example from in-process packaging and equipment (Nerin et al., 2013). Both IAS and NIAS can migrate from the finished plastic articles during use, for example from food packaging, as well as being released as emissions during (uncontrolled) combustion at the end of life. In the case of chemical migration from packaging materials to foodstuffs, the chemical harm mechanism is difficult to assess, as these chemicals regularly ingress and egress the body, resulting in a potential stock of a mixture of all the chemicals to which an individual is exposed routinely. These chemicals can either mimic or block functions of hormones and contribute to, amongst others, diabetes, obesity and impaired fertility (Kassotis et al., 2020).

The second important distinction is between the ability of pollutants and chemicals within organisms to represent **hazards as opposed to risks**. A hazard is posed by the ability of a substance to contribute to a harmful reaction. The risk is the probability that the harm will actually occur depending on the actual occurrence, frequency and severity of the hazardous events that individually or collectively can cause harm. In reality, chemicals do not enter, one by one, a body free of other chemicals. Many chemicals enter the already contaminated body simultaneously and at various times in different combinations. It would therefore lack rigour and scientific validity to attribute a harmful outcome to a single chemical through a single route of ingress at a specific time. It is important to consider relevant dependencies

2.2 Dependencies

To substantiate claims over a causal link between the reduction of import tariffs and actual harm to human and environmental health, it is necessary to examine the baseline situation and other phenomena occurring at the same time that can substantially influence outcomes. The minimum set of applicable guiding questions must include the following:

- *Which specific products are actually produced with the polymers imported in primary form?*
  In practice, several polymers such as polyethylene can become inputs for producing dozens of different products for different applications. Within applications different brands can use different formulations, densities and business models that affect how products, even of the same kind, can have significantly different impacts.
- *What additives are used for which products?*
  Even two similar products being made by different manufacturers can contain different chemical additives for the same function. For example there are dozens of commercial plasticisers, ultra-violet light stabilisers and antioxidants on the market. The final formulations used in products clearly influence how much they can contribute to toxicity.
- *When can imports into South America from the EU undercut low-cost competitors such as far East Asia?*
  Fixed- and variable cost differences between Asia and Europe can still be significant. It is therefore important to evaluate whether the inputs, and, more importantly, any finished articles, will at all be able to compete so favourably on the global market that a specific fraction of environmental damage could be attributed to them.
- *How are products in the receiving countries marketed, used and regulated?*
  In addition to their composition, the performance and potential for damage of many products depends largely on how they are meant to be used and how they are used and disposed of in practice. There are many examples such as the higher-price "bags for life" offered by many supermarkets instead of single-use bags, which nonetheless are often used by consumers as single-use bags but with a significantly higher environmental impact.
- *What are common consumer behaviours in use, reuse, recycling and disposal?*
  In many other cases, governments or commercial establishments offer waste separation facilities that consumers in practice do not use. Common practices in the local population can influence, the level of consumption, the preferred quality of products, the length of use before becoming waste and the way disposal occurs. Moreover, practices determine what other chemicals consumers are exposed to in their daily lives over time.
- *What is the availability of waste collection and management infrastructure like?*
  Even in cases where chemicals have low or no toxicity and finished products could be recycled, services of waste collection, separation and final disposal infrastructure through incineration or engineered landfill are often lacking. The extent of these facilities is the single most important driver of pollution and environmental toxicity regardless of how innocuous or harmful materials might be.

2.3 Red flag items

Amongst the chemicals, materials and finished articles that were identified as potentially problematic there are some examples for which one or more characteristics merit attention. In all cases, and particularly for polymers in primary forms in the tariff schedule, it is important to refer to the dependencies outlined above.

Expansible polystyrene in primary forms (39031110 with fillers, 39031120 without fillers)
Polystyrene is included in the schedule in primary forms. This raises the uncertainty as to what products exactly will be produced and, more importantly, with what additives. Expanded polystyrene can break up easily in the environment leading to significant pollution on land and in aquatic environments. In particular, its low density makes it difficult to recycle. It is usually downcycled. It can cause mechanical damage to biota and to a lesser extent chemical damage. If disposed of by open burning it can produce significant quantities of toxic gases such as polycyclic aromatic hydrocarbons (PAHs).

Tableware, kitchenware, other household articles, of plastic. (39241000)
It is worth highlighting that this category of articles can be made from different polymers and with different combinations of additives. Dominant polymers are melamine, unexpanded polystyrene and polypropylene. Melamine in particular can lead to leaching of chemical additives during use. Disposable cutlery is one of the most common items found in field counts along coastlines and at sea. All three polymers can degrade at different rates and cause mechanical damage as macro-plastic in the digestive tract of marine wildlife. Microplastics can lead to both mechanical and chemical damage in plankton. As a disperse waste type, these articles are highly likely to leak into the environment and to be disposed of by open burning.

Polyvinylchloride (PVC) (39041020)
MERCOSUR decided to exclude from tariff reductions PVC in suspension, by far the most common form. However, PVC obtained from emulsion does have a reduction schedule. PVC can contain 10%-60% phthalates by weight, which can leach into the environment during manufacturing, use and disposal. Unwanted migration of plasticiser additives such as short-chained chlorinated paraffins (SCCPs) from toys or shower curtains made of PVC has been identified previously. This poses a hazard to most vulnerable groups such as children and the elderly. In the absence of waste management infrastructure, uncontrolled combustion of halogen-rich PVC can cause emissions of persistent organic pollutants (POPs) including carcinogenic dioxins. Finally, exposure of children to POPs has been detected in toys made with abundant use of SCCPs in soft PVC toys.

Waste parings of polyethylene, styrene and PVC (39151000; 39152000; 39153000)
Closed loop recycling is not possible since waste parings come from different products and brands even if they consist of the same polymer. The unknowable mix of additives would yield low quality recyclate. Therefore, the potential toxicity of recycled products is likely to be high. In principle, repurposing and downcycling could take place. More likely, these parings may be used as fuel in waste to energy plants or in industrial kilns after some refining. They can end up as mismanaged waste depending on how developed the recycling and recovered fuels markets are. In the case of open burning, all plastic types, in particular PVC, can generate toxic gases that can include polychlorinated Dibenzodioxins and -furans (PCDD/F). If they leak to the environment, as all of them are already fragmented, they can lead to mechanical damage to the biota that ingest them, most typically birds, amphibians and fish. In the case of repurposing or downcycling, it is often overlooked that the composition of the plastic might not be suitable for the new purpose. For instance, plastic that might have been part of home cleaning appliances can end up as material for toys that small children often put into their mouths. There are many dependencies for these materials to be used safely. Unless a recycling market that can deal with plastic with variable compositions and the right waste management technologies are all in place, these streams can become pollution, be disposed of by open burning or leak to the environment.

Garments made of mesh fabrics with plastic/rubber (61130000) and articles of apparel/accessories of plastics (39262000)
Micro- and nano-fibres and plastics are produced during the use and washing of all synthetic garments. At the end of life, chemicals are released while burning plastic such as benzo(a)pyrene (BAP) and polyaromatic hydrocarbons (PAHs), which are both potentially carcinogenic. It is worth considering that in the places were indigenous communities have widespread access to polymer fibres but not to waste management, there may be increased impacts of open burning on air quality as well as pollution of surface water and soil through the ashes.

2.4 Watching brief

Propylene Copolymers (39023000)
Polypropylene, which is on the market as either homopolymer or copolymer, is one of the most commonly used plastic types and is deployed in many items that become plastic pollution, **such as disposable cutlery**. A close watching brief is recommended.

Polyethylene (39011010 low density; 39012029 high density without fillers)
It is not possible to know without a historical and prospective Material Flow Analysis **which products will be made with the polymer and, more importantly, what additives they will contain**. Thin plastic bags and milk bottles with their caps are only two examples of the many products that are not widely reused and can become plastic pollution.

2.5 Common remarks across categories

Fossil fuel dependence
It is estimated that all monomers and polymers in this report currently derived from fossil hydrocarbons will continue to be highly dependent on this source. Unless chemical synthesis using retrieved CO_2 emissions as source of carbon is further developed, then fossil fuels will be the dominant source. Otherwise, bio-renewable feedstocks as source of carbon may have very varied levels of sustainability safeguards and their own unintended consequences such as Indirect Land Use Change (ILUC).

