Achieving Net Zero: A Handbook For The Food And Drink Sector
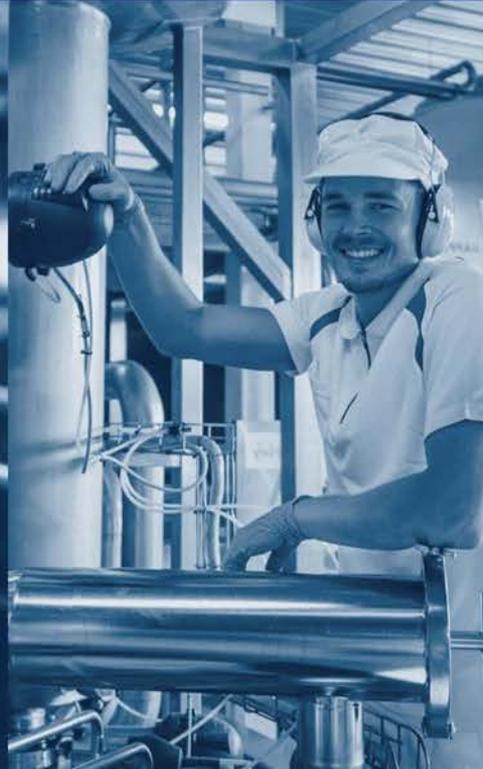
Practical guidance for food and drink manufacturers to achieve Net Zero emissions

food & drink federation

passionate about food & drink

FOREWORD

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Ian Wright
Chief Executive, Food and Drink Federation

"The publication of this excellent handbook for food and drink manufacturers is a significant moment in our journey to Net Zero. The handbook will be an important tool for food and drink manufacturers - and others across the supply chain - striving to achieve Net Zero by 2040. This work demonstrates the huge value of ever stronger collaboration with all stakeholders across the farm to fork supply chain. That is the only possible choice if we are to achieve our net zero ambitions. Created and published in the slipstream of COP26, the ideas and actions outlined here provide an indispensable blueprint for food and drink businesses to deliver their Net Zero ambitions."

Jon Woods
Vice President & General Manager at Coca-Cola Great Britain & Ireland, President of the Food and Drink Federation

"In April 2021, the FDF announced our Net Zero by 2040 Ambition for the UK's food and drink manufacturing sector.

Thanks to the collaboration with stakeholders across the supply chain, this handbook will equip our members with the blueprint to build on sector progress to date and deliver their Net Zero ambition.

I continue to be proud of the steps the industry is taking to enhance its efficiencies, and at Coca-Cola we're doing all we can to contribute to the huge milestones our sector is set to achieve by 2040."

Emma Piercy
Head of Climate Change & Energy Policy, Food and Drink Federation

"Food and Drink businesses have a huge role to play in both tackling the climate crisis and also in meeting the needs of population growth.

As we seek to build a sustainable and resilient food system with these challenges in mind, this handbook marks a key milestone. Companies are making great progress, but this needs to be accelerated both domestically and internationally: COP26 provides the perfect springboard for us and I look forward to working with all stakeholders, farm to fork and with Government to implement this handbook's recommendations."

EXECUTIVE SUMMARY

The UK food and drink sector has always adapted to changing conditions, most recently the upheavals from EU Exit and COVID-19. The next great challenge is responding to the causes and consequences of **climate change**, which is already having a negative impact on many aspects of our lives, including food production. Governments have agreed to limit warming to well below 2°C, preferably to 1.5°C. Achieving this goal requires global greenhouse gas emissions to fall to **Net Zero** as soon as possible, and by mid-century at the latest.

To reach Net Zero, the food and drink sector will require strong leadership and effective action by employees throughout the sector. There are many practical measures businesses can start implementing without delay, and this Handbook highlights key actions manufacturers can take in each part of the farm-to-fork supply chain.

Manufacturers are directly responsible for only a small proportion of food and drink sector emissions. But you have the power to start reducing **manufacturing** emissions straight away - for example, by improving energy efficiency and procuring renewable electricity. Ultimately you will achieve Net Zero manufacturing by decarbonising heat processes, sourcing 100% renewable electricity, and switching to sustainable refrigerants.

The largest source of the sector's emissions is the production of raw **ingredients**. The emissions associated with individual ingredients vary widely, but those with higher emissions tend to be animal products and imported ingredients linked to deforestation. This Handbook advocates measuring your ingredient emissions, procuring lower carbon ingredients and incorporating carbon targets into product reformulations.

To address emissions elsewhere in your value chain, such as **packaging** and **logistics**, this Handbook recommends engaging your suppliers to understand current emissions and working in partnership to reduce them. Your **customers** and **consumers** will also welcome low carbon approaches, as they are increasingly demanding lower impact products. Manufacturers can capitalise on these opportunities, and the advent of product labelling systems will be used to communicate carbon footprint performance.

Finally, **carbon offsets** can play a positive role in your Net Zero strategy but must be used with care. They must be certified high-quality offsets, and used only to compensate for emissions which are truly unavoidable.

INTRODUCTION

Chapter   Page

About this Handbook

This Handbook provides guidance for food and drink manufacturers seeking to play their role in achieving Net Zero emissions. It has been released alongside the Roadmap for Net Zero Overview which summarises the business case for climate action, and is aimed at wider stakeholders.

The Handbook has been designed to help all food and drink manufacturers, but particularly those at the early stages of developing their climate strategy.

The core of this handbook on value chain stages presents **practical actions** and information for each stage of the chain from farm to fork. Supporting information for each stage provides the context for action, and signposting to useful further resources available online.

- Chapter 2 covers the strategic framework for the actions.

- Chapters 3, 4, 6 & 7 cover upstream and downstream parts of your value chain with **3 key actions** for each area.

- Chapter 5 on manufacturing has a larger number of more detailed actions, as you are likely to have most control over emissions.

- Chapter 8 provides advice on how to use carbon offsets.

INTRODUCTION ACHIEVING NET ZERO 2040

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The ambition for Net Zero by 2040

In April 2021, the FDF announced our ambition for the food and drink sector to reach Net Zero emissions by 2040. To achieve this aim will require significant changes across the sector, to decarbonise rapidly while continuing to feed the nation a varied, healthy diet.
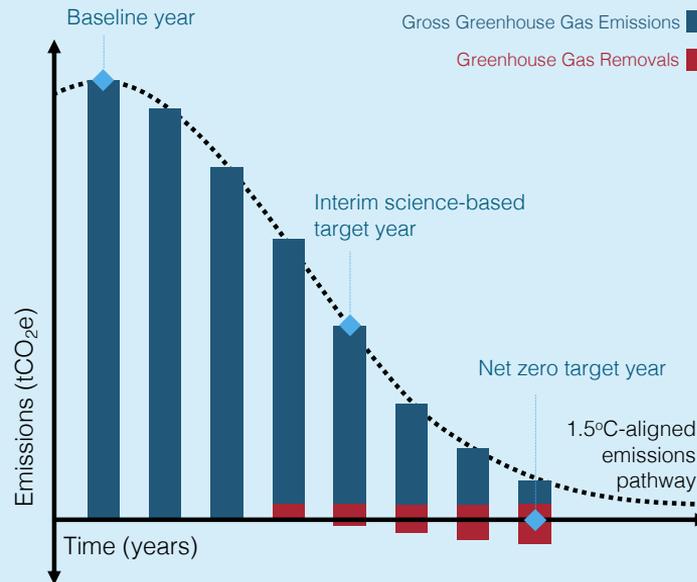
Why Net Zero?

We are already experiencing the effects of climate change and its impacts on food production, both in the UK and internationally. To avoid the worst consequences of climate change, greenhouse gas emissions must fall to Net Zero as quickly as possible.

The UK has a legislated target to achieve Net Zero by 2050, and the UK Government has set an ambitious emissions reduction target of 78% by 2035. Similar commitments have been made by the Scottish and Welsh governments, which have set Net Zero emissions targets of 2045 and 2050 respectively. Northern Ireland is also considering a target of Net Zero, by 2045.

Companies are also making Net Zero commitments, often through public international initiatives such as the Science Based Targets initiative, Race to Zero and The Climate Pledge. Many manufacturers and retailers of food and drink have signed up to these targets, with businesses of all sizes committing to Net Zero by 2050 through the UK Business Climate Hub.

All companies need to respond to the shift to Net Zero, and the food system will need to adapt to climate change to ensure the resilient provision of healthy and affordable food. Climate strategy is becoming core business strategy, and this presents opportunities - to cut costs, raise productivity, improve supply chain resilience, innovate new products, attract investors and gain a market edge. The actions in this Handbook will help food and drink manufacturers to embark on reducing emissions, and realising these opportunities.

WHAT IS NET ZERO?

Baseline year

Gross Greenhouse Gas Emissions ■
Greenhouse Gas Removals ■

Interim science-based target year

Net zero target year

1.5°C-aligned emissions pathway

Emissions (tCO$_2$e)

Time (years)

Reduce emissions - As first priority, mitigate emissions as far as technically possible at a pace consistent with a 1.5C target

Remove carbon - Net Zero is achieved when all residual emissions are neutralised with robust and permanent carbon removal & storage

INTRODUCTION GREENHOUSE GASES

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Carbon footprint measurements *can be* complex and involved, but needn't be. The central concepts are:

Kilograms of carbon dioxide equivalent = kgCO$_2$e - standard unit for measuring carbon footprints. Can also be in grams (gCO$_2$e) or tonnes (tCO$_2$e).
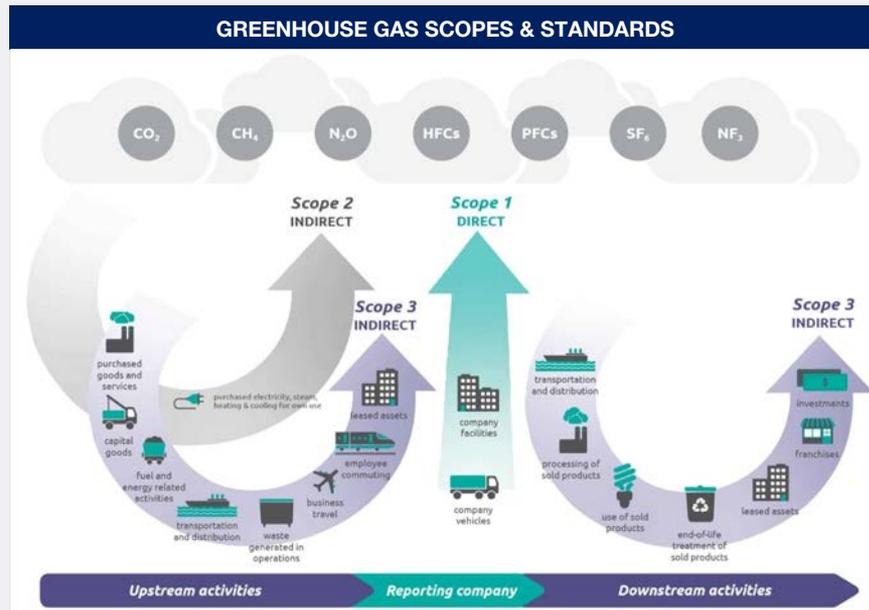
Carbon intensity - the carbon footprint per unit. E.g. 2 tonnes CO$_2$e per tonne of finished goods.

Emissions factors - used to convert business activities into carbon footprint values - see table below. Emissions factors for most activities and inputs are available from a range of public and licensed databases.

Example input	Emissions factor (kgCO$_2$e)	Details
1 kWh UK grid electricity	0.23	Determined by power generation mix
1 km by 100% laden HGV	1.00	Average calculation of diesel burnt per kilometre
1 kg virgin plastic film	2.57	Includes oil extraction, distillation & processing
1 kg potatoes	<0.50	Includes fertiliser production, soil emissions, machinery fuel, wastes

Key Greenhouse Gas Accounting Standards include:

- GHG Protocol Corporate Standard - the most common standard for corporate reporting of Scope 1 & 2 emissions
- Corporate Value Chain (Scope 3) Standard - the only internationally accepted method for corporate reporting of Scope 3 emissions.

GREENHOUSE GAS SCOPES & STANDARDS

CO$_2$ CH$_4$ N$_2$O   HFCs   PFCs   SF$_6$ NF$_3$

Scope 2 INDIRECT   Scope 1 DIRECT   Scope 3 INDIRECT   Scope 3 INDIRECT

Upstream activities   Reporting company   Downstream activities

Carbon footprints are categorised into three emissions 'scopes':

- **Scope 1** - burning of fuels and refrigerant losses from your sites/assets.
- **Scope 2** - electricity supplied to and used at all sites.
- **Scope 3** - 'everything else' - upstream activities such as supply of ingredients or packaging, and downstream activities such as consumer use. For food and drink manufacturers, Scope 3 emissions will typically be more than 85% of your footprint.
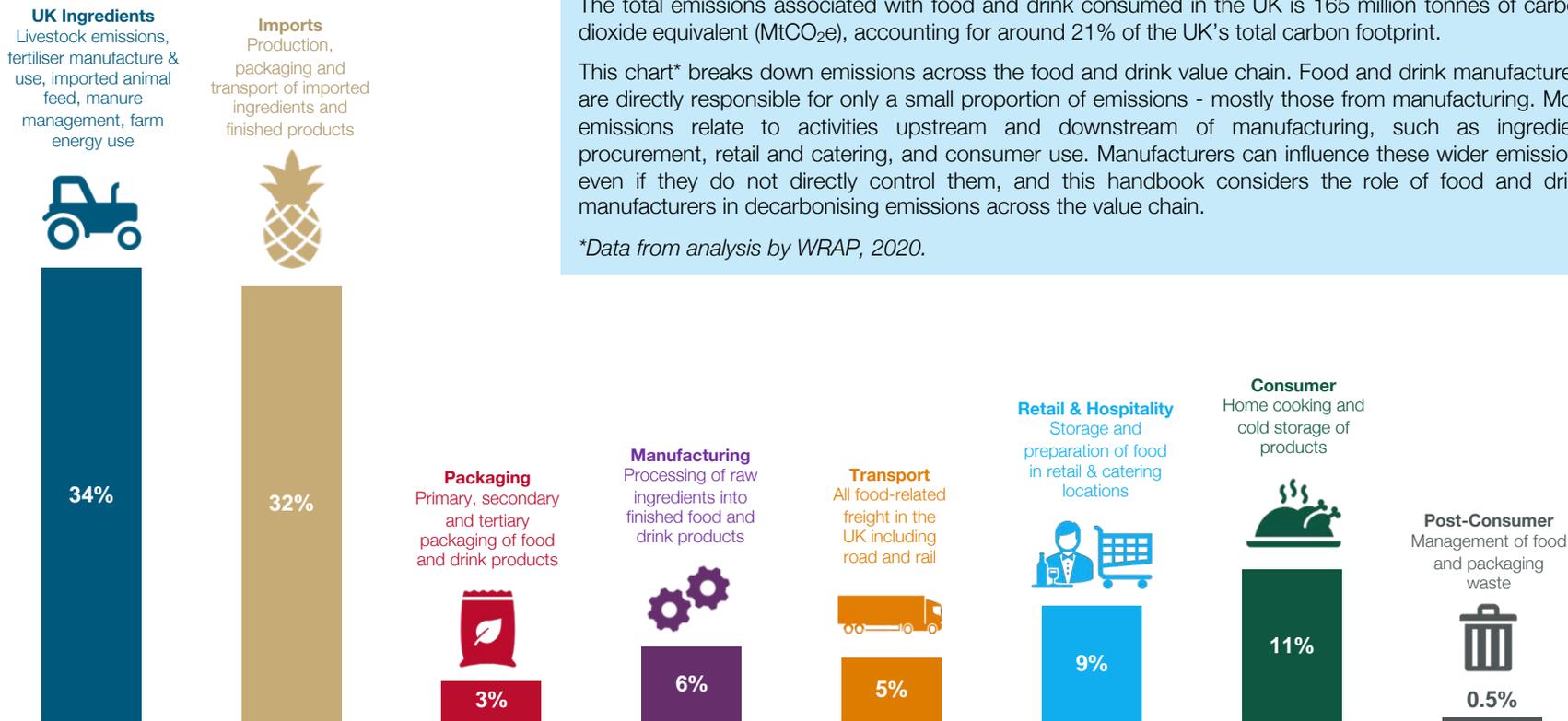
INTRODUCTION SECTOR EMISSIONS

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SECTOR TOTAL IN 2019 = 165 MILLION TONNES CO_2e*

The total emissions associated with food and drink consumed in the UK is 165 million tonnes of carbon dioxide equivalent ($MtCO_2e$), accounting for around 21% of the UK's total carbon footprint.
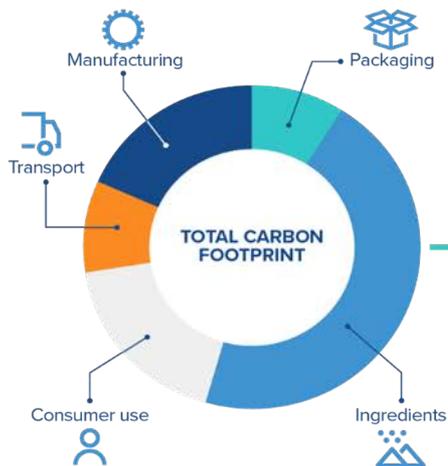
This chart* breaks down emissions across the food and drink value chain. Food and drink manufacturers are directly responsible for only a small proportion of emissions - mostly those from manufacturing. Most emissions relate to activities upstream and downstream of manufacturing, such as ingredient procurement, retail and catering, and consumer use. Manufacturers can influence these wider emissions even if they do not directly control them, and this handbook considers the role of food and drink manufacturers in decarbonising emissions across the value chain.

