MSc Program
Environmental Technology & International Affairs

A Critical Analysis of the Consequences of the EU-Proposed Ban on Single-Use Plastic Items

A Master's Thesis submitted for the degree of
“Master of Science”

supervised by
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Vienna, 13.06.2019

Affidavit

I, **PATRICIA SCHEDIFKA, BSC**, hereby declare

1. that I am the sole author of the present Master's Thesis, "A CRITICAL ANALYSIS OF THE CONSEQUENCES OF THE EU-PROPOSED BAN ON SINGLE-USE PLASTIC ITEMS", 54 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted the topic of this Master's Thesis or parts of it in any form for assessment as an examination paper, either in Austria or abroad.

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Abstract

In recent years, marine litter became one of the biggest concerns. Worldwide, 9 million tonnes of mismanaged plastic waste enter the oceans every year, and the adverse effects on the environment will multiply. By proposing a new directive “on the reduction of the impact of certain plastic products on the environment” (single-use plastics) in 2018, the European Union has itself committed to combat macro plastic marine litter. The ban on certain plastic products, including cutlery and straws, enjoys the most popularity. For this reason, the master’s thesis studied the impacts that the ban will have on the environment and the plastic industry. The outcome was disillusioning.

Only 220 tonnes of marine litter from the banned items could have been reduced by 2030. Compared to the annual amount of 15,000 tonnes in Europe, or 9 million tonnes of mismanaged plastic waste that flows into the ocean worldwide, the 220 tonnes are neglectable. Although the reduction may be observable throughout beach counts, an assessment of the actual impact on the environment (e.g., reduction in the number of entanglements of species) is not envisaged under the proposal. Furthermore, a great resistance of the industry to the implementation of the ban is not expected.

Although the impact of the ban is minimal, the overall value of the legislative proposal is not. When properly implemented and monitored, the action taken by the EU can further raise awareness, trigger more countries to act, and be the starting point of the needed international and global cooperation that is needed to combat marine litter.

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List of abbreviations

bn	Billion
EC	European Commission
GHG	Green house gases
JRC	Joint Research Centre
kt	kilo tons
LCA	Life Cycle Analysis
MU	Multi-use
SUNP	Single-use non-plastic
SUP	Single-use plastic

Acknowledgments

I like to express my very great appreciation to Ass. Professor Dr. techn. Johann Fellner for being the supervisor of my master thesis, his enthusiastic approach of teaching waste management, his patient guidance and useful critiques of this research work.

I also thank Sebastian Suppan for his unconditional support throughout my academic career.

Last not but not least, I express my deepest gratitude to my family, especially my parents for their endless encouragement and believe in me.

1. Introduction and objective of the thesis

Since plastics was commercially introduced in the 1930/40s, its use of application and consumption has grown steadily (Jambeck et al. 2015). Nowadays, it can be claimed that life without plastics is not possible since it is part of many manufactured goods whose functions rely on the characteristics of this unique material. Its malleability allows that plastic can be shaped into any form convenient for both the industry and the end-consumer. It is this convenience that make people reluctant to resign from its consumption, even if the good is used only once. Without caution, this will lead to overconsumption and depletion of resources, and plastics already harm the environment when its disposal is insufficiently managed. This is very true for marine pollution, and the amount of plastic pollution in the oceans is accumulating. The negative effects of plastics on the environment also impinges on the economic performance of countries – a threat that lead to the acknowledgement of the global plastics crisis. Although it was already reported more than two decades ago that plastics debris pollute the marine environment, too little progress was made in tackling the issue. Plastic pollution is transboundary in nature which means that ocean currents transport it from one place to another and that national strategies to mitigate the inputs of plastics from land to the ocean can be nulled by another country's inaction. Therefore, global partnership and enhanced efforts are needed to reduce the amount of plastics entering the ocean. An attempt to do so is the EU-wide ban on single-use plastics which was proposed by the European Commission in 2018. The *Proposal for a Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment* and the analysis of it constitutes the core of this master's thesis.

By providing an overview of the chemical characteristics of plastics, its introduction on the market, historical and future patterns of production and consumption rates, the reader will gain insights that help him or her to better understand the need for and value of legislations and actions combating plastic pollution. Such legislation is the proposal by the EU commission, which is reviewed and its intended measures, especially the envisioned ban on certain single-use plastic products, will be critically analysed. Thereby, the first research question

> *What is the impact a ban on single-use plastics would have on the plastics industry and the environment?*

is answered. To ban certain plastic products implies that alternatives made from other materials, often biomass, will gain in importance. Therefore, it is necessary to evaluate

the environmental performance of the alternatives to limit or avoid negative consequences of their use.

After this, the lessons learned from the ban on single-use (lightweight) plastic carrier bags, which was spread across the globe since the 2000s, are presented in order to shed light on the opportunities and challenges of the EU-proposed directive on single-use plastics. Then, parties affected by the upcoming legislation will be presented because the implementation is likely to be affected and halted by some of them.

In the last chapter, findings are discussed with the aim to conclude and try to answer the second research question, namely

What is the overall added value of the proposed EU action?

before the conclusion is presented.

2. Methodology

To be able to provide possible answers to the two research questions, it was decided to conduct a documentary analysis. A systematic review of existing literature on marine pollution and the ban on single-use plastic carrier bags was done, and due to the actuality of the topic, articles earlier published than 2010 were not considered. In order to find such literature search engines including Google Scholar, Scopus, Open knowledge maps were consulted, and search terms included “marine litter,” “single-use plastic bag ban,” “ocean pollution”. Existing life-cycle analysis of the products and alternatives were also used within this text. Google itself was consulted for newspaper articles and to find new non-plastic alternatives for the plastic products that are to be phased out soon.

Furthermore, the legislative text *Proposal for a Directive of the European Parliament and of the Council on the reduction of the impact of certain plastic products on the environment*, its annex and complementary exhaustive impact assessment, and online press releases by the European Commission, are building the foundation of this master’s thesis. In this context, a quantitative assessment was undertaken because numbers and figures mentioned in the legislative texts were not always straightforward and clear.

The results of the extensive literature review can be understood as the state-of-the-art and is presented in the first and last sections of the thesis, while the critical analysis of the EU-proposed ban on single-use plastics constitutes the core.

3. Results

3.1. Review of plastic production and marine litter

Maybe not always at first glance but still, everywhere we look we find something made of plastic nowadays. The large role that plastic plays in the world of today is undeniable as it became an indispensable part of everyday life. Its characteristics allow the material to be used for a vast range of applications from being used for packaging to be used as a construction material. Its qualities like longevity and resistance are highly valued during usage but not when plastic is disposed and littered into the environment. It is these qualities that cause widespread public concern.

3.1.1. Characteristics and types of plastic

The term plastic derives from the Latin word “plasticus” and the Greek word “plastikos” to describe a flexible material that can be easily shaped into any desired form. Today, the terms “plastic (products)” or “plastics” often subscribe to a whole category of materials with different characteristics, mostly polymers which means “of many parts” as they consist of long chains of molecules. The first synthetic polymer was invented in 1869, and since then a lot of different types of plastics were discovered. They can be put into the two categories thermoplastics and thermosets. The former refers to those plastics that can be melted when heated, hardened when cooled and reversed. It further allows the concerned plastics to be reheated, reshaped, and refrozen repeatedly. Different types of commodity plastics that are used daily belong to this category and will be described more exhaustively. The second category includes plastics that undergo a chemical change when heated and once heated and formed, the plastics cannot be re-modeled (PlasticsEurope 2018; Science History Institute 2019).

Worldwide, only a handful of the diverse plastic materials account for approximately 90% of the most used commodity (thermo-)plastic products. These include polypropylene (PP), high-density and low-density polyethylene (PE), polyethylene terephthalate (PET), polyvinyl-chloride (PVC), polystyrene (PS) and expanded polystyrene (EPS). For instance, PP is said to be the single most used thermoplastic globally as it serves as a packaging film for crisps and nuts or is shaped into thin-walled containers like yogurt cups, food trays. A great variety of household goods like combs and hair dryers is also made from polystyrene. The second most widely used is polyethylene that is required to make plastic films and applications, including carrier bags, freezer and sandwich bags, and some other molded products. One of the few polymers that are potentially suitable for plastic bottles is PET, which was discovered in 1941. Due to its properties such as

transparency, gloss, lightweight, and resistance to permeation of carbon dioxide, it is the preferred material to manufacture bottles.

In 2017, data provided by PlaticsEurope (2018) for the EU28+NO/CH market on the European plastic converter demand by polymer types showed the same segmentation. PP accounted for 19.3%, high-density and low-density PE made up 29.8%, the share of PVC and PET was 10.2% and 7.4%, PS and EPS together shared 6.6% of the total demand and polyurethane (PUR) as one of the thermosets plastics used for insulation and mattresses accounted for 6.6%. The rest (19%) is made up of plastics that are used for eyeglasses lenses, cable coating in communications, and other applications.

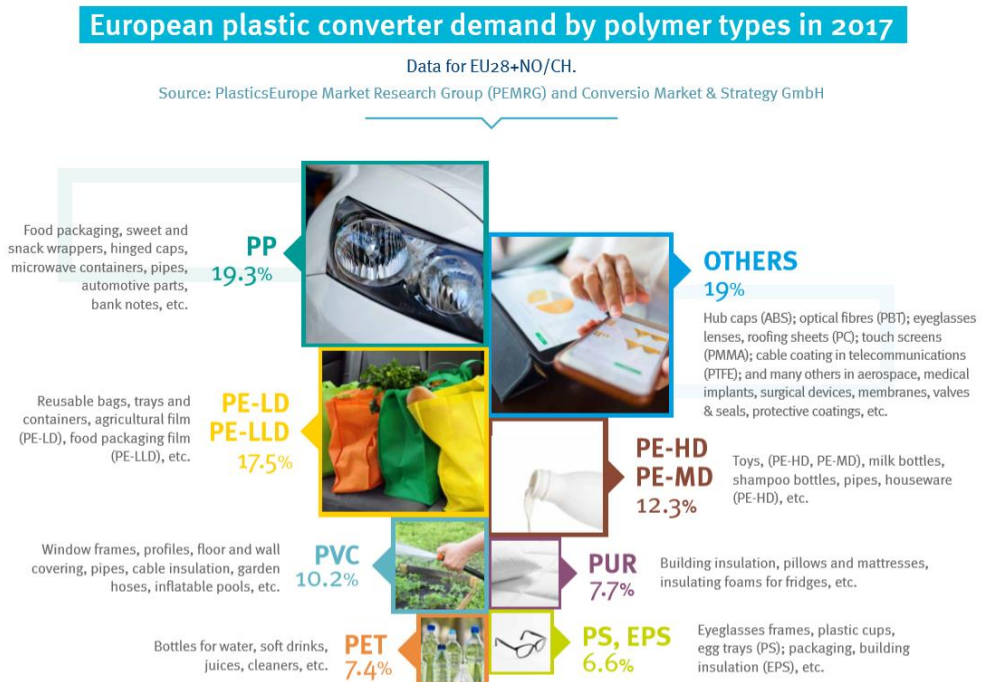

Figure 3.1: European plastic converter demand by polymer types in 2017.
Source: PlasticsEurope 2018.

