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Sustainable & Thematic Investing

Food Waste: Ripe for Change

We waste an unsustainable one third of the food we produce globally, valued at \$1 trillion pa and accounting for 8% of GHG emissions. This report proposes that the time is ripe to execute change through collaborative action across the food value chain.

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CONTENTS

EXECUTIVE SUMMARY	3
THE PROBLEM WITH FOOD WASTE	6
It's a global issue and it's expected to grow.....	6
A greatly overlooked driver of climate change.....	9
WHY SHOULD INVESTORS FOCUS ON FOOD WASTE?	11
5 key factors to consider	11
WHAT CAN BE DONE ABOUT THE PROBLEM	14
A collaborative approach is key.....	14
Calls to action – Government, Consumers, Industry	15
All players in the food value chain will need to take action.....	20
Emerging innovation can help accelerate change	21
INVESTOR GUIDEBOOK – SECTOR IMPLICATIONS.....	25
Dissecting the food value chain	25
Contributing Authors	27
Food Retail.....	28
Food Manufacturing.....	34
Agribusiness.....	37
Leisure	41
Packaging	47
Energy.....	52
Chemicals	55
Food Delivery & Meal Kit Solutions.....	58
Transport	59
APPENDIX 1 – EXPERT & START-UP INTERVIEWS	60
APPENDIX 2 – UK/US SUPERMARKET SCORECARDS	66

EXECUTIVE SUMMARY

We currently waste 1.3 billion tonnes of food per year, about one-third of all food produced for human consumption. This represents a loss of around \$1 trillion dollars annually, a figure estimated to hit \$1.5 trillion by 2030. Such massive waste is simply unsustainable in a world far off course from our two-degree climate change limit and one where an expanding population is putting ever-increasing pressure on resources. We think food waste is a greatly overlooked driver of climate change, accounting for as much as 8% of global greenhouse emissions, and an area ripe for transformation. The UN's Sustainable Development Goal 12.3 targets halving food waste by 2030, but without decisive action, the world risks failing to meet this goal. Companies are starting to see food waste as an opportunity, rather than simply a by-product of doing business, and this is particularly true in the developed world where most waste occurs at the consumption stage. We question the current dynamics of the food value chain and see the need for collaboration across key stakeholders, with a clear role for innovation to accelerate change.

Food waste is forecast to rise to 2.1 billion tonnes per year by 2030, at a yearly value of \$1.5 trillion dollars, according to BCG (Figure 1). Food waste per person is significantly higher in the developed world, where the majority occurs in the later stages of the value chain with significant sources including restrictive appearance standards and over-reliance on expiry dates. Whereas in the developing world, the majority of food waste occurs at earlier stages due to inadequate storage and infrastructure. Similar to the current spotlight on plastics, we believe food waste will be a key focus in the coming years and see awareness continuing to grow.

We believe that a collaborative approach is necessary with specific calls to action from key stakeholders: governments, consumers and industry. We argue that change is necessary all along the food value chain and draw on numerous discussions with futurist NGOs, disruptive start-ups and VC firms. Furthermore, we see the increasing use of emerging innovation to tackle the problem of food waste (page 21) such as shelf life extension technology, AI, innovative packaging and surplus food platforms.

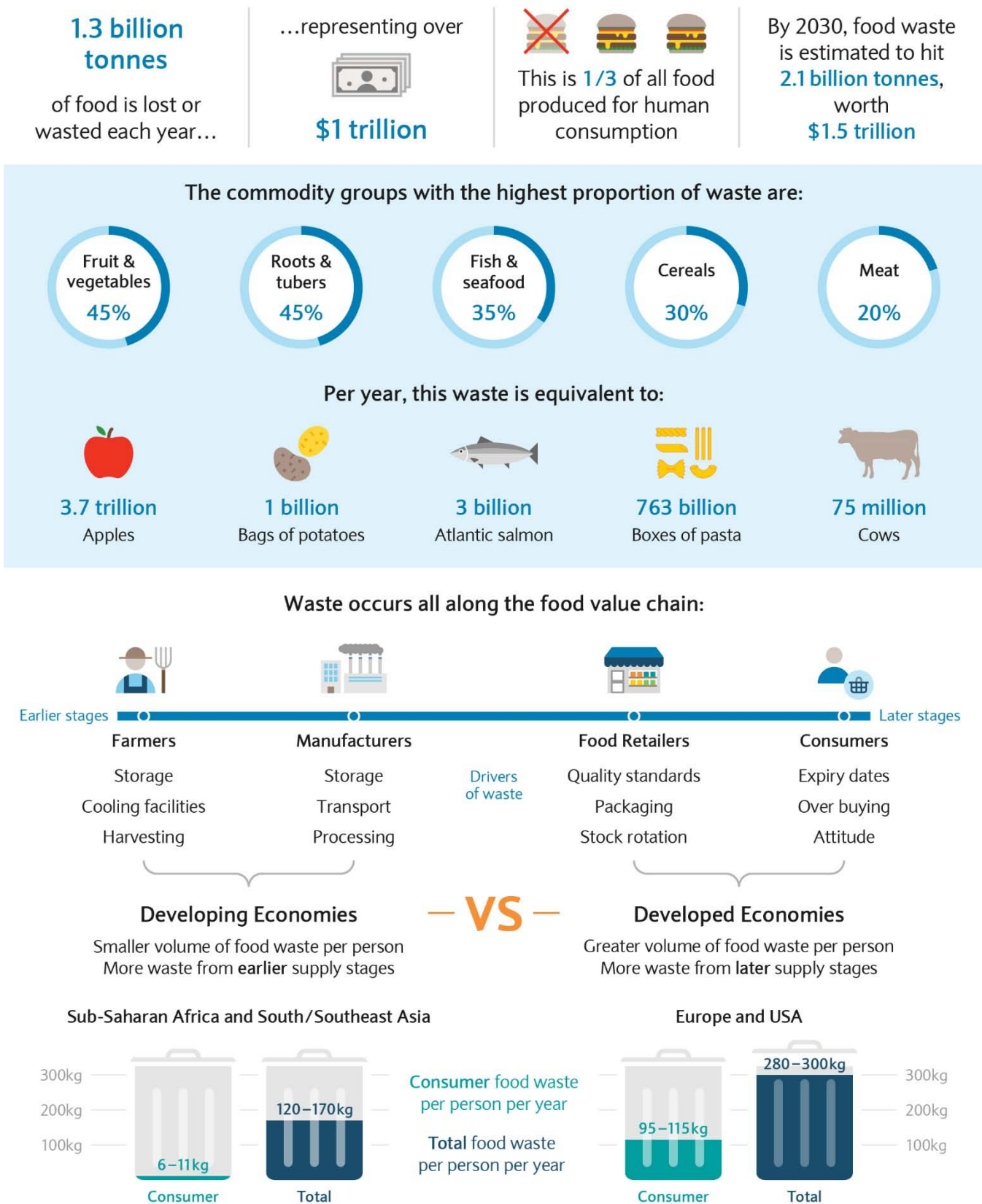
Our Investor Guidebook (page 25) assesses the impacts of increasing food waste awareness on a wide variety of sectors, following discussions with our sector analysts. We see Food Retail and Leisure as the sectors most at risk due to regulatory change and consumer pressure. Whereas we see greatest opportunity in the Food Manufacturing and Agribusiness sectors due to brand perception and cost opportunities, respectively. We think food waste also has implications for Packaging, Energy, Chemicals, Food Delivery and Transport. Refer to Figure 2 for our sector overview and key company mentions. Our current food system is synonymous with waste, but we think growing awareness has the long-run potential to redefine the balance of power across the food value chain and hence promote the shift to a leaner society.

Why read this report?

Viewing companies through a sustainable lens, investors should ensure that food waste is firmly on their radar. If a company does not take appropriate action on food waste, its relevance in an ethical and sustainable long-term portfolio may come into question. We argue that increasing awareness around food waste highlights the risks of significant regulatory change and consumer backlash. As such, investors should be putting pressure on companies to prioritise efforts to tackle this problem.

In the wider discussion around the move to a lower-carbon world, this report adds to the series of Barclays research on the topic (*European Energy: Value in a lower-carbon world* 21/11/18, *European Mining: Decarbonisation - an opportunity not a threat* 17/1/19, *Global Agriculture: Winds of change: the next environmental debate* 11/2/19). Importantly, this report also highlights food waste as an area of significant opportunity that we think is greatly overlooked when it comes to combatting climate change – if food waste was a country, the FAO estimates it would be the third-largest contributor of GHG emissions.

FIGURE 1 Barclays Sustainable & Thematic Investing – The problem with food waste



The commodity groups with the highest proportion of waste are:

Fruit & vegetables

45%

Roots & tubers

45%

Fish & seafood

35%

Cereals

30%

Meat

20%

Per year, this waste is equivalent to:

3.7 trillion Apples

1 billion Bags of potatoes

3 billion Atlantic salmon

763 billion Boxes of pasta

75 million Cows

Waste occurs all along the food value chain:

Earlier stages

Farmers

Storage

Cooling facilities

Harvesting

Manufacturers

Storage

Transport

Processing

Food Retailers

Quality standards

Packaging

Stock rotation

Consumers

Expiry dates

Over buying

Attitude

Later stages

Developing Economies

Smaller volume of food waste per person

More waste from earlier supply stages

— VS —

Developed Economies

Greater volume of food waste per person

More waste from later supply stages

Sub-Saharan Africa and South/Southeast Asia

300kg

200kg

100kg

6–11kg

Consumer

120–170kg

Total

Consumer food waste per person per year

Total food waste per person per year

Europe and USA

300kg

200kg

100kg

95–115kg

Consumer

280–300kg

Total

Consumer food waste per person per year










Total food waste per person per year

Source: FAO 2011, BCG 2018

4 March 2019

4

FIGURE 2 Sector implications around growing food waste awareness

	Sector	Impact	Emerging innovation	Key company mentions
Opportunity	Food Manufacturing 	<ul style="list-style-type: none"> • Create innovative product offerings • Adapt existing products • Develop sustainable brand image • Re-engineer manufacturing processes 	<ul style="list-style-type: none"> • Shelf life extension • Repurposed products • Assortment management system 	<ul style="list-style-type: none"> • Kellogg • Mondelez • Kraft Heinz
	Agribusiness 	<ul style="list-style-type: none"> • Benefit from more flexible supply contracts • Invest in technology around yield, storage and demand forecasting 	<ul style="list-style-type: none"> • Supply management • Repurposed products • Land analysis • Produce monitoring 	<ul style="list-style-type: none"> • Tyson • JBS and PPC • BRF • Hormel
	Packaging 	<ul style="list-style-type: none"> • Improve shelf life stability • Reformulate to meet sustainability goals • Enhance supply chain efficiencies • Enable consumers to waste less through portion control and re-sealability 	<ul style="list-style-type: none"> • High barrier film technology • RFID and smart labels • Atmospheric control 	<ul style="list-style-type: none"> • Sealed Air • Bemis • Sonoco • Avery Dennison
	Energy 	<ul style="list-style-type: none"> • Increasing demand for renewable fuels • Food waste as feedstock 	<ul style="list-style-type: none"> • Energy recovery 	<ul style="list-style-type: none"> • Neste • Covanta
Risk	Chemicals 	<ul style="list-style-type: none"> • Leverage agrochemical solutions • Improve consistency of food production • Facilitate transport and prolong shelf life 	<ul style="list-style-type: none"> • Seed enhancements • Biostimulants • Shelf life extension 	<ul style="list-style-type: none"> • BASF • Croda • Covestro
	Food delivery & Meal kit solutions 	<ul style="list-style-type: none"> • Shift towards flexible eating • Pre-portioning of ingredients 	<ul style="list-style-type: none"> • Demand analytics • Intelligent logistics • Modified atmosphere packing 	<ul style="list-style-type: none"> • HelloFresh
	Transport 	<ul style="list-style-type: none"> • Increasing demand for supply chain management • Demand for in-transit shipment monitoring 	<ul style="list-style-type: none"> • Remote monitoring • Spoilage reduction 	<ul style="list-style-type: none"> • DPDHL • Kuehne + Nagel • DSV • Hapag-Lloyd
	Leisure 	<ul style="list-style-type: none"> • Invest in waste analytics • Increasing use of demand forecasting • Embrace consumer waste initiatives 	<ul style="list-style-type: none"> • Data analytics • Smart waste management system • Excess food platforms 	<ul style="list-style-type: none"> • Carnival • Sodexo • SSP • JD Wetherspoon • Greggs
	Food Retail 	<ul style="list-style-type: none"> • Review promotions strategy • Increase flexibility of supplier contracts • Optimise order forecasting • Promote food waste awareness 	<ul style="list-style-type: none"> • Upcycled products • Innovative packaging • Ethical supermarkets 	<ul style="list-style-type: none"> • Tesco • Walmart • Kroger • Sainsbury • Carrefour

Source: Barclays Research

THE PROBLEM WITH FOOD WASTE

We already waste 1.3 billion tonnes of food each year and this is expected to increase to 2.1 billion tonnes by 2030. Fresh produce presents the biggest problem, with almost half of the world's fruit and vegetables being thrown away each year. The scale of the problem is also greatest in the developed world, where an over-reliance on expiry dates and lack of understanding over the value of food means that consumers waste around 10 times more than in poorer regions. Food waste is not only a serious market inefficiency, but also a major contributor to greenhouse gas emissions throughout food production and disposal processes. We believe the developed world holds the greatest potential in terms of tackling food waste in the medium term through improved technology and awareness in the later stages of the value chain.

It's a global issue and it's expected to grow

Each year roughly one-third of the food produced for human consumption globally is wasted (*FAO*). This equates to around 1.3bn tonnes of wasted food and in monetary terms represents around \$1 trillion (c\$680bn in developed countries and c\$310bn in developing countries). Food waste is expected to continue growing, and is forecast to reach 2.1 billion tonnes by 2030, worth around \$1.5 trillion (*BCG*).

Looking at the composition of food waste, fresh produce is the biggest contributor with fruits, vegetables, roots and tubers having the highest rates of wastage (Figure 3).

FIGURE 3 Proportion of food wasted is highest in the fresh produce section

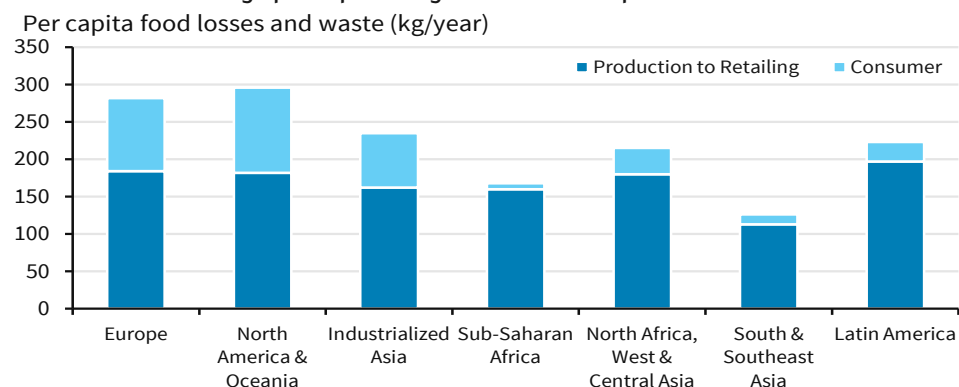


Source: *FAO* 2011

Food waste per capita is greater in the developed world

Per capita food wastage from all stages of the supply chain is generally higher in developed countries – at 280-300kg per capita per year in Europe and North America compared with 120-170kg per capita per year in sub-Saharan Africa and South/Southeast Asia. The proportion of food waste relative to total food production is, however, similar at 31-33% in Europe and North America and 26-37% in sub-Saharan Africa and South/Southeast Asia.

FIGURE 4 Food wastage per capita is higher in the developed world



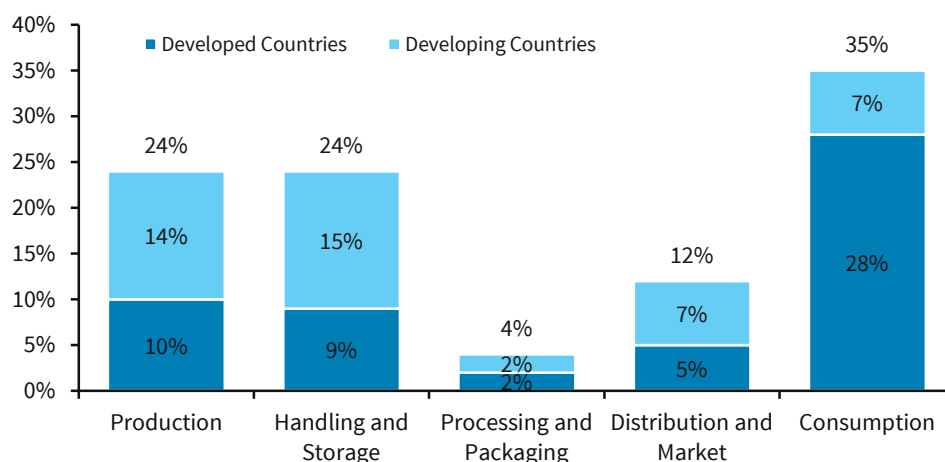
Source: *FAO* 2011

Consumer waste is more prevalent in developed countries

There is wastage all along the food supply chain, from the initial production stages all the way through to final consumption. However, wastage at the final consumption stage represents a greater proportion of the total in more developed countries – Figure 5. The FAO estimates that per capita food waste by consumers in Europe and North America is 95-115kg per year compared with only 6-11kg per year in sub-Saharan Africa and South/Southeast Asia. In the UK, the *Institute of Mechanical Engineers* highlights that food wastage by consumers costs the average household around £480 per year.

FIGURE 5

Food waste from later supply stages (and consumption) is higher in developed regions



Source: FAO 2011, WRI 2013. 100% = 1.5 quadrillion kcal.

Expiry dates, multi-buy promos and pack sizes

One factor likely driving this consumer waste is the developed world's over-reliance on expiry dates and best-before dates. The *Institute of Mechanical Engineers* finds that between 30-50% of the produce that reaches the supermarket shelf is thrown away by the consumer, "often at the direction of conservative 'use by' labelling." This presents an opportunity to reduce food waste through innovative packaging that enables consumers to more accurately determine whether the food is safe to eat – we explore this later in the report (see our Mimica interview, page 62). Another reason for food waste in the home is due to grocery retailers' prominent use of multi-buy promotions such as 'buy-one-get-one-free', encouraging consumers to purchase more than is required. Consumers are also constrained by pack sizes – i.e. it is often difficult for a consumer to purchase only the quantity of food they need.

Some produce doesn't even make it to the consumer

Other dominant sources of food waste in developed countries include the introduction of appearance quality standards – i.e. grocery retailers have set strict produce specifications that farmers and manufacturers need to meet. This is particularly prevalent in the fresh produce space such as fruits and vegetables (which is also the commodity group with the largest proportion of waste – Figure 3). The result is a significant amount of produce that ends up being wasted because it is not accepted by the grocers. In the UK, the Soil Association estimates that 20-40% of fresh produce doesn't make it to the supermarket shelf due to aesthetic reasons.

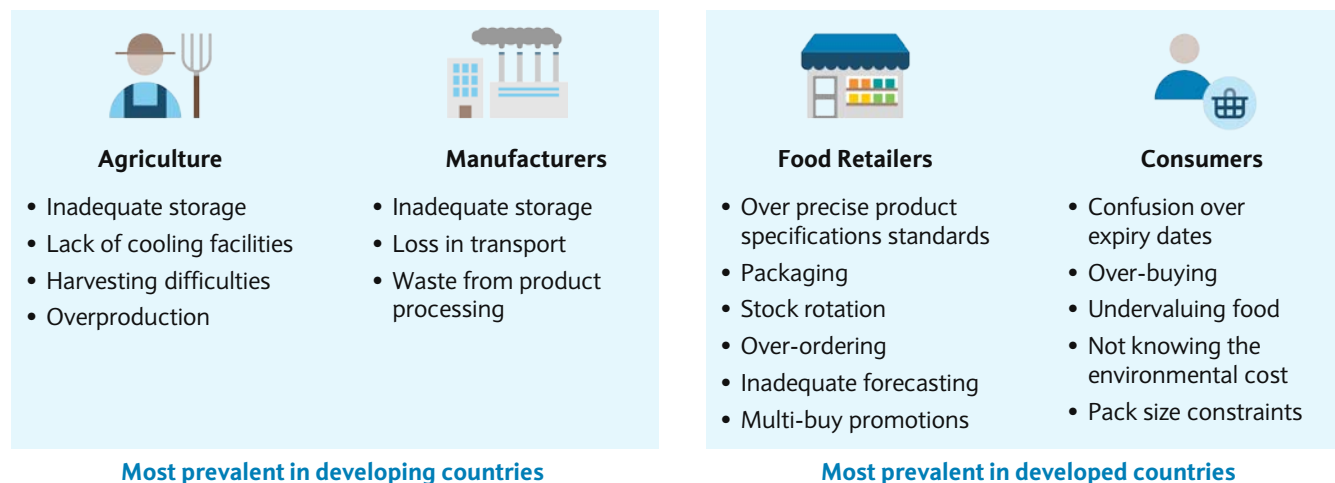
In contrast, in developing countries, food wastage generally occurs in earlier stages, with difficulties in harvesting, storage, infrastructure, packaging and transport systems. Figure 5 shows that in developed nations, food waste in the distribution and consumption stages

makes up a greater proportion of the total than in developing nations where a greater amount of waste comes from the production and handling stages.

Scope for change all along the food supply chain

There are a variety of factors influencing the food supply chain that can lead to food waste; we outline some of the main reasons in Figure 6.

FIGURE 6 Factors contributing to food waste – a lack of awareness along the value chain



Source: Barclays Research

A focus on the developed world

We acknowledge that many families in developing nations rely more heavily on agriculture, while also living closer to food insecurity, hence a reduction in food wastage could have larger benefits for their standard of living. We see scope in the long-run for governments of developing nations to improve infrastructure and for companies to embed suitable technology to improve harvesting techniques and storage conditions.

However, in the medium term we see the largest opportunity to reduce food wastage in the developed nations. This is due to the larger scale of the problem in developed nations per person and the greater opportunities to improve technology and awareness in the later stages of the value chain. Due to our focus on the developed world, we have included some statistics for the scale of the problem in the US, Europe and the UK (Figure 7).

