

Eating patterns for health and environmental sustainability



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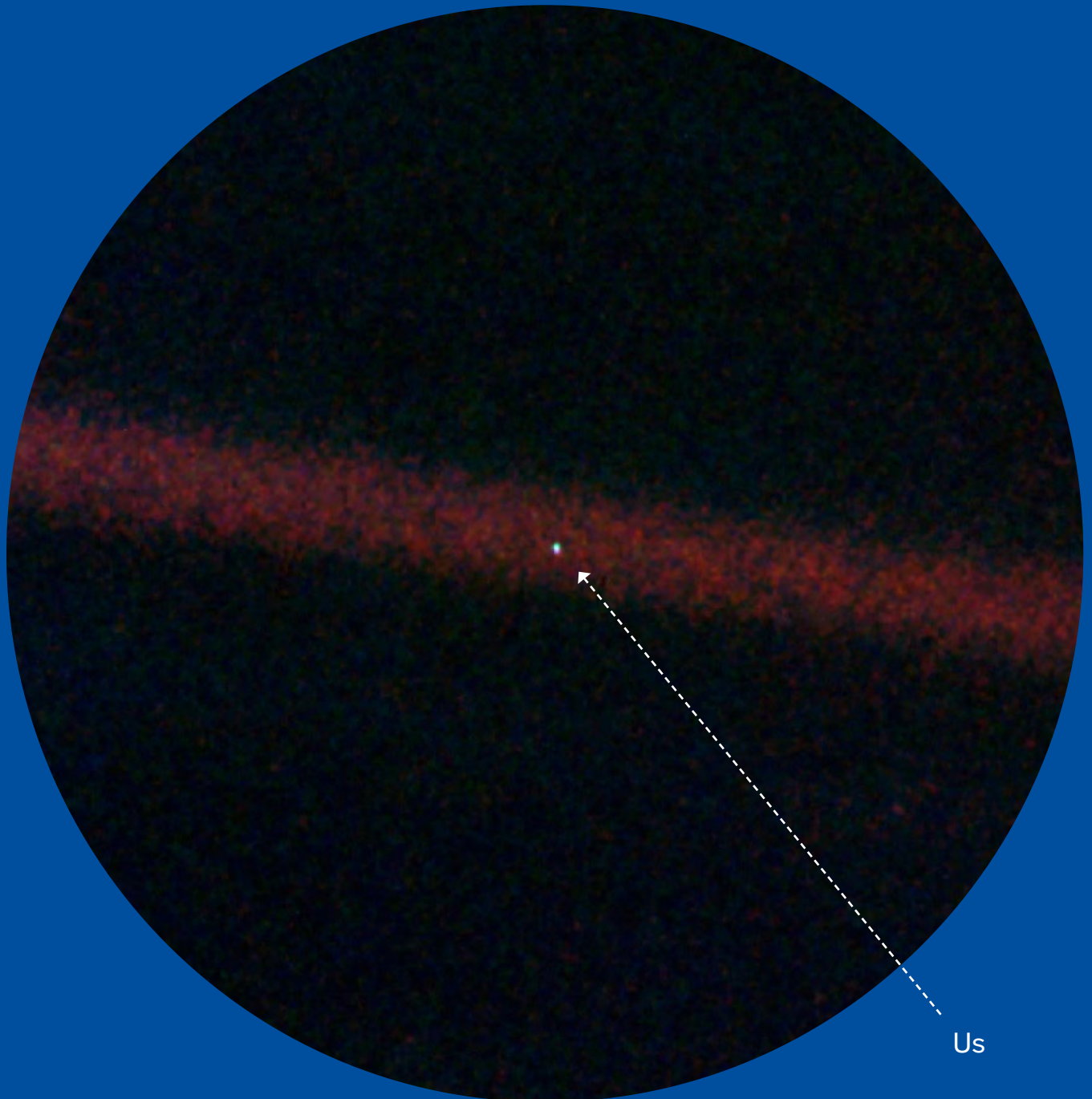
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Introduction



Photograph of the Earth taken by the Voyager 1 space probe on February 14th 1990 at a distance of 6 billion kilometers. ©NASA

We are one blue dot

The speck on the photograph taken by Voyager 1 as it left our solar system, is Planet Earth. It sits on the western spiral arm of an unremarkable galaxy in an unremarkable part of space. But it is our home. It is the only one we have and ultimately, the responsibility of taking care of it lies squarely with us.

In this, the early part of the 21st century, it is accepted that our eating habits are having an adverse impact on the environment and we are endangering the future of the planet.

There is mounting pressure for radical change from leading environmental specialists, organisations, and governments - as well as growing public interest and support.

We need to work together to combat climate change. By making dietary changes, it's win-win for the planet and health if we all act now.

BDA Dietitians are perfectly placed to help consumers, clients, and stakeholders navigate the complex messages surrounding this subject. They are able to translate national and international guidance to help the public understand what practical changes they can make to improve both their own health and that of our planet - our one blue dot.

About this guide

This reference guide forms the basis of a toolkit which expands on the BDA's Sustainable Diets Policy Statement. The policy states that the profession should be leading discussions on how our food behaviours can affect both health and the environment. Dietitians are in a strong position to combine healthy eating messages and sustainable diet advice.

The BDA believe that dietitians should be able to reconcile the nutritional and environmental science to give consistent messages about a healthy, sustainable, and varied diet. They should be aware of the challenges that may result for vulnerable groups and individuals (e.g. those suffering ill health, pregnant women, people on low incomes, and older adults) and be able to provide advice on sustainable eating as appropriate.

This reference guide forms the core part of the toolkit. This begins by describing the reasons that dietitians need to understand sustainable diets, before looking in more detail at what a more sustainable diet looks like. With reference to the UK Eatwell Guide, the guide considers specific nutritional issues raised by a more sustainable diet that dietitians will need to consider.

The wider toolkit will be made up of the reference guide, and other documents including practical tips, as well as plenty of links to other useful resources and information sources. The toolkit will, by necessity, remain “live” with updates and extra information.

We are grateful for the assistance of our Sustainable Diets Working Group for drafting this guide and identifying many of the useful links, to Alpro for providing an education grant, and to the many individual dietitians, allies and partners who contributed to the drafting process.

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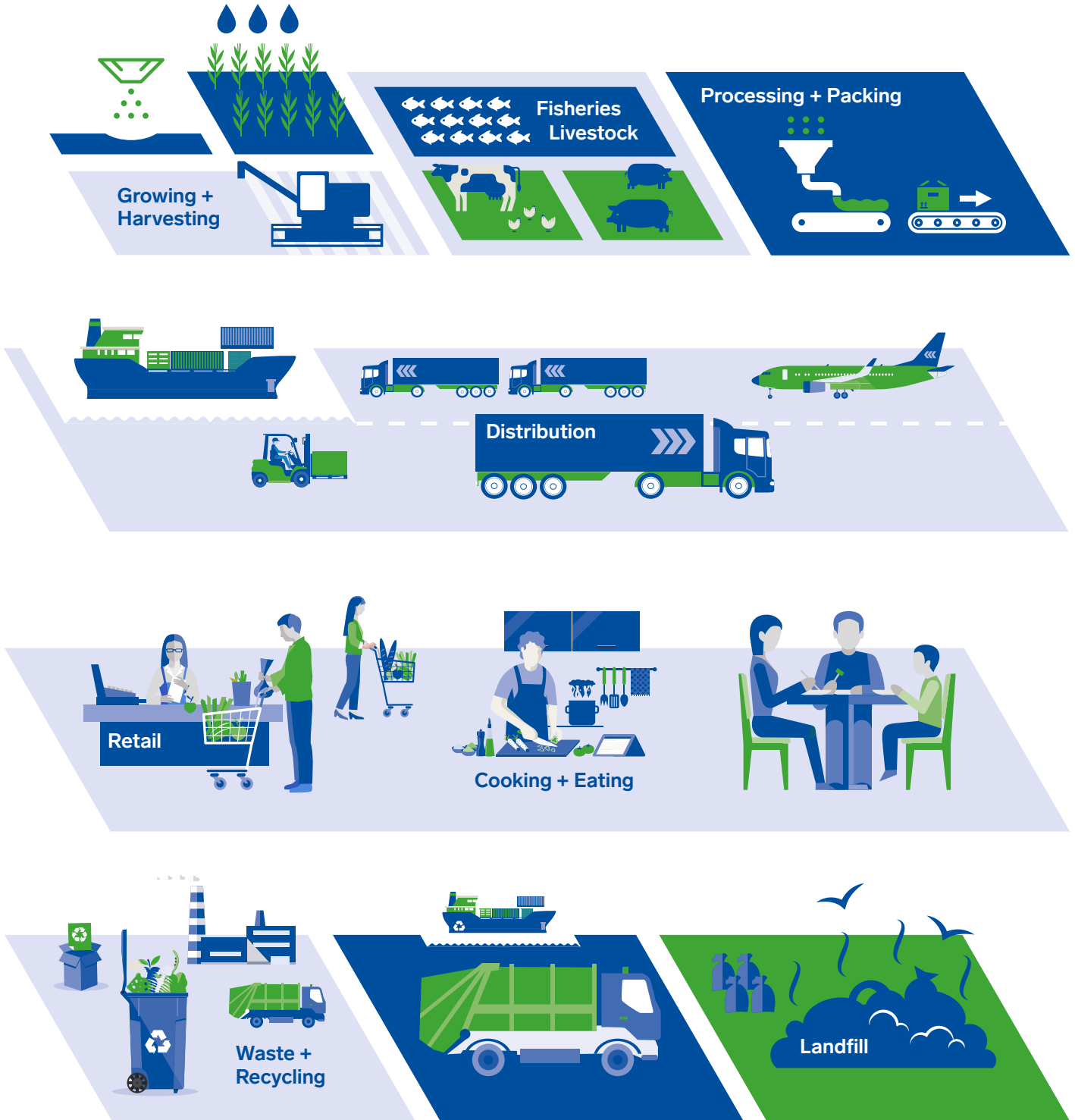
Our thanks to Dr Brian Cook, Senior Researcher in Health Behaviours, Nuffield Department of Primary Care Health Sciences for his contribution to the 'Motivators and Opportunities' section.



Why should environmentally sustainable diets be important for dietitians?

From farm to fork to waste

All stages of food production impact on the environment



Our current diets are harming the environment and our health

As dietitians, we are all too aware of the poor eating habits of the nation: low intakes of fibre, fruit and vegetables, and essential micronutrients whilst we are overconsuming energy, saturated fats, and sugars.¹ Our current dietary habits are fuelling obesity, type 2 diabetes, heart disease, and as some cancers.²

But, our eating habits also have an impact on the environment and are jeopardising the future security of our planet.

Taking into consideration farming, production, distribution, and delivery through to waste, our current food system has a major impact on the planet:

-
- Food production contributes 15-30% of total greenhouse gas (GHG) emissions in the UK and therefore contributes significantly to global warming.³

 - Is a leading cause of deforestation, biodiversity loss, and soil and water pollution.⁴

 - Accounts for 70% of all human water use.⁴

 - 9.5 million tonnes of all food produced is spoiled or wasted in the UK every year with the majority (71%) occurring in the home.⁵ Some of this is avoidable and represents a waste of land, water and other inputs, and produces 'unnecessary' GHG emissions.⁶

 - Over fishing and poor fishing practices have impacted on fishing stocks with 90% of fisheries now fully exploited⁷ and/or over fished, the marine vertebrate population fallen by more than a third⁸ and the marine ecosystem has been damaged.
-

The environmental impact

How current food systems damage our planet



Dietitians as key players in combatting climate change

This section looks at international and UK policies, as well as other stakeholder views. As part of the development of this guide and the preceding policy statement, the BDA undertook an online survey with members (319 dietitians), a workshop at the March 2018 BDA Live event (70 dietitians) and a specially convened focus group (8 dietitians). Feedback was also gathered from members during the development of the policy statement in 2017. This helped the working group to understand dietitians' perceptions and interest in the topic of sustainable diets. It became clear that this is a topic that dietitians feel is of growing importance. A range of possible barriers and challenges were also highlighted.

In particular, dietitians emphasised four key areas they believe we need to focus on to ensure that dietitians can play an important role in the facilitation of sustainable diets, as outlined in our 2017 Policy Statement:

-
- **Changing the environment and multi-organisation involvement:** Improving the availability of sustainable and healthier foods by developing integrated multi-organisation sustainable policies with government, local authorities, farmers, local producers, and NGOs such as food banks and commercial companies.

 - **Improving education and knowledge for health professionals as well as consumers:** A strong focus for under and post graduate dietetic training on sustainable diets, as well as placing sustainable diets on the school curriculum and training other healthcare professionals.

 - **Clear and simple language:** Making sustainable diets easier to understand and taking part in conversations which move us towards gaining a consensus.

 - **Relevancy:** Ensuring that messages were relevant for different population groups, especially teenagers, and accommodating different cultures. Use of social media was highlighted, especially for the younger generations.
-

These four key areas of focus have been considered to inform the development of this reference guide and associated toolkit aspects/elements.

Greenhouse Gas emissions, global warming and the food system

Increased Greenhouse Gas (GHG) emissions have a direct impact on global warming which, as well as increasing temperatures, cause extreme weather events (droughts and floods) and water scarcity.⁶ Whilst a rise is inevitable, the UN Intergovernmental Panel on Climate Change (IPCC) has proposed a safe limit for global warming increase by 2050. At the IPCC meeting of October 2018, experts set the safe limit for global warming increase to no more than 1.5°C by 2050 if we are to prevent catastrophic consequences for extreme weather conditions: heat, droughts, floods, and subsequent poverty.^{11,12} The glossary which accompanies this guide will assist you in better understanding terms like CO₂ eq and GHG emissions.

1.5°C

Recommended
safe limit for global
warming increase

Requires 70-95% reduction in
current GHG emissions by 2050¹²



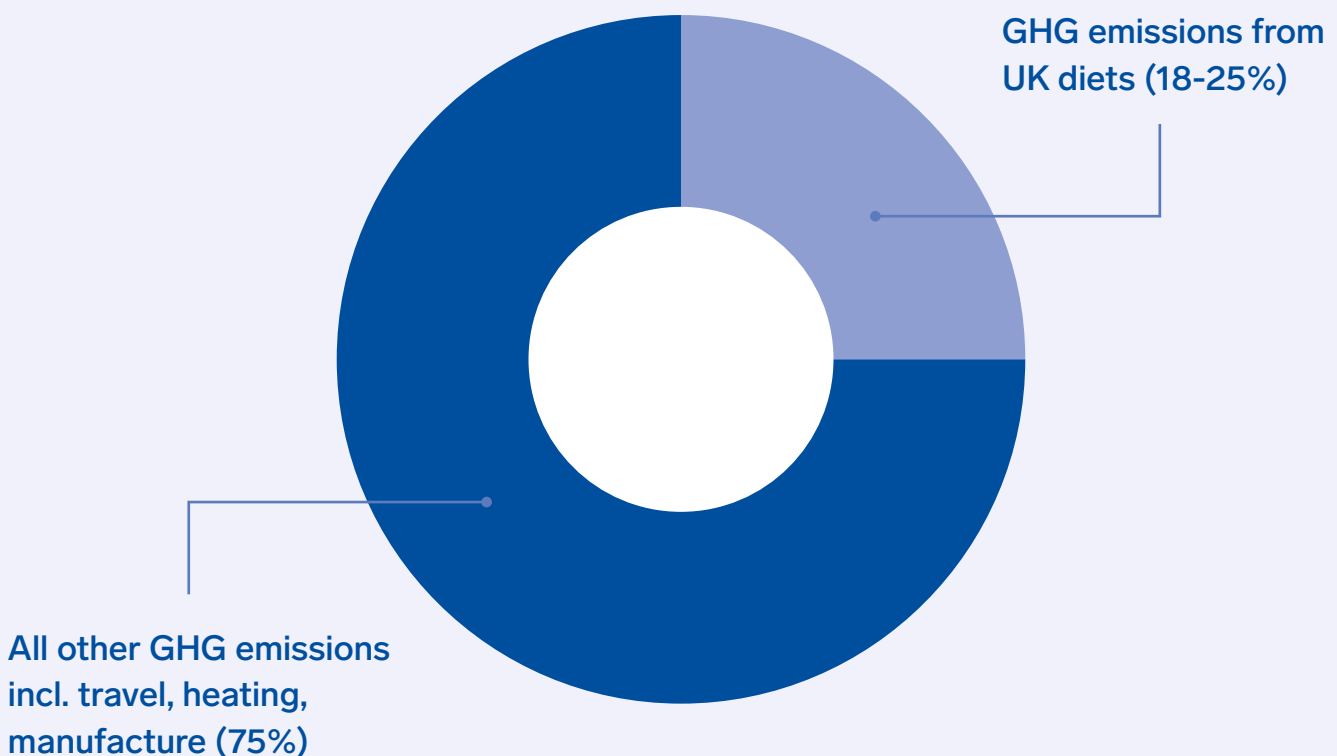
Fig 2.1: The UN Intergov recommendations Climate Change¹³

The IPCC's 2018 report emphasises that livestock is by far the biggest contributor to dietary GHG emissions, and urgent changes are necessary if the target of a 1.5°C rise is to be achieved. In the report, as well as focusing on changes to farming practices and food processes needed to mitigate the impact on global warming, it tackles the shifts needed in consumer behaviour change. With regard to diet, the IPCC's report lists specific actions that individuals should be urged to take, including the above.¹³

UK government policy

The UK Government, through a 2019 amendment to the Climate Change Act 2008¹⁴, is committed to an 100% reduction in GHG emissions by 2050 (compared to 1990 levels), and to contribute to global emission reductions to limit global temperature rise to no more than 1.5°C above pre-industrialised levels. This is supplemented by 5-yearly “carbon budgets”¹⁵ where the government sets out its GHG emission reduction targets. Even an 80% GHG emission reduction target equates to reducing our current emissions of 11.9 tonnes per person per annum from all activities (including travel, food, heating, etc.) down to 2.4 tonnes CO₂ equivalent per person by 2050.¹⁶

Fig 2.2: Current proportion of GHG emissions per person in the UK showing impact of dietary intakes