It seems as if there were enough types of plastic to manufacture goods, but plastics are rarely used by themselves, but so-called "additives" are needed to enhance performance. These additives can adversely affect health when leached out of plastics as they are endocrine disruptors, carcinogenic, or provoke toxic reactions (EC 2018d, 56). For instance, Bisphenol A (BPA), which was used in plastic packaging, toys, and drinking bottles, can disrupt the endocrine (hormonal) system of both humans and animals. Since there are evidence and proof of the risk of the intake of BPA, the industry began to forbid its use (Andrady and Neal 2009).

3.1.2. Production and consumption rates of plastics

In the 1930s/1940s plastics were widely introduced into commercial markets and since then gained immense importance for end-consumers (Jambeck et al. 2015). One of the first consumer items made from plastic was American scotch tape, but the versatility of plastics was revealed during World War II with nylon stockings and parachutes. Toothbrushes, Tupperware and records became other examples of products that could be made from moulded plastics, and the range of products has steadily become broader. By 1950 and 1960, plastics were already used to manufacture bags, clothing, and toys. The increase in availability and variety of plastics on the consumer marketplace had triggered the steady rise in production rates, from 2 million tonnes in 1950 to 35 million tonnes in 1970 (Dauvergne 2018; Geyer, Jambeck, and Law 2017). Since then, total production kept climbing and reached 120 million tonnes in 1990, over 200 million tonnes in 2000, and exceeded 300 million tonnes in 2010. Dauvergne (2018) claims that production of plastics "was hovering around 400 million tonnes in 2018". This data implies that at least half of the plastics produced since 1950 were produced in the last two decades.

Of the overall plastics production, Asian countries account for half it, including China, the single largest producer with a share of 29.4%. In the EU28+NO/CH market, around 64.4 million tonnes of plastics were generated in 2017, which corresponds to 18.5 % of the overall global plastics production. This number, however, does not include PET-, PA- and polyacrylic-fibers (PlasticsEurope 2018). In 2018, Europe's production fell in all plastic sectors, but it said to increase again in 2019.

Globally, the use of plastic is said to rise, and so will its production, assumingly (Andrady and Neal 2009). Regarding consumption rates, in Europe, 51.2 million tonnes is the total plastic converter demand. The leading market sector is packaging, which demands 39.7% of the plastics. The second largest segment is building and construction (19.8%), followed by automotive (10.1%) and the electrical and electronic market sector (6.2%). The remaining quantity is shared between household, leisure and sports (4.1%), uses of plastics in agriculture (3.4%) and other applications including medical equipment and plastic furniture (16.7%) (PlasticsEurope 2018). This segmentation is very similar to those of other developed countries, and usage patterns vary between developed and developing countries insofar as in the developing countries the packaging sector might be more prominent (Andrady and Neal 2009). Still, the most significant marketplace for the world's plastic is packaging, "an application whose growth was accelerated by a global shift from reusable to single-use containers" (Greyer et al. 2017, 1). This shift caused a massive increase in amounts of plastics in municipal solid waste by mass, from

less than 1% in 1960 to more than 10% by 2005 in the middle- and high-income countries. The high share is due to the rather short lifetime of plastics. The shortest lifespan of one year (or even less) has packaging which is mostly discarded already in the same year it is produced. Consumer and institutional products made of plastic are normally used for less than five years, and textiles are thrown away after five years the latest. It is said, that around 70% of the world's total plastic production to date is no longer in circulation because it is either landfilled, burned, recycled or "lost" (Geyer, Jambeck, and Law 2017; Dauvergne 2018).

Recycling does not relieve the pressure on fossil hydrocarbons for primary plastic production because secondary material from recycling is often contaminated and of limited quality and thus, of limited economic value. Only China and Europe have a recycling rate of 25% and 30% while the rest of the world, like the US (9%), recycle very little plastic. The most common option for plastic litter remains landfilling while in the US, a relatively small fraction of plastic waste is thermally incinerated, but this process causes health and environmental concerns in case that the plant is not equipped with a sufficient flue gas cleaning system (Geyer, Jambeck, and Law 2017).

The steady rise in the production of plastic derived from fossil resources put even more and immense pressure on natural resources and that the design of plastic products, which seduce consumers to use them only once, contributes to the accumulation of plastic waste. Still, it is not the plastic production or consumption that poses a single threat to the environment but mismanaged plastic waste. Due to non-sufficient waste disposal facilities and other reasons, plastic waste often ends up in natural environments like seas and oceans where it causes harm to ecosystems and potentially human health.

3.1.3. Marine litter

Plastics are the most abundant and widespread source of marine debris and account for 60-95% of marine litter. It was estimated that only in 2010, approximately 8 million tonnes, and in 2015, 9 million tonnes of mismanaged plastic waste has entered the oceans and predictions of the future amounts are even worse. Statements like "the amount of plastic flowing into the oceans is on track to double from 2010 to 2025" and "if trends continue, by 2050 the oceans could end up containing more plastic (by weight) than fish" (Jambeck et al. 2015; Dauvergne 2018) sound the alarm. This is not because plastic waste in the oceans is no aesthetic appearance but due to the impacts that it is causing.

3.1.3.1. Negative impacts

Once littered into the environment, plastic waste persists for several hundred years and even though more significant plastic parts, often referred to as macro plastic, may disintegrate into smaller particles (microplastic), plastic is a non-degradable material. Floating around in the water, it causes various adverse effects on the marine environment and biodiversity. Entanglement and ingestion of plastic debris can have deadly or sub-lethal effects for marine species since both affect “an individual’s ability to capture food, digest food, sense hunger, escape from predators, and reproduce” (CBD 2012). Ingestion can also lead to bioaccumulation of toxic chemicals because plastics themselves can absorb persistent organic pollutants, which are toxic chemical substances, and once entered the body, these substances build up in the body and cannot be excreted. The toxic concentration can be significantly magnified throughout the food chain and hence, can also affect human health. (EC 2018c, 59; Kasper-Giebl 2018). Furthermore, macro plastic can alter biodiversity when species use it to travel longer distances than otherwise possible and thereby affect their or other species’ population structure at specific spots. “One study predicted that global marine species diversity might decrease by as much as 58% if worldwide biotic mixing occurs” (Mckinney 1998).

Something that is also predicted to decrease due to plastic marine litter is economic revenues from shipping, fishing, tourism, and recreation. Just in the Asia-Pacific region, the annual damage to these sectors is estimated to cost about US$ 1.265 billion (UNEP 2016). Globally, the damage to marine environments is estimated to be at least US$ 8 billion per annum (EC 2018c; UNEP 2016). “For the EU, costs to the tourism and recreation sector (extrapolated from beach cleaning costs) have been estimated up to €30 million per year” (EC 2018c, 60) but the “removal of plastic debris from coastlines costs approximately €630 million each year” (Schnurr et al. 2018).

3.1.3.2. Sources of marine plastic pollution

In the framework created by Jambeck et al. (2015) data on the plastic waste generated annually by populations living within 50km of a coast worldwide was linked with data on solid waste management, and economic status to estimate the amount of plastic that potentially litters into the ocean from land. Land-based sources of marine litter are among others, stormwater discharges, uncontrolled landfills, illegal dumping, sewer overflows, and wastewater outflows (Jambeck et al. 2015; EC 2018d, 27). Therefore, the plastic that flows into oceans reflects inadequately discarded waste that is not formally

managed. The most significant amounts of such waste are released by middle-income countries where “fast economic growth is probably occurring, but waste management infrastructure is lacking” (Jambeck et al. 2015). Examples for such countries are China, Indonesia, and the Philippines, which are also leading the top 20 countries ranked by mass of the mismanaged plastic waste. The collective of the 23 coastal countries of the European Union is ranked eighteenth on the list. What this global map does not show is “distancing of waste” which means that plastic waste is exported from developed countries, including European countries and the US, to countries with poor recycling and management standards like China (Dauvergne 2018). There, it will not necessarily end up as marine litter, however, to transfer the waste to countries with poor waste management can serve as a reason why one study estimated that just five Asian countries account for 60% of global marine litter.

Jambeck et al. (2015) argue that if waste management is streamlined and the amount of mismanaged waste halved in the top 20 countries the overall amount of mismanaged waste would decrease by 41% by 2025. Given the significant investment needed to do so and the fact that 16 of the top 20 are low- and middle-income this undertaking remains a utopian idea. It is more realistic for industrialized and or high-income countries to reduce their overall waste generation, and thus plastic waste, to the 2010 average (1,7kg waste/day/capita) and thereby achieving a 26% reduction in the overall plastic waste by 2025. It is indeed a smaller reduction of marine litter but would “require smaller global investments” (Jambeck et al. 2015).

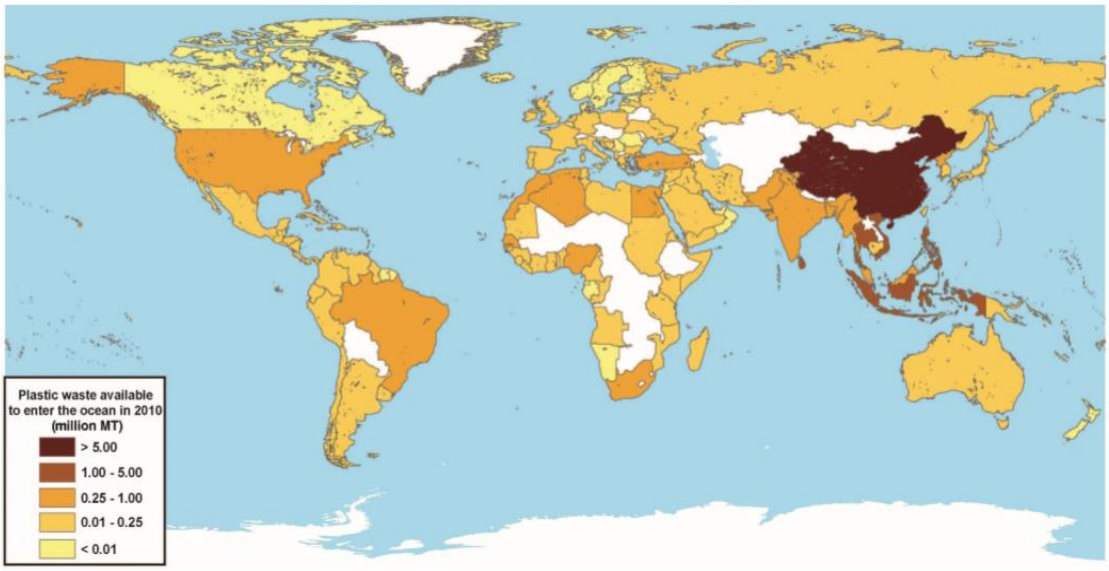

Figure 3.2: Plastic waste available to enter the ocean in 2010.
Each country is shaded according to the estimated mass of mismanaged plastic waste (in tonnes), generated in 2010 by populations living within 50 km of the coast, and likely to enter the marine environment.
Source: Jambeck et al. 2015.

