Single-use plastic reduction at UK higher learning institutions

Motivations and best practice

MSc Climate Change and Environmental Policy [SOEE5020M]

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"This plastic man will come into a world of colour and bright shining surfaces where childish hands find nothing to break, no sharp edges, or corners to cut or graze, no crevices to harbour dirt or germs…all his toys, his cot, the moulded light perambulator in which he takes the air, the teething ring he bites, the unbreakable bottle he feeds from [are all plastic]. *As he grows, he cleans his teeth and brushes his hair with plastic brushes, clothes himself in plastic clothes, writes his first lesson with a plastic pen and does his lessons in a book bound with plastic. The windows of his school curtained with plastic cloth entirely grease- and dirt-proof…and the frames, like those of his house are of moulded plastic, light and easy to open never requiring any paint…"*

"…until at last he sinks into his grave in a hygienically enclosed plastic coffin."

(Yarsley and Couzens, 1945, pp.149–152)

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Abstract

To date society has produced 6.3 billion tonnes of plastic waste. Currently half of all plastic is considered to be single-use. When disposed of, 80% of plastic enters landfill or the natural environment, where it can have devastating impacts on ecosystems. Through media exposure, there is an increasing demand to address this issue, and higher learning institutions (HLIs) have been vocal in their support of this. This paper aims to determine how HLIs perceive and act on SUP, what motivates them to do so, and the wider national context of this. A rapid evidence assessment of 170 HLIs and 12 in-depth interviews were used to identify trends, perceptions and motivations. The paper found a good understanding of the issues but a lack of institutional definitions on SUP. Seventy-six HLIs have taken measures to reduce SUP, with particular success found in reusable coffee cups and accompanying levies or discounts. Institutions were motivated by student pressure and public discourse in the main. The paper highlights the uncertainty from many of these institutions and illustrates the need for additional research and support from Government.

Key words: single-use plastic, higher learning institutions, best practice, motivations

1. Introduction

Plastic has rapidly become a ubiquitous and critical aspect of modern-day society. Indeed, some have claimed that we are now living through a 'Plastic Age' (Thompson et al., 2009). Synthetic plastic was first created in 1907 and over 8.3 billion tonnes – and rising – has been produced since (Crespy et al., 2008; Geyer et al., 2017). This is an incredible amount considering the mass production of plastics only began after World War II (Crespy et al., 2008). The unique and versatile range of properties obtained from plastic, such as its durability and lightness, have driven innovation and provided benefits throughout almost all areas of society (Andrady and Neal, 2009; Thompson et al., 2009).

However, humanity has now produced 6.3 billion tonnes of plastic waste (Geyer et al., 2017). Of this, only 9% is recycled with 80% destined for landfill or the natural environment, resulting in a myriad of problems (Geyer et al., 2017). For instance, around 5-13 Mt enters the oceans annually (Jambeck et al., 2015), where it impacts marine fauna causing death and serious injury (Kühn et al., 2015). Humans are not free from impacts either, with plastic entering the bodily systems via food, water and air, causing a range of health problems (Eerkes-Medrano et al., 2019).

Annually, global plastic production has reached 300 million tonnes (five million tonnes of which is used in the UK) and half is deemed to be single-use (Mathalon and Hill, 2014; DEFRA, 2018b). This demand for single-use plastic (SUP) has driven ever increasing consumption (Geyer et al., 2017), resulting in a rapidly rising proportion of fossil fuels dedicated to its manufacture (Van Eygen et al., 2017). Due to the durability of plastic and the increasing production of these single-use items, contamination and concentration in the natural environment is becoming patently evident (Leal Filho et al., 2019).

With a proliferation of media exposure, the issue of plastic (predominantly SUP) has swiftly become one of the most topical environmental issues worldwide. This was highlighted particularly clearly in 2017 with the airing of BBC's Blue Planet II series in which the impacts of plastic on the marine environment was watched by 14.1 million people in the UK and 80 million people in China (Loughrey, 2017). As a result of this exposure and accompanying public pressure, a flurry of proposals (DEFRA, 2018a), policies (DEFRA, 2018d), new standards (EU, 2018), and technological solutions (Cordier and Uehara, 2019) were announced from organisations, governments and institutions of all kinds.

However, there is still a lot of confusion over plastic and what it actually means. Many consumers believe it describes a specific material but, as da Costa et al. (2016) explains, it is more to describe the malleability of a material. Whilst plastic is well defined in the literature, SUP is not, but can generally be understood to mean a plastic item that is intended to be used once or for a short period of time (EC, 2018b).

Higher Learning Institutions (HLIs) within the UK have a large influence in society and have responded to the increasing pressure to act on plastic with their own measures and pledges (University of Leeds, 2018; Aberystwyth University, 2018). There are numerous authors within the literature that discuss and evaluate the response of society, organisations and HLIs to a variety of sustainability issues (Sonetti et al., 2016; McCoy et al., 2018). However, there is very little academic literature on the actions HLIs are taking to address the current issues surrounding SUP and what is driving these decisions. The literature review below reveals this gap which has guided and supported my aims and objectives:

The aim of this study is to understand how HLIs perceive and act on SUP, what motivates them to do so, and the wider national context of this. The project objectives are:

1) Explore how HLIs define, understand and contextualise SUP.
2) Determine what SUP reduction initiatives and best practice have emerged from UK HLIs, and the challenges involved in implementing these.
3) Examine the motivations driving the implementation of these initiatives and the associated pledges and commitments.
4) Consider how the findings fit within the broader context of UK policy.

It is hoped this research will provide a valuable tool for HLIs looking to develop or initiate plastic reduction measures. This research may also prove useful for students and advocacy groups looking to drive environmental change within HLIs, through the examination of motivations within these institutions.

The paper will proceed to review the literature, discussing the benefits and issues surrounding SUPs, and investigating the solutions being implemented. The paper will then detail the methods used to collect and analyse primary data before examining the results of this data. Academic literature will be drawn upon to discuss these findings and the paper will close with recommendations for applications in real world settings.

2. Literature Review

This review will first seek to define plastic itself and then SUP. The benefits of plastic and the problems associated with its creation, use and disposal are then assessed followed by solutions and motivations to take these decisions.

2.1 Defining single-use plastic

A lot of the language used to define plastics can be confusing to many consumers. How plastic is described, behaves, and understood can be wildly different, and this can impact how it is handled, processed and disposed of. There are many definitions of plastic within the literature (Appendix 1) but primarily: it's a synthetic or semi-synthetic compound that can be moulded into a variety of shapes (da Costa et al., 2016).

The vast majority of plastic is derived from oil or gas and is formed when the monomers of these fossil fuels are polymerised and combined with chemical additives (Thompson et al., 2009). For clarity, this paper will refer to fossil-based plastic as conventional plastic (CP). Whilst uncommon, not all plastic is a derivative of fossil fuel. Bioplastics are produced from plant material such as cellulose or starch (Harding et al., 2017).

Fossil-based plastics and bio-based plastics are simply terms referring to the composition, they do not indicate functionality. Both types can create biodegradable, non-biodegradable, and compostable plastic (Figure 1). However, most CPs produced are not biodegradable and thus accumulate in the environment (Geyer et al., 2017). Additionally, the majority of biodegradable and compostable plastic cannot be disposed of in the environment, with only a small amount suitable for home composting, and neither suitable for recycling (WRAP, 2018b).

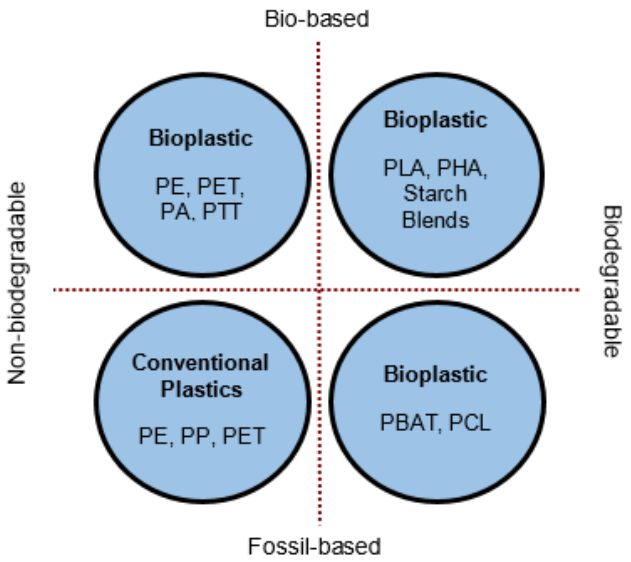

Figure 1. Examples of the different classes of plastic. Adapted from WRAP, 2018b.

It is also appropriate to discuss what makes a plastic item single-use. However, despite a relatively large body of literature, definitions are sparse (Appendix 1). Essentially SUP is: a product containing plastic that is intended to be used once or for a for a short period of time (HM Treasury, 2018). A key point to make here is that both CP and bioplastic are both forms of plastic and thus could both be classed as SUP.

2.2 The 'plastic problem'

Much of the national discourse around the issue of SUP has been negative, but it is worth examining why, and how justified this is. This section will first look at the benefits and advantages of plastic followed by the problems and impacts.

2.2.1 Benefits and advantages

The primary advantage of plastic is its high versatility. It can be durable, strong, insulative from heat and electricity, moulded to any shape, textured or smooth, any colour, corrosion resistant, and lightweight (Thompson et al., 2009). These properties have given society the ability to progress technologically and socially (Andrady and Neal, 2009).

In total, 380 Mt of plastic are now produced worldwide every year and this is down to the safe production ability of high volume manufacturing facilities (Voit, 2005; Geyer et al., 2017). It has also given plastic the ability to replace traditional materials such as glass, paper, leather and metal (Thakur et al., 2018). Indeed, the greenhouse gas emissions from plastic, when addressing manufacturing alone, can be lower than other materials (Figure 2). Furthermore, the production of plastics has created millions of jobs directly and indirectly, and contributed significantly to economic growth in many nations (Flores, 2008). It is therefore clear that plastic has numerous benefits that are not achievable to the same standard and at the same cost using other materials (Appendix 2). This includes increasing the shelf life of food up to 14 days or decreasing transport emissions by 60% (BPF, 2018).

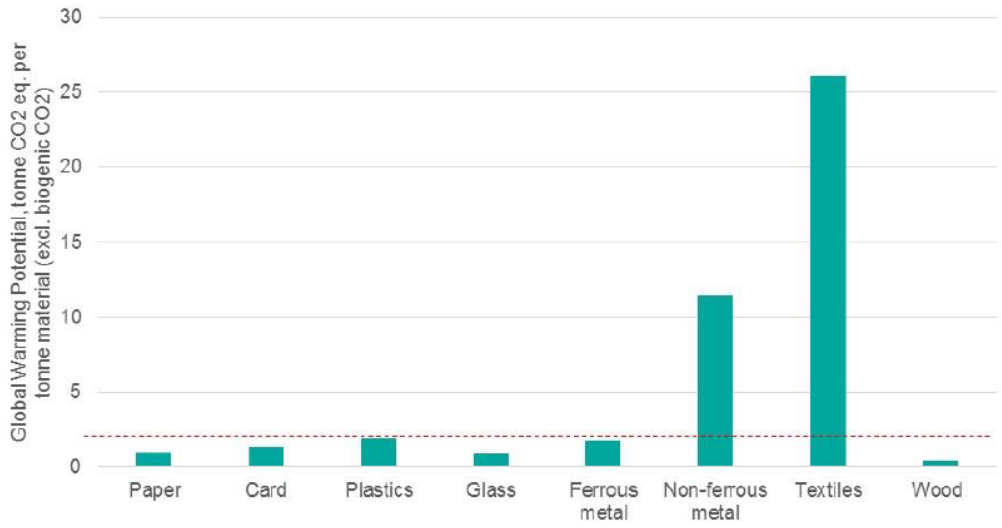

Figure 2. Manufacturing burdens in tonnes GHGs per tonnes of material produced. It must be noted that the functional unit here is weight and thus does not account for number of uses. Source: EC (2018a)

It is also worth noting the benefits of bioplastics. These have gained hugely in popularity over recent years – growing from 1.7 Mt in 2014 to 6.2 Mt in 2018 – to become the principle option for replacing CP (Mostafa et al., 2018; Thakur et al., 2018). In comparison to CP they are sustainable, have lower greenhouse gas emissions, lower fossil fuel usage, and can be renewable (Harding et al., 2017).

2.2.2 Problems and impacts

In this section, the concerns over plastic are examined at three stages: creation, usage, and disposal. By doing this a broader picture of the impacts of plastic, over the course of its life, can be explored.

2.2.2.1 Creation problems

The creation of plastic products is associated with one principle problem: the use of fossil fuels. Ninety-nine percent of plastic is manufactured using oil or gas and this accounts for 4% of the world's annual production of these fuels (Hopewell et al., 2009; Degnan, 2015). An additional 3-4% of oil and gas are needed to provide the energy necessary for plastic creation (Van Eygen et al., 2017). If the current trends of plastic production continue, by 2050 the plastics industry may require 20% of global oil use annually (WEF, 2016).

The extraction and combustion of these fuels generates numerous environmental, social and economic problems (such as polluted water courses, release of pollutants etc), but they are also finite resources and thus this is not a sustainable option (UNEP, 1997).

2.2.2.2 Usage problems

The issues regarding the use of plastic are predominantly focused around three areas: SUP items, the rate at which plastic is consumed, and the health impacts of using plastic. These are explored below.

2.2.2.2.1 Single-use plastic

Given the pace and low cost at which SUP can be produced there has been an accelerated shift from reusable to single-use products, now accounting for 50% of the plastic waste produced worldwide (Geyer et al., 2017; UNEP, 2018). Furthermore, the manufacture of SUP is predicted to increase in the UK, in all but two household items (Figure 3).

There are three significant problems with SUP: it is resource intensive considering longevity of use, it is easily (and often) discarded or littered in the natural environment – where it quickly accumulates, and it has low levels of recycling/re-use (EC, 2018a). Evidence on the impacts of these issues are discussed in Sections 2.3.2.1, 2.3.2.3.4 and 2.3.2.3.1 respectively.