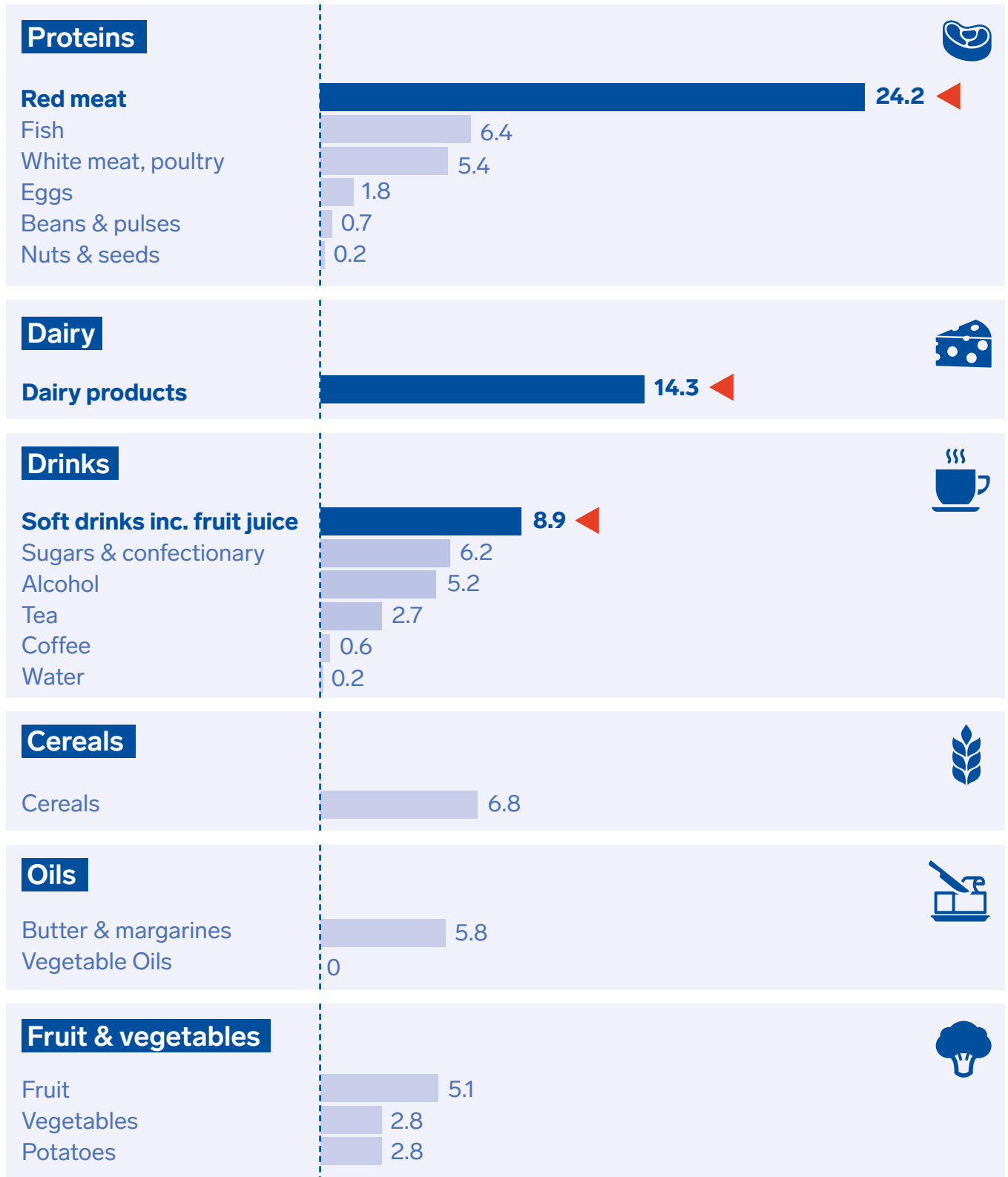
There has been no progress in reducing emissions from agriculture since 2008.

The UK Committee for Climate Change (CCC) report, Net Zero, included specific dietary recommendations that UK intakes of ruminant meat (beef and lamb) and dairy should be reduced by 20%.¹⁹

Current UK dietary habits (based on the National Diet and Nutrition Survey 2013/14) are estimated to contribute on average 2.1 tonnes CO₂ eq per person per annum. When taking account of typical under-reporting of energy intakes, this may be as high as 3 tonnes CO₂ eq.¹⁷ These values equate to 18% and over 25% of an individual's total (measured by carbon footprint of products, CFP).

The UK reduced its GHG emissions by 40% between 1990 and 2018, ahead of its carbon budget targets.¹⁸ However, the latest assessment by the Committee on Climate Change (CCC) has emphasised that the majority of these reductions are attributable to the switch from fossil fuel and that emissions from agriculture have actually increased slightly in recent years. There has been no progress in reducing emissions from agriculture since 2008.¹⁸ It is estimated that despite an excellent start, the UK will fail to meet future carbon budget targets, with projections of a 3% and 7% overshoot for the fourth and fifth budgets (2023-2032) respectively.²⁰

Figure 2.3: Foods that contribute the most to GHG emissions in the UK diet¹⁷



% GHG emissions (CO2 eq) of total dietary intake

Agriculture and food waste related emissions have failed to come down

The Committee for Climate Change in the UK voiced their concerns about our lack of progress in agricultural practices, and indeed the overall share of emissions is increasing as other sectors do more to reduce their footprint. Amongst its recommendations, the committee suggests urgent action to “help consumers to make food choices which reflect government nutritional advice and which support lower carbon footprint food products”.²¹ In practice, this means a reduction in meat (especially beef) and moderation in dairy intakes, with a consequent increase in plant food sources of protein such as beans, legumes, and seeds.

Additionally, the UK’s lack of resource efficiency policies, including food waste, is a key contributor to the projected overshoot of future carbon targets. Food waste alone (mainly in the home but also in food manufacture) will contribute between 16% and 12% to the projected overshoot in the fourth and fifth carbon budget targets respectively.²⁰ The committee has highlighted waste as a key priority for the government, recommending that strategies are put into place to ensure that no biodegradable waste, including food, is sent to landfill by 2025.¹⁸

The UK’s lack of resource efficiency policies, including food waste, is a key contributor to the projected overshoot of future carbon targets.²⁰

Devolved government policy

Sustainability is not just a priority for policy in England, but for each of the devolved governments in the UK. The Climate Change Strategy for Wales sets an even more ambitious target to reduce GHG emissions in Wales by 3% every year and achieve at least a 40% reduction by 2020 compared to figures from 1990.²² The Welsh Government action plan for the food and drink industry 2014-2020²³ also emphasises a vision of “green growth where [food] businesses are the custodians of our natural resources, businesses that are both environmentally and socially responsible”.

In Scotland, the government’s climate change plan for 2018-2032²⁴ went one step further, targeting a 42% reduction in emissions by 2020, and has the specific ambition for agriculture in Scotland to be among the lowest carbon and most efficient food producers in the world. The Good Food Nation policy, first published in 2014, set out an aspiration for Scotland to produce food which is “both tasty to eat and nutritious, fresh and environmentally sustainable”.²⁵

There are no specific targets in Northern Ireland for emissions reduction. However, it has asked the Committee on Climate Change to model a target of a 35% reduction by 2030 compared to 1990 levels.¹⁵⁹ Agriculture is a relatively high contributor to emissions in Northern Ireland and there has been little reduction since 2009 because of its contribution.

In Scotland, the government’s climate change plan for 2018-2032²⁴ went one step further, targeting a 42% reduction in emissions by 2020.

Growing public interest

Aside from the obvious policy drivers, dietitians are going to increasingly encounter individuals who are seeking information on the sustainability and environmental impact of their diets. In the UK the public are becoming more aware of how their eating habits impact on our planet.

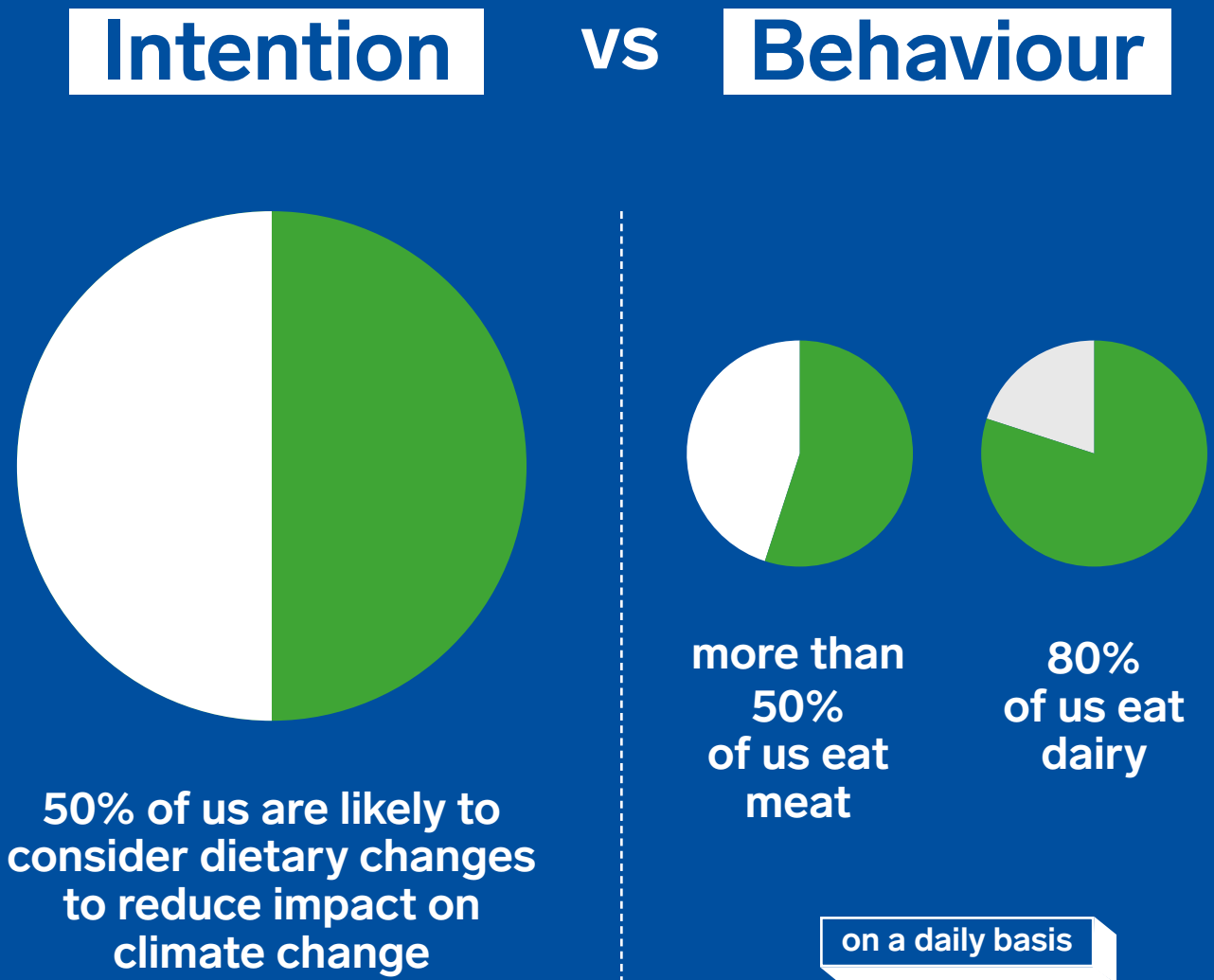
More than seven in ten (74%) people regularly surveyed by the Department of Business, Energy and Industrial Strategy, are very or fairly concerned about climate change.²⁶ This figure has grown slowly year on year since surveying began in 2012. A ComRes survey²⁷ has found that taste, value for money, reducing costs, convenience, and the healthiness of food rank most highly. However, over half of the respondents stated that they were likely to consider changes to their diets if doing so would reduce their impact on climate change. Whilst a fifth reported they consumed meat only once or twice a week, another 38% stated they would consider changing their diet in the future. Over half stated that they already seek to choose seasonal fruit and vegetables, whilst another third would consider doing so in the future.

Another Ipsos poll²⁸ has identified that although over half of respondents ate meat on a daily basis, 48% reported a consumption frequency of three times a week or less. A 2017 survey by the Food Standards Agency found a small decline in red meat consumption from previous surveys, with 84% of respondents reporting to consume beef, lamb or pork less than three times a week: however, this was at the expense of a higher white meat consumption. The survey also identified that dairy consumption occurred on a daily basis for over 74% of respondents.²⁹

In the UK the public are becoming more aware of how their eating habits impact on our planet.²⁶

Although the awareness and intention is there, it is clear from the latest UK dietary survey that this has yet to translate into sustainable dietary behaviour change for the majority, and significant barriers will need to be identified and overcome.

Fig 2.4: Intention vs current behaviour in samples of the UK population^{27,28}



Intention is there but significant barriers to behaviour change for the majority

3

What do we mean by a sustainable diet?

What do we mean by a sustainable diet?

Defining what is meant by a sustainable diet is difficult, and there is currently no consensus. The word sustainable itself is used in a number of ways, and there are generally accepted to be three broad ‘pillars’ of sustainability; 1) economic, 2) social and 3) environmental.³⁰ All three are important when considering overall sustainability, **but within the context of this reference guide and the BDA’s Sustainable Diets policy, we have focused specifically on an environmentally sustainable diet.**

Fig 3.1: The three pillars of sustainability³⁰













Further complexity is added by the fact that environmental sustainability itself can have a range of meanings, and that there can often be differing priorities – land and water use, GHG emissions, biodiversity, etc. Sometimes one priority can contradict another.

Despite this complexity it is important to have a clear direction of what is meant by the term sustainable diets, at least in relation to this reference guide. In this section we summarise the BDA recommendations and we consider definitions from key organisations and thinkers in the field, which taken together give a good indication of what is meant by an environmentally sustainable diet.















A clear direction 

The BDA Environmentally Sustainable Diet recommendations for the UK

<p>Red meat</p> 	<p>Red meat </p> <p>If consumed, no more than 70g/per person per day or 350g-500g per person per week (cooked weight).</p>	<p>Processed meats. </p>
<p>Plant proteins</p> 	<p>Prioritise beans and lentils, soya (beans, mince, nuts, tofu), mycoprotein (Quorn™), nuts and seeds. </p>	
<p>Fish</p> 	<p>From sustainable sources and follow oily fish recommendations.</p>	
<p>Dairy</p> 	<p>Moderate dairy consumption. Use calcium fortified plant-based alternatives where needed. </p>	
<p>Potatoes, bread, pasta, rice and other starchy carbohydrate foods</p> 	<p>Recommend wholegrain. Recommend tubers such as potatoes. </p>	

continues ↓

<p>Fruit and vegetables</p> 	<p>Seasonal + locally produced vegetables/fruit or tinned/frozen. </p>	<p>Air freighted, pre-packed and prepared fruit and vegetables. </p>
<p>Portion control</p> 	<p>Animal proteins </p> <hr/> <p>Dairy produce </p>	<p>High Fat, Sugar and Salt (HFSS) foods </p>
<p>Hydration</p> 	<p>Tap water and tea or coffee over soft drinks. </p>	
<p>Reduce food waste</p> 	<p>Especially perishable fruit and vegetables. </p>	<p>Any food waste should be recycled. </p>

 Avoid  Reduce  Moderate  Increase

Current definitions of sustainable diets

United Nations

The official definition of a sustainable diet from the Food and Agriculture Organisation (FAO) of the United Nations, which we use in the BDA Policy Statement, is:

‘Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; **nutritionally adequate**, safe and **healthy** while optimizing natural and human resources.’

FAO, 2010³¹

This definition, perhaps understandably, tries to define sustainable diets in the broadest possible terms, but has been critiqued for including too many stipulations. It is interesting to note however, that within its definition, the nutritional adequacy of a diet for health is included. In 2019 the FAO has expanded on this definition, creating more comprehensive guiding principles for sustainable healthy diets. They still have the aim of "promoting all dimensions of individuals' health and wellbeing; and having low environmental pressure."¹⁶⁰

Fischer and Garnett

Carlos Fischer and Tara Garnett from the Food Climate Research Network (FRCN) at the University of Oxford³² provide a more practical definition of a sustainable diet, taking on board key aspects of the FAO definition but with a clear focus on nutritional adequacy for health, or in their words: “low environmental impact diets consistent with good health”. The definition can easily be applied to current dietary recommendations.

'... low environmental impact diets consistent with good health...'

-
- Diversity – a wide variety of foods eaten.

 - Balance achieved between energy intake and energy needs.

 - Based around: minimally processed tubers and whole grains; legumes; fruits and vegetables.

 - Meat, if eaten, in moderate quantities – and all animal parts consumed.

 - Dairy products or alternatives (e.g. fortified milk substitutes and other foods rich in calcium and micronutrients) eaten in moderation.

 - Unsalted seeds and nuts.

 - Small quantities of fish and aquatic products sourced from certified fisheries.

 - Very limited consumption of foods high in fat, sugar or salt and low in micronutrients.

 - Oils and fats with a beneficial Omega 3:6 ratio such as rapeseed and olive oil.

 - Tap water in preference to other beverages – particularly soft drinks.

EAT-Lancet Planetary Health Diet

A very rigorous definition of a environmentally sustainable diet was provided in 2019 by the EAT-Lancet Commission. The Commission convened 37 leading scientists from 16 countries in various disciplines including human health, agriculture, political sciences and environmental sustainability. The commission reviewed global targets for healthy diets defined to reduce premature deaths from chronic disease, and sustainable food systems. Planetary boundaries directly linked to food production were assessed by six measures including greenhouse gas emissions, cropland and water use, nitrogen and phosphorus application, and biodiversity scores.

