Jessica Winton 300502232

How a Cap and Trade System Can Reduce Single Use Plastic Pollution

Plastic waste reduction measures have been implemented in over 120 countries (OECD, 2022) and yet continue to increase year over year with more evidence pointing towards the detriments of human health as a result of plastic contamination in our ecosystem and physiology.

Cap and trade systems have proven effective for reducing carbon emissions with a reduction in market failures (Flachsland et al, 2011). This concept could be applied to the production of plastic in order to meet these same goals, as plastic is a broad category with many useful cases, there exists a market failure with the current system incentivizing inefficient use of these materials causing an overproduction of plastic as the negative externality of environmental impact is not accounted for. Global plastic production is expected to triple by the end of the century with a business as usual scenario. [Figure 1.] (Stegmann et al., 2022)

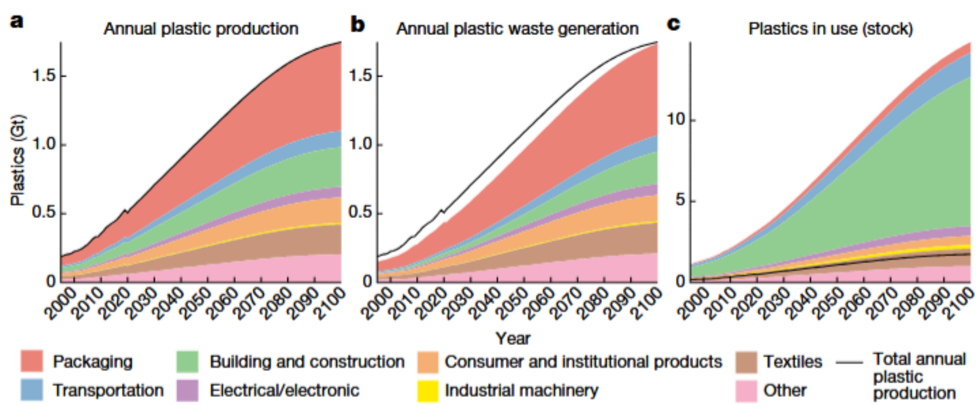


Fig. 1 | Projections of global plastic production, waste generation and plastic stocks in use, by sector. a–c, Annual plastic production (**a**), annual plastic waste generation (**b**) and plastics in use (**c**), 2000–2100.

Types of plastic fall into 7 main categories globally that account for over 80% of produced plastic known as commodity plastics (Andrady & Neal, 2009), all with differing levels of environmental impacts. Current efforts to levy a blanket plastic production tax have been minimal and focus on weight or the analysis of plastic characteristics as the taxable factors, targeting primarily single use plastic. Environmental costs throughout the entirety of each plastic type's life cycle is not easily measurable given the nearly endless use cases that plastic has taken form of (Andrady & Neal, 2009) but must be holistic to avoid gaps that result in lax enforcement and negligible outcomes. However to avoid the constant policy game of catch up, a cap and trade system on the production of all plastics regardless of use case would reduce administrative burden as market forces would self-regulate as in the case of carbon emissions cap and trade systems (Flachsland et Al., 2011).

Markets are capable of producing an equilibrium with proper regulation and cap and trade systems have proven effective when considering uncertainties (Flachsland et Al., 2011), of which plastic has many. Because the goal of a cap and trade system is not to eliminate the regulated entity [plastic], but to optimize its production and minimize market failure, single use plastics are an ideal use case for a cap and trade market as the limits of production will create market forces that maximize the marginal benefit of plastic usages.

Single use plastics take many forms and account for a large majority of plastic pollution (OECD, 2022). The incentives to optimize the manufacturing processes so plastic is only used where it maximizes marginal benefits are not being implemented at scale in a sufficient manner. The marginal benefit of a single-use plastic protecting a syringe's sterility is far greater than protecting a bar of chocolate. In a cap and trade model on plastic production, the system would allow producers to price in these benefits and optimize the supply chain of single-use plastics so that the marginal benefit of plastic usage is greatest while minimizing negative environmental impacts.