FIGURE 7 The problem of food waste in the developed world

US	Europe	UK
<ul style="list-style-type: none"> • 63mn tonnes of food wasted yearly • Represents 40% of food in the US and c\$165bn in value • 40% of food waste comes from restaurants and grocery stores • Reducing fruit and vegetable waste is an \$18bn opportunity for retailers • A 15% decline in food waste could feed 25million Americans yearly 	<ul style="list-style-type: none"> • c88mn tonnes of food waste per year, or 20% of the food produced for human consumption • The associated cost is cEUR143bn • Food waste of around 2.5x the average body weight for every person, per year • Households generate over 50% of the food waste 	<ul style="list-style-type: none"> • c10mn tonnes of food waste annually • Represents c25% of the food purchased in the UK • Represents over £20bn in value • 25mn tonnes of greenhouse gas emissions are associated with the waste • c70% of food waste from households and 18% from food manufacturing

Source: ReFed, NRDC, Fusions, WRAP

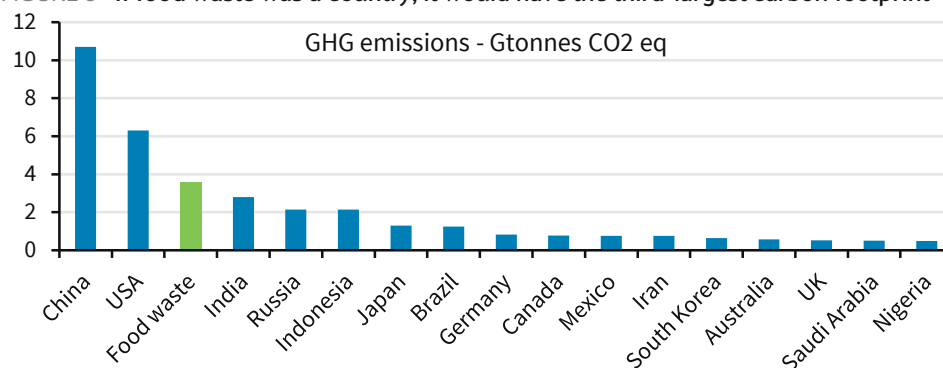
A greatly overlooked driver of climate change

It is clear that food waste is a serious market inefficiency – the \$1 trillion value of global annual food waste represents c1.2% of global GDP. But food waste also poses a significant environmental challenge in terms of its carbon footprint as well as land and water use.

Food waste's significant carbon footprint

The FAO estimates that if food waste was a country, it would be the 3rd biggest emitter of greenhouse gases at 3.6 Gtonnes of CO₂ equivalents, behind only China and the USA (Figure 8). This means that food waste contributes around 8% of global greenhouse gas emissions, almost equivalent to global road transport emissions (*IPCC*). Producing the food we waste causes GHG emissions all along the value chain from farm-to-fork and also leads to emissions when it is sent to landfill, releasing methane when it decomposes anaerobically. ReFED, a US coalition to reduce food waste, *estimates* that a 20% reduction in US food waste over the next 10 years would avoid almost 18 million tonnes of greenhouse gases annually, recover c1.8 billion meals per year and save over 1.6 trillion gallons of water annually.

FIGURE 8 If food waste was a country, it would have the third-largest carbon footprint




Source: WRI's Climate *Data Explorer* 2011 data, *FAO* for 2011 food waste estimate


Wider environmental costs

A land mass larger than Canada and India combined is needed to grow the food that we waste each year (*FAO*) and the water and energy used to produce this food are wasted as well. Agriculture is the world's largest user of fresh water and it is *estimated* that over 25% of fresh water use in the US is accounted for by wasted food.

FIGURE 9 Food waste is a significant burden on the environment

In the US, food waste consumes:


18% of cropland


19% of all fertiliser


21% of landfill volume

Source: *ReFed*

Reducing food waste can help the shift to a lower-carbon world

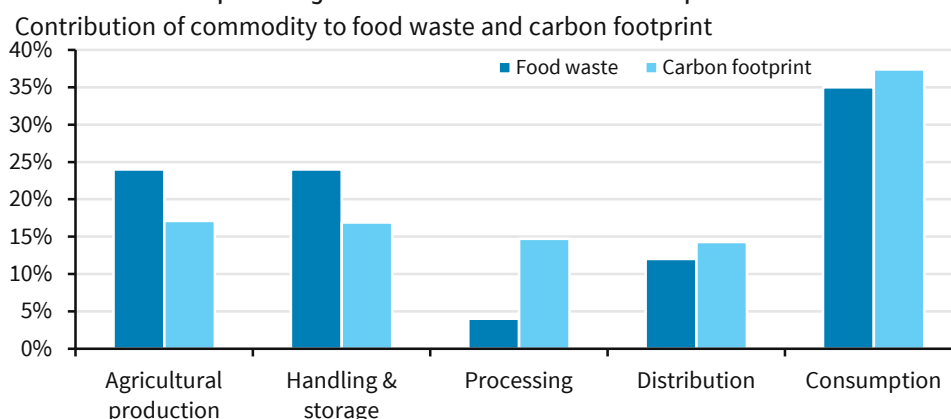
Barclays has already published on the move to a lower-carbon world – see *European Energy: Value in a lower-carbon world* (21/11/18), *European Mining: Decarbonisation - an opportunity not a threat* 17/1/19, *Global Agriculture: Winds of change: the next environmental debate* 11/2/19). However, we think food waste is an often over-looked, and yet solvable, factor and presents an opportunity to dramatically improve the environmental outlook. *Project Drawdown's* researchers found that reducing food waste could lower

emissions by 70 Gtonnes over the next 30 years and ranked reducing food waste as the third most impactful action to targeting climate change, behind only refrigerant management (90GT) and onshore wind turbines (85GT).

Consumer food waste presents largest opportunity for reducing carbon footprint

In terms of the food value chain, the highest carbon footprint is generated from the consumption stage because of the cumulative effect from previous stages (Figure 10). As an example, a single tomato wasted at the harvesting stage will have a much lower carbon footprint than a consumer wasting tomato sauce because the harvesting, transportation and processing accumulates additional greenhouse gas emissions. As most food waste occurs at the consumer level, this suggests that reducing food waste in the consumption stage is likely to have the biggest impact in terms of carbon footprint.

FIGURE 10 Consumption stage contributes most to carbon footprint

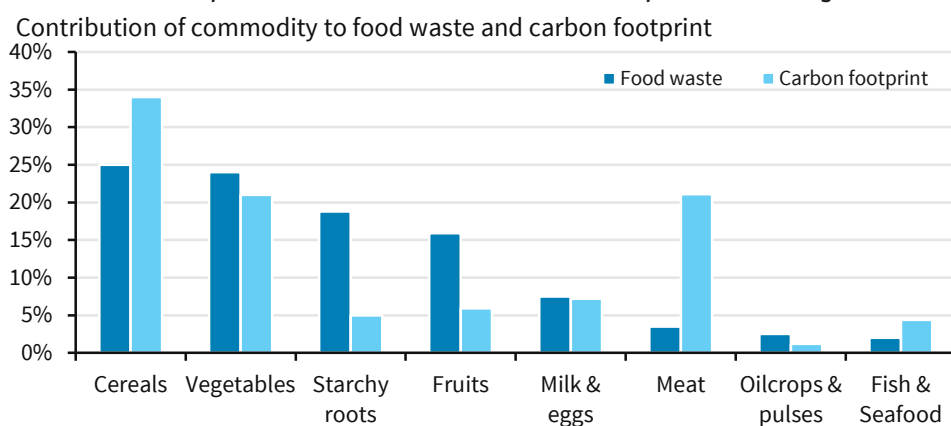


Source: *BIO Intelligence Service, Presentation of the Footprint 2013, FAO 2011, WRI 2013*. Note: Food waste by energy.

Animal products – low wastage rates but high carbon footprint

Animal products contribute significantly towards the global carbon footprint, much more so than their contribution to food waste (Figure 11). This is because of the intensity of GHG emissions to produce meat, specifically beef products. For further details see [Global Agriculture: Winds of change: the next environmental debate 11/2/19](#).

FIGURE 11 Animal products contribute more to carbon footprint than wastage



Source: *BIO Intelligence Service, Presentation of the Footprint, 2013*. Note: Contribution to food waste by volume.

As awareness around agriculture's impact on the environment has grown, investor pressure has also become more apparent. On [29 January 2019](#), over 80 investors supported a letter sent to some of the largest global fast food companies including McDonald's and Burger King urging them to take swift action on climate change. We think similar investor pressure could emerge as awareness around food waste continues to grow.

WHY SHOULD INVESTORS FOCUS ON FOOD WASTE?

Tackling food waste should be seen as a significant investment opportunity that not only champions long-term sustainable business practices but also offers a way to develop additional consumer brand value. Over \$125 million of private capital was invested in food waste start-ups in 2018 and we believe that, with growing awareness around the issue, companies that ignore their responsibilities on food waste could be labelled ‘unethical’ and ‘uninvestable’ when viewed through a sustainable lens. Whereas we think firms that are proactively tackling the problem through innovation and collaboration are likely to be viewed more positively by both investors and consumers. Similarly to how society is being dramatically reshaped by the plastic movement, we argue that food waste should be firmly on the investor radar given the growing risks attached to regulatory action and the potential for consumer backlash.

5 key factors to consider

We acknowledge that food waste fits within the much broader discussion on food sustainability and climate change, and thus we have included sustainability factors within our five key factors for focusing on food waste – Figure 12 – as we think food waste is a powerful driver that is often overlooked. Consumer awareness continues to be a key catalyst in addition to the UN’s Sustainable Development Goals, forcing companies and the government to shift their viewpoint on food waste away from a by-product of doing business to an opportunity to improve efficiency.

FIGURE 12 A summary of the 5 key factors to consider on food waste

1. Sustainability factors	2. Policy momentum	3. Consumer awareness	4. Private capital investments	5. Investment opportunity
<ul style="list-style-type: none">• Climate change driver• UN’s SDG 12.3 target• Increasing population• Misuse of resources	<ul style="list-style-type: none">• Mandatory measurement, taxes, fines or incentives• French-style regulation	<ul style="list-style-type: none">• Consumer driven campaigns• Risk of consumer backlash	<ul style="list-style-type: none">• >\$125 mn of private capital invested in 2018• Larger funding rounds	<ul style="list-style-type: none">• \$1trn global annual value• \$1.9bn per year in business profit

Source: Barclays Research, ReFED, FAO 2011

Sustainability factors

Greatly overlooked driver of climate change

As discussed already on page 9, we think food waste is a greatly overlooked driver of climate change contributing around 8% of global greenhouse gas emissions. Investors are taking note of the carbon footprint of certain activities and we think this will be the case with food waste also. The letter on 29 January 2018 from over 80 investors to some of the largest global fast food companies (McDonalds, Burger King, Domino’s Pizza) about the carbon footprint in their supply chain shows the growing awareness around sustainability factors within investment decision making.

The UN’s Sustainable Development Goal 12.3 target to halve food waste

Food waste is emerging as a critical global issue with the UN including a specific target for food waste as part of its 2015 Sustainable Development Goals. SDG 12: Responsible Consumption and Production seeks to “ensure sustainable consumption and production patterns” and the third target within this goal (SDG12.3) calls for “halving per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” by 2030. We think it is therefore important for investors to be aware of the action needed to achieve this goal.

Increasing population puts pressure on resources

In a world where the population is predicted to reach 9.8 billion by 2050 ([UN 2017](#)), increasing pressure on resources requires urgent action to tackle the problem of food waste. Interestingly, we are already growing enough food for 10bn people, according to the [Journal of Sustainable Agriculture](#), but the problem is that we are wasting a third of it. Unsustainable food practices are creating hunger and inequality around the world.

Food waste highlights a misuse of resources

Even though we produce enough food to feed everyone, the [World Food Programme](#) estimates that around 800 million people in the world are undernourished, representing around one in nine people. If we can reduce food waste by even 25%, this would save enough food to effectively end world hunger (also achieving SDG 2: Zero Hunger).

Policy momentum – risk of restrictive policy changes

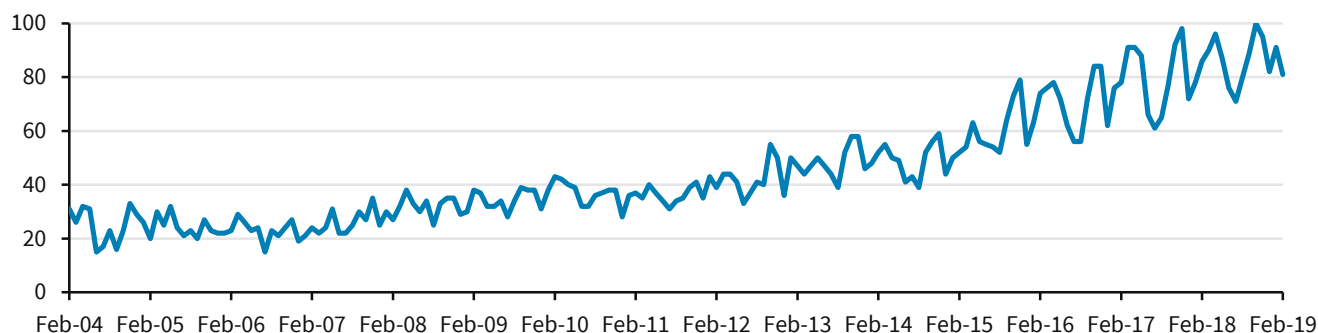
Food waste is moving up the policy agenda. The EU and US have committed to the SDG 12.3 target and a group of around 40 CEOs, government officials and NGO leaders have launched a coalition called Champions 12.3 to mobilise progress towards the SDG's goal. The Champions 12.3 have produced a [2018 Progress Report](#) for the SDG target. The report indicates some impressive progress made by the industry on food waste, with nearly two-thirds of the world's 50 largest food companies participating in programmes with a food waste reduction target and more than a quarter measuring their waste. However, the report indicates that there is still a way to go for government action on food waste. We explore the government's role in the solution to food waste in more detail in the next chapter.

We have seen some governments prioritising food waste, for example France's law prohibiting supermarkets from sending excess food to landfill, hence we see a risk of future regulatory change whether in the form of mandatory measurement, taxes, fines or incentives. We think voluntary, collaborative company action has the potential to shape future regulation around food waste and is therefore a more positive outcome than waiting and risking intrusive regulation.

Consumer awareness is growing

Consumer awareness around the issue of food waste is growing and we think this will continue – Figure 13. There have been a growing number of consumer-driven campaigns around food waste, for example Isabel Soares founded Fruta Feia (Ugly Fruit), a co-op in Portugal that has rescued 300 tonnes of blemished produce, and Italian chef Massimo Bottura set up a soup kitchen at the Rio Olympics using excess food from the Olympic Village. Selina Juul is also a notable food activist who has driven significant change in the food waste culture in Denmark through the Stop Wasting Food movement (see page 18).

FIGURE 13 The increase in interest over time for the term 'food waste'



Source: Google Trends, Note: Numbers represent search interest relative to the highest point on the chart for the given region and time.

A survey conducted for Zero Waste Week in the UK [found](#) that over 75% were concerned about food waste; in the US this figure was 89%, according to the [American Frozen Food Institute](#). [WRAP](#) also find that concerns around food waste increase with more information that is given about food waste, so we think that as awareness grows the risk of consumers putting significant pressure on companies will increase. There is also the risk of consumer backlash on social media, for example, similarly to what we have seen with plastics.

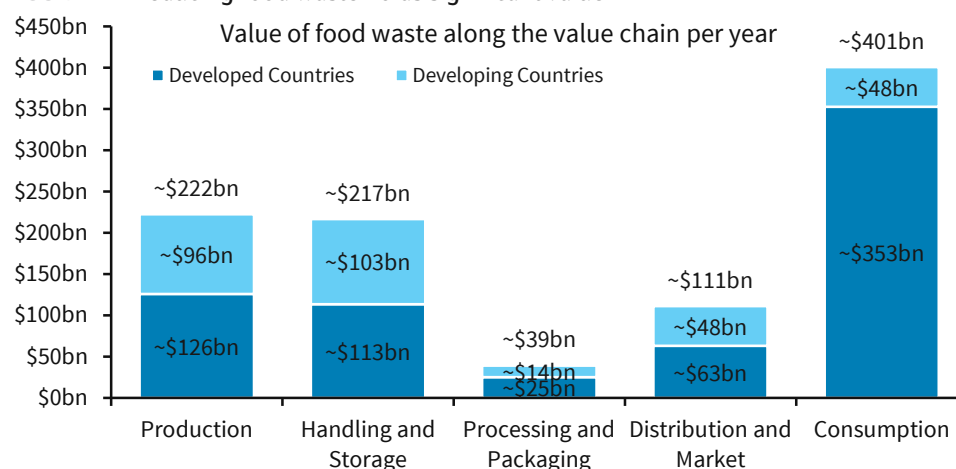
VC and PE investment in food waste start-ups

In 2018, over \$125 million of private capital was invested in food waste start-ups according to ReFED. This includes Apeel Sciences (\$70m), WISErg (\$19m), Full Harvest (\$9m), FoodMaven (\$9m), TeleSense (\$7m) and Blue Cart (\$5m) Jan-Sept 2018. With ever-increasing funding rounds, we think investors should be paying close attention to the space.

A significant investment opportunity

We also see significant value to be had from investing in companies tackling food waste. Using the FAO's estimate of the value of food waste per year of \$680 billion in the developed world and \$310 billion in the developing world, we have broken down the value by stage of the supply chain in Figure 14 (see page 25 for our detailed sector analysis). We highlight that, although we do not see food waste falling to zero, as there will always be some unavoidable waste, the values in Figure 14 indicate a significant opportunity from even a small change in food waste.

FIGURE 14 Reducing food waste holds significant value



Source: Barclays Research, FAO 2011, WRI 2013

In the US alone, [ReFED](#) estimates that an \$18 billion investment in its proposed 27 solutions to reduce food waste by 20% over a decade has the potential to deliver an expected \$100 billion in societal economic value. It is also estimated that the 20% reduction in food waste could generate \$1.9 billion in potential annual business profit as well as \$5.6 billion in potential annual consumer savings.

In the next chapter we look at the relevant stakeholders around the problem of food waste and highlight what can be done to unlock some of this untapped value.

"In the same way that child labour used to be endemic in the fashion industry but is now completely unacceptable, I believe the same is happening to food waste."

Tessa Clarke, Co-founder of OLIO

WHAT CAN BE DONE ABOUT THE PROBLEM

We see increasing awareness as a first step towards collaborative action, followed by improvements in the infrastructure and efficiency of the supply chain. We provide calls to action from three key stakeholders: governments, consumers and industry. The recent wave of newsflow in this space is encouraging, from countries introducing specific regulation around food waste to companies making food waste pledges. We also see the increasing use of emerging innovation to tackle the problem of food waste such as artificial intelligence, shelf life extension, innovative packaging and surplus food platforms.

A collaborative approach is key

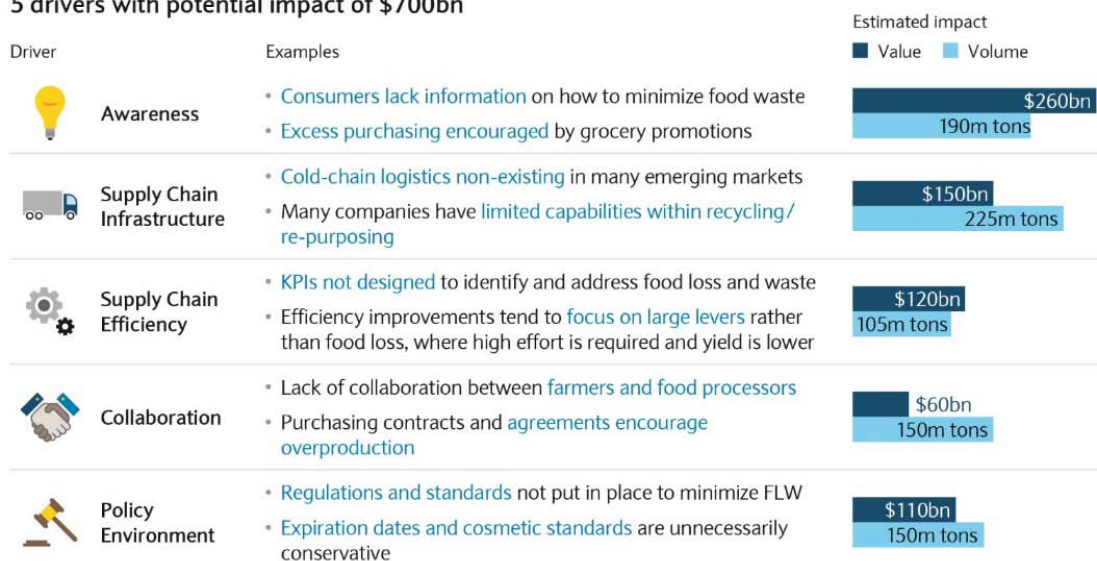
In the long term, we think a collaborative approach across the value chain is key to tackling the systemic problem of food waste. Businesses at each stage must realise that food waste is a risk to the entire system and work together to implement solutions. We believe the solutions put in place should prioritise prevention given this is likely to deliver long-term sustainable change, followed by recycling, recovery and then finally disposal.

We acknowledge the current difficulties of full collaboration – it is a tall order to bring all the relevant players into the same room. Management teams are under scrutiny to provide shareholder value and hence investing in tackling food waste may not be a top priority. However, as we have discussed (page 12), awareness around food waste is growing and consumers and governments are putting increasing pressure on companies to take action.

Awareness is the first step, with the supply chain close behind

We therefore argue that improving awareness around food waste is crucial as a first step towards collaborative action, highlighting the longer-term rewards of acting now. We spoke with BCG, whose work estimates that improving awareness could save 190 million tons of food waste per year by 2030, representing c\$260 billion in yearly value (Figure 15). We also think the supply chain is another key area in which collaborative action can reduce food waste. BCG estimates that improving infrastructure could save 225 million tons of waste per year and that improving supply chain efficiency could save 105 million tons per year.

FIGURE 15 Action needed across the value chain
5 drivers with potential impact of \$700bn



Source: BCG Analysis

Calls to action – Government, Consumers, Industry

We see the problem of food waste as a collective responsibility and hence provide calls to action from 3 groups: governments, consumers and industry.

FIGURE 16 Calls to action from three groups



Source: Barclays Research

1. Governments – enabling regulation is certainly helpful

Europe – France sets a good example

France has been recognised for its action against food waste through its number one position in the *Food Sustainability Index* for both 2016 and 2017. In 2013, France launched its National Pact against Food Waste target of halving food waste by 2025 and then in 2016 passed a law requiring grocery stores over a certain size to donate unsold food, with a fine of €3750 for each violation. The law also made it simpler for food manufacturers to donate excess products, requires restaurants to recycle excess food and offer ‘doggy bags’, bans expiry dates on products like wine, baked goods and sweets and ensures food-waste education starts at primary school.

Following France’s move, Italy created regulation in 2016 to incentivise restaurants and grocers to donate excess food rather than waste it. The regulation enables retailers to donate food past its sell by date and pay a lower amount of waste tax.