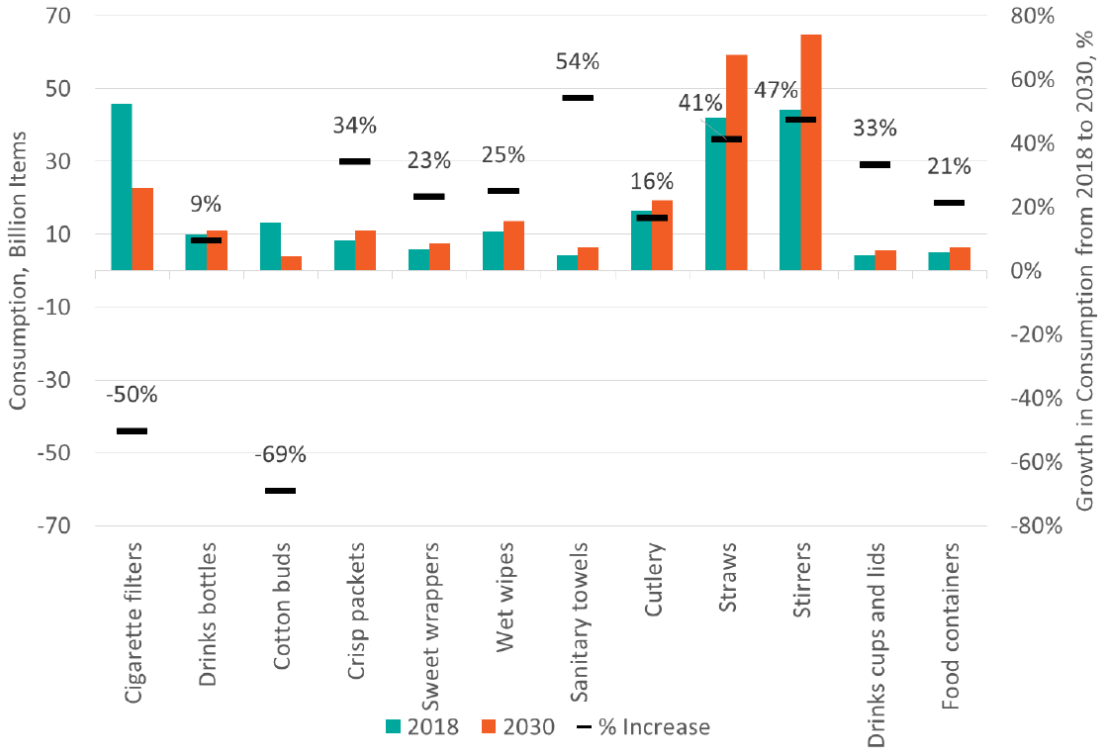

Figure 3. Projected consumption of SUP items in 2030 compared to 2018 levels. Source: Elliott and Elliott (2018)

2.2.2.2.2 Consumption

Global consumption of plastic in 2015 was 380 Mt and the trend suggests this is going to increase rapidly (Figure 4) (Geyer et al., 2017). The majority of the increase is within SUP items, exacerbating the issues discussed in the previous section. Indeed, the UK ranks 5th overall in the EU for the consumption of SUP (Elliott and Elliott, 2018; Appendix 3). The demand for ever more plastic products results in greater environmental pressures both creating the plastic and disposing of it (EC, 2018a). That is not to say that consumption of plastic is necessarily wrong (as seen in Section 2.3.1), but it is argued that we need to move away from plastic as a default, particularly when it is single-use (De Smet, 2017).

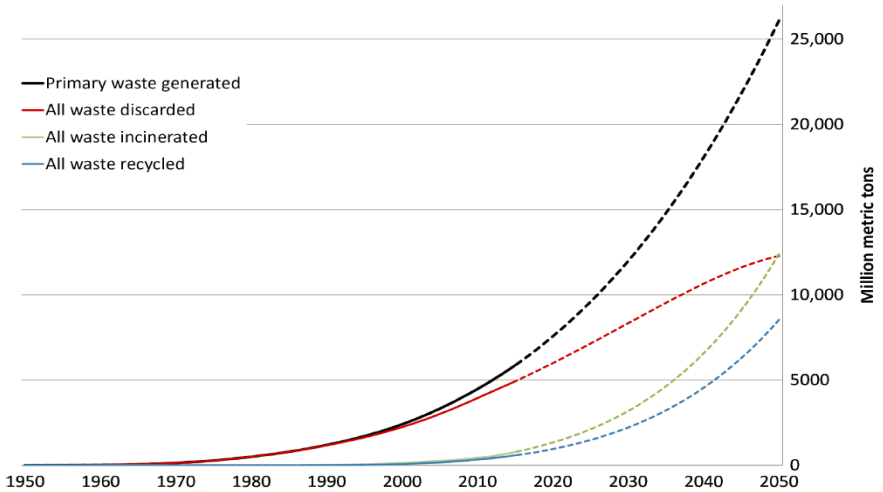

Figure 4. Global cumulative plastic waste generation and disposal. Solid lines show historical data (1950-2015) and dashed lines depict projections to 2050. Source: Geyer et

2.2.2.2.3 Health implications

Plastics can enter the human body through three essential processes: eating (particularly seafood), drinking (both tap and bottled water), and breathing (indoor and outdoor air) (Eerkes-Medrano et al., 2019). The leaching of plastic additives such as phthalates and bisphenol A into bodily systems has been shown to have estrogenic activity and disrupt endocrine functioning (Sohoni and Sumpter, 1998). Additionally, plastic can cause oxidative stress in bodily systems and this can lead to inflammation and tissue damage (Eerkes-Medrano et al., 2019). Lastly, the impacts of airborne microplastics can range from asthma and allergies to autoimmune and cardiac diseases (Chang, 2010).

2.2.2.3 Disposal problems

There are essentially three disposal options for plastic: it can be recycled into a secondary material, it can be thermally destroyed through incineration or pyrolysis, or it can be discarded either in the natural environment or landfills (Geyer et al., 2017). All three options will be discussed below.

2.2.2.3.1 Recycling

Globally, 9% of plastic waste is recycled (Geyer et al., 2017). Yet, when considering end of life solutions, recycling generates the lowest emissions for all plastics (WRAP, 2018b). This, in part, is due to the lack of demand for recycled plastic from both the consumer and the manufacturer, with the cost of recycling waste plastic a disincentive when compared to producing virgin plastic (Flores, 2008). Additionally, recycling delays – not replaces – final disposal and the secondary plastic that is produced is often contaminated with a mix of polymer types, reducing quality and value (Geyer et al., 2017).

The current UK recycling rate for plastic waste is 31% (PlasticsEurope, 2018), and for SUP is estimated to be 29% – and only projected to increase 8% by 2030 (T Elliott and Elliott, 2018). Additionally, there are many products that have recycling rates of less than 1% (EC, 2018a). From a household perspective, the array of recycling regulations and rules, together with the differences between jurisdictions, have been shown to confuse the general public and lead to incorrect waste disposal (Stephenson, 2018).

2.2.2.3.2 Incineration

Twelve percent of global plastic waste is incinerated (Geyer et al., 2017). In the UK energy recovery is the fastest growing waste processing option with 7.3 million tonnes incinerated in 2016 including 18% of plastic waste (Elliott and Elliott, 2018; DEFRA, 2019). However, incineration has been questioned due to the emission of harmful dioxins, the CO_2 intensive nature of this form of energy generation (second only to coal), and the fear of a reliance on this process after China's ban on waste plastic (Elliott and Elliott, 2018). Furthermore, acid rain can be produced during combustion through the emission of corrosive fumes into the atmosphere (Flores, 2008).

2.2.2.3.3 Landfill

After food and paper waste, plastic is the third largest contributor to municipal and industrial waste in cities whilst also being the fastest growing (Philp et al., 2013). The UK sends 48% of its plastic waste to landfill (EC, 2018a), depositing almost 50,000 tonnes of plastic waste into or onto land, excluding the plastic waste from households (DEFRA, 2019).

The act of 'dumping' plastic waste in landfills is seen to damage the aesthetics of the surrounding area and can create an unpleasant smell (Flores, 2008). Some countries are also limited for space and suitable areas for landfills are rare (Hopewell et al., 2009). Yet, placement and management of landfills is important as evidence shows the degradation of plastics can contaminate soils and groundwater (Teuten et al., 2009).

2.2.2.3.4 Discarded into the natural environment

This area has had perhaps the most scrutiny globally, but while plastic pollution on land is significant, it is the pollution of global oceans that is the centre of attention for the media, as well as the majority of academic literature.

While there is a high degree of uncertainty in approximations of plastic content in the oceans, reasonable estimates are 200 million tonnes since 1950, and 5-13 Mt/yr presently (Jambeck et al., 2015; Dauvergne, 2018). Sources of this marine plastic are predominantly land based (10.5 Mt/yr) with the rest contributed from sea activities (1.75 Mt/yr) (EUNOMIA, 2016). Evidence suggests 50-60% of marine plastic pollution originates from Asia, particularly China, India and South East Asia (Jambeck et al., 2015; Boucher and Friot, 2017).

Recent reports show that the UK litters 24 billion plastic items per year into the natural environment, comprised of around 18,000 tonnes of macroplastic (>5mm in diameter) and 20,300 tonnes of microplastic (<5mm in diameter) (Hann et al., 2018). Whilst there is uncertainty over quantity and type of pollution, reasonable estimates suggest fishing items, tyre wear, and bottles are the most prolific, although importantly the majority of items are SUP (Elliott and Elliott, 2018; Appendix 4).

Contamination of global oceans with plastic has had a direct and indirect impact on marine wildlife. Entanglement of marine fauna - most often in fishing equipment - commonly results in death by starvation or predators (Laist, 1997). Significantly, ingestion of plastic by fauna (intentionally or unintentionally) can block the digestive tract, impede the absorption of nutrients, and physically damage the digestive system (Kühn et al., 2015). Additionally, plastic not only contains toxic additives but can also absorb persistent organic pollutants in oceans, and once ingested, these pollutants can enter the food chain and harm other organisms (Teuten et al., 2009; Hann et al., 2018).

Despite the numerous reports on marine plastic, it has been suggested that contamination of terrestrial ecosystems could be up to 23 times more than in oceans (Nizzetto et al., 2016; Horton et al., 2017). This pollution has been traced to a number of sources. For example, it has been reported that 80-90% of microplastics in sewage are retained in the sludge, which is used as a fertiliser (Horton et al., 2017; Talvitie et al., 2017). Evidence shows this could equate to as much as 63,000 tonnes of microplastic each year on European agricultural lands (Nizzetto et al., 2016). Road verges have been found to contain up to 7% microplastics by mass and as microplastics may persist for well over 100 years, concentrations will continue to rise (Fuller and Gautam, 2016; Horton et al., 2017). Lastly, reports have found plastic may produce greenhouse gases (methane and ethylene) when exposed to sunlight and thus contribute towards climate change (Royer et al., 2018). It must be noted, however, that additional research into all these areas is needed.

2.2.2.4 Bioplastics

Bioplastics have their own complications. Bioplastics are still a relatively new material in the international market, with legislation or guidance lacking (Hann et al., 2018). As such, studies have shown that products labelled as bioplastics often perform in the same ways as CP under identical conditions (Harding et al., 2017). Additionally, the conditions under which bioplastics can biodegrade are not communicated well and given the stark differences between industrial composting and other processes (Figure 5), consumers may discard an item incorrectly with the belief it will completely degrade (Heidbreder et al., 2019).

Furthermore, they are more expensive to manufacture than CP (Thakur et al., 2018), they cannot be mixed into the recycling stream with CP (Chida, 2011), they may create a 'carbon debt' through the destruction of rainforest and peatland (Piemonte and Gironi, 2011), incorrect disposal and inefficient breakdown can result in a release of greenhouse gases (Reddy et al., 2013), they add to compost structure but do not contain nutrients (WRAP, 2018b), and there is risk of offsetting food production and compromising water resources (EC, 2018a). Yet, there is uncertainty in all these findings.

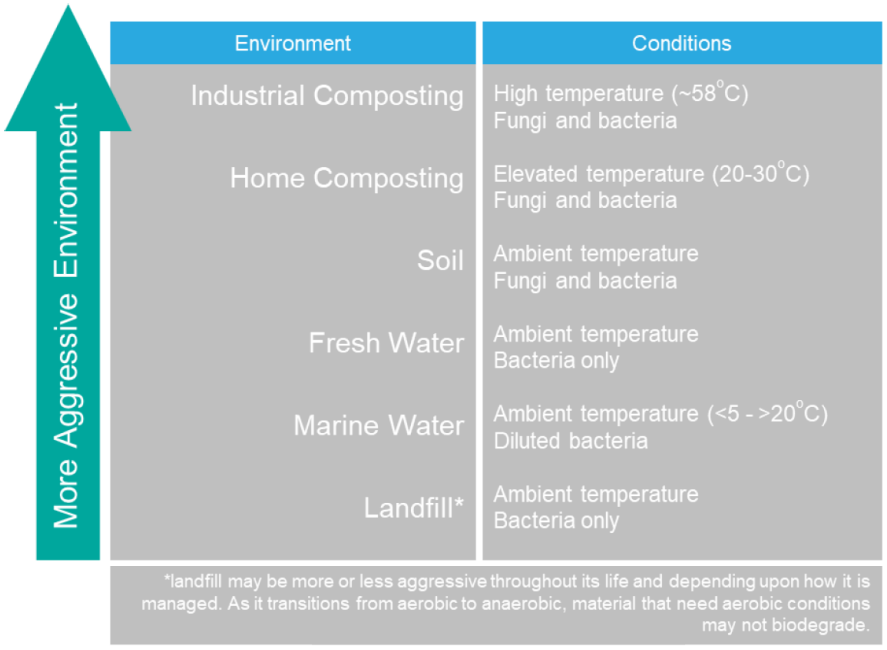

Figure 5. Ranking the aggressiveness of different biodegradation environments. Source: Hann et al. (2018).