Nevertheless, global governance of plastic waste and thus, marine pollution is not existing and in case it is, all of the factors described above (the acceleration of production; extensive influence of industries; globalization of consumption and trade, and consequently diversification of pollution sources; uncoordinated efforts) challenge it to such extent that governance “is failing to rein in marine plastic pollution.” (Dauvergne 2018).

Despite that, the European Union is convinced that it can lead the way on tackling the issue and if it takes action other countries will also be triggered to act, resulting in a global reduction of marine litter in European Seas and beyond (Proposal 2018). Since 1980, over 150 million tonnes of plastic marine litter is estimated to have accumulated, out of which between 1.4 and 3.7 million tonnes in the EU (EC 2018c, 28).

3.2. Action taken by the European Union to reduce marine litter

The EU went an essential step towards fighting marine pollution by considering a new Directive (of the European Parliament and of the Council) on the reduction of the impact of certain plastic products on the environment (EC 2018a). Although the directive is not in place yet, and an agreement on negotiations between the EU institutions and Member States is expected to be reached by the end of this year, the proposal presents the core of this master’s thesis and is critically analysed and reviewed in the following chapter. Reasons for its introduction and other legislation which it builds upon will be presented, however, the plastics items affected by the proposal and the intended measures and resulting scenarios are the areas of particular focus and will be elaborated in more detail. As some single-use plastics are envisaged to be banned soon, their share in the overall European plastics production is given and combined with data from the first chapter, their contribution to marine litter can be estimated. With this estimate, it might be possible also to assess the quantitative impact a European ban on single-use plastics would have. Thus, the research question What is the impact a ban on single-use plastics would have? is answered to some extent in this chapter.

3.2.1. Reasons for the proposal and complemented legislations

On 24 May 2018, the European Commission proposed a directive on macro plastic after counts on European beaches have revealed that single-use plastics such as cutlery, plates, and bottles represent almost half of all marine litter items found. The ten most found single-use plastic products take up 43% and together with fishing gears that contain plastic, they present 70% of all marine litter. To mitigate the adverse effects on

ecosystems, biodiversity and human health, and to reduce the cost of plastic litter that includes the lost economic value in the material and for tourism, the EU decided to act. With the directive on the reduction of the impact of certain plastic products on the environment, the problem of macro plastic marine litter will be explicitly tackled and thereby it complements measures already envisaged under multiple EU legislation. For instance, it "complements the objective established in Article 9 of the Waste Framework Directive, as amended in 2018, that Member States shall take measures aimed at halting the generation of marine litter and measures to prevent, combat and clean-up litter" (EC 2018a). In contrast to being complemented, the Marine Strategy Framework Directive, including its long-term monitoring of marine litter on European beaches, serves as the scientific base of the legislative proposal. Other legislation that work towards the same or similar goal as the concerned initiative are the Urban Waste Water Framework Directive that regulates the collection and treatment of municipal wastewater, and the legislation on port reception facilities and the Fisheries Control Regulations that waste and the reporting provisions on lost fishing gear.

In general, the legislative proposal is an integral part of the European Strategy for Plastics in a Circular Economy, short Plastics Strategy, which was introduced at the beginning of 2018. This strategy lays down already a framework to tackle marine pollution, including actions to curb microplastic pollutions; however, macro plastics are not explicitly mentioned, and therefore the new directive sheds light solely on macro plastic pollution. Still, the initiative "should be seen in the broader context of the transition to a circular economy" (EC 2018a) which is supposed to support innovations in product design to avoid plastic, lead to investments into marine litter prevention and sustainable alternative materials, while boosting the overall competitiveness of European business by creating a resource-efficient and decarbonised economy. It thereby contributes to the Plastics Strategies' vision of "a smart, innovative and sustainable plastics industry, where design and production fully respects the needs of reuse, repair, and recycling brings growth and jobs to Europe and helps cut the EU's greenhouse gas emissions and dependence on imported fossil fuels" (EC 2018g).

Nevertheless, the main objective of the proposal is the prevention and reduction of the impact of certain plastics products on the (aquatic) environment.

3.2.2. Method of data collection

The upcoming directive serves as a set of comprehensive measures that are to be applied to the most found macro plastic items on European beaches. As stated already, macro plastics covers 70% of all marine litter, and this percentage is calculated either by

item count, volume, weight, or the ratio of surface area to volume. Measuring the plastic pollution in item weight, per year, per sources, in the EU, shows a different picture in so far as that plastic form the major part of marine litter (up to 300,000 tonnes) while macro plastic – when not fragmented into microplastic particles – contributes 15,600 tonnes with single-use plastics and 11,000 tonnes with fishing gear each year (EC 2018b). Still, to inform this legislation, beach counts were conducted as they serve as a reasonable indicator of the composition of marine litter and are internationally accepted as method and suitable to inform policy. Information about the most find litter items was comprised and gathered from different sources. The Joint Research Centre's Technical Group on Marine Litter activities collected 355,671 items in total from 276 beaches of 17 EU Member States (EC 2018b), whose coastal areas stretch across four marine regions namely Baltic Sea, Black Sea, Mediterranean Sea and North-East Atlantic Ocean (EC 2018b; Addamo et al. 2017).

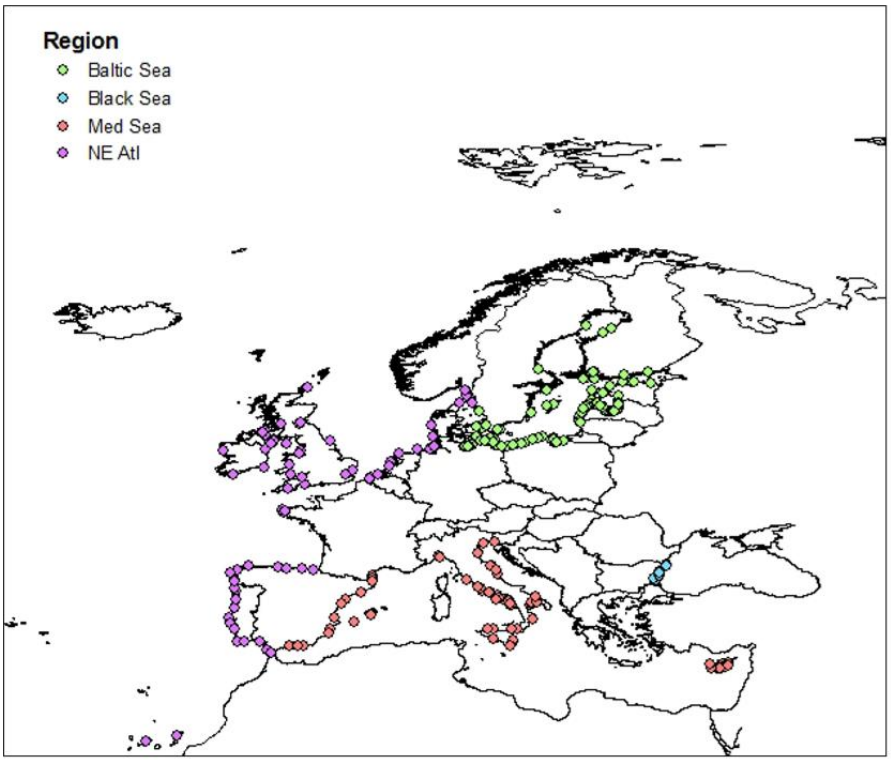

Figure 3.3: Map of the distribution of beaches included in the 2016 data set provided by the Joint Research Center.
Source: Addamo et al. 2017.

The spatial monitoring and reporting units for beach litter surveys vary between studies, but the number of items is commonly expressed either per 100-m transect length or per m². The former spatial indicator was chosen for the surveys conducted by the JRC. Taken into account that one beach "may contain several surveyed transects of 100 m and might be monitored several times a year", the total meters surveyed in the European

coastal countries between December 2015 and January 2017 by the JCR amounted to 135,706 meters, or 135 km (Addamo et al. 2017, 27).

The found items were then analysed, and after aggregation of several survey data sets, it was possible to rank them by abundance. There exist several such lists but to offer an overview, JRC (Hanke 2016) refers, in its short draft summary on top-items, to the information provided by ARCADIS 2013 (consultancy firm) and OSPAR (cooperation between governments and the EU to protect the marine environment of the North-East Atlantic). The beginning of the top marine litter items-list by ARCADIS 2013:

- Cigarette butts are found on average 461 times per 100-m
- Plastic/polystyrene pieces 2.5 cm > < 50cm (total): 225/100m
- Caps/lids (total): 209 /100m
- Drink bottles (total): 186/100m
- Cutlery/trays/straws (total) 143/100m
- Crisp/sweet packets and lolly sticks (total) 138/100m
- plastic/polystyrene pieces 0-2,5 cm 81/100m
- String and cord (diameter less than 1 cm) 68/100m
- Cotton bud sticks 62/100m
- Drink cans 55/100m
- Bags (e.g. shopping) 48/100m
- Food incl. fast food containers 42/100m

In the Joint Research Centre's short summary on Marine Beach Litter in Europe (Hanke 2016), several lists were used and items, which are alike in terms of source and use of material, were further clustered to provide the relative contributions of them. Across the different lists, the following objects rank as top ten:

1. Nets+ ropes
2. Plastic caps and lids
3. Cigarette butts
4. Crisp and sweet wrappers
5. Lolly sticks
6. String and cord < 1 cm diameter
7. Cotton bud sticks
8. Plastic drink bottles
9. Plastic food containers
10. Balloons

Followed by

11. Plastic cutlery
12. Plastic bags

The EU proposal is based on this data complemented by the Marine Litter Watch, an existing ongoing project that collects data by combining citizen engagement and with modern technology, and expertise from the European Marine Observation, Data Network EMODnet partnership, and external consultants. In the proposal it is also claimed that "formal and informal interviews with stakeholders from public institutions, NGOs, industry associations and businesses were carried out" and that "these interviews examined what was technically feasible and the likely direct effects of certain options" (EC 2018a). The standpoint and views of some stakeholders also including NGOs and industry associations will be discussed at the end of the thesis in more detail, to provide a useful overview of the opportunities and challenges of the legislation and its implementation.

Figure 3.4: The top 10 Single-Use Plastic items represent the list, on which the EU-proposal is based upon.
Source:http://www.europarl.europa.eu/news/en/headlines/society/20181005STO15110/plastic-in-the-ocean-the-facts-effects-and-new-eu-rules

To conclude this sub-chapter, the data collection and evaluation of marine beach litter revealed that single-use plastics and fishing gear were the items most found on European beaches. It is them that are addressed in the proposed directive on the reduction of the impact of certain plastic products on the environment.

