National
Food Strategy
Independent Review

THE EVIDENCE.

Contents

National
Food Strategy

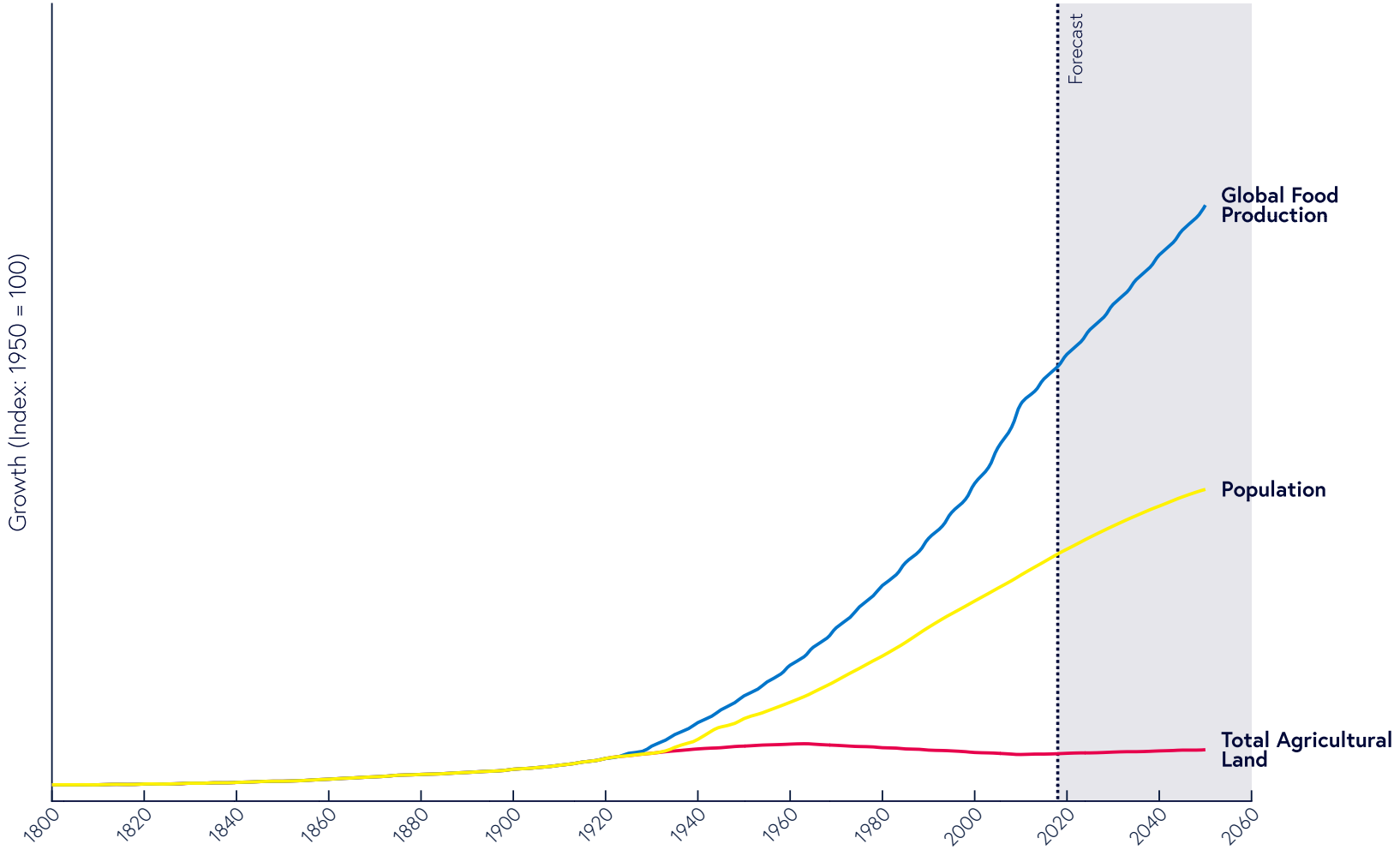
NATURE AND CLIMATE

Nature and climate

WHY IT MATTERS

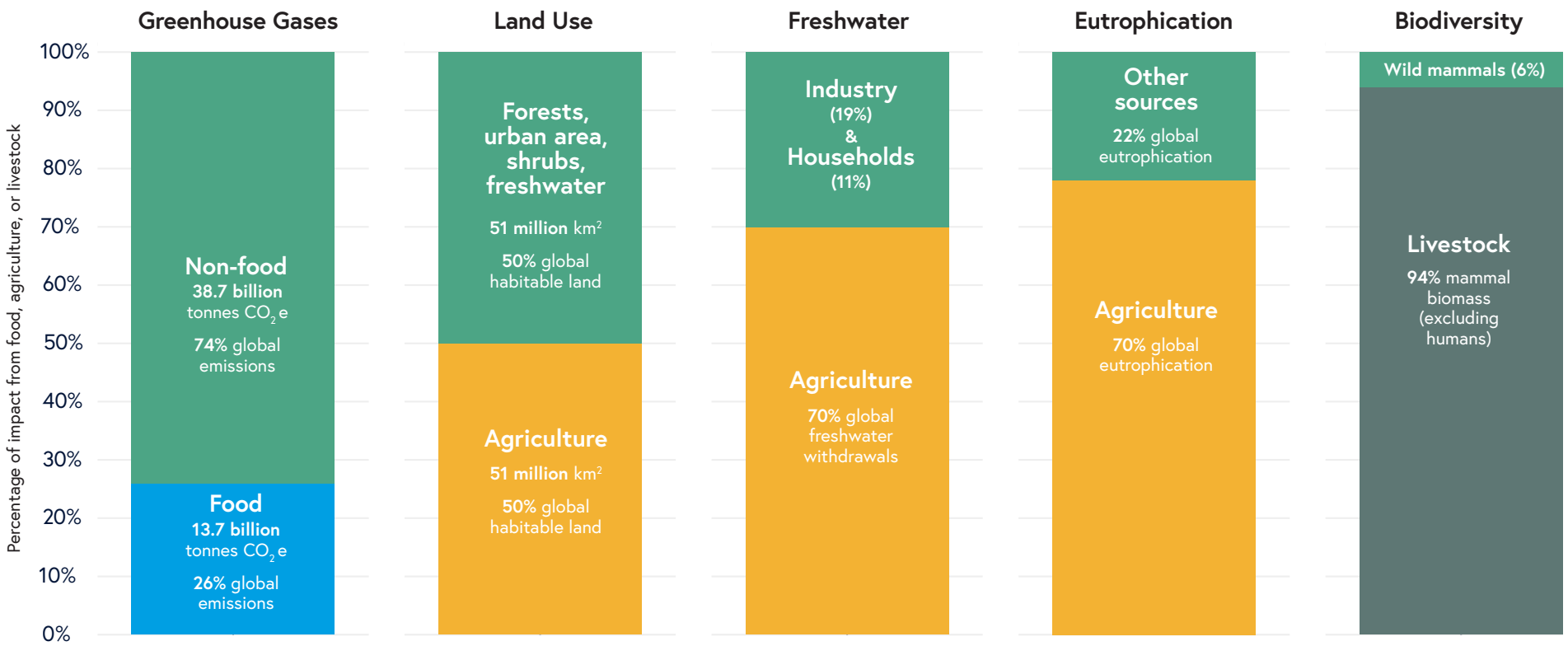
Global impacts

Modern intensive farming has enabled us to feed a growing population from the same amount of land



SOURCE: BAIN Analysis for the National Food Strategy (2019), based on: 1800 to 2010 source: Population data from Maddison's historical statistics for 1820-1940; UN Population Division for 1950-2030; 1800 and 1810 extrapolated from Maddison. Agricultural (crops and pasture) land data for 1800-2010 from the History Database of the Global Environment (HYDE 3.2), Klein Goldewijk et al. (2017). Global agricultural production data for 1960-2010 from FAOSTAT (Net Agricultural Production Index); 2010 onwards sources based on forecasts from: Food production and agricultural land from The Future of food and agriculture: Alternative Pathways to 2050, FAO, 2018 (agriculture land based on arable land forecasts); Population data from Historical population data and projections, OECD (Accessed 12th Dec 2019)

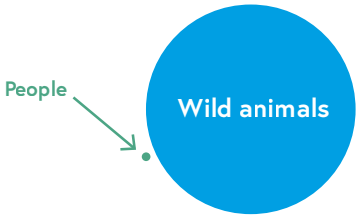
However, the modern food system is a major cause of environmental problems



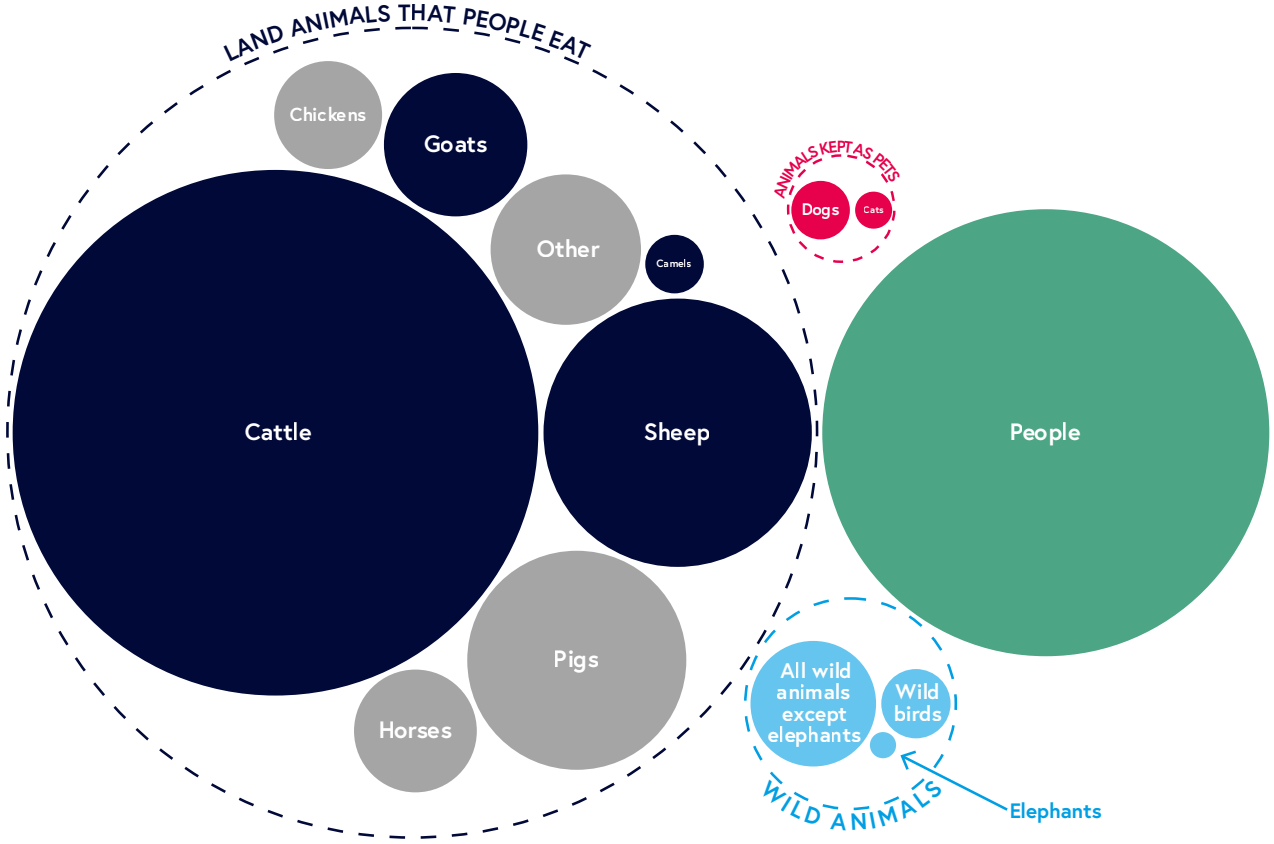
SOURCE: Ritchie, H. (2019). Our World In Data; [online]