*Data from analysis by WRAP, 2020.

% of UK Food & Drink Emissions

UK Ingredients
Livestock emissions, fertiliser manufacture & use, imported animal feed, manure management, farm energy use

34%

Imports
Production, packaging and transport of imported ingredients and finished products

32%

Packaging
Primary, secondary and tertiary packaging of food and drink products

3%

Manufacturing
Processing of raw ingredients into finished food and drink products

6%

Transport
All food-related freight in the UK including road and rail

5%

Retail & Hospitality
Storage and preparation of food in retail & catering locations

9%

Consumer
Home cooking and cold storage of products

11%

Post-Consumer
Management of food and packaging waste

0.5%

Carbon Footprint Measurement

TOTAL CARBON FOOTPRINT

Manufacturing · Packaging · Transport · Consumer use · Ingredients

Gather activity data such as energy use and procurement volumes. Combine with emissions factors to calculate carbon footprint results.

Actions

- **Understand baseline** sources of emissions

- **Carbon hotspot identification** to focus efforts on tackling emissions

- **Target setting** to lower emissions, including use of frameworks such as science-based targets

- **Decarbonisation planning** to reduce emissions and meet targets

- **Verification of data** to support external reporting

Outcomes

Internal KPIs

Investor enquiries

Sustainability and annual report

Customer engagement

Marketing materials

Note - Carbon footprinting methodologies are open to interpretation, making it hard to compare footprints between companies or products. Industry stakeholders are working on a common set of data sources and consistent methodology for measuring and verifying emissions of food and drink products. This is essential for on-pack carbon labelling.

PLANNING FOR NET ZERO STRATEGIC FRAMEWORK

The actions to achieve Net Zero presented in this Handbook should be implemented within the context of an overarching strategic framework.

The IGD's Building your Net Zero Roadmap sets out such a framework. It is a free guide to help food and drink businesses with carbon reduction.

The IGD guide provides a useful starting point for developing a Net Zero strategy. It outlines five key areas where businesses of all sizes can act to accelerate progress towards Net Zero.

Building your Net Zero roadmap

A guide for industry leaders and decision makers

July 2021

from IGD
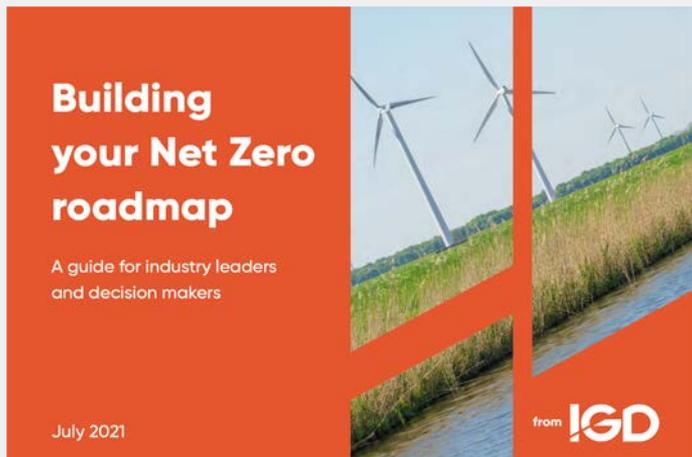
Measure

Scoping and measuring your carbon footprint

Target

Setting a Net Zero target and developing a roadmap

Implement

Developing deep carbon reductions across your operations and value chain
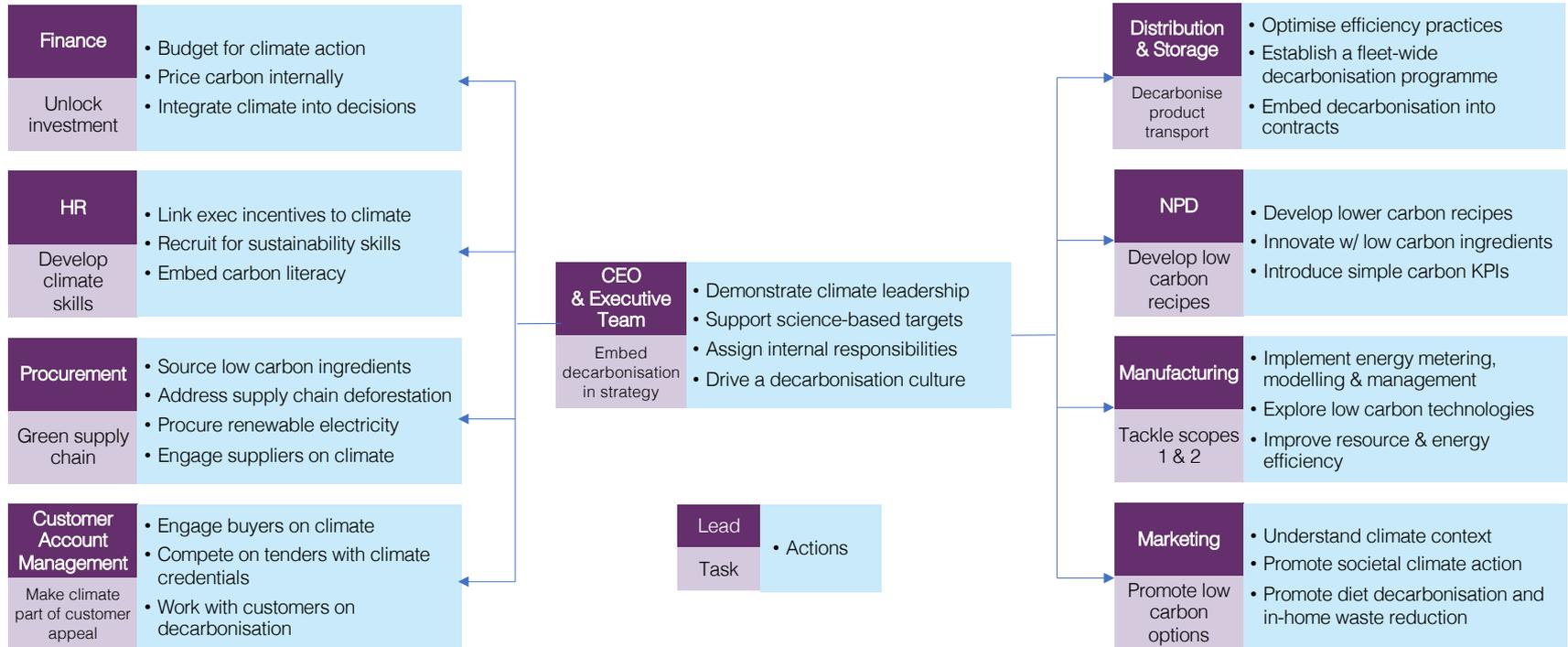
Finance

Financing your climate actions

Communicate and advocate

Reporting and disclosure, communicating progress, advocating for change

This Handbook provides details on how to **Implement** decarbonisation actions.

Five key areas in IGD's Building your Net Zero Roadmap

PLANNING FOR NET ZERO INTERNAL ACCOUNTABILITIES

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Achieving Net Zero requires commitments and contributions from across the organisation. The requirements for Net Zero are often viewed as "technical challenges", but to be successful, transformation must take place throughout the business and be supported by all staff and employees. This change must be led from the top, and become embedded across the whole organisation - clear internal accountabilities are essential. The chart below shows different functions common to many manufacturers. For each role, the primary task and supporting actions are presented, indicating the importance of colleagues across your organisation.

Finance
Unlock investment
- Budget for climate action
- Price carbon internally
- Integrate climate into decisions

HR
Develop climate skills
- Link exec incentives to climate
- Recruit for sustainability skills
- Embed carbon literacy

Procurement
Green supply chain
- Source low carbon ingredients
- Address supply chain deforestation
- Procure renewable electricity
- Engage suppliers on climate

Customer Account Management
Make climate part of customer appeal
- Engage buyers on climate
- Compete on tenders with climate credentials
- Work with customers on decarbonisation

CEO & Executive Team
Embed decarbonisation in strategy
- Demonstrate climate leadership
- Support science-based targets
- Assign internal responsibilities
- Drive a decarbonisation culture

Lead
Task
- Actions

Distribution & Storage
Decarbonise product transport
- Optimise efficiency practices
- Establish a fleet-wide decarbonisation programme
- Embed decarbonisation into contracts

NPD
Develop low carbon recipes
- Develop lower carbon recipes
- Innovate w/ low carbon ingredients
- Introduce simple carbon KPIs

Manufacturing
Tackle scopes 1 & 2
- Implement energy metering, modelling & management
- Explore low carbon technologies
- Improve resource & energy efficiency

Marketing
Promote low carbon options
- Understand climate context
- Promote societal climate action
- Promote diet decarbonisation and in-home waste reduction

PLANNING FOR NET ZERO OVERVIEW OF ACTIONS

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Achieving Net Zero requires action at every stage of the value chain. These actions should be implemented within the context of an overarching strategic framework for Net Zero.

Ingredients & imports*

1) Understand your ingredient emissions

2) Procure lower carbon ingredients

3) Reformulate products to reduce emissions

Packaging

4) Assign internal responsibility for packaging emissions

5) Set company policy on packaging sustainability

6) Engage packaging suppliers to find low carbon options

Manufacturing

7) Improve energy efficiency

8) Decarbonise electricity

9) Decarbonise process heat

10) Shift to sustainable refrigerants

Distribution & Storage

11) Embed climate performance into logistics services

12) Shift to electric vehicles for light goods vehicles

13) Optimise your HGVs

Customers & Consumers

14) Understand customer expectations on climate

15) Capitalise on growing demand for lower carbon products

16) Engage consumers on climate issues and waste reduction

Share of food sector emissions	66%	3%	6%	5%	20%

*This category includes emissions related to production of UK ingredients (agricultural emissions), as well as emissions embedded in imported ingredients, animal feed and finished goods (production, packaging and transport to the UK).

Ingredients

Section contents

UK Agriculture = 34% of food sector emissions

Imports = 32% of food sector emissions

Ingredients: A key focus area for emissions reduction

- Ingredients and imports are the largest (66%) source of emissions in the UK food and drink sector.

- Measurement of emissions from ingredients includes agricultural inputs such as fertiliser and feed for livestock, as well as energy for processing.

- The sources of greenhouse gases from agricultural production are increasingly well understood. There is a range of farming techniques that can minimise emissions from different production systems.

- One key source of emissions is deforestation and other changes in land use. These must be identified and tackled as a priority.

AGRICULTURAL GHG EMISSIONS SOURCES AND SINKS (NFU)

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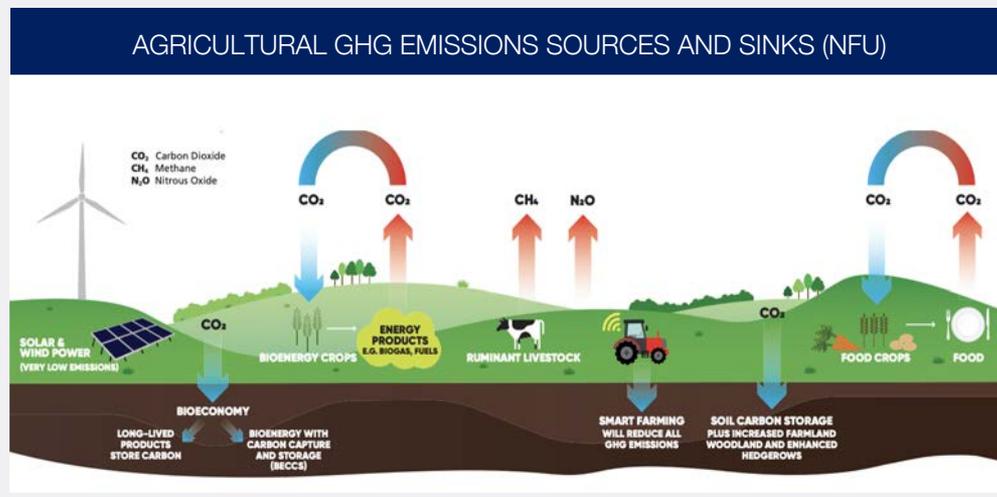
1 **Understand your ingredient emissions.**
Ingredients are likely 50 to 75% of your total corporate emissions. The first action is to understand the carbon footprint of your products, and where high impacts reside.

2 **Procure lower carbon ingredients from your producers and other suppliers.**
Ingredient emissions are determined by your upstream suppliers. Suppliers should be engaged, and over time procurement requirements introduced for climate performance.

3 **Incorporate carbon targets into product reformulations and new product development.**
Current product formulations may need to be updated or reformulated, to reduce high emission ingredients in line with requirements for Net Zero.

Ingredients comprise almost 66% of emissions from the UK food and drink sector, comprising 34% from ingredients produced in the UK and 32% from overseas.

The figure, right, shows how UK agricultural emissions come from a number of different sources. Given the complexity of emissions from agricultural production, a range of actions are necessary for decarbonisation (see page 17).

However, it will not be possible to reduce agricultural emissions to absolute zero by 2040 because some emissions will remain, principally those from ruminants, fertiliser, and emissions from soil.

One route to achieving Net Zero is by releasing land and then using it for afforestation; peatland restoration; energy crops and other land use measures. According to Climate Change Committee forecasts, around 9% of the UK's agricultural land needs to be made available for carbon removals by 2035, with 21% needed by 2050. (See Chapter 8 - Carbon Offsets.)

EMISSIONS FROM UK AGRICULTURE in 2019 (analysis by WRAP, 2020)

Total Emissions
55.6
$MtCO_2e$ / year

- Enteric fermentation 34%
- Direct soil emission 16%
- Animal feed 12%
- Animal wastes 11%
- Land use change 10%
- Fuel combustion 7%
- Other 10%
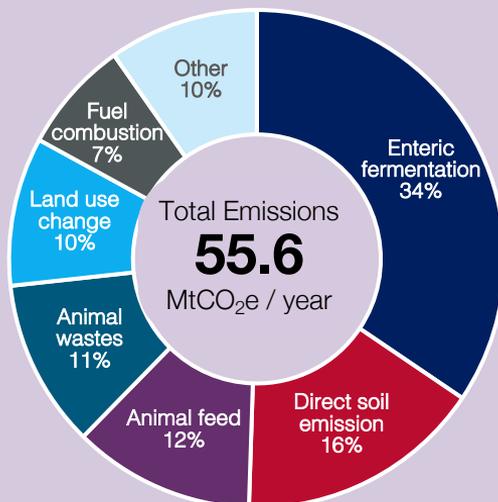
- **Enteric fermentation** – methane emitted from digestive processes of ruminants, such as cattle and sheep
- **Direct soil emission** – includes nitrogen (from fertilisers) not absorbed by crops, and released to air as nitrous oxide
- **Animal feed** – emissions related to production and transport of imported and UK-grown animal feedstocks
- **Animal wastes** – methane emitted from manure
- **Land use and land use change** – soil erosion; peatland degradation and extraction.
- **Fuel combustion** – fossil fuels used to run vehicles and machinery on farms
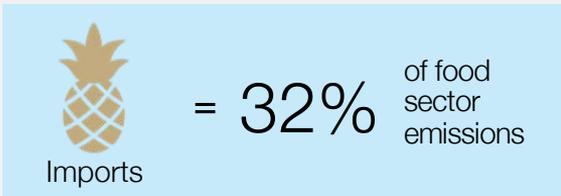- **Other** – liming, urea application, indirect nitrous oxide emissions, fertiliser manufacturing

INGREDIENTS OVERSEAS EMISSIONS

45% of the UK's food and drink ingredients are imported, by value.