2.3 Addressing SUP

Given the notable problems associated with plastic and SUP in particular it is prudent to assess the actions being taken to address this within the UK. This section first discuses procedural initiatives and then the development of alternative products, and finally the response from HLIs.

2.4.1 Procedural initiatives

Plastic waste is often addressed through top-down legislation, regulation, and market-based instruments. The UK Government have taken a number of steps to address the problem of plastic and SUP specifically (DEFRA, 2018b). Key initiatives have been legislating for a ban on microbeads (DEFRA, 2018d) and a 5p levy on supermarket plastic bags (DEFRA, 2018c). The Waste and Resources Strategy maps out the ambitions and policy plans of the UK Government until 2050 regarding plastic, including eliminating all avoidable plastic waste and bans on specific SUP items (DEFRA, 2018b; Appendix 5).

Plastic is also one of the top sustainability issues facing companies and organisations, and they are often voluntarily trialling alternative materials or reducing plastic through other means. Indeed, the Waste and Resources Action Programme (WRAP) now has 60 companies committed to 100% of their plastic packaging being reusable, recyclable or compostable by 2025 (WRAP, 2018a). Supermarkets in particular are showing signs of reducing their plastic waste with initiatives such as: phasing out SUP bags, plastic free aisles, and taking action on plastic pellets (EIA, 2018).

2.4.2 Technological solutions

Technological solutions to plastic waste are becoming increasingly popular. Large efforts to collect plastic waste in the oceans have attracted millions of dollars in investment, and research shows these initiatives could reduce ocean plastic by 25% by 2030 (Cordier and Uehara, 2019). Other initiatives have included harnessing social media to pressure companies and organisations into reducing plastic waste (Dauvergne, 2018), revaluating recycling schemes and how to optimise use (Keramitsoglou and Tsagarakis, 2013), and studying the biodegradation of plastic by bacteria and wax moth caterpillars (Bombelli et al., 2017).

However, there are a number of criticisms within the literature regarding technological solutions, primarily: A) a lack of time to effectively address the plastic problem; B) acceptance is needed from society; and C) psychological impacts such as the rebound effect (Hertwich, 2008; Heidbreder et al., 2019). Therefore, effective strategies for plastic reduction will also need to consider attitudes and motivations.

2.4.3 Higher Learning Institutes

UK HLIs were chosen as the focus of this study at they have been at the forefront of efforts to reduce SUP and comprise both large and small institutions, which together have influence regionally and nationally (Uhl and Anderson, 2001). Indeed, a number of different institutions have announced their plans to become ‘single-use plastic free’ (University of Leeds, 2018; University of Manchester, 2019) and two institutions have already been awarded ‘plastic free status’ (Aston University, 2018; Aberystwyth University, 2018). Understanding what interventions these institutions are implementing is vital to ensuring efficient dissemination of ideas and uptake of best practice.

A reasonable number of studies have been conducted into the measures HLIs are taking to become more sustainable. However, these focus more broadly on recycling and waste management (Tangwanichagapong et al., 2017; McCoy et al., 2018), outreach activities with business and community (Too and Bajracharya, 2015; Findler et al., 2019), carbon emissions (Thurston and Eckelman, 2011; Versteijlen et al., 2017), and generally ‘greening’ HLI campuses (Uhl and Anderson,

2001; Sonetti et al., 2016). Whilst plastic waste at HLIs is mentioned in the literature, no studies were found that focus on SUP reduction initiatives at HLIs, possibly due to the relatively recent emergence of this issue into mainstream discourse.

2.4 Motivations

There have been numerous studies on the motivations of consumers to adopt sustainable behaviours in a wide range of areas, from fashion (Lundblad and Davies, 2016) and food (Meeks et al., 2015) to recycling (Park and Ha, 2014) and tourism (Ooi and Laing, 2010). This is complimented by a range of studies examining the motivations of companies and organisations to push a sustainable agenda (Hahn and Scheermesser, 2006; Parguel et al., 2011; Windolph et al., 2014). However, no papers were found that examined the motivations of a body or organisation to reduce SUP waste or use.

It therefore follows that there are no known papers analysing the motivations of HLIs towards SUP reduction, with most studies examining sustainable development more broadly. For example, some within the literature argue that current sustainable approaches by HLIs are top-down, self-serving agendas that fail to contribute to the broader ecological challenge (Jones, 2012). However, others see the impact of HLIs on sustainable development as being crucial (Cortese, 2003). Whilst these studies occasionally touch upon plastic, motivations of HLIs to reduce plastic is widely absent from the literature. Determining the motivations driving change will aid in future efforts to petition further change.

2.5 Summary

From this review it is clear to see that this is a complex situation. The differences between what a plastic product is and how it performs can be wildly different to a consumer's perception. Despite the evident benefits of plastic, there are far too many problems - many becoming dangerously out of control - to not address this issue. The rise in SUP is the cause of many of these problems, fuelling consumption with no real thought given to waste management. HLIs have the power to make significant change and are increasingly looking to do so. This review of the literature highlights the gaps in the knowledge around the best practice and motivations of HLIs when addressing the problems of SUP. Therefore, this paper seeks to fill the research gap by proving a critical analysis of the current state of SUP initiatives at UK HLIs, and the motivations behind the adoption of these initiatives.

3. Methods

3.1 Methodology and approach

This research used a duel methodology approach which utilises both a complete systematic assessment of HLIs supported by evidence from in-depth interviews. A qualitative route was taken as the knowledge that is needed to address the research aim sits within a small group of people within each institution. A qualitative approach most effectively allows for the collection and examination of

this information. Additionally, the data needed cannot be simplified to binary answers, as a more nuanced and detailed explanation is needed to fully understand specific issues.

The data was collected in this analysis with an inductive perspective. This approach follows a process of data collection from which commonalities and patterns can be drawn and thus allows for the formulation of general conclusions and theories (Bernard, 2018). This approach also provides the necessary flexibility that enables changes in formulation of theories as the process evolves (Goddard and Melville, 2011).

3.2 Rapid Evidence Assessment

3.2.1 Context

The purpose of conducting a Rapid Evidence Assessment (REA) was to understand the current situation among UK HLIs regarding SUP reduction measures. This was to determine:

- The number of HLIs employing measures to address SUP.
- The average number of measures a HLI implements.
- The areas where most of the initiatives are focused (e.g. catering, laboratories, offices).
- The most common measures taken within each area.
- The number of HLIs adopting pledges or targets and what these are.

REA provide a balanced assessment to determine what is known and unknown about the current state of an issue, by using a systematic approach to analyse existing evidence – most often empirical studies (Barends et al., 2017). They are often chosen as they are rigorous in approach and can be completed in as little as a few weeks. However, to achieve an outcome on this timescale requires a sacrifice of the breadth and/or depth of the research. REA were developed, and have been extensively used, due to the growing need for policy makers to have a quick and inexpensive review that maintained the thoroughness of a systematic review, thus suiting the fast-paced nature of policy development (Khangura et al., 2012). This has proved successful, particularly in the area of public health policy (Watt et al., 2008).

This decision was taken to use a REA for the purposes of this study for a number of reasons. Firstly, the short time frame allocated for data collection (five weeks) did not allow time for an in-depth systematic review, particularly as the interviews were also being conducted concurrently to the REA. Secondly, given the breadth of research, depth had to be sacrificed and this approach allowed for this while maintaining systematic rigour. Thirdly, there is currently no similar analysis in the literature, and thus, this would provide valuable empirical evidence in this area. Lastly, the research aim could only be addressed by reviewing a specific and known literature.

3.2.2 Data Collection

3.2.2.1 Selection Criteria

There are 170 recognised bodies (able to award degrees) as determined by the Department for Education (DfE), and all these institutions were included within the REA (DfE, 2018). In this, the breadth of study was kept as wide as possible.

3.2.2.2 Process

Six search terms were used ("Plastic", "Single-use plastic", "Plastic free", "Sustainability", "Waste+ plastic", "Catering+plastic"; Appendix 6) via the search feature on each HLI home webpage and the first twenty results from each search were observed. If the title or description of a webpage referred to SUP it was examined further. If a webpage was found to contain appropriate material, links were used to gather further information. For each HLI, data was gathered on: whether the search terms returned any relevant results, what measures had been implemented to address SUP, and what pledges or targets had been made. Crucially, results describing plans for future initiatives were not included as the aim of this exercise was to determine the current state of affairs.

By only using six search terms the depth of study was limited as alternative terms may have yielded applicable results. Additionally, results may not have appeared for several other reasons:

- The HLI has not implemented any measures;
- The information was contained in search results outside the first twenty;
- The algorithms used to perform the search do not include or prioritise applicable results;
- The title or description of the result does not mention SUP despite the page itself doing so;
- The institution may have filtered information from the website due to the audience they were intending to reach;
- The institution may have decided not to publish information on this matter or is yet to do so.

The most likely impact of the above will be an under-representation of both the quantity of institutions returning results and the extent and variety of the measures implemented. This study was unable to adjust for these limitations and therefore the conclusions must be considered with these in mind.

3.2.3 Data Analysis

To address the questions the REA is looking to answer, simple descriptive statistics using Microsoft Excel were sufficient. Broad conclusions about the state of SUP within the sector can then be made.

3.3 In-depth interviews

3.3.1 Context

The purpose of conducting in-depth interviews was to broadly determine how HLIs understood and contextualised SUP and what motivated institutions to implement SUP reduction measures.

An in-depth interview is a research technique designed to explore the motivations and perspectives of those interviewed, allowing the researcher to obtain a rich understanding beyond a surface level answer (Guion et al., 2006). This form of interview has now become one of the key methods of data collection used in qualitative research (Ritchie, 2011). However, whilst it provides the advantage of greater detail, this is inevitably accompanied by trade-offs: it is prone to bias from both the researcher and interviewee, it can be a time intensive process to collect and analyse the data, and it is hard to generalise the results as they are often from a small sample and random sampling methods are not employed (Boyce and Neale, 2006).

In-depth interviews were chosen for this study primarily for three reasons. Firstly, an in-depth interview provides the opportunity to scrutinise and probe answers to further understand the significance and meaning of what a participant thinks (Arthur et al., 2012). Secondly, an environment is created where a participant feels more at ease and is likely to share information they wouldn't under other circumstances (Ritchie, 2011). Lastly, the alternative qualitative methods often used – namely focus groups and questionnaires – produce data incompatible with addressing the research objectives (Walonick, 1993; Adams and Cox, 2008).

3.3.2 Data Collection

3.3.2.1 Selection criteria

A purposeful sampling technique will be utilised to select adequate participants for the study. This technique is used widely in qualitative research for obtaining information-rich cases with limited resources (Palinkas et al., 2015).

From the 170 HLIs, those that had been awarded plastic free status or those that have made pledges regarding SUP were contacted in the first instance, followed by a random selection of HLIs that had implemented two or more SUP reduction measures. Within these institutions departments that are responsible for SUP reduction measures (likely an estates or sustainability team) were contacted with a request to interview the individual that had the closest involvement to these initiatives. Individuals were contacted until a practical number of interviews had been confirmed within the timeframe established – it was anticipated that between 10 and 15 interviews would be conducted. Given that these individuals are involved in SUP reduction measures, it is recognised that self-reported actions and motivations may have a personal bias (Pepper et al., 2009).

3.3.2.2 Process

Ultimately 12 interviews were completed. All institutions and participants were anonymised, although may be identifiable from the details of their pledges, initiatives, and comments. Participants were made aware of this before the interviews. For the purposes of this report the institutions were numbered 1-12 with institutions identified as 'In[institution number]' and participants as 'P[institution number]'. Each interview was conducted via telephone, excluding two; one of which was conducted in person, the other over Skype. In all instances, interviews were recorded, with the participants permission.

A topic guide was used to organise the interviews into the central themes of context, reduction initiatives and motivation. The interviews were semi-structured which gives the benefit of set questions to follow but also allows a more conversational tone, giving both parties the option to explore areas of importance (Longhurst, 2010). This approach enables a blend of closed and open questioning which provides limited and easily interpreted answers, alongside detailed and personal viewpoints (Fink and Kosecoff, 1998). A neutral position was adopted for the interviews, prompting and nudging where necessary, without leading the questions (Seale et al., 2004).

3.3.3 Data Analysis

Written transcripts of the interviews were constructed using intelligent verbatim. Once complete, the text was read through with three approaches: literal (determining the factual content), interpretive (examining the implicit meaning), and reflexive (considering the influence of the interviewer) (Mason, 2002). At each stage of reading, codes were used to highlight key material, from simple descriptive codes to more interpretive and analytical codes. By coding across various levels, a deeper insight of trends and meanings can be attained, to aid in addressing the research objectives (Basit, 2003). When analysing the data suspicious and empathetic interpretation was used.

4. Results

4.1 Rapid Evidence Assessment

From 170 analysed institutions, 76 returned results – i.e. at least one SUP reduction measure was found (Appendix 7 Appendix). The majority of these institutions (44) have employed three of fewer measures and five have implemented 10 or more initiatives (Appendix 7). The average number of initiatives per HLI engaged was 5.8.

Fifteen HLIs have made pledges or commitments concerning the reduction or elimination of SUP (Appendix 8). Two HLIs have been awarded Plastic Free Status by the campaign organisation Surfers Against Sewage. Four institutions have signed the New Plastics Economy Global Commitment (De Smet, 2017). A further four HLIs have pledged to eliminate SUP completely, with the other institutions committing to a reduction in specific items or areas. Interestingly, two of these institutions (the University of Portsmouth and Ravensbourne) have made a commitment but not recorded any SUP reduction measures (Appendix 7). The timescale for the commitments ranges from 2019 through to 2027 with most being 2022-2025.

