Compostable packaging: replacing fossil-based plastics in single-use takeaway food and drink containers

DISCUSSION PAPER

[Updated May 2021]

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Executive summary

Background

The purpose of this discussion paper is to understand the issues of replacing fossil-fuel plastic single-use takeaway food and drink containers, and by association other materials that are challenging to recycle, with compostable packaging. A number of issues related to takeaway packaging are encountered in both urban and non-urban areas, in particular littering, with a 59% increase recorded in fast food-related litter in England between 2004 to 2015. In Scotland a 33% increase in detritus recorded between 2014 and 2020 consisted mainly of fast-food related packaging (three quarters of high public use retail/residential areas audited).

Other issues are evident throughout the lifecycle of fossil-fuel plastics, with environmental impacts of its production including fossil-fuel use and hazardous industrial waste, and in the case of expanded polystyrene (EPS) with evidence of styrene, a potential carcinogen, leaching during use and after disposal. The low weight of EPS also makes it largely uneconomical to store and transport for recycling purposes, with the result that few facilities exist. Where recycling facilities do exist for EPS and other plastics, food and drink contamination of containers is often an issue.

Compostable packaging: an alternative material

While the replacement of single-use plastic fast food and drink packaging by alternatives such as paper or cardboard is feasible, these all have the same issues with food contamination and recycling. Paper and card packaging can be problematic to recycle if made of a mixture of different materials, for example coated with plastic and chemicals, and are poorly regulated as a food contact material with the potential to cause significant health risks. As such, these alternatives are also destined for landfill, or at best incineration.

Compostable products are portrayed as a viable alternative and can be made from a wide variety of raw materials which are often waste products, such as corn-starch. Being manufactured from plants they are a natural and renewable resource, have a significantly lower carbon footprint than oil-based plastics, and offer a potential key to zero waste as certified compostable products can be recycled with food waste, removing the limitations imposed by contamination. In addition, businesses that use compostable packaging could save costs through reduction of their general waste stream.

Barriers to implementation of use and collection of compostable packaging

Significant logistical challenges to the implementation of collections of food waste and compostable packaging exist through the nature of the fast food industry, where the product is taken away from the premises, requiring on-the-go recycling facilities.

At present, the Scottish Government has specific regulations requiring the separate collection of food waste, with exemptions for businesses in rural postcodes. There is therefore limited regulatory incentive to have food waste collected, restricting the ability to collect compostable packaging at all.

Where food and compostable waste is collected, the bulk is processed at Anaerobic Digestion (AD) plants. The initial treatment steps at AD plants are mechanical and remove most if not all packaging, making it an unsuitable route for effectively processing compostable packaging. Commercial In-Vessel Composting (IVC) sites are limited and gate fees are higher than those for AD plants, offering no financial incentive.

Conclusions and Recommendations

There is an urgent need to provide alternatives to single use packaging that cannot be effectively, or efficiently recycled. Compostable packaging is regarded as a viable alternative, although barriers to its collection and processing are addressed.

The following recommendations are central to this:

- Where single-use packaging is required, incentivising the use of alternative materials to plastic through a levy on fast food packaging with the vendor retaining enough to cover additional costs if using compostable packaging.

- Facilitating structural changes in food waste collection systems to allow compostable food packaging to be fully composted with food waste.

With fast food takeaways particularly prevalent in coastal tourist areas, an initial case study centred on North Berwick highlighted many of the barriers to substituting EPS packaging with a compostable alternative. However, it also highlighted possible solutions through the identification of the key issues and could serve as a pilot study for a town fully free of single-use plastic.

Introduction

The use of takeaway food and drink packaging made from fossil-based plastic is prevalent in most towns and cities. Many towns and cities encounter a number of issues relating to takeaway packaging, including littering and limited opportunities for recycling. In addition, fossil-based plastic has numerous broader environmental impacts associated with it. Using a compostable alternative is frequently portrayed as a possible way to eliminate and reduce these concerns. This paper discusses the feasibility of such a proposal, including associated legislation and logistics. Included in this is the concept of a 'compostable town', already evident in the USA where at least two cities, Richmond, CA and Oakland, CA, have banned expanded polystyrene and stipulated the use of compostable packaging as alternatives[1].

Consideration of issues associated with disposable plastic on-the-go packaging has been increasing, from the UK Government's Environment Audit Committee inquiries into disposable drinks packaging, which focused on the damage being done to the environment by coffee cups[2] and plastic bottles[3], to the EU Single-Use Plastics' Directive[4] and the subsequent consultations by the Welsh Government[5] and Scottish Government[6].

Background

There has been substantial growth in the number of takeaway food outlets in recent years in the UK: a survey of 205 electoral wards in Norfolk with a total population of 796,728 showed a 45% increase in the number of fast food outlets from 1990 to 2008[7]. A subsequent England-wide study found a 59% increase in fast food-related litter for the period of 2004 to 2015, indicating correlation with increases in food and drink outlets[8]. In Scotland a 33% increase in detritus recorded between 2014 and 2020 consisted mainly of fast-food related packaging (three quarters of high public use retail/residential areas audited).[9]

Issues with single-use fossil-based plastics are evident during their production and use, as well as their disposal and role as a litter item in the environment. After use, fossil-plastics have an environmental impact as a component of terrestrial and marine litter[10]. Surveys by the UK Marine Conservation Society (MCSUK) show plastic to be a consistent component of coastal litter in the UK[11]. Additional compounds incorporated during production can be lost from plastics, such as once they are disposed of after use[12] [13]. These have the potential to enter the environment either by leaching from landfill or through degradation on land, in waterways and in the sea[14] [15]. Plastics in the marine environment also adsorb pollutants from seawater, which present an additional hazard to the additives already present and their degraded products[16].

Current policies and legislation

10 million tonnes of packaging waste are produced every year in the UK. Of this almost two thirds are estimated to be recoverable, leaving a significant amount to go to landfill. Packaging waste is regulated by two sets of regulations that fall under the **EU Directive on Packaging and Packaging Waste**[17] (Box 1).