Emissions profiles of imported food are largely similar to emissions from UK ingredients (page 14). Deforestation may be a major additional factor for some commodities, particularly soy*, palm oil, coffee, tea, cocoa and meat (page 19).

Transport emissions are of lower significance than commonly assumed, unless goods are air freighted. Air freight is generally reserved for certain higher value goods such as shellfish and some fresh produce. The very high emissions per tonne for air freighted goods should be avoided where possible to do so.

While many of the emissions reduction actions for ingredients are similar for imports and for home-grown produce, the longer supply chains for imported materials often make it more difficult to trace origins and influence change.

= **32%** of food sector emissions

Imports

Total GHG emissions from food and drink net imports

53.3 MtCO$_2$e / year

EMISSIONS FROM OVERSEAS PRODUCTS* (BY TYPE)

Beverages, 3%
Fish and seafood, 3%
Sugar and confectionary, 3%
Miscellaneous, 5%
Cereals, 6%
Dairy and eggs, 7%
Fruit and vegetables 11%
Oils and Oil Seeds 15%
Coffee, tea, cocoa, spices 16%
Meat 31%

Our food system relies on farmers. The supply of high quality, responsibly produced agricultural produce is a key feature of the success of the UK food industry.

The carbon cycle and other greenhouse gas emissions from agricultural activities are complex. Optimal growing techniques to reduce emissions vary by crop and location. Some farms achieve lower carbon outputs by achieving very high yields, while others use low inputs. In all circumstance, recognising the whole farm system - including crop rotations and outputs across multiple years - should underpin sustainable farming practices.

On-farm management practices and new innovations present opportunities to lower emissions from both livestock and arable systems. Nevertheless, projections for future emissions indicate farming as a 'hard to abate' sector, because eliminating emissions from natural systems is so challenging. But because farmers manage large swathes of land, there are opportunities to achieve Net Zero agriculture through sequestration in soils, hedgerow and trees, known as 'carbon removals' or sequestration.

In the future, on-farm carbon removals are likely to become a valuable asset, with farmers and their supply chain customers looking to neutralise emissions through carbon sequestration. These opportunities, and holistic thinking around 'regenerative agriculture' place responsible agricultural practices the core of achieving Net Zero.

EXAMPLE LOW-CARBON FARMING PRACTICES	
Emissions source	**Selected emissions reduction measures**
Livestock	Improving livestock health and productivity Low-impact and deforestation- and conversion-free feed mixes Low-methane diets and feed additives for ruminants
Manure & wastes	Slurry acidification Anaerobic digestion
Soils & fertiliser	Nitrogen use efficiency (NUE) and controlled-release fertilisers Low-till and no-till farming Cover crops & grass leys
Electricity	Onsite renewables such as solar and wind turbines can provide zero carbon electricity supply

ON-FARM CARBON REMOVAL OPPORTUNITIES	
Emissions sink	**Removal mechanisms**
Trees	Planting trees, focussing on broadleaf woodland
Agricultural soils	Accumulation and retention of soil organic matter, particularly for enhancement of degraded soils
Peatland	Restoration of upland peat and rewetting of lowland peat
Energy crops	Planting perennial energy crops alongside short rotation forestry
Other land measures	Integration of trees on farmland; extending the length and width of hedgerows; better woodland and hedge management

On-farm GHG calculators are being used more widely by farmers to measure and report production emissions to their customers.

Cool Farm Tool

Farm Carbon Toolkit

INGREDIENTS SOURCING LOWER CARBON

Ingredients have variable carbon intensities.

Researchers have determined the relative carbon intensity of different ingredients, known as 'full lifecycle' emission measurements. These take account of farm inputs, soil emissions, fuel for machinery, transportation, and so on. There is some debate over precise carbon footprint values for some ingredients, but there is recognition that ingredients with higher emissions tend to be animal products, particularly beef and lamb, as well as imported ingredients linked to deforestation. There are two key opportunities for sourcing lower carbon:

1) Reducing emissions intensity of key ingredients

Individual ingredients can have different emissions intensities, depending on how they are produced (figure, right). For example, UK beef generally has lower emissions than beef sourced from Latin America; the carbon footprint of chocolate can increase several-fold if its cultivation is linked to deforestation. Manufacturers should identify high ingredient emissions in their supply chain, and investigate production methods and seek product-level carbon data from suppliers.

2) Switching to lower carbon ingredients

Another route to reducing emissions from ingredients is through ingredient substitutions and new product development. One of the clearest trends in the food sector has been the rise of plant-based foods - since 2016, sales have risen by 40%, and by 100% for plant-based milks.

Demand for low carbon products is rising, and the trend for plant-based alternatives presents an opportunity for growth for food manufacturers.

CARBON INTENSITY OF DIFFERENT FOOD TYPES (SOURCE: POORE & NEMECEK)
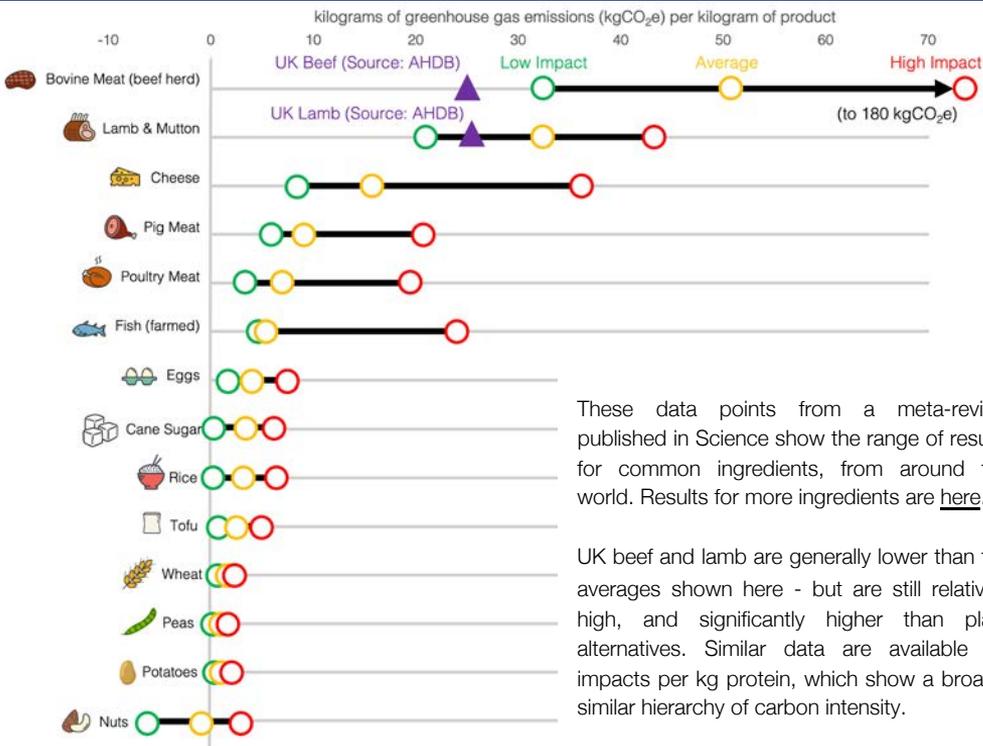
These data points from a meta-review published in Science show the range of results for common ingredients, from around the world. Results for more ingredients are here.

UK beef and lamb are generally lower than the averages shown here - but are still relatively high, and significantly higher than plant alternatives. Similar data are available for impacts per kg protein, which show a broadly similar hierarchy of carbon intensity.

ACTION: Incorporate carbon targets to product reformulations and NPD
Designing lower carbon products needn't be complex and onerous. Identifying high carbon ingredients to reduce or setting plant-based sales targets will lead to emissions reductions across the product range.

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Some foods imported into the UK contribute to deforestation and conversion of natural ecosystems in producer countries. Healthy forests are essential for moderating climate change, but forest destruction produces greenhouse gas emissions which exacerbates the climate problem in a negative feedback loop.

Soy, palm oil, cocoa and beef cause most tropical deforestation. Emissions associated with land use change for the production of these commodities are roughly equivalent to 8% of the UK's total overseas carbon footprint. Other food and drink imports sometimes associated with deforestation include maize, coffee, tea, and soy-fed chicken.

Best practice guidance:

- Set policies and commitments with a cut off date for acceptable land conversion, and report publicly on progress

- Engage with suppliers and support implementation of policies and commitments across entire supply chain

- Implement policies and operational systems consistent with the Accountability Framework Initiative

- Implement an effective monitoring, reporting and verification system to ensure compliance with your policies

- Use certified products that reduce the risk of deforestation

SOY - Three-quarters of UK soy imports are either fed to livestock (59%) or embedded in imported meat, eggs and dairy from animals raised on soy (18%). Over 65% of these imports come from places where soy production is linked to deforestation, such as Brazil and Paraguay.

PALM OIL - UK demand contributes 5% of the global palm oil land footprint. Most UK imports of palm oil are used for food or animal feed, and come from countries where forest is cleared for production, such as Indonesia and Malaysia.

COCOA - UK demand contributes 9% of the global cocoa land footprint. Almost 80% of the UK's cocoa is produced in West African countries, such as Ivory Coast, Ghana and Nigeria, with a high risk of deforestation.

BEEF - Most beef consumed in the UK is produced domestically or in the EU and is not linked to recent deforestation. However, about 8% of imported beef comes from places where forest is still cleared for cattle, such as Australia and Brazil.
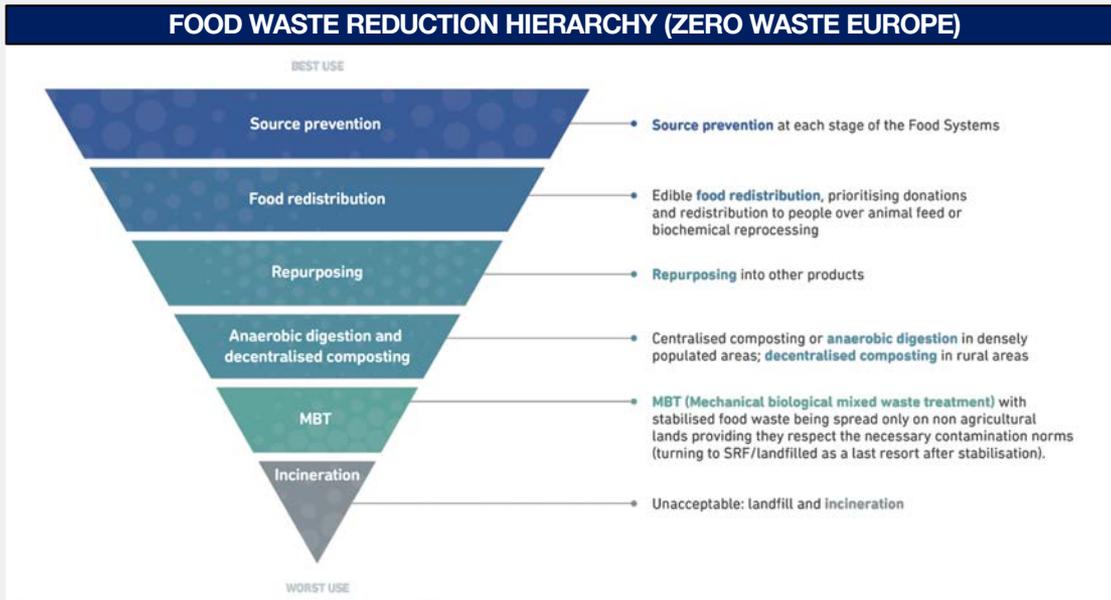
INITIATIVES RELEVANT TO UK FOOD MANUFACTURERS

There are a number of initiatives working to eliminate deforestation from the production of high-risk commodities and improve supply-chain transparency:

- UK Roundtable on Sustainable Soya
- UK Sustainable Soya Initiative
- UK Sustainable Palm Oil Initiative
- UK Roundtable on Sustainable Palm Oil
- Palm Oil Transparency Coalition
- Soy Transparency Coalition
- Cocoa and Forests Initiative
- Forest Positive Coalition

Around 9.5m tonnes of food is lost or wasted across the UK food supply chain each year, with 1.5m tonnes of this wasted in manufacturing. Guidance on preventing food waste tends to follow three key principles:

- **Measurement** - food waste is often not measured onsite. This can be addressed by installing waste containers and measurement systems, process and equipment auditing, and regular inspection and review.

- **Implementation** - once measured and identified, reductions should be implemented through elimination of unnecessary processes, improving inputs, processes, and machinery, staff training, minimisation of transfer losses, and even product redesign, if necessary.

- **Diversion** - when a surplus of food is produced, it is important that it is used efficiently to ensure that it is not wasted. As shown in the waste reduction hierarchy to the right, food can be redistributed to people, or if not possible, used for animal feed or processed into fuels or chemicals (see UK Food Waste Reduction Roadmap).

FOOD WASTE REDUCTION HIERARCHY (ZERO WASTE EUROPE)

BEST USE

Source prevention — Source prevention at each stage of the Food Systems

Food redistribution — Edible food redistribution, prioritising donations and redistribution to people over animal feed or biochemical reprocessing

Repurposing — Repurposing into other products

Anaerobic digestion and decentralised composting — Centralised composting or anaerobic digestion in densely populated areas; decentralised composting in rural areas

MBT — MBT (Mechanical biological mixed waste treatment) with stabilised food waste being spread only on non agricultural lands providing they respect the necessary contamination norms (turning to SRF/landfilled as a last resort after stabilisation).

Incineration — Unacceptable: landfill and incineration

WORST USE

FOOD WASTE INITIATIVES

- UN's Sustainable Development Goal 12.3 - calls for halving global food waste at the retail and consumer level, and reducing food losses along production and supply chains by 2030.
- Champions 12.3 - a coalition of governments, businesses and others dedicated to achieving SDG 12.3.
- Courtauld 2030 - voluntary agreement from WRAP enabling collaborative action across the UK food chain to deliver farm-to-fork reductions in food waste, greenhouse gas emissions and water stress.
- Food Waste Reduction Roadmap - commitments by UK retailers, food producers, manufacturers, and hospitality and food service companies to reduce food waste in their own operations and work collaboratively on whole chain food waste reduction plan projects to tackle food surplus and waste.

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WORKING WITH FARMERS	Nomad Foods has partnered with WWF to find agricultural solutions to the "triple challenge" of feeding a growing population, tackling climate change and reversing biodiversity loss.
	Kellogg's Origins programme invests in sustainable agriculture projects in partnership with farmers and suppliers to improve farm productivity, regenerate soil health, protect species and habitats and reduce greenhouse gas emissions.
	Nestlé is working with farmers and suppliers to improve soil health, enhance biodiversity and limit greenhouse gas emissions. This will contribute to delivery of Nestlé's Net Zero Roadmap, and includes avoiding deforestation, conserving habitats and planting millions of trees.
	PepsiCo works with farmers in 60 countries to reduce emissions through its Positive Agriculture strategy. The company aims to spread regenerative farming practices across 7 million acres, saving at least 3 million tonnes of emissions by 2030.
	McCain Foods is implementing regenerative agricultural practices across 100% of its potato acres worldwide by 2030, and has committed to reducing emissions related to potato farming, storage and freight by 25% by 2030.
	Jordans cereals are all LEAF-Marque certified, ensuring their oats are grown to high sustainability standards.
FOOD WASTE	Pladis, the snack foods producer, cut internal waste by 13,000 tonnes, saving £5.5 million as well as over 3,000 tonnes of emissions.
	Paterson Arran, a producer of shortbread, biscuits and oatcakes, has reduced its waste by 59% despite increasing production by 87%. Most remaining waste is either recycled as animal feed or used to generate electricity.
	Warburtons partnered with Toast Ale to brew beer with wonky crumpets.
	WRAP has many additional case studies of food and drink producers and manufacturers implementing a 'Target, Measure, Act' approach to reducing food waste.
ALTERNATIVE PROTEINS	Heck, the sausage maker, has entered the plant-based meat market with a range of vegan sausages and meatballs.
	Unilever's Future Foods plan sets an annual €1 billion sales target for plant-based meat and dairy alternatives.
	Nestlé has assigned 10% of R&D employees to work on developing plant-based products such as alternative tuna.
	Tyson, one of world's largest meat companies, has launched Raised & Rooted, a brand of 'blended' food containing meat and plant ingredients.
DEFORESTATION	Ginsters uses only 'segregated certified' palm oil that can be traced to the plantation, and demands all other makers of pastry products commit to this.