Open burning or incineration of plastics
There are several reasons why waste can ultimately be disposed of by open burning. Primarily when there are no material markets and the waste management system cannot cope with all streams and the total quantity of waste, it is highly likely that plastic waste will end up in uncontrolled landfills or in dumps where waste is normally burnt in open fires. In many examples across the world it is common for this fires to be located near densely populated areas. In some cases even next to schools or children play areas. The toxic emissions from burning waste include nitrogen oxides, sulphur dioxide, volatile organic compounds (VOCs) and Polychlorinated Dibenzodioxins/Dibenzofurans (PCDD/Fs) and Polybrominated Dibenzodioxins/Dibenzofurans (PBDD/Fs) (Wiedinmyer et al., 2014). In turn, when the waste management system involves incineration – with state of the art technology – emissions are reduced by several orders of magnitude. Nevertheless, the pollutants are still emitted. Bottom ash needs to managed in "standard" engineered landfills, whereas fly ash is significantly more toxic and needs to be sent to hazardous waste landfills.

Availability of effective waste collection and treatment facilities
For many of the categories analysed, particularly traded waste, a major dependency is the effectiveness of the waste management system. The first component is disposal at the household level. Not all local authorities provide the option for source-separation of biodegradable and recoverable fractions such as metals, glass, paper and plastic. If all waste is disposed of in a single

stream, then suitable separation technology (or labour with safe working conditions) must be available. Otherwise, recycling becomes uneconomic, low-quality and low-yield. In addition to infrastructure and market arrangements for the recovery of all fractions mentioned, there must be suitable disposal infrastructure such as properly engineered landfills to prevent percolation of leachate into the subsoil and ultimately pollution of aquifers. It becomes apparent that if one or several parts of this system are missing, it will be more difficult to manage all waste. When the cost of dealing with all fractions needs to be cross-subsidised by revenues from few fractions, the risk increases that management and recycling become more difficult and leakage more likely.

3 Analysis of individual polymers and additives in relation to the EU-Mercosur tariff reduction schedule

1. 390931 Poly"methylene phenyl isocyanate" "crude MDI", "polymeric MDI", in primary forms (not in the schedule as of early 2023)

Methylene diphenyl diisocyanate (MDI) is an aromatic diisocyanate. The most widely used isomer is **4,4'-MDI,** also known as 4,4'-diphenylmethane diisocyanate. This isomer is also known as **Pure MDI**. Specifically 4,4'-MDI is mainly used in the production of rigid polyurethane foams, which are good thermal insulators and used in nearly all freezers and refrigerators worldwide, as well as buildings.

MDI is also an important feedstock in in the production of Polyurethane and Polyamide-imide involved in the production of adhesives, soft foams and rigid insulation materials with several applications (ACC, n.d.). Polyurethane has a wide range of stiffness, hardness, and density. It is commonly used to manufacture high-resilience foam seating, rigid foam insulation panels, gaskets, sealants, elastomeric wheels and tires, high-performance adhesives and surface coatings. Flexible or rigid foams, and the furniture market is its most important sector. In recent years there has been significant growth in lightweight and insulation materials in construction, electronics, and automotive.

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*Limited but variable* The applications are varied but in many cases the material is not in direct contact with humans.
Toxic at end-of-life waste management stage	*Yes* Polyurethane waste is problematic as numerous hazardous chemicals, such as isocyanates, hydrocyanic acid, and dioxins, are released when these materials are burned (Son et al., 2021).
Appraisal of human toxicity	*Medium* Importantly, it is not mentioned on the tariff schedule as of April 2023. In most cases and uses, the final products are long-lived and not directly in contact with humans. It will depend on how the market for the applications (from fridges to insulation materials and interior of car seats) evolves as well as the quality of waste management technologies across MERCOSUR. Compared to the magnitude of the impacts of other plastics, it is **unlikely to be one of the most significant threats.**

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	Relative to other plastic types, no major additional toxicity could be expected and attributed to changes in trade conditions.
Ecotoxicity for pristine soil and aquatic environments	Highly dependent on landfill and incineration standards in the MERCOSUR states.
Appraisal of environmental harmfulness	It is **unlikely to be one of the most significant threats** compared to the magnitude of the impacts of other plastics.

Sustainability assessment

Criteria	Specific characteristics
Application in single use	Applications in the built environment are often for long-term use. It represents a different kind of socio-technical material flow.
Feasibility of reuse or other product-service systems	*Low or none* There are practically no incentives to reuse. Current dominant waste management practices are landfill and incineration driven by economies of scale and fast revenues.
Feasibility of recycling and downcycling	*Low or none* Recycling polyurethane is currently very difficult and energy intensive, as most polyurethanes are thermosetting polymers that do not melt when heated
Likely to become plastic pollution	*Moderate* Many of the applications, such as insulation, are managed as waste streams that are slightly more controlled than Municipal Solid Waste.
Dependence on fossil (or sensitive bio-) feedstock	*High*
Appraisal of sustainability	The demand for the final products from this component is likely to rise globally. As the applications are mostly long-lived, environmental harmfulness will depend on the efficacy of landfill and incineration of commercial, demolition and bulky waste streams.

2. 390810 Polyamides -11, -12 – also known as Nylon

Other names: Polyamide -11 and 12, PA -11 and 12, polylaurolactam or **nylon -11 and -12**

Ar	Br	Py	Uy	M
2	2	2	2	4

Nylon 12 has many applications including films for food packing, sterilised pharmaceutical and medical films and bags, in sporting and leisure textiles. It is also prepared as sintered powder for coating metals. It is used for covering cables and insulating material, to prepare oil and gasoline resistant automotive tubes. Nylon 11 is used in textiles, filters, as well as woven and technical fabrics.

(Note: Polyamide-6,6, -6,9 are used for rigid, high-strength fibres. Less problematic and they have staging category 14.)

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*None to limited* Residual components ("monomers") have not been present at a sufficient level to cause any reactions in test subjects at the maximum ingredient use concentration. Some existing tests consider it not a significant hazard in common dermal cosmetic use (Burnett, C. L., 2013).
Toxic at end-of-life waste management stage	*Variable* Substances such as hydrogen cyanide (HCN) are produced when materials such as (amongst others) nylon, plastics and melamine, burn (Fire Engineering, 2009). Toxicity will depend on whether they are combusted in a high-specification incinerator or in an open fire and the impact will depend on the quantity, the mix and the location of burning.
Appraisal of human toxicity	Although this is not likely to be the highest concern, the **impact of trade changes will depend on waste management infrastructure and practices**.

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Moderate, in research* Whether it is as fragment (secondary microplastic) of packaging film, textiles or cable insulation, the effects are still being studied. In particular there is growing interest in studying the effects of nanofibres lodged in respiratory tissue. Also, impacts on small aquatic organisms such as plankton are in research.
Ecotoxicity for pristine soil and aquatic environments	*Moderate, in research* Research on impacts on soil are at an early stage. Methods, concentrations and samples are varied and it is a subject that will need to develop quickly. There can be interactions with other chemicals released by other pollutants in the aquatic environment.
Appraisal of environmental harmfulness	Analysis and regulation of impacts of plastic on soil and aquifers are lagging behind other subjects such as regulations on single use plastics. Although not yet fully understood scientifically, and although impacts are likely to be more varied than originally thought, impact will depend on waste management. **Research on microplastics in the environment should be closely followed.**

Sustainability assessment

Criteria	Specific characteristics
Application in single use	*Yes* Packaging films, nylon-based fast-fashion garments and cosmetics are amongst the main single-use applications. Packaging of foods that require a strong oxygen and moisture barrier to preserve their aroma and prevent fermentation will likely use more nylon in future as it has superior barrier properties, does not dissolve or

	absorb grease, oil, or acidic foods. Nylon also offers good scratch, puncture and flex-crack resistance (Firn, 2020).
Feasibility of reuse or other product-service systems	*None to low* Given its low cost, low weight, difficult handling and hygienic requirements it is difficult to reuse.
Feasibility of recycling and downcycling	*Low* In principle, nylon 12 could be technically recycled around four times without drastically changing its properties. A slight change in the tensile strength, glass transition temperature, and percentage of crystallinity can be expected as the number of reprocessing cycles increases (Nur-A-Tomal et al., 2021).
Likely to become plastic pollution	*Moderate to high* Food packaging films are likely to be deployed in on-the-go applications amongst others. Given the low cost, difficulty to reuse and recycle, **they are likely to leak to the environment in places with poor waste management infrastructure and practices.**
Dependence on fossil (or sensitive bio-)feedstock	*High*
Appraisal of sustainability	Under poor waste management practices there is propensity for open burning or leakage.