These extend the principle of "the polluter pays", ensuring the businesses who produce potential waste take responsibility for it at the end of its life. These packaging regulations leave little responsibility to small and medium businesses in how their packaging is dealt with after use.

The **EU Waste Framework Directive** sets out five steps for dealing with waste, ranked according to environmental impact[18]. It gives top priority to preventing waste, and when waste is created, priority goes to preparing it for re-use, then recycling, then recovery such as energy recovery and last of all disposal such as landfill. Targets set by Scotland's Zero Waste Plan require 70% of all waste to be recycled and no more than 5% to be sent to landfill by 2025, with a ban on landfilling biodegradable waste from the end of 2020[19].

The Producers Responsibility Obligations (Packaging Waste) Regulations 2007 and **The Producers Responsibility Obligations (Packaging Waste) Regulations (Northern Ireland) 2007** place requirements on all UK companies that have a turnover in excess of £2million and handle more than 50 tonnes of packaging per annum. The amount each business has to recover is determined by three factors: the amount of packaging the business handles, the business recovery and recycling targets for the year and the activity the business carries on packaging.

The Packaging (Essential Requirements) Regulations 2015 require that packaging should be minimised, that it should be capable of reuse, recycling or recovery and that it contain restricted amounts of certain hazardous substances.

Box 1: UK packaging waste regulations under the EC Directive on Packaging and Packaging Waste.

Plastic litter is highlighted as the most abundant type of marine litter in the **Regional Action Plan (RAP) for Prevention and Management of Marine Litter in the North-East Atlantic** for the period 2014-2021 (OSPAR Agreement 2014-01)[20]. The UK Government is a signatory to the RAP and had stated its intention to use it as part of its obligation for reaching Good Environment Status under the **Marine Strategy Framework Directive** (MSFD)[21]. The Actions listed under 'Development of sustainable packaging' in the RAP state that Contracting Parties should:

- "Engage in a dialogue with industry aimed at highlighting the top marine litter problem items based on OSPAR beach monitoring surveys and/or other evidence on impacts."
- "Explore with industry the development of design improvements to assist in the reduction of negative impacts of products entering the marine environment in order to better inform industry on alternative solutions."

Disposing of single-use fossil-plastics

Consumer behaviour change

The lowest environmental impact to remove packaging from landfill would be to substitute it with reusable containers brought by the consumer or provide returnable containers. Both would require a significant behavioural change, and in the latter case would require resources to buy, clean and store containers. Although many takeaway drink providers now encourage consumers to bring their own cups, the drinks are still often prepared in a disposable cup and then decanted. This offers less risk of the cup reaching the environment as litter but puts it into the general waste stream, to landfill or incineration.

Recycling

Re-use and recycling of fossil-based plastics are both possible, even if intended for single-use. Waste plastic polymers are usually collected together as the low weight of most makes it uneconomical to collect them independently, and then generally recycled separately. A major issue with the recycling process of takeaway food or drink containers is the very high contamination levels, requiring extensive initial treatment to produce a product clean enough to be recycled[22].

Incineration

Incineration has been widely used by EU Member states to recover the high calorific value of fossil-based plastics[23]. The UK's Energy from Waste Recovery facilities have to date been regulated by environment agencies, with emissions controlled by the Waste Incineration Directive and the Industrial Emissions Directive. A Department for the Environment, Food and Rural Affairs (Defra) report classed Energy from Waste plants as a low source of environmental pollutants and referred to the Public Health England view that any health effects resulting from their operation would be very small[24]. However, incineration creates the most carbon dioxide emissions among plastic waste management methods[25], the processes produce hazardous waste that needs to be disposed of or treated for reuse[26] and bottom ash from incinerators can still be a source of microplastic release into

the environment[27]. Issues with emissions, capacities and costs have led to some proposed projects being discontinued for financial or planning reasons[28]. A recent EU communication on Waste-to-Energy notes that circular economy proposals to increase waste recycling would result in a fall in feedstock for incinerators, with the result that public financial support for the recovery of energy from mixed waste may be phased out[29]. This indicates that incineration of fossil-based plastics is not a viable long-term solution.

Landfill

The risk of chemicals leaching from fossil-based plastics to the environment makes landfill an undesirable disposal method, even in the absence of Scotland's Zero Waste Plan target to reduce the proportion of waste reaching landfill to 5% by 2025[30].

Compostable packaging: an alternative material

Fossil-based plastic fast food and drink packaging has in many cases been replaced by alternative materials such as paper or cardboard. However, as with the plastics, food contamination can cause problems with the recycling of all these materials, especially if containers are used for consumption away from households and therefore away from cleaning facilities. Mixed Paper and card packaging is often complicated to recycle due to being made of a combination of materials, for example card coated with plastic. In addition, paper and card food contact materials are currently poorly regulated and may pose significant health risks[31]. Such materials are destined for landfill, or at best incineration.

Compostable packaging is often viewed as a viable alternative and can be made from a wide range of raw materials, which are often waste materials, such as corn-starch[32]. Characteristics of compostable products that are used as supporting arguments for their use include:

- ***Renewable*** *– manufactured from plants that are natural and renewable resources unlike oil and synthetic chemicals used to manufacture plastics;*
- ***Low in Carbon*** *– Plant based bioplastics emit less than half the CO^2 during production than oil-based PET plastic and sugarcane fibre (bagasse) has 99% less embodied carbon than polystyrene;*
- ***A potential key to zero waste*** *– unlike conventional food service packaging, certified compostable products can be recycled with food waste and remove the limitations imposed by contamination.*[33] [34]

The term 'compostable' is often attributed to the term 'bioplastics', however the term 'bioplastics' can cover materials with plastic properties in 1 of 4 categories: bio-based (some/total biological content), biodegradable, non-biodegradable or fossil-based (and degradable; see Box 2).