FOOD & AGRICULTURE SECTOR

- NFU has set a goal of Net Zero emissions across the whole of agriculture in England and Wales by 2040.
- WRAP Courtauld Commitment - through Courtauld 2025 UK food sector participants committed to reducing the sector's emissions by 20%. Courtauld 2030 has raised this ambition to a 50% absolute reduction in emissions associated with food & drink consumed in the UK by 2030 (against a 2015 baseline).

GOVERNMENT POLICY & INITIATIVES

- UK's 25 Year Environment Plan - commits the government to taking "all possible action" to cut emissions from land use and agriculture. In support of this, the government will introduce three Environmental Land Management schemes to reward farmers for managing land sustainably and supporting nature recovery: Sustainable Farming Incentive scheme; Local Nature Recovery scheme and Landscape Recovery scheme.
- The government will issue a Food Strategy White Paper for England early in 2022 informed by the National Food Strategy.
- Governments are considering mandatory reporting of food waste by food businesses in England, Wales and Scotland.
- The Scottish Government will introduce a Good Food Nation Bill to ensure a healthy, sustainable food system.

DEFORESTATION

- The UK government will introduce a new law through the Environment Bill to prevent illegal deforestation in the supply chains of large UK businesses. This law is in response the Global Resource Initiative.
- UK Global Resource Initiative - issued its Final Recommendations Report recommending government action to reduce the UK's global commodity supply chain footprint on land, natural resources & ecosystems.
- The UK, by signing the Amsterdam Declaration, has committed to eliminating deforestation from agricultural commodities by 2025.

INGREDIENTS FURTHER INFORMATION

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Low-carbon farming

- NFU Doing our bit for Net Zero - real examples of net zero action on farms
- SAI Platform - network of food industry participants supporting the development of sustainable agriculture worldwide
- World Resources Institute, Creating a Sustainable Food Future: A Menu of Solutions to Feed Nearly 10 Billion People by 2050

Lower-carbon ingredients & dietary change

- WWF & Knorr, Future 50 Foods
- Good Food Institute, Plant-Based Meat Manufacturing Guide
- IGD, Appetite for Change - summary of 2019 Research
- WWF, Eating for 2 degrees - new and updated Livewell plates

GHG measurement tools for farms

- Cool Farm Tool - GHG emissions calculator for farmers and the companies they supply
- Farm Carbon Toolkit - UK-focussed carbon reduction toolkit for farmers including a GHG emissions calculator

Deforestation

- Accountability Framework initiative - supports the global effort to produce agricultural and forestry products while protecting ecosystems and human rights
- WWF & RSPB, Riskier Business: the UK's overseas land footprint

General

- Climate Change Committee, Land use: Policies for a Net Zero UK
- FDF Sustainability Resource Hub information on certifications, collaborative platforms and tools for business sustainability
- The Prince's Countryside Fund, A-Zero: A farmer's guide to breaking free from environmental jargon

Packaging

Section contents

1. Actions
2. Action checklist
3. Emissions
4. Case studies
5. Initiatives and policies
6. Further information

Packaging: low emissions but high profile

- Packaging is a minor contributor to overall emissions from the UK food system. Despite this, consumers are concerned about excess packaging, and that concern is a driver for reducing packaging and its related emissions.

- Emissions from packaging vary by product and can be relatively significant for certain categories, such as drinks (figure, right).

- Any design changes must take account of the critical role of packaging for preserving and protecting food and drinks.

- Reducing packaging emissions requires a dedicated strategy, and analysis of complex trade-offs.

IMPACT OF PACKAGING ON CARBON FOOTPRINT OF DIFFERENT PRODUCTS

kgCO₂e per kg product gross weight

fdf
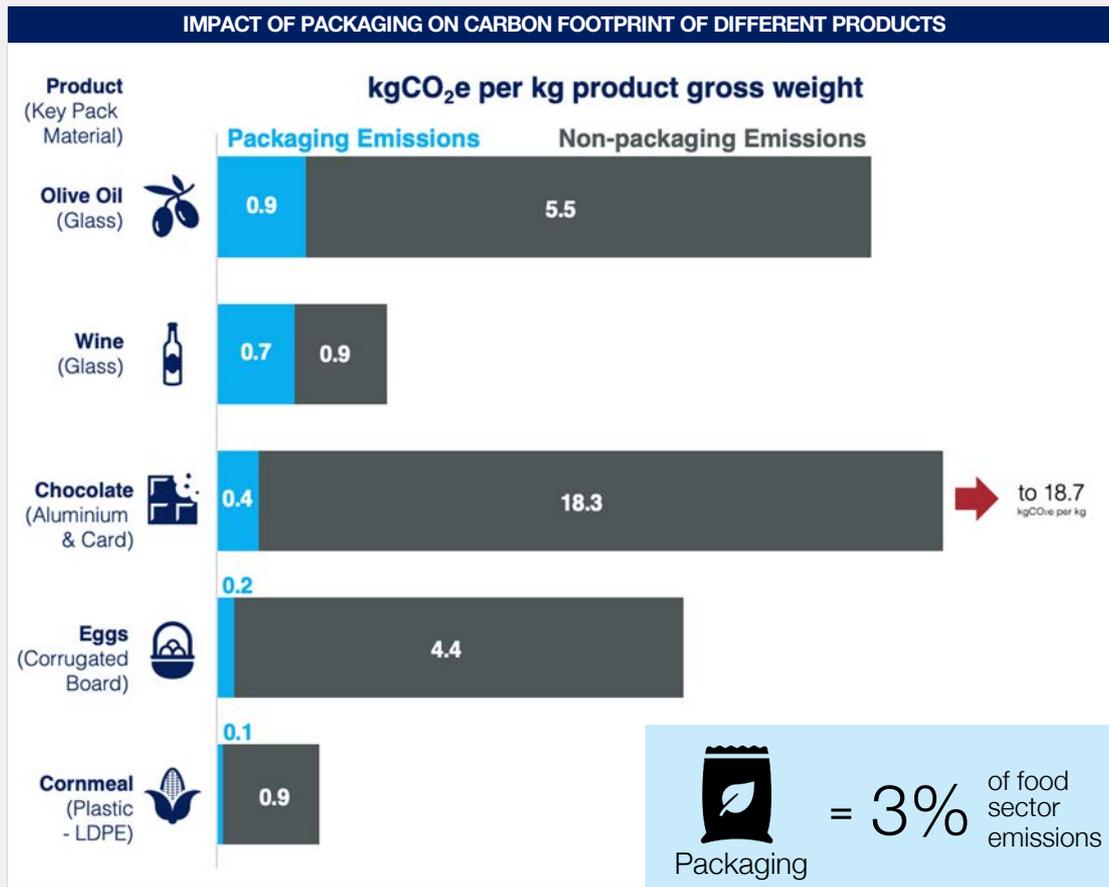
1 **Assign internal responsibility for carbon in packaging.**
Packaging is a technical discipline, and carbon performance should be integrated with other metrics during design.

2 **Formalise your company policy on packaging sustainability.**
Principles such as increasing recycled content and ensuring recyclability at end of life should be developed, while ensuring that packaging maintains its critical function of protecting and preserving the contents.

3 **Review packaging suppliers to find low carbon solutions.**
The packaging sector is innovating rapidly. Engage your current supplier, and review others, to identify the lowest carbon packaging formats that fulfil all functional requirements for your products.

PACKAGING ACTION CHECKLIST

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There are many potential actions to reduce emissions from packaging. You can use the checklist, right, to support implementation of the three actions on the previous page. (Not every checklist item will apply in every circumstance.)

Packaging plays an important role in reducing waste by preserving and protecting food. The first checklist item reflects a guiding principle of any packaging redesign: to maintain its role in food preservation.

Hierarchy of actions to reduce emissions from packaging

Most Preferred

Reduce — packaging volume by minimising material use

Reuse — packaging items in their current form

Recycle & Compost — packaging to recover valuable products

Recover — energy through waste treatment processes

Dispose — of any residual packaging safely via landfill

Least Preferred
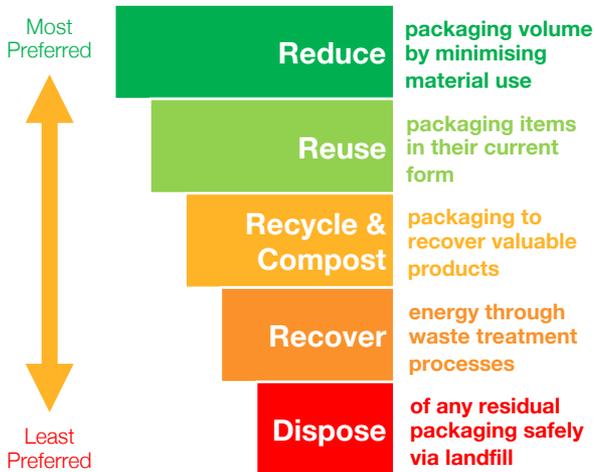
REDUCING EMISSIONS FROM PACKAGING: CHECKLIST

✓	Ensure any changes to packaging do not increase food waste
✓	Use the right amount of packaging - where possible reducing its material weight through redesigning the packaging or the product
✓	Ensure recyclability by using materials that are easy to recycle in the UK, and single material packaging where possible
✓	Ensure clear, consistent and accurate labelling that encourages recycling where possible
✓	Maximise the proportion of recycled content in packaging, ensuring adherence to conditions for food contact
✓	Consider switching to a packaging material with lower embodied emissions (while maintaining a broad view of all environmental impacts - see next page)
✓	Work with suppliers to find lower-carbon sources of individual packaging materials such as glass and aluminium
✓	For paper and cardboard packaging, ensure it is sustainably sourced by using certifications such as PEFC or FSC
✓	Work with retailers to develop options for refill/reuse-based systems (where life cycle assessment shows better environmental outcome)
✓	Collaborate to standardise reusable packaging, including secondary packaging
✓	Prepare for the UK Plastics Tax and reforms to Producer Responsibility regulations

Packaging **contributes 3% of emissions** from the UK food system. It also helps avoid additional sector-wide emissions by reducing food waste. For a few products such as drinks, packaging can represent over 20% of emissions (page 24).

Consumers are increasingly concerned about the impacts of packaging. Over 80% of consumers say they are trying to reduce their personal waste, and 50% say they would pay more for eco-friendly packaging. These concerns extend beyond climate change, relating also to the impacts of packaging on wildlife and in nature, resource waste and increased landfill.

Developing sustainable packaging requires tailored analysis which considers complex trade-offs. Establishing the emissions of a material requires analysis of each stage of its life cycle (figure, right). You should ask your packaging suppliers to share the results of life cycle assessments they have conducted so you can compare emissions and environmental impacts of different materials.

LIFE CYCLE ASSESSMENT OF EMISSIONS FROM PACKAGING

Raw materials
Extraction, processing, transport

Manufacturing
Heat, electricity, process emissions

Distribution
Transport, storage

Use phase
Cooking, storing, packaging re-use

Disposal / Recycling
Recycling, landfill, energy recovery

All common packaging materials have a useful role, but choosing the lowest carbon option can be complex. Life cycle assessment (LCA) provides a way of assessing the multiple factors that contribute to the emissions associated with packaging at every stage, including sourcing of raw materials, manufacturing, distribution, use and end-of-life treatment. LCAs of alternative packaging solutions can be compared to find the most sustainable option.

Remove	PG Tips will remove the plastic film from boxes of tea in 2021.
	Waitrose Unpacked pilot scheme has removed packaging from a range of products - 160 types of fruit and vegetable are sold loose with no packaging. Shoppers can fill their own containers from dispensers of foods such as pastas, cereals, lentils and rice.
Reduce	Carlsberg has replaced traditional plastic rings on multipacks with an innovative glue technology. The new Snap Pack system cuts plastic usage by 76%, and will save 1200 tonnes of plastic annually once all of 4, 6 and 8 packs have been converted.
	Macphie is reducing its plastic use with plant-based packaging. Working with Tetra Pak, the food manufacturer is packing its ready-to-use dessert and sauce ranges into cartons made from 87% renewable materials, reducing the packs' carbon footprint by 11%.
	KP Snacks 'pacKPromise' is a three-stage plan to reduce packaging impact by using less and recycling more, with the longer-term goal for all plastic film packaging to be 100% recyclable, reusable or compostable by 2025.
	Encirc, a glass manufacturer, has reduced the embodied emissions in its bottles by using up to 100% recycled glass and low-carbon biofuels
	Accolade Wines has reduced its packaging footprint by introducing lighter-weight glass bottles and adding more recyclable packaging to its 'Wine on Tap' formats. They also bottle in the UK to reduce the transport emissions associated with heavy packaging.
Reuse	Nestlé is piloting reusable and refillable in-store dispensers for petcare and coffee as part of efforts to reduce single-use packaging.
	Tesco trialled a scheme where online shoppers receive products in reusable packaging. Customers apply for the service where 150 items are delivered in reusable containers under a Deposit Return Scheme.
Recycle	Coca-Cola in Great Britain has significantly increased the recycled plastic (rPET) content of its packaging, with all on-the-go bottles of 500ml or less now 100% recycled plastic. It is also replacing plastic shrink wrap on all multi-packs with cardboard packaging.
	Pladis is increasing the recyclability of its packaging by removing all PVDC film and black plastic from its product portfolio.
	Britvic intends all plastic bottles in its GB portfolio to be made from 100% recycled plastic by the end of 2022.
	PepsiCo will eliminate virgin plastic from Pepsi brand bottles sold in nine EU markets by 2022, by moving to 100% rPET.
	Wiltshire Farm Foods has launched a closed-loop recycling system for ready meal trays. The company collects its trays (made from up to 80% recycled plastic) and recycles them into new trays. The company also reuses its delivery boxes multiple times before they too are recycled.

The government is reforming the UK Packaging Waste Regulations to reduce the environmental impact of packaging, and placing more responsibility on producers. These reforms include:

Extended Producer Responsibility (EPR) - The government plans to introduce legislation in 2023 to reform the Producer Responsibility (Packaging Waste) Regulations. Under the EPR reforms, producers of packaged products will have to pay the costs associated with collecting and recycling of packaging waste - estimated at £2.7 billion per year. 'Producers' will include brand owners, so these reforms will directly or indirectly affect all food and drink processors. The reforms will also introduce obligations on data reporting and clearer labelling on recyclability.

UK Plastic Tax - A new tax on plastic packaging will be introduced in April 2022. UK importers and manufacturers will have to pay £200 for each tonne of plastic packaging. Packaging with over 30% recycled plastic will be exempt.

Deposit Return Scheme (DRS) - Scotland will introduce a DRS in 2022. England, Wales and Northern Ireland will follow suit in 2024 (at the earliest). These schemes will allow consumers to get rebates when they return drink bottles or cans. Obligated businesses, such as brand owners, will be required to apply a deposit to drinks containers when they are sold to distributors. In 2021 the government consulted on Consistency in Household and Business Recycling in England. This is part of plans to reduce confusion about what can be collected for recycling at kerbside.

Scottish Government plans to introduce a **Circular Economy Bill** as part of wider plans to drive Scotland's circular economy by reducing, reusing and recycling materials.