3.2.3. Products concerned and designated measures

The plastic items addressed by the legislative proposal are so-called single-use plastics (SUPs). Article 3 (2) of the designed directive provides the following definition for the term “single-use plastic product”: It “means a product that is made wholly or partly from plastic and that is not conceived, designed or placed on the market to accomplish, within its life span, multiple trips or rotations by being returned to the producer for refill or re-used for the same purpose for which it was conceived.” In short, the concerned products are plastics that were designed neither for re-use nor for cost-effective recycling but are discarded after having been used once. Of all SUP items littered into the marine environment, 86% is comprised of ten products that are the most found on European beaches. The top ten to which the European Commission is referring to, differs a bit of the lists presented above and include in order of magnitude (by sampling numbers) beverage bottles including cups and lids, cigarette butts, cotton bud sticks, packets and wrappers, sanitary items such as wet wipes and sanitary towels, plastic bags, plastic tableware including cutlery, plates, stirrers and straws, plastic cups and cup lids, balloons and balloon sticks, and food containers including fast food packaging (EC 2018b). The remaining 14% of SUP is not addressed within this legislation as it presents items minimal by count “and so in environmental damage potential” (EC 2018b, 11). Besides, to focus on ten items facilitates the communication of the chosen measures to the public, particularly when they cause the most public concern. Nevertheless, it is not possible to provide a statistical analysis of the relative harm caused by each of the top 10 SUP items individually, but an overview of their resulting types of impacts is given below (EC 2018b, 12).

Table 3.1: Assessment of the impacts on environment, economy and potentially human health of the top 10 single-use plastic items and fishing gear.
"-" represents no impact, while "+" represents a weak and "+++" a strong impact.
Source: EC 2018b, 20.

	Entanglement of marine wildlife	Ingestion by marine animal	Pollution of marine waters (chemicals release, microplastics)	Transport of invasive species (rafting)	Microbial contamination	Economic impacts on tourism	Economic impacts on fisheries	Potential human health impacts
Drinks bottles & caps	+	++	+	+++	+++	+++	+	+
Cigarette butts	-	+++	+++	+++	+++	++	++	+
Cotton buds sticks	-	+++	+	+++	+++	++	+	+
Crisp packets	+	+++	+	+++	+++	+++	++	+
Sanitary applications	+	++	++	+++	+++	+++	++	+
Plastic bags	+++	+++	+	+++	+++	+++	+++	+
Cutlery, straws & stirrers	+	+++	+	+++	+++	++	+	+
Drinks cups & lids	+	++	+	+++	+++	+++	+	+
Balloons & sticks	+	+++	+	+++	+++	+	+	+
Food containers	++	++	+	+++	+++	+++	++	+
Fishing gear	+++	++	++	+++	+++	+++	+++	+

These impacts will become more drastic as the amount of plastic marine litter is estimated to multiply. The current situation will build up to a worst-case scenario if no action is taken and no governance on plastic tried to establish. In the context of the legislative proposal, the current situation serves as "option 1" and the baseline scenario to which a set of measures to curb marine litter is compared. With public consultations, surveys, experts work, and product-by-product analyses, it was possible to link different measures to the ten individual items concerned and create a range of four "sub-options".

- Sub-option 2a is said to be relatively cheap and straightforward to implement and consists of measures to raise awareness. These include information campaigns, voluntary actions, and labelling of items like cotton bud sticks and balloons to inform consumers on the potential implications of marine litter when improperly flushed or let fly in the open air). The effectiveness of such measures is difficult to assess, but a lower impact on reducing marine litter is estimated (EC 2018a; EC 2018b, 47).
- Sub-option 2b includes the same measures as sub-option 2a but also others like a ban, extended producer responsibility (EPR), product design measures, and reduction targets. The ban would affect plastic cotton bud sticks because alternatives from wood already exist on the market. Plastic bottles are targeted with the product design measures. Costs for clean-ups would be transferred to producers and plastic items including cutlery and straws will be reduced by 30% by 2025 and 50% by 2030. Clearly, the combination of these measures leads to

a higher reduction on marine litter while at the same time, this option is more expensive and more challenging to implement as the burden for those affected increases.

- Sub-option 2c triggers a medium-high impact on reducing marine litter as it combines the measures of the second sub-option with reduction targets for wet wipes, which were not included in sub-option 2b, and bans on SUP where apparent alternatives on the market exist. Such a ban affects cutlery, straws and stirrers, and balloon sticks and results in the redundancy/needlessness of other measures addressing the same items.
- Sub-option 2d combines the measures of the preceded sub-option with additional investments in improving the wastewater infrastructure to capture wet wipes better and with the introduction of a deposit refund system for beverage containers. This scenario further includes EPR for crisp packets and wrappers, reduction targets for sanitary towels and cigarette filters and higher reduction targets for drinks cups and lids, and food containers. With these measures, the highest reduction of marine litter would be achieved, but also the costs of implementation would be the highest.

The following table is a summary of the model analysis per sub-option, showing their reduction in marine litter (these numbers need to be treated with caution because marine litter volumes are estimates), change in green-house-gas due to the reduced number of SUPs, and the corresponding costs by the end of the period which is the year 2030 (EC 2018b).

Table 3.2: Summary of the model analysis per sub-option (by the year 2030).
Source: EC 2018d, 60.

	2a	2b	2c	2d
Marine litter by count (as % of SUP Top 10)	**-16%**	**-50%**	**-56%**	**-74%**
Marine Litter, tonnes	**-2,750**	**-4,450**	**-4,850**	**-12,070**
Change in GHG, million tonnes	**-1.28**	**-2.02**	**-2.63**	**-3.97**
External Costs, € billion	**-7.1**	**-9.5**	**-11.1**	**-30.9**
Savings for consumers, € billion	**3.7**	**5.1**	**6.5**	**10.0**
Impact on producer turnover, € billion	**-1.8**	**-2.5**	**-3.2**	**-5.0**
Information campaign costs, € million	**714**	**698**	**596**	**596**
Business compliance, commercial washing & refill scheme costs, € million	**338**	**1081**	**1385**	**2099**
Waste management costs, € million	**30**	**445**	**511**	**9175**
Employment, 000 FTE	**-3.8**	**3.8**	**4.0**	**5.0**
Feasibility	**High**	**Med**	**Med**	**Low**
Ensure Internal Market	**-**	**+**	**++**	**++**

The framed numbers result from the summation of the model outputs for sub-option 2c (2030) as presented in the Impact Assessment (EC 2018d, 62) but only the figures on the banned items will be discussed in the upcoming sections of this thesis.

Based on the model analysis, it was decided that sub-option 2d will not be implemented because of the high costs that result from the needed investment in the wastewater treatment and waste management facilities in particular, and the high burden for plastics producers. In contrast, both sub-option 2a and 2b are much “cheaper” to implement but do not promote the desired shift away from SUPs as sub-option 2c does. The latter one was chosen due to its slightly higher reduction in marine litter by count, and the assumption that the internal market is ensured as fragmentation will be avoided (EC 2018b, 59; EC 2018a).

Thus, the proposed directive for single-use plastics builds upon sub-option 2c. It includes for each item specific measures, comprised and presented in the table below. If these measures are introduced, the two main impacts of the directive will be cost savings and emission mitigation (EC 2018f).

Table 3.3: Overview of the set of measures under the directive.
Source: EC 2018a-d.

	Consumption reduction	Market restriction = ban	Product design requirements	Labelling requirements	Extended producer responsibility	Separate collection objective	Awareness raising measures
Beverage containers, their caps and lids			X		X	Beverage bottles (90% collection and recycling rate)	X
Cigarette butts					X		X
Cotton bud sticks		X					
Packets and wrappers					X		X
Sanitary items (wet wipes and sanitary towels)	Wet wipes (30% by 2025, 50% by 2030)				X		X
Plastic bags					X		X
Cutlery, straws and stirrers		X					
Drinks cups	X (30% by 2025, 50% by 2030)				X		X
Balloons				X	X		X
Balloon sticks		X					
containers	X (30% by 2025, 50% by 2030)				X		X

That “Cotton bud sticks, (except for swabs intended and used for medical purposes), cutlery (forks, knives, spoons, chopsticks), plates, straws (except for straws intended and used for medical purposes), beverage stirrers, and sticks to be attached to and to support balloons, except for industrial or other professional uses and applications that are not distributed to consumers, including the mechanisms of such sticks” (EC 2018e), are prohibited to be placed on the market is due to the fact that these products belong to the category of “items for which there are available sustainable alternatives” (EC 2018a, 12). Which alternatives there are, if and under what circumstances they are more sustainable than SUP, is elaborated in chapter 3.4.

Although a ban was not enforced for other items because either there exists no alternative yet or these items are already captured by existing legislation, “measures for adoption by public authorities” including sales restrictions were considered in the Impact Assessment accompanying the proposal. These may not restrict but limit the sale of those items.

3.3. Impact and value of the legislative proposal

By 2030, which marks the end of the directive’s period, €22 billion will be saved that otherwise would have been spent due to environmental damages, and 3.4 million tonnes of CO2 equivalent will be avoided if sub-option 2c is implemented together with other ongoing already existing measures of EU legislation (EC 2018f). It is, however, not transparent how these numbers are calculated. In Table 3.2 above, it is shown that sub-option 2c itself contributes to the saving/reduction of GHG with 2.63 million tonnes but the cost savings are less clear presented.

The affected plastic items mentioned above, including cotton bud sticks and straws, will be banned from the EU market from 2021 (News EP 2018) and therefore it is of great interest to analyse what the impact of such a ban is on the plastic industry and the environment and to identify the corresponding numbers.

3.3.1. Impact of a ban on single-use plastics

According to the supplementing impact assessment of the proposal, the consumption of the top ten SUP items amounts yearly to about 4.4 million tonnes (EC 2018d, 45). Almost 10% is dropped as litter, and the amount entering the oceans from European beaches is calculated to be 15,604 tonnes. The soon-to-be-banned items hold a rather small share

of this amount. In the marine environment, 67 tonnes of cotton buds, 48 tonnes cutlery, 139 tonnes straws, 11 tonnes of stirrers were found in this sampling (EC 2018d, 45).

The amount of balloon sticks in the marine environment is not given in the corresponding document; however, if the sampling number of balloons and balloon sticks consisted only of balloon sticks, then the banned items would represent 21% of it by item count. The empirical work done on European beaches showed that a sample of 100,174 items, consisted of 13,616 cotton bud sticks, 4,769 pieces of cutlery, straws and stirrers, and 2,706 balloons and balloon sticks (EC 2018b, 11). Of all marine litter found on European beaches where 43% is taken up by ten most found SUP items, the mix of cotton bud sticks, cutlery, straws and stirrers, and balloon sticks would constitute 9% by count. In the beach count of 2016 conducted by the JRC's Technical Group of Marine Litter Activities, cotton bud sticks took up 3.82% of all marine litter items found and listed (not only including the ten most-found ones). Cutlery, including straws and stirrers, represented 1.18%, and balloons and balloon sticks 0.71%. Thus, the soon-to-be-banned items accounted for 5.71% of all marine litter in the EU (EC 2018c, 31-32).

In the Impact Assessment, the exact model outputs for sub-option 2c result in a slightly different number because balloons and balloon sticks were not especially modeled and "reductions are calculated relative to the total marine litter of these 'top ten' items" only. By 2030, the marine litter reduction of SUP by weight (or count) is -0.1% (or -0.9%) of cotton buds, -0.3% (or -0.3%) of cutlery, -1% (or -5.4%) of straws, and -0.1% (or -0.3%) of stirrers (EC 2018d, 62; Table 3.6). By count, the reduction of marine litter of banned products amounts to -6.9 % by 2030. This percentage would equal a reduction of 6,912 items flowing into the ocean (901 cotton buds, 301 pieces of cutlery, 5,409 straws, and 301 stirrers) in case it is referred to the sample of 100,174 items mentioned above.