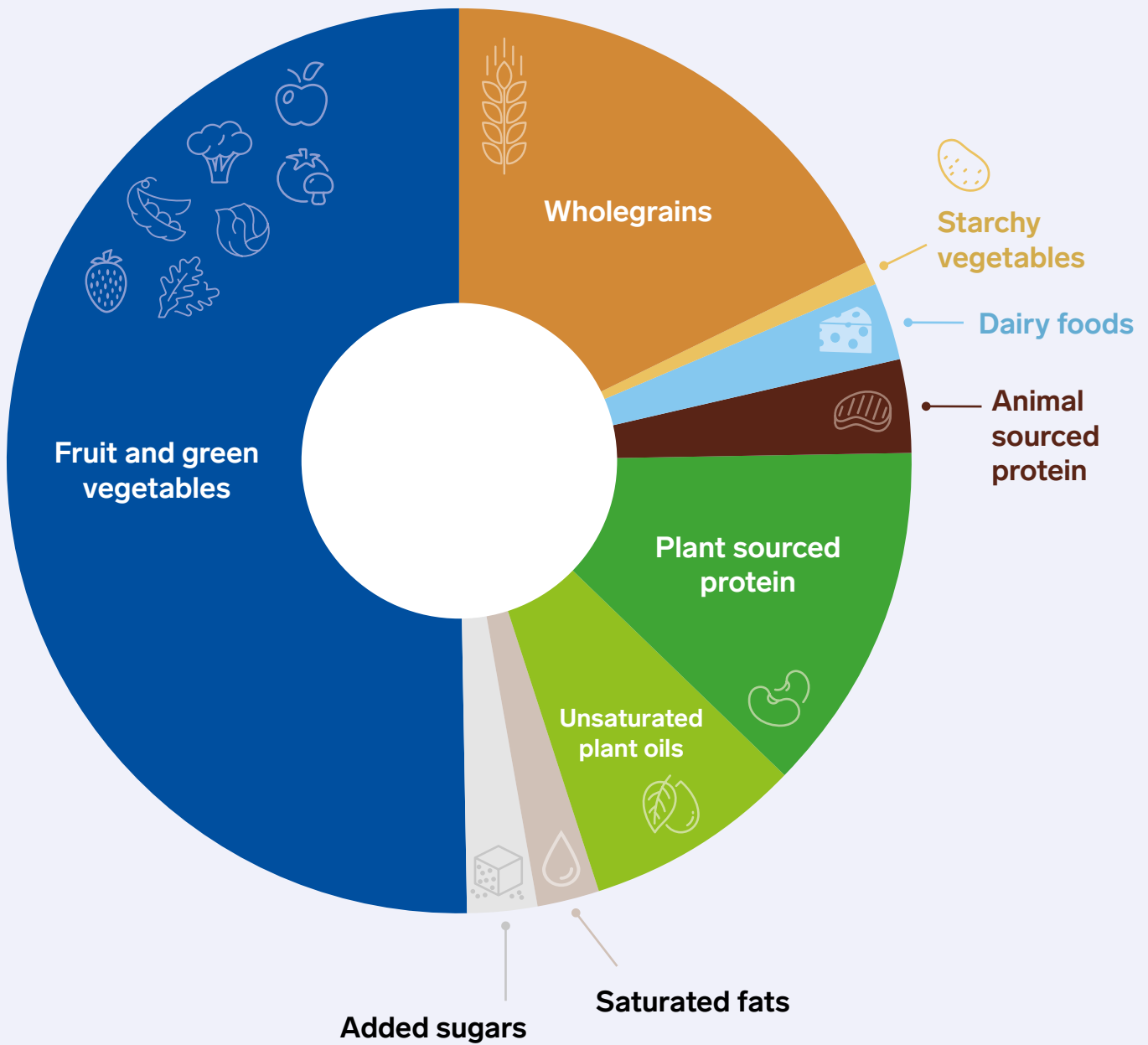
Overall, the commission recommends;

'doubling in the consumption of healthy foods such as fruits, vegetables, legumes and nuts, and a greater than 50% reduction in global consumption of less healthy foods such as added sugars and red meat.'¹⁶¹

The commission calculated a reference diet to provide adult reference intakes of energy, macro- and micronutrients. Compared to typical UK diets, the EAT Lancet diet contains more fruit and vegetables, more wholegrain starchy foods and more plant protein, but less meat and dairy, starchy tubers, sugars and processed foods.

They also provide specific quantities of foods, including as little as 14g per day of red meat, 29g of white meat but 75g of legumes and 50g of nuts. The BDA has deliberately avoided such a prescriptive approach, as individual diets will vary considerably. However, EAT-Lancet does provide a clear indication of the degree of change necessary to sufficiently reduce environmental impact from our food system.

Fig 3.2: EAT-Lancet Planetary Health Diet



Note: Percentages for food groups other than fruit and vegetables based on proportion of calories consumed.

For further information on terms and ideas, take a look at our glossary, which forms part of the wider toolkit.

4

**A more environmentally
sustainable diet can be a
healthy diet**

A more environmentally sustainable diet can be a healthy diet

The FAO, EAT-Lancet and Fishcher and Garnett definitions of sustainable diets state that such diets must be nutritionally adequate for the health of a population and therefore, sustainable diets can be synonymous with healthy diets.

However, care needs to be taken as not all healthy eating patterns are guaranteed to be sustainable and a diet that has a low environmental impact is not necessarily nutritionally adequate.³³ For example, sugar has a relatively low environmental burden whilst perishable fruit and vegetables can have a high environmental burden due to the high level of wastage, greenhouse energy use and air freight.

Overall, the scientific evidence consistently demonstrates some common traits between sustainable and healthy diets. In the main, a lower reliance on livestock products (especially beef and dairy), with a shift to more plant proteins (including wholegrains, beans, nuts and seeds), and reduced intakes of pre-packaged or highly processed foods, especially those high in fat, salt, and sugar.

Modelling and real consumption data studies have repeatedly demonstrated that dietary patterns of higher nutritional quality, which are based on healthy plant foods and lower intakes of meat and dairy products, also have lower GHG emissions and better overall sustainability scores.^{17,34-41}

Such dietary patterns, whilst meeting national micronutrient recommendations, tend to be lower in energy dense foods and saturated fat whilst providing higher fibre and fruit and vegetable intakes. It is not surprising, therefore, that healthy sustainable eating patterns have been associated with improved health outcomes such as reduced risk of obesity and reduced rates of diabetes and heart disease, and could result in reductions in total mortality by 6–16%.^{38,42}

Healthy, sustainable eating habits included in the government's Climate Change Act

As part of the government's Climate Change Act, agriculture and farming are targeted for improved practices to lower their carbon foot print. Changing current consumer dietary habits were a key focus in the fourth carbon budget.⁴³

Three dietary scenarios involving various adaptations to current intakes were evaluated for macro and micronutrient adequacy and environmental impact by Scarborough and colleagues – see Table 4.1. Scenario 1 showed significant reductions in all meat and moderation in dairy, and provided the most favourable outcomes for both environmental and health benefits.⁴⁴

Additionally, key micronutrients often associated with red meat and dairy consumption were similar to actual dietary intakes across all 3 dietary scenarios.⁴⁴ All dietary scenarios, including current intakes failed to meet male zinc dietary recommendations. With regard to iron intakes, despite reductions in red meat, iron increased in scenario one which could reflect contributions made from increased cereal product consumption. As expected, dietary vitamin D intakes were low across all dietary patterns.

Dietary modelling studies involving significant reductions in all meat and moderation in dairy, provided the most favourable outcomes for both environmental and health benefits.

Table 4.1: Three dietary scenarios based on modifications to UK dietary intakes* and the potential impact on health, nutrition and environmental outcomes.⁴⁴



1. Reducing current intakes **of all meat by 64% and dairy by 40%**.
2. Plus adapting intakes of **all other food group to meet recommendations**.

1. **Reducing red meat (beef and lamb) consumption by 75% and partly replacing with more white meat consumption (increasing consumption by 45%)**.
2. No other dietary adaptations.

1. **Halving current white meat consumption**.
2. No reductions in dairy or other meat.
3. Moderate improvements in other food groups.

GHG emissions		▼ 19%	▼ 9%	▼ 3%
Land use		▼ 42%	▼ 39%	▼ 4%
Delayed or averted deaths		36,910	1,999	9,297
	Current intakes			
Iron mg/d [#]	10.5	11.8	10.0	11.1
Calcium mg/d	904	854	908	943
Zinc mg/d [^]	8.3	7.4	7.6	8.4
Riboflavin mg/d	1.7	1.5	1.7	1.8
Vitamin A mcg/d	799	727	731	812
Vitamin D mcg/d ^{**}	2.7	2.3	2.6	2.6
Vitamin B12 mcg/d	5.8	3.9	5.2	5.7

* Meat, dairy and other food group intakes based on 2008 Family Food Survey data. Nutritional comparisons based on NDNS 2000/1 data.

[#] Iron: similar intakes across all dietary scenarios. None meeting female under 50 year recommendations of 14.8mg/d.

[^] Zinc: all dietary scenarios providing similar levels to current intakes. No dietary scenario meets male recommended intakes of 9.5mg/d.

^{**} Vitamin D consistent between current and all 3 dietary scenarios – all below latest recommended intakes of 10mcg/day.

Eatwell Guide: an example of a more sustainable and healthy diet?

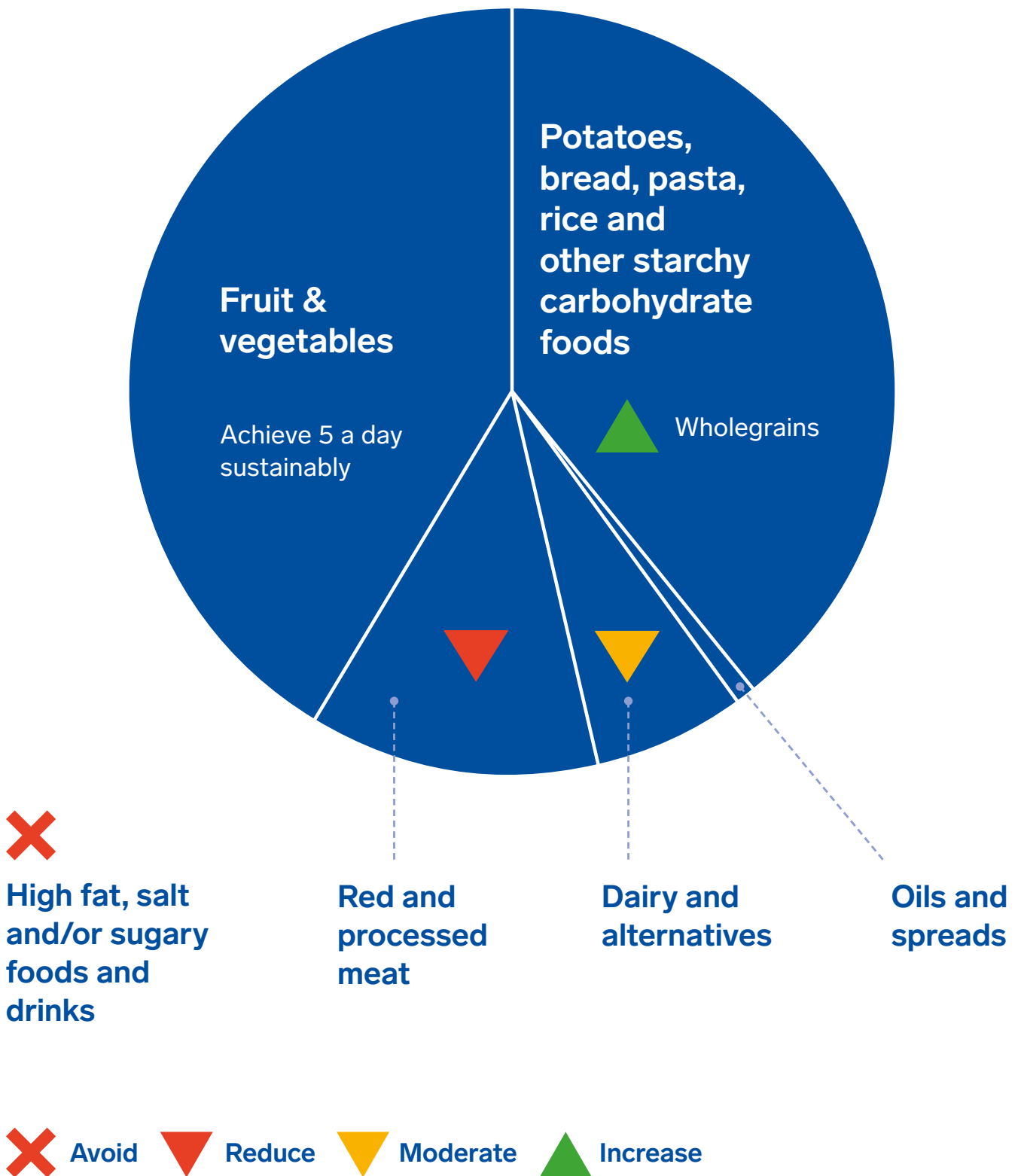
Public Health England sought to address sustainability in its broadest sense within the revised Eatwell Guide while at the same time ensuring that all macro and micronutrients and fibre recommendations were met.⁴⁵

As a result, the Eatwell Guide came with some notable modifications to its predecessor, the Eatwell Plate.

The Carbon Trust analysis of the Eatwell Guide shows a lower environmental impact than the current UK diet¹⁶ attributed to a number of factors, including an increase in potatoes, fish and bread, vegetables, and fruit, alongside reduced amounts of meat, dairy, rice, pasta, pizza, and sweet foods. The Carbon Trust estimates that if individuals moved from current eating patterns to the Eatwell Guide recommendations, a 31% reduction in GHG emissions, 17% saving on water use and 34% reduction in land use could be achieved. Based on the more recent assessment of UK dietary habits, estimating 2.1-3 tonnes CO₂ eq per person per annum,¹⁷ this means an individual's food related emissions would reduce to 1.5-2.1 tonnes CO₂ eq by 2050. This is a significant reduction and does not include the impact of improved farming and food production practices or reductions in waste which would further lower the carbon foot print.

The Carbon Trust analysis of the Eatwell Guide shows a lower environmental impact than the current UK diet.¹⁶

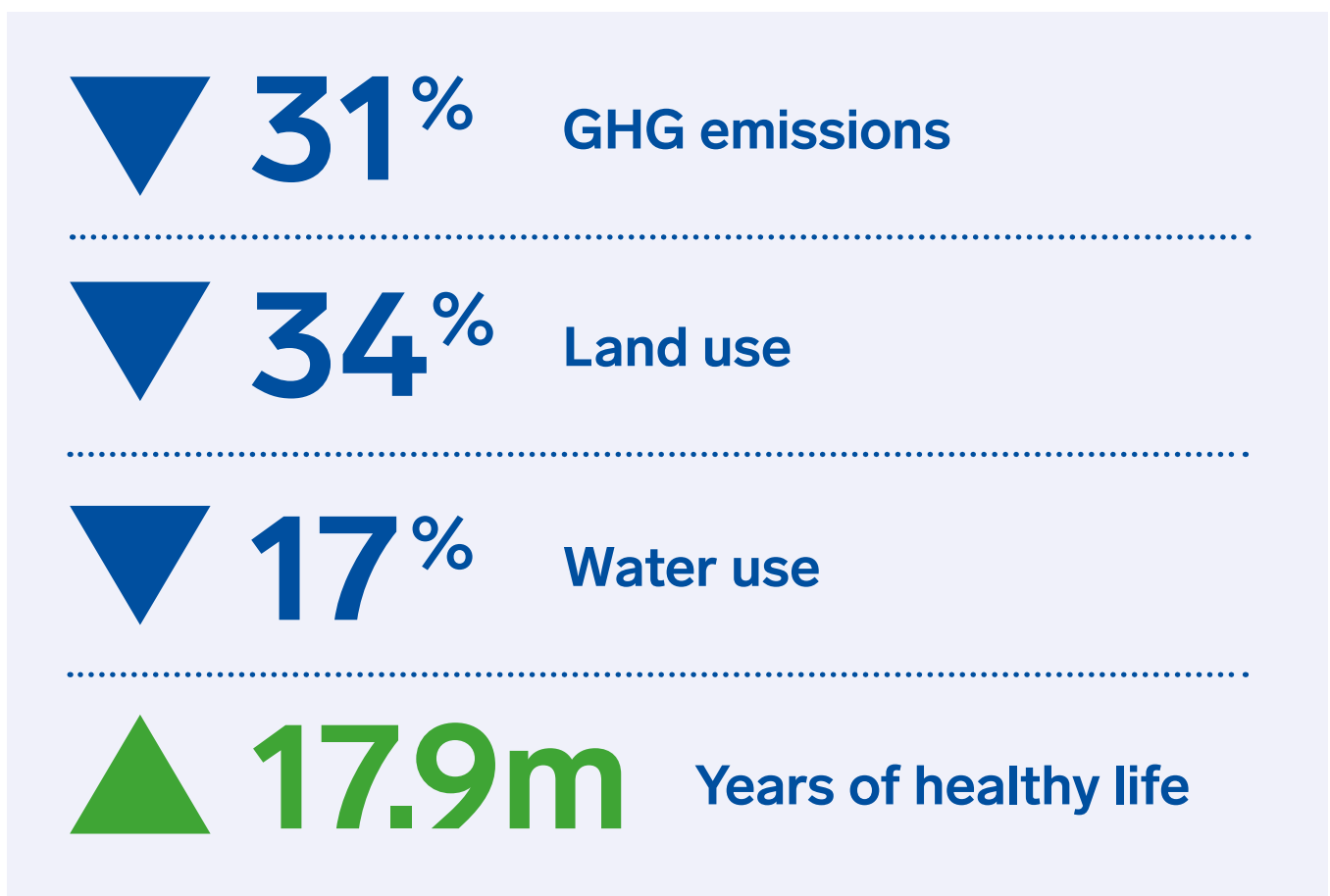
Figure 4.2: Summary of the changes when the Eatwell Plate was updated to the Eatwell Guide⁴⁵



As well as environmental benefits, the Eatwell Guide, if all recommendations are met and energy requirements are not exceeded, would increase life expectancy by more than five months. It would also avert 17.9 million disability-adjusted life years over the lifetime of the current population as a result of reduced incidence of type 2 diabetes, cardiovascular disease, and colorectal cancer.⁴⁶

The UK is not alone in adopting sustainable factors into national dietary guidelines. The current dietary guidelines of countries such as Canada,⁴⁷ Belgium (Flanders),⁴⁸ and the Netherlands⁴⁹ have also placed sustainability at the core of their recommendations.