The global mass of farm animals is now 22 time heavier than all wild animals combined

LAND ANIMALS BY MASS:
11,000 YEARS AGO



LAND ANIMALS BY MASS: **PRESENT**

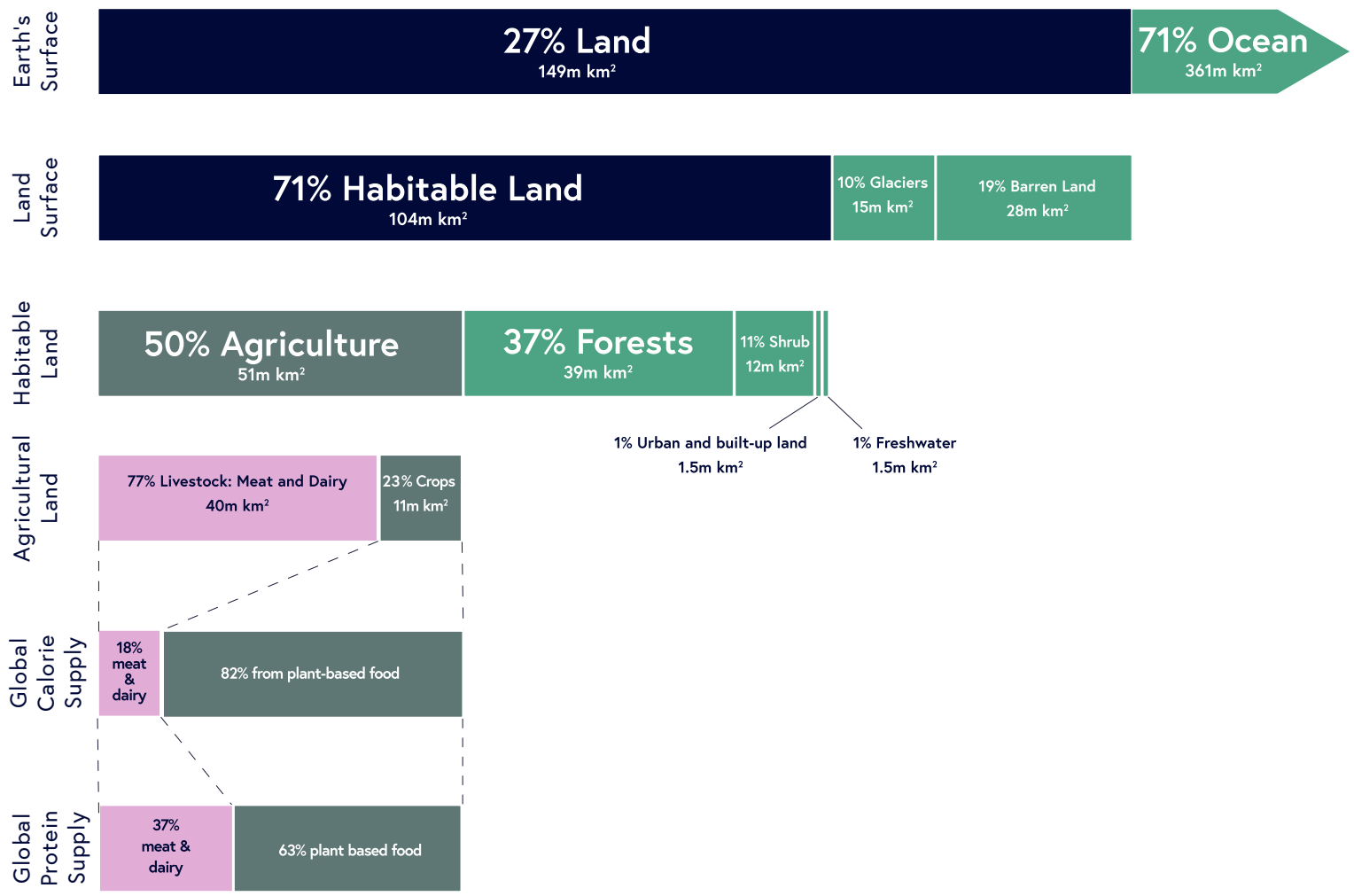


Note: for this visualisation 'animals' refers to terrestrial vertebrates. Terrestrial invertebrates and all life in the oceans are excluded.

SOURCE: National Food Strategy analysis based on: Bar-On, Y. M., Phillips, R., & Milo, R. (2018). The biomass distribution on Earth, Proceedings of the National Academy of Sciences, 115(25), 6506-6511 [online]

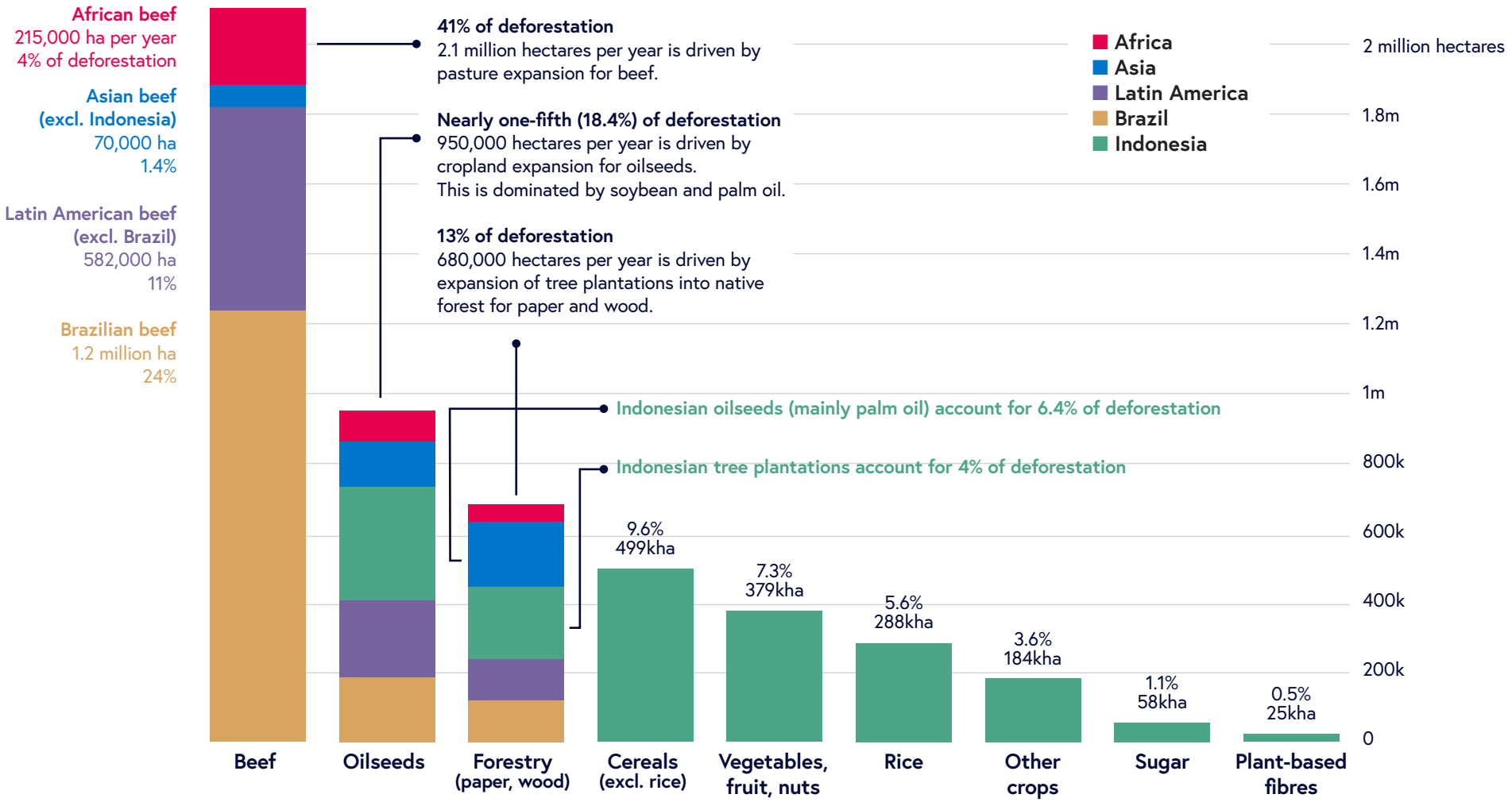
Around 50% of Earth's habitable land is used for agriculture, of which 77% is used to graze animals or to produce crops to feed to animals

GLOBAL LAND USE FOR FOOD PRODUCTION



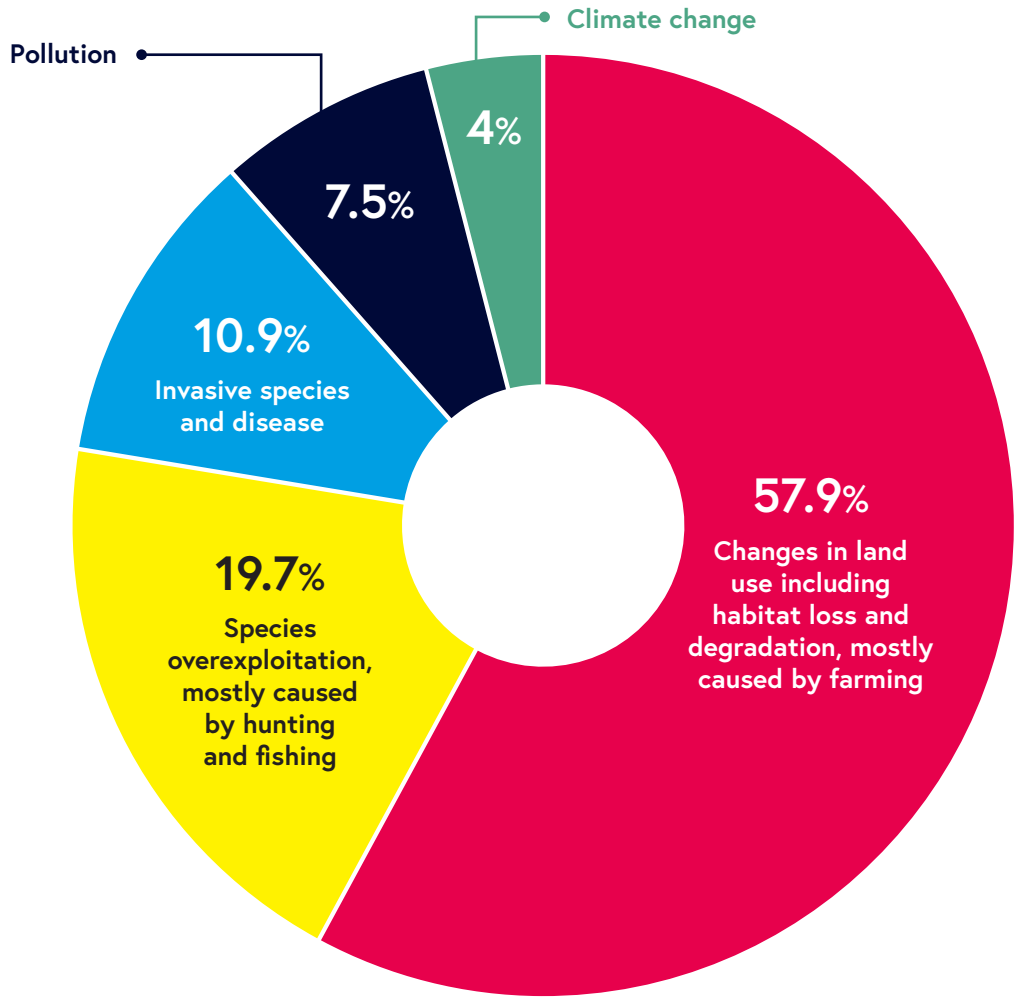
SOURCE: Ritchie, H. Roser, M. (2019). Our World In Data; [online]