Nevertheless, such a simple calculation cannot yield a reasonable outcome to determine the impact of the legislative proposal. It would be necessary to calculate how many cigarette filters, drinks bottles, cotton buds, crisp packets and sweet wrappers, wet wipes, sanitary towels, cutlery, straws, stirrers, drinks cups and lids, and food containers (considering corresponding measures like reduction targets and better recycling rates) would have been used by 2030, but to undertake such calculations clearly goes beyond the scope this master's thesis. In the Impact Assessment of the proposal, the model outputs are split into different figures, but underlying assumptions and numbers are not documented. It would be helpful for the reader if the Impact Assessment elaborated more on the origin of those numbers.

This is also true for the figures indicating the mitigation of GHG or change in manufacturing related land. To ban cotton buds and cutlery, straws and stirrers, is said to save 1.75 million tonnes of GHG and result in a change of 3.04 km² of manufacturing related land. Additionally, the material demand would have decreased by 286.23 kilo tons by 2030 (EC 2018d, 62). Although neither the underlying estimates of these numbers are known, an approximal estimate to yield similar outcomes is within the scope of the thesis.

Table 3.4: Model outputs (by 2030) for sub-option 2c concerning the environment.
Source: EC 2018d, 62.

	Cotton buds	Cutlery	Straws	Stirrers
Change in GHGs, million tonnes	-0.00	-0.56	-0.47	-0.72
Change in manufacturing related land use, km²	- 0.08	- 0.88	- 0.44	- 1.64
Change in material demand, kt	- 0.26	- 131.39	- 112.04	- 42.54

For instance, if there was no ban and the average person used one cotton bud per day and hence, 3,285 in the period between 2021 and 2030, the entire European Union (508 million people) would consume 1.6 trillion cotton buds by 2030. This consumption rate would demand 267,004 tonnes, or 267 kilo tons of plastic for nine years (multiplying the number of cotton buds with its weight of 0.16 grams). For one year, 29,667 tonnes of plastic would be needed for the plastic stemmed cotton buds. Nonetheless, this simple estimate is not realistic; at least it is the highest estimated value since not everyone uses one cotton bud a day. It also does not consider that there are already non-plastic stemmed cotton buds on the market. What this number still shows, is that the restriction of cotton buds does not play a significant role for the plastic industry. The plastic demand for cotton buds amounts to only 0.0046% of the entire plastic production in Europe (64.4 million tonnes), and 0.058% of the total European converter demand in 2017 (51.2 million tonnes).

In general, to assess the number of single-use items consumed in the EU28 per annum poses a real challenge. The simplest way to estimate the quantity is to use a country's statistic and scale it up to EU level by using population data. For instance, a newspaper article stated that 4.7 billion plastic straws are used in England per year and this number divided by England's population (55.6 million) and multiplied by the EU population (508 million), in total 42.9 billion plastic straws are used annually. Nonetheless, to provide more accurate figures, estimates made by Sherington et al. (2017) are used as they took into account not only the national population but also gross domestic product purchase

power parity and other statistics. For instance, the number of straws provided daily by McDonald's in the UK was used to aggregate other countries' consumption data, and so it was estimated that in total 36.5 billion plastic straws are consumed in the European Union per year (Sherington et al. 2017, 18). Multiplying this number with a weight of 0.42 grams (Borenstein 2018) result in a plastic demand of 15.33 kilo tons (kt) PP per annum. Multiplying this by nine years (period of the legislation from the implementation of the ban 2021 until the calculated model outputs for 2030) 137.97 kt would be needed or will be saved. In the model outputs for sub-option 2c, the corresponding change in material demand in kt is estimated to be 112.04 kt (EC 2018d, 62). The gap between the two estimates may be caused by the underlying assumption and simplification of the first number, that only pure PP is demanded while in the production process colorants and other additives reduce the actual amount of PP needed.

In contrast to the case of straws, specific data on coffee stirrers are not available (Sherington et al. 2017, 18). A very simple way to still estimate a figure, regardless its accuracy, would be to claim that if 139 tonnes of straws (number taken from the first paragraph of 3.1.1.) correspond to 36.5 billion, then 11 tonnes of stirrers will correspond to 2.8 billion thereby assuming one stirrer also weighs 0.42 grams. In this case, 1.18 kt of plastic would be needed annually and hence, 10.58 kt within the given period. Surprisingly, this number is much smaller than 42.54 kt as given (EC 2018d, 62), but assuming that the number of stirrers equals the number for single-use coffee cups (16bn annually, Eunomia 2017, 14), the number plastic demand, until 2030, would amount to 60.48 kt. This is much closer to what was estimated in the Impact Assessment. By assuming that just two-thirds of single-use coffee cups are given away together with a stirrer, then the plastic demand for stirrers changes to 40.31 billion in nine years, which is the closest to the given number.

Nevertheless, the number is based on arbitrary assumptions, and the reader of the Impact Assessment has no other choice than to accept the figures and numbers since data is barely detectable and the calculations behind the given numbers not presented. As already said, the conducted estimates in the scope of this master's thesis should be understood as a possible approximation to the numbers provided by the Impact Assessment and regardless the gap between the results, do the numbers still signify a positive impact on the environment. For plastics producers, it is a bit of a different story as the ban on cotton buds, cutlery, straws and stirrers, adversely affects their turnover. While the negative change in revenue of SUP is partly compensated by a positive change in the turnover of single-use non-plastics and multi-use items, the net turnover is considered to decrease.

3.3.1.1. Impact on the industry

Even though the extensive Impact Assessment of the proposal presents the quantitative/financial impacts on the industry, including producers and retailers of plastic items, numbers are still neither clear nor straightforward. For this reason, an attempt to calculate those numbers was undertaken. Corresponding numbers for the banned products are presented in Tables 3.4-3.6, and average prices for plastic products were used in order to reproduce the presented results for producer turnover.

Table 3.5: Model outputs (2030) for sub-option 2c.
Source: EC 2018d, 62.

	Cotton buds	Cutlery	Straws	Stirrers
Change in producer turnover (SUP), € million	- €29	- €2,712	- €1,944	- €2,306
Change in producer turnover (SUNP), € million	€ 29	€2,505	€718	€298
Change in producer turnover (MU), € million	€ 0.5	€2.3	€11	€1.5
Change in retailer turnover, € million	€ 0	- €409	- €2,431	- €4,021
Change in material demand, kt	- 0.26	- 131.39	- 112.04	- 42.54

First, the sum of the changes in material demand, namely 286.83 kt indicates that the plastic industry expects a rather small impact by the legislation. This change over nine years corresponds to less than 0.05% of the European plastic production in one year.

Second, online research showed that straws are made of Polypropylene, and cutlery and stirrers are made of Polystyrene. The specific type of plastic used for cotton buds is not given. Figures and numbers already mentioned above can be used to estimate the impact of the proposed ban on the industry.

By taking the statistics of the UK (Defra 2018) and by applying its consumption rate for straws to the EU level and the nine years of the proposal, 386.5 bn straws is the amount that would neither be produced nor sold any longer. If the producer could sell one straw for 1 Eurocent the lost turnover by 2030 was € 3.8. This value is double the value given in the table above and hence, estimated by the EU. Considering that the retail price for one straw is around 3 cents, the change in retailer turnover will result in €11.6bn by 2030, which is far away from the estimated number (see Table 3.5). One explanation for this gap is that the model outputs provided by the Impact Assessment included the effectiveness of other measures than in the legislative proposal as well (EC 2018f). This,

and the fact that reliable statistics are often not available, making it almost impossible to reconstruct the given numbers.

An example to illustrate how arbitrary attempts to estimate consumption rates can lead to absurd numbers is a very simplified calculation on cotton buds. Given England's consumption of cotton buds of 1.8 billion per year, 32 per capita per annum, at EU level, 16 billion cotton buds are used annually (Busby 2018). This number, for sure, is the simplest aggregation and does not include any other statistic. At the Austrian retailer dm, a pack of plastic cotton buds contains 160 pieces and costs 0.45€. Therefore, if only plastic cotton buds were sold solely at dm on the European market, then the retailer turnover would change by €45 million annually. This number does not reflect the current situation because many retailers already sell cotton buds with wooden or paper sticks (UK Defra 2018). Table 3.5 also shows that the impact on producers and retailers of cotton buds is not as tremendous.

In contrast, producers and retailers of cutlery and stirrers will suffer the most, at least regarding single-use plastics. The €2.71bn-change of producer turnover of SUP cutlery implies that for 1 Eurocent, 271.2bn pieces of cutlery would have been used in the EU in nine years. This equals to an annual consumption of 59 pieces of cutlery per person. If the demanded plastic cutlery is replaced by single-use non-plastic or multi-use cutlery and sold at a higher price, the positive producer turnover in Table 3.5 is explained. This assumption does, however, not explain the negative change in retailer turnover. Nevertheless, the same table and calculation can still be consulted to estimate possible consumption rates per person per year:

- If the change in producer turnover of cotton buds is €0.29bn, and the dm retail price is €0.0028 (production price not given), 103.5bn cotton buds are used in nine years. Divided by the nine years and 508 million people (EU), 22 cotton buds are used per person per annum.
- Forty-three straws are consumed per person per year if the producer turnover-change of €1.944 bn is divided by 0.01€ (assumed producer price) and further divided by 9 (years) and 508 (EU population).
- Given a change in producer turnover of €2.306 bn and an assumed producer price of 1 Eurocent, 50 stirrers are consumed per person per year.

Furthermore, the impact on the plastic industry itself can be calculated. Table 3.6 was consulted to calculate the individual weight of the concerned products. By considering that 371.5 million straws weigh 156.03 tonnes (one straw weighs 0.42) and that this represents 1% of the marine litter reduction, it was able to use this relation to assess the

marine litter reduction of SUP by weight for the rest of the banned items. Assuming that 0.3% of marine littered cutlery amounts to 46.8 tonnes, one piece of cutlery weighs 2.6 grams, and this fits the norm. Based on this relation, it can be assessed that one cotton bud weighs 0.26 grams and one plastic stirrer weighs 0.79 grams.

For instance, one piece of cutlery weighs about 2.6 grams. Given that 59 pieces are consumed per person per year and hence, 29.97 billion in the EU, 77,927 tonnes of plastic are needed to satisfy the annual demand. The same calculation yields an annual European-wide consumption rate of 25.4bn of stirrers, and this number multiplied by 0.79grams results in 20,066 tonnes of plastic. Since both product classes are made of Polystyrene, which costs approximately 1250€/ton on the European market (Plastics Insight 2019), the plastic industry loses €122.5 million in one year and thus, €1.1bn in the years between 2021 and 2030. This is, although it is the sum of changes in turnover of both, producers of cutlery and stirrers, only half of the individual numbers given for each product.

Therefore, it can be claimed that the ban will not have a strong negative impact on the plastics industry, given that the plastic producer or retailer does not only produce and sell the concerned products.

