

Paper versus Plastic:

Choosing Sustainable
Materials



Climate Action

CONSULTANCY

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Introduction

Single-use plastic products such as checkout bags, disposable cutlery, straws, and stir sticks have recently become one of the primary targets for managing waste and protecting the environment. Over 35 countries have partially or completely banning their use.¹ Single-use paper products have rapidly replaced the banned plastic products, and corporations such as Starbucks and American Airlines have willingly replaced their plastic straws with the paper variety.² However, the reason for this switch to paper may be unclear to some and many people have questioned if there is any significant difference. The aim of this report is to provide a general overview of the climatic and environmental impacts of paper and plastic single-use products with the intention of helping small businesses make informed decisions.

Prior to discussing the benefits and drawbacks of paper and plastic products there are several key terms that will be referred to throughout this report that are important to understand. **Macroplastics** refers to any plastic product 5-50 cm in size and includes items such as plastic bottles, checkout bags, and straws. **Microplastics**

refers to any plastic product that is 0.05-0.5 cm in size. These microplastics can be further categorized into **primary microplastics** and **secondary microplastics**. Primary microplastics are plastic particles that are small to begin with, such as exfoliating beads in some cosmetic products or hand sanitizers. Secondary microplastics are small plastic particles that form when a macroplastic breaks down in the environment. This report will focus primarily on secondary microplastics and their source macroplastics.



Figure 1: Microplastics of varying size and colour obtained from aquatic sediments.³

It is also important to understand the term **bioaccumulation**, which refers to the accumulation of toxic substances in a food chain. Throughout this report the **carbon footprint** of products will also be discussed, representing the total amount of carbon

containing pollutants released into the environment for the production of that product. Additionally, the **carbon flux** will also be discussed, which is simply the flow of carbon in and out of the various reservoirs in the carbon cycle.

Carbon Footprint

One metric that is commonly used to compare the climatic impact of products is their initial carbon footprint. This measure includes the refinement of raw materials needed for the product, the manufacturing of the product, and its transportation around the world. Plastic products, usually made of high- or low-density polyethylene (HDPE, LDPE), are manufactured from petroleum in a complex industrial process. Paper bags are manufactured much like other paper products, where trees are cut down, turned into pulp, and then processed into the desired paper product. Both processes emit pollutants into the atmosphere, but plastic production is more environmentally friendly, emitting 6 kg of carbon dioxide (CO₂) into the atmosphere per kilogram produced.⁴⁻⁶ Estimates for paper production CO₂ emissions range from 1.2-3 times that of plastic.^{4,5,7} Additionally, paper products

generally weigh more than their plastic counterparts, thereby requiring more fuel for transportation.⁶ It should also be noted that paper production uses considerably more freshwater than plastic production.⁷

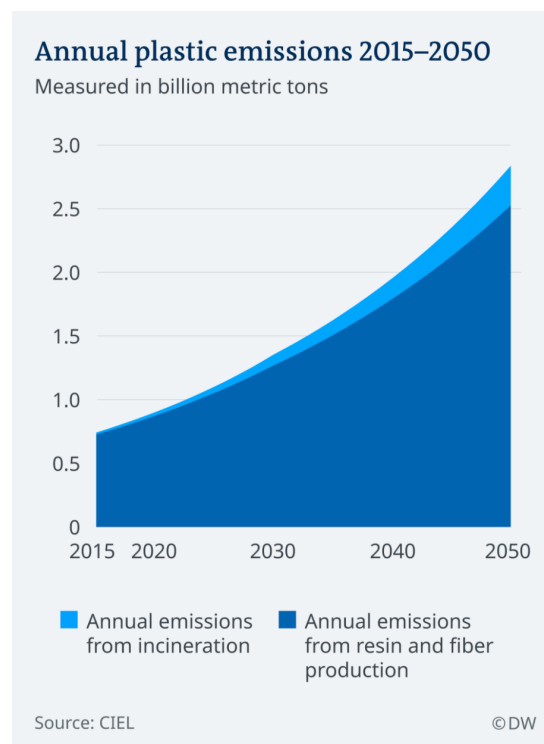


Figure 2: Projected carbon dioxide emissions from plastics from 2015-2050.⁸

Although the initial carbon footprint of products is important to consider, it does not give an accurate picture of the total footprint of the product throughout its entire life cycle. Simply stated, how the product is reused and disposed of greatly impacts its effect on the climate and environment.

Studies that examine the impact of products from manufacture to decomposition, usually referred to as a life cycle assessment (LCA), provide a more complete picture of how certain products contribute to climate change and impact the environment. One of the primary concerns in the life cycle of plastics is the formation of secondary microplastics.⁹ These small plastic particles have a significant impact on the selective bioaccumulation of toxic substances in marine species and have also been linked to a decrease in carbon flux into the deep ocean.⁹⁻¹¹ These results are concerning for several reasons: 1) the bioaccumulation of toxic substances in marine animals such as fish could have an impact on human health if the concentrations reach high enough levels;³ 2) the deep ocean is the largest carbon sink on the planet, so decreased carbon flux into the deep ocean could result in increased atmospheric CO₂ levels;^{10,11} and 3) the amount of plastic in the ocean is increasing.^{12,13} Paper products do not have these concerns as they naturally break down in the environment. An alternative method of disposal is combustion. The burning of both paper and plastic releases greenhouse

gases, however, the emissions of plastic combustion are significantly higher.¹⁴

Financial Considerations

So far the climatic and environmental impacts of paper and plastic products have been compared, with an emphasis on the issue of secondary microplastic formation. This information is meant to assist business owners in making an informed decision if they are unsure whether to switch or maintain their current practices. Therefore, it is also critical to consider the cost of plastic versus paper products as well as future government policy. As such, the cost of paper bags and plastic bags are compared here to showcase what businesses might expect to see if they switched from plastic to paper.

Prices for similarly sized medium plastic and paper bags were obtained from the online distributor Uline.^{15,16} Plastic bags were priced at \$55 USD per 1000 bags and paper bags were priced at \$288 USD per 1000 bags (\$72 x 4 cartons of 250 bags). As seen, paper bags can be over 5x as expensive to purchase compared to plastic bags. If this trend also holds for disposable utensils, straws, and other single-use

products, costs may accumulate very quickly for businesses. However, the Government of Canada has made a commitment to ban all single-use plastic products by 2030 and will begin the process of the ban after regulations are finalized at the end of 2021.¹ In fact, the government has already announced that an incentive to transition away from plastic food service ware may be coming in the near future.¹⁷ Business owners should be vigilant in keeping up to date with potential incentives and subsidies that the government may provide to ease the transition away from single-use plastics. One incentive to be aware of is the Plastic Waste Reduction Standard, a program which enables impact assessments of plastic pollution and provides incentives for initiatives which reduce the use of plastics.¹⁸ Participants join a network of over 1000 companies eligible to receive plastic ‘credits’ from the program used to implement recycling programs.

Conclusion

The decision to switch from plastic to paper single-use products is a challenging one that requires weighing the benefits and drawbacks of each. Plastic products have a lower initial carbon footprint and could be considered “environmentally friendly” if they are reused and recycled perfectly by everyone. However, this is very unlikely to happen. Paper products are more costly than plastic and have a larger initial carbon footprint, but provide better climatic and environmental outcomes in the long term. The Government of Canada has made a commitment to zero plastic waste by 2030 and will ban single-use plastic products by that time. This decision supports longer-term solutions and will help to reduce the amount of plastic polluting marine ecosystems. Businesses are encouraged to seek out information regarding this topic in order to make an accurate and informed decision.

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