UK – moving in the right direction

The UK does not have any formal legislation to require retailers to stop wasting food; instead it has focused on a voluntary agreement. The *Courtault Commitment 2025* is a voluntary agreement to bring together organisations across the food system to progress towards more sustainable production and consumption of food and drink. However, we do see some moves in the right direction:

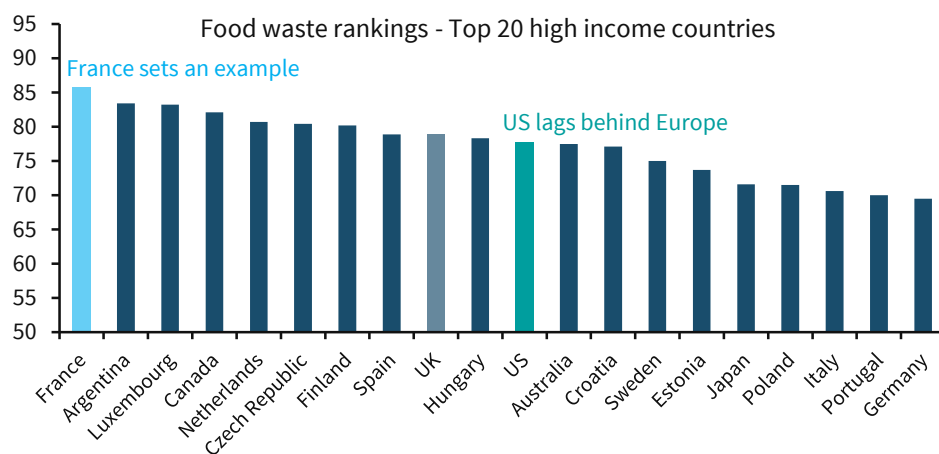
- The *Mayor of London* has adopted the UN’s SDG to help cut food and associated packaging waste by 50% by 2030.
- A £15 million *pilot scheme* set for 2019/20 to promote awareness and work towards eliminating food waste sent to landfill by 2030 (as part of the *25 Year Environment Plan*).
- Publication of the *Resources and Waste Strategy* in December 2018, with key proposals including the introduction of mandatory reporting of food waste statistics by businesses and the potential for future food waste targets if progress should be “insufficient”.

US – some way to go

The US has attempted to tackle food waste through a set of bills called the *Food Recovery Act*, introduced in 2015. The legislation establishes programmes to educate consumers about food waste, aims to improve cooperation amongst the industry and help schools to use food that would otherwise go to waste. The bill also expanded tax deductions that could be made for the donation of food to charities as well as stipulating the language to be used for ‘sell-by’ dates. Despite this, we see the US as lagging behind Europe in terms of regulation on food waste. The US comes in 11th place in the November 2018 Food

Sustainability Index data when looking only at food loss and waste in high-income countries (Figure 17).

FIGURE 17 France leads the way on food waste, US lags behind



Source: *Food Sustainability Index by The Economist and BCFN*, Nov 2018.

Actions to take:

- **Targets:** We think governments should primarily ensure an official target has been set on the topic of food waste. A number of developed countries have decided to adopt the UN's SDG 12.3 target to halve food waste by 2030, but others have taken less aggressive targets. From this first step, companies can then be asked to set their own targets on food waste alongside proper measurement and data disclosure.
- **Mandatory measurement:** We think that mandating standardised measurement of food waste could be one of the most important roles for governments in the developed world. The UK's Waste & Resources Action Programme (WRAP) has produced guidelines for reporting and measurement as part of its [Food Waste Reduction Roadmap](#). Its core recommendations include measuring and quantifying the tonnage of food sent to various destinations, separating out the food redistributed to charity, sent to animal feed or bio-based materials.
- **Penalties & Incentives:** We think governments should be actively pursuing comprehensive policies that change consumer attitudes towards food and dissuade retailers from rejecting produce due to aesthetic conditions. We think France's approach of making it illegal for supermarkets to throw away food is a bold one, which has significantly boosted its food waste credentials. We think fiscal penalties for food waste are likely to have greater impact than incentives, which can be seen from government policy around issues such as the sugar tax and plastic bag charge.

2. Consumers – education required to raise awareness

Consumer power through social activism

We see consumers as an important driver of change as awareness around food waste continues to grow. Consumers can pressure companies through their purchasing decisions as well as through their ever-increasing social media influence (we refer to Generation Z as social activists in our report [Generation Z: Step aside Millennials](#), 28.6.18). We have seen this phenomenon with plastic waste, with younger consumers using hashtags such as #StrawsSuck and #SkiptheStraw on social media to highlight their commitment to limit plastic use. A variety of foodservice, retail and leisure companies have since responded by cutting their availability of plastic straws. Jacob Hansen at BCG agrees that “if consumers put pressure on companies, the industry will become more conscious of the problem”, adding that “similarly to what has happened in plastics, companies will try to differentiate themselves on their food waste actions”.

Expectation of abundance and perfection

Consumers in the developed world have become detached from the process of producing food and many now have the expectation of being able to buy anything they want, at all times. This expectation of abundance puts a burden on supermarkets and restaurants to over-order to ensure sufficient availability, in turn leading to food waste. The [Institute of Mechanical Engineers](#) estimates that the catering industry wastes around one-third of its food as restaurants frequently over-order. Although we see this problem reducing in the future as forecasting systems become more accurate (we highlight innovative solutions using big data/AI such as Tenzo and Winnow on page 24), we still see a need for consumers to be more conscious about their expectations on availability.

There is also a tendency for consumers to expect perfect produce, which has led supermarkets to impose strict aesthetic produce standards on farmers and contributed to significant amounts of waste.

What about a sugar-style tax?

Although some may argue that a sugar-tax style tax on food would be an effective solution to change consumer behaviour around food waste, we think this type of solution would be difficult to apply globally and politically unpopular with lobby groups. Similarly to a GHG tax to reduce the consumption of meat (discussed in [Global Agriculture: Winds of change: the next environmental debate](#) 11/2/19), a tax of this nature would likely have a regressive impact, hurting lower income families the most. This is particularly significant given that most waste comes from fruit and vegetables and hence a tax to reduce food waste would likely disincentivise the purchase of healthy produce, particularly problematic given growing concerns around obesity. We think a more plausible policy would be to charge consumers for the amount they waste. In [South Korea](#) the recycling rate of food waste rose from 2% in 1995 to 95% in 2009, driven by its ‘pay-as-you-throw’ solutions. Municipalities could choose between 3 solutions: paid-for standard plastic bags, attaching paid-for stickers to food waste bins, and bins that weigh food waste in order to calculate a household’s charge.

Shift to convenience shopping could be helpful for food waste

Modern lives are busy and likely to get even busier – the IGD estimates that 71% of 18-24 year olds believe their lives will be busier in 5-10 years’ time. This has meant that the food retail market has seen consumer behaviour shift away from large weekly shops, towards more frequent but smaller shopping trips. We discuss the growth in convenience grocery shopping in our thematic note [Future of Food Retail: Long Live Clicks and Mortar](#) (12.10.18). We argue that this shift to convenience-style shopping could help with the problem of food waste as consumers buy their food as and when it is needed, reducing the chance that food is forgotten about/goes off and is hence wasted. On the other hand, some may argue that planning and scheduling meals in advance is the best way to reduce waste.

Case Study: Denmark's change in attitude towards food waste

Denmark has reportedly cut its food waste by 25% in the past 5 years, *according* to the Danish Agriculture and Food Council. This has been achieved in large part due to a change in consumer attitudes towards food waste, driven by numerous waste reduction initiatives and innovative start-ups. Denmark has a wide variety of awareness campaigns around the topic whilst also hosting food waste supermarkets (e.g. *We Food*) and cooking schools for food waste.

We think there are a number of factors influencing the rapid change in mindset: 1) the small population size means it is easier to spread the message, 2) food is expensive (Danes spend almost twice what Americans spend on food) a cultural expectation of knowing how to cook (according to *Rikke Bruntse Dahl* at Copenhagen House of Food).

Actions to take:

- **Education:** We think educating consumers around the scale of the food waste problem, the impact this is having on the environment (and their wallet) as well as informing them on practical solutions is important to help tackle the issue. Specific programmes around food waste and the food production system in general could be included in national curriculums rather than sporadically taught through charity programmes. In the UK, for example, WRAP's Love Food, Hate Waste campaign contributed to a 21% reduction in food waste over five years.
- **Attitude:** Consumers should recognise the pressures they put onto supermarkets through their expectations of abundance and perfect produce. Buying 'wonky' produce sends signals to retailers that these products are demanded and hence should not be wasted. There is also an opportunity for consumers to impact the restaurant and leisure industry – ask to take excess food home, ask for smaller portions and hold to account those companies that waste food.
- **Embrace innovation:** Many options now exist for consumers to use technology in order to reduce food waste – we explore some of these in our emerging innovation section on page 21. Consumers can make use of excess food sharing platforms such as OLIO and Too Good To Go, support ethical supermarkets such as HISBE and buy items produced using excess food such as Snact's fruit jerky.

3. Industry – revenue vs. responsibility or simply bad for business?

Although it may at first appear that tackling food waste represents a trade-off between revenue and responsibility, growing awareness about the issue, as well as innovative solutions (page 21), suggest that food waste is simply bad business. Food waste presents opportunities for businesses on many levels including cost savings, enhancing their reputation, boosting margins and improving staff retention.

Revenue opportunity

Tackling the issue of food waste presents numerous revenue opportunities for existing and potential new businesses. Excess food that would otherwise have been wasted can be turned into new products (see examples in our emerging innovation section on page 21) or sold as ‘imperfect’ produce. We do acknowledge there is a risk to the industry if consumers purchase less due to growing awareness of food waste. However, we think this is likely to be partially offset through both product substitution by consumers and the use of emerging innovation across the industry to protect profitability.

Margin opportunity

We see significant margin opportunity for companies tackling food waste. After analysing data for 700 businesses across 17 countries, the WRI and WRAP *found* that for every \$1 invested in reducing food waste, companies on average saved \$14 or more. BCG also estimates that companies that lead in reducing their environmental footprint tend to boast margins 3.3pp higher than competitors.

Case Study: Apeel and Harps Food Stores – interview on page 61

We spoke with Head of Marketing at Apeel, Michelle Masek, about their work extending the shelf life of avocados at Harps Food Stores using their plant-based coating. “*Harps have reduced their food waste in the Hass avocado category by over 50%*”, this led to a “*10% sales lift in avocados*” and hence a “*65pp increase in margin.*”

Investor pressure

Alongside consumer pressure to tackle food waste, we think the issue will increasingly appear on the investor radar as awareness continues to grow. We think food waste will increasingly impact investment decisions and believe that companies ignoring their responsibilities could fall short on certain sustainability measures. We spoke with Geraldine Gilbert at Forum for the Future, who told us that investors are showing “*more interest for ethical and ambitious companies*”, and that investor pressure “*would likely help the issue*”.

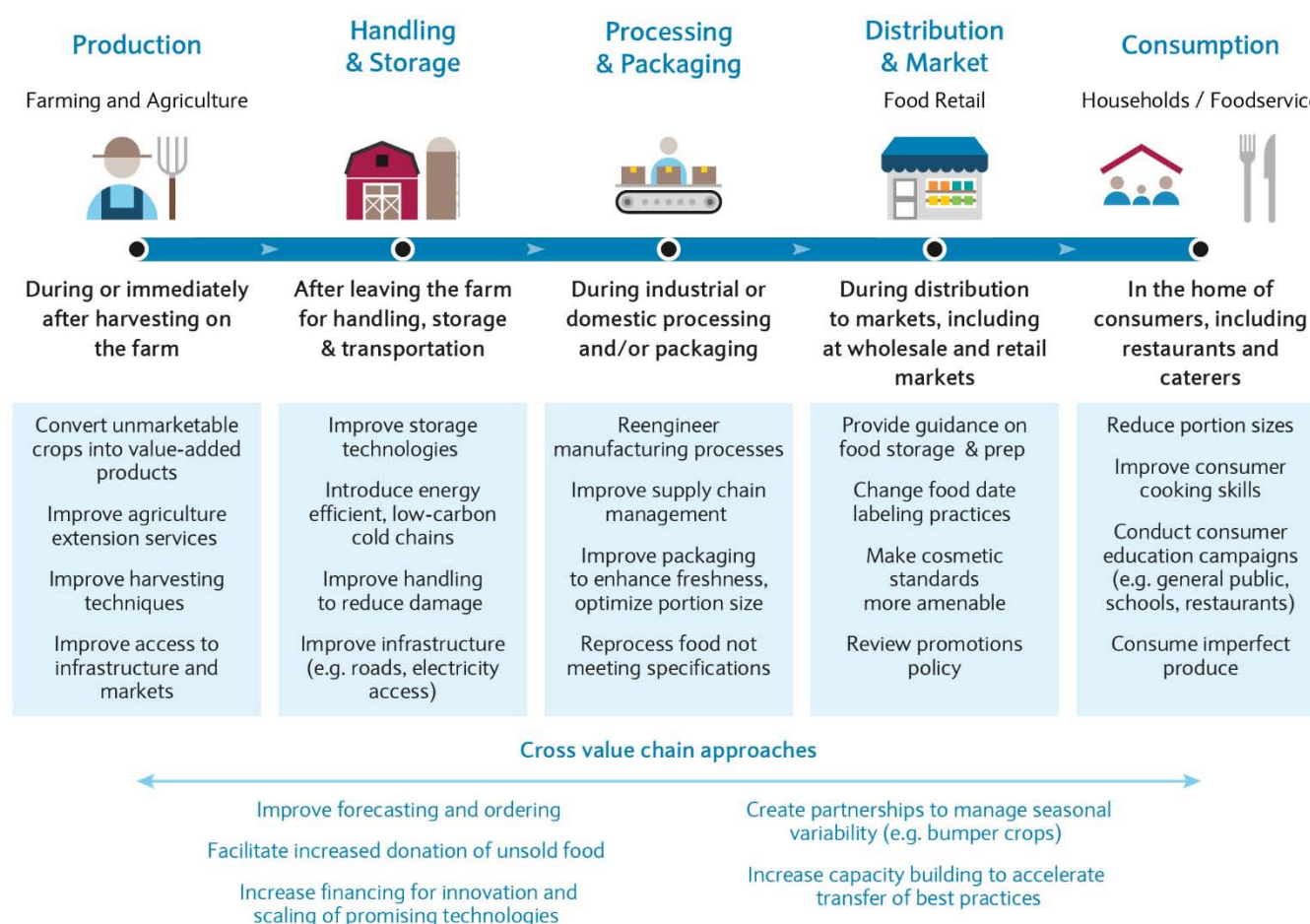
Actions to take:

- **Aesthetic standards:** In an attempt to combat strict aesthetic standards, ‘wonky’ veg has been introduced by several of the mainstream food retailers. We see ‘wonky’ produce as still relatively niche but think this can help adjust consumer expectations of perfect produce – particularly if they can buy the imperfect produce cheaper.
- **Collaboration:** We believe industry should increasingly engage in collaborative initiatives with non-profits and industry organisations. We also see the need for network and knowledge sharing along the supply chain – for example, the largest grocers should be encouraging farmers to not waste produce by linking up farmers with other industry players who could use the excess produce.
- **C-suite support:** We think senior support is significant when it comes to driving change in the food waste agenda. Tesco’s CEO Dave Lewis chairs the Champions 12.3 group and we think this has been instrumental in Tesco becoming one of the leading companies on food waste.

All players in the food value chain will need to take action

We argue that there is scope for action on food waste at all stages of the food value chain and that significant progress towards SDG 12.3 will require all stakeholders to work collaboratively towards the goal. We highlight the value chain in Figure 18 below and offer potential actions that each stage could take in order to improve food waste. Some of the actions available can be adopted immediately; however, in the next section we highlight emerging innovation that could help each stage tackle the problem of food waste.

FIGURE 18 Possible approaches for reducing food waste across the food value chain...



Source: Barclays Research, *Champions 12.3 2018 Progress Report*

Emerging innovation can help accelerate change

There are many factors behind the problem of food waste and hence we do not believe there is one solution. But it is clear that innovation can help improve awareness around the issue as well as provide solutions to reduce food waste along the food value chain. Following our discussion with the start-up community and specialised VCs, we highlight examples of innovation and companies along each stage of the value chain in Figure 19-23.


Production – Farming & Agriculture

Within Farming & Agriculture, we believe there are five key areas of innovation: harvesting & supply management, storage & transportation, alternative business models, product innovation and repurposing waste – Figure 19. The increased use of AI and big data analysis has led to a variety of smart imagery and crop management software, as well as the greater use of autonomous robots for both data collection and field management.

For example, [Trace Genomics](#) (VC backed – \$19m funding) uses machine learning to analyse soil samples and can help farmers increase yield and see potential threats long before they are visible in the field. [Taranis](#) (VC backed – \$30m funding) is an international precision AgTech start-up. Its AI platform combines high-resolution imagery and sensors to derive real-time and historic insights with over 90% accuracy. Taranis is currently targeting commodity crops (corn, cotton, sugarcane, soybean, wheat, and potatoes) and charges \$5-\$20 per acre per season. It is *claimed* that Taranis' suite can boost crop yields across-the-board by as much as 7.5%. [Pivot Bio](#) is a synthetic biology company working on nitrogen-producing microbes (VC backed – \$87m funding). It will offer the first in-field solution to biological nitrogen fixation available to farmers for 2019 planting in selected US states.

Within Barclays partnership with Unreasonable Impact, [AeroFarms](#) is a data-driven vertical farming company on a mission to enable local production at scale. They propose an alternative business model given that they enable local farming at commercial scale all-year round, using 95% less water and with yields 390 times higher per square foot annually.

FIGURE 19 Emerging innovation in the production stage

Value chain stage	Area of innovation	Example Companies	Description
Farming & Agriculture 	Harvesting & supply management	<i>Farmers Edge</i>	Smart imagery & VR: Monitoring crops and grid soil sampling
		<i>Trace Genomics</i>	Disease prevention: Agronomic insights using soil DNA
		<i>Vultus</i>	Reduce fertilizer waste: Offers satellite based fertilizer prescriptions
		<i>Taranis</i>	Precision air-scouting: Aerial surveillance imagery to avert crop yield loss
		<i>AgCode</i>	Specialty crop management software: Harvest scheduling
		<i>EarthSense</i>	Autonomous robots: Data collection and field management
		<i>Small Robot Company</i>	Autonomous robots: To monitor, weed and plant
		<i>Scott Technology</i>	Automation and robotics: Used in meat cutting
	Storage & transportation	<i>TeleSense</i>	Wireless monitoring: Sensors collect data about grain/cold storage & transport
		<i>PICS</i>	Hermetic storage: Low-cost crop storage bags that preserve food longer
	Alternative business models	<i>AeroFarms</i>	Vertical farming: Aeroponic technologies reducing environmental impact
		<i>Plenty</i>	Vertical farming: Hydroponic tech at farms just outside major urban centres
		<i>Local Roots</i>	Modular farming solution: 24/7 sustainable crop production
	Product innovation	<i>Inari</i>	Plant breeding & seed foundry: Developing new crop varieties
		<i>Rootility</i>	Root-focused plant-breeding: Smart root technology to boost yields
		<i>Indigo</i>	Smart/precision farming: Coated seeds with yield-enhancing microbes
		<i>Pivot Bio</i>	Crop nutrition specialists: Nitrogen-producing microbes
	Repurposing waste	<i>Solum Gruppen</i>	Generating value from waste: Anaerobic digestion and in-vessel composting


Source: Barclays Research

Handling & Storage

Within Handling & Storage, we believe there are two key areas of innovation: storage & transportation and excess produce management – Figure 20. The increased use of real-time technology has led to the industry adopting various intelligent supply chain solutions. This has effectively redefined the way transportation of food is planned and managed, in our view, as well as promoting innovation focused on reducing spoilage.

For example, **BT9** is an Israeli-based cold chain management solutions provider. It has a suite of products tailored for the food industry, including BT9's Xsense system which minimises risks to fresh produce quality by providing real-time or offline monitoring information to decision-makers at every segment of the cold chain. For produce storage, **Hazel Technologies** is a USDA-supported AgTech company that develops biotechnology to increase the shelf life of produce. Hazel's products are packaging inserts that release an anti-fungal shelf life extending vapour. For apples, they have delivered 5x extended shelf, 2x improved post-stage firmness and a 90% reduction in the incidence of scald.

FIGURE 20 Emerging innovation in the handling & storage stage

Value chain stage	Area of innovation	Example Companies	Description
 Handling & Storage	Storage & transportation	<i>BT9</i> <i>Hazel Technologies</i>	Real-time cold chain technologies: Visibility for the entire cold chain Spoilage reduction: Conditions the storage environment to slow spoilage rate
	Excess produce management	<i>Food Cowboy</i>	Charity collection platform: Connects food transporters and wholesalers with food charities, offering a waste hotline and running awareness campaigns

Source: Barclays Research

Processing & Packaging

Within Processing & Packaging, we believe there are three areas of innovation: shelf life extension & unique packaging, repurposing surplus foods and innovative products – Figure 21. Consumer interest in sustainability and the environment has meant that up-cycled products like **Snact**, **ChicP** and **Toast Ale** have proved popular. We have even seen other players within the value chain leverage this trend, including Tyson Foods which has started to make crisps from up-cycled chicken breast. For food waste specifically, we believe shelf life extension & unique packaging has garnered significant interest across the VC community and industry bodies.

Within Barclays partnership with Unreasonable Impact, **Mimica** aims to reduce food waste and improve food safety through its innovative food expiry labels. The Mimica Touch labels allow customers to monitor the freshness of the product through simply feeling the texture of the packaging. We spoke with the founder of Mimica who championed the value of partnerships as the most mutually beneficial way to work. For example, for milk it is now incorporating its label into the milk lid through a partnership with Coveris, which makes 80% of milk caps in the UK. (Refer to Appendix 1 for our full interview including information on pricing/ROI and its global expansion plans).

We highlighted **Apeel** in our thematic note *Future of Food Retail: Long Live Clicks and Mortar* (12/10/18), though we equally think this is relevant to our discussion on food waste. Apeel develops invisible plant-based edible skin aimed at extending the shelf life of fruits and vegetables by slowing down water loss and oxidation. Existing partnerships have shown that Apeel-coated avocados have led to a 65pp increase in margin and 10% increase in sales. (Refer to Appendix 1 for our full interview including trial feedback).

FIGURE 21 Emerging innovation in the processing & packaging stage

Value chain stage	Area of innovation	Example Companies	Description
Processing & Packaging 	Shelf life extension & unique packaging	<i>BluWrap</i> <i>Apeel Sciences</i> <i>Mimica</i>	Shelf life extension technology: Focusing on perishable protein Shelf life extension: Edible coating to extend the shelf life of fruit and vegetables Innovative packaging: Tactile label to indicate the spoilage of the product
	Repurposing surplus food	<i>Snact</i> <i>Rubies in the Rubble</i> <i>ChicP</i> <i>Foxhole Spirits</i> <i>Toast Ale</i>	Fruit jerky: Turning excess/ugly fruits into snacks Condiments: Makes condiments from surplus produce Hummus: Made from surplus fruit and vegetables Gin: Made from unused resources in the English wine industry Beer from bread: Beer brewed with surplus bread from sandwich manufacture
	Innovative products	<i>Beyond Meat</i> <i>Memphis Meats</i> <i>MycoTechnology</i>	Plant-based meat alternative: To reduce waste in supply chain Cultured meat: Made in a lab, with less waste in production Mushroom fermentation: To produce mycoproteins

Source: Barclays Research

Distribution & Market – Food Retail

Within Food Retail, we believe there are three areas of innovation: innovative retail formats, excess produce management and repurposing surplus food. Within Barclays partnership with Unreasonable Impact, **HISBE** is the most widely discussed innovative format within food retail and is known as the “*supermarket rebel*.” Powered by local people and a social enterprise business model, HISBE aims to reduce food waste by providing products loose and products that are locally and ethically sourced. We spoke with co-founder Amy Anslow who told us that their goal is to “*hack the current supermarket model to make it fit and fair for the 21st century*”. (Refer to Appendix 1 for our full interview including information on the business model and expansion plans).