In total 50 different measures were found addressing SUP across all institutions – although this does not mean they are all effective (Appendix 9). The majority (64%) were aimed at SUP items within a catering setting. Only three initiatives (6%) addressed SUP within laboratories and the 15 remaining initiatives (30%) manage SUP in a variety of settings. The most common initiatives are regarding coffee cups, most often a combination of selling/promoting reusable coffee cups complemented by a levy or discount to encourage the use of these cups. Other notable drink related measures include upgrading or increasing the number of water fountains. Regarding food, the use of compostable or biodegradable takeaway items is the most commonly adopted measure. Popular miscellaneous initiatives include plastic free events and using alternative materials for bags. It must be noted that even the more widespread initiatives have only been adopted by around half of the HLIs engaged in the process.

4.2 In-depth interviews

The in-depth interviews uncovered additional knowledge that complements the REA and allows for greater understanding and analysis. The reporting of these results is divided between perceptions of

SUP, reduction initiatives, and motivations, to reflect three of the core themes detailed in the objectives.

4.2.1 Perceptions of plastic

Interestingly, only two participants interviewed had institutional definitions for SUP (P9 and P10, Appendix 10) and these were based on or directly taken from the Government. The other HLIs had no institutional definition for a number of reasons such as: "*It's not really something that is discussed*" (P8) or "*single-use plastics are quite easy to define*" (P1).

When participants were asked to clarify why they deemed SUP 'a problem' six themes emerged as principle concerns, the top three are discussed below (Appendix 10).

1. **Quantity.** This broadly refers to the amount of SUP produced and consumed, and was the most quoted (66% of participants). From the production side P7 mentions that "*we shouldn't be producing it in the first instance*". More of the comments were focused on consumption: P12 stated that it's "*the whole consuming ethos that we have*" and is echoed by others; "*the size and the scale of what you can buy has become a great issue*" (P2), and "*the apparent need in society to consume lots of stuff*" (P9).

2. **Single-use.** This was the second most quoted concern with four HLIs making a reference. This theme includes issues about the disposable nature of products – "*it's disposable and single use items in general*" (P8) – and a throw-away culture – "*living in a throwaway society and that's seen as acceptable*" (P3).

3. **Disposal**. A quarter of HLIs mention issues of waste and method of disposal as a problem of SUP. P1 broadly refers to a "*general waste problem*" and P2 raises the issue of "*people not disposing of it properly*". P10 discusses the "*types of plastic which we can't currently recycle*" and how it's "[plastic] *pollution that seems to be the biggest problem*".

However, it must be noted that most of the HLIs also commented on the benefits of SUP and the constructive role it plays in society. As P2 states: "*obviously plastic itself has very good properties…it's not like we should eliminate it completely*". Importantly, P10 notes that *"there aren't necessarily alternatives when you need plastic to perform that function, the other alternatives are no better at the moment".*

4.2.2 Reduction initiatives

4.2.2.1 Quantity of initiatives

In every instance the number of initiatives cited by each participant differed from the number found in the REA. On average each HLI cited 3.5 more initiatives during the in-depth interviews than were found in the REA. There were three exceptions but as P10 stated "*I probably can't remember them all off the top of my head*" which may explain the lower figure for this – and the other two – institutions.

4.2.2.2 Successful initiatives

With regard to best practice there are a variety of initiatives the participants claim as being successful (Appendix 10). Reusable coffee cups was by far the most cited measure with over half the participants

claiming this to be their most successful initiative. However, as the results show this may have been due to its combined effect with a levy/discount – "*they have got these things* [reusable coffee cups] *and they get money off every time they get a drink now, so it's worth their while using*" (P6) – or as they have been the most longstanding measures – "*they've probably been the most impactful in time because we've been doing it for such a long time*" (P10).

That is not to say that other institutions have not found success with alternative initiatives. P4 notes "*the most striking would be the removal of all plastic water bottles that's…been the biggest headline initiative*". Additionally, reusable water bottles have been mentioned by 25% of HLIs as being a successful intervention: "*we went for Chilly* [bottles]…*and the take up of them was unbelievable*" (P5).

When comparing the 'most successful initiatives' against the most popular initiatives (as measured through the REA) there appears to be a little discrepancy. Only one HLI stated that Vegware was one of their most successful initiatives despite it being the joint fourth most implemented measure. Similarly, neither water fountains (second most implemented) or straws (joint fourth) were mentioned during the interviews as the most impactful.

4.2.2.3 Quantification

None of the institutions had quantifiable data for all of the initiatives they had implemented and two HLIs had not attempted to quantify any at this stage. Most institutions stated this was due to timing – "B*ecause a lot of it has only been done recently we haven't really quantified anything*" (P1), a lack of resources – "O*ne thing we are bad at is collecting quantifiable data and as I am the only sustainability person here"* (P6), or the size of the HLI – "Q*uantifying is proving quite difficult I guess because of the scale of the institution*" (P9). Therefore, whilst some initiatives (primarily reusable coffee cups) have been relatively well quantified among a number of institutions – "*60,000 cups saved in the last year*" (P9) – it is difficult to fully determine the success or impact many measures have had.

4.2.2.6 Challenges and future initiatives

There are a range of barriers to introducing new measures and maintaining stakeholder engagement in current ones (Appendix 10). The primary barrier cited by 75% of the participants was financial; either cost – "*it will be down to cost, alternatives tend to be more expensive*" (P12) – or lack of funding to the university – "*we are being faced with changes in funding to universities with the student fee review*" (P11). Another barrier mentioned by a quarter of the participants was a conflict in environmental interests. As P6 notes: "*looking at the overall environmental impact is very blurred in a lot of things*" and this is echoed by P3: "*for someone else it being Fairtrade is more important"*.

Another issue mentioned by 75% of participants, but not stated when asked about barriers, is the use of compostable/biodegradable takeaway items. The primary issue appears to be disposal with only two participants confirming they had an end of life solution (In4 and In6), both sending them to anaerobic digestion facilities. The other institutions process the items with general waste: "*although it's deemed biodegradable a lot of anaerobic digesters and companies won't take them*" (P8). Interestingly, only two of the participants interviewed (P3 and P7) said they don't use bioplastics: "*we are not going to be substituting materials if there is no end of life plan*" (P3). Responses to using

bioplastic range from "*there are question marks about whether if what we did was a genuine benefit*" (P1) to simply "*they haven't got the plastic content in there so that's kind of the only benefit*" (P12).

4.2.3 Motivations

4.2.3.1 Motivations to act

When directly asked about what was driving the recent trend in SUP reduction measures at their institutions, the participants had a variety of reasons (Appendix 10). Chief among these was the pressure from students, with 75% of participants citing this. As P8 explicitly states: "*it's the students that drive that change*". Comments from P5 support this and also highlight the influence of staff: "*led and decided by the staff and students, if you've got the pressure from them it's easier then to influence".*

The national public discourse is another frequently declared motivation for action, with two thirds of participants discussing this. As P4 explains: "*increased self-awareness as a result of public discourse on single-use plastics*". The public discourse around SUP is often discussed in relation to the effect of the media – particularly Blue Planet II – and was cited by over half of the participants. P12 mentions how "*you only have to mention Blue Planet, even if you haven't seen it you know what it's about*". P10 adds that "*there was obviously a lot after Blue Planet II, it was in the public eye a lot more*".

However, all these motivations are often influenced by each other. As P9 summarises: "*the Blue Planet effect over the last couple of years, and the huge increase in public awareness and therefore staff and student pressure to act, all come together to make the perfect opportunity to…ride the wave to help drive quick and effective change"*.

4.2.3.2 Pledges and commitments

As mentioned in a previous section 15 HLIs have pledged or committed to reduce SUP or become SUP free. However, only two participants thought it was possible for their institution to be SUP free (P5 and P9) with one of these having made a pledge. Whilst P5 believes it will be possible with "*pressure from a lot of students*", P9 says "*yes it's possible*" but caveats this with: "*we need to be very careful… we need to be very mindful of the fact that sustainable solutions don't yet exist*".

Over half the participants believe it is not possible for their HLI to become SUP free. There are a variety of reasons for this. P3 argues that if HLIs pursue a SUP free agenda it will create "*material that they will be unable to deal with sustainably…some of the* [alternative] *items…can have negative effects on the environment*". Alternatively, P6 mentions: "*I don't think we have the power…to dictate it because a lot of it comes from the suppliers*". Finally, P11 states that it is not possible to be SUP free as "*in many cases it* (SUP) *is still the only real solution to some of our problems like contamination in labs* (laboratories)".

Despite the above arguments, the institutions that had made pledges or commitments had a variety of justifications. P9 remarks that "*unless you set the challenge and start the journey in motion then you are never really going to make progress towards it*". P3 states that a pledge can "*pull a lot of people together with different targets*". Those that had not made a pledge or commitment have not done so for a range of reasons. Some have a process issue that prevents a pledge being made: "*it's*

not a centralised procurement thing and…we've got a medical school who are heavily reliant on plastic" (P6). However, for P8 they have "*a culture at our university where we don't generally put pledges to things we're not 100% sure we're going to achieve*".

5. Discussion

The results will be discussed in four sections below corresponding with the research objectives outline in Section 1.

5.1 Understanding and defining single-use plastic

As seen in the results, there appears to be a lack of clarity among HLIs over the definition of SUP. Only two institutions interviewed have a definition, and both adapted this from the Government's, which has limitations. For example there are ambiguities over whether bio-based and biodegradable plastics are included in this definition, and around the duration of use – is SUP a product designed to be used only once or for a short period of time (HM Treasury, 2018). By the very nature of plastic, most of these SUP items are durable (Thompson et al., 2009; Section 2.3.1) and could be used multiple times, such as a SUP bottle with a screw-on cap. Therefore, it begs the question, how much is an item designed to be single-use and how much is it society prescribing a label for the sake of convenience?

Yet, even with these limitations it is commendable that definitions were sought. If these results are typical of UK HLIs then it can be assumed that very few institutions have adopted a definition of SUP. A justifiable response to this could be: if SUP is being reduced, does it matter? To this, two important points need raising. Firstly, it depends on what that plastic is being replaced with. As shown with biodegradable plastics, the numerous varieties can react differently under distinct conditions, potentially doing more harm than good (Emadian et al., 2017). Secondly, a clear definition creates a common understanding of an issue, establishing robust parameters (Whitfield, 2012). This allows for better comparability and more effective standardisation.

Despite the above, results show a far greater understanding of the issues around SUP, which are consistent with those from the literature. This is particularly evident around the primary issues of quantity (Thevenon et al., 2015; Elliott and Elliott, 2018), and SUPs disposable nature (Hopewell et al., 2009; De Smet, 2017). The actions of HLIs reflect these views among the more popular initiatives seen in the REA (reusable coffee cups, water fountains, coffee cup incentive/levy) which all address issues of both quantity and disposability (Poortinga and Whitaker, 2018). Yet, while these are effective consumption reduction strategies, only 14 measures have been taken to eliminate a SUP item entirely and seven measures simply replace one single-use item for another or look to improve recycling for existing SUP items.

Given the evidence discussed, it seems more clarity is needed over the definition of SUP within HLIs. Yet this is an understandable situation, with uncertainty in other sectors and the Government readily admitting more research is needed, particularly into bio-based and biodegradable plastics (DEFRA, 2018b). Additionally, there are alternative classifications of the issue with some actors choosing to be more specific and refer to 'problematic plastics' (WRAP, 2019), while others discuss 'avoidable SUP'

more broadly (DEFRA, 2018b). Lastly, although institutions appear to understand the issues around SUP, results suggest more could be done to eradicate rather than reduce SUP items.

5.2 Reduction initiatives

5.2.1 Engagement

The results of the REA show just under half of HLIs have implemented SUP reduction measures. However, as the interviews show, the participants quoted 3.5 more initiatives than were found in the REA for their institution. This variation may confirm the limitations discussed in Section 3.2.2 and suggest this trend could extend to other HLIs, implying greater engagement than is evidenced. Yet, as seen from the literature implementing and disclosing environmental policies has a positive benefit on an organisation's reputation (Toms, 2002). It is therefore reasonable to conclude that if HLIs want to take advantage of this they should endeavour to make this information publicly and easily accessible.

5.2.2 Best practice

It is not practical to analyse all initiatives but the most prevalent will be discussed below under themes of coffee cups, single-use bottles and takeaway items.

5.2.2.1 Coffee cups

The measures taken to reduce disposable coffee cups (reusable cups, discounts and levies) were cited as the most successful initiatives by a majority of interviewees and returned the most results in the REA (Appendix 9, Appendix 10). This issue is addressed throughout other nations (Rosa, 2018), and UK businesses have also taken the initiatives up (Appendix 11**Error! Reference source not found.**).

While the literature regarding reusable cups is limited, it does highlight their ability to reduce the use of disposable cups (Poortinga and Whitaker, 2018). This was found to be even more effective in combination with a levy (reusable cup usage increased to 17.4%) and to a lesser extent a discount (12.4%), implying the former is more effective (Poortinga, 2017). This is interesting given levies are adopted less than incentives among HLIs (Appendix 9) and businesses (Appendix 11), suggesting it may be perceived as a financial risk.

From a materials viewpoint Almeida and Bengtsson (2018) conducted a cradle to grave analysis and found that cork, plastic, glass and bamboo all had similar results for energy use, water use and kg CO_2 eq, with a reusable plastic cup being marginally better than the others overall and all materials outperforming disposable cups (Almeida and Bengtsson, 2018; Appendix 12). However, it must be noted that this report was produced for KeepCup (a reusable coffee cup producer).

5.2.2.2 Single-use bottles

Upgrading or increasing the number of water fountains was the second most adopted measure found in the REA (**Error! Reference source not found.**) and reusable water bottles were mentioned as one of the most successful initiatives by 25% of participants (**Error! Reference source not found.**). The literature supports these initiatives with one study showing 91% of university students would be willing to switch away from disposable water bottles if there was an easy way to refill reusable bottles

(Chudwick et al., 2013). Eleven HLIs are going even further by phasing out or eliminating plastic bottles completely (Appendix 9). However, research of a university that had trialled a plastic bottle ban does show that this may not eliminate the problem, pushing sales away from campus outlets to nearby retailers (Choate et al., 2018).

Despite all these measures having success, studies from countries in Asia and North America highlight significant barriers to uptake, such as the perceived health risk of tap water and poor taste (Qian, 2018; Graydon et al., 2019). Given HLIs in the UK have almost 500,000 non-UK students combined (UKCISA, 2019), it suggests the above measures should be accompanied by awareness campaigns to encourage engagement.