Agriculture – especially beef farming – is still the main cause of land use change, including tropical deforestation



SOURCE: Ritchie, H. (2019), Cutting down forests: what are the drivers of deforestation, Our World in Data , [online]

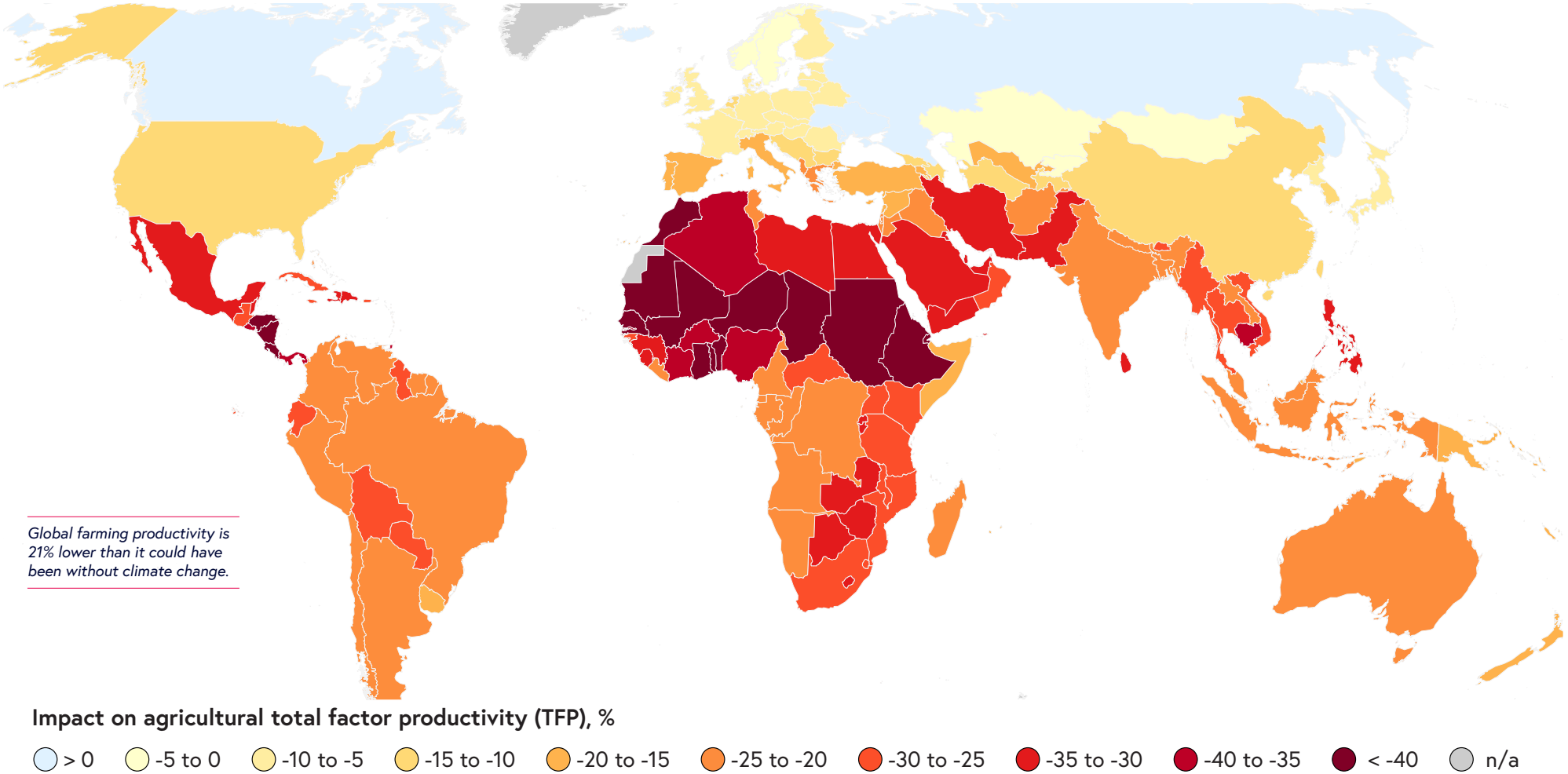
Farming, hunting and fishing are the principal causes of species decline in Europe



Note: Percentages describe the share of Living Planet Index species decline attributable to different factors.

SOURCE: Zoological Society of London and WWF (2020). Living Planet Report 2020 - Bending the curve of biodiversity loss. [online]

Climate change has already lowered agricultural yields



Global farming productivity is 21% lower than it could have been without climate change.

SOURCE: Ortiz-Bobea, A., Ault, T.R., Carrillo, C.M. et al. (2021 Anthropogenic climate change has slowed global agricultural productivity growth | Nature Climate Change. 11, 306–312. [online].

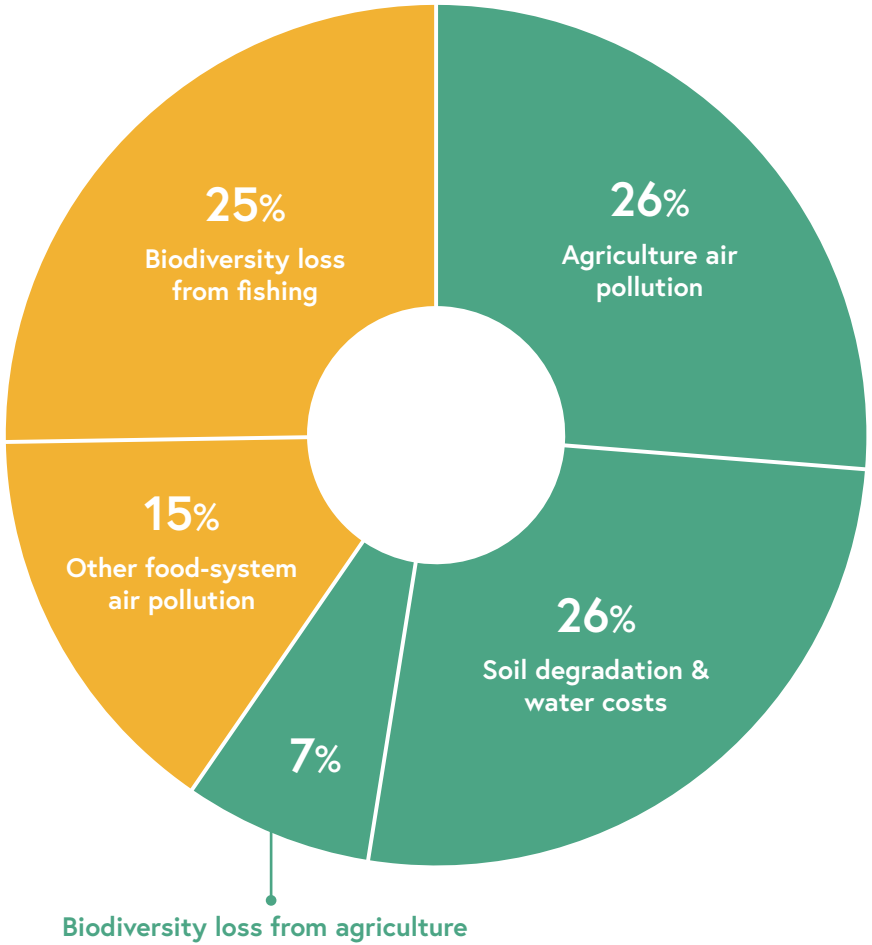
Nature and climate

WHY IT MATTERS

UK impacts

In the UK, agriculture has more environmental impact than the rest of the food system

~60% OF AIR AND WATER POLLUTION, SOIL DEGRADATION AND BIODIVERSITY COSTS FROM AGRICULTURE; TOTAL COST ~£7B P.A.



Note: Does not cover imported food production costs to the environment; GHG emissions allocated based on 2017 SIC codes emission figures for Agriculture, Manufacturing, Chemicals, Wholesale, Retail, Foodservice and Freight transport by road adjusted for % of market that is food-related – Wholesale 12%, Retail 37%, Freight transport 34%, %s from ABS; National 2017 prices for air pollutants used; Soil Degradation costs for England and Wales only (Cranfield 2011 for Defra); Biodiversity costs proxied on basis of cost to implement biodiversity restoration and management; fertiliser shown as GHGe from fertiliser manufacture, fertiliser use included in Agriculture GHGe; Other food system air pollution includes pollution from food transportation and manufacturing; All prices shown in 2017 using ONS GDP deflator; ***full detail on calculations and assumptions in BAIN appendix.***

ADDITIONAL RESOURCES AVAILABLE

SOURCE: BAIN for National Food Strategy. Total greenhouse gas emissions by industry section and group, ONS, 2017; Valuation of energy use and greenhouse gas emissions for appraisal, BEIS, 2019; Emissions of Air Pollutants in the UK, Defra, 2019; Air Quality Cost guidance, Defra, 2019; Cost of soil degradation in England and Wales, Cranfield University, 2011; Annual Business Survey (ABS), ONS, 2017; Biodiversity: Finance and the Economic and Business Case for Action, OECD, 2019; Environmental Accounts of Agriculture, Cranfield University on behalf of Defra, 2007; Costs of the UK Biodiversity Action Plan Update, GHK on behalf of Defra, 2010; Total fisheries production, World Bank, 2017; The Sunken Billions Revisited, World Bank, 2017; Pollinators, Pollination and Food production, IPBES, 2015; Status of pollinating insects indicator, Defra, 2017; GDP deflator, ONS, 2018

UK farming has many environmental impacts

AGRICULTURE CONTRIBUTES 1% THE UK ECONOMY, BUT HAS A HIGH ENVIRONMENTAL IMPACT

Note: All environmental impact data for UK 2017 except: water abstraction – England, nitrogen in rivers – England & Wales 2004, phosphorus in rivers – Great Britain, 2006, ammonia emissions – 2016. List covers key impacts but is not exhaustive (e.g. faecal bacteria pollution not covered).