'**Degradable'**: chemical changes take place, maybe from sunlight or heat, altering a plastic's structure and properties, like fragmenting or going cloudy.

'**Biodegradable':** requires degradation from naturally-occurring microorganisms (bacteria, fungi or algae), but does not require the products to be non-toxic or make good compost.

'**Compostable'** goes further: the ISO and ASTM definitions specify that the microorganisms' breakdown products must give "CO^2, water, inorganic compounds, and biomass at a rate consistent with other known compostable materials, and leave no visible, distinguishable or toxic residue", such as heavy metals.[35] [36]

Box 2: Definitions of degradable, biodegradable and compostable

Standards for measuring how plastics break down are still in development but international standards have been established by both ASTM International (formerly American Society for Testing and Materials) and the Switzerland-based International Organisation for Standardization (ISO).

Use and collection of compostable packaging with food waste

At present the collection of food waste in Scotland, England, Wales and Northern Ireland varies significantly (Box 3).

In Scotland, the Waste (Scotland) Regulations 2012 set out a number of provisions to help Scotland move towards the objectives in its Zero Waste Plan, including the requirement (from 2016) that all businesses and organisations producing over 5kg for food waste per week and in an urban area present it for separate collection[37]. At present this requirement does not apply to those with a rural postcode[38]. A ban on household biodegradable waste being sent to landfill is already in place, and eventually the regulations will bring into effect a ban on all non-household biodegradable waste being sent to landfill by 2025[39]. This will be implemented by amending the Landfill (Scotland) Regulations 2003[40] and has been delayed from the original intended date of 1 January 2021.

In Northern Ireland similar legislation in the form of The Food Waste Regulations (Northern Ireland) 2015 also requires separate collection of food waste from households and businesses producing more than 5kg of food waste a week. To date no such requirements have been in place for households or businesses based in England or Wales, with voluntary objectives deemed sufficient.

Box 3: Regulation of food waste in Scotland, England, Wales and Northern Ireland.

All four Governments hold a voluntary agreement with food retailers and manufacturers called the Courtauld Commitment[41]. A 2017 enquiry, Food Waste in England, conducted by the EFRA (Environment, Food and Rural Affairs) Committee concluded that WRAP (Waste and Resources Action Programme) and Government should increase efforts to encourage participation in the Courtauld process[42]. Additional recommendations were a national food waste target to ensure a continued focus on reducing food waste, and a requirement by Government for food businesses and retailers to separate food waste. Most recently, the UK Government's proposed Environment Bill legislates for household and business food waste to be separated and collected, with implementation expected to start by 2023[43] [44].

Based on feedback from takeaway food businesses local to the Fidra office in North Berwick, Scotland, in-house collection of compostable packaging for food and drink outlets is likely to take place separately to food waste. This would be most effective in the front-of-house accessed by customers, rather than in the service area. Although the regulations use weight as a marker, waste collection vessels and charges are based on volume. For example, businesses are charged for the volume of wheeled bin and the frequency with which it is emptied, irrespective of weight. Food waste collection units are small due to the heavy weight, which contrasts with compostable packaging which is light and therefore will require large volumes. By collecting the food waste together with compostable packaging, larger bins could be used to collect food waste, with the same frequency and similar charges. Removing fast food packaging from the general waste stream would then require lower volume general waste bins. In addition, the removal of food from the general waste could enable less frequent collections, as there would be no issues with organic waste decomposition.

By the nature of the product, fast food businesses have most of their packaging removed from the premises and as such are unable to control how it is recycled. Working alongside Councils to recover any compostable packaging removed from premises could be coordinated with 'on the go' collection of both compostable packaging and food waste. 'On the go' (i.e. street bins) recycling could be located in areas where concentration is high (at the beach front, outside chip shops etc.). This could be an innovative development for 'on the go' recycling which would serve as an example to other bodies interested in banning single-use fossil-based plastic packaging.

On the street (municipal) collections of compostable packaging could benefit from smart solar bins, which compact rubbish and inform when they are full. An example of this in the UK can be seen in the city of Nottingham[45] (Box 4).

- The city of Nottingham has deployed 'BigBelly' solar powered compactor rubbish bins to replace stainless steel bins in the city centre after complaints that some street bins, particularly those near fast food outlets, overflowed at weekends.
- Each bin can hold up to eight times more waste than standard bins and sends out an alert over the cellular GPRS data network to maintenance crew mobile phones and a central office to indicate that it is ready to be emptied.
- The initial order of 130 bins was the largest outside the US at the time. There are now 170 bins in the city centre
- Overall weekly collections have reduced from 4,400 to just 260 and there have been significant reductions in the need to pick up street litter.
- Each bin costs £3,500 compared to around £400 for a standard bin – this is funded through a leasing arrangement which costs £98,748 per annum. Revenue is generated by the sale of space on the side of the bins for advertising.

Box 4: Case study: Nottingham's smart solar bins

Processing of compostable packaging with food waste

Food waste and compostable packaging both constitute organic material that can be used as feedstock for anaerobic digestion and composting (Box 5). To be recovered by either process, packaging must conform to the European Standard EN 13432. It should be noted that anaerobic digestion will not fully break down compostable or biodegradable packaging as this requires oxygen, however, it can be part of the treatment process. The behaviour of compostable plastics in anaerobic conditions varies depending on temperature, solids retention time, composition of the material, shape and thickness of compostable items[46].

The typical 8 to 12 weeks required for composting raw feedstock may be reduced to as little as 2 to 3 weeks for digestate because the material has been partly decomposed in the digestion process, making it easier for the composting organisms to break it down to stable compost. Experience in Europe has shown that the overall throughput time for material going through anaerobic digestion and digestate composting can be reduced to 5 to 8 weeks. This substantial reduction in time (about 40%) will produces result in reduction in both the capital and operating costs for processing the same amount of material.