3. 39011010 Polyethylene with a specific gravity of < 0,94, in primary forms AND 39012029 Other polyethylene not c/fillers, density>=0.94, primary forms

These two polymers were prioritised for analysis as the large variety of similar polymers was too broad for the scope this project. For instance, there are varieties containing and not containing (unspecified) fillers, which makes them too undefined for the analysis as **many toxicity aspects depend precisely on the additives (including fillers) used**. In addition, these two categories are complementary because they are often used together. For example, the main body of many milk bottles consists of LDPE, whilst the cap is made of HDPE.

i) 39011010 Polyethylene linear, density<0.94, in primary forms
This is the feedstock to make Linear low-density polyethylene (LLDPE), **Low-density polyethylene (LDPE)** and Very-low-density polyethylene (VLDPE)

ii) 39012029 Other polyethylene not containing fillers, density>=0.94, primary forms
This is the feedstock to make High-molecular-weight polyethylene (HMWPE), **High-density polyethylene (HDPE)**, and Medium-density polyethylene (MDPE).

Stage category for both of these polymers has mixed values

Ar	Br	Py	Uy	M
14	14	0	0	E

LDPE is widely used to make plastic bags. Both LDPE and HDPE are used in the manufacture of containers, dispensing bottles, wash bottles, tubing, plastic parts for computers, and various moulded equipment. Its most common use is in plastic bags. Other products made from it include:

- Trays and general purpose containers
- Corrosion-resistant work surfaces
- Parts that require flexibility

- Pliable parts such as snap-on lids
- Six pack rings
- Waterproof inner and outer layer (LDPE) of juice and milk cartons
- Cling film
- Pipes
- Housewares

Human toxicity assessment

Criteria	Specific characteristicsin
Toxic at (product) use stage	*Low to medium* Research on the toxicity of these polymers in food contact applications is at a relatively early stage. Risk analyses are complex and real experiments unethical and impractical. Animal testing as well as in vitro techniques are used for some of the associated chemical additives. The complexity resides in the intake over time and mixture toxicity. Evidence is growing of migration of chemicals additives from packaging to food but there are few studies specifically on LDPE and HDPE. Some of the chemicals reported include ethyl acetate and n-propanol in a study about decorative shrink sleeves in food packaging identified that HDPE polymers used for food containers represent comparatively more viable migration as they are poor barriers to a wide range of migrants (Lord and Obrhai, 2006).
Toxic at end-of-life waste management stage	*Medium* Several substances are emitted from commercial incinerators but the emissions from open fires contain a complex mixture with many more chemicals including furans and dioxins . For incineration, when compared to PVC and polypropylene, HDPE was found to have the highest mean emissions factor of total polycyclic aromatic hydrocarbons (PAHs) from the stack flue gas (Li et al., 2001).
Appraisal of human toxicity	It is early to conclude significant attributable impact but **the results from the emerging field of food packaging toxicity should be followed closely.** The **impact on public health from inhalation of combustion products will depend on the waste management infrastructure and practices** of the MERCOSUR countries.

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Medium* Chemical damage analysis is at an early stage of research combining laboratory studies with fewer field samples. Due to diverse concentrations and mixture effects it is still early to quantify the damage potential. Mechanical damage by plastic fragments in fish, small aquatic organisms and marine birds is more widely documented. Resolution of research to identify single polymers causing the damage is increasing but still at an early stage.
Ecotoxicity for pristine soil and aquatic environments	*Moderate to substantial*

	Research on impacts on soil are at an early stage. Methods, concentrations and samples are varied and it is a subject that will need to develop quickly. Interest in aquatic environments has been more widespread and understanding is growing of the potential for pollution and ecotoxicity.
Appraisal of environmental harmfulness	As leakage continues, mechanical (and to a less known extent chemical) damage is likely to continue to increase in several species of fish and marine birds. **It is a priority to establish current levels of leakage.**

Sustainability assessment

Criteria	Specific characteristics
Application in single use	*High* Bags are the most common single-use application is also one of the main applications of both LDPE and HDPE.
Feasibility of reuse or other product-service systems	*Low* Reuse is growing in popularity but there is still lack of clarity in the market, on which materials will be the most commercially successful. Moreover, the evidence in chemical additive migration from reuse bottles in general is at an early stage.
Feasibility of recycling and downcycling	*Low to moderate* In principle, LDPE is recyclable. In practice, it is difficult. LDPE grocery bags can tangle in recycling machinery. They are difficult to collect and separate, their low density also increases the cost. HDPE in articles with high density can be recycled and often downcycled into plastic lumber, outdoor furniture, rope, toys, piping, fencing, and rubbish bins (Accel Polymers, n.d.). However, the market conditions are not as favourable as those for PET as a rule. HDPE film is also difficult to recycle.
Likely to become plastic pollution	*Moderate to high* In areas where recycling and management are not prevalent there is likelihood that the residual waste from unmanaged dumps will leak in cases of small articles or fragments. Geographical and socio-economic variations will influence the volume of leakage.
Dependence on fossil (or sensitive bio-)feedstock	*Yes*
Appraisal of sustainability	**It is a priority to establish current levels of leakage.**

4. 39023000 Propylene copolymers, in primary forms

Polypropylene is one of the most commonly used plastic polymers and has many single use applications. It is worth highlighting that **MERCOSUR excluded this item – for now – from the tariff reductions.** Civic society organisations may need to keep a watching brief on this item in case negotiations change.

Ar	Br	Py	Uy	M
14	14	14	0	E

There are many different types of copolymers that can fit under this category and their impacts and fates can vary widely. This undermines the possibility to make concrete recommendations. Hence,

this section provides examples that, though relevant, cannot be regarded as representative of all the implications in the category.

Polypropylene Random Copolymers are produced by polymerising ethene (6% by mass) and propene together. These polymers can be flexible and optically clear. This makes them suitable for applications requiring transparency and an excellent appearance. They can offer anti-bacterial properties and a glossy appearance, heat resistance and rigidity. **They are used amongst others for food contact containers, baby milk bottles, sports drinking bottles and toys**.

By contrast, in **Polypropylene Block Copolymers** the ethene content ranges between 5 and 15%. It has co-monomer units arranged in regular blocks, which makes it tougher and less brittle than the random copolymer. These polymers are suitable for applications requiring high strength, such as industrial use. They can include additives to enhance performance. For example, a 20% glass fibre, to provide impact and insulating properties suitable for use in automotive interior and under-bonnet applications. It can also be used in agricultural, electrical and construction applications such as **piping for hot and cold water at relatively high pressures**, such as in buildings.

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*Varied* Food contact applications (of random copolymers) will present different levels of potential hazard that depend more on the additives used than on the polymer itself. **It is important to follow the ongoing developments of the European Chemicals Agency on the assessment and regulation of additives** Industrial and construction applications (of block copolymers) will likely present a lower potential hazard as, once incorporated in its application as feedstock, e.g. in long-lived piping, the use stage does not involve significant exposure.
Toxic at end-of-life waste management stage	*Moderate to medium* For **consumer goods, the impact on public health will be influenced by the effectiveness of the waste management system, as recycling and reuse rates will tend to be low.** For most industrial and construction uses there tend to be more managed waste streams; however, the toxicity will also depend on the efficiency of waste management.
Appraisal of human toxicity	The high-value consumer goods (random copolymer) can tend to cause substantial levels of human exposure to toxic additives. The high performance industrial and construction applications (block copolymer) will tend to lead to lower levels of exposure to toxic additives. It is worth following international developments in any case as these polymers are exempt from the reduction of tariffs. However **it is important to follow the latest findings on public health hazard research, as more studies are completed and new evidence continues to emerge**.