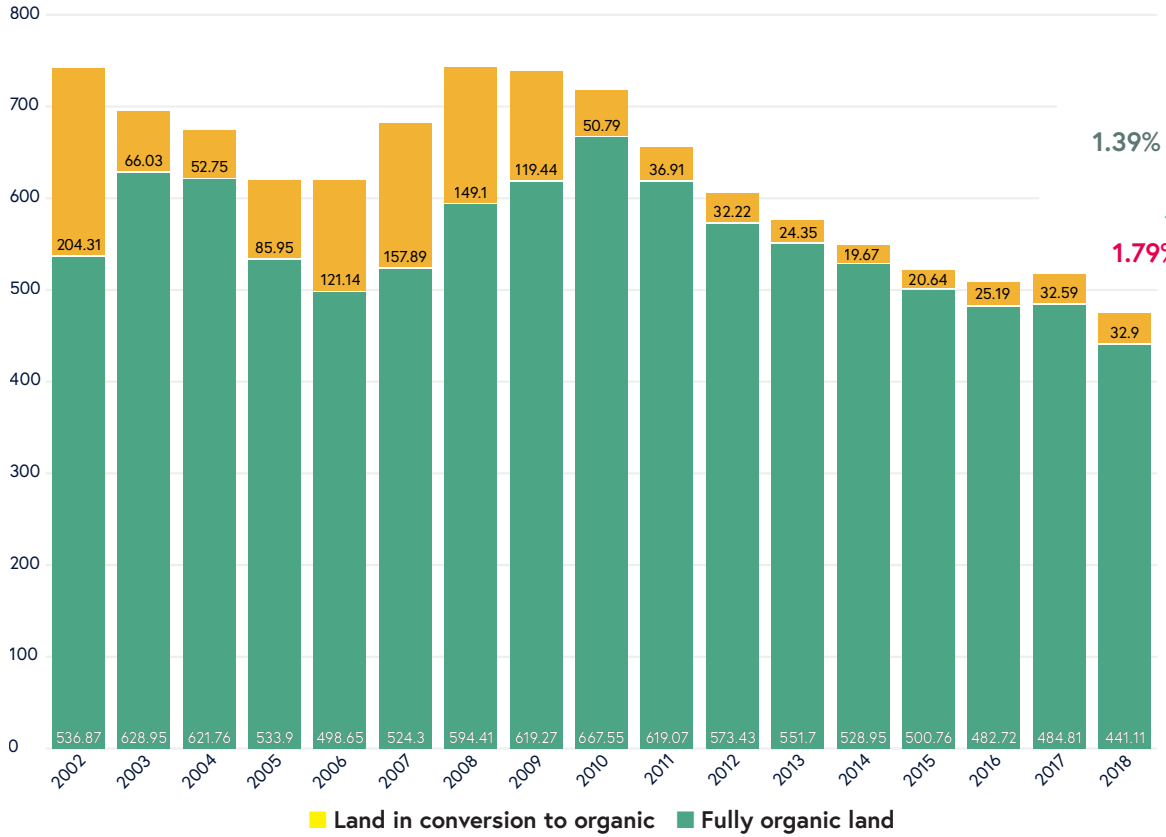
ADDITIONAL RESOURCES AVAILABLE

SOURCE: Bain analysis for the National Food Strategy, based on, Defra, (2018). Agriculture in the United Kingdom 2018, [online].

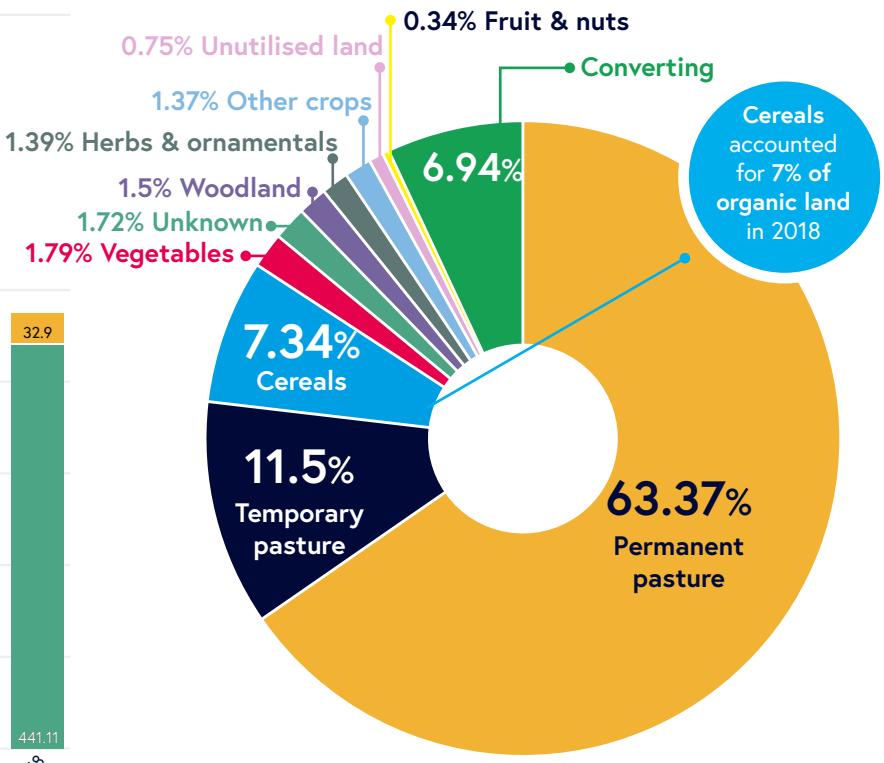
The amount of land under organic production is declining

ORGANIC LAND HAS DECREASED BY 56% SINCE 2002; IN 2018 ~75% IS FOR PASTURE AND ~5% FOR CROPS

Organic land in the UK (k hectares)



Organic land, 2018 (k hectares)



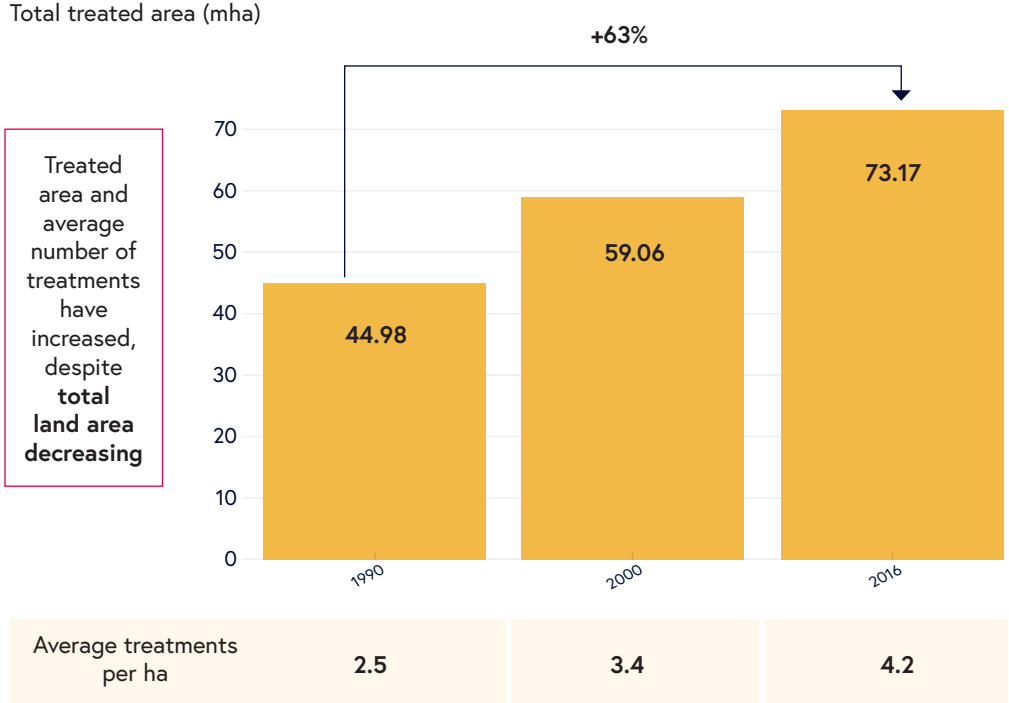
Note: Land in conversion in 2018 has not been split by land use type; 'Other crops' includes unknown use, other crops and land set side.

ADDITIONAL RESOURCES AVAILABLE

SOURCE: Bain analysis for the National Food Strategy, based on, Defra, (2018). Agriculture in the United Kingdom 2018, [online].

The area treated by pesticides has increased over the past 30 years

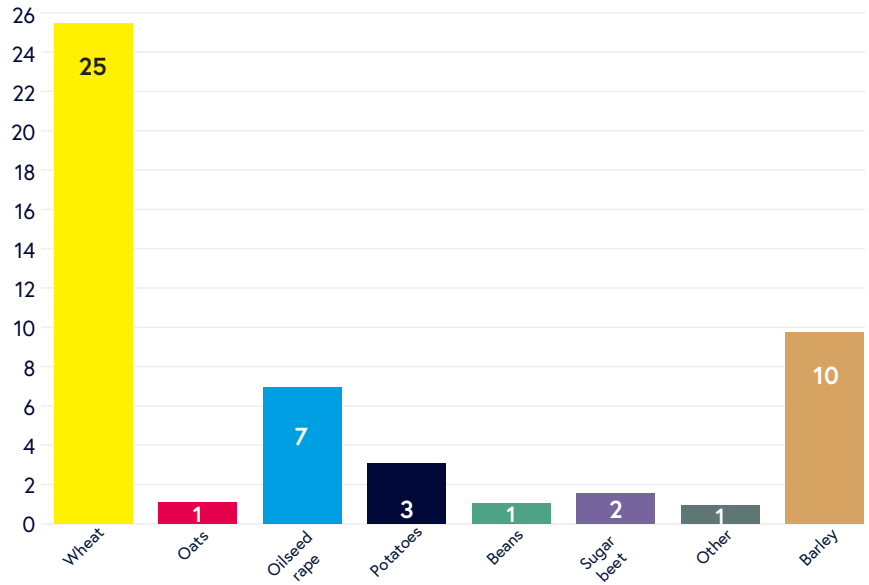
Total treated area (mha)



Treated area and average number of treatments have increased, despite **total land area decreasing**

	1990	2000	2016
Average treatments per ha	2.5	3.4	4.2

Total pesticides applied, 2018 (m spray hectares)



*"By volume, modern neonicotinoid insecticides are **10,000 times more potent than DDT (history's most notorious pesticide** which was banned globally in 2001 due to concerns about harm to the environment and human health)*

*… Therefore **while the weight of pesticides used in UK agriculture may have decreased, the rise in toxicity means that we are no less exposed to their harmful impacts**"* PESTICIDE ACTION NETWORK UK, 2018

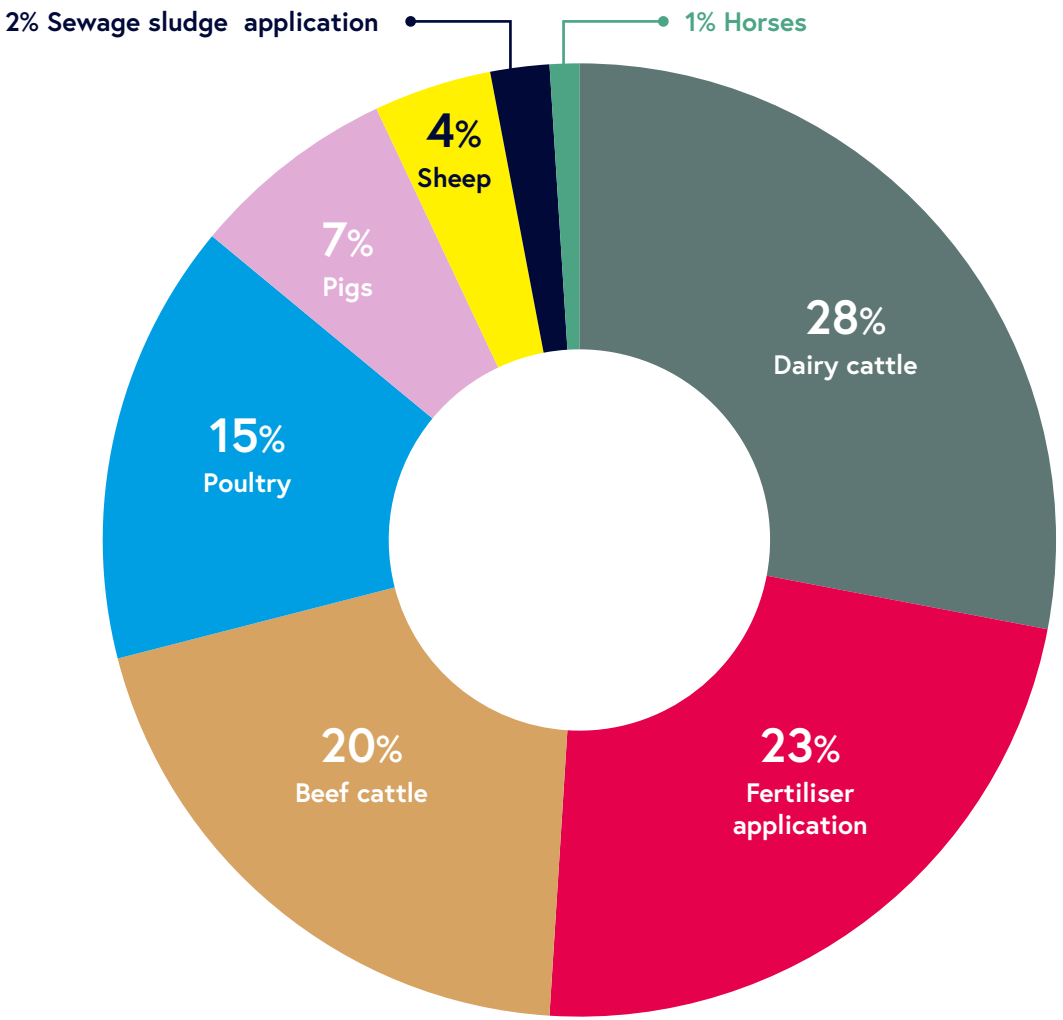
Note: Other includes Rye, Linseed, Triticale and Peas; other crops such as fruits and vegetables not shown as no 2018 data and only accounted for ~10% of hectares treated in 2015.