High quality recycling of food waste is defined in the Scottish Government's statutory Guidance on applying the waste hierarchy[47], as:

- **Anaerobic digestion** (AD) of source segregated food waste with energy recovery and production of PAS110[48] compliant outputs.
- **In-vessel composting** (IVC) of source segregated food waste where PAS100[49] standards are met.

Not all materials are suitable for application to agricultural land meaning AD and composting cannot process all packaging materials. Some 'biodegradable' materials for example would not be suitable (Box 4). SEPA's Regulatory Position Statements on the Regulation of Outputs from Composting and Anaerobic Digestion Processes provide the exemptions and limits for physical contaminants [50] [51] [52].

Anaerobic digestion is the biological decomposition of organic material, predominantly food waste (with some other types of organic material) in the absence of oxygen or in an oxygen-starved environment in a fully enclosed structure. Anaerobic digestion systems can vary, for example material may be fed into a reactor in distinct batches, or in a continuous flow. The entire digestion process occurs in tanks or other sealed containers. The products are biogas (consisting primarily of methane and carbon dioxide) and digestate, the solid and/or liquid residual material remaining after organic material has been digested. The biogas is stored and can be used for any of the following: refined further into biomethane for vehicle fuel or for injection into the gas grid; burned in a combined heat and power engine to produce electricity and heat; burned in a gas boiler to produce heat for local use such as district heating or heat for an industrial process. Digestate solid fractions can be processed further on site by being put into a composting operation for further processing or used directly on land. Liquid digestate can also be used on land as a biofertiliser. In Scotland if the digestate complies with both PAS110 and SEPA's regulatory position statement on the 'Regulation of Outputs from Anaerobic Digestion Processes', it may be spread on land without waste management regulatory control.

Composting is the biological decomposition of biodegradable solid waste under controlled, predominantly aerobic conditions. Composting can be done at small-scale on-site facilities or at large-scale commercialized facilities that handle high volumes of organic material. Compost facilities can range from the very simple 'open windrows' (large heaps) to sophisticated computer controlled in-vessel composting systems (IVCs). All process compostable organics (mostly agricultural and green material) into finished compost. End uses of the compost product include: soil amendment, fertilizer and mulch. The most common markets are agriculture and horticulture markets.

In-vessel composting can be used to treat food and garden waste mixtures. There are many different systems, including containers, silos, agitated bays, tunnels, rotating drums, enclosed halls. A range of product grades are produced for various end uses such as soil conditioning. If the compost complies with PAS100 and SEPA's 'Regulation of Outputs from Composting Processes' regulatory position statement, it may be spread on land without waste management regulatory control. The compost produced can be used in a range of places including in gardens, on brownfield sites, for landscaping and in agriculture.

Box 5: Anaerobic digestion and composting

Scotland's Circular Economy Strategy indicates that Scotland could become a leader in anaerobic digestion (AD) in parallel with the drive to reduce food waste[53]. Recent figures in Scotland show 68 operational AD plants, of which 21 are fed with municipal/commercial waste[54]. On a UK scale there are 579 operational AD plants of which 167 are fed with municipal/commercial waste.

Furthermore, there is concern that the use of chemical fertilisers can have negative effects on the environment. The growing movement to develop new agricultural practices without environmental costs could incorporate the use of organic fertilisers made from secondary raw materials such as food waste or compost[55]. These are expected to become more important, as the reserves of non-renewable materials such as rock phosphate are often poorly documented and may become scarce[56].

AD and composting: current suitability

A major challenge of using biodegradable packaging is keeping it separate from conventional plastics packaging. It is vital that biodegradable and compostable materials are not mixed with fossil-based or non-compostable bio-based plastics, and sent for recycling into new plastic products. Any collection and sorting scheme must ensure that all compostable packing cannot enter conventional plastic recycling schemes.

Screening for contaminants takes place in both anaerobic digestion and composting. In composting, this is usually carried out manually and can be relatively selective, with the result that compostable packaging can be retained if easily identifiable, i.e. by labelling or branding. In AD the initial treatment

process involves automated de-packaging of the food waste, with the majority of packaging including compostable materials removed. As this is an automated function there is no facility to distinguish between different types of packaging. East Lothian Council recently changed from the use of compostable bags for the collection of domestic food waste to plastic bags to enable easier removal of the packaging. The physical properties of compostable bags resulted in stretching during the initial treatment of food waste, rather than shredding. When stretched they frequently caught in machinery and required manual removal. The plastic bags used as replacements disintegrate more readily, can be easily removed with other packaging and are suitable for energy recovery from incineration.

This suggests that currently only composting is a suitable route for food waste containing compostable packaging. With a general trend towards higher gate fees for organic waste at IVCs, more organic waste is likely to be processed at AD plants where available (Table 1).

Table 1: Summary of UK gate fees: 2019/20 (£/tonne)[57]

Treatment	Material/Type of Facility/Grade	Median	Mode	Range
Materials Recycling Facility	All contracts (4 materials or more)	£43	£40 to £45	-£38 to £113
Organics	In-vessel composting (IVC) Mixed food & green	£49	£45 to £50	£27 to £67
	In-vessel composting (IVC) All feedstock types	£37	£20 to £25	£18 to £67
	Anaerobic Digestion (AD)	£20	£35 to £40	£3 to £37
Mechanical Biological Treatment	Household residual waste	£88	£80 to £85	£66 to £170
Energy from Waste	All	£93	£90 to £95	£48 to £150
	Pre-2000 facilities	£62	£60 to £65	£49 to £104
	Post-2000 facilities	£95	£95 to £100	£48 to £150
Wood Waste	All Grades/tonne collected from Household Waste Recycling Centres (HWRC)	£35	£45 to £50	-£7 to £80
Landfill	Non-hazardous waste including landfill tax	£116	£111 to £116	£93 to £187
	Non-hazardous waste excluding landfill tax	£25	£20 to £25	£2 to £96

In Scotland, a 2017 AD survey estimated 141,651 tonnes of food waste being processed at AD facilities along with 34,300 tonnes of food waste from composting feedstocks, giving an overall total of 175,951 tonnes, compared with an overall total of 141,028 tonnes (composting and AD) processed in 2014[58] This tonnage refers to food waste from households and commercial sources (processors, hospitality and catering sectors).