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Medium to high*

	Consumer goods applications (random copolymer) are more likely to contribute to plastic pollution, and hence toxicity, if they leak the waste management system, than the industrial applications.
Ecotoxicity for pristine soil and aquatic environments	*As above*
Appraisal of environmental harmfulness	If the waste management system of any of the MERCOSUR countries allows for leakage of any polymers, then **this category will also be affected, particularly the random copolymers.**

Sustainability assessment

Criteria	Specific characteristics
Application in single use	*Medium* High-value consumer goods (random copolymers) as well as construction and transport applications are often meant for repeat, long-term use. Construction and transport applications (block copolymers) are also long-lived. Therefore it is a different magnitude and kind of socio-technical material flow that could potentially be managed.
Feasibility of reuse or other product-service systems	*Limited* Few high-value consumer goods (random copolymers), e.g. some reusable water bottles are meant for reuse. **It will depend on product configurations and offerings, as well as policy and civic practices whether the share of single-use articles can decrease.** Construction and transport applications (block copolymers) are long-lived and deployed in repeat-use products such as piping.
Feasibility of recycling and downcycling	*Low* Whilst recycling of polypropylene is very low internationally. **Downcycling and repurposing are increasing. However the environmental benefits of these activities are likely to remain modest, as they are orders of magnitude smaller than the supply of plastic and they also imply some uncertainty in safety**.
Likely to become plastic pollution	*Low to medium* The end of life of construction waste is typically more manageable and attributable than plastics used for mass consumer goods. The point-source nature of construction waste streams makes them more amenable to management via straightforward commercial contracts.
Dependence on fossil (or sensitive bio-)feedstock	*Yes*
Appraisal of sustainability	The extent to which these polymers become problematic **depends on various trends in consumption for random copolymers as well as the efficacy of waste management systems in MERCOSUR countries**.

5. 390690 Acrylic polymers, in primary forms

Polymers in this group (Polyacrylates) are typically polymers of acrylic acid fluids and are used in the manufacture of plastics, coatings, adhesives, elastomers, paints and floor polishes as well as in cosmetic products as rheology modifiers and film formers. Within the category "390690…" there are numerous sub-categories, which necessitates more detailed research across the range. However,

three examples of polymers with scheduled tariff reductions are included below with a short narrative about their potential human health hazards. At present, it is difficult to establish the human and environmental toxicity or potential to become plastic pollution for all of them for two reasons: (i) their use as ingredients with different fates depending on the short or long-lived product they become part of; (ii) empirical data are not sufficiently available on attributable impacts.

The three subcategories analysed have been assigned a MERCOSUR schedule of 4.

Ar	Br	Py	Uy	M
2	2	2	2	4

i) 39069022 2-diisoprop.methacrylate copolymer, in suspension, etc.
Used as co-monomer for acrylic resins and as a component of polymersomes in drug delivery systems in chemotherapeutics. Empirical data on human toxicity are not readily available, whereas in animal studies Diisopropylaminoethyl methacrylate was weakly irritating to skin of guinea pigs and conjunctiva of rabbits (NIH, n.d.).

ii) 39069043 Carboxypolymethylene, in powder
Group of polymers primarily made from acrylic acid, frequently used as gels in cosmetics and personal care products. Found in a wide variety of product types including skin, hair, nail, and makeup as well as dentifrices. It is considered to have the lowest hazard profile for carcinogenicity, immunological stress and reproductive toxicity, and it is also not suspected to be an environmental toxin (EWG, n.d.a). It is considered in general for cosmetic use, they are large compounds unable to penetrate the skin barrier and have been proven to be safe for cosmetic use. Therefore, **it does not represent a category of concern**.

iii) 39069047 Ethyl acrylate copolymer, n-butyl acrylate,
Raw material for fibre processing agents, adhesives, coatings, plastics, acrylic rubber, and emulsions. Exposure to ethyl acrylate is primarily occupational. **Acute, short-term, exposure of workers to ethyl acrylate vapours has been reported to cause drowsiness, lethargy, headache, nausea, convulsions, and respiratory and gastrointestinal irritation** (EPA, n.d.). In the USA, labour unions have access to activities and information programmes according to the Right to Know Act (NJDH, 2022). **The seriousness of the import of this chemical will largely depend on the occupational health provisions in each country in the MERCOSUR block.**

6. 390410 Poly"vinyl chloride", in primary forms

39041010 Poly(vinyl chloride) obtained in suspension, primary forms
It is important to note that for Paraguay and Uruguay the tariff is already 0%.

Ar	Br	Py	Uy	M
14	14	0	0	E

39041020 Poly(vinyl chloride) obtained in emulsion, primary forms
In this case, MERCOSUR decided to **include** this subcategory in a tariff reduction schedule of 10.

Ar	Br	Py	Uy	M
14	14	14	0	10

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*Medium* Unwanted migration and release of additives such as plasticisers, e.g. short-chained chlorinated paraffins (SCCPs) from toys or shower curtains made of PVC has been identified previously (IPEN, 2020). This poses a hazard to most vulnerable groups like children and the elderly.
Toxic at end-of-life waste management stage	*High* Uncontrolled combustion of plastic waste and, in particular of plastics containing halogens such as PVC, polytetrafluorethylene or brominated flame retardants, can cause emissions of hazardous substances, for example persistent organic pollutants (POPs) such as dioxins (Weber and Kuch, 2003).
Appraisal of human toxicity	PVC can contain 10%-60% phthalates by weight, which can leach into the environment during manufacturing, use and disposal (Net et al., 2015). Exposure of children to POPs have been detected in toys made with abundant use of SCCPs in soft PVC toys (UNEP, 2018).

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Chemical, yes, in research* The study of toxicity in biota is growing beyond laboratory studies but impacts are difficult to attribute as there is always a mixture effect. *Mechanical, yes, in research* Fragmented pieces of PVC (secondary micro-plastics) have been found along with other polymer types in the digestive tract of birds feeding in coastal areas leading to tearing or blockage of the tract resulting in starvation.
Ecotoxicity for pristine soil and aquatic environments	*Medium to High* Plasticisers from PVC are of concern, as they have been found in a wide range of environments (IPEN, 2020). For instance, the removal via sand blasting of paints, which often contain PVC-based coating such as Polychlorinated biphenyls and SCCPs, has contaminated the environment, including several hundred kilometres of river sediments or fjords with PCBs from a single point source such as a road bridge (Jartun et al., 2009).
Appraisal of environmental harmfulness	PVC is a rigid material that requires plasticisers, several of which have toxic properties. When goods made of PVC become waste with a propensity to leak into the environment they have substantial potential to cause mechanical and chemical harm. It is therefore a **high priority to ensure that regulations on the use of PVC and its additives in MERCOSUR states reflect the latest international knowledge to prevent chemical hazards**. National waste management systems also warrant high vigilance to prevent or minimise mechanical hazards to wildlife..

Sustainability assessment

Criteria	Specific characteristics
Application in single use	*Yes*

	Although it is also often used in long-lived applications.
Feasibility of reuse or other product-service systems	*Moderate* Although in several countries PVC is being phased out for toys, there is still production of toys and other articles some of which are repeat-use or long-lived.
Feasibility of recycling and downcycling	*None to Low* Although technically recyclable, it is not often recycled precisely due partly to the complex composition of the additives.
Likely to become plastic pollution	*Yes* As many other polymers that are used in medium to long-lived consumer goods for which local authorities rarely offer recycling, PVC is likely to leak the system.
Dependence on fossil (or sensitive bio-)feedstock	*Yes*
Appraisal of sustainability	On pollution, but mainly on public health, grounds, PVC is starting to be banned for certain applications in various countries (CHEJ, n.d.). But **consolidating the public health hazards, little or no recycling and the potential of leakage, PVC is a complicated polymer with interesting performance but liable to cause much migration of chemicals to humans and the environment**.

7. 390720 Polyethers, in primary forms (excl. polyacetals, bis(polyoxyethylene) methylphosphonate)

The seriousness of the import of this category depends on what products are made with the material, in what formulations (including different additives), and in what applications they are deployed. In general there is scarce information on impacts of the varied pathways

Polyether-1 is a copolymer of PEG-180, Dodoxynol-5, PEG-25 tristyrylphenol and tetramethoxymethylglycouril monomers (EWG, n.d.b).