UK Plastics Pact is a WRAP-led initiative to create a circular economy for plastics, capturing their full value and keeping them out of the natural environment. Businesses from across the plastics value chain are collaborating to change how to design, produce, use, re-use, dispose and reprocess plastics. Pact members include major retailers and processors of food and drink, as well as the FDF, working together on four targets:

- Eliminate problematic single-use plastic packaging through redesign, innovation or re-use models
- 100% of plastic packaging to be reusable, recyclable or compostable
- 70% of plastic packaging effectively recycled or composted
- 30% average recycled content across all plastic packaging.

Innovate UK is offering grants to companies for projects that help to deliver these Plastics Pact targets.

FDF & INCPEN Packaging for people, planet and profit - a sustainability checklist.

WRAP provides technical support on resource efficiency, packaging recyclability, alternative materials and food waste prevention. As part of its leadership of the UK Plastics Pact, WRAP has several free guides on plastic packaging:

- Design tips for more recyclable rigid plastic packaging
- Compostable plastic packaging guidance
- Guidance on defining what's recyclable and polymer choices
- Eliminating Problematic Plastics.

WRAP's Paper and card packaging: Design tips for recycling aims to help retailers and brands specify and design packaging that can be reprocessed in paper mills, improving the recyclability of paper and card packaging.

RECOUP's Recyclability by Design guidelines on technicalities of plastic packaging recyclability and sustainable alternatives for problematic polymers and packaging types.

Ellen Macarthur's Reuse – Rethinking Packaging - a framework for understanding packaging reuse models.

Zero Waste Scotland Circular Economy Investment Fund for SMEs developing new circular economy products and services.

Welsh Government's Beyond Recycling - a circular economy Strategy for Wales.

The Packaging Federation's collection of fact sheets cover a range of topics from minimising the amount of packaging, to conducting a Life Cycle Assessment.

The **On-Pack Recycling Label** (OPRL) scheme aims to help consumers recycle more correctly, more often by improving recycling messages on packaging. Brands and packaging manufacturers that subscribe to the scheme can use its clear recycling labels that support consumers to recycle more packaging in the right way.

Manufacturing

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Section contents

1. Emissions

2. Improving energy efficiency

3. Decarbonising electricity

4. Decarbonising process heat

   a. Electrification

   b. Low-carbon fuels

5. Shifting to sustainable refrigerants

6. Initiatives and policies

7. Further information

Manufacturing - emissions under direct control

- For food and drink manufacturers, emissions from manufacturing are the main source of Scope 1 & 2 emissions.

- For producers of a few food products, such as beet sugar, manufacturing is the largest source of emissions.

- Decarbonising manufacturing requires action across operations, including new heating technologies and improvements to processes and efficiency.

- For many companies, improving energy efficiency and switching to renewable electricity could be the most significant short-term actions to reduce emissions.

 = **6%** of food sector emissions

Manufacturing

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The emissions reduction opportunity

The food and drink processing industry emits about 9.3 million tonnes of emissions per year, most of which relate to consumption of electricity and fossil fuels. The sector has halved emissions from these sources since 1990 (figure, right).

Manufacturing accounts for about 6% of the sector's emissions, but for some individual companies it is much higher.

Decarbonising manufacturing

The table, right, summarises how processors can eliminate these emissions. Fully decarbonising both heat and electricity would reduce emissions from manufacturing by over 95%. Improving both energy and resource efficiency will reduce the size of this decarbonisation challenge. Most remaining emissions would be eliminated by switching to more sustainable refrigerant fluids.

This section provides further detail on actions to reduce emissions in these areas.

CO_2e EMISSIONS TREND IN UK FOOD & DRINK SECTOR

Total sector emissions have halved since 1990
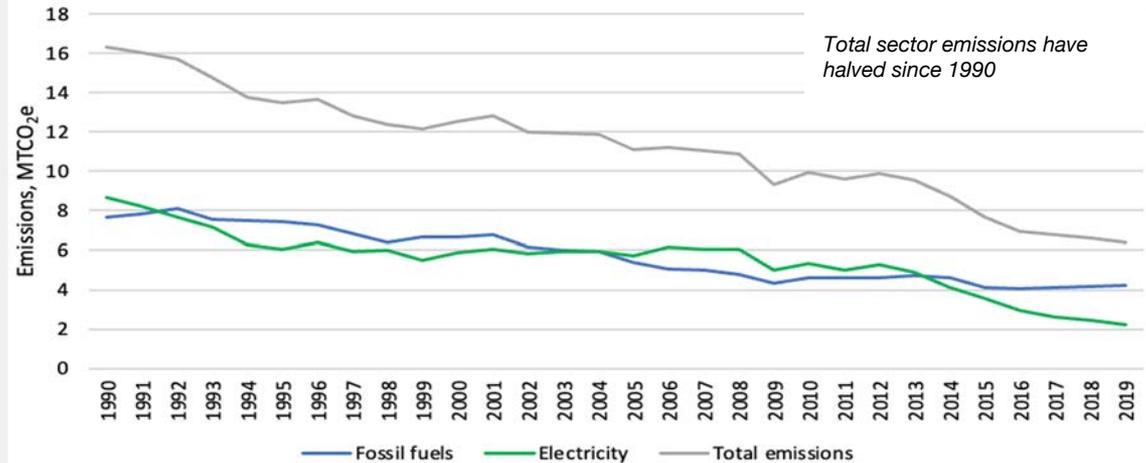
Action areas for decarbonising manufacturing

1. Improve energy efficiency

2. Decarbonise electricity supply

3. Decarbonise process heat with renewable electricity; bioenergy or low-carbon hydrogen

4. Switch to sustainable refrigerants with low global warming potential

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ACTION AREA 1 - ENERGY EFFICIENCY & MANAGEMENT

1 General

✔ Develop a corporate energy efficiency policy with targets and responsibilities

✔ Implement an Energy Management System to monitor and optimise energy use

✔ Staff training on energy management principles and practices

✔ Install sub-meters to measure energy use of individual processes

✔ Plan a programme of regular maintenance and cleaning of motors, boilers, pipework, ovens etc

✔ Install automatic process control and switch off equipment when not required

2 Electric motors
(e.g. fans, pumps, conveyors)

✔ Use motors of correct size

✔ Use high efficiency motors

✔ Consider Variable Speed Drives

3 Boilers

✔ Check for leaks from steam traps, pipes, flanges and joints

✔ Insulate pipes, flanges and joints

✔ Consider replacing less efficient parts of system with electric heat pumps

4 Demand management

✔ Adapt energy use patterns to maximise real-time consumption of renewable energy

More efficient energy use means lower emissions

Most manufacturers have the potential to use less energy. Many actions to improve energy efficiency are low- or no-cost, such as turning off equipment when not in use or implementing a regular maintenance schedule. Where energy efficiency does have a cost, the initial investment is often paid back quickly through lower energy bills.

The Carbon Trust's Manufacturing guide provides advice on energy saving opportunities, as well as more specific guidance on efficient motors and drives in the food and drink sector. It is also worth reviewing the list of efficient equipment that qualifies for an Enhanced Capital Allowance - a tax benefit in the year after purchase.

Energy efficiency in the context of Net Zero

Energy efficiency can play an important role in reducing your emissions, and is an early step towards decarbonisation. However, it is important to understand energy efficiency in the context of a Net Zero strategy.

You won't eliminate emissions by making fossil-fuel powered processes more efficient - in the long run you will do that by switching to 100% renewable energy. So, you should avoid over-investing in gas-fired processes that may eventually need to be decommissioned as part of a longer-term Net Zero strategy (table, right).

Compatibility between improving energy efficiency and a Net Zero strategy	
Question	**Compatible with Net Zero?**
Does the measure improve efficiency of an electrical system (e.g. new electric motor or pump)?	Yes
Does the measure improve efficiency regardless of the fuel type? (e.g. insulating hot water pipes, introducing an energy management system)	Yes
Does the measure involve switching from a fossil fuel to renewable energy?	Yes
Does the measure improve efficiency of a gas-fired system or prolong the life of a gas-fired system?	May be compatible in short term, but should be considered in context of a timetable to eliminate natural gas use.

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ACTION AREA 2 - DECARBONISING ELECTRICITY

1 Learn more about options for procuring renewable electricity

2 Review your site(s) for suitable for renewable electricity - e.g. rooftop or ground-mounted solar

3 Explore options for a Power Purchase Agreement and other green electricity products

4 Identify trusted sources of advice on renewable electricity

5 Design renewable electricity procurement strategy compatible with corporate decarbonisation targets

6 Switch to 100% renewable electricity by 2030

Manufacturers can now switch to renewable electricity

Electricity consumption currently accounts for about a third of emissions from manufacturing food and drink. However, the carbon intensity of the UK electricity grid is falling and could be near-zero carbon from the mid-2030s (figure, right).

You may be able to accelerate the decarbonisation of your electricity supply by procuring renewable electricity. For many companies this could be the most significant short-term action to reduce emissions. It may also be an opportunity to lock in low-cost electricity in the long term.

The table, below right, summarises the main models of renewable energy procurement. There is a lot of variety within these models, and they can be used in combination. Together they provide the flexibility to tailor strategies to suit business needs in terms of demand profile, risk appetite, cost structure and internal access to finance. SMEs may be attracted by multi-buyer power purchasing agreements (PPAs) which allow reduced costs and effort by contracting as a consortium. Another potential opportunity is to set up a PPA supplied by renewable energy hosted on farms within your supply chain.

Renewable energy procurement can be complex. You are likely to need expert advice to get the best deal and to ensure your procurement contributes to the development of new renewable energy infrastructure.

PROJECTED UK GRID CARBON INTENSITY COMPARED TO NATURAL GAS (kg CO_2e/kWh)
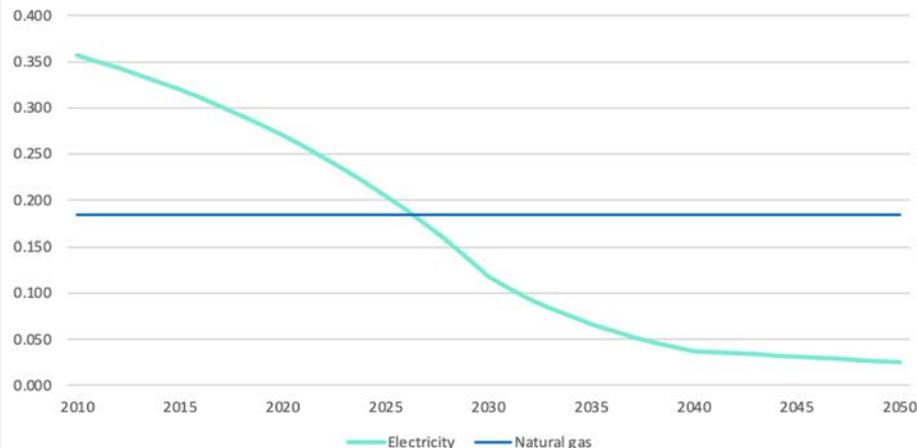
TYPES OF RENEWABLE ENERGY PROCUREMENT (by order of preference)

Onsite generation	1) Generation from installations owned by the company
	2) Purchase from on-site installations owned by a supplier
Offsite power purchase agreement (PPA)	3) Direct line to an offsite generator with no grid transfers
	4) Direct procurement from offsite grid-connected generators
Other green electricity products	5) Contract with suppliers (green electricity products)
	6) Unbundled energy attribute certificate purchase

ACTION AREA 3 - DECARBONISING PROCESS HEAT

1 Learn more about technological options for decarbonising process heat

2 Explore electrical alternatives for hot water and steam

3 Consider current and future availability of sustainable biomass and low-carbon hydrogen

4 Investigate government incentives for fuel switching (see page 46)

5 Select renewable heat options to take forward to feasibility studies

6 Develop a long-term plan for decarbonisation of process heat

7 Implement energy efficiency measures compatible with long-term plan for decarbonisation

8 Decarbonise heat processes by commissioning alternative systems powered by renewable energy

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Electrification provides many flexible options for decarbonising heat

Food and drink processors use fossil fuels to generate heat for a wide variety of equipment, of which the most significant are boilers and ovens (figure, right). FDF & SLR's Decarbonisation of heat report showed that 97% of heat-related emissions are from natural gas. The report also outlined a range of alternative electrical heating technologies that could replace gas-fired heat equipment in food manufacturing.

Advantages of electric heating

Electric heat technologies with applications in food and drink processing include: heat pumps; electric boilers & ovens; microwaves and infrared grills (page 42).

Electric heating systems are often faster, safer and more controllable than gas-fired systems. They can also be far more efficient due to their ability to:

- deliver heat at the precise temperature required
- transfer heat directly to a product, with little heat escaping
- provide heat at the point of use, minimising distribution losses
- reuse waste heat.

Electric heating systems can often be installed as modular systems, allowing them to be implemented over time, spreading cost and risk. As renewable electricity becomes more available and its cost continues to fall, electrifying heat will become more attractive.

Current limitations of electric heating technologies

Despite these advantages there are barriers to the electrification of process heat. These include the large disparity in the UK between price of natural gas and electricity (figure, right); the potential need for electricity connection upgrades; the weak domestic supply chain for electrical heating equipment and a lack of expertise in their design and installation.

FDF CCA SECTOR EMISSIONS BREAKDOWN

- Lighting and other electrical, 9%
- Cooling and Freezing, 17%
- Compressed air, 8%
- Stirring, mixing and conveying, 7%
- Fans and pumps, 12%
- Other direct fired applications, 4%
- Direct-fired drying and ovens, 7%
- Steam or hot water, 37%
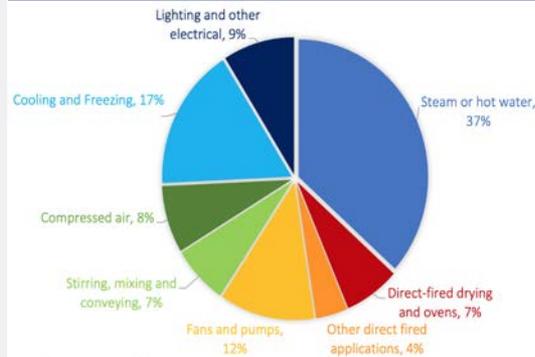
What is the FDF CCA?

Climate Change Agreements (CCAs) are voluntary agreements between UK industry and the Environment Agency to reduce energy use and carbon emissions. Participants get a discount on the Climate Change Levy, a tax on electricity and fuel bills in return for meeting targets. FDF negotiated the overall 'umbrella' industry sector agreement. Contact the FDF if you're interested in joining the sector agreement.

COST PROJECTIONS FOR FUEL TYPES (from Climate Change Committee)

Legend:
- Biomass
- Gas
- Coal
- Oil
- Hydrogen (green)
- Electricity
- Electricity (excluding network costs)
- Hydrogen (blue)

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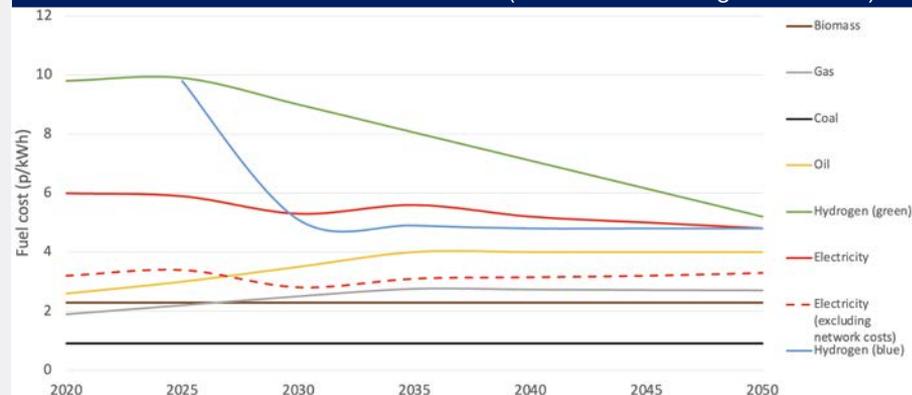
The electric technology with the greatest potential in the food and drink sector is the heat pump.