The current structure of applying a blanket production tax on plastic production does not account for the different characteristics of plastic types. For example, Polystyrene (Type 6 plastic, aka styrofoam) has a far greater negative environmental impact by virtue of its chemical structure. Polystyrene is easily broken down into microplastics and being 95-98% air by weight (Kwon et al., 2014), a tax focused solely on weight by plastic type would not account for these factors. Similarly, a plastic production tax by weight that would mimic a carbon emissions tax, would miss out on the volume of plastic being created. As polystyrene is majority air by volume, this facet of production is unaccounted for by most attempts at regulation.

The utility of polystyrene is vast, as it can act as insulation, which has a far greater marginal benefit than a single-use takeout food container, which is why this use case of food containers is being regulated to make up for the market failure of overproduction with minimal benefit. The functional utility of plastics in general cannot be understated as it remains a key component of items like paint, glue, medical equipment, food storage, tires and much more (Andrady & Neal, 2009).

Society as a whole is addicted to plastic and the development of alternatives has stagnated thanks to the systemic failures that incentivize path dependency on plastic as a ubiquitous solution. A cap and trade system for the production of plastic would create incentives to target the optimization of production where the benefit from the usage of plastic is greatest. In the following figure [Figure 2.], we could see how this cap and trade system would work in reducing overall plastic production with the example of medical goods and food goods that use single-use plastic. In a broader approach to reduce plastics entirely, the example of durable goods could substitute for the usage of single use plastics in the medical field, and single use plastic as a whole for the usage of single use plastics in food products.