Another growing area of focus is the idea of turning food waste into locally produced fertiliser. For example, **Vivid Life Sciences** has partnered with ag-tech start-up WISerg to produce the *Lifeforce* line of fertilisers, created from food waste from local grocery stores. The “*zero-waste process*” reportedly retains 90% of the food nutrient value, providing a full spectrum of nutrients and minerals to promote higher-quality crops, healthier soils and increased ROI for growers.

FIGURE 22 Emerging innovation in the distribution & market stage

Value chain stage	Area of innovation	Example Companies	Description
Food Retail 	Innovative formats	<i>HISBE</i> <i>Bulk Market</i> <i>The Source Bulk Foods</i> <i>WeFood</i> <i>Flashfood</i>	Ethical supermarket: Focusing on local suppliers and minimal waste Bulk supermarket: Focus on minimizing waste Buy-what-you-need: Minimal waste, bulk food grocery store Excess food supermarket: Sells unwanted food products at a 30-50% discount Excess food app: Sells foods near its best-before to customers via an app who then pick up the produce in-store from a designated Flashfood area
	Excess produce management	<i>Spoiler Alert</i> <i>412 Food Rescue</i> <i>FoodCloud</i>	Unsold inventory management: Mitigates unsold food and recovers value Charity donation: Connects grocers with non-profits in Pittsburgh Charity donation: Connects grocers with partner charities in Ireland and the UK
	Repurposing surplus food	<i>Vivid Life Sciences</i> <i>California Safe Soil</i>	Repurposed fertilizer: Made from grocery food waste Repurposed fertilizer: Aerobic, enzymatic digestion technology

Source: Barclays Research



Consumption – Foodservice and Households

Within Consumption, we believe innovation has either focused on foodservice (e.g. restaurants) or the individual household.

For foodservice companies, this includes order forecasting, waste measurement, excess food platforms, buying networks and repurposing. For example, **Tenzo** is a restaurant management software solution that collates sales/labour/inventory data to provide actionable insights. We spoke with the co-founder who mentioned how its offering can help restaurants optimise labour and food – each of which account for c. 25-30% of a restaurant's cost line. (Refer to Appendix 1 for our full interview including Tenzo's partnership with Mitchell & Butlers).

For individual households, innovation has focused primarily on making the idea of food sharing and meal planning more accessible. **OLIO** is a free app that connects neighbours and local shops so that surplus food can be shared rather than wasted. It is another member of the Barclays partnership with Unreasonable Impact and we spoke with the co-founder who mentioned that, within the consumption stage of the value chain, there is very little understanding of the environmental consequences attached to food production. (Refer to Appendix 1 for our full interview including OLIO's retail partners in the UK and how awareness is set to grow).

FIGURE 23 Emerging innovation in the consumption stage

Value chain stage	Area of innovation	Example Companies	Description
Foodservice 	Order forecasting	<i>Tenzo</i>	Restaurant demand forecasting: AI forecasting to optimize inventory levels
	Waste measurement	<i>Winnow</i> <i>Leanpath</i>	Tracks and measures food waste: Through weighing and logging systems Data analytics: To reduce food waste in kitchens
	Excess food platforms	<i>Too Good to Go</i> <i>Karma</i> <i>Goodr</i>	Surplus food marketplace: For restaurants Surplus food marketplace: For grocery stores, cafes and restaurants Blockchain food management system: Enables businesses to donate surplus food, captures waste analytics and IRS tax savings data
	New formats	<i>Instock</i>	Surplus food restaurant: Creates meals from supermarkets' excess food
	Buying network	<i>Bluecart</i>	Wholesale procurement: Platform to connect buyers and sellers of produce
	Repurposing surplus	<i>FatHopes Energy</i>	Biofuel production: Used oil is piped directly from restaurants
Households 	Food sharing	<i>OLIO</i>	Food sharing platform: Allows users to share food with the local community
	Meal planning	<i>Innit</i>	Virtual chef: Helps consumers with meal planning, shopping and cooking

Source: Barclays Research

INVESTOR GUIDEBOOK – SECTOR IMPLICATIONS

Alongside our sector analysts, we assess the impacts of increasing food waste awareness on a wide variety of sectors. We see Food Retail and Leisure as the sectors most at risk, whereas we see greatest opportunity in the Food Manufacturing and Agribusiness sectors (Figure 25).

A number of sectors fit neatly into the stages of the food value chain we have been analysing (e.g. Agribusiness and Food Retail), whereas others sectors will be impacted by changes across the entire value chain (e.g. Energy and Chemicals).

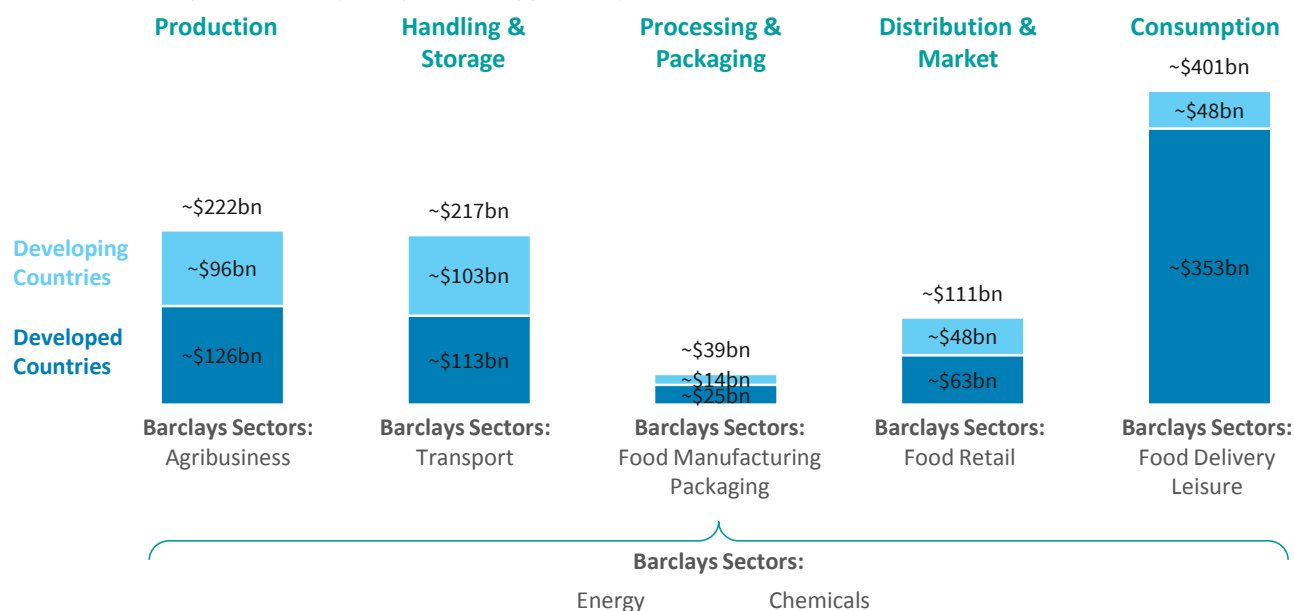
We analyse the risks and opportunities for each sector from increasing awareness around food waste, highlight specific company actions that can reduce food waste and assess relative company positioning within each sector.

Dissecting the food value chain

In Figure 24, we show the breakdown of the food value chain alongside the Barclays sectors we believe to be both directly and indirectly impacted by growing food waste awareness. A number of sectors fit neatly into the stages of the food value chain we have been analysing (e.g. Agribusiness and Food Retail), whereas others sectors will be impacted by changes across the entire value chain (e.g. Energy and Chemicals).

We have broken down the \$ opportunity around food waste for each stage using the FAO's estimate of the value of food waste per year of \$680 billion in the developed world and \$310 billion in the developing world. We highlight that, although we do not see food waste falling to zero, as there will always be some unavoidable waste, the values in Figure 24 indicate a significant opportunity from even a small change in food waste.

FIGURE 24 Barclays sector analysis – potential opportunity across the food value chain



Source: Barclays Research, FAO 2011, WRI 2013

We see Food Retail and Leisure as the sectors most at risk from growing food waste awareness, whereas we see greatest opportunity in the Food Manufacturing and Agribusiness sectors (Figure 25).

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Looking across the food value chain, we think food retail could be the sector at greatest risk from the consequences of increasing awareness around food waste (Figure 25). Consumer pressure may be a significant driver as consumers see supermarkets as the face of their interaction with food, shaping the amount and type of foods that consumers buy as well as how it is stored and cooked. In response to consumer pressure, food retailers will likely want to use their actions on food waste as a competitive advantage to build a sustainable brand image.

Pressure to act on food waste will also come from a greater focus on the sustainability of the retailer-supplier relationship. The historical power imbalance between food retailers and suppliers – especially those who produce the fresh goods that are at greater risk of being wasted – has meant that a large proportion of the food waste in the supply chain is driven by food retailers (Feedback *estimates* that UK supermarket practices drive farmers to waste around 10-16% of their crops). Some of the reasons for this include the imposition of strict aesthetic standards on fruit and vegetable suppliers, cancelling orders and changing the order size depending on multi-buy timings. We think that – in some countries at least – greater focus on the retailer-supplier relationship may be needed from regulators and investors, with retailers being held more accountable for treating suppliers fairly and taking ownership of the food waste that is being created along the supply chain (not just in their stores).

We see Tesco, Sainsbury, Carrefour, Kroger and Walmart as the grocers taking most action around food waste and hence think they are the most likely to be able to mitigate the risks around increasing food waste awareness within the food retail sector, potentially even turning the threat it into an opportunity to improve brand image and customer loyalty.

Risks vs. opportunity

Although we see the reduction of food waste as an opportunity for food retailers to cut costs and develop a sustainable brand image, we think the risks of not acting upon food waste are greater. Firstly, the cost reduction opportunity of reducing food waste at the store level is perhaps not as significant as at the supplier level, due to the historical power imbalance we mention above. Secondly, as food waste awareness grows, we think food retailers will see increased pressure from consumers, government and investors. Customers may take food waste credentials into greater account when choosing where to buy their groceries, investors will likely include food waste factors into their investment decisions and we see the risk of intrusive government regulation (such as penalties for wasting food in France). We therefore argue that retailers taking no action on food waste will likely lose out to those who are leading the industry. We also argue that there is more of a risk in concentrated food retail markets, such as the UK, where the supplier-retailer power imbalance is the greatest.

Company-specific strategies

Although we see the growing awareness around food waste as a risk to the food retail sector as a whole, within the sector we see some companies taking more decisive action than others. We see Tesco, Sainsbury, Carrefour, Kroger and Walmart as the grocers taking most action around food waste and hence think they are the most likely to be able to mitigate the risks around increasing food waste awareness within the Food Retail sector, potentially even turning it into an opportunity to improve brand image and customer loyalty. We see differences between the US and EU in terms of action on food waste – the European grocers tend to have a greater focus on food waste policies and data, whereas the

US grocers appear to focus more on excess food donation and recycling. We show greater detail of how these actions impact company strategy in Figure 26.

FIGURE 26 Company action on food waste – relative positioning in the food retail sector

Food Waste Action	Policy & data monitoring	Product innovation	Supply chain initiatives	Consumer support	Optimise storage and packaging	Active industry collaboration	Relative position on food waste
Tesco	✓	✓	✓	✓	✓	✓	Positive
Sainsbury	✓	✓			✓	✓	Positive
Kroger	✓	✓	✓	✓	✓	✓	Positive
Walmart	✓	✓	✓	✓	✓	✓	Positive
Carrefour	✓	✓	✓	✓	✓	✓	Positive
Ahold Delhaize	✓	✓		✓			Neutral
Casino		✓	✓			✓	Neutral
Morrison	✓		✓			✓	Neutral
M&S	✓			✓			Negative
Aldi*	✓			✓			Negative
Lidl*	✓			✓			Negative

Source: Barclays Research. *Private. See Appendix 2 for Feedback scorecard on the UK supermarkets and The Centre for Biological Diversity's US scorecard.

Impacts on strategy

In Figure 27 we highlight potential impacts on business strategies within food retail. While we can see many supermarkets responding to consumer pressure with media-friendly 'wonky veg' campaigns, we are concerned that these could be tokenistic measures rather than substantive action, hence we see a need for supermarkets to consider making radical changes to their current ways of doing business. Supermarkets have a dominant position in the fresh food value chain and should realise the direct control they have over food wastage from farm to fork. Food retailers may have to rethink their relationships with suppliers to work collaboratively to disincentivise food wastage.

FIGURE 27 Impact of food waste action on strategy

Food waste action	Impact on strategy
Policy & data monitoring	<p>Monitor food waste reduction</p> <ul style="list-style-type: none"> - Consistently record food waste: standardized measures across the industry including crop utilization rates, quantity and type of waste, avoidable vs unavoidable. - Regularly publish data: e.g. Tesco, Ahold Delhaize, M&S. - Set targets for waste reduction: e.g. Kroger's target to <i>eliminate waste by 2025</i>, Tesco will continue with food waste action despite missing <i>elimination target date</i>, Ahold Delhaize's Moving to Zero Waste programme. Carrefour targets halving food waste by 2025 vs 2016 levels. Walmart's <i>target</i> is for zero waste in Canada, Japan, the UK and US by 2025.
Product innovation	<p>Reduce food wastage through product innovation</p> <ul style="list-style-type: none"> - Stock upcycled excess food: e.g. Snact's fruit jerky, Toast Ale's beer brewed from excess bread (see our emerging innovation section on page 21). Casino's Monoprix has partnered with Re-Belle craft jams to use up excess fruit. - Promote and sell imperfect produce: many grocers in the UK and US sell imperfect produce, e.g. Tesco Perfectly Imperfect, Morrison wonky veg box, Ahold Delhaize's 'misfits' produce at Hannaford chain, Kroger's Imperfect Produce. - Promote seasonal produce: to absorb excess produce in peak times of the year and reduce wastage. Tesco and Carrefour purchase 'bumper crops' and pass the savings onto customers. - Focus marketing on products with a lower wastage rate: reduce marketing on highly processed foods with high wastage rate. - Send food waste to animal feed: currently inhibited by UK regulation to only allow certain foods to be turned into pig feed. Common practice in the US and Japan. Tesco, Sainsbury and Iceland are only major UK retailers to do this. In Japan, Walmart recycles fish traces into raw materials for pet food. - Inedible waste to anaerobic digestion (AD): most supermarkets send zero waste to landfill, instead sending inedible waste to AD to recover energy. Tesco recognizes that AD is inferior to redistribution of food or turning it into animal feed, although AD is often cheaper. Carrefour and Casino send waste that cannot be sold or donated to be converted into biogas and biomethane. ASDA sends inedible unsold food to AD plants. - Inedible waste to fertilizer: California Safe Soil creates fertilizer from supermarket waste using aerobic digestion technology, Vivid Life Sciences' LifeForce fertilizer is made from grocery store food waste (see page 23).
Supply chain initiatives	<p>Prevent food waste through improved supply chain relationships</p> <ul style="list-style-type: none"> - Relax aesthetic standards and move to whole crop purchasing: to prevent wastage at the supplier level. By widening specifications, ASDA <i>sold</i> an additional 690 tonnes of produce in 2017. - Work with suppliers on optimizing supply chain network: optimize time in supply chain and improve cold chain. E.g. Tesco <i>has</i> cut two days out of the supply chain with suppliers in Spain for citrus, lettuce, tomatoes etc. Casino reports working with suppliers on extending shelf life. Walmart's <i>Project Gigaton</i> encourages suppliers to measure and report food waste in their operations. - Work with suppliers on ordering & forecasting: share forecasts to help reduce over-production, move to guaranteed order for suppliers. E.g. Tesco shares forecasts through its Tesco Connect system, Walmart's blockchain system with IBM for supply chain traceability. Carrefour has created an 'Anti-waste award' to stimulate competition amongst suppliers. - Help suppliers with network of contacts: to enable re-selling of excess produce that does not meet specification. E.g. Tesco <i>claims</i> to be connecting growers with fresh & frozen food suppliers. ASDA <i>launched</i> a surplus produce hotline which enables suppliers to connect with others who can utilize the food. - Limit multi-buy promotions: to stabilize ordering of products from suppliers, reducing over-ordering. - Focus on sourcing locally: to reduce time in transit and extend life on the shelf.

Source: Barclays Research

FIGURE 27 CONT'D Impact of food waste action on strategy

Food waste action	Impact on strategy
Consumer support	<p>Enable customers to limit their own food waste</p> <ul style="list-style-type: none"> - Limit multi-buy promotions: Tesco trialed <i>Buy One Get One Free Later</i> promotion and has stopped BOGOF offers on fruit & veg since 2014, Sainsbury has removed most multi-buy promotions. - Offer smaller pack sizes: e.g. Tesco expanding its range of 430 <i>single-serve</i> products, <i>Morrison</i> customers can choose between one and 30 eggs. Casino is developing single or portioned offers. - Offer loose produce: to enable customers to buy only the produce they need, such as in Bulk Market and The Source Bulk Foods (see our emerging innovation section on page 21). - Improve awareness through campaigns: offer recipe ideas to use up leftovers, provide food charity collection points in store. E.g. Tesco Love Food Hate Waste tips on its website, Albert Heijn's campaign on food storage, Walmart's education initiatives. Carrefour Italy works with Barilla to educate consumers around how to use excess vegetables and pasta. Casino improves awareness through in-store campaigns. - Improve system of reducing near-expiry foods: reduce near-expiry products earlier in the day to reduce chance of wastage. Most supermarkets already do thus but Co-op was the first supermarket to sell food past its best before date and reduces prices to as little as 10p. <i>Walmart</i> sold more than 262 million reduced products in FY2018. - Rethink store layout and stocking strategy: to reduce customer expectation of abundance and newest products being sold before older items (particularly in fresh and bread where wastage rates are high). - Grow produce in-store: Auchan has partnered with <i>Agricooltur</i> in a Turin store to grow fresh herbs and salad, Casino has trialled small greenhouses in-store and Albert Heijn has trialled fixtures for customers to harvest lettuce.
Optimise storage and packaging	<p>Improve conditions of produce to extend shelf life</p> <ul style="list-style-type: none"> - Adopt innovative packaging solutions: e.g. Kroger is using Apeel's edible coating on its avocados (see our emerging innovation section on page 21). M&S used ethylene strips in strawberry packets to extend shelf life, improving <i>wastage by 4%</i>. Walmart uses ruggedized, reusable containers to transport eggs to reduce damage in-transit; this helped the company prevent 37 million eggs from being <i>wasted</i> in 2016. - Improving date labels: standardizing language on labels, clarifying 'use by' and 'best before'. Work with innovative labels to give more accurate representation, e.g. Mimica's tactile label (see our emerging innovation section on page 21). Carrefour France has removed use-by dates on over 50 items including sugar and vinegar and has extended the date for 300 other products. Tesco is <i>set</i> to remove best before dates from more produce to reduce waste. - Phase out best before labels: ASDA has removed dates from apples and onions, Tesco has removed them from some fruit and veg, Walmart has also worked to standardize date labels.
Active industry collaboration	<p>Engage with industry organizations and non-profits</p> <ul style="list-style-type: none"> - Charity partnerships: e.g. Tesco and WWF partnership, Tesco CEO Dave Lewis chairs the <i>Champions 12.3</i> committee, Tesco partnership with FareShare to donate excess food to local charities, Hannaford's partnership with Feeding America, Kroger partners with WWF and Feeding America. Supermarkets in France have to have these partnerships by law. Casino has partnerships with Phénix and Ecosphère. Walmart <i>donated</i> the equivalent of 628 million meals globally in 2017 and created the <i>Closed Loop Fund</i> to help communities redirect food waste. - Food waste trials: e.g. Sainsbury launched its 5-year '<i>Waste Less, Save More</i>' campaign in 2015. The trial was an innovative experiment but Sainsbury has since ended it due to "broadening and changing customer priorities". - Encourage innovation: Tesco's partnership with WRAP for <i>Innovate UK's Future Retailing</i> competition, Kroger's \$10 million innovation fund, Walmart's \$650k grant to WWF and Walmart Foundation's funding of food waste research.

Source: Barclays Research

Companies to highlight

Tesco: Leading the UK on food waste

We see Tesco as the most transparent and proactive retailer in terms of tackling food waste (see Appendix 2 for the 2018 [Food Waste Scorecard](#) highlighting Tesco's action on food waste). What we think makes Tesco stand out is its emphasis on prevention and partnerships. Tesco works with suppliers to prevent the food waste in the first place through measures such as whole crop purchasing and aims to educate customers to prevent food waste in the home through its Love Food Hate Waste campaign.

Head of Sustainability, Sourcing and Waste Policy for Tesco, Mark Little, told [Food Navigator](#) that new supply chain technologies, as well as increased collaboration, have been central to Tesco's efforts to help reduce food waste. Tesco was also the first UK retailer to publish its food waste data, with the latest [2017/18](#) data showing that food waste in its UK operation increased from 46,684 tonnes to 53,126 tonnes, representing a "broadly flat" 0.5% of food sales. Although Tesco missed its target to eliminate food waste by February 2018, it continues to focus on its battle against waste and has called on other retailers and suppliers to follow its lead.

Walmart: Holistic action on waste

Walmart tackles the problem of food waste within its broader target to achieve zero waste in its operations in Canada, Japan, the UK and US by 2025. The company started analysing its waste in 2005 and [reportedly](#) diverted 78% of unsold products, packaging and other waste materials from landfill in 2017. In recognition of its work, Walmart recently received an A-rating on the CDP's environmental scorecard, making it the top US food retailer.

On food waste specifically, Walmart is working to tackle food waste both up and down the value chain (The Centre for Biological Diversity grades Walmart a B for its efforts, see Appendix 2 for the latest [Scorecard](#)). Project Gigaton encourages suppliers to measure and report food waste and Walmart's moves towards more flexible supply contracts will help reduce food waste at the farm level. Walmart stores are adopting a culture of waste reduction, learning from ASDA's 'We Hate Waste' programme, which involves a daily 'waste parade' and tracking waste on a daily basis. Walmart also aims to help consumers reduce waste through reducing near-expiry food, standardising date-labels and innovative packaging to extend shelf life. Finally, unsold food is either donated to local food banks or inedible produce is sent for animal feed, composting or anaerobic digestion.

Kroger: Zero Hunger Zero Waste and innovative packaging

The Centre for Biological Diversity grades Kroger a C for its efforts (see Appendix 2 for the latest [Scorecard](#)). We find Kroger's '[Zero Hunger Zero Waste](#)' campaign to eliminate waste in the company by 2025 encouraging, which includes establishing a \$10 million innovation fund, donating 3 billion meals by 2025 and advocating for public policy solutions. Kroger has also [partnered](#) with protective coating company Apeel (see our emerging innovation section on page 21) to extend the life of its avocados.

M&S: Lagging behind on food waste

M&S scored poorly on Feedback's [Food Waste Scorecard](#) from 2018, with a score of 25% compared with Tesco's 66% (see Appendix 2 for a detailed breakdown of scores for the major UK supermarkets from Feedback). Although M&S has some food waste data publicly available, it is far less detailed than Tesco's or Sainsbury's data. Unlike most other major supermarkets, M&S also does not offer a 'wonky veg' line of products – perhaps because its premium image makes it more difficult to offer visually 'suboptimal' goods.