Figure 4.3: Benefits of adopting Eat Well Guide recommendations^{16,46}



Reducing Red and Processed Meat (RPM)

The environmental impact

Red and processed meats have the single biggest environmental impact of any type of food, with beef and dairy cattle in particular contributing significantly to the environmental burden.^{17,50-52} Livestock farming is the biggest contributor to food related GHG emissions, deforestation, biodiversity loss, and soil pollution, as well as land and water use.

Red and processed meats have the single biggest environmental impact of any type of food.^{17,50-52}



Livestock farming:

-
- Globally, livestock are by far the biggest contributor to food-related GHG emissions, estimated to be responsible for 14.5% of all human-caused emissions.⁵⁴
-
- An assessment of UK dietary intakes (NDNS 2008/2009-2011/12) found that red meat alone (including beef, lamb, pork, goat, and venison) was responsible for 24.2% of dietary related GHG emissions whilst white meat contributed 5.4%.¹⁷ The authors took into account under-reporting and provided values based on 'plausible' food intakes over the course of a day.
-
- An earlier assessment by Green and colleagues⁵² using NDNS 2008/2009–2010/11, found similar findings and also provided a more detailed breakdown of GHG emissions of different types of red meat. Results were presented as per capita per year.
 - Based on this analysis: Beef consumption was by far the biggest single food contributor to dietary GHG emissions at 16.2%, lamb contributed 3.8%, whilst white meat contributed another 4.1%.⁵²
-
- Cattle are by far the largest contributors due to being ruminants (methane gas emitters) and the most commonly farmed animal.^{17,53,54} It is estimated that cattle are responsible for around 5.0 gigatonnes CO₂-eq, or 62% of the sector's emissions.
-
- Livestock is the largest single agricultural water user.
-
- Finally, livestock farming is responsible for degrading 33% of UK soil, polluting 1/3rd of water supply and has the biggest impact on biodiversity loss.⁹
-

Figure 4.4 illustrates that, taking into consideration regional and process variability, shifting our reliance from meat (especially red meat) to plant protein will significantly reduce both GHG emissions and land use.

Figure 4.4: Mean GHG emissions, land use and water use values of different foods providing 100g of protein⁵⁵⁻⁵⁷

These are average values based on a combination of data sets from around the world, therefore there will be significant variability depending on country of origin and practices used⁶. See table below.

	GHGe as kg CO ₂ eq per 100g of protein	Land use m ² per 100g of protein	Stress weighted water use 1000s litres per 100g of protein
Nuts	 0.3	 7.9	 140.8
Peas	 0.4	 3.4	 12.6
Other pulses	 0.8	 7.3	 10.5
Peanuts	 1.2	 3.5	 23.6
Tofu	 2	 2.2	 3.2
Eggs	 4.2	 5.7	 16.2
Poultry meat	 5.7	 7.1	 8.2
Fish (farmed)	 6	 3.7	 18.2
Pig meat	 7.6	 11	 41.3
Cheese	 11	 40	 81.9
Dairy cattle (milk)	 17	 22	 60.7
Shellfish (farmed)	 18	 2	 86.2
Sheep meat	 20	 185	 70.9
Beef meat	 50	 164	 17.4

“Water stress” considers several physical aspects related to water resources, including water scarcity, water quality, environmental flows, and the accessibility of blue (stored) water for human consumption. Therefore a product with high stress weighted water use, implies it is using blue water (storage water) for irrigation due to dry conditions which is depleting water stores that could be used for human consumption in an area whose overall water levels are already scarce. Crops relying more on rainfall will utilise more ‘green’ water, thus their stress-weighted water use will be lower.

Table 4.5: Fuller summary of the original data by Poore and Nemecek 2018 highlighting the significant variability in values for GHGe and land and water use.⁵⁵⁻⁵⁷

Functional unit	Per 100g protein											
	GHG Emissions kg CO ₂ eq				Land Use m ²				Stress-Weighted Water Use litres			
Environmental measure	5th %ile	Mean	Median	95th %ile	5th %ile	Mean	Median	95th %ile	5th %ile	Mean	Median	95th %ile
Beef meat	19	50	30	135	35	164	85	456	103	17,419	221	95,685
Dairy cattle (milk)	7.6	17	17	29	6.2	22	13	54	21,365	60,692	61,893	108,521
Sheep meat	12	20	20	30	24	185	64	362	129	70,927	129	297,490
Pig Meat	4.3	7.6	6.5	15	4.6	11	8.3	21	32	41,327	33,525	94,147
Poultry Meat	2.3	5.7	4.3	12	3.7	7.1	6.4	12	12	8,186	193	38,132
Cheese	4.6	11	8.4	27	3.6	40	9.1	146	787	81,907	36,442	358,171
Eggs	2.6	4.2	3.8	7.7	3.8	5.7	5.1	7.9	369	16,206	16,782	34,931
Fish (farmed)	2.4	6.0	3.5	14	0.1	3.7	2.5	12	2,417	18,229	3,720	58,695
Crustaceans (farmed)	5.0	18	10	78	0.4	2.0	0.6	3.5	15,570	86,160	32,998	666,721
Other Pulses	0.4	0.8	0.6	1.9	1.9	7.3	5.7	20	0	10,499	0	49,582
Peas	0.2	0.4	0.4	0.8	1.0	3.4	3.0	9.2	0	12,578	0	118,810
Nuts	-2.5	0.3	-0.8	6.6	2.5	7.9	5.3	16	0	140,778	79,219	494,586
Peanuts	0.5	1.2	1.3	2.3	1.6	3.5	3.0	5.9	908	23,605	16,941	74,536
Tofu	0.9	2.0	1.6	4.5	1.0	2.2	2.1	3.7	8	3,196	20	19,677

Additionally, the overall environmental impact will also depend on many other factors including biodiversity loss, deforestation, pollution of water, and degradation of soil.⁶

Meat protein's potent environmental impact is also reflected in studies looking at dietary patterns which consistently show a direct correlation between the quantity of meat in the diet and the projected environmental burden.^{36,37,44,58}

The health impact

Attempts to reduce rates of obesity, type 2 diabetes, cardiovascular disease, and cancers by the government,^{45,46} WHO,⁵⁹ and many health organisations include limiting red meat (especially processed meat) and/or shifting towards a diet with more plant protein as overarching dietary recommendations.

In 2011, SACN recommended that high red meat consumers (>90g per day) should reduce intakes to no more than 70g per day, to reduce colorectal cancer risk without compromising iron intakes.⁶⁰ The Eatwell Guide has prioritised plant proteins over animal proteins whilst assessing that micronutrients including iron and zinc are not compromised for the general population.⁴⁴ Current intakes of red meat alone in the UK, taking into consideration under-reporting within the national diet and nutrition survey data, is estimated to be at 90.5g per day.¹⁷ The WHO⁵⁹ has been emphasising more plant-based diets for a number of years and dietary recommendations from the WCRF^{61,62}, and Heart UK⁶³ focus on reducing red and processed meat intakes whilst increasing plant proteins. The WCRF has specifically recommended that processed meat should be avoided. Red meat, if consumed, should be limited to no more than 350-500g per week (50-70g daily).^{45,60,62}

In the main, reductions in red and processed meats are associated with reduced risk of colorectal cancer and reduced intakes of saturated fat and salt while the inclusion of plant proteins in the diet results in an improved fat profile, lower energy density and significantly increased fibre content.^{44,64-67} These dietary modifications are associated with reduced incidence of obesity, cardiovascular disease, type 2 diabetes, and some cancers.^{38,41,42,44,46,68-71}

UK's meat eating habits and how they impact on the environment

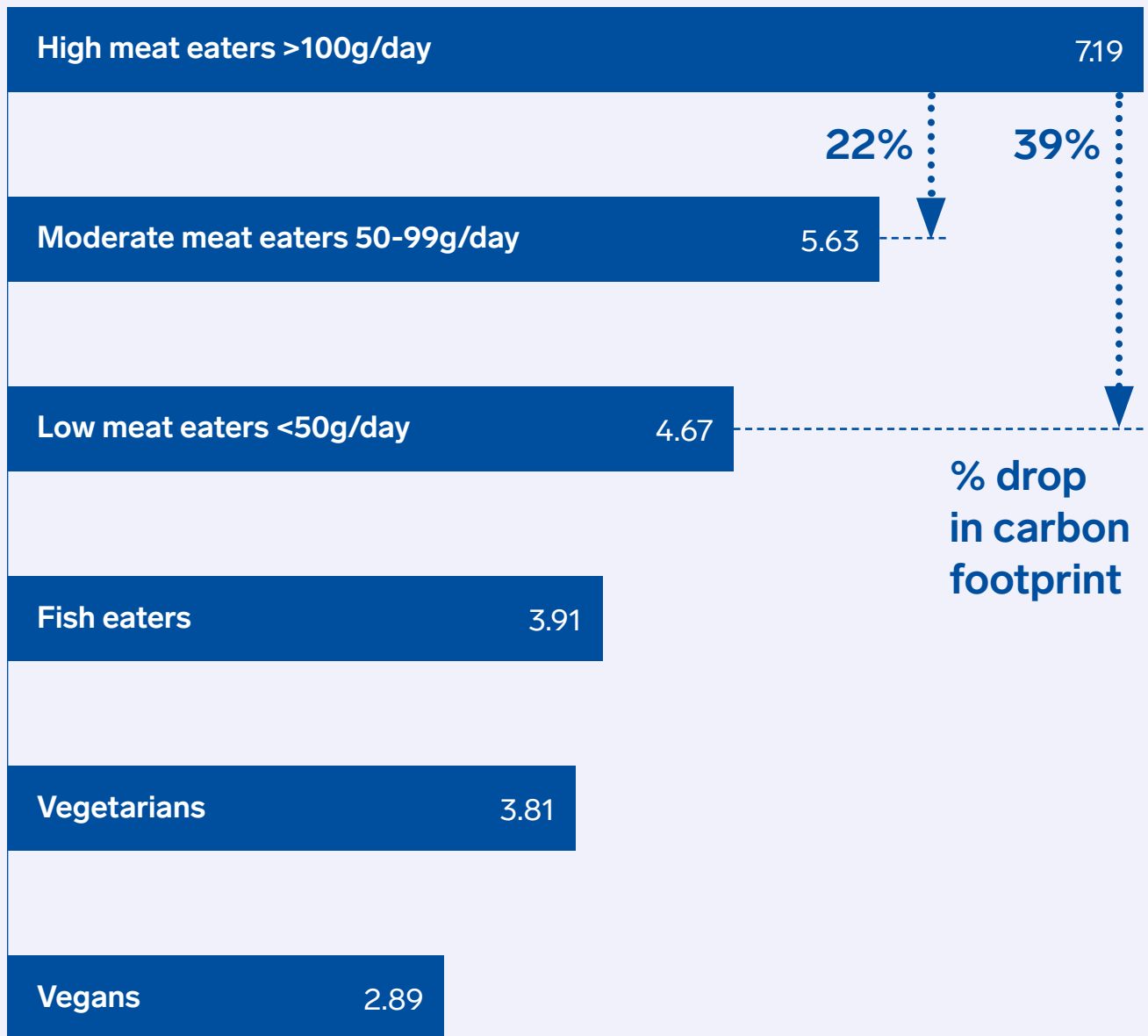
Figure 4.5 highlights that reduced intakes, and not avoidance, of meat can significantly reduce our carbon footprint.⁵⁸ A reduction in current UK consumption of total meat (108g per day)¹ for adults to 50-99g would reduce our carbon footprint by around 22% whilst a further reduction to below 50g per day would result in a 39% reduction. It is expected that similar savings would be made to land and water use as well as biodiversity loss, soil degradation and water pollution.

More recent UK consumption data (NDNS data set 2008/2009 and 2013/2014), further emphasise that switching to more plant protein sources is key to reducing the environmental burden and improving the nutritional quality of the diet (see Figure 4.5).¹⁷

39% 

A reduction in current UK consumption of total meat (108g per day)¹ for adults to below 50g per day would result in a 39% reduction in our carbon footprint.⁴⁴

Figure 4.5: Daily mean GHG emissions (kg CO₂ eq) per person consuming a self-selected diet of 2,000kcal.⁵⁸



Increase consumption of plant food sources of protein

A key part of a more sustainable diet is to consume more plant sources of protein in place of animal proteins. As discussed above, it is clear that shifting dietary patterns towards more plant proteins such as beans, pulses, nuts, and seeds will help reduce both the environmental and some of the health burdens we are currently facing.

Protein quality

Protein quality and quantity is not compromised when switching to more plant-based diets, whether meat and dairy are included at reduced quantities or totally excluded. Plants contain all essential amino acids and diets entirely based on a variety of plant foods which meet daily energy requirements will also meet all essential amino acid requirement.⁷¹⁻⁷⁶ Thus the terms 'complete' and 'incomplete' or 'high biological value' and 'low biological value' should be used with care as these only reflect the quantity and quality of essential amino acids in one serving of a single food and do not provide an assessment of the overall ability of a diet to meet requirements.

The graphs and tables above demonstrate the significantly lower GHG emissions, water use, and land use needed to produce 100g plant proteins versus 100g of animal protein. Additionally, it has been demonstrated that diets based predominantly on plants which meet national dietary needs have an overall lower environmental impact compared to high meat diets.^{33,36-38,41,42,46}



Moderate dairy intake

Compared to ruminant meat products, dairy products produce significantly lower GHG emissions, however, their footprint remains a major contributor to dietary emissions and is significantly higher when compared to plant-based alternatives. In terms of actual consumption in the UK, the most recent assessment of the NDNS data found dairy products to be the second biggest contributor after red meat at 14.3%.¹⁷ These findings concurred with the earlier assessment by Green and colleagues⁵² estimating dairy* (milk, yogurts, cream, cheese, ice-cream, dairy desserts) to be responsible for 11.7% of total dietary GHG emissions and second only to beef consumption. Green et al also identified cheese as the most GHG emission intense dairy product. Table 4.6 below shows that despite cheese consumption being significantly lower (15g per day) compared to milk, yogurt, cream, and dairy desserts (>189g/d), it was responsible for almost 40% of dairy GHG contributions.⁵²

Table 4.6: UK dairy consumption and estimated GHG emissions contributions⁵²

Dairy category	Consumption g/day	GHGe (kg CO ₂ eq per capita per year)	% contribution to total dietary GHGe	% contribution of dairy category only
Milk, yogurts, cream, dairy desserts	189	138	6.6%	56.5%
Cheese	15	97	4.6%	39.7%
Ice cream	5	9.3	0.4%	3.8%
All dairy	208	244.3	11.7%	NA

These factors are reflected in the government's more sustainable Eatwell Guide where the dairy section has been reduced by almost a half (from 15% to 8% of total food weight).⁴⁵ This means that dairy can continue to contribute to important calcium and iodine intakes in the UK diet.

*This does include plant-based dairy alternatives, but these represent a very small proportion of the total.

Environmental impact of dairy and plant-based alternatives beyond GHG emissions

Whilst this document relies mainly on GHG emissions as an indicator of climate change impact, the Sustainable Nutrient Rich Foods index (SNRF)⁸⁶ is a new measure which reflects both the climate and nutritional impact of food products. Using this system, dairy milk is rated as a food with good nutrients and medium climate change impact.

As well as considering GHG emissions from plant based dairy alternatives, it is important to also take note of other environmental factors such as land and water use which could mitigate any benefits of a lower GHG emission value. Table 4.7 highlights that soya dairy alternatives (tofu and soya drinks) are significantly more sustainable compared to dairy (cheese and milk) across all measures: GHG emission, land use and water use.

Data on plant-based drinks other than soya is more limited. Available data indicates that the overall environmental impact of plant-based drinks will be more favourable than dairy milk.^{77,79,80}

Table 4.7: Environmental impact of dairy milk, dairy cheese, tofu and soya drinks per average serving – from farm to household waste. Value ranges reflect the 5th and 95th percentiles. Taken from Poore & Nemecek 2018 supplementary data.^{55,57}

Dairy vs soya alternatives	Serving size	GHG emissions kg CO ₂ eq	Land use m ²	Stress-Weighted Water Use (Litres)
Cheese	30g	0.3-1.8	0.2-9.9	53.1-24,177
Tofu	75g	0.1-0.5	0.1-0.4	0.9-2,263
Milk	200ml	0.3-1.4	0.16-6.4	40.2-16,284
Soya alternative to milk	200ml	0.1-0.3	0.06-0.2	0.4-1,153

There is more information on plant-based milks in the One Blue Dot FAQ document which accompanies the reference guide. The FAQ highlights the variability in the environmental impact data available and different stages of the product lifecycle used for different foods, making comparisons sometimes difficult. Of importance, is the need to consider all environmental factors when assessing the sustainability of a product and not just GHG emissions, which although important, are not a reflection of the total environmental cost and sometimes trade-offs need to be made.

Dairy farm and production processes gradually improving to help reduce the environmental burden

Acknowledging the heavy environmental burden of dairy farming, in 2007, Dairy UK set out its roadmap for improvements in dairy production processes in the UK to reduce its burden. 10 years on, they have been successful in improving energy efficiency and effluent waste management (only 5% factory waste going to landfill and a target of zero factory waste sent to landfill by 2020).⁸¹ The report highlights that they still have a way to go and they have set further targets to improve biodiversity and soil quality.

Nutritional quality of plant-based drinks

Most non-organic variants are calcium fortified with a similar content and bioavailability to dairy milk.⁸²⁻⁸⁵ Additionally, many non-organic plant-based drinks are also fortified with vitamins B2, B12 and D⁸⁴ and some are now also fortified with iodine.^{85,162}

Meet fruit and vegetable intake targets

While the consumption of plant proteins would be more environmentally sustainable, assessing the environmental impact of fruits and vegetables is more complex and trade-offs between health and environmental impact may have to be taken into consideration. The environmental impact of fruit and vegetables will vary significantly depending on how and where they are produced. Consuming fruit and vegetables out of season which are produced in greenhouses and/or require heating, refrigeration, or airfreight and are perishable resulting in waste will mitigate any environmental benefits.^{6,54}

Perishable fruit and vegetables make up the majority of household waste which is a major source of potent GHG emissions.⁵ The environmental impact of using more affordable frozen or tinned fruit and vegetables is not necessarily greater than opting for fresh produce which will also require refrigeration, are often air freighted and make up the largest proportion of unavoidable food waste.^{54,87,88} Other considerations include water use, pesticide use and the impact on soil and water quality.