3.3.1.2. Impact on the environment

What is even harder to assess, is the (positive) impact on the environment when cotton buds, cutlery, stirrers, straws, and balloon sticks are phased out until 2030. Although a "ban would induce a switch in consumption from single-use plastics either to multi-use alternatives or to single-use non-plastic alternatives" (EC 2018d, 72), it only theoretically provides an immediate solution to the problem of marine litter.

Table 3.6: Reduction in marine plastics by 2030.
*%reductions are calculated relative to the total marine litter of these 'top ten' items only.
Source:EC 2018d, 62.

	Cotton buds	Cutlery	Straws	Stirrers
Reduction in marine plastics, kt	-0.01	-0.05	-0.15	-0.01
Reduction in marine plastics, million items	-59.66	-17.94	-371.5	-19.87
Marine litter reduction - % of SUP by weight*	-0.1%	-0.3%	-1.0%	-0.1%
Marine litter reduction - % of SUP by count*	-0.9%	-0.3%	-5.4%	-0.3%

The model outputs for the sub-option 2c present a positive impact as a reduction in marine plastics. Banning cotton buds and cutlery, straws, and stirrers would reduce marine plastics by 468.97 million items by 2030. This equals less than 60 tonnes per year. In sum, by banning cotton buds, cutlery, straws, and stirrers, a reduction in marine plastic of 220 tonnes could be achieved. What may sound a lot is only a small fraction of the amount of plastic that flows into the oceans every year. In 2015, 9 million tonnes of mismanaged plastic waste had been washed into the marine environment, which equals to one garbage truck full of plastic released into ocean every (Jambeck et al. 2015; Munir 2018).

From a global perspective, a 220 tonnes-reduction that could be achieved not in one year but within nine years does not tremendously alter the current situation regarding plastic pollution. It can be even claimed that the impacts of the ban on the environment are neglectable because it only concerns products that take up a rather small share of all SUP ending up in the marine environment.

Despite existing tables with figures and numbers, the real impact on the environment, in particular the marine environment can hardly be assessed. The presented numbers do not include transported marine litter from somewhere else than Europe, and it is indispensable to establish efficient monitoring in order to control and oversee the taken measures and the progress.

Another fact that cannot be ignored is that bans can also have unintended consequences if poorly implemented and enforced by the government, or when promoted alternatives cause even more harm to the environment. For this reason, the next two sub-chapters

evaluate the environmental performance of alternative products and present the case of the ban on lightweight plastic carrier bags.

3.3.2. Overall added value of the proposed EU action

All measures of the legislative proposal put in place can trigger a reduction of 4,850 tonnes in marine litter by 2030, however, the added value of the proposed EU action to existing international efforts and legislation to combat marine litter cannot be judged. Every aspect of it, its impact on the environment and industry, its promotion of alternatives, lessons learned from other legislation, and the challenges regarding its implementation and "running phase" as well as the international significance must be considered. Still, an attempt to estimate the value of the legislative proposal and thereby answer the second research question is made in the last chapter of this thesis.

3.4. Life Cycle Analysis

3.4.1. Alternative Products

The European Commission proposed a ban on specific single-use plastic items because there are 'available sustainable alternatives' for them (EC 2018a, 12), on which the accompanying impact assessment only shortly comments. The impact, which alternatives could possibly have on the environment, is not elaborated, and it seems as if everything made of a material other than plastic is accepted without question. Some alternatives can even put more pressure on resources or cause a higher release of CO_2 during production and transport. Only because an item is made of renewable resources and labelled as biodegradable and compostable does not imply that it cannot cause harm to the environment.

Moreover, the practice of greenwashing is likely to appear more frequently - a marketing strategy to mislead consumers about how sustainable a product truly is. (Gibbens 2018). For instance, 'bio-plastics' made from biological material, like extracted sugar from plants, instead of petroleum, is advertised as biodegradable. It should break down to water, carbon dioxide, and methane within a reasonable timeframe when released into the environment, but this process happens only under optimal circumstances. In addition to that, additives within bio-products would then also be released and hence, contaminate the surrounding. Often, bio-plastic functions just like petroleum-based plastic and does not biodegrade but fragment into smaller pieces, which adds to the problem of microplastic pollution (Huffadin 2018; Gibbens 2018).

An experiment, which was undertaken by Nazareth et al. (2019), actually revealed that only one-third of the tested commercial products that were labelled as biodegradable showed changes of their surface after a 180-day exposure to seawater. This change in surface structure suggests biodegradability. Although someone could claim that this experiment was carried out in North America and hence, do not imply to the situation of biodegradable products in Europe because standards here are much more "robust" (Huffadin 2018), it still serves as good example and warning that "green" alternatives should also be consumed with caution.

For this reason, there is an urgent need to conduct a life-cycle analysis of the alternatives that are promoted to substitute the banned plastic products. Within the scope of this master's thesis, inexhaustive information on the environmental performances is presented in the upcoming sub-chapters.

3.4.1.1. Plastic-stemmed cotton buds

The plastic stem of cotton buds can and is already often made of either wood or paper. Especially on the US market, such substitutes are the norm. Another way to prevent mindless action like flushing cotton buds down the toilet is to use reusable ones which currently are pure plastic and without the cotton at the ends of the stem, they can be cleaned and reused multiple times. LastSwab and Eeears are two companies that invented two different types of reusable cotton buds.

Figure 3.5: LastSwab's reusable cottong buds to combat marine litter. Source: https://www.lastswab.com/

Figure 3.6: Reusable and plastic free cotton bud. Source: https://www.eeearsofficial.com/

LastSwab claims that its silicon cotton buds are the best alternatives to standard cotton buds including paper, wood, and hemp stemmed cotton buds due to the high CO_2 emission from the production and transport of the single-use pendants. It may be claimed that this argument can be neglected given the small weight of the product. In addition to that, the packaging of LastSwab is biodegradable and packed in cardboard (LastSwab on Kickstarter 2019). What sounds persuasive must be treated with caution because the

word ‘biodegradable’ is often misused and misunderstood, as already discussed above. Furthermore, there is no data on how much CO_2 is released during their cotton buds’ production and shipping, but those possible undesirable numbers may be compensated by the high number of uses for which they were designed.

Those two facts generally apply to data on cotton buds. There is no specific LCA on cotton buds, neither on plastic nor on wood, but in general, it is understood that everything that is used more than once is better than its single-use counterpart (Waste Pyramid).

3.4.1.2. Plastic cutlery (and plates)

The waste hierarchy or pyramid in order from the preferable option to the least preferable option, prevention, reduction, reuse, recycling, (energy) recovery, disposal should be considered as a guideline for every product, including plastic cutlery and plates. In the impact assessment of the EC (2018d) metal cutlery is claimed to be the clear alternative to single-use items as it is washable and reusable. This could be fully implemented in eat-in sales but to use reusable cutlery for take-out sales would require consumers to carry and bring their own cutlery, which adversely affects convenience. Although it may be a bit straightforward and thought-provoking, the text of a picture included in an assessment of single-use disposable plastic cutlery is worth to be shared. “It’s pretty amazing that our society has reached a point where the effort necessary to extract oil from the ground, ship it to a refinery, turn it into plastic, shape it appropriately, truck it to a store, buy it, and bring it home is considered to be less effort than what it takes to just wash the spoon when you’re done with it” (Grarian 2012).

To substitute single-use plastic cutlery, wood alternatives could be used (EC 2018d, 29). At this point, it would be interesting and necessary to estimate how much wood would be needed to replace the demanded amount of plastic cutlery, and what the downsides of the use of bio-based materials are. A common argument against the use of bio-based material is the increased use in land and resources to grow those materials. In a life cycle assessment study by Fieschi and Pretato (2018) the environmental performances of biodegradable and compostable single-use tableware (cutlery and plates) and traditional fossil-based plastic tableware used for catering in quick service restaurants were assessed and compared. Although the authors set the assessment in concrete context with food service and waste management, the obtained results are universal applicable/useful. To evaluate the environmental performances, they followed the fifteen impact categories of the Product Environmental Footprint methodology of the European

Commission. The results showed that compostable single-use tableware had a lower impact in seven categories including climate change, human toxicity – non cancer effects and cancer effects, marine eutrophication, freshwater ecotoxicity, water resource depletion and mineral, fossil& renewable resource depletion. In the remaining eight categories which are ozone depletion, particulate matter, ionizing radiation – human health effects, photochemical ozone formation, acidification, eutrophication – terrestrial and fresh water, and land use, were the impacts of compostable tableware than those of its counterpart which is mainly due to the bio-based feedstock production (e.g. corn) (Fieschi and Pretato 2018).

Despite that “score,” the authors concluded that compostable and biodegradable tableware is the preferred option because the lower impacts were “on the most relevant and recognised environmental issues, such as climate change, water scarcity, and resource depletion” (Fieschi and Pretato 2018).

Notwithstanding, it has to be mentioned that this conclusion is in respect to food waste management where organic recycling is the preferred option while compost is generated, and this implies a good waste management infrastructure and good recycling possibilities. Only then does such tableware produce a smaller impact on climate change, and GHG emission released during production can be resaved because of the compost. A general conclusion is given by the article as well by stating that for effective comparison and decision-making purposes, priority is usually given to those environmental indicators which appeal to the general public and are therefore also more scientifically robust and considered as pressing (Fieschie and Pretato 2018).

This general comment seems to apply to the proposed ban as well. Yet, there is no formal LCA analysis of wooden cutlery or cutlery made from bamboos, made out of potato starch or other biomass. Every new substitute should undergo an environmental assessment before it is produced on the large-scale and sold on the market because it may not become plastic marine litter but has other overlooked consequences. Examples would be the higher weight, the depletion of other resources like wood or overuse of land when the product is not made of residues.

The colourful picture below illustrates the different stages of the life of a (plastic) fork.