Carrefour: Ambitious target by 2022

When presenting its new strategic plan for the group in January 2018, Carrefour's new management team set the target to become the 'the pioneer of the food transition' by 2022. While this primarily aims to promote food quality for customers, the group also plans to strengthen its fight against food waste. This *includes* actions at different levels, namely among its producers, during transport operations, in its stores and among its customers. The strategies include: ordering more effectively and better managing stock, working with suppliers, selling products with short use-by dates at low prices, extending the use-by dates, donating excess produce and sending unsellable products to recover energy. We think Carrefour is acting decisively on food waste from many angles to achieve its ambitious target of halving food waste by 2025 compared with 2016 levels.

Casino: Some differentiating initiatives but lack of targets

In 2013, Casino signed the National Pact against food waste set up by the French Ministry of Agriculture and Food. In order to tackle food waste, the group tries to limit spoilage through training of staff, donating excess food, charity partnerships, working with suppliers to extend shelf life and optimised packaging with the development of single/portioned offers. In addition, Casino's Monoprix sends excess fruit to be made into jam by Re-Belle, GPA in Brazil launched a zero waste campaign and Assaí reports on waste recycling and composting. Although combatting food waste is part of *Casino's CSR Spirit*, it appears the company does not have a clear target on food waste, which we see as one of the important first steps to tackling the issue.

Questions for management

How are you preventing food waste at all stages of the supply chain?

How do you see your role in tackling food waste?

What is the breakdown of what happens to your food waste currently?

What measures are in place to reduce it?

How are your product innovations changing to utilise surplus food?

How are you helping reduce consumer food waste?

Is consumer pressure on food waste a risk?

Do you see regulatory change, such as that in France, as a risk or an opportunity?

Food Manufacturing

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Looking across the food value chain, we think food manufacturers have the biggest opportunity to capitalise on growing awareness around food waste (Figure 25). The majority of the manufacturers have already adopted successful measures to reduce food waste in their factories and we see further opportunity for them to help both farmers and consumers reduce their waste also. We see limited risk of regulatory change impacting the manufacturing sector and instead see significant opportunity to reduce food waste more broadly and be the wider drivers of change, through more flexible supply contracts, innovative products and adapting current offerings.

Compared with the food retailers, we think there is likely to be less consumer pressure, due to the greater degree of separation, and instead see a more significant opportunity to use growing awareness on food waste as a catalyst to further develop a sustainable brand image with consumers. We outline a variety of strategies that have already helped reduce food waste at the manufacturing level and highlight some areas of further opportunity (Figure 28).

Although we think the entire sector has an opportunity around growing food waste awareness, we see Kellogg as the leader on food waste due to its thorough measurement and senior level commitment.

Risks vs. opportunity

We see the opportunities for food producers as centred around three areas; 1) supply chain efficiencies, 2) adapting current products and 3) developing new products. Each of these areas benefits the sustainability of the company as well as being financially motivated. We think supply chain efficiencies have already been a focus for the food manufactures and hence food waste from this sector specifically is already relatively small (Figure 24). However, we do see some opportunity for the manufacturers to adopt more flexible supply contracts as well as for further development in the assortment management space, using data analytics and AI to help with demand forecasting.

Adapting current products and developing new products both offer an opportunity for the manufacturers to reduce food waste at the farm level as well as the consumer level. Manufacturers can develop products using ingredients with historically higher rates of wastage or adapt current offerings so that they can help consumers waste less (e.g. through smaller pack sizes, frozen products or standardising date labels). We think growing consumer awareness around food waste therefore offers an opportunity for food manufacturers to further build their sustainable brand image and differentiate their products through their focus on tackling waste.

Impacts on strategy

In Figure 28 we highlight potential impacts on business strategies within the food manufacturing sector. Although the majority of the food manufactures have already implemented policies around food waste, benefited from supply chain efficiencies and joined in collaborative initiatives, we think there is an opportunity to further tackle food waste through adapting current products as well as developing new, innovative products.

FIGURE 28 Impact of food waste action on strategy

Food waste action	Impact on strategy
Policy & data monitoring	Target and monitor food waste reduction <ul style="list-style-type: none"> - Consistently record & publish food waste data: standardized measures across the manufactures including waste at the farmer level from producer specifications, waste from the production line and in storage. Kellogg reports its food waste by destination. - Set targets for waste reduction: e.g. Mondelez targets to reduce total waste in manufacturing by 20% vs 2013. Kraft Heinz targets to reduce waste sent to landfill by 15% by 2020 vs 2015.
Supply chain efficiencies	Reduce waste in the supply chain and manufacturing process <ul style="list-style-type: none"> - Assortment management: use data analytics and consumer testing to help predict which products will be successful with customers, to reduce wasting newly launched products. - Make supplier contracts more flexible: by relaxing product specifications. - Train employees and suppliers: particularly in developing countries. E.g. Kellogg has partnered with <i>TechnoServe</i> to help farmers reduce loss on farms by providing training. - Factory efficiency measures: Kraft Heinz has developed a manufacturing playbook and records hourly waste metrics. Mondelez has implemented Integrated Lean Six Sigma.
Adapting current products	Changing current products to help reduce food waste <ul style="list-style-type: none"> - Reduce pack size: particularly relevant with snack products where consumers want to limit waste. Snack companies such as Kellogg, Mondelez and The Hershey Company have commented on reducing pack sizes. - Focus on frozen products: frozen food generates 47% less waste when compared to ambient and chilled food consumed in the home. - Reformulate products: to incorporate ingredients with lower wastage rates. - Standardise date labels: to reduce wastage through confusion over food expiry. Kellogg is in the process of standardizing date labels on its US food products to 'BEST if used by'. - Shelf life extension: using innovative packaging such as Apeel (see our emerging innovation section on page 21) or through high pressure pascalisation (HPP).
New products	Develop new products to reduce waste <ul style="list-style-type: none"> - Repurposed products: e.g. Snact uses fruits that would have been wasted to make fruit jerky, Rubies in the Rubble uses excess food for condiments and Toast Ale uses leftover bread to make beer (see our emerging innovation section on page 21). Kellogg has partnered with <i>Seven Brothers Brewery</i> to create beer made from rejected cornflakes. - Focus on alternative products: to reduce waste in terms of environmental impact. Beyond Meat and Memphis meats produce plant-based and cultured meat respectively (see our emerging innovation section on page 21).
Innovation	Invest in innovation around food waste <ul style="list-style-type: none"> - VC/start-up unit: to accelerate innovative solutions to food waste. Campbell Soup - Acre Ventures, Kellogg - 1894 Capital, General Mills - 301 Ventures.
Collaborative initiatives	Engage in industry programmes to reduce waste <ul style="list-style-type: none"> - Commitment to the Food Waste Reduction Roadmap: major UK manufacturers have committed to the WRAP's <i>roadmap</i> to halve food waste, e.g. Bakkavor, Coca-Cola, Kraft Heinz UK, Unilever UK. - Collaborative initiatives: Kellogg was one of the first companies to join Champions 12.3. Mondelez is a member of the Consumer Goods Forum. - Charity partnerships: Kraft Heinz has partnerships with Feeding America and Rise Against Hunger, having <i>donated</i> over 2 billion meals.

Source: Barclays Research

Companies to highlight

Kellogg: Leader in measurement and senior commitment

Kellogg piloted the WRI Food Loss and Waste Standard reporting methodology in 2016 and has been one of the first companies to report global food waste data by destination. In 2017, Kellogg reduced total food waste by 4.7% and *reported* that 86% of food waste went to animal feed compared with 6.4% to the sewer and 1.6% to landfill. Kellogg was also one of the first companies to join Champions 12.3¹ and hence has committed to working towards the SDG of halving food waste per capita by 2030. Kellogg's regional business presidents have also spoken at highly visible global events including Sustainable Brands,

¹ Champions 12.3 is a group of around 40 CEOs, government officials and NGO leaders with the aim of mobilising progress towards the SDG's goal.

Business Climate Summit and Climate Week, indicating the senior level commitment to tackling food waste. We think Kellogg is one of the leaders on food waste within the food manufacture space given its thorough measurement and backing by senior management.

Mondelez: Focus on lean manufacturing

Mondelez has [worked](#) to improve awareness around food waste amongst its factory employees as well as adopting lean manufacturing techniques such as Integrated Lean Six Sigma to improve efficiency and reduce waste. Mondelez also [reports](#) to “*continually search for innovative reduction solutions*”. Mondelez reports that most of its factories have already achieved zero waste to landfill and hence has targeted reducing total waste in manufacturing by 20% by 2020 compared with the 2013 baseline. The company has also supported the Consumer Goods Forum’s resolution to halve food waste by 2025. The 2017 [Impact for Growth Progress Report](#) shows a 15% reduction and hence suggests the company is on track to meet its target.

Kraft Heinz: Less focus on food waste specifically

Kraft Heinz’s [sustainability](#) page on its website does discuss reducing energy usage to improve the environment as well as it making business sense, but food waste specifically appears to be less of a focus than for Kellogg and Mondelez. However, Kraft Heinz does publish its waste to landfill statistics in its [CSR 2017](#) report – having reduced waste to landfill by 9.5% in 2016 vs 2015 to 9.2kg of waste per metric tonne of product made.

Questions for management

What happens to your food waste currently?

What is the cost of this waste and what measures are in place to reduce it?

How are you collaborating with suppliers and retailers to improve food waste?

How are your product innovations changing to reduce waste?

Do you see increasing awareness around food waste as a threat or an opportunity?

Agribusiness

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Looking across the food value chain, we think agriculture is the sector with the second-largest opportunity from increasing awareness around food waste, behind only food manufacturing (Figure 25). Compared with other stages of the value chain, agriculture is a sector that produces a significant amount of avoidable food waste, whether through retailer aesthetic standards, spoilage in storage or inadequate produce management. This wastage comes at significant cost to the companies and hence we see a significant cost opportunity for agribusiness companies as awareness around food waste improves.

Fewer aesthetic standards to meet enables agriculture companies to sell their previously unsellable produce at very little extra cost, whereas improving technology around storage may require some upfront capital expenditure. However, partnerships with spoilage reduction companies such as Hazel Technologies or supply management services like AgCode (see our emerging innovation section on page 21 for further details) enable access to this technology with lower upfront spend. There are also opportunities for agriculture firms to send excess produce for repurposing into both consumer products (such as snacks or condiments, see page 21) and agricultural supplies (such as organic fertilizers), as well as into energy via anaerobic digestion.

While most companies account for waste management actions as part of their sustainability efforts, we see a correlation between companies' diversification across the different proteins and the amount of policies and information available. Large, well-diversified companies such as Tyson and JBS, as well as BRF and Hormel, have shown a wide array of company initiatives to reduce food waste, from data monitoring and innovation in storage, packaging, and transportation, to excess produce management. This has allowed these companies to turn waste management efforts into a profitable exercise. On the other hand, we think greater disclosure around food waste is needed from Sanderson Farms, while Marfrig could update its waste management goals post recent M&A activity.

Risks vs. opportunity

Although we see significant opportunity for agricultural firms, we do note that a large proportion of the benefits are likely to only appear when manufacturers and retailers take serious action with regards to contracts and aesthetic standards. Generally, retailers hold significant power over agriculture companies (particularly those only supplying to one retailer) and hence retailer action is likely to generate greater benefits than investing in storage technology alone. Although we see most benefit of lower food waste occurring when supermarket practices change (either voluntarily or through regulatory change), we still see scope for the agriculture businesses to take action themselves (see Figure 29-30 for actions and impacts on strategy).

Company-specific strategies

Although we see the growing awareness around food waste as an opportunity for the agriculture sector as a whole, within the sector we see some companies taking more decisive action than others. JBS (and subsidiary PPC), TSN, Hormel and BRF are the companies we believe provide the most updated information on the matter and have a broader approach to food waste. We show greater detail of how these actions impact company strategy in Figure 30.

FIGURE 29 Company action on food waste – relative positioning in the agribusiness sector

Food Waste Action	Policy & data monitoring	Demand forecasting	Process innovation	Storage & transport innovation	Excess produce management	Collaborative initiatives	Relative position on food waste
BRF	✓	✓	✓	✓	✓	✓	Positive
Hormel Foods Corp	✓		✓	✓	✓	✓	Positive
JBS	✓		✓	✓	✓	✓	Positive
Pilgrim's Pride	✓	✓	✓	✓	✓	✓	Positive
Tyson Foods	✓	✓	✓	✓	✓	✓	Positive
Marfrig Global Foods	✓		✓				Neutral
Sanderson Farms		✓	✓				Negative

Source: Barclays Research

Impacts on strategy

In Figure 30 we highlight potential impacts on business strategies within agribusiness companies.

FIGURE 30 Impact of food waste action on strategy

Food waste action	Impact on strategy
Policy & data monitoring	<p>Monitor food waste reduction</p> <ul style="list-style-type: none"> - Consistently record & publish food waste data: <i>BRF</i> publishes waste by type and disposal method and has an Environmental Compliance Index to measure waste and air emissions. <i>Hormel</i>, <i>JBS</i>, <i>PPC</i> (within JBS USA) and <i>Tyson</i> have similar disclosures regarding waste breakdown and historical performance. Marfrig reported a reduction of waste in 2017 vs. 2016, but the different types and disposal methods weren't provided for 2017. SAFM does provide metrics regarding its electricity, natural gas and water usage, but there is a lack of disclosure on food waste. - Set targets for waste reduction: BRF is committed to the UN's SDG 12.3. Hormel Foods has set the target to halve its food waste by 2020 vs 2016 levels. JBS has metrics for solid & organic waste reduction; in 2017 the company increased its waste sent to composting to 34% from 32% a year earlier. BRF and Pilgrim's Pride's Moy Park business have targeted zero waste to landfill.
Demand forecasting	<p>Improve forecasting and ordering systems to reduce waste</p> <ul style="list-style-type: none"> - Data analytics: companies rely on industry data, e.g. Agristats, and on internal processes (e.g. BRF's and TSN's sales and operations planning process) to analyze industry dynamics and forecast demand trends. This is more useful in the chicken business, as companies can be more responsive to trend shifts given the lower product lifecycles vs. beef and pork. - Use robotics/satellites to collect data on land: to analyse quality of the soil and optimizing land usage etc. E.g. EarthSense's TerraSentia robot, the Taranis 'air scouting' system (see our emerging innovation section on page 21 for more examples).
Process innovation	<p>Reduce food waste during production</p> <ul style="list-style-type: none"> - Disease control: most companies follow measures to control the risk of disease and product recall. - Automated meat cutting: robotics and automation of meat processing e.g. Scott Technology, which is used and partially owned by JBS (see our emerging innovation section on page 21).
Storage & transport innovation	<p>Reduce food waste during storage and transport</p> <ul style="list-style-type: none"> - Monitor storage and environment conditions: most of the companies use technology to assess farms temperature, quality of feed, and overall livestock conditions. TeleSense's grain monitoring can help grain agriculture businesses (see our emerging innovation section on page 21). - Innovative packaging solution: <i>Hormel</i> has produced different canned foods and shelf-stable microwaveable meals that have a long shelf life and thus don't need refrigeration when being shipped and stored. Tyson offers portion-controlled options and label guidance to reduce food waste. - Waste sorting and management: to reduce spoilage and spread of disease. BRF's logistics centres have a waste sorting structure. JBS and PPC have been focusing on engaging with suppliers and producers to yield improved logistics and waste management efficiencies.

Source: Barclays Research

FIGURE 30 CONT'D Impact of food waste action on strategy

Food waste action	Impact on strategy
Excess produce management	<p>Utilise or donate excess produce</p> <ul style="list-style-type: none"> - Recover value for animal feed, fertilizer or anaerobic digestion: <i>BRF</i> reuses by-products, e.g. using the sludge generated in the treatment of effluents as a fuel for the boilers, turning waste into organic fertilizer. Hormel has been using its food waste as animal feed, feedstock for AD and for composting. JBS New Business unit and JBS USA also transform byproducts into value-added products, including products sold to consumer goods companies to be used in cosmetics and pharmaceuticals as well as composting and fertilizer. Tyson also uses its waste to create animal feed, biofuels, fertilizers, cosmetics, leather and pharmaceutical ingredients. - Repurpose into new products: the Tyson Innovation Lab launched ¡Yappah! <i>Protein Crisps</i> from rescued ingredients in 2018, as part of its plan to use almost every part of the animal. - Donate excess produce: Hormel Foods contributed \$7.8million in cash and product donations in 2017. Tyson also partnered with Flashfood (see page 23 for more details on Flashfood) in 2018 to provide a direct-to-consumer surplus <i>food box</i> to households in Detroit. - Join supply platforms: to send excess produce to markets, manufacturers, retailers or foodservice providers, e.g. through Bluecart's supply platform (see our emerging innovation section on page 21).
Collaborative initiatives	<p>Engage in collaborative initiatives to utilize surplus food</p> <ul style="list-style-type: none"> - Food waste programmes: the <i>BRF Institute</i> is present in 60 cities, with over 1 million people benefiting from its projects. Hormel Foods created the Hormel Foundation and Hormel Institute to work on food waste solutions. JBS sponsors a recycling programme in Brazil. PPC's Moy Park was the first poultry company to sign up to the Courtauld Commitment 2 to reduce waste in the supply chain. <i>Tyson</i> has donated more than 9mn pounds of protein to food banks in the U.S. to reduce food waste.

Source: Barclays Research

Companies to highlight

Tyson: A leader in excess produce management

Tyson foods is a US-based protein company with operations across the world, and a well diversified portfolio (beef, chicken, pork, and prepared foods), with growing exposure to its value-added business and a small exposure to alternative meat via its recent investments. Tyson provides disclosure on its food waste management, and has been an advocate of reducing food waste across the supply chain. Moreover, Tyson has been a leader in using excess produce and the launch of its ¡Yappah! snacks brand demonstrates the company's ability to launch value-added products whilst also reducing food waste.

JBS and PPC: Waste management as a generator of value-added products

JBS is the largest protein company in the world, with a well diversified portfolio across the different proteins (beef, chicken, pork and prepared foods). JBS is the owner of chicken company Pilgrim's Pride, which operates in the US and Europe. JBS has been focusing on waste management, as can be seen with its new plants that have been modernized to improve production performance and waste treatment processes. The company's New Business unit transforms by-products and waste from processed proteins into high value-added products. This program included 12 plants and 49 affiliates, and develops products and solutions to be used both in-house and exported to over 20 countries. One of the results of this program was the launch of a fertilizer product made using organic waste. Overall, the company is committed to using every part of livestock in an attempt to reduce waste. Similarly to its parent company, PPC is committed to efficient waste management, and in Europe, its Moy Park unit has maintained its zero percent to landfill program.

BRF: Focus on sustainability and connections with start-ups

BRF is a Brazil-based protein company with a large exposure to the chicken and processed foods businesses. BRF's annual reports continuously reference sustainability and the company appears to have a keen focus on the issue of waste – we highlight some of its actions in Figure 30. We also think the company is open to innovation with the *b.Connect* programme to bring BRF closer to start-ups to build a more sustainable future. We think this shows promise for continued action on food waste in the future and collaboration with industry bodies and innovative start-ups.

Hormel: Reaching targets ahead of time

Among protein companies, Hormel is the company with the largest exposure to prepared foods and value-added products, while most of its offering is based on pork protein. Hormel's target of reducing solid waste sent to landfill by 3,500 tons per year was reached in 2014, 6 years ahead of its target. Besides committing to halve food waste by 2020 vs 2016 levels, the company has set the goal to reduce its non-renewable energy use, water use, solid waste sent to landfill and GHG emissions by 10% by 2020 (vs 2011 levels), which in our view reflects a solid view on sustainability. Additionally, the company's production of canned foods and shelf-stable microwaveable meals, which have a long shelf life and thus don't require refrigeration when being shipped, reflect efforts across the supply chain.

Marfrig: Update needed

Marfrig is a Brazil-based protein company with growing exposure to the US via its recent acquisition of National Beef, which has led the company to be mostly exposed to the beef business. While Marfrig was able to reduce waste by more than 20% in 2017 vs 2015, we believe that the company could provide more information on its waste reduction initiatives as disclosure of the different types and disposal methods was not provided in the company's 2017 annual report. Moreover, some of its initiatives, such as a target to send zero solid waste sent to landfill by 2020, were related to its Keystone subsidiary, which was sold in 2018, followed by the acquisition of National Beef. We thus believe that updated disclosure on targets and waste metrics could be provided.

Sanderson Farms: More information needed

Sanderson Farms is one of the largest poultry companies in the US, mostly exposed to the commodity chicken business. While the company is subject to Environmental Protection Agency regulations, which include regulations regarding the discharge of materials into the environment and waste handling and disposition, we think that further breakdown of the company's initiatives to manage waste could help measure progress throughout the years. The company's lower exposure to value-added products could be one of the reasons for the lack of disclosure on excess produce management, but other topics in waste management also lack disclosure.

Questions for management

What happens to your food waste currently?

What measures are in place to reduce it?

How are you collaborating with retailers and manufacturers to improve food waste?

Are there any packaging innovations that have helped reduce food waste?

What is the cost opportunity of reducing food waste?

What do you consider to be the main risk/pushback in reducing food waste?

If undertaken, what has the feedback been for repurposed products from excess food?

Would clearly marketing these products as an antidote to food waste be most successful?

What is the feedback within the company on your sustainability measures?

Leisure

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Looking across the food value chain, we think leisure could be the sector with the second-largest risk around growing food waste awareness, behind food retail. Within leisure, we think the restaurants will be most impacted but also see implications for travel and hotel companies. Similarly to the food retailers we see the risk of regulatory change impacting the sector – for example, regulation requiring measurement and disclosure of food waste, donations of excess food or a French-style requirement of ‘doggy bags’. However, we think leisure companies are less at risk from regulatory focus in the nearer term compared with the food retailers due to the less consolidated nature of the industry.

We think leisure companies will also face pressure to act on food waste from consumers. Similar to the backlash against restaurants using excessive amounts of plastics, we think consumers will name and shame companies not tackling the food waste issue (particularly on social media) and will likely show preferences for restaurants with greener credentials. We note, however, that this may lead to some companies taking tokenistic measures for the sake of PR rather than fundamentally re-evaluating their systems around food waste.

Although we think the leisure companies have already taken some steps to improve efficiencies within their supply chain, we see scope for further action through measures such as waste analytics and improved demand forecasting. We also see the opportunity for leisure companies to help both farmers and consumers waste less. Flexible menus and improved demand forecasting may help suppliers waste less food and initiatives such as smaller portions or even ‘trayless-dining’ may help consumers.

Although we think the leisure sector is at risk over growing food waste awareness, we see the opportunity for individual companies to differentiate themselves based on their actions in respect of food waste. **We see Carnival as the most transparent in the leisure sector regarding its waste management approach, but think Sodexo, SSP, JD Wetherspoon and Greggs are also taking decisive action.**

Risks vs. opportunity

We see leisure as a sector at risk of being impacted by regulatory change as well as a target of potential consumer backlash. A 2018 study by [Booking.com](#) showed that 87% of travellers say sustainability is important on holiday.