5.2.2.3 Takeaway items

Substituting SUP takeaway items - such as cutlery and takeaway boxes - with alternative materials, was the fourth most adopted measure among HLIs (Appendix 9Appendix 10). In the main, SUP takeaway items were exchanged for a compostable or biodegradable alternative.

The benefits (Kale et al., 2007; Meeks et al., 2015; Mostafa et al., 2018) and concerns (Piemonte and Gironi, 2011; Reddy et al., 2013; Balestri et al., 2017) over bio-based and biodegradable plastic are discussed in Sections 2.2.1 Benefits and advantagesand 2.2.2.4 Bioplasticsrespectively, but the amount of literature on both sides shows just how much additional research is needed in this area. Despite this uncertainty, adopting bioplastic takeaway items may be a justifiable position – if only because fossil fuels are a finite resource – but HLIs face an added complication over a lack of available infrastructure for correct disposal. That is, via in-vessel composting (IVC) or anaerobic digestion (AD) with a pre-treatment composting step (DEFRA, 2018b, p.126). Results show only two institutions had contractors accepting this waste, with the rest processing it as general waste. Yet there is an argument to say bioplastics are still preferable both under landfill conditions (Kolstad et al., 2012), and when incinerated (NatureWorks, 2019), although this is contested (Reddy et al., 2013). It is therefore very clear that this technology is still at an early stage and additional examination and resource is needed. Thus, it is interesting to note that this is one of the most popular measures taken by HLIs, especially considering the reservations of all participants to have implemented it (Section 4.2.2.6

What the above perhaps shows most clearly is the need to move away from single-use items more generally and towards reuse. Indeed, results from the REA show some institutions are eliminating takeaway cutlery entirely and only offering metal cutlery for eating in, while others are implementing a levy on takeaway cutlery (Appendix 9)All initiatives found during the REA and the number of HLIs that have implemented them.. However, the number of institutions employing these measures is limited and there are reported disadvantages to both bans and levies (Carter, 2007). That said, these are interesting interventions and should be monitored closely as they have large potential.

5.2.5 Challenges

Similar to the section above, there are a number of barriers and it is simply not practical to discuss them all given the parameters of this report. The primary challenges will be discussed, however, due to the variety of barriers this is something requiring additional research.

5.2.5.1 Financial barriers

Seventy-five percent of interviewees cited financial reasons as the greatest challenge to implementing SUP reduction measures. It seems there are ultimately two concerns here: the costs of making a transition; and the level of funding received.

Funding is a delicate point for HLIs. In 2018 a Government commissioned review called for a number of changes but of particular interest is a reduction in the cap on tuition fees from its current level of £9,250 to £7,500 (Augar et al., 2019). While the report does recommend that the Government replace the shortfall in fees, there is concern around these proposals within HLIs, particularly given the uncertainty within the current political climate (Coughlan, 2019). Therefore, there is sound reason to assume HLIs may be hesitant before taking any bold steps with regard to SUP that may impact its income.

With regard to cost, purchasing alternative materials that may be more environmental than CP will almost always incur greater costs (Appendix 13). These additional costs can be passed along to the consumer in the case of retail items but – when HLI's primary customers are students – it proves a difficult balancing act given the average debt for a 2018 graduate was £36,000 (Bolton, 2019) and 78% of students worry about their financial situation (Bushi, 2018).

5.2.5.2 Conflicting environmental issues

Twenty-five percent of participants noted that while reducing SUP was important, this often conflicted with other environmental issues.

One of the most topical trade-offs regarding SUP reduction is the potential for food waste. A review paper noted that annually 173kg of food is wasted on average per person – or 20% of food produced – in the EU (Fusions, 2015). One of the principle methods supermarkets use to reduce this waste is to package food items in plastic. There are clear benefits to packaging – just 1.5g of wrapping extends the shelf life of a cucumber from three days to 14 – and plastic offers a lighter, alternative to glass and card, reducing transport emissions (Iacovidou and Gerassimidou, 2018).

However, it could well be argued that plastic food packaging is failing to stop the food waste problem. Schweitzer and colleagues (2018) support this, concluding: food waste has grown in line with the growth of plastic packaging; pre-determined packaging sizes has led to food being 'cut-to-size' to fit the packaging, in some cases wasting as much as 30-40% of the product; and multi-packs force customers to buy more food than they actually need.

What seems to be apparent from these trade-offs is the need to develop an integrated approach to addressing SUP. Additionally, although packaging practises should be altered, there is nothing as cheap and effective as SUP to preserve food. Therefore, unless a new material is produced, large-scale change will be needed to remove SUP packaging and decrease food waste.

5.3 Motivations

The motivations and implications of HLIs pursuing SUP reduction measures will be discussed in this section, along with the motivations to announce pledges or commitments.

5.3.1 Single-use plastic reduction

Results from the interviews highlight two principle motivations for SUP reduction: student pressure, and public discourse through increased media exposure.

Student – and increasingly staff – pressure to act on environmental issues has been historically effective at driving change. One clear example of this is the embracement by students in numerous HLIs, of the fossil fuel divestment movement (Ayling and Gunningham, 2017). The campaigning pressure resulted in 76 UK HLIs committing to divest from fossil fuel companies covering an endowment wealth of over £12bn (People & Planet, 2016). More recently student strikes over a lack of action on climate change has lead to a flurry of announcements by HLIs declaring a climate emergency, with over 7,000 globally committing to new climate targets (UNEP, 2018).

The second most cited reason for reducing SUP is the increased scrutiny of the media and the prominence in public discourse because of this. This is seen clearly in the effect of Blue Planet II which is thought to have changed how 88% of the public use plastics (Waitrose and Partners, 2018) and led to a record 162,000 members of the public responding to a call to evidence from the Treasury (HM Treasury, 2018). The response from Government was no less urgent with the Prime Minister urging a 'war on plastic waste' and vowing to eliminate avoidable plastic waste by 2042 (Hann et al., 2018). Despite this sudden attention on SUPs, the situation may detract from other – arguably more important – issues such as global warming, through either a diversion of resources or political will to act, although the participants interviewed deny this is the case within their institutions.

Despite the above motivations to reduce SUP, there is a broader issue to discuss here; should HLIs be motivated to simply take action, or are perceptions and behaviours also within the ability (and remit) of HLIs to shape. McIntosh et al. (2001) notes how – despite the best efforts of some within the system – educating to enhance sustainability is simply not a priority. This notion is highlighted by a perpetuation of unsustainable behaviour, led by the very elite that are educated at the world's best HLIs (Cortese, 2003). Therefore, whilst efforts are made by many within HE to incorporate sustainable issues into the curriculum (Figueiró and Raufflet, 2015), if HLIs truly desire to affect change, a more integrated and holistic approach is needed. However, it could well be argued this is not for HLIs to address, instead falling to national and local governments.

5.3.2 Pledges and commitments

It is also fitting to discuss the motivations behind the pledges and commitments made by HLIs.

Firstly, it is worth discussing whether the pledges made are realistic. A majority aim to eradicate all – or a portion of – SUP items, for completion in the range of 2022 to 2025. This is relatively consistent with pledges made by organisations and institutions worldwide, such as the New Plastics Economy Global Commitment, which looks to eradicate 'problematic' plastic packaging by 2025 and is signed

by over 400 institutions – including the UK Government (New Plastics Economy, 2019). However, there are very few examples of organisations pledging to eradicate SUP entirely, with most retaining recyclable and biodegradable plastics (WRAP, 2018a). Furthermore, only two participants stated it was possible to eliminate SUPs, with most believing it unlikely in the current climate.

Given the above it appears that eliminating specific plastic items may be achievable, however, eradicating SUP completely seems unfeasible. This raises a number of questions: why make such ambitious targets; are no SUPs considered beneficial or necessary; is it advantageous to pledge something impossible to achieve, potentially counterproductive, or not within the control of the institution; and how will stakeholders respond to an unfulfilled pledge?

Koessler (2019) discusses a number of motivations for public commitments, including a genuine desire to affect change, or to conform to a current trend. The participants interviewed in this study claim the primary motivations of pledging to eliminate plastic are to unite different parties around a common cause, and to inspire change (Section 4.2.3.2). This sentiment is supported by the literature which highlights the potential of pledges to promote cooperation and drive further contributions (Koessler, 2019).

It could be argued that setting unachievable, aspirational targets is not harmful if SUP is being reduced, innovation pushed, and the public engaged. However, findings by Barrett and Dannenberg (2016) show that pledges can only be effective if they are credible. Additionally, caution must be taken due to the potential ramifications of an unfulfilled pledge, with some scholars claiming that once trust is broken, it can never be repaired (Tomlinson et al., 2004), or at the least is counterproductive to collaboration (Wilson and Sell, 1997).

With regard to the necessity of SUP, almost all participants interviewed spoke of the need to retain SUP within laboratory settings for the foreseeable future. Plastic waste from laboratories is significant, thought to contribute about 5.5m tonnes of waste worldwide annually (Urbina et al., 2015). Despite this, the vast quantities of SUP is justified on the grounds of cost, and to save time and resources by avoiding laborious decontamination processes (Sawyer, 2019). Therefore, if most institutions can't foresee a workable solution to this SUP it further reinforces the notion that complete eradication from HLIs is untenable at present, and the use of CP is – if not necessary – then the best existing option.

The quantification and monitoring of implemented measures was relatively poor among the interviewed HLIs both from those who had, and hadn't, set pledges or targets. It therefore calls motivation into question as it seems counterintuitive not to monitor these measures, when doing so is a crucial step for making sense of large amounts of data, planning, and tracking progress towards a target (Shor, 2008). However, there may be a number of reasons for the lack of quantification or monitoring: a deficiency in staff time or funding (as stated in interviews); the desire to act before establishing a monitoring system due to the rise in public pressure; or potentially less concern about creating a robust monitoring scheme and more over developing a public vehicle to drive engagement and change (similarly to motivations behind many of the pledges).

5.4 National context

The policies and ambitions of the UK regarding SUP have been laid out clearly in the Government's Waste and Resources Strategy (DEFRA, 2018a; Appendix 5)UK Government policies, targets and ambitions regarding plastic. Source: DEFRA (2018b). The below analyses how HLIs fit within the national context before broadening out to discuss wider implications.

The impact of HLIs at a national scale can be significant. As Uhl and Anderson (2001) highlight, they are influential and prestigious institutions in their own right, with the ability to contribute towards national objectives from the bottom up. Indeed, HLIs are forming crucial regional and even global partnerships to promote sustainable development (Kawabe et al., 2013), and are vital to the development of rigorous scientific research that informs local and national policy decisions.

Despite this, more can be done at a national level to assist HLIs in achieving greater reductions in SUP. Producers and suppliers need to be compelled to reduce the SUP in their products and packaging, which the Government is looking to do through extended producer responsibility and targets around the content of packaging materials (DEFRA, 2018b). Yet if more HLIs move towards using an increasing amount of recyclable, compostable or biodegradable products, consideration will need to be given over the waste process. That said, plastic waste is not merely a domestic issue but a global one, evident in the recent Chinese intervention to ban the import of nonindustrial plastic waste (Brooks et al., 2018). This caused backlogs in high export nations, like the UK, where infrastructure is not in place to deal with the demand (Walker, 2018), while simultaneously causing an increase in illegal dumping of this waste overseas (Ross, 2018).

Yet despite the above, the explosion in exposure over SUP has caused the public to demand change, exhibited through multiple polls (Populus, 2017) and consultations (HM Treasury, 2018), that gives industry and Government a social license to operate (Vince and Hardesty, 2017). This recognition from society, together with proposals from a range of actors, has created a potentially unique window of opportunity in which to push ambitious policies (Kingdon, 1995). To progress, it now only needs the political will from those in power to take advantage of this window. Signs of this came with the commitments from Government to address SUP, outlined in the Waste and Resources Strategy (DEFRA, 2018b). However, if the government fails to act within this window and the issue falls from public attention, it could result in the missed opportunity for meaningful reform.

6. Conclusion

This paper fulfils the aim established in Section 1: to understand how HLIs perceive and act on SUP, what motivates them to do so, and the wider national context of this. This is achieved through in-depth interviews and a REA, to address the four research objectives.

With regard to the first objective, UK HLIs have not clearly defined SUP and the classification of bio-based and biodegradable plastics within any definition is unclear. Furthermore, the clarity around what constitutes a single-use item is vague. Given the ambiguity around this subject within both the literature, and wider institutions, this is understandable. However, when looking at how HLIs perceive the issues surrounding SUP, there is a much closer understanding, in line with current research.

The results highlighted that SUP reduction measures are dominated by initiatives related to catering, with particular success seen in reusable coffee cups (with an accompanying levy or discount) and water fountains. This is consistent with industries and organisations which have also focused on this area. However, there is an emphasis on reduction as opposed to elimination measures, despite much of the literature indicating a shift away from single-use items is required. Additionally, there seems to be considerable confusion over biodegradable plastics and the true environmental benefit of these, contrary to their popularity. Further difficulties for HLIs lie in reduced levels of funding and available resources, together with conflicting environmental commitments. These findings address the second research objective.

When examining the motivations for reducing SUP the interviews highlighted that student pressure and media exposure were primary contributing factors. This is reinforced by evidence from the literature and past environmental campaigns. These findings indicate that further action – both on SUP and other environmental issues – can be achieved if students are willing to coordinate and campaign, bringing the issue to the public and institution's attention.

When exploring motivations for announcing pledges or commitments, HLIs note the need to inspire change and bring stakeholders together – despite the apparent impossibility and undesirability of complete elimination of SUPs. It is not yet clear whether the strategy of careful planning and research is more effective or sustainable than bold pledges to drive action. The former may provide stability and prevent the risk of transitioning to a less environmental solution, while the latter may drive innovation and prevent the issue falling from public attention. The above achieves objective three.