ADDITIONAL RESOURCES AVAILABLE

SOURCE: Bain analysis for the National Food Strategy, based on The Hidden Rise of UK Pesticide Use, Pesticide in Action Network UK, 2018 via. The Pesticide Usage Survey Statistics, Fera on behalf of Defra; Agriculture in the UK, Defra, 2019; Pesticide Usage Survey, Fera on behalf of Defra, 2018

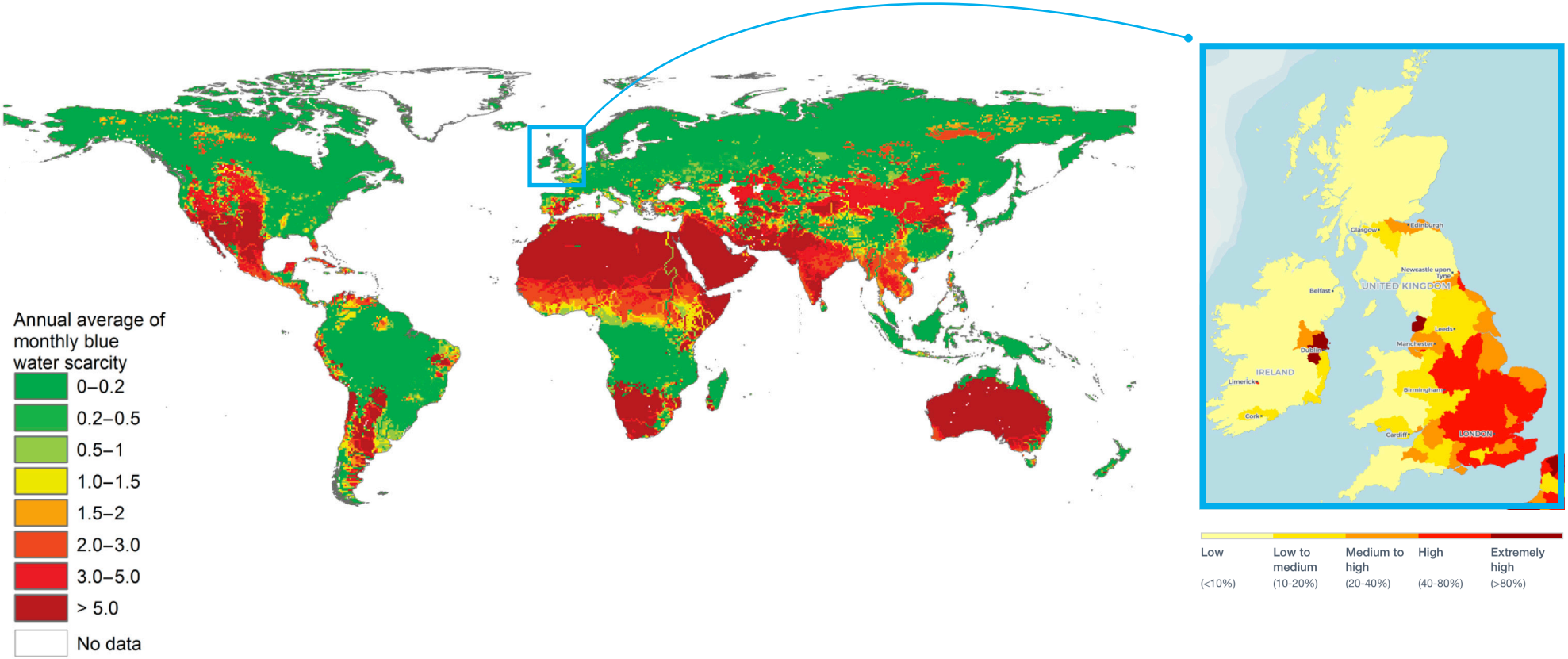
Almost all our ammonia emissions are from livestock and fertiliser

SHARE OF AMMONIA EMISSIONS



SOURCE: Defra, (2019). Clean Air Strategy 2019. [online]

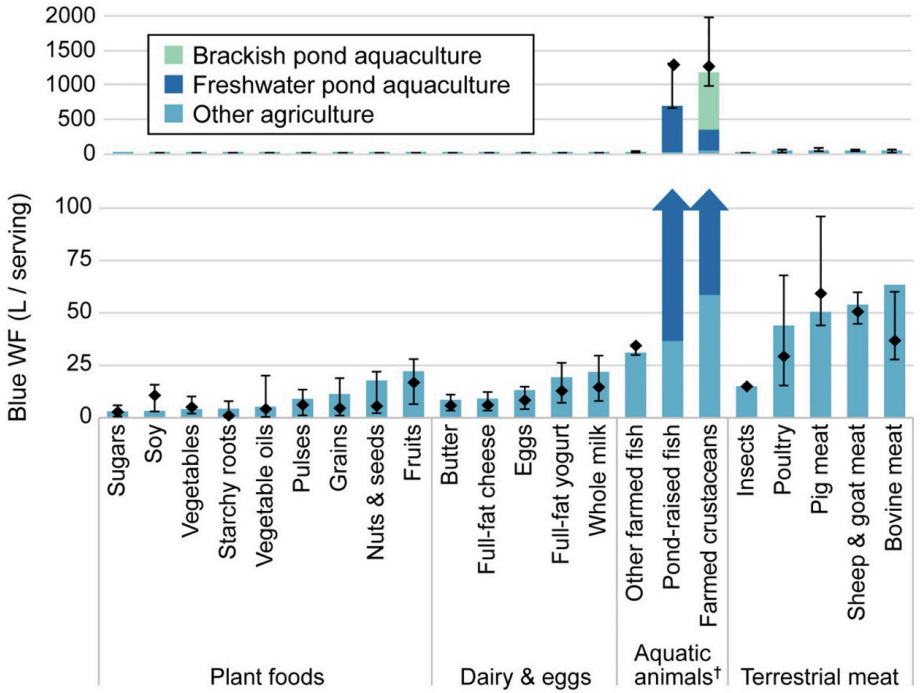
The UK is relatively water secure, but not in every region

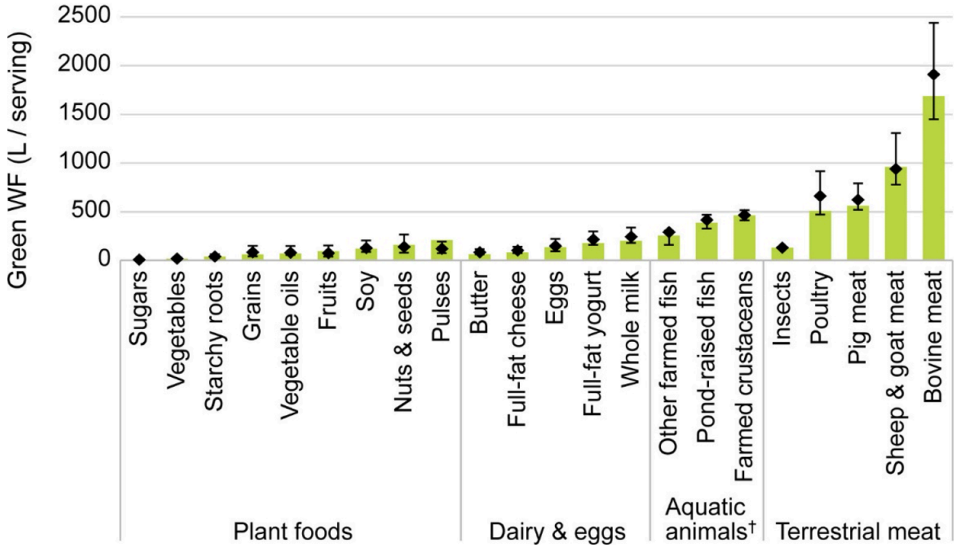


Note: Inset map measures the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use. Higher values indicate less water availability and more competition among users.

SOURCE: Global map: Mekonnen, M. & Hoekstra, A. (2016). Four billion people facing severe water scarcity, Science Advances, 2(2) [online]. UK inset map: WRI Aqueduct Tool, [online] accessed June 2021

Water use for food varies significantly





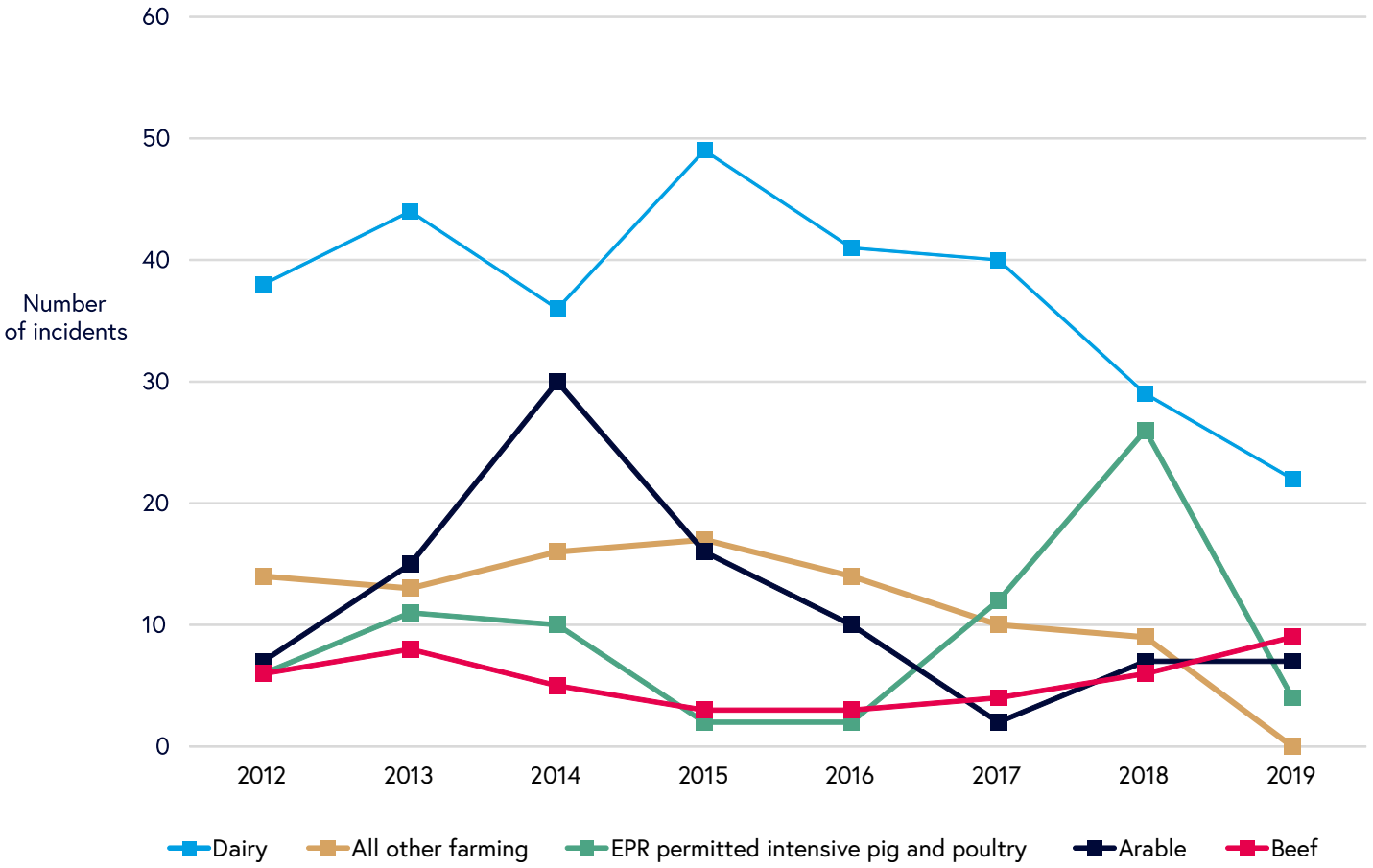
Note: 'Blue' water refers to surface and groundwater; 'green' water is derived from precipitation. Although complex and location specific, efficient use of green water in rainfed agriculture can lessen reliance on blue water.