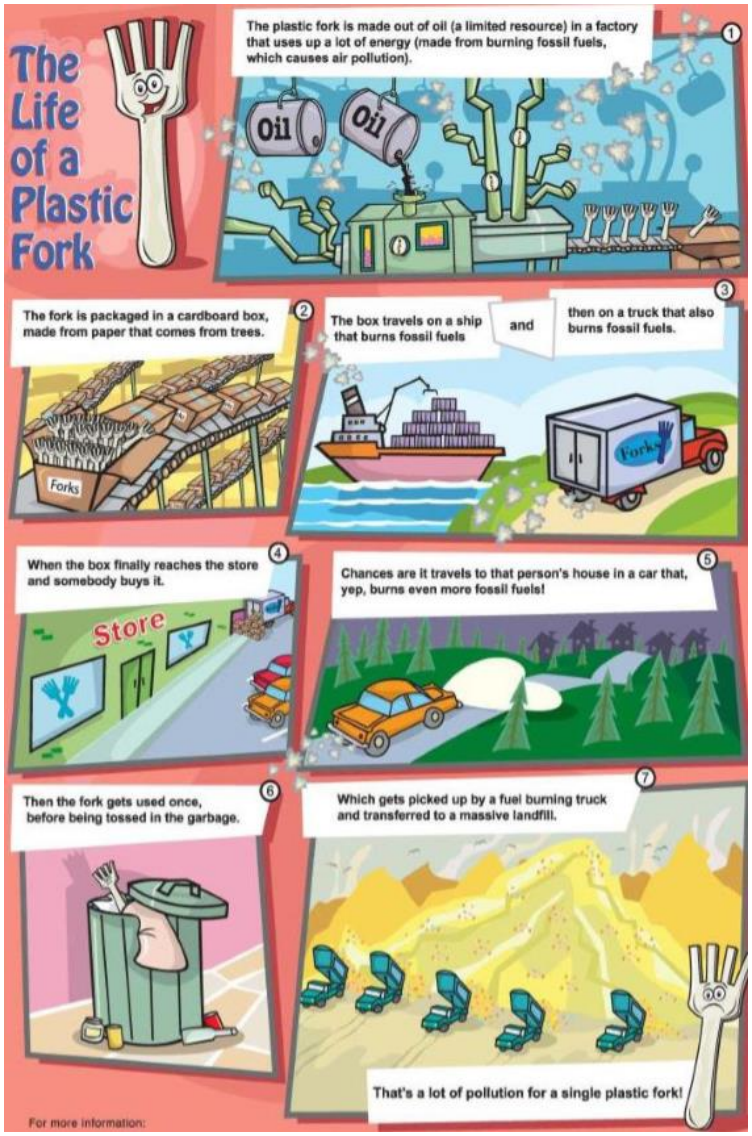

Figure 3.7: Illustration of the life-cycle of a plastic fork.
Source: https://commons.pratt.edu/sesresearch/wp-content/uploads/sites/157/2017/12/Aswitha_Kadekar-Capstone_Presentation.pdf

Generally speaking, the three main categories that are concerned during all stages are: the acquisition of the raw materials; manufacturing, processing, and formulation; distribution and transportation; use, reuse, and maintenance; recycling; and waste management are energy, use of materials, and waste (Mujushi et al. 2018).

3.4.1.3. Plastic straws and stirrers

The primary plastic in plastic straws is polypropylene, which is made from gas and thus, fossil fuels. Together with electricity, they serve as the primary energy source for the

extraction and refinery of the material. This material is then equipped with plasticizers (which make plastic flexible) and colourants. The production uses and also wastes much energy which puts immense pressure on the environment and hence, has a negative impact. In the next stage of the life cycle of a plastic straw is packaging which is either made of plastic, cardboard, or paper in which the plastic product is transported, often by means using fossil fuels. The use of straws by the customer requires no energy. At the end of their life cycle, they are disposed and land in nature or landfill and energy would still be required for collection and sorting (Downer and Cogdell 2018).

In the paper of Downer and Cogdell (2018), the environmental impact of the life cycle of plastic straws is expressed in terms of CO_2 equivalent ($kgCO_2e$) emission per kg of product. 1.6 kg CO_2e/kg product is emitted during manufacturing and transport; 3.245 are released when landfilled and 2.449 when incinerated. “In the end of the life cycle of the plastic straw there is over a 4:1 ratio in kg of emission to kg of product which doesn’t include the harsher chemicals that are emitted when incinerated or the landfill space that is taken up on top of this emission value” (Downer and Cogdell 2018). Compared to paper straws, plastic straws are said to require more energy for processing and extraction because the paper industry would need only one-third of the required energy with its raw material, wood, however the maintenance of the land demands (energy) resources. With this arises one question. What would be the impact if not only the packaging is paper, but straws were also made of it? There are some benefits of using paper straws. For instance, paper straws would break down in the marine environment within a couple of days or last up to six months depending on how they were processed, which is still much less than many years that plastics need to decompose. Paper straws also require a shorter time (2-6 weeks) than the soon-to-be-banned plastic straws (up to 200 years) to decompose in a landfill (Koonin 2018).

The best alternatives to both plastic and paper straws, however, are still straws that are designed for multiple usages. Stainless steel straws or glass straws may require much more energy to be produced and washed for reuse, but they can avoid much waste. Still, one glass straw should be used 100 times to balance the environmental impact caused during its life cycle.

Another possible alternative would be to use edible straws provided by companies like the Germany-based start-up Wisefood. The edible straws consist of wheat and residues from apple juice production in Germany, but there is no data on the environmental impact online available.

In addition to the already mentioned alternatives, there also exist bioplastic straws that are often praised as being eco-friendlier, but there exists evidence that they have a higher carbon footprint in all production steps than plastic (polypropylene) straws (Boonniteewanich et al. 2014). Overall, the best way to cope with the ban on plastic straws or to avoid using them and single-use products is to use no straw at all. In contrast, stirrers themselves are hard to avoid completely when the hot beverage is bought to-go, and therefore, stirrers made of wood are most likely to substitute plastic stirrers (EC 2018d, 29).

3.4.1.4. Plastic balloon sticks

In contrast to the wide availability of alternatives for single-use plastic cutlery or straw, alternatives for plastic balloon sticks are not even mentioned in the impact assessment (EC 2018d, 29). It is only mentioned that the sales restriction/ban for sticks and balloons, is in so far feasible as the licensing of mass releases at events can be limited, and "if public authorities purchase balloon sticks, they could seek to procure alternatives to SUPs" (EC 2018d, 42). Still, not a multi-use alternative but an alternative for plastic balloon sticks could be a cardboard balloon "holder" as shown in the pictures below.

Figure 3.8: "Biodegradable, recyclable, and sustainable" balloon sticks.
Source: BalloonGrip™ (https://www.balloongrip.co.uk/)

Figure 3.9: ‘Eco-friendly’ balloon sticks by Ecosticks ®. Source: https://www.bwstore.eu/shop2/en/astina-ecologica-ecostick174----50.html?chapter=0

To conclude this chapter, it can be claimed that non-plastic alternatives may be better in terms of marine plastic pollution but yet, attention should be paid to the impact on the environment and resources that alternatives could possibly have. At all time, the ban on one material implies an increase in the use of another material and only because future plastic products will be made of paper, wood, or other material, as long as the alternatives are designed for single use only, they will not cure the littering problem, and neither does a ban.

3.5. Experience from other plastic bans: ban on plastic carrier bag

Some claim that product bans are “typically adopted by governments, where they are unable to improve waste collection services and where they have little control over the design of products in their market” and that this form of response to (environmental) issues has started with single-use plastic carrier bags (Godfrey 2018). For this reason, it is of great value to review the ban on plastic bags as similar future legislations, such as the proposed EU-ban, can benefit from lessons already learned; even if the ban on plastic bags constitutes a tax or levy.

Lessons regarding the implementation and success of a ban on plastic lightweight carrier bags have been made across the whole globe since the early 2000s. Today, more than 50 countries have implemented such a ban, some with more success than others.

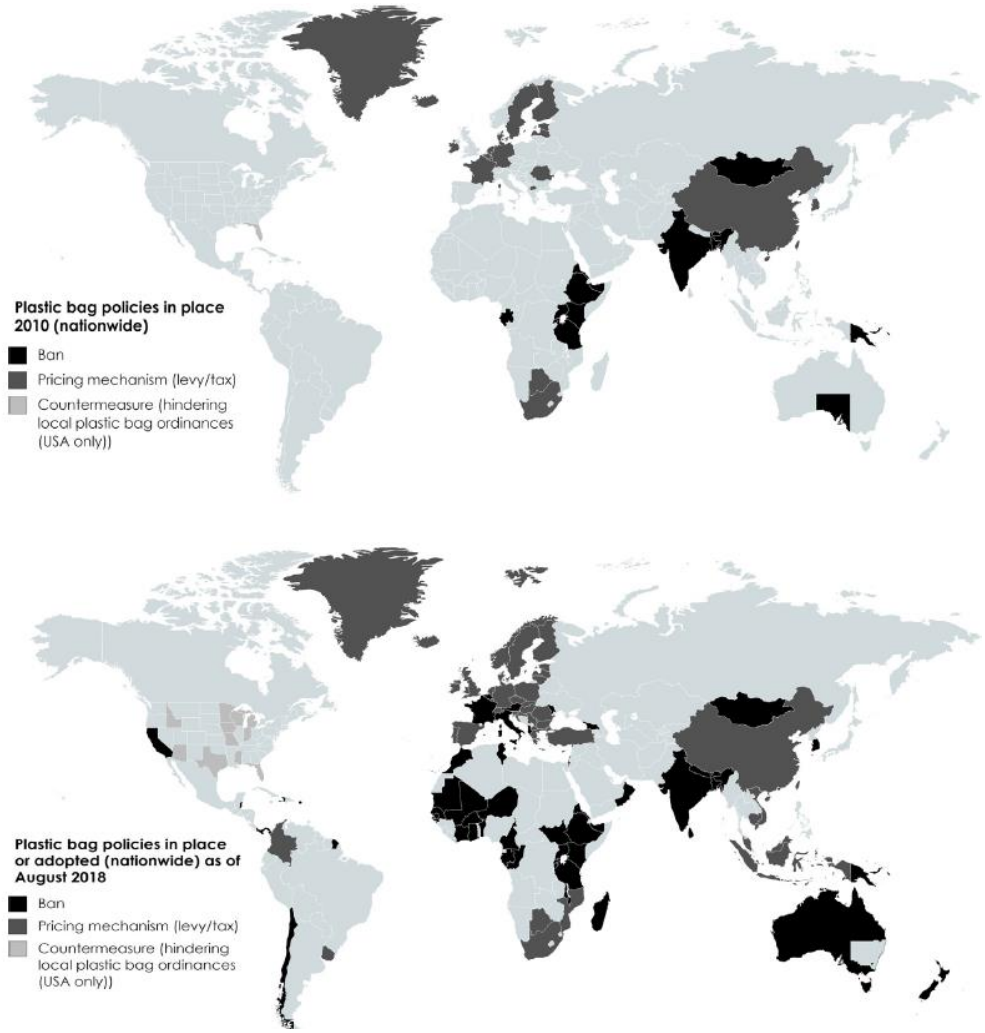

Figure 3.10. Expansion of plastic carrier bag governmental initiatives from 2010 to August 2018. The number of public plastic bag policies has more than tripled since 2010.
Source: Nielsen et al. 2019.

The existing literature often refers to Ireland and Rwanda because the former set an example for a successful implementation while the later illustrates that bans can have significant unintended consequences.

Ireland has set the benchmark for plastic carrier bag levies since the government imposed a 15-cent plastic bag levy at supermarket checkouts in 2002. This action resulted in a 90% decrease in plastic bag consumption, from estimated 328 bags to 21 bags to 14 bags per capita in 2014 (Dauvergne 2018; Schnurr et al. 2018; Xanthos and Walker 2017). During these years, the levy was twice increased, once to 22 cents in 2007 and then again to 44 cents in 2009 due to a temporary increase in per capita bag

use. Another essential detail to mention is that the revenues resulting from levy were contributed to an Environment Fund, which was used to invest in environmental programmes (Xanthos and Walker 2017).

Although the consumption rate dropped, this does not automatically imply a reduction in litter and research related to environmental outcomes is still lacking (Schnurr et al. 2018). In addition to that, it seems that this “ban” but rather a tax on plastic bags delivers only short-term results, “partly because the attention of plastic bag policies seems to decrease over time, and policy evaluations are seldom made in a structured fashion” (Nielsen et al. 2019). This is a remarkable statement and sheds light on the importance of structured implementation and long-term monitoring.