Seasonal, locally produced fresh vegetables and fruits are a better choice, with tinned and frozen produce reducing waste from perishability.⁵

Examples of particularly GHG intensive fruits and vegetables from the Food Climate Research Network⁸⁹:

-
- **Air freighted produce:** Typical examples include US berries and cherries, African green beans and peas, and pre-prepared salads produced outside Europe.

 - **Unseasonal Mediterranean style produce:** Grown either in heated greenhouses in the UK or under protection (sometimes heated) overseas. Examples include tomatoes, courgettes, aubergines, peppers, and salads.

 - **Pre-prepared, trimmed or chopped produce:** Examples include salad bags and bowls, fruit salads, and cut pineapple.

 - **Fragile or highly perishable foods:** These foods are prone to spoilage, which represents a waste of the energy embedded in their production, transport, and storage.
-

Currently few of the age groups monitored by the NDNS are managing to eat the recommended at least five portions of fruit and vegetables per day, with just 8% of children aged 11-18 and 31% of adults aged 19-64 achieving this.¹ Increasing awareness and nudging consumers towards more sustainably sourced fruit and vegetables and how to reduce waste will help bring down emissions whilst achieving the recommended 5-a-day. Based on current emission, land use, and water use data, a diet based predominantly on plants which includes fruit and vegetables to recommendations, will still lower GHG emissions significantly.^{41,42}

Consuming fruit and vegetables out of season will have a higher impact on GHG emissions.^{6,54}

Consume fish from sustainable sources

Consuming sustainably sourced fish is paramount for the environment: 90% of fisheries are now fully exploited or overfished, the marine vertebrate population has fallen by more than a third in the last 50 years and there is extensive degradation of the marine ecosystem.⁶

Sustainable fish sources are those that can continue indefinitely and do not have an impact on the wider ocean ecosystem. A 'certified fishery' has received certification from the Marine Stewardship Council (MSC). The MSC standards are based on three principles: sustainable fish stocks, minimizing environmental impacts, and effective management.⁹⁰

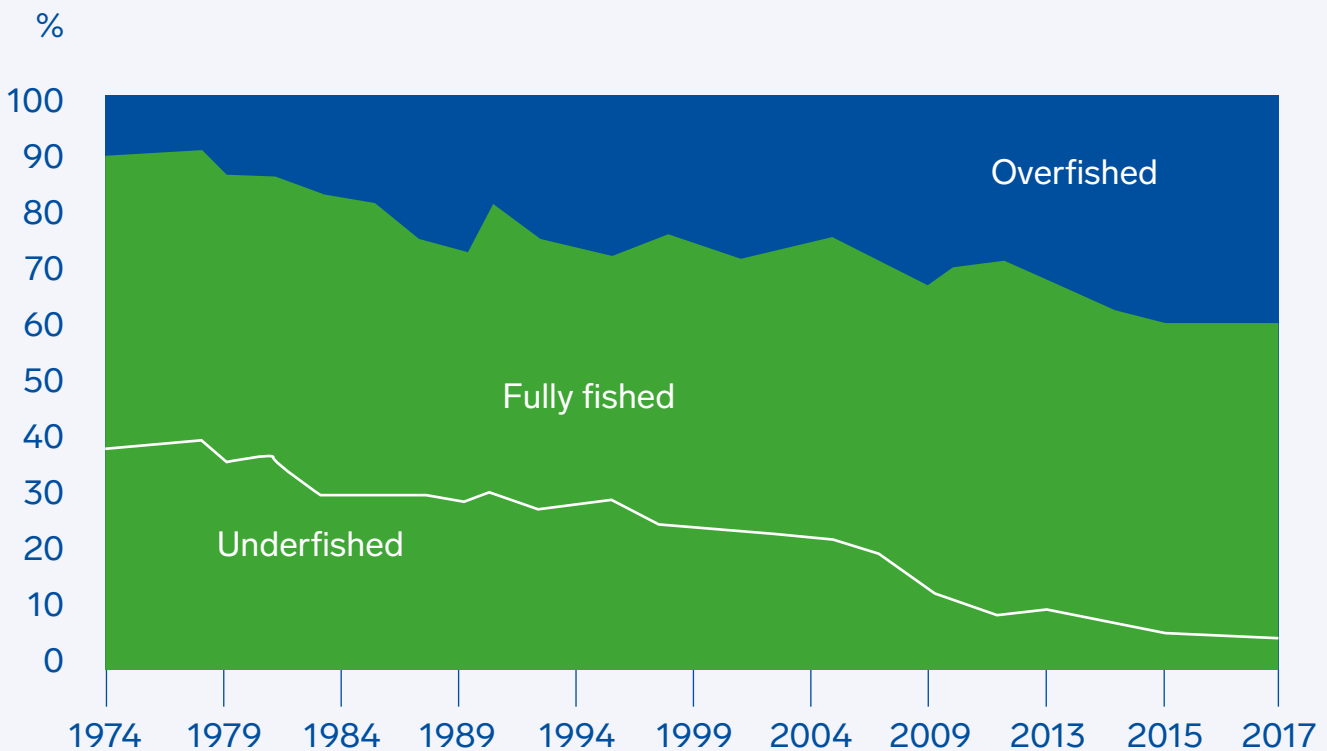




90% of fisheries are fully exploited or overfished⁷

Additionally for farmed fish, the Aquaculture Stewardship Council (ASC) logo represents sustainably farmed fish.⁹¹ The Marine Conservation Society (MCS) maintains a “Good Fish Guide” which can be used to identify which fish and shellfish species are most at risk and which are most sustainable.⁹²

It is important to eat a variety of fish species both for health and sustainability. The recommendation remains that the public should consume two portions of fish, one of which should be oily, per week. Reliance on marine foods should be for long-chain omega 3s and iodine only as other sources of lean and plant proteins are plentiful in typical UK diets.

Figure 4.8: The state of our fisheries: Global trends in the state of world marine stocks since 1974⁷



-  At biologically unsustainable levels
-  Within biologically sustainable levels

Sustainable hydration

Tap water remains the most sustainable and healthiest source of hydration and should always be recommended as such. Tea and coffee, although contributing slightly more GHG emissions (3.5% of the UK's dietary carbon footprint) compared to tap water, are still good sustainable hydration sources.^{17,52}

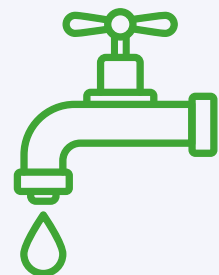
However, soft drinks and fruit juice are the third biggest contributors to our dietary GHG emissions (9-10%).^{17,52} Soft drinks require more energy to produce and have significantly higher transport costs as a result of a range of ingredients. Although the government's 2018 tax on sugary soft drinks will bring about appreciable health benefits, it will do little to help reduce the environmental burden as consumers are simply switching to unsweetened variants rather than reducing their overall consumption.⁹³ The impact of plastic waste from drinks packaging is also significant, and efforts should be made to encourage people to use refillable water bottles or public water fountains to rehydrate, plus to choose easily recyclable packaging.

Tea and coffee are commonly referred to as an important and healthy source of hydration.

Soft drinks and fruit juice are the third biggest contributors to dietary GHG emissions.^{17,52}



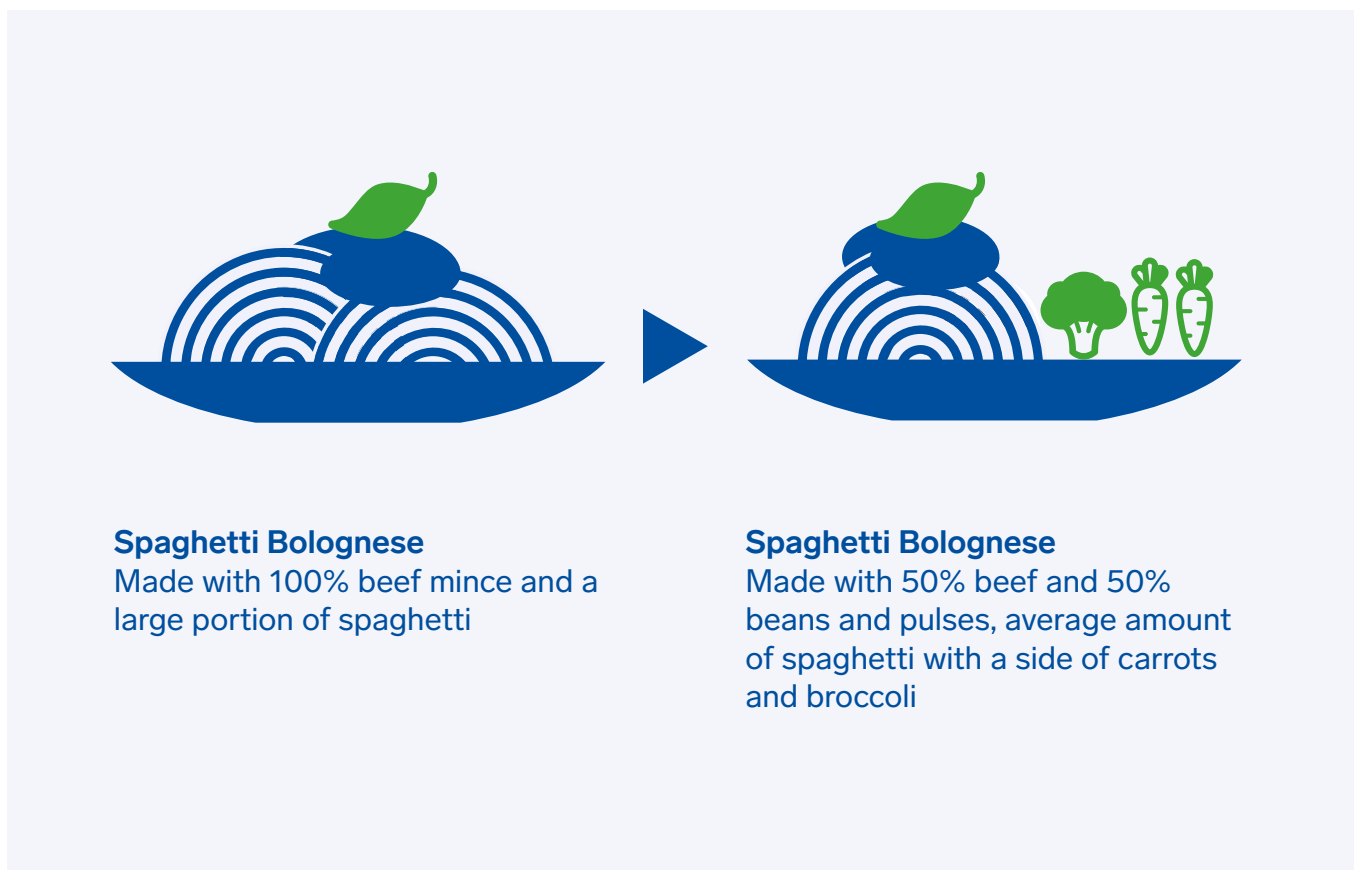
Tap water remains our most sustainable source of hydration.^{17,52}



Eating less energy-dense foods

In the simplest terms, overall dietary intake in the UK is too high, especially of energy dense, micronutrient poor foods.¹ The majority of the population needs to significantly reduce energy intake if we are to make headway with reducing obesity and obesity related diseases.⁹⁴ Currently, 63% of adults and 28% of children aged 2-15 years are overweight or obese.⁹⁵ To tackle this, the government is taking aggressive action to curb the offerings of high sugar foods, portion sizes, and calories by all out of home food suppliers.^{93,94} Correcting the over consumption of food and in particular animal proteins has been recognised as the most significant change that can be made to improve the sustainability of diets.⁹⁷

Figure 4.9: An example of altering energy density and improving sustainability in a typical meal



Waste less food and drink

Wasted food and drink, regardless of its source, is harmful to the environment because of all of the land, water and energy used in its production as well as the release of potent GHGs (methane) by decomposing organic matter in landfill.^{6,54} Household waste accounts for 70% of all food and drink waste which equates to approximately 25% of all food purchased.⁵ More importantly, 60% of food waste is avoidable. WRAP estimates that in 2018 the UK needlessly wasted 6.4 million tonnes of food, which is responsible for 25 million tonnes of GHG emissions.⁵ Positively, by 2018 there has been a 7% reduction in food waste from the 2015 Courtauld baseline, or a reduction of 480,000 tonnes of food waste.¹⁶³ This is good progress but more will need to be done. The government has been advised that policies to reduce food waste are paramount if the UK is to meet its future carbon foot print targets.^{19,20}

70%



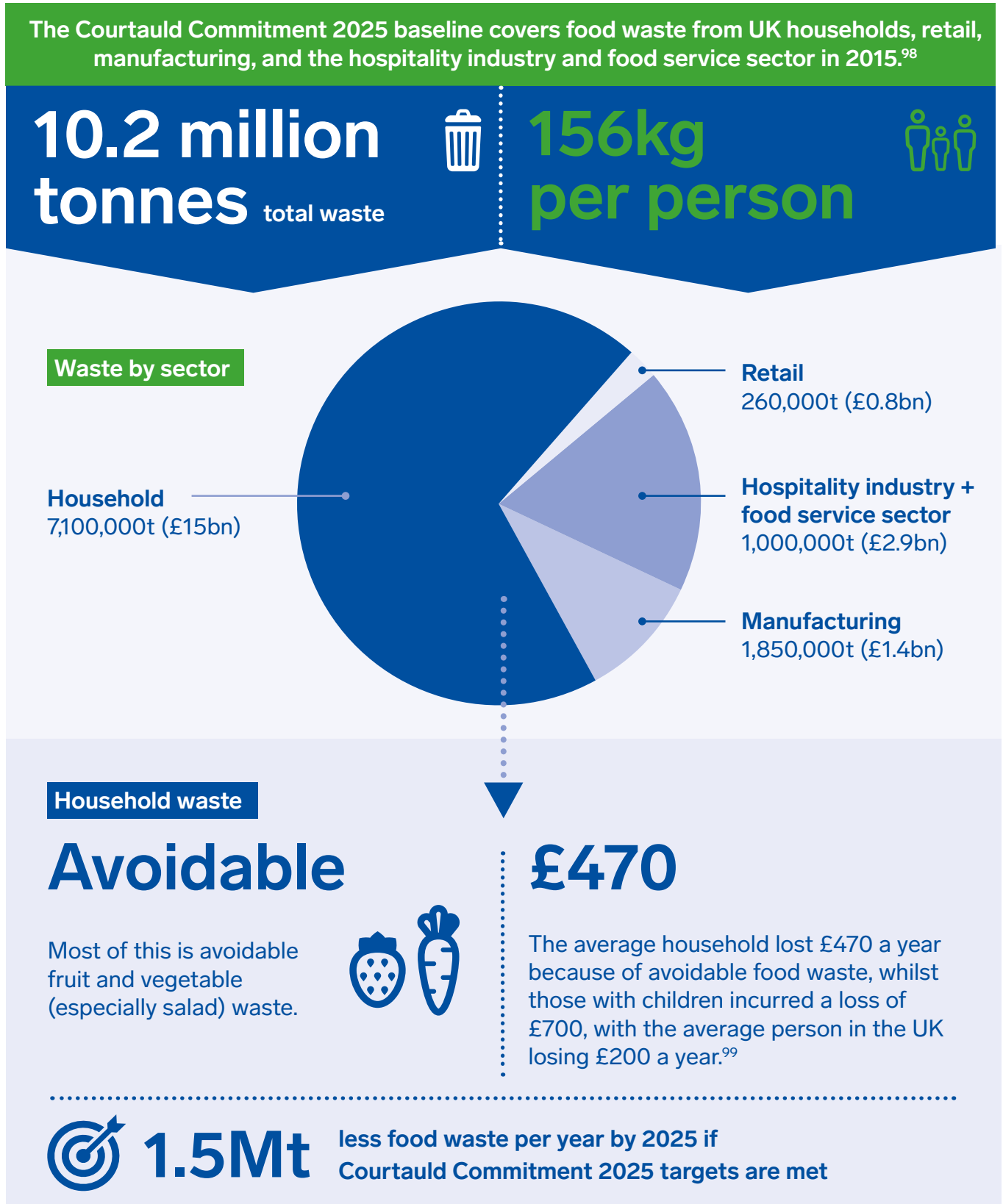
Household waste accounts for 70% of all food and drink waste which equates to approximately 25% of all food purchased.⁵

60%



60% of food waste is avoidable.⁵

Figure 4.10: Courtauld Commitment 2025 Food Waste Baseline



What is NOT meant by an environmentally sustainable diet

Given the broad definitions of sustainable diets, it is also important to consider what is not meant (for the purposes of our policy and this reference guide) by an environmentally sustainable diet.

Vegetarian or Vegan diets

As per the Fischer and Garnett definition³² and modelling undertaken on UK dietary habits,^{17,31,34,35,44,52,58} sustainable diets can be, but do not necessarily equate to vegetarian or vegan diets, although these do have a lower environmental impact than the typical UK diet. Research has shown that linking more sustainable or “plant-based” eating to vegetarianism and veganism will significantly lower the likelihood of the majority of the UK population changing their eating behaviour.¹⁰⁰ Therefore, for the majority of the UK population, emphasis should be placed on a significant reduction in meat and moderating dairy consumption alongside increasing consumption of plant foods to improve the sustainability and nutritional quality of a diet.

The BDA believes that dietitians are best placed and able to provide sustainable diet messages to meet all types of circumstance/eating preferences, including vegetarian and vegan diets.

Animal Welfare

Although animal welfare is an important consideration for many people when thinking about their food choices, it is not something that is usually within the definition of an environmentally sustainable diet.