Research objective four was accomplished by analysing all data within a national context. It is clear to see that HLIs are frontrunners within SUP reduction. Yet they require support from central government to drive further change. From the Government's position this is a prime opportunity to take control of the recycling market and develop a more integrated system of infrastructure, thereby providing the capacity needed to process the required waste. However, the demand for high quality recyclable materials needs to be stimulated. Furthermore, Government needs to demonstrate they are willing to put the necessary regulations in place to reduce SUP products and packaging. The Government has committed to a raft of measures within their Waste and Resources Strategy which addresses these issues, but it will require the necessary political resolve to push these policies forward.

Overall, the primary message that comes through from HLIs is uncertainty. Uncertainty about the meaning of SUP, uncertainty about the correct measures to implement, uncertainty about the extent or outcome of pledges made, and uncertainty about the future national direction on the issue of SUP. This could be due to a number of reasons such as lack of knowledge or guidance, but mostly seems to stem from the pace of change regarding SUP. As a result, HLIs are finding it difficult to respond to this and pin down clear objectives. It is not a simple matter of a 'good' product and a 'bad' product, but how that product is used.

These institutions are certainly ambitious, and their desire to make a transition away from SUP is clear. If they are to keep innovating and moving forward, they will not only need additional guidance and research, but also for central government to provide support, improved waste infrastructure, and a bold policy agenda.

6.1 Applications, future research and limitations

This research provides an extensive, although not exhaustive, reference of SUP reduction measures specific to HLIs, with an analysis of successes and challenges. With this, HLIs can build upon their existing initiatives or begin the process of introducing reduction measures. Furthermore, it provides an examination of the motivations behind these reductions which can be used to push further change on environmental issues. It is recognised there are limitations regarding interview sample size and the depth of analysis within the REA.

This paper also highlights a number of gaps in the literature that require further research. Importantly, more examination is needed into the definition of SUP, including clarification of bio-based and biodegradable plastics and further clarification of single-use items. Furthermore, additional analysis into the various alternative materials and their relative environmental impacts is necessary for HLIs and others to make evidence-based decisions.

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8. Appendices

8.1 Appendix 1

Table 1. Definitions of plastic

Definition	Source
“Plastics are synthetic and semi-synthetic polymeric compounds, derived primarily from fossil carbon sources such as crude oil and natural gas.”	Gómez and Michel (2013)
“Consisting of a wide range of synthetic and semi-synthetic organics, plastics are malleable materials that can be molded into solid objects of a multitude of shapes and sizes.”	da Costa et al. (2016)
“Synthetic plastic is made up of artificial or semi artificial organic compounds, which are flexible in nature.”	Thakur et al. (2018)
“The term plastics applies to a wide range of materials that at some stage in manufacture are capable of flow such that they can be extruded, moulded, cast, spun or applied as a coating.”	Thompson et al. (2009)
“Plastic is defined as a synthetic material composed of polymers.”	Heidbreder et al. (2019)
“Plastics are synthetic or semi-synthetic organic polymers that are lightweight, strong, durable and low cost.”	Leal Filho et al. (2019)
“Polymeric material that may contain other substances to improve performance and/or reduce costs.”	(Vert et al., 2012)

Table 2. Institutional definitions of SUP

Definition	Source
“'single-use plastic product' 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 reused for the same purpose for which it was conceived.”	(EC, 2018b, p.25)
“…single-use plastics includes all products that are made wholly or partly of plastic and are typically intended to be used just once and/or for a short period of time before being disposed of.”	(HM Treasury, 2018, p.8)
“Single-use plastics, often also referred to as disposable plastics, are commonly used for plastic packaging and include items intended to be used only once before they are thrown away or recycled.”	(UNEP, 2018, p.2)

8.2 Appendix 2

Statistics outlining the benefits of plastic. Source: BPF (2018).

Statistic	Page number
Using plastics in modern washing machine drums reduces water consumption by 40-50%.	p.30
Wrapping bananas in a modified atmosphere bag extends shelf-life by 2 – 3 days.	p.30
In Europe, only 3% of all products delivered to customers are spoilt during transport thanks to packaging – compared to 50% in developing countries.	p.30
Within construction the use of plastic building blocks saves 95% of CO_2 emissions in comparison to traditional bricks.	p.35
The production of plastic bags consumes less than 4% of the water needed to make paper bags.	p.38
Within transport, the lighter weight of plastic packaging results in a 60% reduction in greenhouse gas emissions.	p.43
Plastic food packaging improves the shelf life of foods by as much as 14 days and this can result in up to 20% less waste.	p.43
Plastic water pipes are designed to last more than 100 years and have the lowest failure rate compared to other materials.	p.63
More than 10 million hearing aids have been 3D printed worldwide from plastic and every year 600,000 plastic insulated pacemakers are fitted.	p.96

8.3 Appendix 3

The UK consumption of SUP items and the ranking within the EU28. Source: Elliott and Elliott (2018).

Product	**Consumption** (2018), billion items	**EU ranking**, consumption per capita
Cotton buds	13.2	1
Sanitary towels	4.1	1
Crisp packets	8.3	2
Wet wipes	10.8	2
Cutlery	16.5	2
Straws	42	2
Stirrers	44.1	2
Drinks cups and lids	4.1	2
Food containers	5.2	2
Sweet wrappers	6	8
Drinks bottles	10.1	9
Cigarette filters	45.8	25
TOTAL	**210.2**	**5**

8.4 Appendix 4

The most littered plastic items in the UK (including flushed items), and the top ten UK sources of marine plastic (by number of items emitted to the marine environment). Adapted from: Hann et al. (2018), Elliott and Elliott (2018).

Source of plastic	Litter quantity (billion items)	Litter rate (%)	Marine waste rank (by no. of items)	Material size
Fishing related items	-	-	1	Macroplastic
Tyres	-	-	2	Microplastic
Bottles and caps	0.7	6.9%	3	Macroplastic
Plastic pellets	-	-	4	Microplastic
Wet wipes	3.4	31.3%	5	Macroplastic
Takeaway containers	0.3	5.1%	6	Macroplastic
Clothes washing	-	-	7	Microplastic
Bags	-	-	8	Macroplastic
Feminine hygiene products	0.9	21.3%	9	Macroplastic
Crisp packets	0.3	3.7%	10	Macroplastic
Cigarette filters	14.6	31.9%	-	Macroplastic
Cotton buds	1.8	13.5%	-	Macroplastic
Drinks cups and lids	0.5	13.1%	-	Macroplastic

8.5 Appendix 5

UK Government policies, targets and ambitions regarding plastic. Source: DEFRA (2018b)

Policy/Ambition/Issue	Details	Page No.
Eliminate all avoidable plastic waste	Over the lifetime of the 25 Year Environment Plan.	p.13
All plastic packaging on the market is reusable, recyclable or compostable	By 2025.	p.13
'Polluter pays' principle	Extend producer responsibility for packaging. Ensuring producers pay the full costs of disposal for packaging they place on the market. By 2023 (subject to consultation).	p.31
Ecodesign standards	Setting minimum requirements through ecodesign to encourage resource efficient product design.	p.40
Recycled plastics	Tax on plastic packaging with less than 30% recycled plastic. By 2022 (subject to consultation).	p.41
Carrier bag charge	Extending and increasing the charge for plastic carrier bags. New policy would cover all retailers. Subject to consultation.	p.52
Product labelling	Providing consumers with better information on the sustainability of their purchases. Explore the option of ecolabels and whether labels should identify the level of recycled content within the packaging.	p.53
Ban on plastic products	Only where there is a clear case for it and alternatives exist. Already banned microbeads and currently in consultation to ban plastic straws, stirrers and cotton buds.	p.54
Addressing barriers to reuse	Through reporting and reuse targets for local authorities.	p.56
Promote reusable alternatives	Support consumer campaigns to promote reusable alternatives such as refill points for water.	p.58
Deposit return scheme	For single-use drinks containers. Target for 2023 (subject to consultation).	p.60
Reduce impact of disposable cups	Levy on all disposable cups is not being considered at this point. Government are considering: - Include disposable cups in deposit return scheme - Using packaging producer responsibility to incentivise business to produce cups that are easy to recycle - Setting targets to encourage higher levels of recycling	p.61
Removal of SUP from central government estate	By 2020.	p.64
Consistent recycling materials collected from households and businesses	Government will specify a core set of materials to be collected by all local authorities and waste operators (subject to consultation).	p.68
New waste infrastructure	Government has committed £3bn by 2042. This gives business the confidence to invest in waste management projects like anaerobic digestion.	p.78
Chemical recycling	In the short-term chemical recycling (recovery of base chemical constituents) can be used to recycle waste plastic where mechanical recycling is impractical or uneconomic.	p.79
Plastic free aisles	A commitment to work with retailers and WRAP to explore plastic free aisles where all food is sold loose	p.107
Signed the New Plastics Economy Global Commitment	Endorsed a common vision bringing cities, Government and business together. Committed to put ambitious policies in place well ahead of the 2025 target.	p.112
Recycling rate for packaging	65% by 2025 and 70% by 2030 (subject to consultation).	p.113
Commonwealth Clean Oceans Alliance (CCOA)	Driving international political commitments through the CCOA such as banning microbeads and cutting down on plastic bags. Up to £66.4m of UK aid has been committed to tackle plastic pollution.	p.115

Global Plastic Action Partnership	Public-private partnership to tackle plastic pollution of rivers, deltas and the ocean. Fast track resource and waste solutions in coastal countries. £2.4m of UK aid funding to this project.	p.116
Tackle plastic pollution from manufacturing sources	Over five years back a £20m research programme to generate evidence and solutions on this issue.	p.117
Marine Plastic Research and Innovation Framework	Work with others across the Commonwealth to develop this framework. This will encourage researchers from a broad range of disciplines to work across a range of relevant issues, including (but not exclusively): - Developing a circular economy to prevent plastics from becoming waste and getting into the oceans in the first place - The development of low carbon sustainable alternative to plastic - Sustainable options for cleaning up the marine environment. A contribution of £25m will be made to this.	p.117
Build capability and capacity	£16m to provide technical assistance and facilitate knowledge sharing with Commonwealth countries to tackle plastic pollution. £6m Commonwealth Litter Programme £3m Improve recycling and cost recovery from plastic waste in developing countries.	p.117
Standards for bio-based and biodegradable plastics	Call for evidence on the development of these materials	p.125
Plastic Research and Innovation Fund	This fund aims to reduce the environmental costs of plastic and litter. Sights are set on problematic plastics such as cigarette filters and chewing gum, which contain single-plastic polymers, and blight our streets and seas. £20m pledged to this fund.	p.127
Plastic and Waste Investment Fund	£20m of funding for this initiative. Will include exploration of new packaging materials, new recycling processes, packaging waste management, and reducing litter.	p.128
Smart sustainable plastic packaging	Establish the UK as a leading innovator in smart and sustainable plastic packaging for consumer products, such as biodegradable plastic bags, delivering cleaner growth across the supply chain, with a dramatic reduction in plastic waste entering the environment by 2025.	p.131

8.6 Appendix 6

Search terms used in the REA and the justification for these.

Search Term	Justification
Plastic	An overarching search intended to obtain results about plastics more broadly that may themselves lead to more specific pages.
Single-use plastic	A specific search precisely addressing the issue. May capture results not shown in the broader 'plastic' search.
Plastic free	A search term intended to yield results that may reference broad pledges, events or specific interventions.
Sustainability	Interventions addressing single-use plastic often fall under the remit of a sustainability team or are referenced to within the sustainability section of an HLI website.
Waste + plastic	If not a sustainability issue, then plastics are often discussed as a waste issue.
Catering + plastic	As has been addressed in section… many current initiatives have focused on catering and thus this is an area worth searching.

8.7 Appendix 7

The number of initiatives employed by each HLI to address SUP. As determined via the REA. This table only displays the 76 institutions that have taken one or more actions to address SUP, 170 HLIs were analysed in total.

Rank	HLI	Number of initiatives
1	Aston University	14
2	University of Manchester	13
3=	Aberystwyth University (Prifysgol Aberystwyth)	11
3=	King's College London	11
5	University College London	10
6	University of the West of England, Bristol	9
7=	University of Huddersfield	8
7=	Nottingham Trent University	8
7=	University of York	8
10=	University of Glasgow	7
10=	Guildhall School of Music and Drama	7
10=	University of Reading	7
10=	University of Warwick	7

14=	Bangor University (Prifysgol Bangor)	6
14=	De Montfort University	6
14=	Plymouth University	6
14=	Royal Northern College of Music	6
14=	University of Surrey	6
19=	Bournemouth University	5
19=	University for the Creative Arts	5
19=	University of Edinburgh, The	5
19=	Glyndŵr University (Prifysgol Glyndŵr)	5
19=	Institute of Education, University of London	5
19=	Liverpool Hope University	5
19=	University of Nottingham	5
19=	University of Sussex	5
27=	Cardiff Metropolitan University (Prifysgol Metropolitan Caerdydd)	4
27=	Edinburgh Napier University	4
27=	University of Exeter	4
27=	Glasgow Caledonian University	4
27=	London School of Economics and Political Science, The (LSE)	4
27=	Northumbria University Newcastle	4
27=	University of Oxford	4
34=	University of Bristol	3
34=	University of Cambridge	3
34=	Durham University	3
34=	Falmouth University	3
34=	University of Greenwich	3
34=	Imperial College of Science, Technology and Medicine (also known as Imperial College London)	3
34=	Loughborough University	3
34=	Manchester Metropolitan University	3
34=	University of South Wales (Prifysgol De Cymru)	3
34=	University of St Andrews	3
34=	University of Strathclyde	3
45=	Canterbury Christ Church University	2
45=	University of Chester	2

45=	City University London	2
45=	University of Dundee	2
45=	University of East Anglia	2
45=	Edge Hill University	2
45=	Goldsmiths, University of London	2
45=	Kingston University	2
45=	University of Leeds	2
45=	London Metropolitan University	2
45=	Newman University, Birmingham	2
45=	Oxford Brookes University	2
45=	University of Salford	2
45=	University of Winchester, The	2
58=	Anglia Ruskin University	1
58=	Ashridge Business School	1
58=	University of Bath	1
58=	Cardiff University (Prifysgol Caerdydd)	1
58=	University of Derby	1
58=	University of Essex	1
58=	Keele University	1
58=	University of Kent	1
58=	Lancaster University	1
58=	Leeds Trinity University	1
58=	University of London	1
58=	London South Bank University	1
58=	Middlesex University	1
58=	Royal Agricultural University	1
58=	Royal College of Nursing	1
58=	University of Sheffield	1
58=	Swansea University (Prifysgol Abertawe)	1
58=	Teesside University	1

8.8 Appendix 8

UK HLI targets, pledges and awards. *Committed to eliminating SUP entirely.