WF = water footprint

SOURCE: Brent F. Kim, Raychel E. Santo, Allysan P. Scatterday, Et al. (2020). Country-specific dietary shifts to mitigate climate and water crises, Global Environmental Change, Volume 62. [online].

Agriculture is a major source of water pollution

SERIOUS POLLUTION INCIDENTS CAUSED BY FARMING ACTIVITIES, 2012 TO 2019



The Environment Agency's 2021 annual report states that for water, "the top pollutants are pesticides and nitrates from fertilisers" including animal manure.

This is largely due to non-compliance with regulation: "a 2019 study of the River Axe found 95% of the 86 dairy farms visited by the Environment Agency were non-compliant with agricultural regulations. Of these, 49% were causing pollution at the time of the visit."

SOURCE: Environment Agency (2021). Regulating for people, the environment and growth, 2019. [online].

The UK's soil is relatively healthy, by global standards, but eroding faster than it can be formed

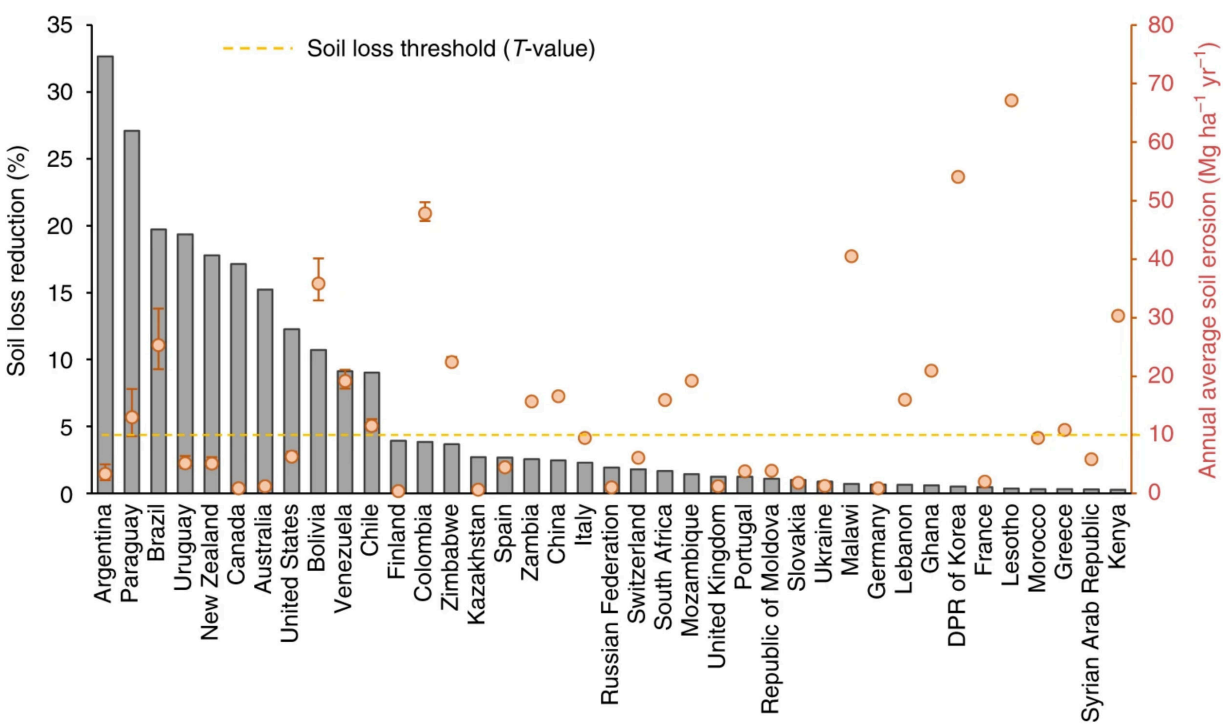
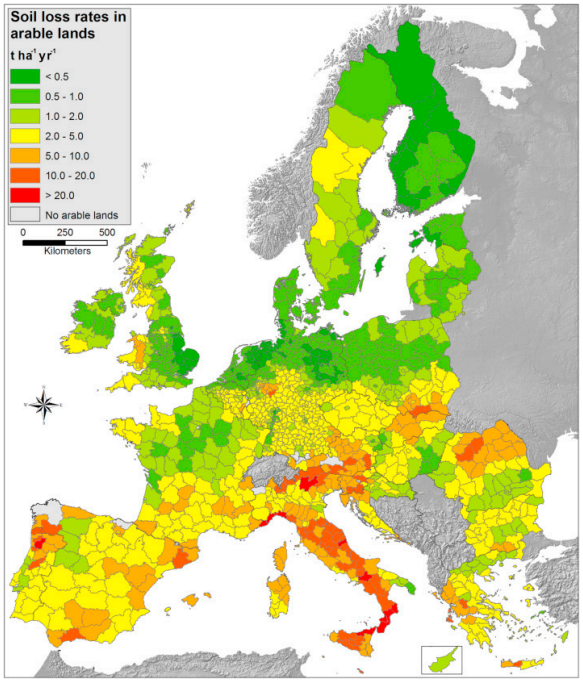


Chart shows (grey bars) reductions in soil loss associated with adopting conservation agriculture globally, alongside current erosion rates (orange dots). The UK has very low soil erosion (as little UK forest is being converted to cropland), though the analysis only modelled data up to 2012. However, the UK imports food from countries with high soil loss rates.



UK soil loss rates are much higher in the uplands, though still relatively low compared to other parts of Europe.

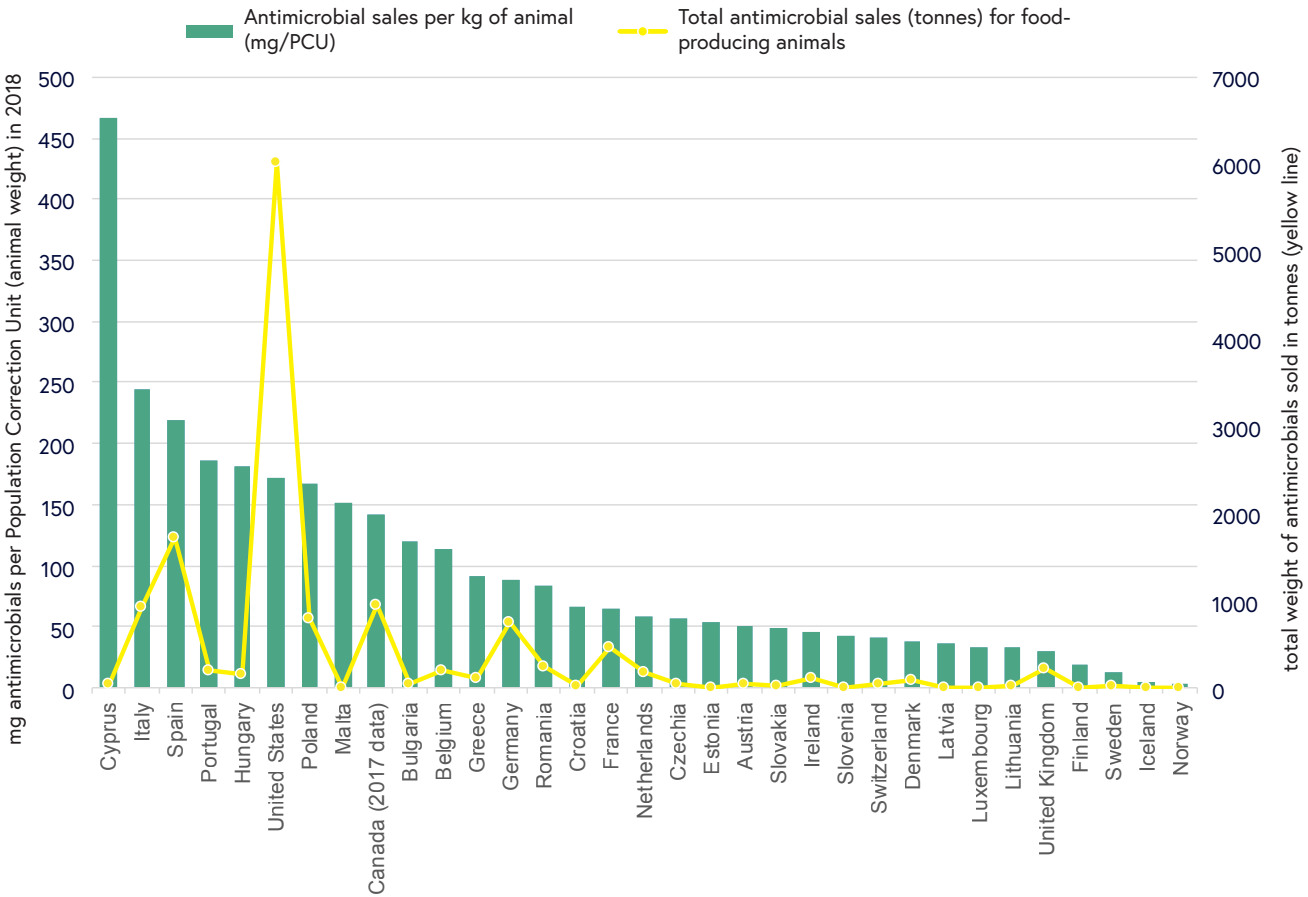
UK arable soil loss rates in areas with conservation agriculture (1.04t/ha/year) are below that of the average rate of soil formation (1.4t/ha/year).

However, UK average soil loss, at 2.38t/ha/year, is 1.7 times higher than the average rate of soil formation.

This points to a need to focus on restoring upland soil cover and to ensure all farming adopts soil conservation practices.