A 2017 survey of Scotland's in-vessel composting sector input tonnage suggests a 4% decrease from 2014, at 398,170 tonnes[59]. A significant change from 2014 was the increase in comingled green and food waste from local authorities (135,000 tonnes in 2017 compared to 75,455 tonnes in 2014) with a corresponding decrease in green only waste. Based on operator estimates of food in comingled green and food waste, alongside separated food waste inputs, the food waste to Scottish composting sites remains at a similar level to the 2014 survey at 34,300 tonnes. Compost production in 2017 was 224,925 tonnes. Compost site outputs diversified in 2017 with production of 16,189 tonnes of anaerobic digestion (AD) 'soup' (produced by cleaning of source-separated food waste). Information was also gathered on production and fate of "oversize". Oversize is the term used within the organic waste recycling industry to describe the large woody part of the finished compost that is

left over after the finer compost grades have been "screened" out. Such organic waste can contain a small amount of non-compostable materials with plastic bags being a particular problem. A challenge for many operators was cleaning of oversize outputs to remove physical contamination (i.e. film plastic); the cost of cleaning countering revenue achieved for the material.

The above surveys show a discrepancy in scale of increase between 2014 and 2017 at the different types of processing plant, with similar levels evident for composting sites and approximately 25% increase at ADs. The continuing trend of lower gate fees for ADs, as shown in Table 1, may account for this.

At present, AD is the preferred treatment method for biodegradable waste and takes about 30 days to turn food waste into energy. Compostable packaging takes 12 weeks to break down and so is considered a contaminate for the food waste process in AD plants. However, this can change if AD can become part of an integrated waste management strategy for the organic fraction of municipal solid waste and used in combination with other processes. In addition, recent research suggests that combining different compostable materials can increase rates at which items break down, and the development of materials better suited to AD treatment may not be far off[60].

Recommendations

There is potential for significant steps to be made to both reduce the impacts associated with single-use fossil-based plastics (and other packaging materials which don't fully breakdown) and improve the current infrastructure to create a truly circular economy for food and drink packaging.

The following recommendation are intended to contribute to the existing discussions taking place on single-use packaging and the circular economy.

1. **Market restrictions on single-use plastics**: Article 5 of the EU Directive on the reduction of the impact of certain plastics on the environment (2019/904) proposes the introduction of market restrictions, effectively a ban, on a list of single-use plastic items: cutlery (forks, knives, spoons, chopsticks), plates (plates, trays/platters, bowls), straws, beverage stirrers, balloon sticks, food containers made of expanded polystyrene, cups and other beverage containers made of expanded polystyrene, including their covers and lids, all oxo-degradable products.

2. **Expanded Polystyrene ban**: over 100 US cities and counties have implemented bans[61]. A ban on the import or sale of expanded polystyrene (EPS) in Costa Rica comes into effect in 2021[62]. Australia has a ban coming into effect in 2022 on expanded polystyrene (EPS) loose packaging fill, moulded packaging in consumer packaging and all consumer single-use food and beverage or fresh produce retail packaging made from EPS[63]. However the ban does exclude business-to-business packaging such as fresh produce boxes, specialist medical packaging, construction materials and business-to-consumer packaging where there is a demonstrated and effective reuse model in operation, such as bulk cold home-delivered meal services.
3. **Facilitating compostable packaging collection with food waste**: implementing a 'Food on-the-go' type scheme where vendors have waste bins outside their premises and sponsor waste bins at strategic points which can be collected and fed into local food waste collection services.

4. **Facilitate structural changes to food waste collection systems**: To ensure compostable materials are composted, incentivise the use of In-Vessel Composting processes as opposed to Anaerobic Digestion or Energy from Waste, for example through subsidising gate fees charged to waste companies.

Annex

CASE STUDY 1: Could a town become fully 'compostable'?

East Lothian Council (ELC) believe that returns from the waste haulage contractor used for municipal waste collections demonstrate a distinct pattern and concerns within North Berwick. There is a significant difference in the tonnage per m^3 of mixed waste between North Berwick and ELC's other 5 operational centres. Figures in 2016 showed this as 15.4 m^3 of mixed waste per tonne in North Berwick versus 6.58 m^3 per tonne average in the other 5 clusters[64]. The cubic meter figure is based on number and cubic capacity of skips and suggests that twice as much bulk is collected from North Berwick as from the 5 other clusters. The only explanation ELC have for the anomaly is the high volume of polystyrene collected from street litterbins. With a large number of businesses providing takeaway food and drink, and a busy tourist season, a polystyrene ban would be unfeasible without the use of alternative materials.

ELC have expressed interest in using cardboard as an alternative food and drink packaging, due to its ability to be compacted more readily than EPS, recycled if not heavily contaminated and biodegraded if in the environment or landfill. However, there is little cardboard packaging that is certified for use as a food contact material if it is not lined with plastic, which then affects its ability to be recycled or biodegrade. Compostable packaging appears to offer a solution to this, as being plastic-free it could be collected and processed with food waste. However, the environmentally harmful "forever chemicals" PFAS have been found by Fidra in packaging products made from paper, card and compostable materials, where they are used as a moisture barrier coating[65].

Due to the fact that commercial and domestic food waste collection in East Lothian is presently processed through ADs, compostable packaging will be diverted to landfill or incineration. With a system that can successfully collect compostable packaging and food waste together, and then process them to produce compost, North Berwick could become a 'compostable town' in terms of fast food and drink packaging. This could be used as a promotional aspect of the town as a tourist destination.