Heat pumps can play a similar role to gas boilers by creating hot water or steam. They are usually several times more efficient than gas boilers. In fact, they can produce several times more thermal energy than they use in electrical energy, achieving efficiencies of 300-700%. They are excellent at reusing waste heat, for example from drying processes, cooling food or refrigeration systems.

The International Energy Agency has a list of case studies of industrial heat pump installations. Most industrial heat pumps today supply temperatures below 100°C, but their capability is growing. A few heat pumps can now supply steam or hot water up to 165°C, and by 2030 systems capable of reaching 200°C may be available.

Heat pumps can be installed as separate units close to the processes that use their heat. This could enable you to replace the most inefficient parts of a steam distribution system rather than replacing the entire boiler system at once. It also means individual heat pumps can be paired efficiently with a process, unlike boilers which tend to produce water or steam at a single temperature.

Heat pumps are highly efficient at reusing waste heat

Low value heat → Heat pump → High value heat

Renewable electricity

EXAMPLES OF ELECTRIC HEAT PUMP APPLICATIONS IN FOOD PROCESSING				
Company/ Location	Heating capacity (kW)	Temperature uplift	Efficiency	Application
Nestlé, UK	1250	5°C to 60°C	600% (combined heating & cooling)	Simultaneous cooling and hot water for chocolate production.
Aurivo, Ireland	1200	to 80°C	670% (combined heating & cooling)	Pasteurisation and refrigeration of milk.
Snellman, Denmark	1090	to 95°C	350%	Sterilising equipment.
Arla Arinco, Denmark	1250	40°C to 85°C	460%	Preheating air for drying milk powder with gas-fired system completing job.
McCain, Netherlands	500	to 70°C	500-800%	Recovers and reuses heat for drying french fries.
Mohren-brauerei, Austria	370	to 70°C		Reuses waste heat from chillers to supply process heat.
Agrana, Austria	400	70°C to 140°C	300%	Recovers and reuses heat for drying starch.

Technology	Benefits*	Process Applications
Heat pumps	❑ Efficiencies of 300-700%, several times more than gas boilers ❑ Can capture waste heat ❑ Reduce space occupied by steam/water distribution	Processes involving hot water, steam or hot air
Electric boilers	❑ Directly replace temperature and throughput of gas boilers ❑ Can take advantage of periods of low-cost electricity	Processes involving hot water or steam
Electrical resistance ovens, fryers, grillers	❑ Can directly replace gas equivalents ❑ Simple, efficient and low-maintenance	Roasting, frying, grilling
Microwaves and radio-frequency	❑ Instant start-up and faster heating, especially for large volumes ❑ Reduced equipment size compared to convection ovens ❑ Efficient and low temperature drying capabilities	Drying, thawing, tempering, sterilising, pasteurisation, baking, blanching
Infrared	❑ Rapid heating and cooking of food surfaces, e.g. pie crusts ❑ Highly energy efficient and precise temperature control ❑ Low maintenance and low cost	Frying, roasting, baking, thawing, grilling, drying, melting, pre-heating, sterilising
Induction	❑ Fast start-up and precise control ❑ Low maintenance	Drying, roasting, sterilising, heating, aseptic packing

Despite these potential benefits, manufacturers may need to address several challenges in switching to electric heating - see page 40.

BIOENERGY

Bioenergy can sometimes offer a low-carbon alternative to fossil fuels. Solid biomass can be used for some heat processes, particularly hot water or steam generation and can be cheaper than natural gas. Biogas has similar applications to natural gas, and some manufacturers could convert their organic waste streams into biogas using _Anaerobic Digestion_.

The supply of sustainable bioenergy is constrained as its use can contribute to biodiversity loss, impairment of ecosystems and competition with food production.

Food and manufacturers may struggle to access the limited national supply of bioenergy - see right. The use of bioenergy is likely to be restricted to situations where manufacturers have a reliable, low-cost, sustainable supply - e.g. waste streams generated within production processes, or a supply from local farms or factories.

Combined Heat and Power (CHP) plants have often been deployed to reduce emissions. However, new CHP plants running on natural gas are no longer a good option for Net Zero. Due to the ongoing decarbonisation of the UK electricity grid, gas-fired CHP installed after 2023 will not deliver net carbon savings.

On the other hand, CHP powered by bioenergy could form part of a Net Zero strategy - with appropriate consideration of the sustainability of supply.

Bioenergy use in the 6th Carbon Budget Report, 2020
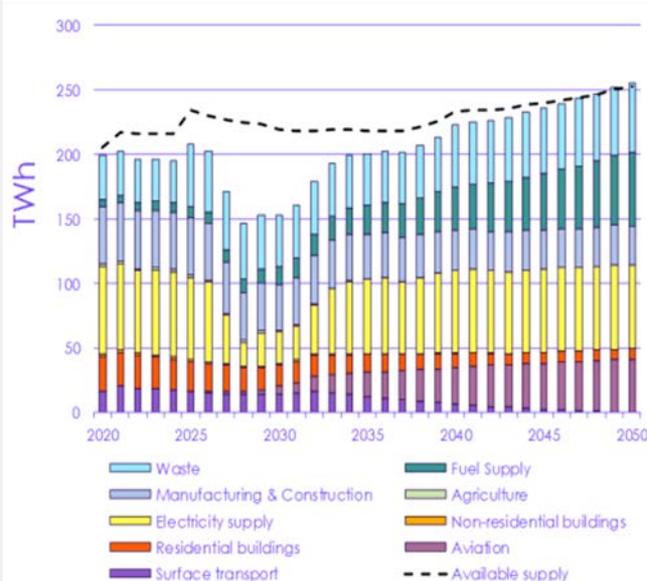
The Climate Change Committee projects limited growth in bioenergy production by 2050. It expects that most bioenergy will be used in combination with carbon capture, which is unlikely to be viable for many food and drink manufacturers. Remaining bioenergy supplies are likely to be dominated by high value uses such as aviation fuel and residential heating (figure above).

HYDROGEN

Hydrogen is expected to play an important role in global decarbonisation. Today most commercial hydrogen is still a relatively high-carbon fuel, but it is possible to produce low-carbon hydrogen. 'Green' hydrogen is made by using renewable electricity to split water into oxygen and hydrogen.

Low-carbon hydrogen will remain more expensive than natural gas for some time. But the potential attraction of low-carbon hydrogen to manufacturers is that it could be used to fuel heat processes in a similar way to natural gas. There are now options for new or modified heating equipment capable of running on pure hydrogen. Most boilers could already run on up to 20% hydrogen blended into natural gas.

The Climate Change Committee forecasts significant low-carbon hydrogen production by 2035. However, access to piped hydrogen is likely to be restricted to a small number of heavy industrial clusters - excluding supply to manufacturers elsewhere. (Though more companies may have access to gas networks where a proportion of hydrogen is blended into the supply.)

In the future, some manufacturers may produce their own green hydrogen on-site. This will become more viable with reductions in the costs of electrolysers and renewable electricity. Due to the energy losses when making hydrogen, it is always more efficient to use renewable electricity directly where that is an option.

ACTION AREA 4 - SUSTAINABLE REFRIGERANTS

1 Ensure implementation of maintenance programme to minimise leaks of refrigerants

2 For new equipment, use only refrigerants with low Global Warming Potential (<150)

3 Upgrade existing equipment to use refrigerants with low Global Warming Potential (<150)

Leaking refrigerants contribute to climate change

Fridges, freezers and heat pumps work by compressing and expanding a refrigerant fluid. Some older types of refrigerant (CFCs and HCFCs) have been phased out due to their role in ozone depletion. They have been largely replaced by hydrofluorocarbons (HFCs).

HFCs do not deplete ozone but many do have a very high global warming potential. Generally, the main source of emissions from refrigeration is from electricity consumption, but leaks of HFCs are also a major component of refrigeration emissions. On average refrigeration accounts for around 4% of all emissions from food processing - though it could be much higher for companies with substantial refrigeration needs or leaky equipment.

COMMON INDUSTRIAL REFRIGERANTS AND THEIR GWP VALUES	
Refrigerant	GWP
R-404A	3,922
R-410A	2,088
R-407C	1,774
R-134a	1,430
R-600a (isobutane)	3
R-290 (propane)	3
R-744 (CO_2)	1
R-717 (ammonia)	0

Alternative refrigerants have lower impact

The most important way to reduce refrigeration emissions is to switch to refrigerants with low global warming potential (GWP), below GWP150. These include natural refrigerants such as CO_2, ammonia and water, as well as some newly-developed HFCs.

Regulations will force many companies to replace refrigerants as the UK has committed to continue to follow the EU's progressive phase-out of HFCs with higher GWP. This is an opportunity to use ultra-low GWP refrigerants - not simply ones good enough to meet the current regulations.

Existing equipment can often be upgraded to use refrigerants with low GWP. For new refrigeration systems, you could consider items on the Energy Technology List. This lists efficient equipment that qualifies for an Enhanced Capital Allowance - a tax benefit in the year after purchase.

You should also implement regular maintenance and cleaning to reduce refrigerant leaks, as well as improve energy efficiency of systems.

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Reaching Net Zero

To be on track for Net Zero by 2050, the UK Government expects industrial emissions to fall by around two thirds by 2035. To help achieve this the government will support uptake of electrification, hydrogen and bioenergy, as well as supporting technologies such as digitalisation, product innovation, advanced technologies and energy efficiency improvements. The government is also considering a recommendation that later in the 2020s upgraded equipment must be low-carbon ready.

Current government funding initiatives for low-carbon industry

- Net Zero Innovation Portfolio - £1 billion fund for low-carbon technologies. Competitive grant windows open periodically for relevant technologies such as bioenergy and industrial fuel switching.

- Industrial Energy Transformation Fund supports the deployment of technologies that improve the energy efficiency of an industrial process (includes resource efficiency and fuel switching). Grant windows open periodically until 2024. Sites in Scotland may apply for the related Scottish Industrial Energy Transformation Fund.

- Industrial Energy Efficiency Accelerator - £13 million programme to accelerate the adoption of novel energy efficiency technologies by UK industry.

- Industrial Strategy Challenge Fund: Manufacturing Made Smarter - £147 million matched funding improve UK's manufacturing capabilities through industrial digital technologies.

- UK Hydrogen Strategy - UK Government plans to publish plans to accelerate the low-carbon hydrogen sector, including a £240 million Net Zero Hydrogen Fund.

Sector initiatives

- Food and Drink Innovation Gateway - FDF will connect companies to universities or innovation centres in the Catapult Network to help them tackle challenges, such as decarbonisation.

- Renewable Thermal Collaborative - global coalition of companies, governments and institutions committed to scaling up renewable heating and cooling at industrial facilities.

General

- Businesswise Solutions supports food and drink manufacturers to become more sustainable through energy efficiency strategies and renewable energy procurement
- UK Government, 2021. Industrial Decarbonisation Strategy
- UK Government, 2015. Decarbonisation and Energy Efficiency roadmap for the Food and Drink sector
- Beverage Industry Environmental Roundtable,2020. Facility Decarbonization Playbook
- Scotland Food & Drink Partnership, Greening Your Business: A practical guide for food and drink SMEs

Energy and resource efficiency

- UK Government, 2015. SME Guide to Energy Efficiency
- Scottish Government loans for SMEs to reduce energy and resource costs
- Carbon Trust, Manufacturing - Introducing energy saving opportunities for business
- Carbon Trust, 2020. Energy efficiency guidance for the food & beverage sector
- Carbon Trust, Effective energy management for business
- ISO 50001 Energy Management
- edie Explains: Sub-metering
- Food Waste Reduction Roadmap, Toolkit and other resources

Sourcing renewable electricity

- RE-Source, 2020. Introduction to Corporate Sourcing of Renewable Electricity in Europe and Renewable Energy Buyers Toolkit
- RE100 Technical Guidance
- UKGBC, 2021. Renewable Energy Procurement & Carbon Offsetting
- Climate Change Committee, 2020. Corporate Procurement of Renewable Energy: Implications and Considerations

Decarbonising heat

- FDF, 2020. Decarbonisation of heat across the food and drink manufacturing sector
- Renewable Thermal Collaborative, 2021. Electrifying U.S. Industry: A Technology- and Process-Based Approach to Decarbonization
- Australian Alliance for Energy Productivity, 2017. High Temperature Heat Pumps for the Australian food industry
- IEA, 2014. Application of Industrial Heat Pumps. Annex 35, Final Report - Part 2

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ENERGY EFFICIENCY	Suntory Beverage & Food has invested £13 million to install a new high-speed bottling line which cuts water and energy use by 40%.
	British Sugar has won funding to improve the efficiency of its heaters and reuse more waste heat. The project will save over 3,500 tonnes of CO_2 per year.
	d'Arta audited the energy it uses to freeze vegetables and ready-meals, showing it could switch turn off 1.6 MW of cold storage for a few hours. The company now earns income by doing this at times of peak demand, enabling it to reduce energy bills and emissions.
	Weetabix Food Company's new factory in Corby uses 50% less energy than its previous facility thanks to a range of new technologies.
DECARBONISING ELECTRICITY	Britvic has sourced 100% renewable electricity for all its UK manufacturing sites since 2018, achieved through a power purchase agreement for wind energy.
	Mondelēz International UK has switched to purchasing 100% renewable electricity for all six of its production sites in the UK.
	The Tracklements Company uses 100% renewable energy, and at times its site can operate entirely from electricity generated by their on-site solar PV system.
DECARBONISING PROCESS HEAT	Moy Park, the largest poultry meat producer in Northern Ireland, installed a heat pump to provide hot water for cleaning. The 1.5 MW heat pump reuses heat expelled from the refrigeration system. This allowed the company to shut down two of its hot water boilers, cutting costs and reducing gas consumption.
	WL Douglas & Sons installed a 6.2 MW ground source heat pump to dry and cool grain. The unit delivers heating and cooling with a combined efficiency of 725%.
	Danone's plant in Wexford has been certified carbon neutral thanks to initiatives such as switching to 100% renewable electricity and installing a biomass boiler.
	GreenStills is an initiative to enable malt distilleries to transition away from fossil fuels, using electric heat pumps to upgrade and reuse waste heat.
	Muntons has installed a biomass plant to provide heat for malt manufacture. The boiler uses waste wood from local forestry operations which would otherwise have gone to waste, and has reduced the corporate carbon footprint by around 20%.
	HySpirits 2 is a government-backed initiative to investigate the feasibility of green hydrogen as a heating fuel for the distilling sector.
SUSTAINABLE REFRIGERANTS	Unilever only buys freezers that use natural refrigerants with low global warming potential. Since 2004 Unilever has purchased 2.9 million such freezers.
	Mackie's of Scotland is installing an efficient, low-carbon refrigeration plant that will use ammonia, a natural refrigerant gas with no global warming potential.

Distribution & Storage

Section contents

1. Actions
2. Emissions
3. What operators can do
4. Further information

Towards Net Zero logistics

- Most emissions from UK distribution come from diesel use to run Heavy Goods Vehicles (figure, right)

- HGVs are unlikely to be fully decarbonised before 2030 - so in the short-term the focus should be efficiency measures

- For light goods vehicles companies should consider adopting electric models already available

- HGV refrigeration adds 15-20% to vehicle emissions. Refrigeration units could be electrified earlier than the vehicle engine

UK FREIGHT EMISSIONS BREAKDOWN BY MODE

Air 0.1%
Waterway 7%
Rail 1%
Vans 13%
HGV 79%
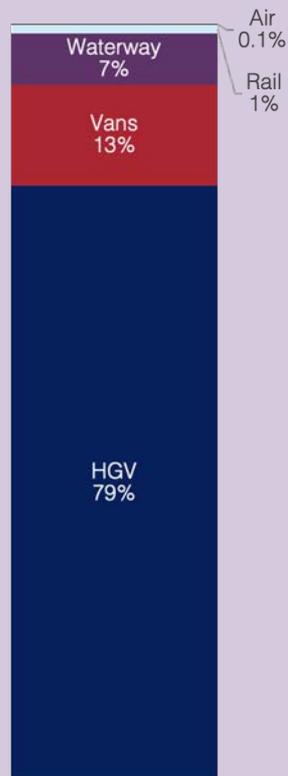
Distribution & Storage = 5% of food sector emissions

1 **Embed climate performance into distribution & storage services.** Depots and distribution centres can source renewable electricity. Road logistics providers should track, report and act to reduce emissions across the network.