In contrast, a strict ban combined with forceful sanctions as it was implemented in Rwanda can impinge positive results. In 2008, Rwanda started to interdict the use of plastic bags, but because they were still smuggled into the country, the government introduced a $150 fine for carrying a plastic carrier bag and store owners still selling plastic bags faced up to one year in prison (Nielsen et al. 2019). The environment also had to pay the price because the smuggled plastic bags ended up with no end-of-life solution because the ban made such management unnecessary. Besides, “product bans should also be weighed up against the potential risks to food and water security, an issue particularly relevant in developing countries where safe, potable, municipal water supplies are often lacking” (Godfrey 2018) and the monetary resources to implement a ban should better be used for waste management improvement. A ban does not address the root causes of single-use plastic and littering.

In case a ban remains the favoured option, its scope should clearly and thoroughly be defined. This is another important lesson that had to be learned. Since lightweight plastic carrier bags with a thickness between 15 to 50 µm are addressed, companies began to produce thicker ones and therefore emitting more GHG. An additional increase in GHG is caused when paper bags are fully replacing plastic bags because it is claimed that their production require 40% more energy (Schnurr et al. 2018).

Nevertheless, the ban on single-use plastic bags encouraged costumers to switch to reusable bags and helped to raise awareness about plastic (marine) litter. On the one hand, the phasing out plastic carrier bags is one of the two most employed examples (the other one is the ban on microbeads) to illustrate strong governance and policies on the reduction of plastic marine pollution from single-use plastics. On the other hand, there is a big discussion on whether a ban (on plastic bags) is only a symbolic undertaking by policymakers to avoid “having to consider some of the more profound, but less palatable

changes that a substantive move towards a more sustainable plastic system would entail" (Nielsen et al. 2019).

4. Discussion of findings

4.1. Challenges of Implementation

Regardless of the discussion on whether the proposed ban on some single-use plastic is a symbolic undertaking or can curb marine litter, its implementation will face several challenges. Resistance from companies producing the concerned plastic products and from the plastics industry itself can cause fragmentation of governance or delay the ban's implementation. There are also movements such as the anti-anti-straw that oppose the new legislation for various reasons.

Furthermore, the efforts of the European Member States in terms of implementation, enforcement, and monitoring will decide upon the success of the new legislation. It is necessary that data is shared between countries and citizens are included (e.g., citizen science).

4.1.1. Stakeholders

In the reviewed literature, a lot of different "stakeholders" or parties affected by the legislative proposal were mentioned. In many jurisdictions, it is the plastic industry that has the most weighty leverage to successfully prevent, delay, or reserve restrictions on, for instance, the plastic bag consumption. This is done by challenging narratives of critics, questioning the science behind data on plastic pollution and environmental impacts as well as the value of recycling, and by emphasising that consumers have the "right" to choose the type of product (Dauvergne 2018). In a recent documentary on television, it was reported that companies including Coca Cola follow strategies explicitly designed to halt EU legislation making use of lobbyism (ZDFinfo Doku 2019). Retailers oppose a ban because it changes buying habits (Schnurr et al. 2018). While most of the industry-backed counterflows are profit-oriented, the voice of European small and medium enterprises that rely on the revenue of specific goods should not be ignored.

About 45 million people are employed by the plastics industry, which has a turnover of 350 billion (including plastic converters and technology providers) (EC 2018c, 52). In general, reduction measures and bans as proposed by the EU can threaten business, those that are not willing or unable to diversify into alternative materials (Godfrey 2018).

However, in case the affected enterprises are not specialised in producing only the concerned products, the impact of the ban is limited. In addition to that, the EU has the responsibility to not obey to the industry's will and to protect and encourage business as well as to facilitate a smooth transition to a sustainable (circular) economy (Godfrey 2018).

Another challenge can arise from the movement "anti-anti-straw" that opposes the ban (Schnurr et al. 2018). People of this movement claim that a ban on straws would impinge on the quality of life of people with disabilities, but this may only be partly true as "straws intended and used for medical purposes" are excluded from the ban (EC 2018f). It would be discrimination if this did not imply that disabled people can use straws, but principally straws made of other materials than plastic might not limit people with disabilities. The movement further argues that plastic straws have a relatively low perceived impact on the marine environment but exact numbers on that are provided in the previous chapter, and in addition to that, straws are perceived as "gateway plastic." In case it is curbed, it helps to trigger a behavioural change of consumers and retailers alike (Schnurr et al. 2018; Xanthos and Walker 2018).

A lot of NGOs and the United Nations advocate the ban, which is why their position is not considered as a challenge and do not pose a threat to the implementation of the legislative proposal.

4.2. Measures

The legal instrument chosen for the proposal by the EU is a directive. This allows the necessary product harmonization at the EU level to avoid market fragmentation while it leaves "some flexibility to Member States to choose the most appropriate legal, administrative and economic instruments to implement the defined objectives and measures" (EC 2018a, 7). Member states have already acted and taken measures to combat plastic pollution.

A more general inspiration for measures and civil empowerment is provided by the #BeatPlasticPollution campaign of the UNEP. Documents referring to this campaign provide guidance for governments for actions like improvements of waste management systems; promotion of eco-friendly alternatives; social awareness and public pressure; voluntary reduction strategies and agreements. The individual is also encouraged to act (UNEP n.d.).

4.3. Monitoring

Research and examples, including the plastic bag ban and EU action, show that the willingness to tackle, reduce or even stop plastic marine litter exists and yet, the amount of plastic flowing into the ocean each year is “on track to double from 2010 to 2025” (Jambeck et al. 2015). It could be claimed that despite the high number of measures in place, they are not enough, at least they are not sufficiently monitored. An ambitious undertaking will be fruitless if measures and goals are not monitored at different levels. At one level, the EU proposal should include a monitoring system that oversees the implementation of the legislative proposal, while at another level, the beaches and the marine litter itself are monitored. At both levels, different challenges will arise. For instance, even if the Member States carefully implemented measures are, they could fail to reach a significant reduction of marine litter. This could be explained by the fact that the problem of plastic pollution in the ocean is transboundary and hence, plastic products that are banned in the EU could still be found on European beaches because of ocean currents that transport the waste from one place to another. Also, it is very challenging to assess the origin of a product because bar codes and labels on the littered items are often lost or become illegible (EC 2018d, 40). Beach counts will remain the “main indicator for progress towards meeting the objectives set for this policy initiative” (EC 2018b, 74). However, the allocation of the cost of monitoring is not specifically mentioned in the accompanying Impact Assessment. It only mentions that the Extend Producer Responsibility of products such as cigarette filters and drink bottles “will contribute to the cost of prevention and cleaning up of litter” from these products (EC 2018d, 72). In addition to that, different methods of data collection and monitoring have to be standardized and made public so that all Member States can profit from them. This would also allow the Identification of strategies and weakness for effective education and awareness of the impacts of plastic pollution (Schnurr et al. 2018).

Furthermore, a broader implementation and use of citizen science can help to monitor marine litter. The Marine Litter Watch, which was designed by the European Environment Agency in order to support data collection, encourages citizens to report on the litter that they found on beaches and coasts. This can be easily done via an installed app on their mobile phones (EEA 2015). How much this will contribute to raising awareness is a big question.

In general, marine litter needs a global treatment and the conducted research shows that there remains a lack of global standards for national monitoring and reporting, “as well as a lack of global industry standards for environmental controls”. Also, “liability and compensation for damage to the marine environment from accidental or intentional

discharge of solid material in the sea is not covered by any international instrument" (Assessment by the United Nation Environmental program cited in EC 2018c, 88). Therefore, the EU could use the implementation of the proposal not only "to trigger other countries to act" but also to promote a new, global way of monitoring marine litter.

5. Conclusion and Outlook

To conclude the answer to the first research question "*What is the impact a ban on single-use plastics would have on the plastics industry and the environment?*" it can be said that a reduction of 220 tonnes in marine litter from single-use plastic by 2030 constitutes a minimal impact on the environment. Despite the given number that can be monitored by beach counts, the actual impact on the environment is almost impossible to assess. The reduction of 220 tonnes in marine litter does not imply or equal a reduction in the number of entanglements and ingestions of plastic debris by marine species. It also does not say if biodiversity loss can be halted by to some extent. In addition to that, the ban can cause unintended consequences and thereby harm the environment. The alternative products that will replace the single-use plastic products have to be analysed throughout their lifecycle, and the results of such analysis must be made transparent and public. Besides, alternatives that are designed for multi-use should be advertised because they have the least environmental impact.

Moreover, lessons learned from the ban on plastic bags should be considered for monitoring the implementation and compliance of measures. The same example further showed that a ban alone is not the solution to the problem of plastic pollution but should be combined with other efforts. Governments should combine different measures that not only restrict the use of a specific product but also trigger a change in behaviour. Overall, the best solution to curb marine litter would be the improvement of waste collection and waste management facilities. It would be of great interest to calculate and assess to what extent waste management could be improved if the same amount of money that would be used for the implementation of a ban was spent.

Furthermore, the plastic industry is not strongly affected by the ban because the concerned products take up only a small share in the overall plastic production. Therefore, it can be said that the resistance to implementing the ban is limited.

The same resistance is expected to be much stronger when other measures of the legislation are considered. For instance, the higher collection rate and extended producer responsibility will be challenged by numerous lobbyists in the EU because both measures will reduce the profit of big companies. Stakeholders and parties affected by the legislation can strongly influence the value of the legislation, expressed in terms of its efficiency.

Concerning the second research question, "*What is the overall added value of the proposed EU action?"* an answer to it is much more challenging to find. Although the EU

has the ability “to lead the way on tackling plastic marine litter in the European Seas,” results at international levels are much harder to achieve (EC 2018a, 11). In the proposal (EC 2018a, 11) it is claimed that “by taking action the EU will trigger other countries to act, leading to a global reduction of marine litter in European Seas and beyond.” If this ambition was fruitful, the contribution of the EU to the global fight against plastic pollution in the oceans would be enormous and so would be the “overall added value” of the proposed EU action. Regarding the assessment done within this master’s thesis, the overall added value would not be the reduction in marine litter, which results from the ban, but the increased awareness. In general, even if the EU legislation enters into force (will be decided at the end of 2019) but delivers not the desired outcomes, people will become more aware of the problem and this may in turn lead also to a decline in plastic marine pollution.

Nevertheless, in the legislative proposal, waste collection and management is hardly mentioned, although it is essential in order to not only scratch on the surface of but to try to cure the problem.

*“*The general consensus of ocean governance scholarship is that current international instruments, state policies, nonstate rules, and consumer norms are simply not strong enough, nor comprehensive enough, to protect and conserve marine ecologies at a global scale” (Dauvergne 2018).

Therefore, the directive proposed by the EU is needed to scale up efforts to combat marine litter and hopefully, after the implementation of the proposed measures, succeeding research can alter that statement and inform about an improvement of the current situation.

The Council of the EU finally adopted the proposed legislation on May 21, 2019. 20 days after the new directive was published in the Official Journal of the European Union, the Member States will have two years to transpose it into their national law (EC 2018h).

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