It is understood that many of the takeaway businesses in North Berwick will have the packaging removed from the premises and as such won't be able to control the recycling of that packaging. Working alongside East Lothian council, perhaps with some funding from Zero Waste Scotland, to implement 'on-the-go' recycling for compostable packaging and food waste should be considered. Areas where concentration is high (at the beach front, outside chip shop etc.) could be a focal point. This could provide a case study from which other communities could replicate and learn from. Such a project would involve the following stages:

1. Identifying key stakeholders, agreeing project aims and objectives;
2. Getting businesses on board, and making the switch;
3. Communicating to the community;
4. Implementing recycling 'on-the-go'.

In early 2017, Keenan's Recycling ran a trial in Glasgow in association with compostable packaging supplier Vegware, with collections being taken to GP Green Recycling in Blantyre. The trial found high levels of contamination in the collections, with all collections rejected by the receiving site. A notable finding during the trial was that businesses using Vegware were reluctant to take part. Many viewed the use of Vegware as sufficient action and were not concerned with the end of life of their packaging.

Vegware subsequently registered as a waste broker and ran a trial of the collection of its products with food waste from its own offices and selected businesses in Edinburgh and Glasgow. The trial was deemed successful and has led to permanent waste collection streams collecting compostable packaging with food waste. The nominated collector used for the trial, Cauda Ltd, collects dry

recycling from a large supermarket chain but has space to collect food waste and is licensed to do so. Collections are again taken to GP Green Recycling based in Blantyre.

Following the trial, in September 2017 Vegware launched a composting collection service called Close the Loop which collects used Vegware and food waste for industrial composting[66]. However, there is no incentive for businesses to take part in areas designated to have a rural postcode and therefore exempt from the 2016 change in legislation requiring businesses with over 5kg of food waste to have separate collections.

A review of suitable suppliers of compostable packaging would be required. Vegware is already used locally (Case Study 3) and as a company can support businesses in sourcing suitable compostable alternatives to current products and give advice on a suitable distributer to purchase through. A possibility would be to partner with one of Vegware's existing distributers in order to reduce the impact of deliveries with all businesses sourcing from one supplier – adding more environmental benefits to the project. Vegware's initiative The Food Waste Network can advise businesses on establishing a food waste collection route for used packaging and food waste. Ideally, businesses in close proximity could all be serviced by one collector, creating a carbon friendly collection route.

Businesses in Scotland can benefit from support offered by Zero Waste Scotland, to cut costs and increase resource efficiency[67]. Support is provided to help with implementing changes in small to medium sized businesses (SMEs) including interest-free loans available to implement changes.

North Berwick businesses are currently exempt from the food waste regulations, independent of their size or the amount of food waste produced, due to the rural postcode classification used by the Scottish Government. However, collections are now available through Vegware's Close the Loop scheme. Getting food businesses recycling their food and compostable packaging on a town wide scale might encourage the government to reconsider the rural / non-rural classification.

CASE STUDY 2: Whynot Café, North Berwick

A not-for-profit community café in North Berwick initiated its own recycling system in 2017 for its takeaway food and drink packaging. Its owners implemented the scheme having witnessed the high levels of litter in North Berwick street bins. They consulted with their waste collector, Max Recycling, on types of takeaway food packaging that it could recycle. Suitable packaging was then sourced, at a greater cost to that being used previously.

The scheme asks customers to return the all takeaway food and drink packaging to the café, which will take it back and add it to its own dry recycling bin. The customer receives a 10% discount to be used in the café or the associated delicatessen. To cover costs of the discount and the more expensive packaging, the café has instigated a 5p increase on its coffee prices. According to the owners this has not been commented on by customers. The scheme was started in July 2017[68]. Despite little take up initially, the owners plan to keep the scheme in existence.

CASE STUDY 3: Vegware's Close the Loop with Steampunk and Archerfield Walled Garden

Vegware's 'Close the Loop' system has been taken up by two local businesses, Steampunk in North Berwick and Archerfield Walled Garden. Both have found that using the system has encouraged them to examine their waste streams and make changes that have saved costs.

Elly Douglas-Hamilton, Director of Archerfield Estates Ltd, comments "Working together with other local businesses like Steampunk means that we can share information and ideas and start translating these ideas into practical reality. I hope this is something we can encourage other businesses in doing and help us all to realise that perceived barriers are perhaps not as great as they seem."

Furthermore, Vegware lids and cups can now technically be accepted by facilities that process garden waste across the UK, although they will announce when consumers are able to use this option on a region by region basis [69].

SUCCESSFUL EXAMPLES

New York City EPS ban

New York City's Mayor, Bill de Blasio, announced that from January 2019 a ban on all EPS products will go into effect. This means that manufacturers and shops will be unable to sell products such as food trays, clamshells or cups anywhere in the city, as well as 'packaging peanuts', without incurring penalties as a result.

Mayor de Blasio expressed that "there's no reason to continue allowing this environmentally unfriendly substance to flood our streets, landfills, and waterways"[70].

Oxford county reusable cups

Keep It Green for Oxfordshire sells reusable cups through Beanbags Coffee company and all profit goes towards supporting environmental initiatives[71]. Cafes and restaurants who buy the reusable cups receive a free window sticker to show that they support the country-wide campaign.

Freiburg city reusable cup scheme

FreiburgCup estimated that around 300,000 disposable cups were consumed every hour in Germany, each one being used for an average of 13 minutes, before being thrown away – usually to landfill.

As a result of these statistics and the ubiquitous influx of takeaway cups in the city, Freiburg embraced a voluntary scheme of reusable cups through a deposit-return scheme[72]. This scheme asked customers to pay €1 for a reusable cup, which they can take back to any one of the 100 participating business.

Seattle disposable packaging

In 2009 Seattle introduced a ban on the use of EPS products. Since then, the city has continued to lead by example with disposable food and drink receptacles. A further ban on non-recyclable and non-compostable food packaging was brought into effect in 2010, and the recent ban on all plastic straws and cutlery in July 2018 has demonstrated their continued commitment[73].