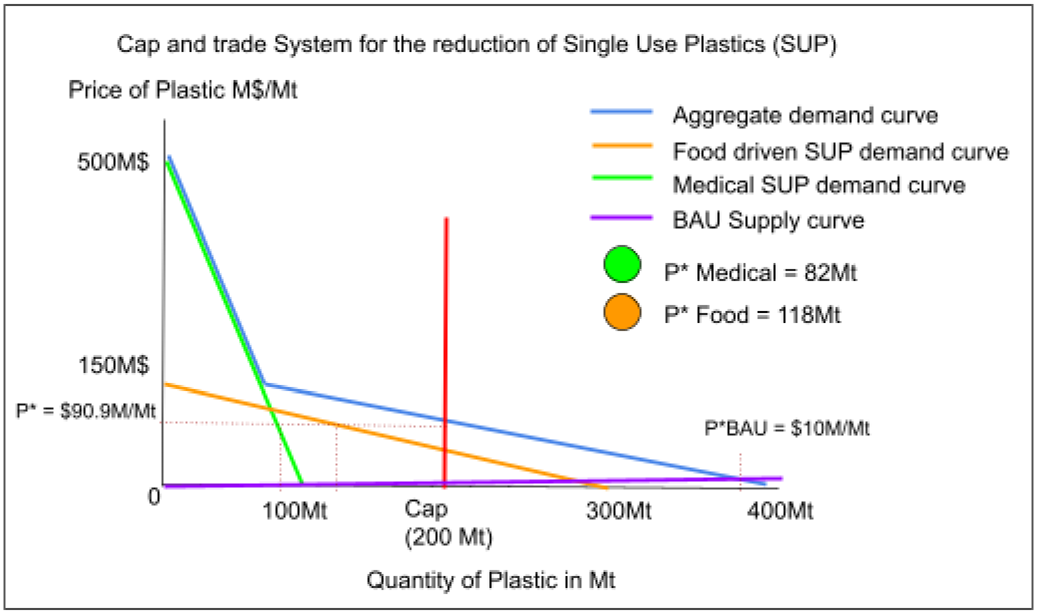


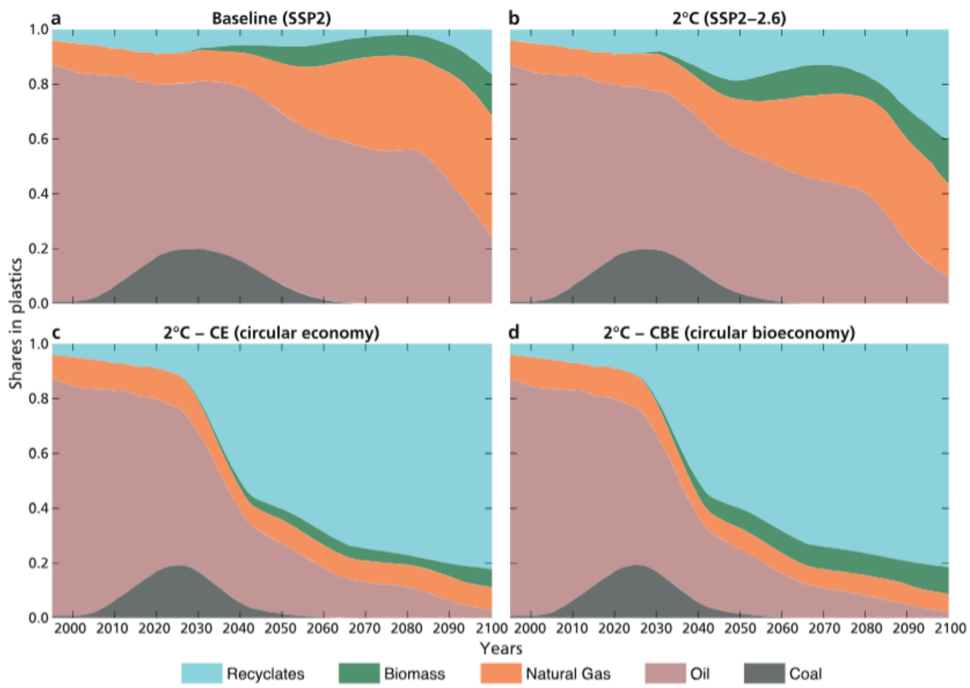
Figure 2. Model for a Cap And Trade System on the Production of Plastic and its effects on the usage of single use plastic for food driven goods and medical goods in year 2050.

Additionally, as proven with carbon emissions, this cap and trade system should be a global agreement in order to reduce leakages (OECD, 2022), as plastic pollution is a global problem. A flat tax on carbon emissions has demonstrated to produce more environmental justice gaps, as it often ends up being a regressive tax (Pereira et Pereira, 2019) which is why a cap and trade system is better suited for reducing single use plastic production. The ways we measure plastic production, namely carbon emissions of the production and production of plastic pollution by metric tonnes, fails to account for the economic markets of the use of plastic which creates further environmental justice gaps. This gap is observable in systems for single-use plastic bags as well in the case study of China (Zhu, 2011) where marginalized communities proceed to absorb the environmental cost of additional single-use plastic usage when no alternatives for that market sector are presented.

Regulating specific types of plastic uses has been proven to be somewhat ineffective as communities eventually adapt to the increased cost such as the case of Ireland with plastic bag usage dropping 94%, with eventual regrowth over the years (Convery et al., 2007). Cap and trade markets are easier to regulate on broader objectives through shifting the target cap with the evolution of the market, until their influence on market innovations are widely adapted.

Additionally, regulating the total amount of units of plastic in circulation would be far too difficult. A system of cap and trade accounting for weight, volume, and type would sufficiently encourage the optimization of single-use plastic efficiency. On-top of existing carbon markets, producers would analyze the value of allocating their production towards plastic, overall driving up cost. A post-producer transformation of plastic would be much more keen to pay a higher price towards their usage of plastic if the marginal benefit is greater than the environmental impact of that unit of plastic and carbon emission production.