However, it is beneficial that dietitians understand animal welfare issues, as they can be key motivators for some individuals to adopting a diet lower in meat and dairy. For more information on animal welfare standards the following links may be helpful:

UK Government Animal Welfare policy:

<https://www.gov.uk/guidance/animal-welfare>

RSPCA Farm Animal Welfare assurance scheme:

<https://www.rspcaassured.org.uk/farm-animal-welfare/>

Compassion in World Farming guide for consumers:

[https://assets.ciwf.org/media/7432869/compassionate food guide web download.pdf](https://assets.ciwf.org/media/7432869/compassionate_food_guide_web_download.pdf)

5

**Summary of specific
nutritional considerations**

Summary of specific nutritional considerations

Some dietitians and consumers have concerns that an environmentally sustainable diet places individuals at risk of deficiency for some key micronutrients and protein. The evidence-based Eatwell Guide and some international recommendations e.g. in Sweden and Germany demonstrate that a healthy sustainable diet that is predominantly based on plant foods can be nutritionally adequate.

For most adults who choose to consume the recommendations set out in the Eatwell Guide of reduced amounts of meat, dairy, and eggs and increased plant based protein sources, nutritional deficiency is unlikely. This section sets out some of the specific nutritional considerations of eating a more environmentally sustainable diet - and some of the population groups which dietitians should be aware of. Full details on these considerations and ideas on alternative sources of key nutrients are available within the full toolkit resources.

Protein

There is often concern that reducing meat and dairy intake will lead to reduced protein intake. The Reference Nutrient Intake (RNI) for protein is 0.75g per kilogram body weight per day in adults. This equates to approximately 56g/day for men and 45g/day for women aged 19-50 years in a person of healthy weight. However, NDNS data¹⁰¹ shows that most adults eat more protein than they require (87g for men and 67g for women). The reduction in protein food intakes required to balance the Eatwell Guide can easily be achieved by a shift away from meat, meat products and animal proteins.

Including more plant protein sources will increase variety in the diet, provide antioxidants and go towards achieving 5-a-day, as well as boosting fibre intake. As covered previously, fish can be consumed for long chain omega 3 fats, iodine and other micronutrients, but not for protein.

More detailed nutritional information on protein and plant based proteins is available on the One Blue Dot webpages for dietitians.

Iron

Red meat is the best source of bioavailable iron and for many people, a sustainable diet would still include some meat. SACN modelling estimates that red and processed meat contributes 12% of men's total iron intake and 9% of women's. This same research has shown that reducing red meat amongst those in the UK who consume large amounts (90g+) would have little impact on iron status of the adult population.⁶⁰

Men are unlikely to struggle to meet iron requirements from plant sources due to relatively lower iron requirements. However, in more vulnerable groups, such as toddlers, girls and women of childbearing age, low iron intake is a concern as low iron stores remains a health issue (even with current intakes of red meat). Fifty-four percent of girls aged 11-18 and 27% of women aged 19-64 have iron intakes below the Lower Reference Nutrient Intake.¹ However, when assessing the prevalence of poor iron status (below the threshold for both haemoglobin and plasma ferritin), this only translates to 9% of girls aged 11-18 years old and 5% of women aged 19-64 (NDNS Yr 7&8).¹⁰¹

In their report SACN highlighted the discrepancy between the high proportion of certain population groups having iron intakes below the recommended amounts and the low prevalence of poor iron status in these groups. They suggested this as an action for research as the DRV may be set too high.⁶⁰

Individuals following a diet lower in meat and higher in plant protein have been shown to have adequate iron intakes and meet national and international recommendations.^{66,67,102} Despite relatively lower iron bioavailability and lower overall iron stores, evidence of an increase in iron deficiency anemia amongst those consuming diets mostly placed on plant foods, such as vegetarian diets, is lacking.¹⁰³ Up to a point, the absorption rates of iron increase in individuals with low iron stores over time. In fact research shows that individuals can adapt to inefficient iron absorption in order to maintain iron status.¹⁰⁴ This may be due to an adaptation to the inhibitory effects of phytate on non-haem iron absorption.^{106,107,109} A study showed

that after consuming a high-phytate diet for eight weeks, non-haem iron absorption increased by 41% compared to baseline values.¹⁰⁸

According to the 2016 position paper of the Academy of Nutrition and Dietetics⁷¹, the absorption process appears to adapt effectively in the case of Western vegetarians because their haemoglobin values, and most other measures of iron, are within the normal range although iron stores are typically lower but not abnormal.

Alternative sources of iron for vulnerable groups include fortified breakfast cereals, nuts and seeds, or vegetables. Recent research has found the non-haem iron found in soya, is absorbed relatively well and does not appear to be affected by the classic inhibitors of iron absorption.^{111,114}

Supplements are a useful option, although a number of studies have identified low adherence to supplementation, in particular to iron supplementation.¹¹⁷⁻¹²⁰ This may be due to side effects, lack of understanding or inconvenience. Nonetheless, policies that advocate fortification with iron or the provision of supplements (in addition to current folic acid and vitamin D supplements) may be required and should be supported by dietitians.

More information for the public on iron:

<https://www.bda.uk.com/resource/iron-rich-foods-iron-deficiency.html>

More detailed nutritional information on iron and sustainable diets is available on the One Blue Dot webpages for dietitians.

Zinc

Red meat is also a significant source of zinc in the UK diet, and animal foods more generally are a major source of zinc. Good plant food sources of zinc include fortified breakfast cereals, beans and lentils, sunflower seeds, pumpkin seeds and nuts. Food preparation methods such as soaking and sprouting of beans, grains, nuts and seeds can improve its absorption.

SACN modelling estimates that red and processed meat contributes 32% of men's total zinc intake and 27% of women's.⁶⁰ Children in particular have low zinc intake, with 27% of girls aged 11-18 and 18% of boys reporting intakes below the LRNI.¹⁰¹

As with iron, for vulnerable groups consuming red meat below the SACN recommendations, supplements may need to be considered. Like iron, the bioavailability of zinc from plant sources is likely to be lower due to the presence of phytates.

Fully understanding the impact of reduced zinc bioavailability and intake has been somewhat hindered by the lack of sensitive clinical measures for zinc status.¹⁰³

More detailed nutritional information on zinc and sustainable diets is available on the One Blue Dot webpages for dietitians.

Calcium

A reduction in milk and dairy consumption would make an important contribution to a reduction in our environmental footprint. The Eatwell Guide has taken this into consideration as well as the need to meet the nation's calcium needs by reducing the recommended dairy contribution to the UK diet from 11 to 8% by food weight. Some concern exists about the impact for certain population groups falling below the LRNI: 22% of 11-18 females, 11% of 11-18 males and 11% of women over 19.¹¹⁵ It is therefore important that dietitians are able to make recommendations to patients to ensure they are consuming sufficient calcium, and this can include dairy products.

It is important to note that milk is not the only major contributor of calcium in the diet. Milk and dairy products contribute 34% of calcium intakes in 11-18 year olds whilst cereal product (mainly from the mandatory fortification of white flour) contribute 39%. Similarly with adults aged 19-64 years, dairy accounts for 34% and cereal products for 31% of total calcium intakes¹⁰¹. While milk and milk-products form 43% of calcium intake in the UK population, other sources, including especially white bread and products made with white flour (which are fortified) also play a significant role.¹⁰²

Most non-organic plant-based drinks and yogurt alternatives are fortified with calcium to a similar level and with comparable bioavailability to dairy. These have the added advantage of providing vitamin D (not present in UK dairy) which will further enhance calcium bioavailability and contribute to bone health.

As well as considering calcium amounts in food, we also need to take into account bioavailability. Milk and milk-products have calcium bioavailability of around 30%. Bioavailability of calcium from plant foods, which is related to oxalate content of foods and, to a lesser degree, phytate and fibre, is an important consideration.¹²¹

Absorption from high-oxalate vegetables, such as spinach and Swiss chard, may be as low as 5%, and so despite their high calcium content, they cannot be considered good sources. In contrast, absorption from low-oxalate vegetables, such as kale, turnip greens, Chinese cabbage, and pak choy, is about 50%. Soya foods such as calcium-set tofu and calcium-fortified soya drinks have similar bioavailability to milk and so can be considered good alternatives to dairy.^{83,122,124}

Dietary patterns in East Asia can be a useful consideration here – studies have shown that high intake of fruit and vegetables is associated with better bone health in these populations, despite the high incidence of milk intolerance. In client groups where calcium excretion is a concern, dietitians can advise on other lifestyle factors which can influence this e.g. smoking, caffeine intake and the benefits of physical activity.

More information for the public about calcium:

<https://www.bda.uk.com/resource/calcium.html>

More detailed nutritional information on zinc and sustainable diets is available on the One Blue Dot webpages for dietitians.

Iodine

Similar to calcium, NDNS data has shown that iodine intake is low amongst children and women and is a particular concern for pregnant women. 27% 11-18 girls, 14% of 11-18 boys and 15% of 19-64 women are estimated to be below the LRNI for iodine.¹ However, it is important to note that iodine intakes are a poor measure of adequate iodine status and according to the latest NDNS, iodine status as measured by spot check urinary analysis, was found to be adequate across all age groups.¹⁰¹

Iodine content in milk varies significantly, depending on seasons and farming practices. Iodine in milk is a by-product of iodine added to animal feed or used as a disinfectant, and organic farming practices or areas of origin can lead to lower iodine content.¹²⁵

Plant-based drinks are less often fortified with iodine. Iodine supplements should be considered for at risk groups or those with higher demands e.g. pregnant and lactating mothers. Iodine supplements are of mixed quality, and patients should be recommended supplements containing “potassium iodide” or “potassium iodate” and they should not exceed the daily adult requirement of 150 mcg. Supplements created from seaweed and kelp should be avoided as total iodine content can vary significantly and it is possible to overdose.¹²⁶

All marine-source foods are good sources of iodine.

More information for the public on iodine:

<https://www.bda.uk.com/resource/iodine.html>

More detailed nutritional information on iodine and sustainable diets is available on the One Blue Dot webpages for dietitians.

Vitamin B12

Vitamin B12 is only available from animal sources and a few fortified plant foods - breakfast cereals, plant-based drinks, fortified yeast extract such as Marmite. Even so, for most adults still consuming reduced amounts of meat, dairy, and eggs, achieving the 1.5 µg/day recommended by government should not be a challenge.¹²⁷ Supplements are strongly recommended for individuals following a vegan diet.

More detailed nutritional information on zinc and sustainable diets is available on the One Blue Dot webpages for dietitians.

Omega 3

As stated, SACN advice remains that people should consume two portions of fish a week of which one should be oily¹²⁸ in order to ensure sufficient long chain omega 3 intake. A portion is 140g of fresh fish or one small can of oily tinned fish. All fish and aquatic products should be consumed in small quantities and from certified fisheries, and people encouraged to eat a diverse range of fish, including from more sustainable populations. NDNS data¹⁰¹ indicates that all age groups on average consume less than the recommended amount of oily fish.

Non-marine sources of the omega 3 fat, alpha linolenic acid, include nuts and seeds e.g. walnuts and pumpkin seeds; vegetable oils e.g. rapeseed and linseed; soya and soya products.¹²⁹ However, research indicates these are good sources of alpha-linolenic acid (ALA), but are much less effective sources of eicosapentaenoic (EPA) and docosahexaenoic acid (DHA), which are related to health benefits.¹³⁰ Algae may be a promising sustainable source of EPA and DHA for the diet.¹³¹ However, products available produced from algae are currently very expensive.

More information for the public on Omega 3:

<https://www.bda.uk.com/resource/omega-3.html>

Selenium

Although there is good selenium intake in the very young, intakes are exceptionally low in all other age groups for both men and women with 25-76% falling below the LNRI¹. Despite fish being an exceptionally good source of selenium, cereal products and meat are the key sources in the UK diet.¹ 5-6 Brazil nuts daily will meet recommendations for older teens and adults, whilst 2-4 will meet the needs for younger age groups.

More detailed nutritional information on zinc and sustainable diets is available on the One Blue Dot webpages for dietitians.

Vitamin D

There is a significant drive for vitamin D food fortification in many countries, including the UK, due to the prevalence of sub-optimal status and lack of dietary sources.^{149,150}

Studies comparing vitamin D status between meat eaters and vegetarian and/or vegans reflect lower intakes and status in vegans and vegetarians. However, vegans still maintain serum 25(OH)D levels above 50nmol/L in winter and summer months.^{151,152}

Red meat, although providing some vitamin D, has a low concentration at 0.2-0.8mcg per 70g serving. Additionally, unlike other countries such as the US, UK dairy is not standardly fortified with vitamin D. Thus, reducing intakes of both meat and dairy will have little, if any, impact on vitamin D status or vitamin D related health outcomes.

More information for the public on Vitamin D:

<https://www.bda.uk.com/resource/vitamin-d.html>

More detailed nutritional information on zinc and sustainable diets is available on the One Blue Dot webpages for dietitians.



**Motivators and opportunities
for a more sustainable diet**

Motivators for a more sustainable diet

Food price

Food prices have remained fairly stable in recent years and for most people food has fallen as a proportion of income spent since 2015.¹³² However, meat and related products remain a relatively expensive commodity, especially for poorer people which may drive reductions in consumption.

Taste

One of the biggest drivers for foods choices is taste and/or taste perception. Therefore, to encourage the behaviour change needed to adopt a sustainable eating pattern, recommendations must ensure that taste will not be compromised and convince individuals that this is the case.

Accessibility

We can choose from a wider variety of food and drink products, and personalise our diets more easily than at any time in human history. Despite some areas of concern (e.g. food deserts in cities, rural villages), new product development, access to world foods, and online retail make it easier to access the foods we want in the UK. Plus, apps/digital technology mean we can identify products which meet our preferences.

The more accessible sustainable food choices are made, the more likely it is for consumers to eat more sustainably. Therefore, an integrated multi-organisational approach is fundamental, bringing together government, NGO's, food providers, local authorities, and consumers.

Health

As has been discussed throughout this reference guide, reducing red meat intake in particular and increasing plant food intake is beneficial to health. Some people may be motivated to improve their diet in this way and as a consequence improve the environmental sustainability of their diet.

International considerations

The impact of our food choices and over consumption on the rest of the global human population may well be a driver for some. Nearly 690 million people in the developing world are undernourished and about two billion do not have regular access to safe, nutritious and sufficient food.¹³³ There is an increasing demand for food from a growing human population, and a challenged food system that is already stressed by the degradation of global ecosystems.¹³⁴ The FSA's 'Our Food Future' Report highlighted a range of concerns from members of the public about the safety and sustainability of the food system at a global level.¹³⁵

Food Waste

Linked to food prices, some people will desire to waste less food, potentially for environmental but also for financial reasons. The total cost of wasted food in UK homes is estimated to be worth £13 billion per year.¹³⁶

Popular champions

UK food writers like Jack Monroe and Jay Rayner, celebrity chefs like Hugh Fearnley-Whittingstall and environmentalists like Sir David Attenborough have popularised discussions on eating well for the planet with their followers. Although growing awareness has not translated into behaviour change for most, this could still be used as a driver alongside other strategies.

Animal welfare

Many people choose to reduce their meat or dairy intake for ethical reasons related to animal welfare, and in doing so, reduce their environmental impact. This is a complex area as animal welfare considerations are not necessarily entirely compatible with sustainable diets - often the most environmentally sustainable forms of meat or dairy production have the worst animal welfare implications.

This concern for animal welfare extends to those animals harmed indirectly by the production of meat, fish or dairy, such as deforestation for cattle ranching and soya based animal feed, or environmentally unsustainable fishing practices.

Language

Many perceive eating "plant-based" food as restricted to vegetarians or vegans. A 2018 conference looked at 'How Language Can Advance Sustainable Diets'¹⁰⁰ and found that the descriptions of these can play a critical role in this negative perception. It was shown that putting these dishes in a vegetarian section of a menu can reduce consumer ordering by 56%. Similarly, calling a dish "healthy" - a typical term used for "plant-based" food - can suppress perceptions of taste and how filling a food will be. New research, however, is finding that changing the language of food on menus and in dining environments can help overcome these perceptions and significantly impact consumer behaviour.

Recent experiments suggest that giving vegetables indulgent names and descriptions can increase sales.¹⁵³ Researchers changed the names of vegetables to sound more indulgent (e.g., "slow roasted caramelised zucchini bites") and this led to a 25% increase in the number of diners choosing them compared to basic labelling ("zucchini").

Creating supportive environments

Individual lifestyle counselling involving motivational and educational sessions with trained health professionals can be effective in promoting more sustainable diets, but are unlikely to be a scalable option. Research has shown that the environments within which food choices are made (physical, economic, digital, social, cultural, and more) exert a very significant impact on decisions people make. The environments we navigate every day contain a huge number of cues that we interact with, mostly below the level of awareness. Research points to a number of strategies that can be harnessed to reshape food environments into ones that support healthy sustainable diets. However, much of the research has been done in experimental or virtual settings and more work needs to be done in real consumer environments to understand what works.

Increasing availability

Increasing the relative availability of healthier, more sustainable food choices (e.g. increasing the proportion of vegetarian sandwiches from 25% to 50%) may lead to more consumers choosing veggie options. A recent review of interventions in vending machines (in schools, universities, hospitals, and worksites) found that five of the seven studies that increased the availability of healthier foods saw increased sales of these foods with no loss of overall sales.¹⁵⁴ Making more choices available means that there's greater variety for different tastes but it also has the effect of helping to normalize these options. This is especially important for meat-free choices that often suffer the stigma of being seen as only for those who identify as vegan or vegetarian.