However, we do see some opportunity for leisure companies to improve productivity through tackling food waste. In the UK, [WRAP](#) estimates that 9% of food waste comes from hospitality and the food service industry at a cost of £2.9 billion per year. The amount of food wasted is equivalent to one in six of the 8 billion meals served each year and, of this waste, it is *estimated* that 75% is avoidable and 40% is carbohydrates (potato, bread, pasta and rice). When looking at the composition of food waste, on average, 21% arises from spoilage, 45% from food preparation and 34% from consumer plates. In addition, a [WRAP & WRI](#) report showed a ROI of \$6 for every \$1 invested by the catering industry in reducing food waste. 64% of the companies recouped their investment after 1 year and food waste was reduced by 36% on average in just 12 months.

Company-specific strategies

Although we see the growing awareness around food waste as a risk to the leisure sector as a whole, within the sector we see some companies taking more decisive action than others. Catering, restaurants and hotels are sectors that generate a lot of consumer-led food waste

but can have great influence on consumer behaviour. Many leisure companies are tackling the food waste problem with innovative solutions but there are a few that lag behind. Our research also suggests a difference between the strategies in the US and Europe, similarly to our analysis of the food retailers. The US restaurants appear to have a greater focus on donations, whereas the European leisure companies tend to tackle food waste earlier along the value chain at either the supplier or the consumer level. We show further detail of how these actions impact company strategy in Figure 32.

FIGURE 31 Company action on food waste – relative positioning in the EU leisure sector

Food Waste Action	Policy & data monitoring	Demand forecasting and ordering	Storage & food preparation innovation	Customer waste reduction	Excess produce management	Collaborative initiatives	Relative position on food waste
Carnival	✓	✓	✓	✓	✓	✓	Positive
Compass	✓	✓				✓	Positive
Elior	✓			✓		✓	Positive
Greggs	✓				✓	✓	Positive
JD Wetherspoon	✓				✓	✓	Positive
Sodexo	✓	✓		✓	✓	✓	Positive
SSP	✓	✓			✓	✓	Positive
AccorHotels	✓					✓	Neutral
Merlin					✓		Neutral
Whitbread					✓		Neutral
Vapiano		✓					Negative

Source: Barclays Research

Impacts on strategy

In Figure 32 we highlight potential impacts on business strategies within the leisure sector.

FIGURE 32 Impact of food waste action on strategy

Food waste action	Impact on strategy
Policy & data monitoring	<p>Measure and track food waste data</p> <ul style="list-style-type: none"> - Waste measurement: Winnow and Leanpath offer services for restaurants to measure and track food waste, highlighting where waste can be saved (see our emerging innovation section on page 21). Carnival's <i>Costa Cruises</i> is working with Winnow to prevent food waste and donates excess meals to those in need. AccorHotels reduced food waste by 54% over the first 12 weeks using Winnow's system with aggregated annualized savings of \$880,000. SSP consistently reviews internal production processes to align them with the business' peaks and troughs (e.g. as a result of this exercise, the amount of sandwiches wasted was reduced by 30%). Sodexo works with Leanpath on its WasteWatch programme. - Adopt targets to tackle food waste: e.g. JD Wetherspoon is working towards a target to recycle 95% of recyclable waste. Carnival's <i>Costa Cruises</i> is aiming to reduce food waste by 50% fleetwide by 2020. AccorHotels is committed to reducing food waste by 30% by 2020 as part of its Planet 21 programme. Sodexo targets a 50% reduction in food waste by 2025. Elior targets no waste to landfill by 2025. Compass targets reducing US food waste 25% by 2020.
Demand forecasting and ordering	<p>Improve forecasting and ordering systems to reduce waste</p> <ul style="list-style-type: none"> - AI and data analytics: to help with forecasting demand for produce. Tenzo's AI system helps restaurants optimise inventory levels (see our emerging innovation section on page 21), with clients including Mitchells & Butlers. - Flexible menus: to utilize excess produce when there is a glut in production, use leftovers in later meals, change menu if there are items that are regularly wasted. Instock is a restaurant that creates meals from supermarkets' excess produce (see page 24). - Order in-season and 'ugly' produce: to use surplus produce at potentially lower prices. Bluecart's platform connects buyers and sellers of produce (see page 24).

Source: Barclays Research

FIGURE 32 CONT'D Impact of food waste action on strategy

Food waste action	Impact on strategy
Storage & food preparation innovation	Improve processes to reduce waste <ul style="list-style-type: none"> - Educate staff around minimizing waste: Thomas Cook has worked with chefs and hotels in its portfolio to develop a manual on sustainable food. - Rotation system for food storage: to enable staff to use up foods nearer expiry first. - Accurate order system: to reduce likelihood of wasting incorrect orders.
Customer waste reduction	Adopt initiatives to help reduce customer food waste <ul style="list-style-type: none"> - Reduce portion or plate sizes: Carnival's 'taste don't waste' scheme to cut consumer-led waste. Reduce plate filler items e.g. chips. - Trayless dining: in buffet-style settings, 'trayless dining' may stop customers taking more than they can eat. - Doggy bags: France has ruled that restaurants must provide 'doggy bags' when requested by customers. - Accurate menu details: to reduce likelihood of customers sending meals back. - Sodexo uses LeanPath to support its 'WasteWatch' initiative, data is analysed and used to drive change in consumer behaviour.
Excess produce management	Utilise excess produce <ul style="list-style-type: none"> - Surplus food platforms: Too Good To Go and Karma enable restaurants to sell their excess food at a reduced rate to customers (see our emerging innovation section on page 21). Similarly, SSP partners with M&S. - Food-sharing platform: OLIO connects foodservice providers such as Pret A Manger with its volunteers to collect and distribute excess food (see page 24). - Donate excess food: Goodr uses blockchain software for businesses to donate surplus food, capture waste data and IRS tax savings (see page 24). Elior works with local communities to distribute excess food. JDW partners with FareShare to donate excess food, c4000 meals worth. Costa Cruises has partnered with food bank charity Fondazione Banco Alimentare to donate excess food, distributing c16k meals in just 6 months. McDonalds, Starbucks and YUM! Brands also have food donation schemes. Greggs works with charities and other organisations to offer surplus food, lowering waste. - Offer staff meals: from leftovers to improve morale and reduce waste. - Biofuels, fertilizer or anaerobic digestion: Elior sends its used cooking oil for biofuels. JDW sends its waste for AD.
Collaborative initiatives	Engage in industry programmes to reduce waste <ul style="list-style-type: none"> - Commitment to collaborative initiatives: major UK foodservice companies have committed to the WRAP's <i>roadmap</i> to halve food waste, e.g. Accor Hotels, Compass Group, Sodexo. Sodexo is also part of Champions 12.3. - Sustainable Restaurant Association: to highlight sustainability in the foodservice industry. JD Wetherspoon won the SRA's <i>Waste No Food</i> 2018 award due to its work including smaller portions, separating prep waste, and donating unavoidable waste to charity.

Source: Barclays Research

Companies to highlight – European Leisure

Carnival: Big company, big plans

We see Carnival as the most transparent company in the leisure sector regarding its waste management approach. With clear sections outlined on its website, its current actions to tackle food waste are thoroughly explained. What we think makes Carnival stand out is the continual evaluation of technology and operations used for food discharge at sea. In 2017, two cruise brands started a pilot program whereby special equipment is used to digest food waste prior to discharge at sea. Another brand has recently completed assessments on food procurement, preparation, consumption and disposal. As part of the '4GoodFood' program, Costa Cruises partnered with University of Gastronomic Sciences to revamp its food & wine offerings based on sustainability principles. It also has an active consumer campaign called 'taste don't waste' which encourages responsible behaviours particularly in buffet-style dining. It is clear to us that Carnival does not hold back on investing, whether it is on campaigns or leading technology. However, we do note that there is limited detail as of yet around the success on any of its initiatives.

Sodexo: Ongoing initiatives and active global partnerships

Sodexo targets 50% reduction in its food waste by 2025. We think it has a differentiated initiative that focuses not only on food waste in the kitchen, but also on consumer-driven waste. Through a partnership with LeanPath, a provider of an automated food waste

tracking and analytics platform, it launched the 'WasteWatch' programme whereby it captures waste data and uses this to drive behavioural change, both in the kitchen and also at the consumer level. The program has been a success so far, reducing food waste by 50% and reducing purchases by 3% in FY18. Sodexo aims to extend this program to 70% of its food sites by 2020, 100% by 2025. In the importance matrix published in its FY18 report, food waste ranks in the top right corner, suggesting high importance to Sodexo and also its stakeholders.

Elior: Focused, measured and collaborative approach

In Oct 2017, the company set up a target that by 2025 no food waste will be sent to landfill. In its five-step food waste elimination approach, the company intends to reduce food waste at every stage of the supply chain with targeted procurements and production, better packaging and measured servings to end-customers. Furthermore, to achieve zero waste to landfill, the company plans effective reuse of food within local communities and recycling of leftovers as fuel and fertilizer. We think that the rigorous approach at each stage and clearly defined plan has led to the good progress on food waste reduction – e.g. in FY17, 82% of the used cooking oil was recycled; c.700 kg of unsold food was redistributed in Spain; and food waste was reduced c.16% in a pilot program in 50 French schools.

JD Wetherspoon: Multi-pronged approach

We see JDW as actively making efforts to find ways to tackle the broader problem. Unlike Carnival and Sodexo, both of which attempt to tackle consumer behaviour, JDW concentrates on dealing with waste responsibly. Its targets are also much broader and without time-frames, unlike the above examples. So far, 900+ pubs separate food waste and send it for anaerobic digestion. JDW currently sends zero waste to landfill and continues to work towards the target of recycling 95% of recyclable waste. It has also partnered with a charity, FareShare, to donate food that would otherwise go to landfill. So far, it has provided about 4000 meals worth, donating to 100+ charities. Currently JDW provides a regular food donation service to centres in Hull, Speke, Manchester, Preston and Newcastle, but given the success of this initiative, it is capable of rolling this out across the UK to make much more of an impact.

Accor: Early but steady progress towards food waste reduction

We think Accor has set the targets and foundation needed to tackle waste management effectively, but, considering that food waste is its biggest source of waste (51% of total waste), the initiatives can be further developed. Though Accor has partnerships with Winnow and LeanPath, it is not clear how effectively the data from these providers are being used and integrated within action plans. The company targets to reduce 30% food waste by 2020. By Dec 2017, 6% of the hotels had implemented its initiatives, of which 96 hotels saw a 52% reduction in food waste worth c€5.4mn. The company recovered/recycled 48% of total food waste and 46% of hotels recycled food in 2017 vs. 36% in the previous year.

SSP: Differentiated initiatives but lack of explicit targets

In Germany, France and Norway SSP uses a third-party app called Too Good to Go (which we highlight in our emerging innovation section on page 21). This app lets consumers know when unsold food is available to be purchased at reduced prices. SSP Norway is currently seeing 700 products/month sold via the app, equating to 21 tonnes per annum of unsold food diverted from landfill. SSP has also developed partnerships to donate food, with 28 M&S sites taking part in a food donation scheme. It seems that SSP is actively attempting to manage food waste, but there are no explicit targets in place.

Vapiano: Lack of detail on targets/initiatives

Vapiano does not specify any targets on food waste or any key stats on the success of its initiatives. Its reports contain a brief paragraph explaining that it aims to calculate precisely

the purchasing and use of goods to prevent any food waste, but there are no specified targets like those set by some of its peers in the leisure sector. There are also no signs of partnerships or campaigns being established in an effort to manage food waste.

Greggs: Focus on unsold food reduction and food donations

We believe that Greggs has a number of steps in place to focus on food waste. The company had a target to increase food donations by 50% in its latest annual report (based on 2016 results). This target was narrowly missed, but there was still a 45% increase in food donations. The company states its “*aim to give away unsold food to community groups and charities*” (amount unquantified) and there are clear systems in place on the company’s website for groups to contact the company about taking unused stock. The amount of unsold food has increased 16-fold since 2013, according to the company’s website. Finally, we also note that Greggs diverts 99.6% of waste from its manufacturing sites away from landfill.

Other pub & restaurant companies: Focus on reducing waste to landfill

We have found slightly less information on food waste policies from the companies listed below. These companies may be doing more than we cite below, but, from looking through annual reports and the responsibility/governance sections of their websites, we would highlight the following:

- **Greene King.** Achieved 98% of waste to landfill in 2017, with an objective of this reaching 100% by 2020. The company is also looking at ways of recycling food waste, with the annual report commenting that there were 10,933 tonnes of food recycled in 2018.
- **Marston’s.** In FY18, the company achieved zero waste to landfill. Waste recycling rates within the company’s pubs have improved over the last two years from 60% to 78%.
- **Mitchells & Butlers.** In FY19, the company intends to “*fully roll out and embed the new stock auto-ordering system, improving control through a reduction in waste, fewer stock outages and a more efficient stock take process.*” In addition, M&B has been signed as a client by Tenzo, which is helping companies reduce food waste using AI (see our emerging innovation section on page 21).
- **Restaurant Group.** The company has improved its diversion from landfill to 99%, up from 90% in 2016. Many sites divert 100% from landfill. The company diverted 14,000 tonnes from landfill via its recycling schedule, focusing on the segregation of food waste from general waste, along with working with suppliers on end-disposal points.

Cynics may comment that focusing on lowering food wastage could purely be a gross margin improvement driver rather than a strategy with genuine altruistic intentions, but this is a clear ‘win-win’ opportunity. Many of the comments we have read show that companies can help combat the food price inflation headwinds they face via more progressive policies with regards to food waste.

Companies to highlight – US Restaurants

McDonalds: Supply chain management and donations

As a central part of its Velocity Growth Plan, McDonald's aims to use its scale for good. Management has noted that in order for guests to feel good about visiting the restaurants, they must feel good about McDonald's food, the company, and the impact McDonald's is having on the world. Ultimately, McDonald's wants to *"ensure that [its] food serves its purpose of feeding people"*. Across multiple countries, the company has started to work with suppliers to reduce food loss and waste within the supply chain and with its franchisees to reduce ongoing waste within their restaurants. That said, the company *"recognize[s] that there is a lot more to be done"*. Within the US alone, the McDonald's Food Donation Program in partnership with Food Donation Connection has registered 785 restaurants and donated 370k+ pounds of food to charities in need, as of January 2018. To take these efforts global, McDonalds has developed a Global Food Disposition policy, which will *"encourage our suppliers and distributors globally to dispose of food in alignment with the food waste hierarchy, including enabling food donations to be made where possible"*.

Starbucks: Leader in food rescue

Management has noted that partners (i.e. employees) across the US advocated for a solution to donate unsold food to help the communities they serve on a daily basis. Through a partnership with Feeding America, Starbucks will rescue 100% of food available to donate from all US stores and thus position Starbucks as the *"sector leader in food rescue"*. At scale, Starbucks will 1) support 100% store participation in food donation, 2) provide 50m meals annually, 3) divert 60m pounds of food waste from landfill, and 4) lead a coalition of like-minded brands in the fight against hunger.

YUM! Brands: Demand forecasting and excess food donation

Management noted that *"reducing wasted food is where [we have] made the most significant strides"*. On a corporate level, YUM! adheres to the US EPA's Recovery Hierarchy, which shows that there are much better places for leftover food than the landfill or compost bin and that *"reducing food waste begins at the source"*. As such, YUM! works with suppliers to purchase only as much fresh food as is expected to be sold to customers based on projections. In terms of excess food, the YUM! Harvest program in partnership with Food Donation Connection donates surplus food from restaurants to food banks, soup kitchens, and other non-profits. The Harvest program is the *"longest-running food donation program in [their] industry and has made Yum! a leader among peers."*

Questions for management

What happens to your food waste currently?

What measures are in place to reduce it?

How are you collaborating with suppliers and retailers to improve food waste?

How are your product innovations changing to utilise surplus food?

Do you think the most effective way to tackle food waste is by focussing on consumer driven waste or waste at the procurement/production stages?

Are you willing to change your end product offering in attempt to tackle food waste (i.e. using different ingredients/reducing portion size)?

Packaging

U.S. Paper & Packaging

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Contrary to conventional wisdom, plastics and consumer product packaging are as much a solution to critical world issues as they may be a problem: Packaging can help solve the world's food waste problems and help to alleviate supply chain issues around food-borne illnesses, but we as a society must let it do its job versus vilifying it in the press. Steel food cans, aluminium beverage cans, and modified atmospheric packaging can provide significant extensions in shelf life while technologies such as RFID and intelligent QR codes can help to alleviate supply chain concerns around food-borne illness. However, as Thomas Hine noted in his book "The Total Package", "packaging is omnipresent and invisible, deplored and ignored", and "it only comes to the fore when there's a problem". That problem manifests today as concerns regarding the potential for plastics to end up in the world's water-ways. To that end, most regulators and NGOs have targeted single-use plastic packaging applications that provide consumer convenience vs those that help to alleviate waste.

While packaging has historically been a vessel to carry products and a marketing tool, it is clear that the importance of packaging to society is increasing. 70%-75% of purchase decisions are made in front of the grocery store shelf within milliseconds and the packages ability to attract eyeballs and generate buys was historically the primary focus. In the new world order, packaging must also be environmentally friendly and solve financial challenges in new market channels such as ecommerce. We think packagers will meet these challenges, with the industry having made significant progress in reducing the volume of material over the past several decades. We expect the coming decade to see these companies take the next step to utilise material sciences to reformulate products and at the same time re-engineer the recycling supply chain.

With the rising importance of ESG factors to consumers, we reference several companies leading with solutions to the critical issue of food waste: We believe that plastic packaging manufacturers such as **Sealed Air, Bemis and Sonoco** will need to be the leaders around food waste given the substrates inherent ability to lengthen shelf life along with the associated concerns regarding post-consumer waste. Food can manufacturers **Crown Holdings, Silgan Holdings and Ardagh** can also play a meaningful role given the product's reduction in waste at the point of harvest, preservation of nutrients, low cost and significant shelf life extension. The same holds true for beverage can producers. Paper based packagers also can add value to the food waste equation by protecting fresh produce through the supply chain with a relatively low cost package. Lastly, **Avery Dennison** with its unique RFID and smart label technology can alleviate waste along the supply chain, particularly at the point of consumption, by alleviating consumer concerns regarding product authenticity, freshness and chain of custody.

Risks vs. opportunity

We see food waste, along with the broader discussion around the environment and sustainability, mostly as an opportunity for packaging manufacturers rather than a risk. Packaging represents a significant portion of food producers' COGS (we estimate ~17%) and has historically been viewed strictly as a cost centre rather than something that could drive differentiation. Again, we go back to our quote above from Thomas Hine. "Packaging is omnipresent and invisible, deplored and ignored". Consumers have historically bought the brand but not the package, which is mostly taken for granted despite the average consumer opening 7 packages per day or ~140k items in their lifetime. However, if packagers can

solve a trifecta of issues (shelf life stability, environmental friendliness, and marketing), the value that they provide can increase and be seen as a source of significant differentiation for brand owners. One need look no further than the recent launch of craft beers and beverages in the United States to see evidence of this trend.

Company-specific strategies

Shelf life stability and hence food waste strategies have been at the core of packaging since it was invented. Plastic packaging is a great example of this reality. Refrigerated lettuce's shelf life is approximately 2-4 days but can be extended to 14 days when placed in Modified Atmospheric Packaging (MAP). Fresh red meat goes from 2-3 days to 21, and cheese from 7 days to 180. The same holds true for beverages and foods placed in air-tight metal containers. Food cans stored properly will last 4-6 years with minimal to no loss in the nutrient value, which is locked in at the point of harvest. And liquids stored in beverage cans maintain their freshness for 6-9 months though the product is still safe to consume for many years thereafter. Even cardboard boxes provide meaningful benefits to food waste. Nearly 50% of box shipments go into Food & Beverage related end-markets, with a heavy focus on fresh produce. Cardboard boxes hold up to the moisture and temperature changes throughout the supply chain while protecting produce from external and internal damage in ways that plastic crates can't. Lastly, while the historical role of packaging was to get a product from point A to B safely, then market the product to consumers before eventually being tossed, packaging today is a source of valuable information though the data is relatively static and limited to what's printed on the side. Avery Dennison's RFID technology can provide the backbone for such projects as IBM's Block Chain Food Trust. RFID hardware allows for tracing and tracking technology to be implemented and, as IBM highlights, increased food safety, a more efficient supply chain, food freshness, sustainability, brand trust, less food waste and a decline in food fraud.

FIGURE 33 Company action on food waste – relative positioning in the packaging sector

Food Waste Action	Policy & data monitoring	Product innovation	Targeted capital allocation	Supply chain initiatives	Consumer support	Active industry collaboration	Relative position on food waste
Ardagh		✓	✓	✓	✓	✓	Positive
Avery Dennison	✓	✓	✓	✓	✓	✓	Positive
Ball Corp		✓	✓		✓	✓	Positive
Bemis	✓	✓	✓	✓	✓	✓	Positive
Crown Holdings		✓	✓	✓	✓	✓	Positive
Sealed Air	✓	✓	✓	✓	✓	✓	Positive
Sonoco	✓	✓	✓	✓	✓	✓	Positive
International Paper		✓		✓			Neutral
Owens-Illinois					✓		Neutral
Packaging Corp.		✓		✓			Neutral
Silgan				✓	✓		Neutral
WestRock		✓		✓	✓		Neutral

Source: Barclays Research

Impacts on strategy

In Figure 34 we highlight potential impacts on business strategies within packaging. While most packaging companies today are focused on sustainability and the environmental aspects of packaging waste, we view food waste as a strategy to change that narrative. Most government regulators and NGOs have targeted single-use plastic packaging that largely provides consumer convenience. Straws, water bottles, cutlery, and plates. These items are predominantly not under the purview of the publicly traded plastic packaging producers. What the companies do provide is high barrier/high value products that reduce food waste by extending shelf life. However, companies will need to work on reformulating their product portfolio to meet these sustainability and recyclability goals but ultimately we think they will be successful. BPA (Bisphenol A) bans across Europe along with consumer backlash in the US is a prime example. While many investors were concerned about the increased cost and complexity, food can manufacturers along with the coatings providers seamlessly tackled this issue such that the price of the container didn't rise significantly despite the increased complexity. To that end, food cans could play a significant role in reducing food waste, but currently doesn't have the support of consumers. Therein lies the rub. Packaging can and will help to solve the world's food waste issues, but has to simultaneously deliver on consumer preferences and sustainability.