The City of Seattle requires that all food service businesses must use either compostable or recyclable packaging, provide suitable bins for staff and customers, and are signed up for their waste to be collected by a suitable service provider.

reCIRCLE

A Bring Back Box scheme was trialled across restaurants in the Swiss city of Bern from 2014-2015, charging consumers a 10-franc (£8) deposit for a solid, reusable plastic takeaway box. When customers finished their takeaway meal, they returned the box to any participating restaurant so they could be washed and redistributed, and they received their 10-franc deposit back. The trial was deemed successful and is now run across Switzerland as reCIRCLE with 300 takeaways participating, and has also established a franchise which is available to operate in other countries[74].

What next?

To encourage North Berwick to look at available solutions and alternatives, Fidra is acting as a catalyst for change, alongside other businesses, community groups and individuals. Through this collaboration, an event, 'Waste Expectations: Trash Talk with Businesses', was held in January 2019 which brought together a variety of stakeholders throughout North Berwick.

You can download and read a summary of this event on Fidra's Food Packaging webpage, here.

As a result of the discussions that took place at this event, a number of solutions that the town could use to transition away from the use of unsustainable materials in takeaway food and drink receptacles were suggested. This included a reusable cup scheme (similar to the FreiburgCup mentioned above); compostable products to be implemented with a town-wide collection of compostable waste; and a Steering Group to oversee such a project.

If you would like to be involved in this project, please get in touch with Fidra on info@fidra.org.uk.

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[1] http://www.surfrider.org/pages/polystyrene-ordinances
[2] https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/657/657.pdf
[3] https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/339/339.pdf
[4] https://eur-lex.europa.eu/eli/dir/2019/904/oj
[5] https://gov.wales/reducing-single-use-plastic-wales
[6] https://consult.gov.scot/zero-waste-delivery/introducing-market-restrictions-on-single-use-plas/
[7] Maguire, E.R. et al (2015) Area deprivation and the food environment over time: A repeated cross-sectional study on takeaway outlet density and supermarket presence in Norfolk, UK, 1990–2008. *Health & Place*, **Volume 33**, 142-147. ISSN 1353-8292, http://dx.doi.org/10.1016/j.healthplace.2015.02.012
[8] Keep Britain Tidy (2015) The Local Environmental Quality Survey of England 2014/2015. http://www.keepbritaintidy.org/Documents/Files/LEQSE%202015/KBT%20LEQSE%20Report%202015%20web.pdf
[9] Keep Scotland Beautiful (2020) Time for a new approach to tackling litter: Towards a Litter-ate Scotland 2020. https://www.keepscotlandbeautiful.org/media/1566897/leq-2020-report-final-041220.pdf
[10] Gallo, F. et al (2018) Marine litter plastics and microplastics and their toxic components: the need for urgent preventative measures. *Environmental Sciences Europe*, **30**, 13. https://doi.org/10.1186/s12302-018-0139-z
[11] https://www.mcsuk.org/news/great-british-beach-clean-results-2020/
[12] Mato, Y. (2001).Plastic resin pellets as a transport medium for toxic chemicals in the marine environment. *Environmental Science and Technology,* **35** (2), 318-324.
[13] Aurisano, N. et al (2021) Enabling a circular economy for chemicals in plastics. *Current Opinion in Green and Sustainable Chemistry*. https://doi.org/10.1016/j.cogsc.2021.100513
[14] Manalac, S.M. et al (2010) Leaching behaviour of sulfonated polystyrene (SPS) from recycled Styrofoam. *International Journal of Environmental Science and Development*, **1(4)**, 368-370.
[15] Rani, M. et al (2014) Hexabromocyclododecane in polystyrene based consumer products: An evidence of unregulated use. *Chemosphere*, **110**.
[16] Takada, H. et al (2006). Pellet Watch: Global monitoring of persistent organic pollutants using beached plastic resin pellets. *Marine Pollution Bulletin*, **52** (12), 1547-8.
[17] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A01994L0062-20180704
[18] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20180705
[19] https://www.gov.scot/policies/managing-waste/
[20] OSPAR Commission (2014) Regional Action Plan (RAP) for Prevention and Management of Marine Litter in the North-East Atlantic. *OSPAR Agreement 2014-01.* https://www.cbd.int/doc/meetings/mar/mcbem-2014-03/other/mcbem-2014-03-140-en.pdf
[21] DEFRA (2015) Marine Strategy Part three: UK programme of measures. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486623/marine-strategy-part3-programme-of-measures.pdf
[22] WRAP (2019*) Drinks Recycling On-the-Go*. Prepared by Valpak and Recoup.
[23] https://www.europarl.europa.eu/news/en/headlines/society/20181212STO21610/plastic-waste-and-recycling-in-the-eu-facts-and-figures
[24] DEFRA (2014) Energy from waste. A guide to the debate. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/284612/pb14130-energy-waste-201402.pdf
[25] Gradus, R. et al (2016) A cost-effectiveness analysis for incineration or recycling of Dutch household plastic. *Tinbergen Institute Discussion Paper*, TI 2016-039/VI.