39072012 **Polyoxyphenylene** without fillers, in primary forms

Ar	Br	Pr	Ur	M
2	2	2	2	4

39072020 **Poly(tetramethylene** ether glycol), in primary forms

Ar	Br	Pr	Ur	M
2	2	2	2	4

Poly(tetramethylene ether)glycol (PTMG) can react readily with isocyanates such as Methylene diphenyl diisocyanate (MDI) to make resins with functional properties. It is available in multiple grades, e.g. PTMG250、PTMG650 through to PTMG3000.

PTMG shows favourable characteristics as a group of polyurethane and polyester resins used for a growing range of applications from apparel through to industrial machinery parts. Its properties include: Impact resilience; low temperature flexibility; wear and tear resistance and fungal resistance. Below are the applications by polymer type (Mitsubishi Chemical Corporation, n.d.):

In polyurethane
- Polyurethane elastic fibres (Spandex)
- Polyurethane elastomers
- Thermoset elastomers (TSU)
- Thermoplastic elastomers (TPU)
- Paints and coatings
- Adhesives and sealants
- Artificial suede and synthetic leather

In polyester
- Polyester elastomers (TPEE)

In polyamide
- Polyether amide elastomers

It is generally **not considered to be of high health concern** in relation to carcinogenicity, immunotoxicity as well as developmental and reproductive toxicity. For example, the Japanese government does not consider it relevant or applicable for the Poisonous and Deleterious Substances Control Law. But data availability is a concern, as no studies in PubMed science seem to include information on its toxicity (EWG, n.d.b).

8. 390950 Polyurethanes, in primary forms

39095012 **Polyurethane in aqueous dispersion**
39095021 **Hydroxyl.polyurethane c/propert.adhesive, in pieces, etc**

Ar	Br	Pr	Ur	M
2	2	2	2	4

Formaldehyde: Formaldehyde sometimes results as a by-product of the foam manufacturing process, though this is much less common nowadays. Formaldehyde fumes can irritate the eyes, nose and mouth, and it is known to be a human carcinogen.
Methylene Dianiline: Used as a reactant in the foam manufacturing process, methylene dianiline causes irritation when coming into contact with skin, and may be carcinogenic.

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*Low* The polymer itself is not regarded as highly chemically toxic but the additives can be. This polymer is mostly used in the interior of products such as car seats and in-wall insulation. Therefore, on a daily-use basis, it is unlikely that consumers will encounter many of the additives or degradation products of the material.
Toxic at end-of-life waste management stage	*Medium* Primary forms are not used by consumers. Ultimately, polyurethane-derived products such as rigid foams will burn rapidly and produce flammable, irritating and toxic gases. Thermal decomposition products consist mainly of carbon monoxide, benzene, toluene, oxides of nitrogen, hydrogen cyanide,

	acetaldehyde, acetone, propene, carbon dioxide, and alkenes (Carey and Baier, 1989). Demolition wase tends to be better managed than post-consumer waste. In the event of mismanagement and open burning, toxic gas emissions will be generated.
Appraisal of human toxicity	The main impact will result from degradation products at the end of life. The toxicity of these will depend on exposure intensity (although not monotonically) and will affect people close to waste management facilities or to places of waste disposal with lack of modern facilities..

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Low* Polyurethane (PUR) is one of the polymers that leak less often to the environment. PUR is not regarded as one of the main sources of chemical or mechanical damage to biota.
Ecotoxicity for pristine soil and aquatic environments	*Low to medium* It is mainly during end of life (mis)management that any impacts may ensue. Toxic degradation products of combustion may affect local soil and air quality, which are seldom in pristine areas.
Appraisal of environmental harmfulness	The main impact might be poor air quality in urban areas close to waste management facilities of various standards.

Sustainability assessment

Criteria	Specific characteristics
Application in single use	Not normally used for single use.
Feasibility of reuse or other product-service systems	PUR is normally used in long-lived applications.
Feasibility of recycling and downcycling	There are limited data on recycling of PUR. In most cases it is not recycled and it is more commonly disposed by incineration or landfill.
Likely to become plastic pollution	It is likely to be dealt with by industrial or construction waste management methods.
Dependence on fossil (or sensitive bio-)feedstock	Mostly made from fossil feedstock.
Appraisal of sustainability	The use of PUR is likely to increase and currently it is neither regarded as one of the main causes of plastic pollution but it is also not normally regarded as highly recycled.

9. 61130000 Garments, made-up of mesh fabrics with plastic/rubber

61130000 **Garments, made-up of mesh fabrics with plastic/rubber**

Ar	Br	Pr	Ur	M

35	35	20	20	8

Given the unspecified nature of the full chemical composition and polymers used, additional materials with similar applications and life cycles are addressed, e.g.:

39262000 **Articles of apparel/accessories, of plastics**

Ar	Br	Pr	Ur	M
18	18	18	18	10

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*Low* Toxicity is related to the additives that can include water repellents, flame retardants and pigments. Research is still at an earlier stage compared to that of food contact materials and chemicals, but actual risk will depend on the combination of chemicals the users are exposed to. Micro- and nano-plastics and fibres are produced during the use and washing of all synthetic garments. For example, one load of laundry of polyester clothes can discharge 700000 microplastic fibres, which release toxins into the environment and can end up in human food chain (Šajn, 2019). These cause various impacts but they are mainly noticeable in places of high concentrations and over substantial periods of time.
Toxic at end-of-life waste management stage	*Medium to high* Interest in attributable impacts is growing but it is still at an early stage. In low and some middle-income countries, open burning is the main waste management strategy. Humans are exposed to reaction products of combustion of plastic and additives. But because this is a mixed stream, attribution is complex. Burning plastic in mixed stream containing other materials such as treated wood also releases heavy metals and toxic chemicals, such as dioxins. Other chemicals released while burning plastic include benzo(a)pyrene (BAP) and polyaromatic hydrocarbons (PAHs), which are both potentially carcinogenic (Wiedinmyer, 2014). It is worth considering that in the places were indigenous communities have widespread access to polymer fibres but not to waste management, there may be increased impacts of open burning linked to air quality as well as pollution of surface water and soil through the ashes (Cosier, 2022).
Appraisal of human toxicity	Damage caused by micro- and nanofibres is still under research as is the potential damage of the associated additives during the use stage. Main impacts are likely to arise in the end-of-life stage and populations close to areas without modern waste management facilities might be disproportionately exposed to the products of combustion.

Environmental harmfulness assessment

Criteria	Specific characteristics

Harmfulness to biota via chemical or mechanical damage	*Medium* Chemical damage, such as endocrine disruption, in fresh and sea water wildlife is still at early stages of research as there is no straightforward way to attribute a health outcome to a single chemical. Physical damage is not attributable to fibres only. Studies are laborious and time consuming. In a study on water fleas fibres showed greater adverse effects than polyethylene beads (Ziajahromi et al., 2017). They also found a dose-dependent effect on growth and reproduction, whereby fibres pose a greater risk than beads with reduced reproductive output observed at concentrations within an order of magnitude of reported environmental levels.
Ecotoxicity for pristine soil and aquatic environments	For both mechanical and chemical damage, the impact will depend on how relevant, local species that inhabit the water bodies or the soil are affected.
Appraisal of environmental harmfulness	There can be significant discharges of degradation products to air water and soil in areas without modern waste management technology.