HLI	Date pledge/ target made, or award achieved	Pledge/target
Aberystwyth University (Prifysgol Aberystwyth)	2018	Awarded plastic free status by Surfers Against Sewage in 2018. Zero Waste Wales institution by 2027.
Aston University	2018	Awarded plastic free status by Surfers Against Sewage in 2018.
Bangor University (Prifysgol Bangor)	2018	Signed the New Plastics Economy Global Commitment (2025).
Canterbury Christ Church University	2018	Eliminate all SUP from catering by end of 2019.
University of Edinburgh, The	2018	Signed the New Plastics Economy Global Commitment (2025).
University of Exeter*	2018	'Plastic free' by 2020 in line with the Plastic Free Exeter Campaign. Drinks stirrers and straws phased out by September 2018.
University of Glasgow*	-	SUP free campus by 2024.
University of Leeds*	2018	SUP free campus by 2023. Offices and catering by 2020.
London School of Economics and Political Science, The (LSE)	2018	Reduce SUP with a focus on: plastic water bottles, SUP cups, disposable coffee cups, plastic disposable cutlery.
University of Manchester	2019	Eliminate avoidable SUP in catering, labs and stationary by 2022.
Nottingham Trent University	2019	Eliminate use of unnecessary SUP, no completion date. The following items have been selected to be removed by end of academic year 2020: water bottles, straws, non-recyclable coffee cups, drinks cups, cutlery, food containers, drinks stirrers, plastic coated paperclips, plastic bags, and new binders and report covers.
Plymouth University	2018	A plan for plastics with a range of actions across its catering, leisure and waste management activities. Joined three major initiatives: the WRAP UK Plastics Pact, Plymouth City Council's Plan for Plastics and the Surfers Against Sewage Plastic Free Waterfront Status.
University of Portsmouth	2018	Signed the New Plastics Economy Global Commitment (2025).
Ravensbourne	2018	Ravensbourne University London's Department of Fashion have signed the New Plastics Economy Global Commitment (2025).
Royal Northern College of Music*	2019	Supporting the Plastic free Greater Manchester pledge to remove SUP by 2020
University of Winchester, The	2019	All unnecessary SUP across offices and teaching spaces, catering and sporting facilities, and halls of residence by 2020.

8.9 Appendix 9

All initiatives found during the REA and the number of HLIs that have implemented them.

Area		Initiative	Number of HLIs employing initiative
Catering	Drink	Selling or promoting reusable coffee cups	38
		Upgrade or increase number of water fountains	31
		Incentive for using a reusable coffee cup	27
		Disposable coffee cup levy	20
		Eliminate SUP straws or switch to compostable/biodegradable alternative	20
		Reusable water bottles	12
		Phase out/elimination of SUP bottles	11
		Participation in the Refill Scheme	8
		Eliminate SUP cups at fountains	8
		Water bottling system into reusable glass bottles	7
		Recycle scheme for disposable coffee cups	7
		Eliminate SUP stirrers	6
		Biodegradable/compostable coffee cups	5
		Eliminate use of disposable coffee cups	2
		Reusable cups for soft drinks	2
		Eliminate SUP bottles and cups at meetings	1
		Levy for SUP cups used at soft drink fountain	1
		Swap scheme for reusable coffee cups	1
		Introduction of Coca Cola Freestyle Machine	1
		Levy for SUP water fountain cups	1
		Levy for purchasing a SUP water bottle	1
		Reverse vending machine for SUP bottles	1
	Food	Biodegradable/compostable cutlery	20
		Biodegradable/compostable takeaway packaging	9
		Increase/exclusive use of silverware and crockery	7
		Levy for using takeaway food packaging	3
		Eliminate plastic packaged condiments	3
		Reusable food container initiatives	3
		Reductions of cling film in catering	2
		Reduction of SUP for events catering	2
		Improved communication system for catering to avoid over-ordering and excess packaging	1
		Replaced plastic packaging on snacks	1
Laboratories		Swap to more glassware in labs	1
		Increased recycling of lab plastic	1
		Reduced glove use in labs	1
Other		Plastic free/awareness events	6
		Reusable/biodegradable/compostable bags	6
		Zero waste shop	3
		Eliminate/reduce pens	2
		Increased communications	2
		SUP action/working groups	2
		Plastic free day	2
		Replace all cleaning products that contain microplastics	2
		Contract/tender requirement to avoid SUP	1
		Recycle pens	1
		Eliminate SUP shampoo and soap bottles in hospitality	1
		Points system for avoiding SUP items	1
		Small scale recycling machine	1
		Eliminate use of balloons	1
		Plastic reduction included in EIAs	1

8.10 Appendix 10

Summary of all key responses during the in-depth interviews.

HLI	Institution definition for SUP	Issue with SUP	Number of initiatives quoted	Most successful initiatives	Shared initiatives	Standards for new products	Future Initiatives	Barriers	Key motivations for reduction	SUP free possible for institution
P1	No	Quantity	15	Plastic free days Sauce sachets.	Yes	No	Pledge. Website updates. Increase coffee cup levy. Plastic free champions.	Cost. Availability and suitability of alternatives.	Students Union Media attention Reputation	No
P2	No	Quantity Single-use	20	Reusable water bottles for cleaners and porters. Pencils instead of pens.	Yes	No	Inspect subliminal marketing. Lab plastics. Communities and organisations.	Cost. Availability and suitability of alternatives.	Public discourse	Majority
P3	No	Single-use Quantity Disposal	12	Awareness Week.	No	No	Work with procurement to ensure that waste is considered at the point of purchase. Lending models.	Misleading branding. Funding. Lack of infrastructure. Conflicting environmental interests.	Media attention Public discourse Student pressure Top-down pressure	No
P4	No	Convenience	12	Removal of plastic water bottles. KeepCups	Yes	No	Behaviour change. New app. Customers can use Tupperware for takeaway.	Hygiene. Laboratory plastic.	Media attention Public discourse Student pressure	Unsure
P5	No	Societal attitude Convenience. Manufacturing issue	8	Reusable water bottle	Yes	No	Disposable coffee cup collection	International students.	Student pressure Public discourse Staff pressure	Yes
P6	No	Societal attitude. Single-use. Manufacturing issue.	5	Vegware KeepCups	Yes	No	Working with suppliers	Cost. No central procurement. Conflicting environmental interests.	Student pressure Saves money Reputation Government policy	No

Continuation of Appendix 10.

HLI	Institution definition for SUP	Issue with SUP	Number of initiatives quoted	Most successful initiatives	Shared initiatives	Standards for new products	Future Initiatives	Barriers	Key motivations for reduction	SUP free possible for institution
P7	No	Quantity	4	Disposable coffee cup levy.	Yes	No	Deposit return for cups. Clearer signage. Increase awareness.	Communication. Unclear recycling guidelines.	Top-down pressure Reputation	No
P8	No	Single-use	5	Reusable coffee cups	Yes	No	Plastic free café Disposable coffee cup levy Customers can use Tupperware for takeaway.	Cost. International students.	Student pressure Top-down pressure Public discourse	No
P9	Yes	Quantity	9	KeepCups Alumni magazine paper cover	Yes	No	Awareness and engagement. Lab based SUP	Convenience. Cost. Lack of knowledge.	Top-down pressure Student pressure Staff pressure Media attention Public discourse	Yes
P10	Yes	Quantity Disposal	7	Reusable water bottles KeepCups	Yes	No	Disposable coffee cup levy	Cost. Availability of recycling schemes.	Media attention Public discourse Student pressure	No
P11	No	Quantity Convenience Disposal Manufacturing issue	10	KeepCup	Yes	No	Disposable coffee cup levy	Funding. Conflicting environmental interests.	Media attention Student pressure Staff pressure City wide policy	No
P12	No	Societal attitude Quantity	8	Reusable coffee cups. Removing the charge for non-disposables.	Yes	No	Coffee cup recycling Lab plastic	Cost. Changing people's perceptions. Convenience.	Reputation Student pressure Media attention Public discourse	Maybe

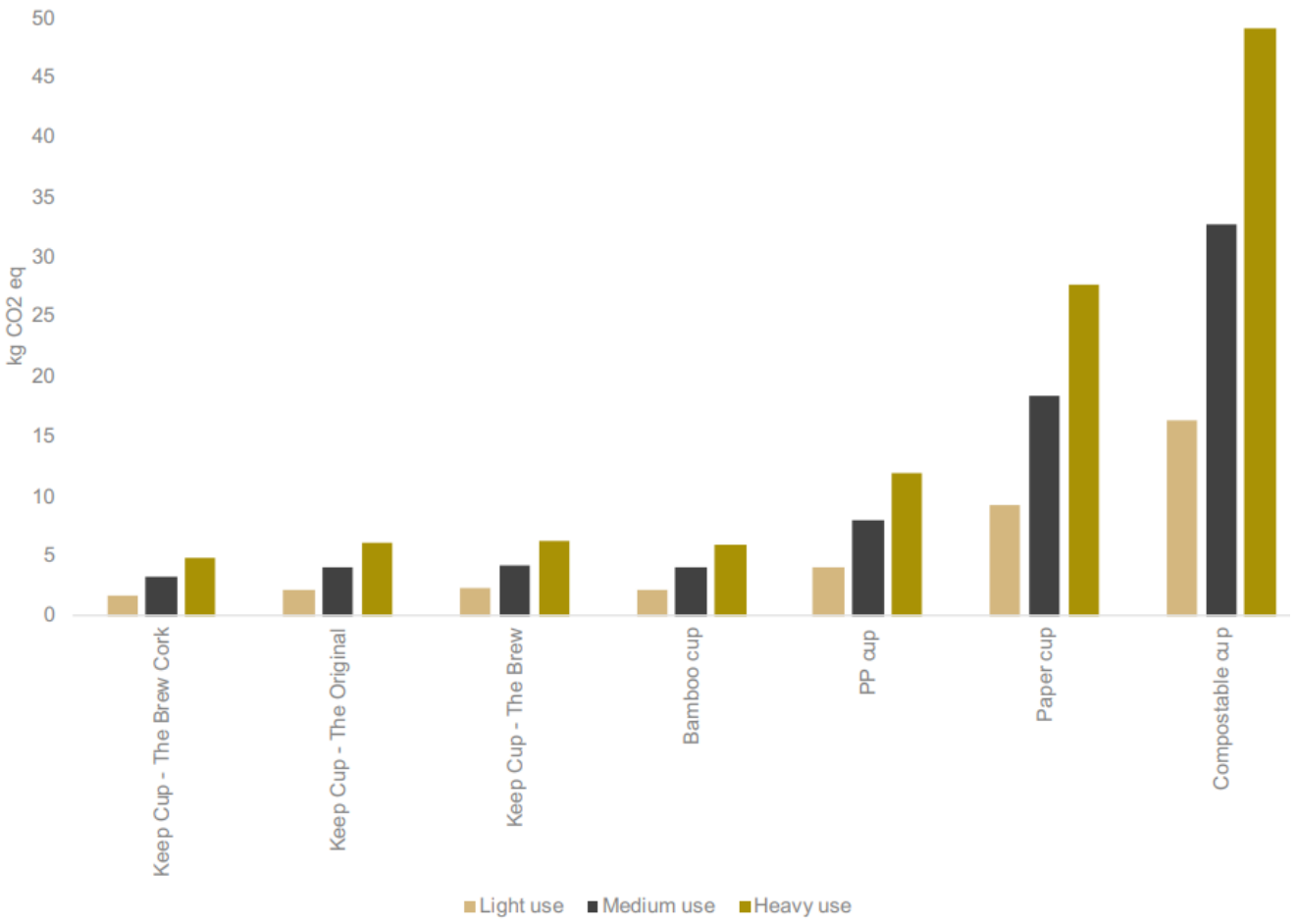
8.11 Appendix 11

Schemes by UK companies to reduce disposable coffee cups. All companies sell reusable coffee cups. Sources: (Schlee, 2017; Smithers, 2018; Costa Coffee, 2019; Boston Tea Party, 2019; Starbucks, 2019; Cafe Nero, 2019; BBC, 2019)