Decreasing portion size

Decreasing the portion size of meat in a restaurant meal has been shown to decrease meat consumption, but just as important, the research also found that there was no negative impact on customers' perceptions of their restaurant experience.¹⁵⁵

Research has shown that placing vegetarian meals at the end of a menu and in a separate section decreases the selection of those meals even by vegetarians.¹⁵⁷

Positioning

A recent systematic review of evidence on “nudges” to reduce meat consumption found that positioning vegetarian choices to give them priority over meat items could be a promising way to reduce the demand for meat in some settings.¹⁵⁶ In these experiments, meat options were repositioned to appear after, rather than before, vegetarian options in online meal booking systems or on restaurant food menus. Other research has shown that placing vegetarian meals at the end of a menu and in a separate section decreases the selection of those meals even by vegetarians.¹⁵⁷

Promoting shifting social norms

Marketers often draw attention to what others are doing as a way to influence consumers’ choices. Most famously, for years many McDonald’s restaurants displayed “over 99 billion served” on their signs. Some studies have looked at the effect of promoting sustainability norms on food purchases. As part of a survey, researchers at Stanford told people standing in line at a café that “over the last 5 years, 30% of Americans have started to make an effort to limit their meat consumption”. Customers were more likely to order a meat-free lunch (34%) compared to a control condition (17%).¹⁵⁸

7

**Barriers to more
sustainable diets**

Barriers to more sustainable diets

Awareness

Despite the growth in people interested in sustainable diets and reducing meat consumption, as mentioned above, many people still show general ambivalence to the environmental impact of their food.¹³⁷

Research by Chatham House indicates that many people are not aware of the environmental impact of meat/livestock production, especially compared with other protein sources. Despite being the joint fourth biggest contributor to climate change, fewer than 30% of those surveyed across 12 countries believed meat and dairy production to be a major contributor to climate change, considerably below those who highlighted heating buildings and waste disposal, despite them contributing significantly less to emissions.¹³⁸

Convenience and difficulty

The importance of convenience to people's food choices is not unique to sustainable diets, it also impacts on people's willingness or ability to consume higher quality, healthier diets.¹³⁹

Cooking and preparing fresh food, and reducing intakes of highly processed foods, in order to eat more sustainability challenges convenience. In Our Food Future, the Food Standards Agency found young people in particular were concerned that moving away from highly convenient foods would be difficult.¹³⁵ YouGov have found that nearly one in eight people in the UK avoided cooking food from scratch.¹⁴⁰ Taste is important and skills to recognise food are falling, along with preparation skills, so recommendations should be feasible.

Additionally, any changes to day to day behaviour is a significant barrier to most consumers, therefore encouraging someone reliant on convenience foods to cook more of their meals will be a significant barrier to overcome.

Food culture

UK food culture includes a significant consumption of meat, fish and dairy. The BBC's Good Food Nation Survey 2016 found that many people still regard meat as a core part of every meal - (49%) stating that 'a meal isn't a meal without meat'¹⁴¹. Studies have shown that there is an unwillingness to accept the role of meat in contributing to climate change and a resistance to changing their own meat consumption.¹⁴²

As has already been highlighted, men eat considerably more meat than women, above the currently recommended upper limit from SACN. Meat has historically had an association with power, wealth and success, and more modern stereotypical associations of meat with strength and virility have been exploited by advertisers. Modern studies have found participants rate omnivorous men as more masculine than vegetarian men.¹⁴³ Messages should be around meat reduction and advice should consider challenging groups.

Expense

Price remains one of the strongest influencing factors that governs choice. There is a perception that healthier eating, especially the higher consumption of fresh fruit and vegetables, is more expensive.

It has been shown that positive pricing policies on healthy foods can influence dietary choices.^{144,145} Due to inequalities in society, however, there are limits for some communities as to how much control they actually have over their food choices. Adults from lower income groups, for example, are known to be more likely to cite cost as an important influence on their eating habits. Recent research has shown, the lower the income, the higher the proportion of income is spent on food.¹⁴⁸

Dietitians should have the skills to show how a more sustainable diet can be cost effective in relation to a 'traditional' diet, especially by replacing meat with plant protein alternatives such as beans and pulses. This may also need to be accompanied with training to help provide the cooking skills necessary to prepare such a diet. A recent costing based on the Eatwell Guide suggested making changes to the diet to improve sustainability would not lead to significant change in the price of the diet.⁴³

Modelling based on the Eatwell Guide

To achieve the health gains in the Eatwell Guide, the UK population would need to increase consumption of fruits and vegetables, carbohydrate-based foods, fish, and legumes, while reducing consumption of red, processed, and white meats, dairy products, and foods high in fat and sugar. Scarborough et al found that the impact on total food and drink costs for the individual would on average be insignificant, actually reducing slightly from 2016 - £6.02 to £5.99.⁴⁶

However, the paper notes the possible impact on the agricultural system on the overall economy.



References

1. PHE. Results of the National Diet and Nutrition Survey (NDNS) rolling programme for 2014 to 2015 and 2015 to 2016 [Internet]. 2018 [cited 5/11/2018]. Available from: <https://www.gov.uk/government/statistics/ndns-results-from-years-7-and-8-combined>
2. PHE. Adult obesity: applying All Our Health [Internet]. 2015 [cited 8/28/2018]. Available from: <https://www.gov.uk/government/publications/adult-obesity-applying-all-our-health/adult-obesity-applying-all-our-health>
3. Food Standards Agency. Food and climate change: A review of the effects of climate change on food within the remit of the Food Standards Agency [Internet]. 2010 [cited 8/28/2018]. Available from: <https://www.food.gov.uk/research/research-projects/food-and-climate-change-a-review-of-the-effects-of-climate-change-on-food-within-the-remit-of-the-food-standards-agency>
4. Garnett, T., Benton, T., Little, D., & Finch, J. (2018). Food systems and contributions to other environmental problems (Foodsource: chapters). Food Climate Research Network, University of Oxford.
5. WRAP. Food surplus and waste in the UK - key facts [Internet]. 2020 [cited August 2020] Available from https://wrap.org.uk/sites/files/wrap/Food_%20surplus_and_waste_in_the_UK_key_facts_Jan_2020.pdf
6. Garnett, T., Benton, T., Nicholson, W., & Finch, J. (2016). Overview of food system challenges (Foodsource: chapters). Food Climate Research Network, University of Oxford.
7. FAO. 2020. The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome. <https://doi.org/10.4060/ca9229en>
8. World Wildlife Fund Blue Planet Report September 2015 <https://www.worldwildlife.org/publications/living-blue-planet-report-2015>
9. DEFRA, Government Statistical Service. The future farming and environment evidence compendium [Internet]. 2018 [cited Aug 2018]. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/683972/future-farming-environment-evidence.pdf
10. UNFCCC. The Paris Agreement [Internet]. 2016 [cited 8/28/2018]. Available from: <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>
11. IPCC. Global Warming of 1.5oC. An IPCC special report on the impacts of global warming of 1.5oC above pre-industrialised levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development and efforts to eradicate poverty [Internet]. 2018 [cited 10/9/2018]. Available from: <http://www.ipcc.ch/report/sr15/>
12. IPCC - Intergovernmental Panel on Climate Change. Press Release: Summary for Policymakers of IPCC Special Report on Global Warming of 1.5oC approved by governments [Internet]. 2018 [cited 10/9/2018]. Available from: http://www.ipcc.ch/news_and_events/pr_181008_P48_spm.shtml
13. de Coninck H, Revi A. Global Warming of 1.5oC. An IPCC special report on the impacts of global warming of 1.5oC above pre-industrial levels and related GHGe, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Chapter 4: Strengthening and implementing the global response Coordinating Lead Authors: (India) [Internet]. 2018 [cited 10/15/2018]. Available from: <http://www.ipcc.ch/report/sr15/>
14. Climate Change Act 2008 (2050 Target Amendment) Order 2019. Available at: https://www.legislation.gov.uk/uksi/2019/1056/pdfs/uksi_20191056_en.pdf

15. UK Government. Carbon Budgets. 2016 [cited 14/8/2020]. Available from: <https://www.gov.uk/guidance/carbon-budgets>
16. The Carbon Trust. The Eatwell Guide: a more sustainable diet: methodology and results summary [Internet]. 2016 [cited Jul 2018]. Available from: <https://www.carbontrust.com/resources/the-eatwell-guide-a-more-sustainable-diet>
17. Murakami K, Livingstone M. Greenhouse gas emissions of self-selected diets in the UK and their association with diet quality: is energy under-reporting a problem? *Nutr J.* 2018;17(1):27. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5822528/>
18. Committee on Climate Change. Reducing UK emissions: 2019 Progress Report to Parliament [Internet]. July 2019 [cited Aug 2020] Available from: <https://www.theccc.org.uk/wp-content/uploads/2019/07/CCC-2019-Progress-in-reducing-UK-emissions.pdf>
19. Committee on Climate Change. Net Zero – The UK's contribution to stopping global warming [Internet]. 2019 [cited August 2020]. Available from: <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>
20. Peake L. Less in, more out: using resource efficiency to cut carbon and benefit the economy [Internet]. 2018 [cited 8/27/2018]. Available from: https://www.green-alliance.org.uk/less_in_more_out.php
21. Committee on Climate Change. Letter to Hon Michael Gove MP. Role of agriculture, land use and the natural environment in tackling climate change [Internet]. 2017 [cited 8/28/2018]. Available from: <https://www.theccc.org.uk/publication/role-agriculture-land-use-natural-environment-tackling-climate-change/>
22. Welsh Government. Climate Change Strategy for Wales [Internet]. 2016 [cited 8/28/2018]. Available from: <https://gov.wales/topics/environmentcountryside/climatechange/emissions/climate-change-strategy-for-wales/?skip=1&lang=en>
23. Welsh Government. Towards sustainable growth: an action plan for the food and drink industry 2014-2020 [Internet]. 2014 [cited Sept 2018]. Available from: <https://beta.gov.wales/sites/default/files/publications/2018-05/food-and-drink-industry-action-plan.pdf>
24. Scottish Government. The Scottish Government's Climate Change Plan, Third Report on Proposals and Policies 2018-2032 (RPP3) [Internet]. 2018 [cited 9/5/2018]. Available from: <https://www.gov.scot/Publications/2018/02/8867>
25. Scottish Government. Recipe for Success: Scotland's national food and drink policy, becoming a Good Food Nation [Internet]. 2014 [cited 9/5/2018]. Available from: <https://beta.gov.scot/publications/recipe-success-scotlands-national-food-drink-policy-becoming-good-food/>
26. Department for Business, Energy & Industrial Strategy. Energy and Climate Change Public Attitudes Tracker: Wave 25 [Internet]. 2018 [cited 9/5/2018]. Available from: <https://www.gov.scot/publications/recipe-success-scotlands-national-food-drink-policy-becoming-good-food/>
27. ComRes. Global Food Security Climate Change and Food System Survey [Internet]. 2017 [cited 9/5/2018]. Available from: <http://www.comresglobal.com/polls/global-food-security-climate-and-food-system-survey/>
28. Ipsos MORI. Vegan Society Poll [Internet]. 2018 [cited 9/5/2018]. Available from: <https://www.ipsos.com/ipsos-mori/en-uk/vegan-society-poll>
29. Food Standards Agency. Food and You - Wave Four [Internet]. 2017 [cited 9/5/2018]. Available from: <https://www.food.gov.uk/research/food-and-you/food-and-you-wave-four>

30. ECOSOC. Sustainable Development [Internet]. 2018 [cited 9/5/2018]. Available from: <https://www.un.org/ecosoc/en/sustainable-development>
31. Burlingame B, Dernini S, Nutrition and Consumer Protection Division, editor. Proceedings of the International Scientific Symposium: Biodiversity and Sustainable diets united against hunger 3–5 November 2010. Sustainable diets and biodiversity directions and solutions for policy, research and action. Rome: FAO; 2012. <http://www.fao.org/docrep/016/i3004e/i3004e.pdf>
32. Gonzalez Fischer C, Garnett T. Plates, pyramids and planets. Developments in national healthy and sustainable dietary guidelines: a state of play assessment [Internet]. 2016 [cited Jul 2018]. Available from: <http://www.fao.org/3/a-i5640e.pdf>
33. Macdiarmid J. Is a healthy diet an environmentally sustainable diet? *Proc Nutr Soc.* 2013;72(1):13-20. <https://www.cambridge.org/core/journals/proceedings-of-the-nutrition-society/article/is-a-healthy-diet-an-environmentally-sustainable-diet/8FDEB972BC8DB183D543969809EBDF7A>
34. Macdiarmid J. Is a healthy diet an environmentally sustainable diet? *Proc Nutr Soc.* 2013;72(1):13-20.
35. Macdiarmid J, Kyle J, Horgan G et al. Sustainable diets for the future: Can we contribute to reducing greenhouse gas emissions by eating a healthy diet? *Am J Clin Nutr.* 2012;96(3):632-9.
36. Kramer G, Tyszler M, Veer P et al. Decreasing the overall environmental impact of the Dutch diet: how to find healthy and sustainable diets with limited changes. *Public Health Nutr.* 2017;20(9):1699-709
37. Horgan G, Perrin A, Whybrow S et al. Achieving dietary recommendations and reducing greenhouse gas-emissions: modelling diets to minimise the change from current intakes. *Int J Behav Nutr Phys Act.* 2016;13:46.
38. Biesbroek S, Verschuren W, Boer J et al. Does a better adherence to dietary guidelines reduce mortality risk and environmental impact in the Dutch sub-cohort of the European Prospective Investigation into Cancer and Nutrition? *Br J Nutr.* 2017;118(1):69-80.
39. van Dooren C, Douma A, Aiking H et al. Proposing a Novel Index Reflecting Both Climate Impact and Nutritional Impact of Food Products. *Ecological Economics.* 2017;131:389-98.
40. González-García S, Esteve-Llorens X, Moreira M et al. Carbon footprint and nutritional quality of different human dietary choices. *Sci Total Environ.* 2018;644:77-94.
41. Aleksandrowicz L, Green R, Joy E et al. The Impacts of Dietary Change on Greenhouse Gas Emissions, Land Use, Water Use, and Health: A Systematic Review. *PLoS One.* 2016;11(11):10. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0165797>
42. Springmann M, Godfray H, Rayner M et al. Analysis and valuation of the health and climate change cobenefits of dietary change. *Proc Natl Acad Sci U S A.* 2016;113(15):4146-51 <http://www.pnas.org/content/113/15/4146>
43. Committee on Climate Change. The Fourth Carbon Budget - reducing emissions through the 2020s [Internet]. 2010 [cited 8/29/2018]. Available from: <https://www.theccc.org.uk/publication/the-fourth-carbon-budget-reducing-emissions-through-the-2020s-2/>
44. Scarborough P, Allender S, Clarke D et al. Modelling the health impact of environmentally sustainable dietary scenarios in the UK. *Eur J Clin Nutr.* 2012;66(6):710-5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3389618/>

45. PHE. The Eatwell Guide [Internet]. 2016 [cited 7/13/2018]. Available from: <https://www.gov.uk/government/publications/the-eatwell-guide>
46. Cobiac LJ, Scarborough P, Kaur A et al. The Eatwell Guide: Modelling the Health Implications of Incorporating New Sugar and Fibre Guidelines. *PLoS One*. 2016;11(12):10
47. Health Canada. Canada's dietary guidelines for health professionals and policy makers. [Internet] January 2019 [cited August 2020] Available from: <https://food-guide.canada.ca/static/assets/pdf/CDG-EN-2018.pdf>
48. Flemish Institute for Healthy Living. Food-based dietary guidelines - Belgium [Internet]. 2018 [cited 7/20/2018]. Available from: <http://www.fao.org/nutrition/education/food-based-dietary-guidelines/regions/countries/belgium/en/>
49. Kromhout D, Spaaij C, de G et al. The 2015 Dutch food-based dietary guidelines. *Eur J Clin Nutr*. 2016;70(8):869-78. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5399142/>
50. Bajzelj B, Richards K, Allwood J et al. Importance of food-demand management for climate mitigation. *Nature Climate Change*. 2014;4:924-9 https://www.researchgate.net/publication/275118744_Importance_of_food-demand_management_for_climate_mitigation
51. FAO and UN. Global Livestock Environmental Assessment Model (GLEAM) [Internet]. 2017 [cited 9/5/2018]. Available from: <http://www.fao.org/gleam/results/en>
52. Green R, Milner J, Dangour A et al. The potential to reduce greenhouse gas emissions in the UK through healthy and realistic dietary change. *Clim Change*. 2015;129(1-2):253-65. <https://link.springer.com/article/10.1007/s10584-015-1329-y>
53. FCRN Food Source. FCRN Food Source. Chapter 8: the difficult livestock issue [Internet]. 2015 [cited 8/27/2018]. Available from: <https://foodsource.org.uk/chapters>
54. FCRN Food Source. FCRN Food Source. Chapter 3: Food systems and greenhouse gas emissions [Internet]. 2015 [cited 8/27/2018]. Available from: <https://foodsource.org.uk/chapters>
55. Poore J, Nemecek T. Reducing food's environmental impacts through producers and consumers. *Science*. 2018;360(6392):987-92
56. Poore J, Nemecek T. Supplementary Materials for Reducing food's environmental impacts through producers and consumers - Materials and Methods. *Science*. 2018;360(987)
57. Poore J, Nemecek T. Data S2 - Supplementary Materials for Reducing food's environmental impacts through producers and consumers [Internet]. 2018 [cited 2018/10/17]. Available from: <http://science.sciencemag.org/content/suppl/2018/05/30/360.6392.987.DC1>
58. Scarborough P, Appleby P, Mizdrak A et al. Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK. *Clim Change*. 2014;125(2):179-92. <https://link.springer.com/article/10.1007/s10584-014-1169-1>
59. WHO Europe. Nutrition - A healthy lifestyle [Internet]. 2018 [cited 7/20/2018]. Available from: <http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle>
60. SACN. Iron and Health Report [Internet]. 2011 [cited 8/31/2018]. Available from: <https://www.gov.uk/government/publications/sacn-iron-and-health-report>