Sustainability assessment

Criteria	Specific characteristics
Application in single use	In most cases garments with plastic and rubber fibres are deployed in repeat-use applications. Nonetheless, due to price competition, they tend to be used in increasingly short-lived products such as budget clothing (fast fashion).
Feasibility of reuse or other product-service systems	Reuse of garments is limited due to personal hygiene considerations.
Feasibility of recycling and downcycling	Recycling is difficult due the amount of pigments and additives typically present. It is worth highlighting that the non-reusable fraction of collected textiles is mostly downcycled into industrial rags, upholstery filling and insulation, whereby less than 1 per cent of textile waste is recycled into new fibres or it is incinerated or landfilled (EEA, 2019).
Likely to become plastic pollution	*Medium to high* Micro- and nano-fibres are produced during every washing cycle. In areas without modern waste collection and disposal technology atmospheric pollution as well as deposition of combustion products in soil and water are highly likely.
Dependence on fossil (or sensitive bio-)feedstock	*High* All polymer-derived textiles are highly dependent on fossil feedstocks (Changing Markets Foundation, 2021). In addition, all mainstream and alternative, natural fibres are highly dependent on crop-based fibres, all of which also have significant environmental impacts, e.g. cotton.
Appraisal of sustainability	All garments tend to have high impacts regardless of where they are produced and with which feedstocks. Inevitably, all areas without modern waste-water and waste management facilities will be affected by atmospheric pollution as well as pollution of soil and water.

10. 39241000 Tableware, kitchenware, other household articles, of plastic

This section covers:

- Disposable and repeat use tableware such as cutlery
- Plastic kitchenware or cooking utensils

Ar	Br	Pr	Ur	M
18	18	15	18	10

Disposable cutlery is mostly made of polypropylene and (high impact) polystyrene and to some extent also of melamine. Polypropylene has a shinier surface and higher heat tolerance. Polystyrene cutlery features a denser design and is not as bendable as polypropylene cutlery. Melamine plates tend to be hard and shatterproof, while polypropylene and silicone plates slightly more flexible.

Kitchenware, mainly utensils, are made of polyamide, whilst dishes are also made of melamine.

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*Medium* Unreacted melamine from tableware and kitchenware made of melamine-formaldehyde resins can leach over time under normal cooking conditions. Acidic conditions and high temperatures can enhance the leaching. Melamine-based dinnerware is not microwaveable due to the potential for migration of melamine into food (Takazawa et al., 2020). Polypropylene is considered to have higher temperature resistance and thus safer than both melamine and polystyrene, however research is still at an earlier stage and, as with other plastic types, actual impacts will depend on the mixture of chemicals that people are exposed to.
Toxic at end-of-life waste management stage	*High* Areas with little or no waste collection and modern disposal technologies are more exposed to the effects of burning of waste. **The product gases of open burning of any of the common plastic types used to make tableware pose significant health hazards including contribution to carcinogenicity.**
Appraisal of human toxicity	With urbanization comes a constant increase in take away food and the use of disposable plastic cutlery. Whilst the exact impact of using these plastic products depends on overall exposure of the population, low-income areas are likely to be exposed to both in-use as well as end-of-life components of toxicity.

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Medium to high* Mechanical damage can occur over time, as leaked plastic waste made of these polymers eventually degrades, e.g., through the influence of UV radiation, and forms macro- and micro-plastics. Shoreline feeding birds have been found to have different kinds of plastic in the digestive tract including pieces made of polymers used for cutlery and tableware. Kühn et al. (2021) found that

	polypropylene was the second and polystyrene the seventh most commonly found polymers in the stomachs of seabirds. Chemical damage will depend on residence time and mixture of exposure but in most cases mechanical damage, e.g. blocking or tearing of digestive tract, is more consequential than chemical damage.
Ecotoxicity for pristine soil and aquatic environments	*Medium to high* Polypropylene is a typical microplastic detected in the environment and its degradation behaviour has long raised many concerns (Cui et al., 2022).
Appraisal of environmental harmfulness	Medium to small sized items such as disposable tableware fragments are often found as plastic pollution both in pristine environments as well as in biota.

Sustainability assessment

Criteria	Specific characteristics
Application in single use	*High* Disposable cutlery is mostly meant for single use. Tableware is partly meant for repeat use and partly for single use.
Feasibility of reuse or other product-service systems	*Low*
Feasibility of recycling and downcycling	*Low* As they are small items in disperse waste fractions it is economically challenging to collect the critical mass.
Likely to become plastic pollution	*Medium to high* Disposable tableware, whole or in fragments, is amongst the most common items found in the environment as plastic pollution.
Dependence on fossil (or sensitive bio-)feedstock	*High* Most kitchenware and tableware are still made from petrochemicals. Emerging biobased alternatives are at an early stage and it is difficult to predict whether they will cause ecological challenges through biomass extraction for their feedstock.
Appraisal of sustainability	The increase in sales of disposable cutlery combined with single use application and limited waste management represent a challenge. Furthermore, from 3 July 2021, the most common single-use plastic items that become pollution cannot be placed on the market of EU Member States including plastic plates, cutlery, straws, balloon sticks and cotton buds as well as cups, food and beverage containers (EC, 2021). However, these articles may presumably still be exported to MERCOSUR unless and until similar restrictions are introduced in the receiving countries.

11. 39151000 Waste management parings and scrap, of polymers of ethylene
39152000 Waste management parings and scrap, of polymers of styrene
39153000 Waste management parings of polymers of vinyl chloride

Polymers of ethylene in this section include polyethylene terephthalate (PET); Low Density Polyethylene (LDPE); and High Density Polyethylene (HDPE).

Ar	Br	Pr	Ur	M

14	14	14	14	10

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	This category and section covers waste scrap after the use stage
Toxic at end-of-life waste management stage	*Medium to high* The various polymers have different levels of recyclability and they can all potentially be used as part of Refuse-Derived Fuel (RDF) in waste to energy plants or as Solid Recovered Fuel (SRF) in industrial kilns after some screening and refining to obtain a higher calorific value. The latter option is more costly and less likely in low income countries. Thus, whether they end up as mismanaged waste will depend on how developed the recycling market is in the receiving country. (See recyclability below.) In the case of open burning, all plastic types can generate toxic gases that can include dioxins and furans.
Appraisal of human toxicity	As post-consumer waste, in the case of not being recycled or used, these polymers can have significant toxicity if they are disposed of by open burning. Particularly polymers of PVC can produce significant amounts of dioxins and furans, which can be carcinogenic.

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Medium to high* If not recycled or used as fuel they can all generate toxicity when being disposed of by open burning. **If they leak to the environment, as they are all already fragmented, they can lead to mechanical damage to the biota that ingest them, most typically birds and fish (Galloway et al., 2017).**
Ecotoxicity for pristine soil and aquatic environments	*Medium to high.* In the cases where import of waste happens without a coordinated uptake for applications in waste-to-energy, recycling or repurposing, and in the absence of waste collection and management technologies, the risk of leakage to the environment is high and immediately related to potential contamination of water bodies and soil.
Appraisal of environmental harmfulness	*Medium to high* These waste streams have a relatively high likelihood of being downcycled, disposed of by open burning or leaking to the environment, as several conditions are needed to manage them properly such as markets and treatment technologies.

Sustainability assessment

Criteria	Specific characteristics
Application in single use	*Low to medium*

	This is post-consumer waste in principle intended for recycling, repurposing or as fuel. If it is indeed recycled, applications can be varied including single-use, repeat use and long lived modalities.
Feasibility of reuse or other product-service systems	*Low* If the materials is recycled, it can potentially be reused but a substantial number of preconditions are necessary.
Feasibility of recycling and downcycling	*Variable* ***Polymers of ethylene*** are recyclable but scrap is exported in cases where local recycling systems cannot accommodate or fully exploit this waste stream. There is a risk that in low income countries the material will be most likely downcycled, burnt as refuse-derived fuel in kilns or industrial boilers. But there is a risk that not all material will be taken up resulting in mismanagement (Tuuri and Leterme, 2023). ***Polymers of styrene*** are hard to recycle; therefore there is a higher probability that if they are not used as fuel they will end up downcycled or as waste to be managed but likely to leak to the environment. ***Polymers of vinyl chloride*** are considered difficult to recycle due to their complex composition and low thermal stability. However, they can be recycled mechanically when they are collected and separated where their composition is known, e.g., back to the product manufacturer. Otherwise, the waste stream needs to be cleaned and the composition must be changed to achieve specific processing and performance for a new application, e.g., by removing thermal stabilisers and plasticisers; however, this process is typically not economically viable (Lewandowski and Skórczewska, 2022).
Likely to become plastic pollution	*Medium to high* Unless a recycling market, waste collection and treatment technologies are all in place, these streams can become pollution through leakage or by being disposed of in open burning (Li et al., 2021).
Dependence on fossil (or sensitive bio-)feedstock	*High* These efforts to recycle fossil derived plastic waste reinforce and perpetuate the dependence on fossil hydrocarbon Feedstock.
Appraisal of sustainability	'The sustainability of international trade of waste parings and scrap of most polymers is fraught with several dependencies. If any of the many preconditions are not met, such as mature and efficient recycling markets, the likelihood is high that this waste stream will lead to toxicity or pollution.