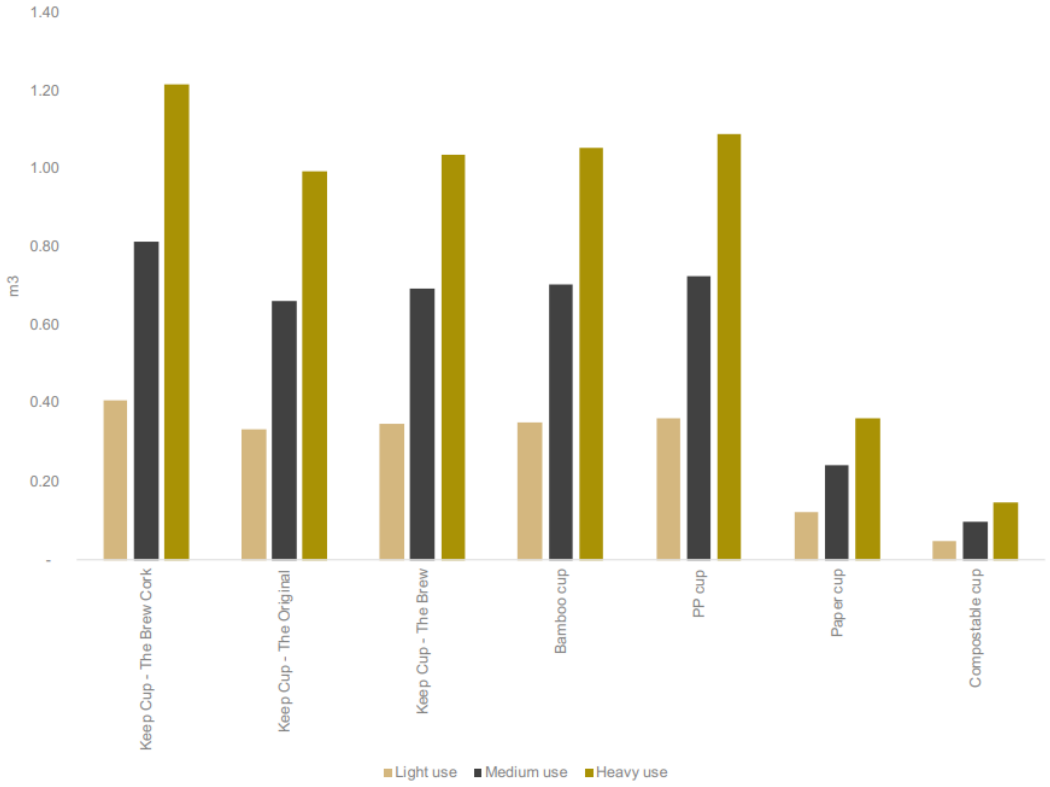
Company	Scheme	Outcome
Pret A Manger	50p discount for using a reusable cup	150,000 drinks served in reusable cups per week. Saved 6 million disposable cups.
Costa Coffee	25p discount for using a reusable cup	NA
Boston Tea Party	Banned disposable cups	186,146 disposable cups avoided 25% reduction in takeaway sales
Starbucks	25p discount for using a reusable cup 5p charge on disposable cups	Discount led to 126% rise in use of disposable cups
Café Nero	An additional loyalty stamp	NA

8.12 Appendix 12

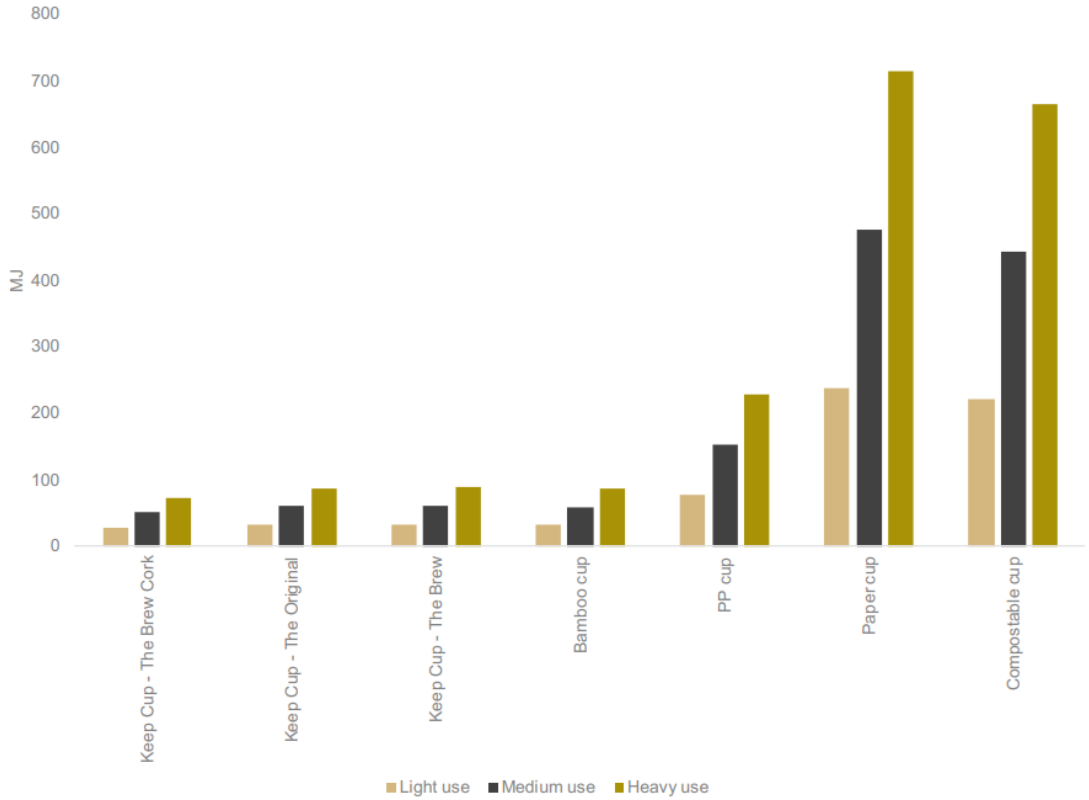
Findings from the cradle to grave analysis of 7 coffee cup materials produced by Almeida and Bengtsson (2018). For clarity KeepCup – The Brew Cork is made from glass with a cork band, KeepCup – The Original is made from plastic (polypropylene) with a silicone band, KeepCup – The Brew is made from glass with a silicone band, and PP is a polypropylene cup.



CO_2 impacts of a year of coffee drinking under different use intensities and different cups. Light use = 250 coffees. Medium use = 500 coffees. Heavy use = 750 coffees.



Water use of a year of coffee drinking under different use intensities and different cups. Light use = 250 coffees. Medium use = 500 coffees. Heavy use = 750 coffees.



Energy use of a year of coffee drinking under different use intensities and different cups. Light use = 250 coffees. Medium use = 500 coffees. Heavy use = 750 coffees.

8.13 Appendix 13

Examples of the price difference between CP products and those of a different material for catering items. Prices calculated for 100 units using the cheapest price per unit. Source: (Nisbets, 2019; Stephensons, 2019; Ascot, 2019)

Product	Price per 100 units for CP option	Price per 100 units for alternative material
Cutlery	£1.20	£2.90 (wood) £5 (compostable bioplastic)
Plate	£2.49	£2.80 (paper) £10.50 (compostable sugarcane) £7.44 (compostable moulded paper fibre)
Cold cup	£1.11	£3.89 (compostable bioplastic)
Hot cup	£3.70	£5.50 (compostable plant based)
Takeaway food container	£3.19	£24.67 (compostable paperboard) £7.40 (compostable sugarcane)
Water bottle	£25 (500ml)	£77 (glass, 1L) £53 (can, 330ml)

8.14 Appendix 14

Table 1. Full results from the REA for all drink related initiatives. Only HLIs with one or more SUP reduction measure implemented are displayed.

University	Total	Selling or promoting reusable coffee cups	Incentive for using a reusable coffee cup	Biodegradable/ compostable coffee cups	Disposable coffee cup levy	Recycle scheme for disposable coffee cups	Swap scheme for reusable coffee cups	Eliminate use of disposable coffee cups	Levy for SUP cups used at soft drink fountain	Reusable cups for soft drinks	Reusable water bottles	Upgrade or increase number of water fountains	Introduction of Coca-Cola Freestyle machine	Levy for SUP water fountain cups	Eliminate SUP cups at fountains	Participation in the Refill scheme	Eliminate SUP straws or switch to compostable/ biodegradable alternative	Levy for purchasing a SUP water bottle	Phase out/eliminate SUP bottles	Eliminate SUP bottles and cups at meetings	Eliminate plastic stirrers	Water bottling system for reusable glass bottles	Reverse vending machine for SUP bottles
Aberystwyth University (Prifysgol Aberystwyth)	4	x			15p							x					x						
Ashridge Business School	1																					x	
Aston University	10	x		x	25p				25p	x	x	x					x		x		x		
Bangor University (Prifysgol Bangor)	5	x	10p													x	x				x		
University of Bath	1					x																	
Bournemouth University	1																x						
University of Bristol	2	x										x											
University of Cambridge	2											x							x				
Canterbury Christ Church University	2	x			25p																		
Cardiff Metropolitan University (Prifysgol Metropolitan Caerdydd)	3										x	x										x	
Cardiff University (Prifysgol Caerdydd)	1											x											
University of Chester	2										x	x											
City University London	2	x	30p																				

University for the Creative Arts	2		10p																		x	
De Montfort University	4	x			25p							x				x						
University of Dundee	2	x	10p																			
Durham University	2	x	20p																			
University of East Anglia	2															x				x		
Edge Hill University	2														x		x					
University of Edinburgh, The	5	x			25p						x	x			x							
Edinburgh Napier University	2	x			5p																	
University of Essex	1											x										
University of Exeter	4									x	x						x			x		
Falmouth University	2		10p														x					
University of Glasgow	6	x			25p						x	x							x			x
Glasgow Caledonian University	3	x	10p									x										
Glyndŵr University (Prifysgol Glyndŵr)	3	x			20p										x							
Goldsmiths, University of London	1			x																		
University of Greenwich	3						x	x				x										
Guildhall School of Music and Drama	4		x									x			x		x					
University of Huddersfield	5	x	20p									x				x				x		
Imperial College of Science, Technology and Medicine (also known as Imperial College London)	2				15p										x							
Institute of Education, University of London	3				15p							x									x	

University of Kent	1	x																					
King's College London	6	x	10p			x					x						x					x	
Kingston University	2											x			x								
University of Leeds	2	x	20p																				
Leeds Trinity University	1															x							
Liverpool Hope University	4	x			25p												x				x		
London School of Economics and Political Science, The (LSE)	4	x	x									x						10p					
University College London	7	x			15p							x					x		x		x	x	
Loughborough University	3	x	10%			x																	
University of Manchester	6	x	25p								x	x					x		x				
Manchester Metropolitan University	3	x	20p									x											
Middlesex University	1											x											
Newman University, Birmingham	1																x						
Northumbria University Newcastle	4	x	20p									x				x							
University of Nottingham	4	x	25p									x					x						
Nottingham Trent University	5	x			x						x	x							x				
University of Oxford	4	x	x					x								x							

Oxford Brookes University	1		25p																			
Plymouth University	4		20p									x					x		x			
University of Reading	7	x			20p	x					x	x	x				5p levy on biodegradable straws, no plastic					
Royal Agricultural University	1					x																
Royal Northern College of Music	5	x	20p			x					x						x					
University of Salford	2											x							x			
University of South Wales (Prifysgol De Cymru)	3	x	10%										x									
University of St Andrews	3											x							x			x
University of Strathclyde	3	x	x									x										
University of Surrey	4	x			5p												x		x			
University of Sussex	5	x	x		x	x													x			
Swansea University (Prifysgol Abertawe)	1														x							
Teesside University	1		40p																			
University of Warwick	6	x	20p	x	10p						x			x								
University of the West of England, Bristol	6	x		x	20p							x		x		x						
University of Winchester, The	2	x			25p																	
University of York	5	x	20p	x	20p											x						

Table 2. Full results from the REA for all food related initiatives. Only HLIs with one or more SUP reduction measure implemented are displayed.

University	Total	Eliminate plastic packaged condiments	Biodegradable/ compostable cutlery	Biodegradable/ compostable takeaway packaging	Reusable food container initiatives	Levy for using takeaway food packaging	Increase/ exclusive use of crockery and silverware	Reduction of SUP for events catering	Improved communication system for catering to avoid over-ordering and excess packaging	Reductions of cling film in catering	Replace plastic packaging on snacks
Aberystwyth University (Prifysgol Aberystwyth)	2		x	x							
Aston University	1						x				
Bangor University (Prifysgol Bangor)	1	x									
Bournemouth University	4	x	x	x			x				
University of Cambridge	1										x
Cardiff Metropolitan University (Prifysgol Metropolitan Caerdydd)	1				x						
University for the Creative Arts	3		x	x		25p					
De Montfort University	2		x				x				
Edinburgh Napier University	2		x	x							
Falmouth University	1		x								
University of Glasgow	1							x			
Glasgow Caledonian University	1					20p					
Glyndŵr University (Prifysgol Glyndŵr)	2		x				x				
Goldsmiths, University of London	1		x								
Guildhall School of Music and Drama	1		x								
University of Huddersfield	1						x				
Imperial College of Science, Technology and Medicine (also known as Imperial College London)	1		x								
Institute of Education, University of London	1									x	

King's College London	4	x	x			x	x				
Liverpool Hope University	1		x								
University of London	1		x								
London South Bank University	1		x								
University College London	3				x		x			x	
University of Manchester	3		x	x					x		
Nottingham Trent University	2		x	x							
Plymouth University	2		x	x							
Royal Northern College of Music	1		x								
University of Surrey	1			x							
University of the West of England, Bristol	2		x	x							
University of York	3		x		x			x			

Table 3. Full results from the REA for all miscellaneous initiatives. Only HLIs with one or more SUP reduction measure implemented are displayed.

University	Total	Eliminate use of balloons	Increased communications	Reusable/biodegradable/ compostable bags	Point system for avoiding SUP items	Contract/tender requirements to avoid SUP	Eliminate/reduce number of pens	Recycle pens	Eliminate SUP shampoo and soap bottles in hospitality	Replace all cleaning products that contain microplastics	Zero waste shop	Small scale recycling machine	Swap to more glassware in labs	Increased recycling of lab plastic	Reduced glove use in labs	SUP action/working groups	Plastic free/awareness events	Plastic reduction included in EIAs	Plastic free day
Aberystwyth University (Prifysgol Aberystwyth)	5			x		x				x								x	x
Anglia Ruskin University	1				x														
Aston University	3	x		x			x												
University of Bristol	1							x											
University of Derby	1																x		
Durham University	1			x															
Guildhall School of Music and Drama	2		x	x															
University of Huddersfield	2		x							x									
Institute of Education, University of London	1												x						
Keele University	1										x								
King's College London	1													x					
Lancaster University	1											x							
London Metropolitan University	2																x		x
University of Manchester	4						x		x		x					x			

Newman University, Birmingham	1															x		
University of Nottingham	1														x			
Nottingham Trent University	1															x		
Oxford Brookes University	1															x		
Royal College of Nursing	1													x				
University of Sheffield	1										x							
University of Surrey	1			x														
University of Warwick	1															x		
University of the West of England, Bristol	1			x														