FIGURE 34 Impact of food waste action on strategy

Food waste action	Impact on strategy
Policy & data monitoring	<p>Limited monitoring specific to food waste as packaging today is doing its job. Monitoring is largely focused on sustainability performance targets.</p> <ul style="list-style-type: none"> - Food waste specific monitoring largely under the purview of plastics: shifting consumer preference towards fresh and natural options generates unique opportunities for plastic packaging. Legacy packages such as food and beverage cans provide significant product protection and hence reduction in food waste, but largely don't participate in fresh and natural as it pertains to reductions in food waste. Paper-based packaging lies somewhere in the middle as fresh fruits and vegetables represent a significant end-market for corrugated packaging. - Regularly publish sustainability data along with 2020/2025 pledges: our companies all publish their progress towards various sustainability goals, such as energy, green-house gas emissions, water, waste, and percentage of portfolio that is recyclable/reusable. Many packagers have pledged to increase the portion of products that are recyclable or reusable and/or increase the amount of recycled materials in their products by 2025.
Product innovation	<p>Innovative products and solutions to reduce food wastage</p> <ul style="list-style-type: none"> - Food packaging at its core is meant to reduce food waste and limit damage to the product: food packaging provides barriers against contaminants, physical protection to prevent damage, increased product portability, security features to prevent tampering and breakage, clear windows for consumers to view a product's freshness, portion control options, and stackable containers/boxes to reduce produce damage from farm to grocery. - More sophisticated solutions: these come in many forms, such as improved packaging processes/equipment (SEE's FlexPrep portion control condiment dispensing solution reduces food waste by >20%), modified atmosphere packaging and vacuum skin packaging to extend a product's shelf life from 1-2 days to as long as 180 days, and temperature regulating packages for e-food. - Managing food inventory with RFID tags: AVY's RFID technology is another example of sophisticated product innovation that allow grocers to significantly improve inventory management, and can be applied to fresh food categories by helping grocers prevent over-ordering and improve the timing of promotions to turn food inventory before spoilage.
Targeted capital allocation	<p>Investing in technologies to improve 'Food Waste Reduction' product portfolio</p> <ul style="list-style-type: none"> - Added capacity: beverage can manufacturers continue to invest significant capital to service various shapes and sizes that can address both portion control and resealability features. - Acquisitions: SON expanded its flexibles portfolio into the frozen food aisle through its acquisition of Clear Lam (the PrimaPak package for Green Giant frozen veggie spirals); frozen food is a good option to extend the shelf life of fresh foods. Also Highland Packaging Solutions and Peninsula Packaging directly target perimeter of the store opportunities. - R&D: plastic packagers continue to spend R&D as a percentage of sales at a significantly higher rate (~1.6%) than other substrates (~0.2% for containerboard and ~0.3% for metal can manufacturers) in an effort to combat some of these issues. - Upstream investments: SON has an interest in a company called Harvest CROO, which is looking at using robotics in automating the picking and packaging process in an effort to reduce food waste.

Source: Barclays Research

FIGURE 34 CONT'D Impact of food waste action on strategy

Food waste action	Impact on strategy
Supply chain initiatives	<p>Prevent food waste through supply chain solutions</p> <ul style="list-style-type: none"> - Proximity to customers to reduce spoilage: Food can manufacturers are typically within 50 miles of their customers to support volumes through various harvest conditions while packaging on site reduces damage and retains nutrients. The same goes for box manufacturers who provide equipment direct to farms so that boxes can be assembled and utilized as close to fresh produce as possible. - Technology in the supply chain: AVY's RFID and smart label technology provide food safety and spoilage visibility in the supply chain by notifying the supplier/customer where damage or temperature fluctuations occur.
Consumer support	<p>Enable consumers to limit their own food waste</p> <ul style="list-style-type: none"> - Portion control packages: smaller single-serve beverage and/or food can options facilitate portion control, as well as reducing food waste. Portion control and portable packages are available for healthy and convenient on-the-go snacking, as well as portion control films for condiments, dips, dressings and sauces. - Resealability and reclose features: increasing food and beverage packages with easy-use resealable option will allow for longer shelf life after the product is opened. - Consumer awareness driving change: principally in emerging markets, companies are driving awareness regarding the positive impact of increased packaging intensity relative to food waste. For Sealed Air, the awareness of food safety and food waste is driving the Chinese market, where only 5% of the 400 million hogs in production are packaged. This growth in awareness is translating to 3-4m more hogs to the package processing plant a year or ~30-50m bags.
Active industry collaboration	<p>Engagement with industry organisations and non-profits is typically focused on sustainability of the product rather than reduction of food waste</p> <ul style="list-style-type: none"> - University partnerships: SON partnered with Clemson University to discover new technologies and new forms of packaging that can optimize the fresh food lifecycle by extending shelf life and reducing food waste. - Alliance to end plastic waste: several companies have joined this Alliance to eliminate plastic waste through infrastructure development, innovation, education/engagement and clean-up. The Alliance spans the finance community, government and civil society, including environmental and economic development NGOs. - Various other sustainability-focused partnerships: metal can and glass manufacturers belong to industry groups like the Can Manufacturers Institute and Glass Packaging Institute that actively collaborate to promote sustainability benefits but also highlight the product's impact on food waste. Packagers across substrates collaborate with various advocacy groups to improve their impact on the planet, from IP's partnerships with World Wildlife Fund, Corporate Eco-Forum, and the Carolinas Working Forest Conservation Collaborative to Ball's own Foundation that supports programs to increase metal packaging recycling rates, improve collection processes and provide education about recycling benefits.

Source: Barclays Research

Companies to highlight

Sealed Air/Bemis: High barrier film technology

Sealed Air's and Bemis' high barrier film technology is best positioned for growth if food waste initiatives take on increasing importance globally. Quite simply, there is no other packaging substrate today that extends the shelf life of perishable products such as fresh meat, fruit, vegetables, and cheese/dairy while at the same time meeting the demands of marketers for shelf appeal and the demands of consumers regarding transparency. Sealed Air generates nearly 60% of its revenues today in these specific food categories, with a clear runway for expansion, particularly in the developing markets where packaging intensity is extremely low. Bemis (which is set to be acquired by Amcor in 2Q19) also exhibits many of these same characteristics but at a lower rate, with ~40% of sales coming from this category.

Sonoco: Leading perimeter of the store initiatives

Following the acquisitions of Highland, PPI, Peninsula and Clear Lam, Sonoco has become the clear packaging leader at targeting the perimeter of the store and in particular fresh fruits and vegetables. At the same time, the company's partnerships, particularly Sonoco Fresh in conjunction with Clemson University, show that management is proactively targeting this area of potential growth. However, with just 15% of total company revenues coming from these categories, we believe the economic benefits to the bottom line will take time to mature but bear monitoring.

Avery Dennison: Long-term supply chain solutions

Avery Dennison is uniquely positioned to help reinvent supply chains, reduce inventories, increase traceability, increase consumer confidence and trust, and ultimately to reduce food waste. Through the use of its RFID technology, consumers and suppliers can generate real time data that enables these activities. Today RFID generates around \$300m in revenue or 4% of total company sales, but is growing at 15-20%+ per year. With the price per RFID tag hovering around 6-7c, cost is the primary barrier to adoption. If prices can be significantly reduced, we think AVY could be a long-term beneficiary of initiatives to reduce food waste.

Questions for management

How are you preventing food waste at all stages of the supply chain?

How do you see your role in tackling food waste?

What is the breakdown of what happens to your food waste currently?

What measures are in place to reduce it?

How are your product innovations changing to utilise surplus food?

How are you helping reduce consumer food waste?

Energy

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The opportunity to produce renewable fuels from waste is growing for the energy industry. We think growing food waste awareness will encourage companies along the food value chain to think more carefully about how they dispose of their waste products and hence energy companies have an opportunity to turn this processing waste, once destined for landfill, into renewable fuel. Within the energy sector, we have seen a number of company initiatives but see Neste as being at the forefront.

Neste is a clear leader on renewable fuels but other major oil companies are also pursuing the opportunity. Eni has launched its pilot plant to produce biofuel from municipal waste at Gela refinery and BP and Johnson Matthey have developed Fischer Tropsch technology to convert municipal solid waste into biojet fuel. This technology has also been licensed to Fulcrum, which will run the first plant in the US that converts household garbage into renewable fuel from 2020. Total has also launched the BioTfuel project to transform lignocellulosic material, such as forest waste, agricultural by-products and energy crops, into biofuel.

Companies to highlight

Neste: A pioneer of renewable fuels

Neste is by far the largest producer of renewable fuels from waste and residues, with capacity of 2.9 million tonnes (mt) and a market share in renewable diesel of over 60% in 2017. Using its own NEXBTL technology, Neste can transform 13 different raw materials including animal fat, fish fat, vegetable oil and used cooking oil into biofuel. The company expects to expand its capacity to 3.2mt through debottlenecking its current facilities and plans to grow capacity to ~4.5mt in 2022 when a new plant in Singapore is due online. Neste themselves *say* that they are “*continuously on a search for new, even lower quality waste and residues to be utilised*” and even *estimate* that if all Thanksgiving turkey waste fat in the US were turned into renewable diesel, it would be enough for a car to drive around the globe over 3000 times. Therefore we think increasing awareness around food waste will help divert waste products from landfill into renewable fuels.

Neste’s customers include UPS, which *announced* a 3-year deal in 2015 to purchase up to 46m gallons of renewable fuels from three companies including Neste. In Finland, City of Porvoo, Helsinki Airport shuttle buses, Lapland Airports, DB Schenker, and Lassila & Tikanoja are among the B2B customers of Neste’s renewable diesel. In California, the main customers are those managing fleets of large heavy-duty vehicles. As we show in Figure 35, the clients span both the public and private sectors and, based on feedback from our trip to California, we expect the number of customers to continue to expand.

FIGURE 35 Some of the organisations that have already made the switch to Neste’s RD

Public organisations	Private organisations
Berkeley University of California	Apple
California Department of Transportation	Facebook
City & County of San Francisco	Google
City of Carlsbad	Kaiser Permanente
City of Oakland	LinkedIn
City of San Diego	Pacific Gas and Electric
City of Walnut Creek	Ryder Trucks
Contra Costa County	Twitter
San Jose Unified School District	UPS
State of California	Whole Foods Market

Source: Barclays Research

What is renewable diesel?

Renewable diesel (RD) is a colourless, odourless fuel that has an identical chemical composition to petroleum diesel and is also often referred to as a ‘second generation biofuel’. RD can replace conventional diesel in existing engines without any blending requirements and can therefore be considered a ‘drop-in’ fuel. It is produced mainly by hydro-treating, where different types of feedstock are reacted with hydrogen in the presence of a catalyst. Palm oil was the first feedstock that Neste used but the company has since expanded the number of potential feedstocks to 13, with the most environmentally friendly being ‘waste and residues’ which predominantly includes animal fats, fish fats and used cooking oil. Feedstock from food waste drives large GHG emission reduction.

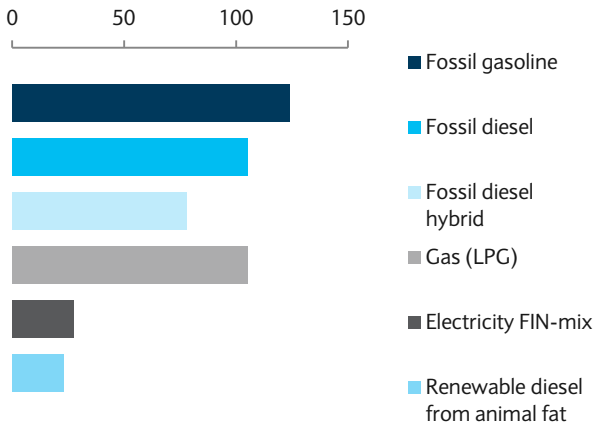
The extent of carbon reduction depends on the feedstock used, with a reduction versus petroleum diesel of up to 90% achieved when using waste and residues. The reduction relies upon the assumption accepted by regulators that biofuels are inherently carbon-neutral with the CO2 emitted in engines reabsorbed by the growth of crops used as feedstock. Since it is not directly associated with deforestation, feedstock classified as waste and residues is considered more environmentally friendly, while it also reduces the amount of waste being sent to landfill, or, in the case of used cooking oil, clogging up sewers. In addition to being low-carbon, switching to RD can also provide important improvements in air quality. The lack of aromatic hydrocarbons, high cetane number and very low sulphur content help reduce emissions of other toxic air contaminants. This includes a ~10% reduction in nitrogen oxides, 24% lower carbon monoxide and significantly fewer carcinogenic diesel particulate emissions.

FIGURE 36
A sample of some renewable diesel



Source: Barclays Research

FIGURE 37
Lifecycle emissions from traffic fuels, gCO2 eq/km



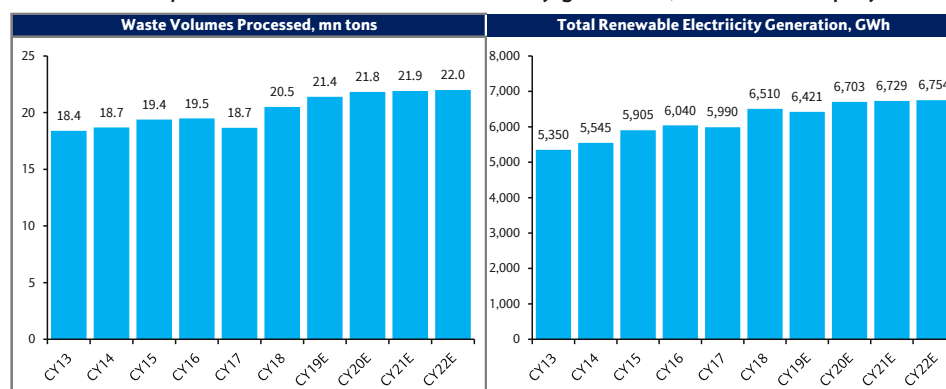
Source: JEC, company data, Barclays Research

Covanta: Leader in Waste-to-Energy

Addressing all forms of municipal solid waste, Covanta (CVA) is the US leader in waste-to-energy (WtE), processing 22 million tons per year. Tons processed represent a 1:1 CO₂ offset, while also generating 500-700 kWh of renewable power and recovering ~50 lbs of metals per ton processed. WtE represents ~7% of total US waste tons processed, landfill accounts for around 2/3, and the remainder is recycled/composted. Covanta accounts for ~75% of the WtE tons processed in the US, and is in the process of expanding into the UK. Sources of waste span the spectrum, from standard MSW such as food and plastics (among others) to profiled and hazardous waste that requires more specialized treatment.

In addition to addressing food waste through its standard business operations, the company has in the past partnered with organizations to address issues around food and other organic waste, one example being its 10-year agreement with Turning Earth, for diverting food waste for reuse at Connecticut municipalities and businesses.

FIGURE 38

Covanta waste processed and renewable electricity generated, historical and projected

Source: Company data, Barclays Research estimates

Questions for management

What is the global opportunity for using processing waste as renewable fuel?

How does this opportunity evolve in the future as awareness on food waste increases?

How are your product innovations changing?

Which sectors along the food value chain present the biggest opportunities for acquiring waste?

Chemicals

European Chemicals

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Chemical companies are not part of the food supply chain, but some provide solutions that enable efficiency gains and reduce wastage. We therefore see an opportunity for companies able to provide such solutions, in terms of both their sustainability profile and growth.

We think companies in the European Chemical space are likely to help mitigate food waste most significantly at the production level compared with the other supply chain stages. We think advancing efforts in food waste present an opportunity for chemical companies to provide solutions that improve production yield (agrochemicals and biotechnology), facilitate transport (insulation and industrial gases) and prolong shelf life (industrial gases). **BASF is the most exposed to this trend.**

Risks vs. opportunity

A fifth of the world's total crop production annually is at risk from herbivorous insects, before or after harvest, according to the FAO. In addition to insect pests, fungi and plants, parasites also pose significant risks to production yields. The intensification of agricultural practices has also created nutrient-rich habitats, with crops highly susceptible to infestation. The situation is worse in hot climates and the implications of production loss are compounded by population growth in the developing economies. At this stage, major agrochemical companies such as BASF and Bayer, and to a smaller extent Croda, play a significant role in improving production. We see the advancing efforts around food waste as growth drivers for their respective segments. Agro-chemicals and ag-tech can help farmers improve techniques and increase resilience against threats such as diseases, insects and weather. We hypothesise that improving the level of certainty around production quality and yield would allow for the fine-tuning of the production/demand balance, as well as for reduced waste due to faulty (off-spec) fresh produce.

Products that increase the lifetime of a product, such as packaging and processing additives, impact food waste directly. In this space, the industrial gas players have technologies to control the gas composition within the packaging. DSM and Johnson Matthey are developing other solutions, but they currently contribute little to sales and are unlikely to be material in the near term. A further source of avoidable loss is at the storage and transportation stages. Industrial gas companies are trying to reduce waste through their chilling and freezing solutions, while insulation and flourogases players allow for prolonged and energy-efficient refrigeration.

Companies to highlight

BASF: Crop protection and digital farming

BASF's Agricultural Solutions segment generated EUR6.2bn sales in 2018, or c10% of group sales, and accounts for close to 20% of our sum-of-the-parts valuation. The business consists of crop protection solutions developed and produced to improve crop health and yields. In addition to fungicides, insecticides and herbicides, BASF also has a functional crop care business for biological crop protection, seed treatment and other applications. In 2018, the company announced the acquisition of Bayer's entire vegetable seeds business as well as a range of seed treatment products. The transaction also added a digital farming capability composed of a diagnosis and crop management platform. About 40% of the R&D expenditure of the group goes into growing this business, selectively expanding capacities for crop protection products.

Croda: Pest prevention, seed enhancements and biostimulants within agriculture

Croda's Crop Care division, which accounts for roughly 15% of group sales, has been the company's fastest-growing segment in recent years. At the heart of this business are delivery systems for active ingredients that prevent pests. Furthermore, Croda acquired seed enhancement technology company Incotec in 2015, which can improve seed quality and stimulate seeds during their early development. Last year, the company also acquired Plant Impact, a technology platform for chemical biostimulants that improve yields under high stress conditions such as drought and climate variability.

DSM and Johnson Matthey: Small solutions targeting food waste

Various solutions can improve the efficiency of the processing and packaging stage of the value chain and increase product shelf life. DSM has several product lines aimed at improving food processing. Pack-Age is a cheese-ripening solution that replaces the natural process; the company estimates it can decrease Gouda and parmesan waste by c200k tons annually. Also in the dairy space, DelvoGuard's protective cultures prevent mould and yeast for longer. In 2015, Johnson Matthey acquired StePac, with sales of cGBP20m p.a. The company increases storage time and shelf life of fresh produce by manufacturing packaging solutions that control atmosphere, humidity and condensation.

Linde, Air Liquide: Cryogenic chilling and packaging solutions

The food and beverage end-market accounts for 5-10% of the Industrial Gases space. Nitrogen and carbon dioxide are used in packaging and cooling across the cold chain, respectively, and together they allow for improved yields, quality and shelf-life. On the packaging side, industrial gas companies, such as Linde and Air Liquide, provide modified atmosphere packaging solutions used to preserve food characteristics, and inerting and deoxygenation technologies. Carbon dioxide and nitrogen are used in cryogenic freezing or chilling technologies, in cold transportation and in in-transit refrigeration solutions.

Arkema: Refrigerants to aid cooling in transport and storage

Food waste can be reduced by improving refrigeration during transportation and in-store. This is an issue mainly encountered in the emerging markets, rather than in the developed world. While reducing food waste at this level could be a driver for refrigerants (Arkema), we do not see it as a material catalyst for accelerated growth.

Covestro: Foams used for insulated storage

In the insulation space, Covestro manufactures rigid polyurethane (MDI-based) foams used in warehouses, trucks, refrigerated counters in supermarkets and private freezers. The refrigeration insulation foam segment grew at c8% on average between 2015 and 2017 and is one of the growth drivers for the polyurethanes market. Covestro grew at 12% p.a. in this space, aided by its proprietary innovation in the space, Microfoam. This allows better insulating properties at lower volumes of insulating material.

The Credit View

Bayer: focus on crop science

Our credit analyst Maggie O'Neal sees improving crop yields as a key component in the drive to lower food waste. Bayer has invested heavily in its crop science product offering, providing the company with a solid base from which to address growing consumer concerns around food waste. Digital farming is part of its product offering and one in which it holds a leading market position. Bayer's FieldView platform allows for precise application of pesticides and fertilizers, which allows farmers to achieve higher yields with less waste.

Questions for management

Where do you see most opportunity around growing awareness of food waste?

Which innovations are helping reduce food waste the most?

Is there scope for further acquisitions or strategic partnerships to help reduce food waste?

Food Delivery & Meal Kit Solutions

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Delivery platforms provide an opportunity to tune into demand for flexible eating, reducing food waste as consumers can eat what they want, when they want it. We think food delivery is taking share from both grocery and dining out – in the latter scenario, we think it can help reduce food waste as it allows consumers to store leftovers more conveniently.

Meal kits, which are largely an online category, offer an interesting solution to food waste. Perishable foods are ordered based on highly accurate demand forecasts, and usually exit the company's fulfilment centres within one day. In addition, ingredients are pre-portioned into meal kit boxes based on a given recipe, substantially reducing waste compared to what one would see in a traditional grocery model.

HelloFresh's business model lends itself to substantially reducing food waste compared with traditional grocery retail. The company has reduced its food waste going to landfill by 65% and nearly doubled its excess products being donated to charity using *Spoiler Alert's* service.

Risks vs. opportunity

In our view, growing awareness around food waste is largely an opportunity for the sector. The flexibility offered by food delivery platforms and the precise quantities inherent in the meal kit model both offer practical solutions to the issue of food waste. However, delivery of these items to the home may cause greater congestion in urban areas – which is another factor worth considering. In addition, meal kits often require more packaging materials than traditional products from a grocery store (precisely because they are pre-portioned); so while food waste is reduced or eliminated, packaging waste might increase – which also needs to be taken into account.

Companies to highlight

HelloFresh: just-in-time orders and pre-packing

As stated above, HelloFresh's business model lends itself to substantially reducing food waste compared to traditional grocery retail. In fact, in its IPO prospectus, the company said that it has nearly eliminated waste from its supply chain by making just-in-time orders and pre-packing food into the right quantities. Packaging is an issue – but the company is actively working on reducing packaging (helpful both from an environmental and a cost perspective).

Questions for management

What happens to your food waste currently?

What measures are in place to reduce it?

How are you collaborating with suppliers and retailers to improve food waste?

How are your product innovations changing to utilise surplus food?

What kind of cost savings are you making – or could you make – by having less food waste compared to your peers?

Transport

European Transportation

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Within transport, we see little risk to the logistics companies from greater food waste awareness and instead see a slight opportunity for an incremental supply chain management service if legislation or food industry practices change.

Some 25% of Supply Chain Management (SCM) is outsourced to the third-party market; this proportion is higher in the food industry, notably across the large food retailers, where it typically exceeds 50%. The third-party logistics operators may be involved across the supply chain; from inbound sourcing both domestically and internationally, through the management of the core Regional Distribution Centres, to the store delivery and returns management. This is usually done under long-term (5-10-year) contracts and will be based on cost and capital employed, with variations built in for both volume and operational efficiency. We believe there is currently little involvement in food waste management, but see the potential for it to count as another component of SCM that would be costed and charged for.

DPDHL, Kuehne + Nagel and DSV already operate SCM across the breadth of the food industry and could expect to see further growth in their outsourced business models from a greater focus on food waste management.

Risks vs. opportunity

There is little risk to the logistics sector from a greater focus on food waste management, in our view; operating standards are already very high and externally monitored and inspected as a matter of public health. If legislation or food industry practice changes to require even higher or different standards and procedures for handling food waste, this would count as an incremental SCM service and be charged to the food industry appropriately.