12. Polyvinyl chloride (PVC) in various primary forms

This section includes the implications of the trade and use of polyvinyl chloride in several forms. Interestingly, national governments as well as MERCOSUR collectively have chosen for different tariff reductions or exclusion from reductions for different forms likely as result of preliminary negotiations.

39041090 **Other poly(vinyl chloride)**, in primary forms

39042100 **Poly(vinyl chloride), non-plasticised**, in primary forms

Ar	Br	Py	Uy	M
14	14	14	14	10

39041020 **Poly(vinyl chloride) obtained in emulsion**, primary forms

Ar	Br	Py	Uy	M
14	14	14	0	10

39041010 **Poly(vinyl chloride) obtained in suspension.**, primary forms

Ar	Br	Py	Uy	M
14	14	0	0	E

39042200 **Poly(vinyl chloride), plasticised**, in primary forms

Ar	Br	Py	Uy	M
14	14	14	14	E

All the items listed are primary forms, which means that they can be deployed in many uses. Products likely to contain PVC include flexible toys (such as rubber duckies, dolls, beach balls, infant bath books), bibs, rest mats, inflatable swimming pools, garden hoses, raincoats, wall panelling and flooring, window blinds, cosmetics, shower curtains, crib bumpers, imitation leather, some food packaging, furniture, credit cards, water pipes in buildings, medical devices and containers.

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*Medium to high* PVC without plasticisers would be rigid; hence, it normally contains additives such as phthalates, lead, cadmium, and/or organotins, which can be toxic (OPDD, n.d.). Consequently, all consumer goods, most prominently, toys can be a source of additives that are not fully embedded in the polymer matrix and can leach. Phthalates are known endocrine disruptors and actual health outcomes will depend on the exposure profiles of various population segments that determine what other chemicals people are exposed to simultaneously.
Toxic at end-of-life waste management stage	*Medium to high* Since recycling is possible but limited in practice, management at the end of life is crucial to prevent emissions of toxic products of combustion such as dioxins and furans (Zhang et al., 2015). Unless modern collection and treatment facilities exist, there is a high risk of open burning.
Appraisal of human toxicity	Whilst the impacts of the use stage will depend on several factors, the hazards of the cases where waste PVC is disposed of by open burning are potentially more serious as they will increase local populations to dioxins and furans.

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Moderate* Since PVC is deployed more commonly in repeat-use than in single-use applications it is significantly less often found on wildlife that accidentally feed on plastic waste that has leaked from insufficient waste management systems. The main impact pathway is likely to be through products of combustion from open burning.
Ecotoxicity for pristine soil and aquatic environments	*Low to medium* The main impact pathway is likely to be through products of combustion from open burning.
Appraisal of environmental harmfulness	The main impact pathway is likely to be through products of combustion from open burning.

Sustainability assessment

Criteria	Specific characteristics
Application in single use	*Low* PVC is deployed more commonly in repeat-use than in single-use applications.
Feasibility of reuse or other product-service systems	*Low* Since PVC is typically used in relatively durable products, there could be in principle opportunities to use shared use business models. However, the main concern would be potential exposure to additives. For this reason, reuse and sharing models are more advisable for materials that do not contain as many additives.
Feasibility of recycling and downcycling	*Very low* PVC has the recycle symbol number 3. It is in principle recyclable where appropriate facilities exist. However, its original rigidity requires extensive use of plasticisers, which are difficult to trace and therefore a recycled stream from different original manufacturers would yield a very uncertain composition and quality. It is the abundance of additives and the requirement of a dechlorination step that is rarely undertaken result in formation of toxicants during thermal treatment such as incineration (Lewandowski and Skórczewska, 2022). **In practice, PVC has very low, if any, recycling tonnages in many countries. It is mostly landfilled or incinerated.**
Likely to become plastic pollution	*Low to medium* PVC is less abundant amongst plastic pollution materials than polyethylene and polystyrene. Nonetheless, in all low-income regions where collection, recycling and treatment facilities are not present there is a risk of leakage as plastic pollution or as atmospheric pollution from open burning, particularly in the countries where it is still allowed to manufacture consumer goods such as toys made of PVC.
Dependence on fossil (or sensitive bio-)feedstock	*High* PVC is typically made from fossil hydrocarbon feedstocks and no specific biobased feedstocks are identified as especially dedicated to producing PVC or a close surrogate.
Appraisal of sustainability	Although it is deployed in durable or repeat-use applications and is theoretically recyclable, PVC is not widely recycled. In cases where

	modern incineration facilities exist, the main (carcinogenic) dioxin and furan emissions from incineration stem from PVC. When open burning is the only disposal option toxic emissions are correspondingly higher.

13. 63053310 Sacks for packing, of polyethylene/polypropylene mesh **63053390 Other sacks for packing, of strip polyethylene, etc.**

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*Low* Mesh sacks are typically intended for heavy duty applications. In such cases human toxicity is limited, as the sacks are for industrial use and under the control of businesses rather than individuals. Strip sacks for domestic use also do not represent the highest toxicity potential as they are not intended for repeated human contact.
Toxic at end-of-life waste management stage	*Low* Mesh sacks are typically managed as commercial waste. This minimises the risk of human toxicity, as they are more likely to be disposed of in either an engineered landfill or a commercial incinerator. Toxicity from incinerator emissions attributable to mesh sacks is low compared to other plastic types and articles. *Medium* Strip sacks for domestic use can potentially be disposed of by open burning in the absence of collection, recycling and treatment facilities. Although their products of combustion are not as toxic as, for instance, those of PVC, they would represent a more substantial fraction of the waste burnt and emissions generated.
Appraisal of human toxicity	Mostly the sacks intended for domestic use can become part of air pollution through open burning.

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Low to medium* Mesh sacks are typically managed as commercial waste. This minimises the risk of chemical toxicity for biota through combustion or mechanical damage through leakage. *Medium* Strip sacks for domestic use can potentially, in the absence of collection and treatment facilities, leak to the environment and cause mechanical damage as they break up into macro- and micro-plastic.
Ecotoxicity for pristine soil and aquatic environments	*Low to medium* Although domestic-use strip sacks and heavy-duty mesh sacks are less abundant and less likely to leak to the environment, they are still at risk of breaking up into secondary macro- and micro-plastic in places without collection and treatment facilities.
Appraisal of environmental harmfulness	It is important to establish whether the importing regions will have sufficient waste collection and treatment infrastructure.

Sustainability assessment

Criteria	Specific characteristics
Application in single use	*Medium to high* Domestic-use strip sacks are not as abundant as single-use groceries carrier bags but they can still be abundant. They can be used as bin liners, i.e. a semi-durable, repeat-use application. *Medium* Mesh sacks used mostly as heavy-duty transport in industrial and construction settings are a single-use, semi-durable application.
Feasibility of reuse or other product-service systems	*Low* Heavy-duty mesh sacks are in few cases deployed in repeat-use models.
Feasibility of recycling and downcycling	*Low* Although they are in principle recyclable, sacks are rarely, or hardly at all, recycled.
Likely to become plastic pollution	*Low to medium* If the importing regions lack collection and treatment facilities, both domestic-use strip sacks and heavy-duty mesh sacks are at risk of leaking to the environment.
Dependence on fossil (or sensitive bio-)feedstock	*High* Polyethylene and polypropylene are typically made from fossil hydrocarbon feedstocks and no specific biobased feedstocks are identified as especially dedicated to producing a suitable substitute for the same applications.
Appraisal of sustainability	The sustainability of domestic-use strip sacks and heavy-duty mesh sacks needs to be also contrasted with the availability or lack of suitable substitutes for the same applications. Unless similar sacks of different durable materials are deployed in sharing and reuse business models (which is hard), it will be difficult to reduce environmental impact significantly. However, impacts are different for each material and particularly for the domestic-use strip sacks there are risks of becoming plastic pollution and of causing toxicity in the absence of collection and treatment infrastructure.