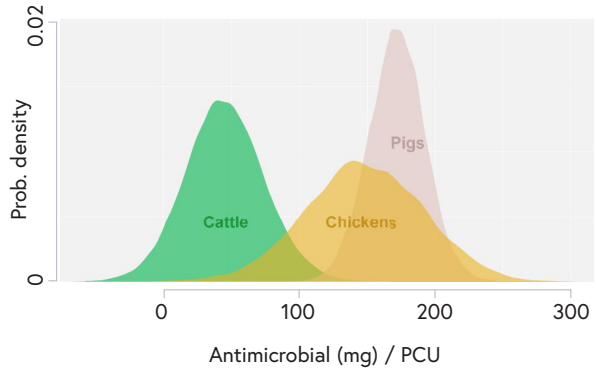
SOURCE: Borrelli et al. (2017) Nature. An assessment of the global impact of 21st century land use change on soil erosion. [online]; Panagos et al (2015) Environmental Science and Policy. The new assessment of soil loss by water erosion in Europe. [online]

Use of antibiotics in livestock, by country



The UK has low antimicrobial use, mostly due to high animal health and welfare standards, and partly due to high pork imports.

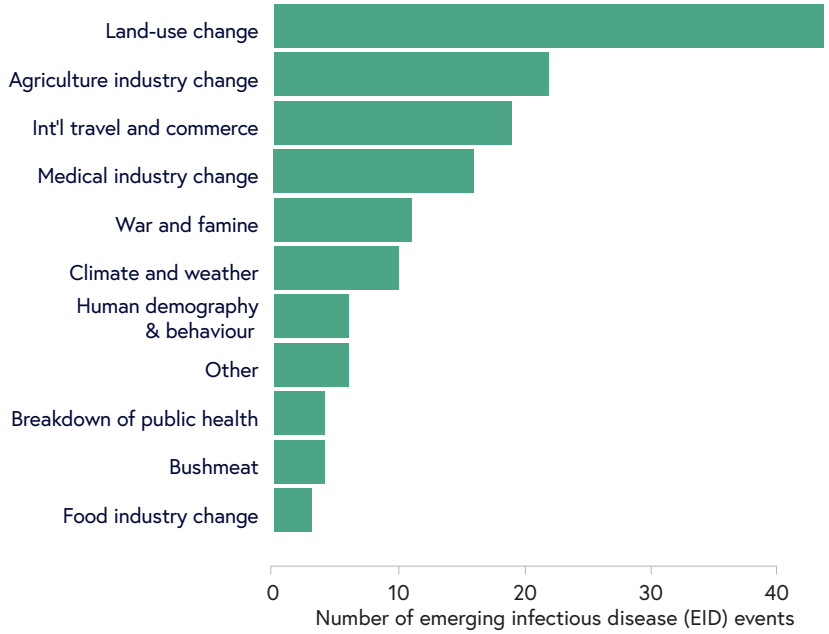
Distributions of antimicrobial consumption in OECD countries



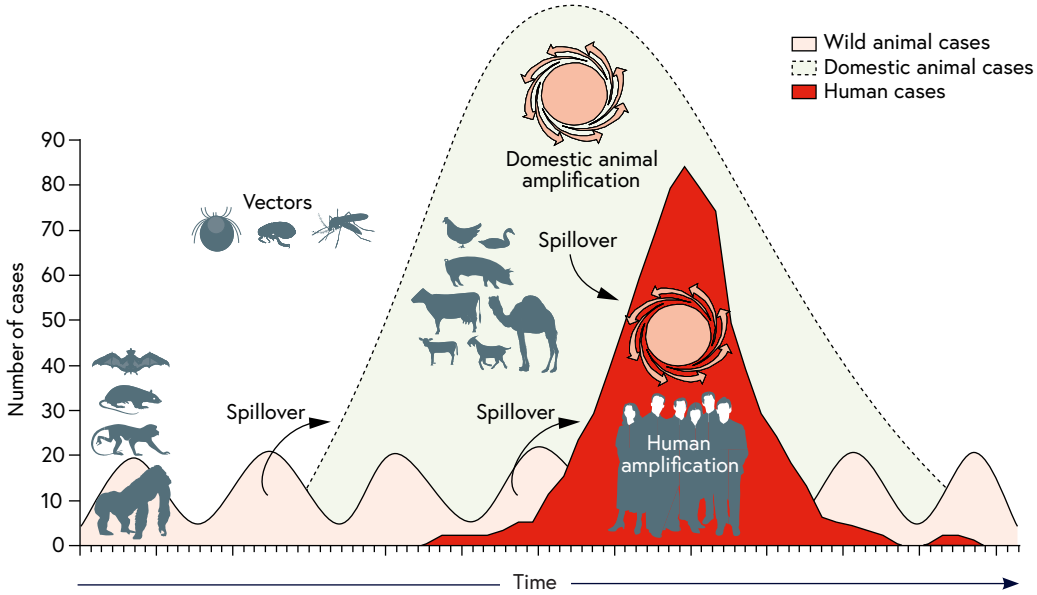
SOURCE: 1) Antimicrobials use - NFS analysis based on: NRDC. (2019). Intensity of Antibiotic Consumption in U.S. Livestock: 2019 Update. [online]. and European Medicines Agency. (2020). European Surveillance of Veterinary Antimicrobial Consumption, 2020. Sales of veterinary antimicrobial agents in 31 European countries in 2018. [online]. 2) Van Boeckel, T.P. Brower, C. Gilbert, M. Et al. (2015). Global trends in antimicrobial use in food animals. PNAS 112(18) 5649 – 5654. [online].

Livestock farming and land clearance are the major cause of zoonotic disease

Land use change and agricultural intensification are the largest drivers of zoonotic disease emergence – both are closely linked to demand for animal protein.

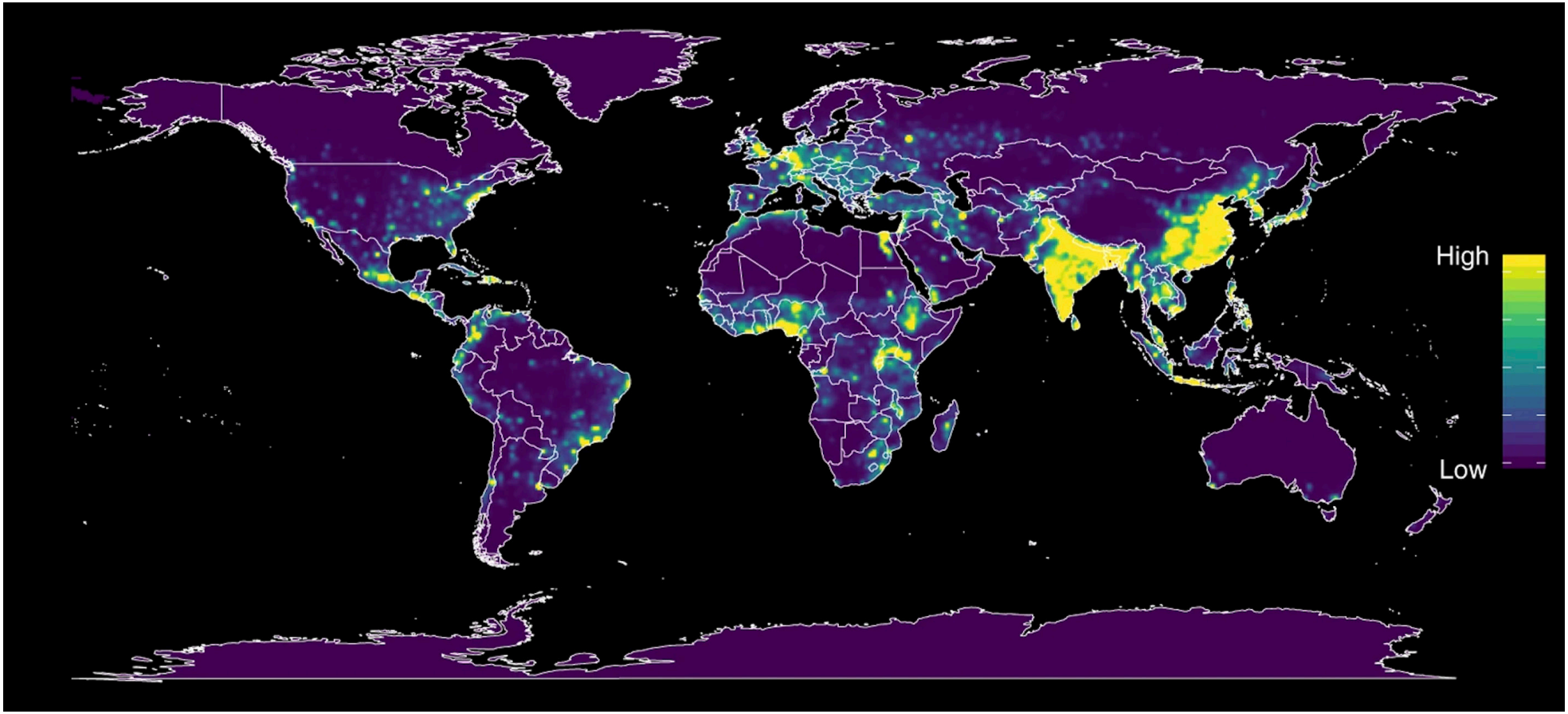


Most zoonoses originate from animals. Eight of the top ten mammalian species with the highest number of viruses shared with humans are domesticated: pigs, cattle, horses, sheep, dogs, goats, cats and camels.



SOURCE: : 1) Loh EH, Zambrana-Torrelio C, Olival KJ, Et al. (2015). Targeting Transmission Pathways for Emerging Zoonotic Disease Surveillance and Control. Vector Borne Zoonotic Dis. 2015 Jul;15(7):432-7. [online]. 2) United Nations Environment Programme and International Livestock Research Institute (2020). Preventing the Next Pandemic: Zoonotic diseases and how to break the chain of transmission. [online]. 3) Johnson Christine K., Hitchens Peta L. Et al. (2020) Global shifts in mammalian population trends reveal key predictors of virus spillover risk. Proc. R. Soc. B.287. [online].

Spatial analysis of zoonotic risk



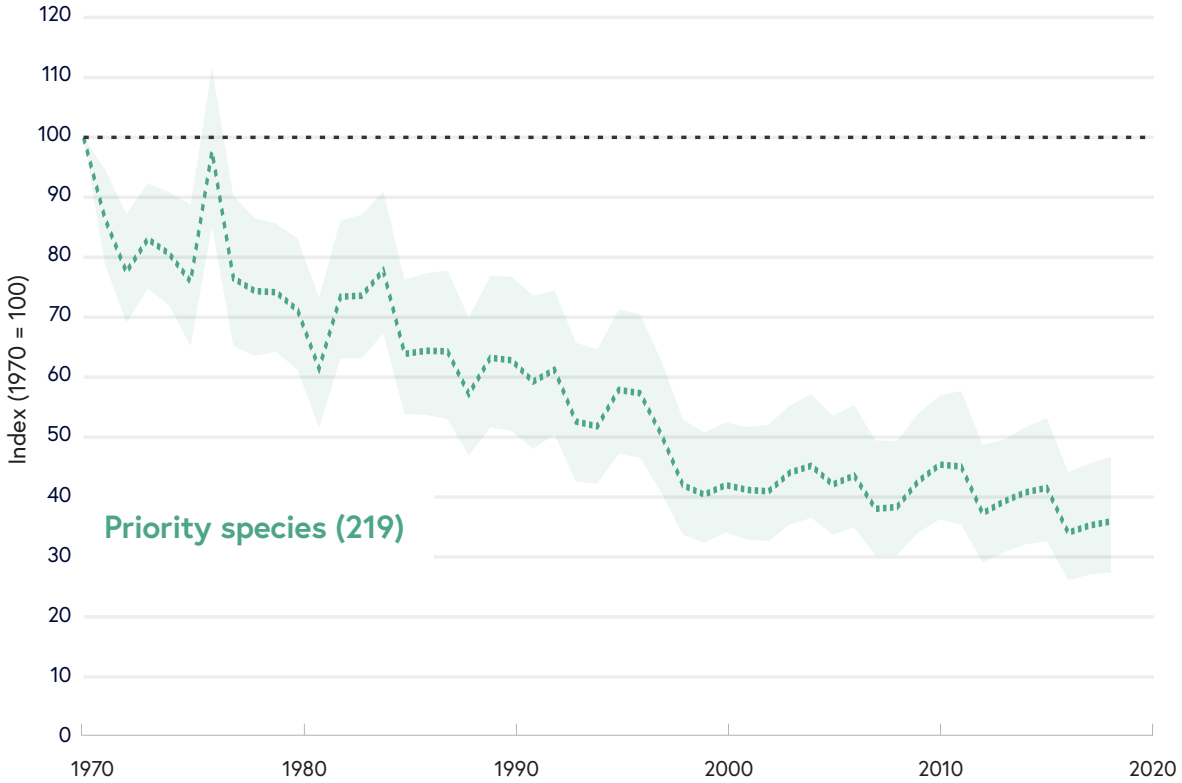
Allen et al. (2017) analysed emerging infectious diseases (EID) of wildlife origin based on a broad set of predictors, such as the distribution of tropical forested regions, human population density, mammal species richness, agricultural land use, and others. The resulting heat map shows the global spatial patterns of estimated risk of zoonotic EID events after factoring out bias.