Companies to highlight

DPDHL, Kuehne + Nagel, DSV: Growth opportunity through outsourcing

The SCM divisions of each of DPDHL, Kuehne + Nagel and DSV already operate across the breadth of the food industry and could expect to see further growth in their outsourced business models from a greater focus on food waste management.

The Credit View

Hapag-Lloyd: Remote Reefer Monitoring

According to our credit analyst, Maggie O'Neal, Hapag-Lloyd has invested in Remote Reefer Monitoring technology, which records data relevant to quality (temperature, humidity, fresh air supply, etc) to ensure minimal waste in transit. Cargo is monitored by reefer experts and engineers who receive alerts if the transport environment becomes sub-optimal. As some fruits (e.g. bananas) are very sensitive to even minor temperature shifts, being able to control the temperature can prevent food perishing en route. The controlled interior atmosphere also helps reduce spoilage and mould so the ripening of fruit and flowers can be delayed.

Questions for management

Are you currently involved in food waste management?

How would you respond to new legislation and higher standards?

Do you believe your customers would be willing to pay for such new services?

What operational challenges might greater food waste management bring?

APPENDIX 1 – EXPERT & START-UP INTERVIEWS

Interview: Forum for the Future – Geraldine Gilbert, Principal Sustainability Advisor, Food and Sustainable Nutrition

Forum for the Future is a charity that works in partnership with business and government to accelerate the shift towards a sustainable future.

What is the problem with food waste and what are some potential solutions? “This is a classic systemic problem in that there isn’t one thing that needs to be fixed and there isn’t one way of explaining it. There are many aspects that have led to the momentous amount of food waste in our system and therefore it requires a collaborative, joined-up effort to fix it. On the consumer end, while the food waste problem is partly due to a food system based on a false sense of abundance, people also have less time for cooking and some haven’t had adequate education around the subject. There are certainly cultural, social, economic factors at play. On the production end, in poor countries the problems come about from factors such as poor infrastructure and lack of training around food safety and hygiene. There is also a problem with farmer and retailer contracts – due to the power dynamic, retailers can often back out of contracts at short notice, and hence food that was destined for a particular retailer will go to waste if the farmer does not have the network to sell the produce elsewhere.”

What can businesses do? “Food waste is clearly bad for business and bad for reputation; if senior management can see it this way then it can enable investment in solutions for the problem. Tesco reports its food waste statistics – companies are almost competing in this space, wanting to be seen to be grappling the issue of food waste.

There are a lot of deeply embedded systems which contribute to food waste, such as food retailer dominance or selling continuously cheaper food to consumers. The businesses in the whole supply chain need to understand that food waste is a risk to everybody. We would advocate a collaborative and systemic approach – one food retailer is not going to fix the problem on its own. Either the retailers will need to get together to decide on a path of action or there can be collaboration along the supply chain. This could involve advocating for better regulation which would enable them to reduce the problem, or trialling technology and new systems along the supply chain to improve food waste.

For a brand or manufacturer it could be having a better procurement process that connects the data of what is being wasted in-store and the ordering system. There are collaborative approaches available in the same way that people are coming together around plastics, for example the Plastic Pact in the UK. It is not necessarily the case that the technology is missing; it is sometimes that the technology is not being deployed in the right way or is not supported with an appropriate regulatory framework. We believe standards and ratings can help; a good example is the EU bringing in energy efficiency ratings on white goods – that really helped to push more efficient goods because no one wanted an F-rated appliance.”

Is regulation needed? “Having regulation can certainly help the issue. The UN’s Sustainable Development Goals are also coming into play; lots of companies are aligning themselves with these goals and wanting to show their contributions.”

Are investors pressuring companies around food waste? “We track broad investor interest and we have seen more interest for ethical and ambitious companies. There is also academic research showing that companies with better longer-term strategies perform better in the long run. The factors are coming together but at the moment the issue is not yet mainstream enough. If investors were to put pressure on companies then this would likely help the issue.”

Are there any successful industry case studies? “I think Sainsbury’s Waste less, Save more campaign was really interesting. It was interesting because the project wasn’t owned by the sustainability team but instead was driven by marketing. This meant that the campaign was immediately about engaging customers with the issue, which was something no-one had done yet. Sainsbury trialled a variety of solutions such as giving out fridge thermometers, providing cooking classes on how to use up leftovers. They even created an app where you could input what was left over in your fridge and it would give you recipes to use up these ingredients. This app not only helped consumers reduce food waste in the home and save money but also gave Sainsbury some valuable data on the most wasted foods – which turned out to be bread, potatoes and milk. Tesco is also releasing its data on food waste, which is really good, because a lot of the time we don’t actually know the scale of the problem so it is encouraging that Tesco are willing to be the first to release their data.”

Interview: Apeel Sciences – Michelle Masek, Head of Marketing

How does Apeel's solution work? “We use food to preserve and protect food – our products are made from plant-derived materials that are found in every bite of fruits and vegetables that we already eat. When we apply this material to the surface of fresh harvested produce, it doubles or triples the shelf life of the produce without requiring refrigeration. We work with fresh food suppliers and the retailers, and our products are applied in the packing house or the distribution facility. For avocados, for example, we coat them with the Apeel product as they are coming down the conveyance system and then when it dries, the barrier of plant materials is left on the outside of the fruit. This barrier then slows down the rate of oxidation and dehydration of the fruit. By slowing down these two processes the fruit is staying healthy for much longer.”

How is Apeel helpful? “Apeel is a value-add as well as food waste prevention solution for every member of the fresh food supply chain. For a grower or a producer, they can optimise harvest practice when they have more time with the fruit – for example, they can leave it on the vine longer which means the fruit can develop more natural nutrition as well as colour. For distributors, the Apeel solution leads to significant cost savings as they can potentially shift modes of transportation, reduce energy use, and even expand to new markets. For the retailers, Apeel leads to a better experience for shoppers as Apeel produce maintains its freshness for much longer, which also means less good food goes to waste.”

What experience do you have with your existing retail partners? “Apeel is proven effective on dozens of types of fruits and vegetables, but we are focusing on three categories at the moment – avocados, citrus and asparagus. In the US, hundreds of stores in the Midwest are carrying Apeel Avocados. The focus on the Midwest initially is because this is the area in the US that has historically had quality issues around fruits and vegetables.

These programmes have shown the tremendous opportunity for value capture when you prevent waste rather than simply divert it. For example, Harps Food Stores have reduced their food waste in the Hass avocado category by over 50%. This shrink reduction then led to a 10% sales lift, after being normalised for any changes in inflation/deflation of the avocado market. This translated to a 65pp increase in margin on avocados. This is very important because the fresh department of the store is where the battle for differentiation is being fought, and produce shoppers tend to be the retailer's best customers.”

What aspect do venture capital firms like most about Apeel? “We have raised \$110mn to date and closed Series C funding of \$70mn in July 2018. We now have the capital we need to expand globally, to expand into the citrus and asparagus categories and we are also expanding our team. From VCs we hear a lot about double bottom-line investing, which means investing that is good for the bottom line as well as good for people and the planet. Apeel is a great opportunity because it satisfies both of these requirements. In the US alone, food waste at the retail level is reported to be an \$18bn loss. Both us at Apeel and investors are seeing this as a massive opportunity. What we are finding is that when you mitigate food loss at the shelf, you can see credible economic benefits that were not captured before. Investors are now seeing food waste as big business, not just as the responsible thing to do for the planet.”

Interview: Mimica – Solveiga Pakšaitė, Founder

What is Mimica's solution? “We aim to reduce food waste and improve safety with a tactile food expiry label to enable customers to monitor freshness by the texture of the label. Mimica's first product is a tactile label for milk bottles. In the milk industry, if you average out the waste in the UK it works out at a cost of 4p per bottle. The Mimica label costs around 1-1.25p per label, this is crucial for a company's ROI.”

What are some potential solutions? Does it require industry action, education and/or regulation? “The problem of food waste is not going to be solved through our solution alone. The specific area we are targeting is the general trend that people are getting further and further away from food – knowing what it should smell like, look like etc. This used to be part of common knowledge 50 years ago but less so now. We are trying to educate people about what conditions are going to keep food fresh for longer. We are filling a part of the education gap but there needs to be more information in schools. This knowledge gap about how much effort goes into production explains why people don't value food as much as they should.

Food is so abundant at the moment, that it becomes difficult to value it. But if you have an understanding about how many work hours, how much water and how much energy goes into producing each item of food then I think people wouldn't waste it as much. I think there is a big issue with people expecting to see abundance in a supermarket and these retailers want to provide this availability so that customers don't switch supermarkets. So I think both sides have built up this unrealistic expectation of abundance and we need to radically shift the way we think about food. Legislation can obviously help with this, with significant moves being made in France around reducing food waste already. But to make radical change we need to start changing our perspective on food and what it means.”

What can industry do about the issue? “New supermarkets like HISBE are really interesting. The name stands for How It Should Be and it's an ethical supermarket model that doesn't just tackle food waste but wider issues also. Mimica are working with HISBE at the moment which is very exciting. HISBE think about waste from a very holistic level – for example if HISBE are ordering in meat, they only order the meat from one or two cows rather than order 1.5 cows as this leaves the farmer with waste. Yes this makes the supply chain harder to manage but at scale this would become easier.”

What is the impact of extending shelf life? “Mimica's CEO Laurence Kayson conducted trials on shelf life extension technology at his previous company It's Fresh! They found that extending shelf life by two days can lead to a 50% cut in waste, which led to a 10% sales increase and a subsequent 17% increase in profits.”

What has the feedback been from Mimica's trials? “Consumers have said that the reassurance of having Mimica Touch on a product would encourage them to buy larger pack sizes, remain loyal to brands and even switch brands.”

What does the competitive landscape look like? “Mimica is the only tactile solution; the others are either using small electronic screens or using colour changing solutions. One of the colour changing labels is by a Scottish company called Insignia who make an open life label, that is on the inside of the film so that when you open it the oxidation would tell you how long it's been open.”

Do you partner with manufacturers only? Would you move into working with supermarkets? “We have found partnerships as the most mutually beneficial way to work. For example for milk we are actually building the label into the lid, so we are working with Coveris who make 80% of the caps in the UK. So when they produce a cap with our technology built in, they can then sell that cap to other dairy manufacturers. This opens us up to their customer channels. This is why it's helpful for us to work with packaging manufacturers in this way. We need to make sure we understand the benefits first with manufacturers before going to the supermarkets.”

What about Mimica's global expansion plans? “The UK is a sensible starting point as we are making the labels in Wales but as we expand we want to find local partners to work with to produce the labels. I can see ourselves moving into Nordic countries very soon as there is a huge appetite for sustainable interventions to reduce food waste. France is another interesting area for us due to their new laws on food waste. The US is another consideration because they have such a big problem with food waste. By product, dairy is where we are starting; it is a huge industry with a lot of waste within it and is a lower risk area. This is a good proof of concept target for us so that we can then move onto other products such as red meat, poultry, seafood, fish and eggs.”

Interview: OLIO – Tessa Clarke, Co-founder

OLIO is a free app tackling food waste through connecting neighbours and local shops so that surplus food can be shared rather than wasted. Launched in 2015, OLIO now has 900k users who have together shared over 1.25m portions of food. OLIO also boasts 30k volunteers who collect food from local retailers and redistribute within their local community.

What are the main factors causing food waste? “I think the dialogue globally around food waste has to date focused on the supply chain and the retailers. However, there has been very little coverage on the role that consumers play even though in developed countries such as the UK, US and countries in Western Europe, well over 50% of food waste occurs in the home. It is an extremely common misconception to believe that most food waste takes place at a retail store level. Using UK data as an example; there are around 15k supermarkets that are throwing away between 0.5%-1% of their food, but there are 27 million households throwing away around a quarter of their weekly shop. This is why households are responsible for over half of food waste in the UK, whereas retail stores, at a store-level, account for less than 5% of all food waste. But there is a perception problem because most people assume the majority of the problem lies with the retail stores.”

How does OLIO fit into the solution? “We are harnessing the power of digital technology to connect neighbours so that they can share their unwanted food. To use OLIO, you take a photo of the food, add it to the app and then neighbours nearby get an alert to say that a food item has been added. They can then browse what is available, request what they would like and then arrange pick-up via private messaging (which usually involves going to collect the products through a doorstep exchange). Around half of the food shared on OLIO comes from within a user’s house, whilst the other half comes from our volunteers going to pick up unsold food at a partner retailer and then uploading this onto the app.

We have partnered with the UK’s leading charitable food redistributor, FareShare, and they have said the charitable sector could absorb about 20-25% of the industry’s unsold food once fully scaled. The remaining 75-80% of the industry’s unsold food is where OLIO steps in to provide a community solution, preventing the food from going to landfill.”

Which retail partners do you work with and what has their feedback been? “Our largest partner at the moment is Pret a Manger, where we currently support around 100 of their stores. We are also working with Sainsbury, Morrison and Planet Organic and have been speaking to all of the major retailers in the UK, having run pilots with a number of them. In terms of feedback, Pret a Manger and our other partners have been thrilled with OLIO because it helps them fulfil their zero edible food waste commitments at a store level. They also tell us that it has improved staff retention and morale because store staff no longer have to throw away food. Additionally, at the moment, the cost of OLIO to our retail partners is comparable to the cost of paying a waste contractor to take the unsold food. As we continue to automate our systems, we will become even more cost-effective.”

Do you see scope for further education into the true value of food? “There is a big problem that, for many people, food has lost its value. If you look at the proportion of household disposable income that is spent on food, over time this has consistently declined, therefore we are valuing it less. There is also very little understanding of the incredibly long supply chain that our food is going through and hence the enormous carbon footprint that is being generated. Generally, people do not realise that the single biggest thing they can do to mitigate climate change is to not throw away food. This can be more impactful than transport or energy or many other things people would cite ahead of food waste.”

Is awareness around food waste growing? “Awareness around food waste is definitely gaining momentum, but it is not yet at the level of awareness around plastic waste. The UN’s Sustainable Development Goals will help and the Mayor of London actually adopted the UN’s goal of halving food waste by 2030 for the city of London in his 2018 environmental report. The USA has also adopted the UN’s SDG as a goal for their country. In the same way that child labour used to be endemic in the fashion industry but is now completely unacceptable, I believe the same is happening to food waste.”

Is there scope for regulation on industry? “I would start with a requirement to measure and publish food waste data, because what gets measured and shared gets addressed very quickly.”

What are OLIO’s next steps? “The events industry is a significant opportunity for OLIO, both large and small-scale including the catering companies. Other areas of opportunity include corporate canteens, hospitals, schools etc. We have already had food successfully shared in 49 countries and at the moment we are focusing on organically growing in the UK. After we have done our next capital raise we will then be focusing on international expansion.”

Interview: Tenzo – Adam Taylor, Co-founder

What is Tenzo? “Tenzo uses AI forecasting to optimize inventory and staffing levels for restaurants. It takes into account data on many aspects such as the weather, sports events, movie releases, promotions and traffic. The Tenzo system enables restaurants to optimize labour hours as well as reduce their food waste. Generally, restaurants have the greatest opportunity to optimize two areas, labour and food, and each of these account for about 25-30% of a restaurant’s cost line.”

Is awareness around food waste increasing in the restaurant space? “We do see a trend of people becoming increasingly aware of food waste. At the moment, this is driven mostly through cost pressure but consumer pressure cannot be ignored. I think both employees and consumers are becoming more socially conscious and the biggest thing a restaurant cares about is the number of people walking through the door.”

Which partners have you worked with and what has their feedback been? “Some of our partners include Nandos and Mitchell & Butlers. The feedback has been really positive and the restaurants have seen a sizeable reduction in wastage. Generally we are able to reduce errors in forecasting by around 30-50% and seeing as food waste can cost c1-3% of sales for some restaurants, the savings can be significant. Typically we can reduce food waste by around 0.5-1% of sales, which can represent a saving in the order of £10-20million. Reducing waste is especially important given that restaurants are such narrow-margin businesses.”

Can flexible menus help reduce food waste at the supplier level? “I think flexible menus are certainly a possibility and could become more of a reality in the future as the use of digital signage and menus increases. However, the problem at the moment is that a restaurant’s menu exists in so many places so it’s difficult to change them all at once – it’s online, on delivery platforms, social media and it’s physically printed.”

Are there other ways restaurants can improve supplier waste? “Some restaurants are also already working with suppliers to plan produce 18 months in advance. I also think existing contracts between suppliers and restaurants are probably more flexible than contracts with a retailer. There is also a trend for locally grown produce. To really minimize food waste, a vertically integrated supply chain is probably the best way to do this but it depends whether the decision-making is at the central or local level.”

Delivery platforms or excess food platforms like Too Good To Go? “I think some restaurants are not sure whether the economics of going on a delivery platform like Uber Eats or Deliveroo is going to work. The restaurants are acutely aware of the costs of going online and using these delivery platforms. However, a platform that means a restaurant can offer meals at a discount and consumers collect these meals may be more appealing.”

Interview: HISBE – Amy Anslow, Co-founder

What is HISBE? “HISBE is a supermarket run on a social enterprise model, with a pilot store in Brighton that has been open for five years. We work across 8 main areas of social impact, one of them being waste. Our goal is to hack the current supermarket model in the UK to make it fit and fair for the 21st century. We offer a fair deal for the people that make the food, have well paid staff, a transparent supply chain, an understanding of provenance and an environment that people want to shop in. We want supermarkets to serve their local communities, so for every £1 spent at HISBE, 50p stays within the local economy.”

How is HISBE working to tackle food waste? “Half of the food waste in the UK is wasted in the home so we at HISBE are trying to reduce this by offering consumers the amount they actually want to buy, for example single carrots rather than 1kg packs. We sell over 100 products loose, which helps reduce plastic packaging as well as reducing food waste. We think there is a lot of scope to change the usual supermarket practices, for example mainstream supermarkets over-order produce by as much as 50% to create the feeling of abundance in-store, with a lot of produce consequently being wasted. But we think this is completely unacceptable. We are very careful with our ordering rates, ordering more frequently to reduce wastage and have good relationships with suppliers. We also start reducing near-expiry products in-store quicker, both to reduce waste and so that lower income customers can buy the produce more cheaply. We also have a policy of refusing to throw away edible food – so we either reduce food further, give food to staff or it gets put outside the shop for people to take. We generally have very little left over, so don’t need to work with charity donation platforms.”

What are HISBE’s expansion plans? “We want to replicate our store in other local areas to ensure we keep close relationships with suppliers and grow their businesses along with ours. We want to create a hub of 10-15 stores around the same area that we are in now and then want to look at replicating the entire hub to a new supply chain area.”

What is the solution for food waste? “People need to be motivated to make different choices and it needs to be easy for consumer to make a change. There has to be a benefit to consumers, it needs to be easier, cheaper, more convenient etc - which is why we make our unpackaged products cheaper. Regulating people on how much they waste is difficult because it ignores why they are having to waste the food in the first place – the three-for-two offers, impulse purchases, large pack sizes, for example. Mainstream supermarkets are creating the need for consumers to buy more produce than they can actually use. Whereas, to really solve food waste, we need to help people buy less. This would require a supermarket to authentically care about the problem of food waste and not just about publishing their data to meet requirements.”

Do HISBE’s customers have different expectations around availability? “As people gravitate from being a top-up shopper at HISBE to shopping more frequently, we find that they become more flexible around what they want to buy, and hence cook accordingly. We find that we actually don’t have a lot of gaps in availability, particularly in our fruit and vegetables where we have a lot of choice. We are careful with our ordering and closely monitor our stock levels.”

APPENDIX 2 – UK/US SUPERMARKET SCORECARDS

FIGURE 39 Feedback's UK supermarket scorecard for action on food waste

	TESCO	ASDA	MORRISONS	SAINSBURY'S	ALDI	CO-OP	WAITROSE	LIDL	ICELAND	M & S
FOOD WASTE REDUCTION										
Targets and policy for food waste reduction										
Corporate policy	•	•	•	•	•	•	•	•	•	•
Sustainable Development Goal	•				•					
Courtald Commitment	•	•	•	•	•	•	•	•	•	•
Monitoring of food waste reduction										
Publicly available food waste data	•		•	•						•
Detailed break-down of food waste data publicly available	•			•						
Reducing food waste in supply chains										
Marketing seasonal produce	•				•			•		
Whole crop purchasing	•		•							
Guaranteed order for suppliers	•									
Improved forecasting	•	•		•			•	•	•	•
Acting on cosmetic specifications to reduce food waste										
Data on how much produce is rejected because of cosmetic specs										
Wonky veg line	•	•	•		•	•	•	•		
Using wonky produce in prepared, pre-cut foods or other product lines	•			•	•				•	•
Data showing whether relaxing cosmetic specs has significantly reduced food waste					•					
Publishing cosmetic specifications			•		•					
In-store and at home food waste reduction										
Removing special offers that promote over-purchasing* i.e. multi-buy offers										
Significantly altering store layout to reduce over-purchasing i.e. not over-stocking shelves										
Detailed analysis of customers' household waste										
Date labelling to facilitate food waste reduction in homes										
Removal of 'Best Before' dates on fresh produce	•	•						•		
Selling food past 'Best Before' Date						•				
Relaxing date labels: making them more realistic						•				
REDISTRIBUTION										
Policy on redistribution of food	•	•	•	•	•	•	•	•	•	•
Quantity of food redistributed (up to 3 points)	• • •	• • •	•	• •	•	•	•	•	•	•
Funding to redistribution organisations		•	•	•						
Data monitoring food donations as a proportion of total surplus	•			•						
ANIMAL FEED										
Support 'The Pig Idea'										
Programme for sending permissible food surplus to animal feed	•			•					•	
Data on food sent to animal feed	•			•						
DISPOSAL										
Only sending inedible food to AD										
Zero waste to landfill commitment	•	•	•	•	•	•	•	•	•	•
Data on food waste sent to AD	•			•						
TOTAL SCORE (OUT OF 32)	21	10	10	15	11	8	7	10	8	8
AS A %	66%	31%	31%	47%	34%	25%	22%	31%	25%	25%

Source: *The Food Waste Scorecard, Feedback 2018*. *Based on in-store investigations and supermarkets online offers.

FIGURE 40 The Centre for Biological Design's US supermarket scorecard for action on food waste

Summary Chart of Company Scores										
Company	Grade	Corporate Transparency	Company Commitments	Supply Chain Initiatives	Produce Initiatives	Shopping Support	Donation Programs	Animal Feeding Programs	Food Recycling Programs	Total Score
Walmart	B	4	3	7	4	5	6	2	1	32
Ahold Delhaize U.S.	C	11	5	3	1	1	2	2	1	26
Kroger	C	3	5	4	2	1	6	2	1	24
Albertsons Companies	C	4	3	3	2	4	3	2	1	22
Target Stores	D	4	2	3	1	1	5	0	1	17
Trader Joe's	D	2	0	2	4	2	5	0	1	16
Whole Foods Market	D	0	0	2	4	3	4	0	1	14
Costco U.S.	D	3	0	2	0	2	3	2	2	14
Publix	D	3	0	2	0	0	3	2	1	11
ALDI U.S.	F	2	0	2	0	0	3	0	0	7

Source: *Checked Out: How U.S. Supermarkets Fail to Make the Grade in Reducing Food Waste*, The Center for Biological Diversity 2018

ANALYST(S) CERTIFICATION(S):

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