[26] http://www.endsreport.com/article/55372/hazardous-waste-to-continue-being-landfilled-after-government-u-turn
[27] Yang, Z. et al (2020) Is Incineration the Terminator of Plastics and Microplastics? *Journal of Hazardous Materials*, **401**, 123429. https://www.sciencedirect.com/science/article/abs/pii/S0304389420314187?via%3Dihub
[28] Zero Waste Europe (2015) Air Pollution from Waste Disposal: Not for Public Breath. http://www.zerowasteeurope.eu/downloads/air-pollution-from-waste-disposal-not-for-public-breath/
[29] https://ec.europa.eu/transparency/regdoc/rep/1/2017/EN/COM-2017-34-F1-EN-MAIN-PART-1.PDF
[30] Scottish Government (2010) *Scotland's Zero Waste Plan*. https://www.gov.scot/publications/scotlands-zero-waste-plan/
[31] http://www.europarl.europa.eu/news/en/news-room/20160930IPR44566/health-risks-of-materials-in-contact-with-food-tighter-eu-safety-rules-needed
[32] Chen, G-Q & Patel, M.K. (2012) Plastics derived from biological sources: Present and Future: A Technical and Environmental Review. *Chemical Reviews*, **112**, 2082-2099
[33] http://www.green-alliance.org.uk/resources/Novel_Materials.pdf
[34] Mooney, B.P. (2009) The second green revolution? Production of plant-based biodegradable plastics. *Biochemical Journal*, **418**, 219-232.
[35]ISO 17088:2012(en) Specifications for compostable plastics. https://www.iso.org/obp/ui/#iso:std:iso:17088:ed-2:v1:en
[36] ASTM International Designation: D 6400 – 04. Standard Specification for Compostable Plastics. http://www.e2efoodpack.com/PDF/ASTM%20D%206400.pdf
[37] The Waste (Scotland) Regulations 2012 http://www.legislation.gov.uk/ssi/2012/148/regulation/2/made
[38] http://faq.zerowastescotland.org.uk/ruralsearch/
[39] https://www.gov.scot/news/action-to-tackle-climate-change/
[40] https://www.legislation.gov.uk/ssi/2003/235/contents/made
[41] http://www.wrap.org.uk/category/initiatives/courtauld-commitment
[42] https://publications.parliament.uk/pa/cm201617/cmselect/cmenvfru/429/42902.htm
[43] https://publications.parliament.uk/pa/bills/cbill/58-01/0220/200220.pdf
[44] https://deframedia.blog.gov.uk/2020/02/10/household-food-waste-to-be-collected-separately-by-2023-and-50000-city-trees-to-be-planted-in-urban-tree-challenge-fund/
[45] https://iotuk.org.uk/smart-bins-as-a-service-in-nottingham/
[46] Garaffa, C. & Rhodes, Y. (2012) Managing compostable bags at anaerobic digestion plants. *BioCycle*, **53**, p.37. https://www.biocycle.net/2012/09/18/managing-compostable-bags-at-anaerobic-digestion-plants/
[47] https://www.gov.scot/publications/guidance-applying-waste-hierarchy/pages/3/
[48] PAS110 is the British Standards Institutions (BSI) Publicly Available Specification for Anaerobic Digestate, to verify it is of consistent quality and fit for purpose.
[49] PAS100 is the BSI Publicly Available Specification for Composted Materials, to verify it is of consistent quality and fit for purpose.
[50] SEPA position statement: Regulation of outputs from composting processes. http://www.sepa.org.uk/media/219843/wst-g-050-regulation-of-outputs-from-composting-processes.pdf
[51] SEPA position statement: Regulation of outputs from anaerobic digestion processes. https://www.sepa.org.uk/media/219842/wst-ps-016-regulation-of-outputs-from-anaerobic-digestion-processes.pdf
[52] https://www.sepa.org.uk/regulations/waste/recycling-including-food-waste/
[53] Scottish Government Publication 2016 Making Things Last – A Circular Economy Strategy for Scotland. 8. Recovering value from biological resources. http://www.gov.scot/Publications/2016/02/1761/12
[54] https://www.biogas-info.co.uk/resources/biogas-map/
[55] Hasler, K. et al (2016). Drivers for the Adoption of Eco-Innovations in the German Fertilizer Supply Chain. *Sustainability*, 8(8): 682. DOI: 10.3390/su8080682.
[56] https://minerals.usgs.gov/minerals/pubs/commodity/phosphate_rock/mcs-2016-phosp.pdf
[57] WRAP (2020) Gate fees report 2019/20 Report. Comparing the costs of alternative waste treatment options. https://wrap.org.uk/sites/default/files/2021-01/Gate-Fees-Report-2019-20.pdf

[58] Zero Waste Scotland (2019) Scottish anaerobic digestion and biogas sector survey 2017. https://www.zerowastescotland.org.uk/sites/default/files/Scottish%20anaerobic%20digestion%20and%20biogas%20sector%20survey%202017.pdf

[59] Zero Waste Scotland (2019) Scottish composting sector survey 2017. https://www.zerowastescotland.org.uk/sites/default/files/Scottish%20composting%20sector%20survey%202017.pdf

[60] Narancic, T. et al (2018) Biodegradable plastic blends create new possibilities for end-of-life management of plastics but they are not a panacea for plastic pollution. *Environmental Science and Technology*, **52**, 10441-10452. https://pubs.acs.org/doi/10.1021/acs.est.8b02963

[61] https://www.surfrider.org/coastal-blog/entry/the-surfrider-foundation-releases-interactive-map-of-u.s-plastic-reduction-policies

[62] https://www.presidencia.go.cr/comunicados/2019/07/law-prohibiting-the-use-of-stereophone-signed-in-costa-rica/

[63] https://www.environment.gov.au/protection/waste/plastics-and-packaging/national-plastics-plan/prevention

[64] Stuart Pryde, East Lothian Council Amenities Officer, pers.comm.

[65] https://www.pfasfree.org.uk/wp-content/uploads/Forever-Chemicals-in-the-Food-Aisle-Fidra-2020-.pdf

[66] https://www.vegware.com/close-the-loop/info_50.html

[67] https://energy.zerowastescotland.org.uk/

[68]http://www.eastlothiancourier.com/news/15423416.Bid_launched_to_tackle_town___s_food_litter_issues/

[69] https://www.vegware.com/news/2018/07/31/newsflash-vegwares-cups-lids-now-allowed-at-uk-garden-waste-composting-facilities/

[70] https://www1.nyc.gov/office-of-the-mayor/news/295-18/mayor-de-blasio-ban-single-use-styrofoam-products-new-york-city-will-be-effect

[71] https://www.keepitgreenuk.org/

[72] https://freiburgcup.de/

[73] http://www.seattle.gov/utilities/your-services/collection-and-disposal/food-and-yard/business-and-commercial-compostables/food-packaging-requirements

[74] https://www.recircle.ch/en