The goal of a cap and trade market for plastic would be to find alternatives for plastic, specifically virgin plastic, as it is the most carbon intensive usage. A cap and trade economy for plastic would help utilize the building stock of plastic waste for recycling under a Circular economy model (Stegmann et al., 2022). Recycling rates vary widely globally but within Canada sit around 16% for plastic packaging (Canada Plastic Pact, 2024). If the maximum amount of new plastic being allowed to be produced did not affect recycled plastic, market forces would incentivize the efficient usage of recycled plastic as the surplus of recyclable plastic material would grow in comparison to the availability stock of more valuable virgin plastic, as cap and trade would feed into a circular economy policy approach see [Figure 3]



Extended Data Fig. 2 | Resource shares in annual global plastic production. This figure shows the final shares of resources in the annually produced plastic products (not the primary resource use for plastics).

(Stegmann et al., 2022)

A cap of overall plastic production would optimize the allocation of plastic production towards the most beneficial use cases, opposed to other market interventions. The cap and trade market would then produce alternatives to plastic under these conditions as innovation is spurred by incentives to diverge from the reliance of plastic in production chains, creating a feedback loop. This positive reinforcement on the supply chain would extend as the cap on plastic production is adjusted over time. The environmental cost of plastics may be too large to measure (OECD, 2022), but policies such as cap and trade markets have proven to deliver efficient market results in the face of uncertainties which makes it the ideal case for the reduction of single use plastic and its many varieties.

Bibliography APA

1. Andrady, A. L., & Neal, M. A. (2009). Applications and societal benefits of plastics. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *364*(1526), 1977–1984. https://doi.org/10.1098/rstb.2008.0304
2. Convery, F., McDonnell, S., & Ferreira, S. (2007). The most popular tax in Europe? Lessons from the Irish plastic bags levy. *Environmental and Resource Economics*, *38*(1), 1–11. https://doi.org/10.1007/s10640-006-9059-2
3. Canada Plastic Pacts (2024) Plastic Packaging Flows: Deposit Return, Residential, and Industrial, Commercial and Institutional Recycling System Performance 2024 Progress Report Summary
4. Flachsland C. et Al. (2011) Climate policies for road transport revisited (II): Closing the policy gap with cap-and-trade. *Energy Policy*
5. Kwon, B. G., Saido, K., Koizumi, K., Sato, H., Ogawa, N., Chung, S.-Y., Kusui, T., Kodera, Y., & Kogure, K. (2014). Regional distribution of styrene analogues generated from polystyrene degradation along the coastlines of the North-East Pacific Ocean and Hawaii. *Environmental Pollution*, *188*, 45–49. https://doi.org/10.1016/j.envpol.2014.01.019
6. Organisation for Economic Co-operation and Development, OECD (2022) Global Plastics Outlook, ECONOMIC DRIVERS, ENVIRONMENTAL IMPACTS AND POLICY OPTIONS. https://www.oecd.org/content/dam/oecd/en/publications/reports/2022/02/global-plastics-outlook_a653d1c9/de747aef-en.pdf
7. Rui M. Pereira, Alfredo M. Pereira. Financing a renewable energy feed-in tariff with a tax on carbon dioxide emissions: A dynamic multi-sector general equilibrium analysis for Portugal[J]. *Green Finance*, 2019, 1(3): 279-296. doi: 10.3934/GF.2019.3.279
8. Stegmann, P., Daioglou, V., Londo, M., van Vuuren, D. P., & Junginger, M. (2022). Plastic futures and their CO2 emissions. *Nature*, *612*(7939), 272-276,276A-276M. https://doi.org/10.1038/s41586-022-05422-5
9. Zhu, Q. (2011). An Appraisal and Analysis of the Law of “Plastic-Bag Ban.” *Energy Procedia*, *5*, 2516–2521. https://doi.org/10.1016/j.egypro.2011.03.432