2 **Shift to electric vehicles for light goods vehicles (and cars).** EVs are becoming competitive for light loads and shorter routes, and have advantages including lower running costs and penalty-free access to cities.

3 **Optimise your HGVs.** If you operate HGVs you should implement efficiency measures to reduce fuel use and emissions.

Distribution and storage accounts for 5% of food sector emissions. The vast majority of these emissions (92%) are from road transport, and 79% from diesel-fuelled Heavy Goods Vehicles (HGVS). Although distribution is responsible for a low proportion of overall food sector emissions it is, like packaging, a focus of consumer concern.

Air freighting is the highest intensity freight method per tonne-kilometre, particularly when compared to alternative international freighting methods such as shipping. As can be seen in the figure to the right, emissions intensities are driven by freight mode, but also the fuel used within each freight category - with electric and hybrid options generally providing lower carbon alternatives to diesel (where possible).

About 10% of distribution emissions relate to refrigeration. The preservation of perishable foods and drinks relies on an effective cold chain that keeps products refrigerated throughout the value chain. During distribution chilling is delivered by temperature-controlled vehicles and warehouses, which use energy and refrigerants which contribute greenhouse gas emissions.

AVERAGE CARBON INTENSITY OF FREIGHT TRANSPORT MODES

Mode	Value
Short Haul Flight	2.30
Long Haul Flight	1.02
Petrol Van	0.72
HGV (Rigid, <7.5 tonnes)	0.49 +0.09
Electric Van	0.25
HGV (Articulated, >33 tonnes)	0.08 +0.01
Rail	0.03
Sea Tanker	0.01

$kgCO_2e$ per tonne-kilometer of goods moved

■ Non-Refrigerated   ■ With Refrigeration*
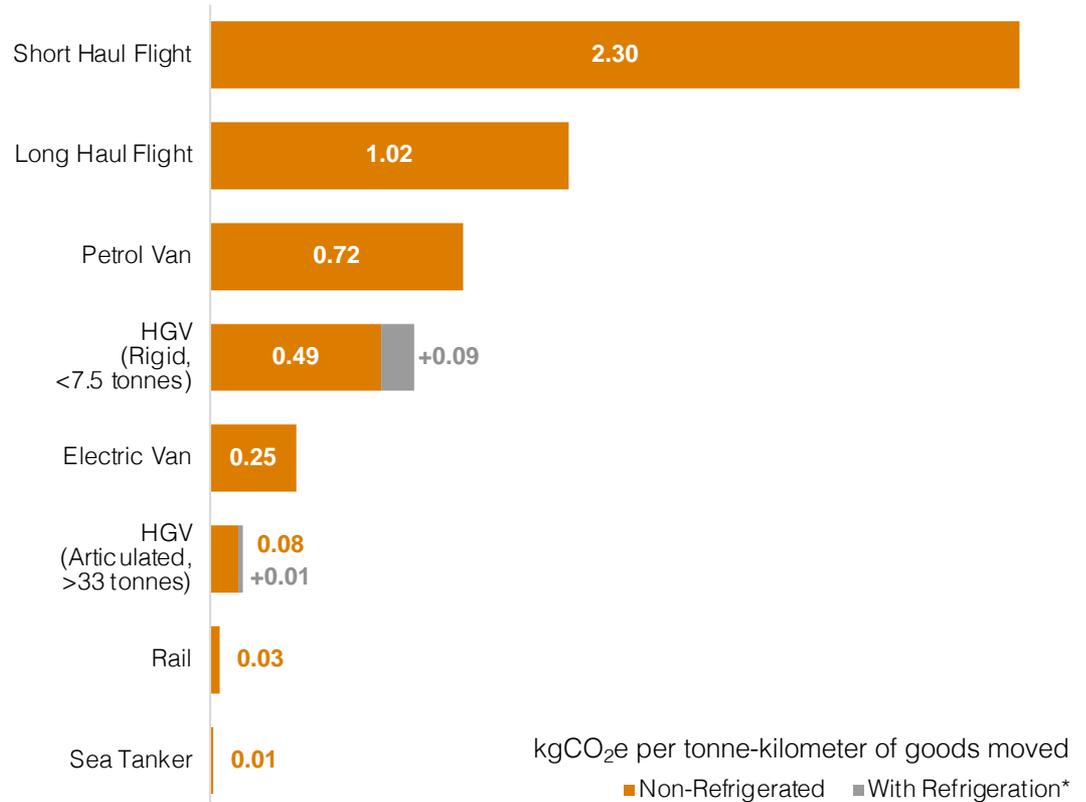
Distribution operators will ultimately decarbonise by switching to zero carbon fuels such as green hydrogen or electricity. The UK government has consulted on plans to end the sale of new diesel and petrol goods vehicles by 2040. There are already many electric models of light goods vehicles (LGVs) and some smaller HGVs. However, alternatives to larger payload HGVs are still at an early stage of commercialisation.

In the short-term logistics operators can reduce HGV emissions through efficiency measures (top table, right). A Department for Transport survey found limited uptake of such measures, even when they would be cost-effective. By embedding climate performance into logistics services you can incentivise logistics providers to implement these measures and reduce emissions. The UK road freight industry has committed to reducing HGV emissions by 15% by 2025.

The cold chain also presents opportunities to reduce emissions (bottom table, right). Over time the sector will decarbonise by switching to low-GWP refrigerants (see page 45) and refrigeration units powered by renewable electricity. Mobile refrigeration in HGVs is often powered by a separate diesel engine – and it may become viable to electrify such units sooner than the main engine.

SHORT-TERM MEASURES FOR VEHICLE OPERATORS	
Variables influencing fuel efficiency	Emissions reduction measures

Vehicle improvements (design, maintenance and technology)	• Regular maintenance, including refrigeration
	• Vehicle procurement (e.g. hybrid drivetrains; electric LGVs)
	• Technologies such as:
	  - advanced tyres to reduce rolling resistance
	  - aerodynamic body designs
	  - systems to reduce engine idling.

Operational efficiency (reducing fuel per tonne-kilometre)	• Reduce distance travelled per unit of product, e.g. by:
	  - increasing size of average payload
	  - shorter supply chains
	  - optimised vehicle routing and timing.
	• Modal shift to rail or barge

Driving (driving speed and style)	• Driver training and incentives • Reducing running speeds and idling • Monitoring and auditing data on fuel use, routes & speed

SHORT-TERM MEASURES FOR COLD CHAIN OPERATORS	
Warehouses	**Vehicles & trailers**
• Onsite renewables • Reduce heat gains to cold stores • Optimised refrigeration plant • Switch to low-GWP refrigerants • Smart temperature monitoring and energy management	• Power fridge directly from main engine • Move to electric mobile refrigeration • Improve temperature monitoring • Switch to low-GWP refrigerants • Improve trailer insulation • Implement better loading/unloading procedures to minimise heat gain

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Distribution

- FDF's 10-point transport checklist for reducing environmental impact of transport operations.
- BRC, Getting UK Retail to Net Zero Vehicle Logistics by 2035.
- Global Logistics Emissions Council's free framework for calculating and reporting carbon footprint of logistics.
- Energy Saving Trust's Fleet Review programme & Freight Portal offer advice on reducing fuel use and emissions in vehicle fleets & HGVs.
- Smart Freight Centre guidance on truck fleet energy efficiency.
- UK Government's 2019 Foresight report Decarbonising road freight outlines decarbonisation measures for road logistics.
- Defra's conversion factors spreadsheet provides emissions factors for different types of freight transport and movements.

Cold chain

- Cold Chain Federation, Defining a Net Zero Cold Chain - a series of reports including Shaping the Cold Chain of the Future: The Road to Net Zero.

UK Transport Decarbonisation Plan, 2021

Part 2 of the government's pathway to decarbonise the transport sector focuses on freight and logistics, and commits the government to:

- consulting on ending the sale of new non-zero emission HGVs by 2040 (2035 for vehicles under 26 tonnes)
- investing £20 million in electric and hydrogen HGV refuelling infrastructure
- grants for up to 20% of the price of plug-in trucks (£25k for largest HGVs)
- supporting modal shift of freight from road to alternatives such as rail
- consulting on increasing maximum weights of zero-emission trucks
- continuing to support efficiency improvements and emission reductions in the existing HGV fleets with measures such as the fuel duty differential.

Customers & Consumers

Section contents

1. Actions
2. Customer commitments
3. Dietary choices
4. Waste reduction
5. Case studies
6. Further information
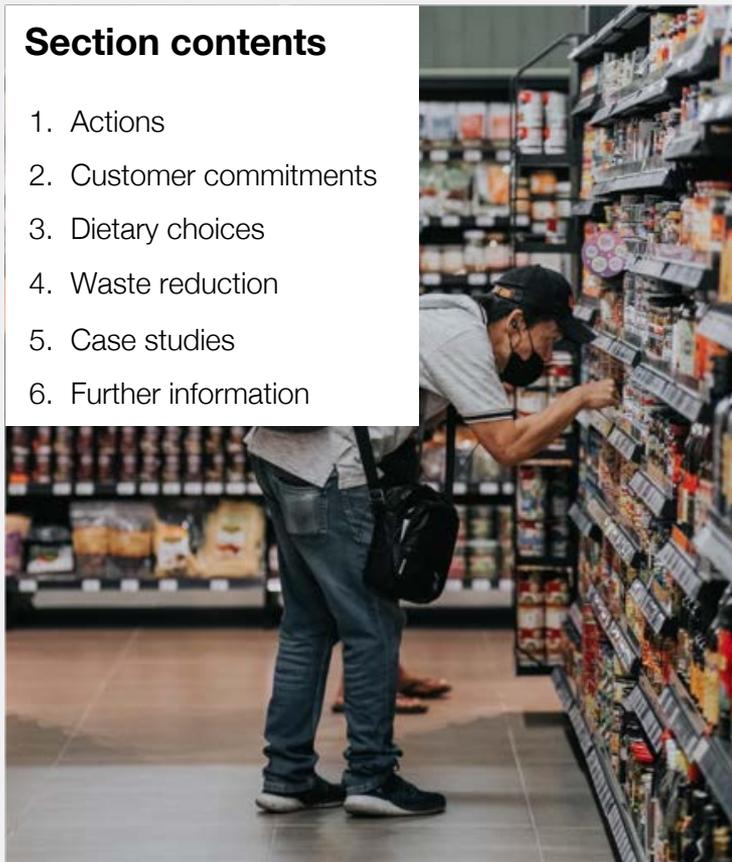
Customers: retail and hospitality

- Retail and hospitality contributes 9% of emissions from the food & drink supply chain. These emissions relate to cooking, space heating, lighting, refrigeration and food waste.

- All major UK supermarkets aim to achieve Net Zero Scope 1 & 2 emissions by 2040 at the latest. Most also aim to reduce emissions from purchased goods - Scope 3.

- Retailer supporters of BRC Climate Action Roadmap have committed to Net Zero emissions for Scope 2 (electricity) by 2030, Scope 1 by 2035, and Scope 3 by 2040.

Retail and hospitality = 9% of food sector emissions

Consumers = 11% of food sector emissions

Consumers: facilitating change

- Consumer emissions are from household refrigeration, food preparation and cooking and even transport to stores.

- Food and beverage waste in the home is a major source of emissions, owing to the 'embodied emissions' in uneaten items.

- There is high demand for low carbon consumer lifestyles, with 88% of customers wanting brands to help them live sustainably

- Facilitating sustainable lifestyles requires clear and transparent communication of information, to promote informed choices. It also means offering more sustainable products to help consumers reduce their emissions.

1 **Understand customer expectations on climate.**
Retail and hospitality is coming under increasing pressure to act on climate. Demands will flow up the supply chain. Build your understanding of present and upcoming customer expectations on climate.

2 **Capitalise on growing demand for lower carbon products.**
Demand for plant-based foods is one of the key trends in the UK. And product carbon labels look set to arrive imminently. Position your business to benefit from future demand and requirements of evidence for low carbon products.

3 **Engage consumers on climate issues and waste reduction.**
Help your consumers to lower their carbon footprints. Promote sustainable, healthy diets and provide guidance to store, prepare and cook food as eco-efficiently as possible.

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Many of your retail and hospitality customers have ambitious climate targets, creating incentives and expectations for support to achieve Net Zero. For example, the British Retail Consortium is aiming for all products sold in the UK to be Net Zero by 2040.

Retailers are already tackling their Scope 1 & 2 emissions, through actions such as sourcing renewable energy and improving efficiency of heating and lighting.

By implementing the actions in this Handbook, you can support your customers on their missions to also reduce supply chain Scope 3 emissions.

You can work with customers to develop lower-carbon products and help consumers reduce their emissions through initiatives such as clear carbon labelling schemes.

Intelligent, demand-driven supply chains are essential to reduce food waste. By sharing data between customers and suppliers, food manufacturers can better predict changes in demand, increase sales and reduce waste, while retailers can respond to boosts in supply with promotions.

Retailer and Hospitality Net Zero Commitments

Retailer	Base year	Scope 3 target	Validated Science Based Target
Co-op	2016	11% by 2025, Net Zero by 2040	Yes
Tesco	2015	17% reduction by 2030	Yes
M&S	2006/2007	Net Zero by 2040	Yes
Sainsbury's	2019	30% reduction by 2030	Yes
McDonald's	2015	36% reduction by 2030	Yes
Nando's	2019	42% per meal by 2030	Yes
NHS	1990	Net Zero by 2045	No

Sector initiatives

- The British Retail Consortium has committed to reaching zero emissions for Scope 2 (electricity) by 2030, Scope 1 by 2035, and Scope 3 by 2040. Food retailers and hospitality providers supporting this commitment include SPAR, Costa, Morrison's, KFC, Ocado and M&S.
- Many retailers have signed up to Courtauld 2030 targets to reduce food waste and greenhouse gas emissions.
- The Zero Carbon Forum is a collaborative group supporting decarbonisation of the hospitality sector. The ZCF is expected to launch Net Zero commitments for its supporters imminently.
- The Consumer Goods Forum is an alliance of retailers and manufacturers committed to reducing food waste, plastic waste and deforestation. Their Refrigeration Resolution commits signatories, including Sainsbury's and M&S to phasing out HFCs and installing ultra-low global warming potential refrigerants.

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Governments and consumers are increasingly interested in the health and sustainability of dietary choices. For example, Tesco plans to increase plant-based sales 300% by 2025 and major catering associations, such as the Hospital Caterers Association, have pledged to cut the amount of meat served by 20%. The independent National Food Strategy called for a 30% reduction in meat consumption over ten years.

Many environmental NGOs are calling for shifts to healthier more sustainable diets - e.g. World Health Organisation's Sustainable healthy diets and WWF's Livewell (figure, right). However, there is still no consensus on how to make diets sustainable without sacrificing consumer choice or raising the cost of food.

Carbon labelling for products
One way to accelerate change could be labelling of climate information to inform consumer choices. The first attempts to carbon label products in 2008 didn't catch on. There is now renewed interest in carbon labelling, and WRAP's carbon footprinting project is informing the development of an aligned industry approach.

In 2021 a number of retailers and brands voiced support for the new Foundation Earth on-pack labelling scheme. LIDL has also announced trials of the Eco-Score label on some of its own-brand products. Some plant-based companies such as Quorn already use carbon labels and Unilever plans to test carbon labelling on its products.