61. WCRF. Continuous Update Project: Diet, Nutrition, Physical Activity and Cancer: a Global Perspective. Third Expert Report [Internet]. 2018 [cited 7/20/2018]. Available from: <https://www.wcrf.org/dietandcancer>
62. WCRF Intern.. WCRF Continuous Update Project. Third Expert Report on Diet, Nutrition, Physical Activity and Cancer: a Global Perspective: Recommendations - Limit red & processed meat [Internet]. 2018 [cited 8/30/2018]. Available from: <https://www.wcrf.org/dietandcancer/recommendations/limit-red-processed-meat>
63. HEART UK. About the Ultimate Cholesterol Lowering Plan (UCLP) [Internet]. 2016 [cited 8/31/2018]. Available from: <https://heartuk.org.uk/cholesterol-and-diet/about-the-uclp>
64. Seves S, Verkaik-Kloosterman J, Biesbroek S et al. Are more environmentally sustainable diets with less meat and dairy nutritionally adequate? *Public Health Nutr.* 2017;20(11):2050-62.
65. Temme E, van D, Thissen J et al. Replacement of meat and dairy by plant-derived foods: estimated effects on land use, iron and SFA intakes in young Dutch adult females. *Public Health Nutr.* 2013;16(10):1900-7.
66. Clarys P, Deliens T, Huybrechts I et al. Comparison of nutritional quality of the vegan, vegetarian, semi-vegetarian, pesco-vegetarian and omnivorous diet. *Nutrients.* 2014;6(3):1318-32
67. Sobiecki J, Appleby P, Bradbury K et al. High compliance with dietary recommendations in a cohort of meat eaters, fish eaters, vegetarians, and vegans: results from the European Prospective Investigation into Cancer and Nutrition-Oxford study. *Nutr Res.* 2016;36(5):464-77,
68. Dinu M, Abbate R, Gensini G et al. Vegetarian, vegan diets and multiple health outcomes: A systematic review with meta-analysis of observational studies. *Crit Rev Food Sci Nutr.* 2017;57(17):3640-9.
69. Sabaté J, Soret S. Sustainability of plant-based diets: back to the future. *Am J Clin Nutr.* 2014;1:476S-82S.
70. Soret S, Mejia A, Batech M et al. Climate change mitigation and health effects of varied dietary patterns in real-life settings throughout North America. *Am J Clin Nutr.* 2014;1:490S-5S.
71. Melina, V, Craig, W and Levin, S. Position of the Academy of Nutrition and Dietetics: Vegetarian Diets. *J Acad Nutr Diet.* 2016;116:1970-1980.
72. Mathai J, Liu Y, Stein H. Values for digestible indispensable amino acid scores (DIAAS) for some dairy and plant proteins may better describe protein quality than values calculated using the concept for protein digestibility-corrected amino acid scores (PDCAAS). *Br J Nutr.* 2017;117(4):490-9.
73. Wolfe R, Rutherford S, Kim IY et al. Protein quality as determined by the Digestible Indispensable Amino Acid Score: evaluation of factors underlying the calculation. *Nutr Rev.* 2016;74(9):584-99.
74. R Young & Peter L Pellet. Plant Proteins in relation to human protein and amino acid nutrition. *Vernon . Amer J Clin Nutr* 1994;59(s):1230s-1212s
75. Palmer S. Plant proteins. *Today's Dietitian.* 2017;19(2):26
76. Marsh K, Munn E, Baines S. Protein and vegetarian diets. *Med J Aust.* 2012;1(2):7-10.
77. Clune S, Krossin E, Verghese K, Systematic review of greenhouse gas emissions for different fresh food categories, *Journal of Cleaner Production* 140 (2017) 766-783

79. Ho J, Maradiaga I, Martin J, Nguyen H, Trinh L. Almond milk vs cow milk. Life cycle assessment [Internet]. 2016 Available from: <https://www.ioes.ucla.edu/wp-content/uploads/cow-vs-almond-milk-1.pdf>
80. Florén B, Nilsson K, Wallman M. Oatly Drinks Environmental Footprint Internal Report [Internet]. 2013 [cited 10/18/2018]. Available from: <https://www.zaailingen.com/wp-content/bestanden/oatly.pdf>
81. Dairy UK. The dairy roadmap 2018: showcasing 10 years of environmental commitment [Internet]. 2018 [cited Oct 2018]. Available from: <http://www.dairyuk.org/media-area/resources/item/the-dairy-roadmap>
82. Heaney R, Dowell M, Rafferty K et al. Bioavailability of the calcium in fortified soy imitation milk, with some observations on method. *Am J Clin Nutr.* 2000;71(5):1166-9.
83. Zhao Y, Martin B, Weaver C. Calcium bioavailability of calcium carbonate fortified soymilk is equivalent to cow's milk in young women. *J Nutr.* 2005;135(10):2379-82
84. Clarkson V. 2020. Fact Sheet: the role of plant-based drinks in the British and Irish diet. [Internet] Alpro Professional website. Available from: <https://www.alpro.com/healthprofessional/uk/updates/2020/06/the-role-of-plant-based-drinks-in-the-british-and-irish-diet>
85. Alpro. Alpro Soya Original chilled. <https://www.alpro.com/uk/products/drinks/soya-plain/fresh-original>
86. van Dooren, C., A. Douma, H. Aiking and P. Vellinga (2017). Proposing a Novel Index Reflecting Both Climate Impact and Nutritional Impact of Food Products. *Ecological Economics* 131: 389-398.
87. WRAP. Household food and drink waste in the UK 2012 [Internet]. 2013 [cited 8/30/2018]. Available from: <http://www.wrap.org.uk/content/household-food-and-drink-waste-uk-2012>
88. Garnett T. Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)? *Food Policy.* 2011;36(Supp1):S23-32 https://fcfn-dev.ouce.ox.ac.uk/sites/default/files/Food%20_Policy.pdf
89. Garnett T. Fruit and vegetables and UK Greenhouse Gas emissions: Exploring the relationship [Internet]. 2006 [cited August 2020]. Available from: https://www.fcfn.org.uk/sites/default/files/Fruitnveg_paper_2006.pdf
90. Marine Stewardship Council. Fisheries: Become part of a collective effort to ensure healthy oceans for future generations [Internet]. 2018 [cited 9/5/2018]. Available from: <https://www.msc.org/for-business/fisheries>
91. Aquaculture Stewardship Council: <https://www.asc-aqua.org/>
92. Marine Conservation Society. Good Fish Guide: your guide to sustainable seafood [Internet]. 2018 [cited 9/5/2018]. Available from: <https://www.mcsuk.org/goodfishguide/search>
93. PHE. Sugar reduction: progress between 2015 and 2018 [Internet]. 2019 [cited Aug 2020] Available from: <https://www.gov.uk/government/publications/sugar-reduction-progress-between-2015-and-2018>
94. PHE. Calorie reduction: the scope and ambition for action [Internet]. 2018 [cited 7/20/2018]. Available from: <https://www.gov.uk/government/publications/calorie-reduction-the-scope-and-ambition-for-action>

95. PHE. Health matters: obesity and the food environment [Internet]. 2017 [cited 7/20/2018]. Available from: <https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-environment/health-matters-obesity-and-the-food-environment--2>
97. Aiking, H., de Boer, J., The next protein transition, Trends in Food Science & Technology. 2018, doi: 10.1016/j.tifs.2018.07.008
98. WRAP The Courtauld 2025 baseline and restated household food waste figures, April 2018 <http://www.wrap.org.uk/content/courtauld-2025-baseline-and-restated-household-food-waste-figures>
99. Food Waste in England, DEFRA, April 2017 <https://publications.parliament.uk/pa/cm201617/cmselect/cmenvfru/429/429.pdf>
100. Wise J, Bacon L, Vennard, D. How language can advance sustainable diets. A summary of expert perspective on how research into the language of plant-based food can change consumption [Internet]. 2018 [cited 9/5/2018]. Available from: <https://www.wri.org/publication/how-language-can-advance-sustainable-diets>
101. Roberts C, Steer T, Maplethorpe N et al. National Diet and Nutrition Survey Results from Years 7 and 8 (combined) of the Rolling Programme (2014/2015 to 2015/2016) [Internet]. 2018 [cited]. Available from: <https://www.gov.uk/government/statistics/ndns-results-from-years-7-and-8-combined>
102. Rizzo N, Jaceldo-Siegl K, Sabate J et al. Nutrient profiles of vegetarian and nonvegetarian dietary patterns. *J Acad Nutr Diet.* 2013;113(12):1610-9,
103. Hunt, J. (2003). Bioavailability of iron, zinc, and other trace minerals from vegetarian diets. *The American Journal of Clinical Nutrition*, 78(3), pp.633S-639S.
104. Gavin, M., McCarthy, D. and Garry, P. (1994). Evidence that iron stores regulate iron absorption— a setpoint theory. *The American Journal of Clinical Nutrition*, 59(6), pp.1376-1380.
106. Hunt, J. and Roughead, Z. (2000). Adaptation of iron absorption in men consuming diets with high or low iron bioavailability. *The American Journal of Clinical Nutrition*, 71(1), pp.94-102.
107. Hunt J, Roughead Z. Nonheme-iron absorption, fecal ferritin excretion, and blood indexes of iron status in women consuming controlled lactoovo-vegetarian diets for 8 wk. *Am J Clin Nutr.* 1999;69(5):944-52
108. Armah S, Boy E, Chen D et al. Regular Consumption of a High-Phytate Diet Reduces the Inhibitory Effect of Phytate on Nonheme-Iron Absorption in Women with Suboptimal Iron Stores. *J Nutr.* 2015;145(8):1735-9
109. Haider L, Schwingshackl L, Hoffmann G et al. The effect of vegetarian diets on iron status in adults: A systematic review and meta-analysis. *Crit Rev Food Sci Nutr.* 2018;58(8):1359-74
111. Lönnerdal B, Bryant A, Liu X, Theil EC. Iron absorption from soybean ferritin in nonanemic women. *Am J Clin Nutr* 2006;83:103–7.
114. Murray-Kolb LE, Welch R, Theil EC, et al. Women with low iron stores absorb iron from soybeans. *Am J Clin Nutr.* 2003;77(1):180-4.
117. Ekström, E., Kavishe, F., Habicht, J., Frongillo, E., Rasmussen, K. and Hemed, L. (1996). Adherence to iron supplementation during pregnancy in Tanzania: determinants and hematologic consequences. *The American Journal of Clinical Nutrition*, 64(3), pp.368-374.

118. Schultink, W., van der Ree, M., Matulesi, P. and Gross, R. (1993). Low compliance with an iron-supplementation program: a study among pregnant women in Jakarta, Indonesia. *The American Journal of Clinical Nutrition*, 57(2), pp.135-139.
119. Galloway, R. and McGuire, J. (1994). Determinants of compliance with iron supplementation: Supplies, side effects, or psychology?. *Social Science & Medicine*, 39(3), pp.381-390.
120. Pavord S, Myers B, Robinson S, Allard S, Strong J, et al. (2012) UK guidelines on the management of iron deficiency in pregnancy. *Br J Haematol* 156: 588–600. pmid:22512001
121. Theobald HE (2005) Dietary calcium and health. *Nutr Bull* 30, 237–277.
122. Weaver, C., Proulx, W. and Heaney, R. (1999). Choices for achieving adequate dietary calcium with a vegetarian diet. *The American Journal of Clinical Nutrition*, 70(3), pp.543s-548s.
124. Tang AL, Walker KZ, Wilcox G, et al. Calcium absorption in Australian osteopenic post-menopausal women: an acute comparative study of fortified soymilk to cows' milk. *Asia Pacific journal of clinical nutrition*. 2010;19(2):243-9
125. Bath, S., Button, S. and Rayman, M. (2011). Iodine concentration of organic and conventional milk: implications for iodine intake. *British Journal of Nutrition*, 107(07), pp.935-940
126. Bath, S. and Rayman, M. (2016). Iodine Food Fact Sheets. [online] The British Dietetic Association (BDA). Available at: <https://www.bda.uk.com/resource/iodine.html> [Accessed 2/11/18].
127. Public Health England. Government Dietary Recommendations. Government recommendations for energy and nutrients for males and females aged 1 – 18 years and 19+ years. [internet] 2016. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/618167/government_dietary_recommendations.pdf [Accessed 25 Oct. 2018].
128. SACN, COT: Advice on fish consumption: benefits & risks. [Internet]. 2014. Available from: <https://cot.food.gov.uk/committee/committee-on-toxicity/cotreports/cotjointreps/sacnfishconsumption>
129. Julie Lanigan (2017). Omega-3 Food Fact Sheets. [online] The British Dietetic Association (BDA). Available at: <https://www.bda.uk.com/resource/omega-3.html>
130. Lane, K., Derbyshire, E., Li, W. and Brennan, C. (2013). Bioavailability and Potential Uses of Vegetarian Sources of Omega-3 Fatty Acids: A Review of the Literature. *Critical Reviews in Food Science and Nutrition*, 54(5), pp.572-579.
131. Adarme-Vega, T., Lim, D., Timmins, M., Vernen, F., Li, Y. and Schenk, P. (2012). Microalgal biofactories: a promising approach towards sustainable omega-3 fatty acid production. *Microbial Cell Factories*, 11(1), p.96.
132. DEFRA. Food Statistics in your pocket: Summary. [Internet] August 2020 [Cited Aug 2020] Available from: <https://www.gov.uk/government/publications/food-statistics-pocketbook/food-statistics-in-your-pocket-summary>
133. FAO, IFAD, UNICEF, WFP and WHO. 2020. The State of Food Security and Nutrition in the World 2020. Transforming food systems for affordable healthy diets. Rome, FAO.
134. Our health, our environment: The Ecological Footprint of what we eat. Frey, S and Barrett, J. Cardiff : s.n., 8-10 May 2007. International Ecological Footprint Conference

135. Our food, our future, Food Standards Agency February 2016 <https://www.food.gov.uk/sites/default/files/media/document/our-food-future-full-report.pdf>
136. WRAP. (2018). Estimates of Food Surplus and Waste Arisings in the UK. [internet] Available at: http://www.wrap.org.uk/sites/files/wrap/Estimates_%20in_the_UK_Jan17.pdf [Accessed].
137. Mylan J, Sustainable Consumption in Everyday Life: A Qualitative Study of UK Consumer Experiences of Meat Reduction Sustainability 2018, 10, 2307; doi: 10.3390/su10072307
138. Livestock – Climate Change's Forgotten Sector Global Public Opinion on Meat and Dairy Consumption, Chatham House, December 2014 https://www.chathamhouse.org/sites/files/chathamhouse/field/field_document/20141203LivestockClimateChangeForgottenSectorBaileyFroggattWellesleyFinal.pdf
139. Monsivais, P., Aggarwal, A. and Drewnowski, A. (2014). Time Spent on Home Food Preparation and Indicators of Healthy Eating. *American Journal of Preventive Medicine*, 47(6), pp.796-802.
140. Non-cooks: selling to those who don't cook from scratch, YouGov, December 2014 <https://yougov.co.uk/news/2017/09/14/one-eight-brits-avoid-cooking-scratch/>
141. How we eat now, what's new and what's next, 2016 BBC Good Food <https://www.bbcgoodfood.com/article/bbc-good-food-nation-survey-results>
142. Macdiarmid, J., Douglas, F. and Campbell, J. (2016). Eating like there's no tomorrow: Public awareness of the environmental impact of food and reluctance to eat less meat as part of a sustainable diet. *Appetite*, 96, pp.487-493.
143. Ruby, M. and Heine, S. (2011). Meat, morals, and masculinity. *Appetite*, 56(2), pp.447-450.
144. Gittelsohn, J., Trude, A. and Kim, H. (2017). Pricing Strategies to Encourage Availability, Purchase, and Consumption of Healthy Foods and Beverages: A Systematic Review. *Preventing Chronic Disease*, 14
145. Darmon, N., Lacroix, A., Muller, L. and Ruffieux, B. (n.d.). Food Price Policies May Improve Diet but Increase Socioeconomic Inequalities in Nutrition. *World Review of Nutrition and Dietetics*, pp.36-45.
148. Food Foundation report: affordability of the Eat well guide https://foodfoundation.org.uk/wp-content/uploads/2018/09/Affordability-of-the-Eatwell-Guide_Final_Web-Version.pdf
149. Pilz S, Marz W, Cashman K et al. Rationale and plan for Vitamin D food fortification: a review and guidance paper. *Front endocrinol (Lausanne)*. 2018;9:373
150. Wilson L, Tripovic L, Hart K et al. Vitamin D deficiency as a public health issue: using Vitamin D2 or vitamin D3 in future fortification strategies. *Proc Nutr Soc*. 2017;76(3):392-9
151. Crowe F, Steur M, Allen N et al. Plasma concentrations of 25-hydroxyvitamin D in meat eaters, fish eaters, vegetarians and vegans: results from the EPIC-Oxford study. *Public Health Nutr*.. 2011;14(2):340-6.
152. Elorinne A, Alfthan G, Erlund I et al. Food and Nutrient Intake and Nutritional Status of Finnish Vegans and Non-Vegetarians. *PLoS One*.. 2016;11(2):10
153. Raghunathan et al. 2006. "The Unhealthy = Tasty Intuition and Its Effects on Taste Inferences, Enjoyment, and Choice of Food Products." *Journal of Marketing* 70 (4): 170–84.
154. Grech A, Allman-Farinelli M. A systematic literature review of nutrition interventions in vending machines that encourage consumers to make healthier choices. *Obesity Reviews*. 2015;16(12):1030-41.

155. M. J. Reinders, M. Huitink, S. C. Dijkstra, A. J. Maaskant, J. Heijnen, Menu-engineering in restaurants: Adapting portion sizes on plates to enhance vegetable consumption: A real-life experiment. *Int. J. Behav. Nutr. Phys.* 14, 41 (2017).
156. Bianchi, F., Garnett, E., Dorsel, C., Aveyard, P., & Jebb, S. A. (2018). Restructuring physical micro-environments to reduce the demand for meat: a systematic review and qualitative comparative analysis. *The Lancet Planetary Health*, 2(9), e384-e397.
157. Bacon, L., & Krpan, D. (2018). (Not) Eating for the environment: The impact of restaurant menu design on vegetarian food choice. *Appetite*, 125, 190-200.
158. Sparkman, G., & Walton, G. M. (2017). Dynamic norms promote sustainable behavior, even if it is counternormative. *Psychological science*, 28(11), 1663-1674.
159. Committee on Climate Change. Reducing emissions in Northern Ireland [Internet] 2019 [Cited Aug 2020] Available from: <https://www.theccc.org.uk/wp-content/uploads/2019/02/Reducing-emissions-in-Northern-Ireland-CCC.pdf>
160. FAO and WHO. 2019. Sustainable healthy diets – Guiding principles. Rome.
161. Reference: EAT-Lancet Commission. Summary Report [Internet] 2019 [Cited Aug 2020] Available at: https://eatforum.org/content/uploads/2019/07/EAT-Lancet_Commission_Summary_Report.pdf
162. Oatly. Iodine [internet] 2020. Available from: <https://www.oatly.com/uk/healthcareprofessionals/faq/iodine>
163. WRAP. Courtauld Commitment 2025 Milestone Progress Report [online] Jan 2020. [Accessed August 13 2020]. Available online: <https://www.wrap.org.uk/content/courtauld-commitment-2025-milestone-progress-report>

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