14. 39031110 Polystyrene expansible, containing fillers, in primary forms
39031120 Polystyrene expansible, not containing fillers, in primary forms

It is noteworthy, first, that MERCOSUR is aiming for tariff elimination in 10 years. Second, these items refer to primary forms and the **impacts are more significant after production and from the use stage onwards in the form of expanded polystyrene (EPS).**

39031110 **Polystyrene expansible**, containing fillers, in primary forms

Ar	Br	Py	Uy	M
14	14	14	14	10

39031120 **Polystyrene expansible**, **not** containing fillers, in primary forms

Ar	Br	Py	Uy	M
14	14	0	0	10

Human toxicity assessment

Criteria	Specific characteristics
Toxic at (product) use stage	*Low to medium* Expanded polystyrene food packaging can exhibit migration of chemical additives. However this tends to be less prominent than in other plastic types and research in migration intensity and its impacts is still in early stages. It is known that long term exposure to high levels of styrene, also known as vinyl benzene, can pose health hazards during production and use including carcinogenicity (NTP, 2021). Exposure during normal, single-use applications is typically not at such high levels but the National Human Adipose Tissue Survey for 1986 of **the US Environmental Protection Agency identified styrene residues in 100% of samples of human fat tissue** taken in 1982 in the USA (Gurman et al., 1987).
Toxic at end-of-life waste management stage	*High* When polystyrene (PS) is incinerated it can produce many different hazardous compounds, notably polycyclic aromatic hydrocarbons (PAHs), albeit at controlled levels. However, **when burnt at lower temperatures typical of open burning, it can produce higher levels of PAHs as well as carbon monoxide and carcinogenic styrene monomers** (Elomaa and Saharinen, 1991).
Appraisal of human toxicity	*Medium to high* The reality of low-income regions with limited waste collection and treatment facilities is that polystyrene often leaks into the environment or is disposed of by open burning leading to significant toxic emissions that can compound emissions generated by other polymers and collectively represent serious hazards from irritation of respiratory tract through to contributing to carcinogenicity.

Environmental harmfulness assessment

Criteria	Specific characteristics
Harmfulness to biota via chemical or mechanical damage	*Chemical, low to medium* Laboratory research has found that components of polystyrene such as ethylbenzene leach in use at temperatures above 90°C, at levels that would be toxic to small marine invertebrates, particularly when containers hold liquids with fat content (Thaysen et al., 2018). In reality, these exact conditions will not encounter marine invertebrates. Long-term exposure to the same toxic leachates after ingestion needs to be further explored. Industrial (unexpanded) PS nanoparticles (density ~1.1 g cm−3) have been frequently **studied through *in vitro* cultures with crustaceans, invertebrates and fish and have shown a range of adverse effects, including delayed growth, repressed immunity, histopathological changes, behavioural changes, and decreased reproduction**, but it remains unclear, whether these

	effects can be extrapolated to buoyant EPS when fragments are weathered down into nano-plastics in the environment (Turner, 2020). Another important consideration is that **depending on the surrounding levels of pollution, EPS can easily absorb persistent organic pollutants.** *Mechanical, low to medium* Ingestion of EPS may arise directly from consumption of material mistaken for food that is floating, deposited on beaches, trapped in macroalgae, or acting as a substrate-habitat, and indirectly via the consumption of contaminated prey. Ingestion has been documented in the stomach contents or faecal matter of a range of marine animals, including crustaceans, fish, birds, turtles, and mammals, whereby seabirds are commonly observed to consume EPS because floating fragments are similar in size and colour to normal prey like fish, fish eggs, and larvae (Turner, 2020). However, given its relatively low density, smooth surface, and propensity to fragment, these impacts may be less severe or long-lasting than those from harder and sharper plastics like polyethylene (Turner, 2020).
Ecotoxicity for pristine soil and aquatic environments	*Medium to high* Because of its light weight and breakability, it drifts away on wind and water currents and given its ubiquitous presence in disposable packaging, polystyrene is one of the most abundant forms of global pollution. It represents a widespread hazard to the health of wildlife and the ecosystems that depend on them (Eriksen et al., 2017).
Appraisal of environmental harmfulness	Particularly small organisms such as plankton and invertebrates may be the most affected form of marine wildlife. EPS continues to be one of the most abundant particles found as plastic pollution in the environment.

Sustainability assessment

Criteria	Specific characteristics
Application in single use	*Medium to high* Polystyrene has several single-use applications such as food packaging and protective packaging for individual delivery of consumer goods. However, polystyrene, particularly as extruded polystyrene (XPS), also has repeat-use, medium- and long-life applications where pressure, temperature stability, and humidity requirements are high such as automobile parts and building insulation. In the marine sector, EPS (and less frequently XPS) has applications such as on-board packaging boxes in the fishing industry, buoys, pontoons, floating docks, net floats and parts of life jackets .
Feasibility of reuse or other product-service systems	*Low to none* Repeat use with medium- to long-life applications are in reality not part of product service systems.
Feasibility of recycling and downcycling	*Low to none*

	For reasons such as food contamination and low density (it consists of around 5% polystyrene and the rest is gaseous blowing agents), EPS it highly uneconomical to collect for recycling.
Likely to become plastic pollution	*High* Due to its use in disposable on-the-go food packaging, its propensity to break up and its low density as well as the difficulty to recover it and recycle it, **EPS can easily leak any waste management system** and then be propagated by the wind as well as fresh and sea water currents.
Dependence on fossil (or sensitive bio-)feedstock	*High* As with most commercial plastic polymers, PS depends on fossil hydrocarbon feedstock. Emerging, alternative biobased sources are at an early stage and it is difficult to predict whether there will be specific sources likely to cause ecological damage through extensive biomass production and extraction. But if all fossil feedstock were replaced in the same quantities with biobased feedstock it is highly likely that direct and Indirect Land Use Change (ILUC) would ensue.
Appraisal of sustainability	Polystyrene for single-use packaging is being banned in some regions of the world. For instance, from 3 July 2021, the most common single-use plastic items that become pollution cannot be placed on the market of EU Member States including plastic plates, cutlery, straws, balloon sticks and cotton buds as well as cups, food and beverage containers made of EPS (EC, 2021). However, these articles may presumably still be exported to MERCOSUR unless and until similar restrictions are introduced in the receiving countries.

4 Conclusion and recommendation

The changes in tariffs of numerous items are taking place in the context of economy-wide trade talks. How significant societal and environmental impacts will be as a result of the overall negotiations is not yet clear, but this study identified some red-flag items that must be observed closely due to their potential to eventually cause environmental and public health impacts. Civic society and Non-Governmental Organisations must **keep track of the dependencies outlined in this report** to discern connections between trade and contextual factors.

The identified red-flag items were:

- Expansible polystyrene in primary forms
- Tableware, kitchenware, other household articles, of plastic
- Polyvinylchloride
- Waste parings of polyethylene, styrene and PVC
- Garments made of mesh fabrics with plastic/rubber and articles of apparel/accessories of plastics

Two important drivers of the outcome must be closely observed. The **manufacturing standards for consumer goods made of plastic** are closely related to public wellbeing. They will determine whether toxic additives are widely used in products and whether they will be compatible with recycling and reuse. The most evident dependency for containing plastic pollution and to minimise the possibility of open burning is the **effectiveness of the local waste management infrastructure**. Civic society must observe closely the infrastructure trends and policies for source-separation, collection, disposal and **market formation for recovered materials**.

Closer **analysis of circular economy and resource efficiency policies** can provide early warning signals on parts of the system that may become problematic. For instance, do governments have strategies to foster recycling, reuse, the sharing economy and the right to repair? Are there fiscal or other mechanisms to internalise value chain external costs? Are there purposefully limited ambitions regarding better use of plastics that mainly concentrate on recycling and neglect reuse and other parts of the circular and resource efficient and healthy economy?

Lastly, civic society and the international community must **monitor in the short and medium term the tonnage of trade in waste plastic** to be able to **challenge undesirable developments considering relevant dependencies**.

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