BREAKDOWN OF CARBON FOOTPRINT OF CURRENT UK DIET AND LIVEWELL PLATES (WWF)
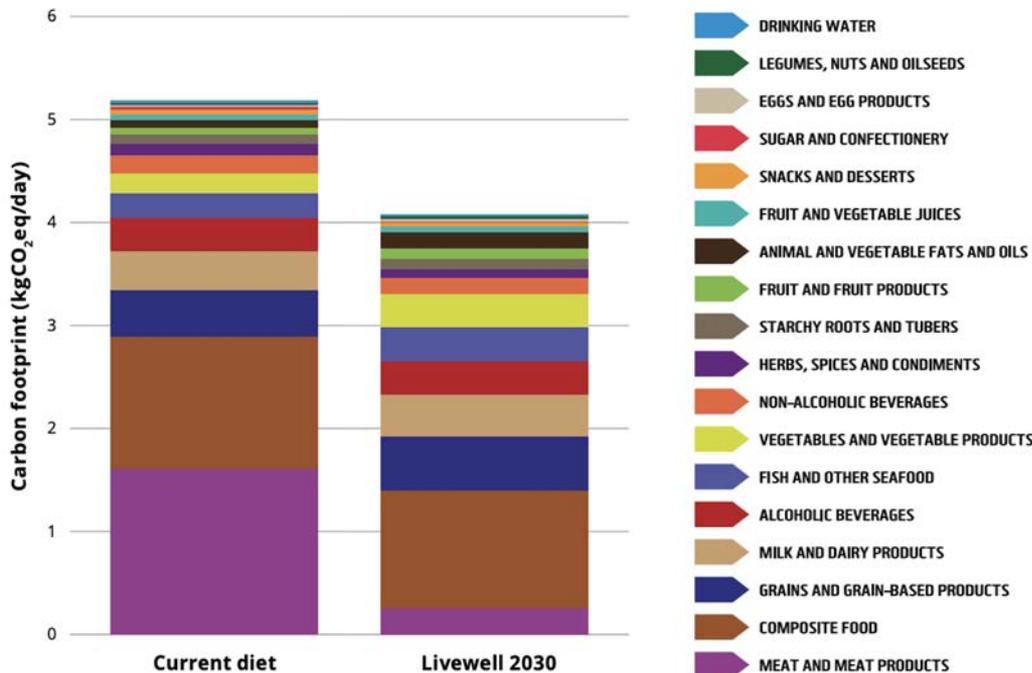
WWF estimates that the current UK adult diet leads to 5.2 $kgCO_2e$/day of emissions per person. The graph above demonstrates how this breaks down into food types, and compares this to WWF's proposed Livewell 2030 diet, which illustrates the dietary changes in 2030 required to keep the average global temperature rise well below 2°C.

Approximately 70% of total UK food waste (post farm gate) occurs in households. WRAP has published reports and guidance documents on food waste reduction, including progress reports on its Courtauld commitments on food waste reduction. Two effective waste reduction measures are:

- **Targeted public campaigns** – manufacturers can support campaigns such as Love Food Hate Waste, Food Waste Action Week and Make Toast Not Waste which promote actions to reduce waste from the most wasted foods.

- **Improved labelling** – about 20% of avoidable UK household food waste is due to label confusion, leading to premature throwing out of food. WRAP's labelling guidance provides useful specifications and guidance, for example on when to use 'best before' and 'use by' for food date stamps.

Products to support waste reduction

Manufacturers can provide products that help consumers reduce waste. These include items with longer shelf life and products, such as sauces, which help to use up leftovers (figure, right).

WRAP also provides resources for businesses to use to help their customers and staff reduce food waste.

Greencore — Top 10 tips for food waste

Consumer engagement	• <u>Ben & Jerry's</u> run a number of campaigns through their products, website and social media aimed at driving consumer engagement on climate change. This includes provision of clear information, support in taking actionable steps, and clear policies and responsibilities of their own to demonstrate leadership. • <u>Ocado</u> has a dedicated 'aisle' on its website, showcasing B Corp products with verified social and environmental standards.
Brand partnerships & new product development	• <u>apetito</u> has achieved a carbon reduction of nearly 20% across a range of its NHS menus by prioritising lower-carbon options. • <u>Meatless Farm</u> has partnered with Pret A Manger to release a meat-free version of its Swedish meatballs.
Product labelling	• <u>Foundation Earth</u> is piloting comparable eco-labels on food and drink products backed by food companies such as Nestlé and the major UK retailers. The labels will score a product's environmental performance, including carbon. • <u>Quorn</u> has run a number of public campaigns highlighting the relative climate impacts of their products compared to meat. • <u>Oatly</u> have also run similar campaigns calling for more transparency and provision of climate information for customers
Plant-based commitments	• <u>Tesco</u> plans to increase plant-based sales 300% by 2025. • <u>Co-op</u> is investing heavily in its vegan range as part of its Net Zero roadmap, and has cut the price of plant-based burgers and sausages to bring them into line with meat-based equivalents. • <u>Starbucks and Oatly</u> are partnering to launch a new range of plant-based coffee drinks, as part of Starbucks' targeted campaign to increase uptake of plant-based milks in its stores and decarbonise its supply chain.
Consumer waste reduction	• <u>Tesco's Food Waste Challenge</u> provides a hub of information for consumers on planning, storing and portioning food to help reduce waste.

INITIATIVES AND POLICIES

Dietary and product information

- Carbon Trust - Carbon Footprint Labels: A series of product carbon footprint labels designed to help consumers understand the carbon footprint of products
- On Pack Recycling Labels: A simple, UK-wide, consistent recycling message for use on both retailer private label and brand-owner packaging
- WWF Livewell Plate: WWF's work on the dietary changes needed to keep temperature rise below 2°C
- WWF Plant Based Diets: Science-based platform to help people understand how plant based diets can reduce negative impacts of the food system
- World Health Organisation's Sustainable healthy diets
- British Dietetic Association's sustainable diet project One Blue Dot

Waste reduction

- WRAP - Love Food Hate Waste: A campaign providing useful resources for minimising food waste and communicating with consumers
- Food Waste Action Week: Annual week of awareness and action to end food waste
- Champions 12.3: A coalition of executives committed to inspiring action to reduce food waste

FURTHER INFORMATION

Other useful resources include:

- IGD and WRAP's joint roadmap containing tools, guidelines and data support for reducing consumer food waste
- UK Government (Defra)'s Green Claims Guidance provides minimum standards for any on-pack or off-pack environmental claims
- The BRC's Climate Action Roadmap contains key information from the retail sector on supporting low carbon consumer lifestyles
- Climate Change Committee reports including sections on supporting shifts to healthier and more sustainable diets, household emissions reduction, and food waste reduction
- UN One Planet guidance on consumer information tools and facilitating low carbon choices
- Academic sources including Poore and Nemecek, Tufts, and Krause et al., which provide evidence-based policies for reduction of consumer emissions

Carbon Offsets & Removals

CARBON OFFSETS REMOVALS

You may not be able to eliminate all product emissions, particularly those related to ingredient. So, your business can purchase carbon offsets to compensate for any unavoidable emissions. Carbon offsets are activities that reduce emissions elsewhere, such as renewable energy or waste-to-energy projects. Offsets are typically procured via global carbon offset markets. **Carbon removals** are offsets that remove carbon dioxide from the atmosphere - e.g. tree-planting.

Companies are increasingly using carbon offsets to make claims of carbon neutrality. This means all emissions are compensated by an equivalent amount of carbon offsets. However, being carbon neutral is not the same as achieving Net Zero, and does not even necessarily mean a company has reduced its emissions.

A Net Zero strategy must minimise the use of carbon offsets by prioritising emissions reductions. Carbon offsets should be reserved for unavoidable emissions. Companies should publish their offsetting strategy and explain why certain emissions are unavoidable. Over time companies should move towards carbon removal offsets that sequester emissions.

Carbon offsets can play a positive role in your Net Zero strategy. But you should follow some established principles and standards, and use only **high-quality offsets** to avoid common pitfalls or accusations of greenwashing. This means offsets should be:
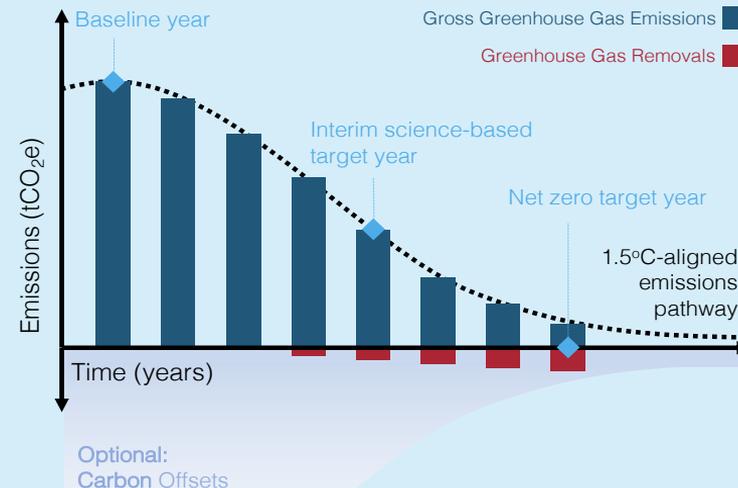
- Additional, permanent and legally enforceable
- Designed to avoid adverse social, environmental or economic impacts
- Registered with an official provider to avoid double-counting
- Certified by an independent scheme, such as the Gold Standard.

This is a complicated area, for **further guidance** on principles and standards, see:

- The Oxford Principles for Net Zero Aligned Carbon Offsetting
- The Gold Standard Principles
- Offset Guide: a more detailed resource on carbon offsets.

PROGRESS TO NET ZERO

Reduce emissions - As first priority, mitigate emissions as far as technically possible at a pace consistent with a 1.5C target

Baseline year

Gross Greenhouse Gas Emissions
Greenhouse Gas Removals

Interim science-based target year

Net zero target year

Emissions (tCO$_2$e)

1.5°C-aligned emissions pathway

Time (years)

Optional:
Carbon Offsets

Remove carbon - Net Zero is achieved when all residual emissions are neutralised with robust and permanent carbon removal & storage

Purchase offsets - On the journey to Net Zero, you could consider offsetting ongoing carbon emissions, ideally from within your supply chain (insetting)

For food and drink manufacturers it may be appropriate to procure carbon offsets related to land use or agriculture, given this is the largest source of the sector's emissions and where existing relationships may exist.

Nature-based carbon offsets can be designed to tackle not just carbon, but also some of the wider environmental impacts of agriculture. For example, a farmer could be paid to plant trees in strategic locations - removing carbon at the same time as increasing biodiversity, improving water quality and reducing flood risk. Such nature-positive approaches require careful design.

Carbon offsets relating to land use or agriculture can be bought from global carbon offset markets or national markets. In the UK verified offsets using nature-based solutions can be bought through projects listed with the Woodland Carbon Code or the Peatland Code. Markets for other types of nature-based solution have yet to be developed, though initiatives such as Financing UK Nature Recovery and the Ecosystem Services Market Consortium aim to mobilise more finance in this area in the near future.

Tackling supply chain emissions through carbon insetting

Food and drink manufacturers may have opportunities to reduce carbon within their own supply chain - called carbon 'insetting'. For example, businesses could enter into bilateral arrangements with ingredients suppliers to reduce emissions through low-carbon farming practices (see page 17), or through nature-based solutions. Another option is to employ the Landscape Enterprise Network (LENs) model, which involves collaborating with other organisations to deliver projects with multiple environmental outcomes, including can carbon removal.

The understanding of nature-based carbon removals is still developing. The Environment Agency has summarised the evidence on the potential of different types of carbon offset, including their effectiveness, permanence and the confidence in the science.

LENs project, River Eden

Photo: A. Dyer, Eden Rivers Trust

TYPES OF CARBON OFFSET

Carbon avoidance	The most common offsets involve avoiding the release of carbon dioxide, often by preventing deforestation or financing renewable energy projects. These can be purchased through global offset markets.
Carbon removals	Methods that remove carbon dioxide from the atmosphere, such as by growing trees or other nature-based solutions. Some emerging technologies remove CO_2 mechanically e.g. direct air capture.
Carbon insets	Offsets within your supply chain are called insets. You could arrange these through bilateral agreements with your suppliers, or through a consortium or networked approach.

Summary of Actions

SUMMARY OF ACTIONS

Achieving Net Zero by 2040 will require unprecedented business transformation over the next 18 years. And in the face of existing, serious impacts from climate change, action is urgent.

This Handbook has been developed to help the food and drink sector to accelerate towards significant decarbonisation. For businesses to do so successfully, the approach will need:

- Low carbon solutions to be placed at the heart of your business

- A strategic framework in which you measure emissions, set targets and finance actions

- Strong leadership showing that reducing emissions is a business priority

- Committed action by employees in all parts of your organisation.

Use the checklist on the following page which summarises our 16 recommendations for food and drink manufacturers to reduce emissions across all value chain stages.

GUIDE TO PRIORITISING ACTION	
1.	**Scope 1 & 2 emissions** – first priority as you have greatest control over these emissions, which come largely from your manufacturing processes
2.	**Scope 3 emissions** - start working with your suppliers and customers to jointly identify and design programmes to tackle product emissions.
3.	**Carbon removals** – these can compensate for unavoidable emissions. You should focus on projects within your own supply chain (carbon 'insets'), but should always be secondary to reducing emissions.

SUMMARY OF ACTIONS

Carbon offsets

Carbon offsets can compensate for unavoidable emissions in the value chain, once all feasible emissions reduction actions have been implemented. Companies should only use high-quality offsets certified by an independent scheme.

Ingredients & imports*

- ❑ Understand your ingredient emissions
- ❑ Procure lower carbon ingredients
- ❑ Reformulate products to reduce emissions

Packaging

- ❑ Assign internal responsibility for packaging emissions
- ❑ Set company policy on packaging sustainability
- ❑ Engage packaging suppliers to find low carbon options

Manufacturing

- ❑ Improve energy efficiency
- ❑ Decarbonise electricity
- ❑ Decarbonise process heat
- ❑ Shift to sustainable refrigerants

Distribution & Storage

- ❑ Embed climate performance into logistics services
- ❑ Shift to electric vehicles for light goods vehicles
- ❑ Optimise your HGVs

Customers & Consumers

- ❑ Understand customer expectations on climate
- ❑ Capitalise on growing demand for lower carbon products
- ❑ Engage consumers on climate issues and waste reduction

*This category includes emissions related to production of UK ingredients (agricultural emissions), as well as emissions embedded in imported ingredients, animal feed and finished goods (production, packaging and transport to the UK).

REFERENCES

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5	Infographic	GHG Protocol, Technical Guidance for Calculating Scope 3 Emissions
5	Table of emissions factors	Defra, Greenhouse gas reporting: conversion factors 2020 Potato emissions from various sources, e.g. Blonk consultants
6	Bar chart	WRAP's internal analysis provided privately
12	Infographic	NFU, Achieving Net Zero: Farming's 2040 goal
14	Pie chart	Based on WRAP's internal analysis provided privately
15	Text - 45% statistic	Defra, Food Statistics Pocketbook
15	Stacked bar chart	Based on WRAP's internal analysis provided privately
17	Infographic	Poore, J. and Nemecek, T., 2018. Reducing food's environmental impacts through producers and consumers. Science. AHDB, 2017. Carbon: Greenhouse gas emissions from agriculture.
17	Text - plant-based statistics	Mintel, UK Meat-Free Foods Market Report 2019
19	Figures on deforestation footprint	WWF & RSPB, Riskier Business
19	Beef import statistic	AHDB, How did the pandemic affect UK beef trade in 2020?
19	Text - UK carbon footprint	Department for Business, Energy and Industrial Strategy, Greenhouse gas emissions national statistics
20	Text - 9.5 Mt food waste	WRAP, Food Waste Data
20	Infographic	Zero Waste Europe, Food Systems: A recipe for food waste prevention
25	Infographic	WRAP's internal analysis & Poore, J. and Nemecek, T., 2018. Reducing food's environmental impacts through producers and consumers
29	Text - consumer opinions, para 2	YouGov, Customer survey
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40	Pie chart	Department for Business, Energy and Industrial Strategy, Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050: Food and Drink
40	Graph	Element Energy, Deep Decarbonisation Pathways for UK Industry - A report for the Climate Change Committee
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43	Text - 'CHP installed after 2023…'	UK Government, Bespoke natural gas CHP analysis
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52	Bar chart	Defra, Greenhouse gas reporting: conversion factors 2021
56	Text - consumers, point 3	Futerra, The Good Life Goals
59	Bar chart	WWF, Livewell
60	Text - 70% and 20% figures	WRAP, 2020. Food surplus and waste in the UK.
60	Graphic	Greencore, Food Waste Action Week: Top ten tips to minimise food waste

For further information, please contact NetZero2040@fdf.org.uk

6th Floor

Food and Drink Federation

10 Bloomsbury Way

London, WC1A 2SL

https://www.fdf.org.uk

This document has been developed with: **3keel** canopy **mikebarryeco**