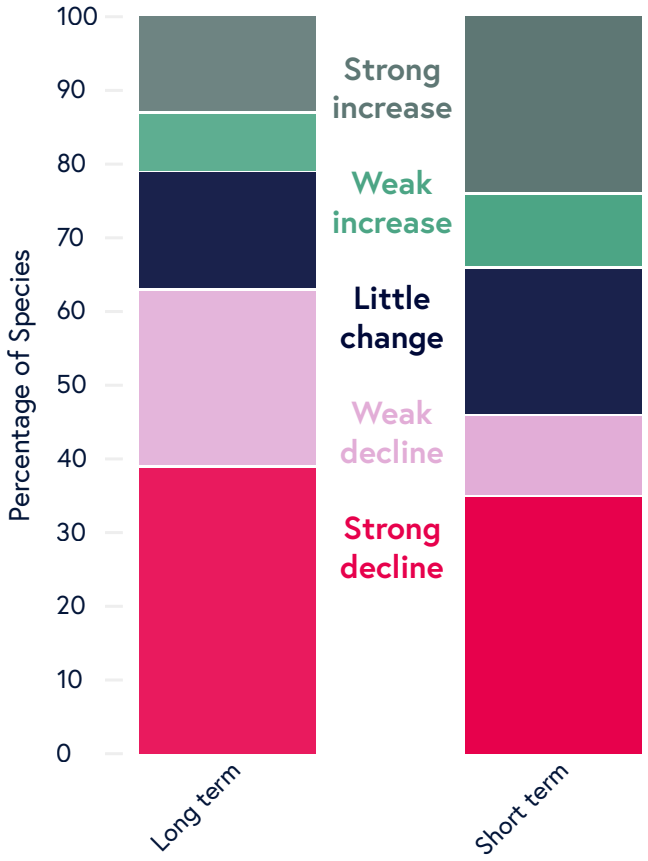
Note: the risk of zoonotic disease emergence becoming a major pandemic is also related to agricultural biosecurity practice and health system response, which varies across these geographies.

SOURCE: Allen, T. Murray, K.A. Zambrana-Torrelio, C. *et al.* Global hotspots and correlates of emerging zoonotic diseases. *Nat Commun* **8**, 1124. [online].

UK biodiversity has fallen over the last 50 years

CHANGE IN THE RELATIVE ABUNDANCE OF PRIORITY SPECIES IN THE UK, 1970 TO 2018

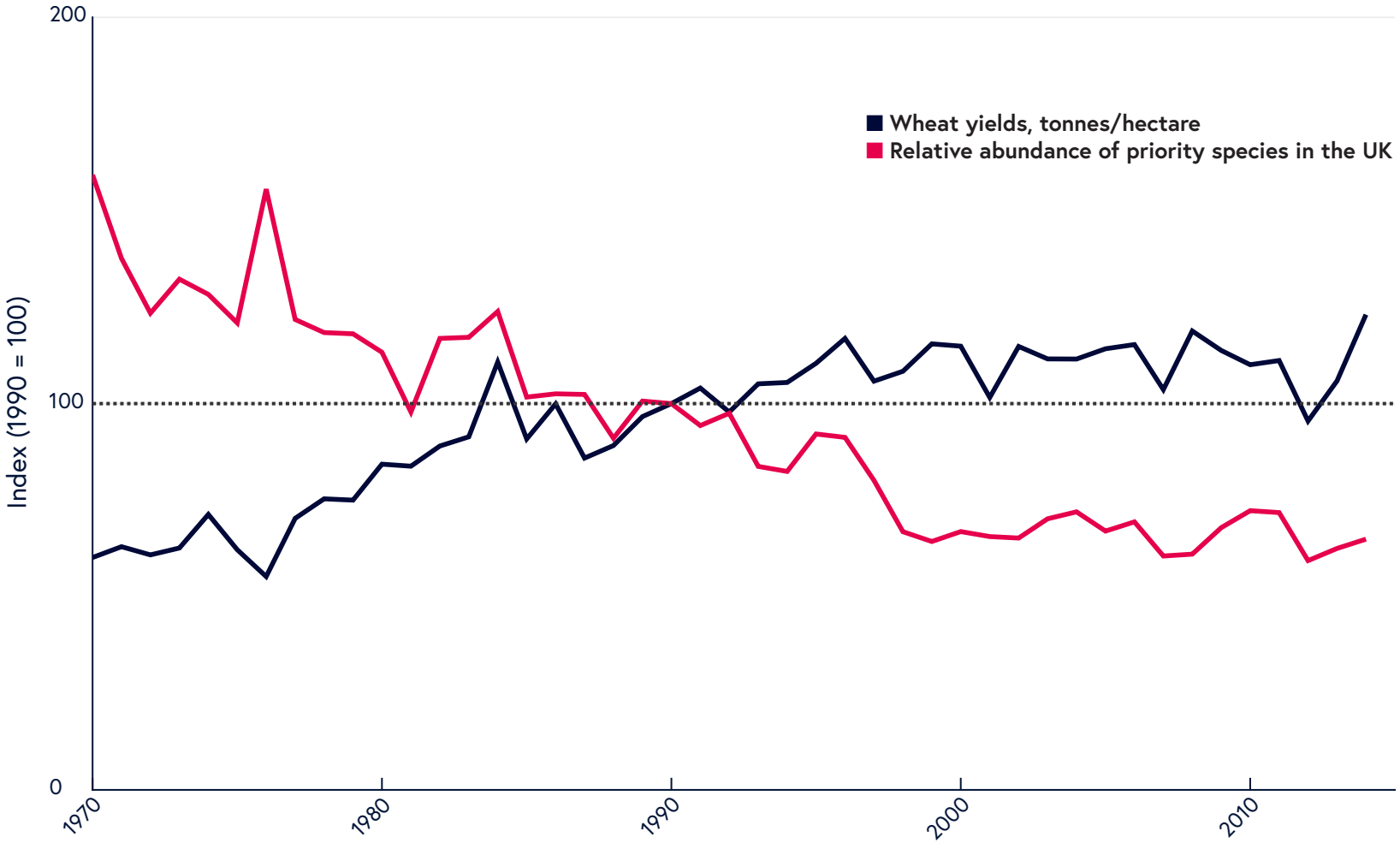




Note: abundance is the estimated population of that species in the latest year of the time series taken as a percentage of its estimated population in the earliest year of the time series (i.e. the base year). The indicator will increase when the population of priority species grows on average and decrease when the population declines.

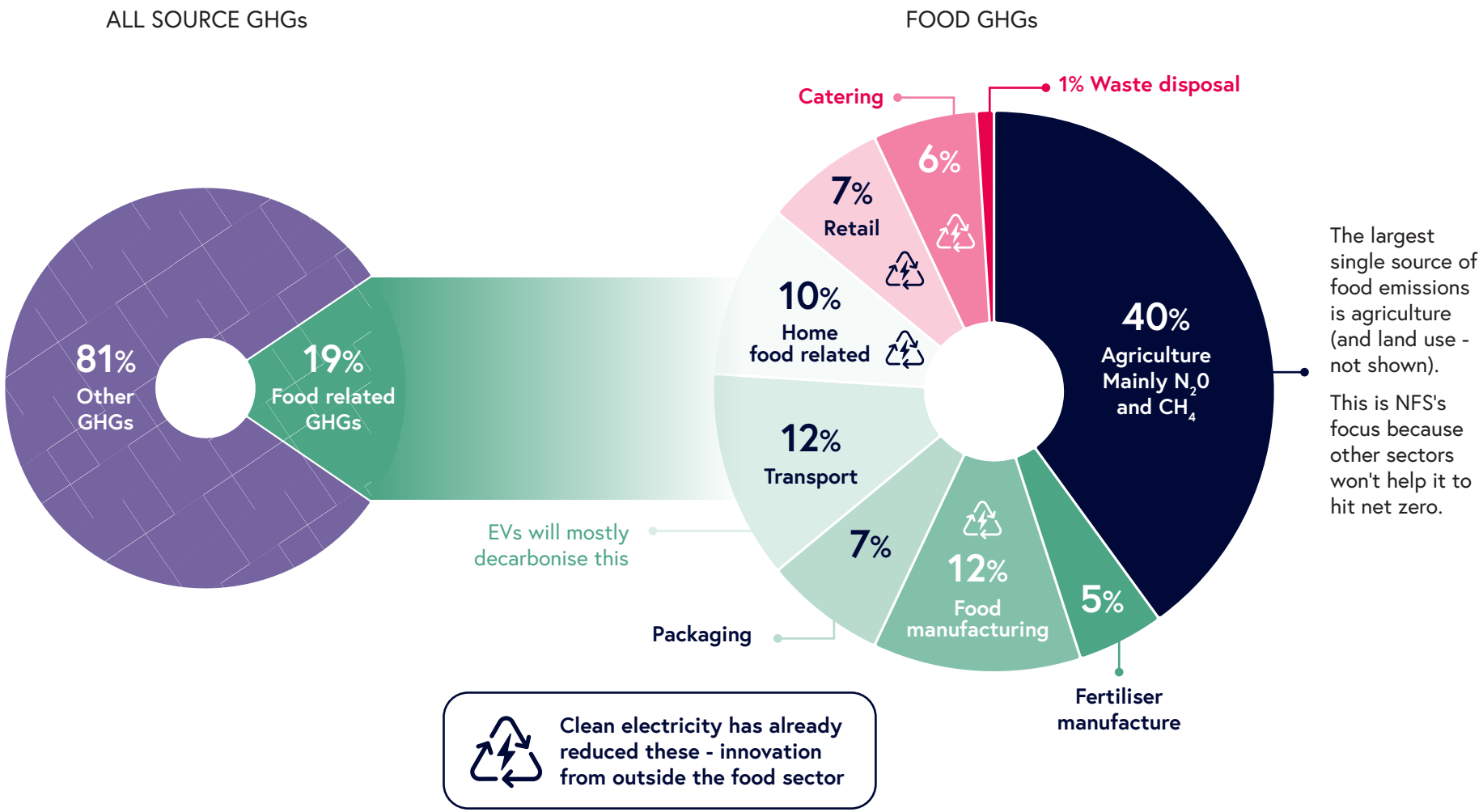
SOURCE: Joint Nature Conservation Committee. (2020). Status of UK priority species – Relative abundance. UK Biodiversity Indicators: State Indicator. [online].

The fall in UK biodiversity has occurred as agricultural production has increased



SOURCE: Bain analysis for National Food Strategy based on: Defra (2018). Agriculture in the UK, Defra, 2018. [online]; Ritchie, H. & Roser, M. (2019). Our World in Data. [online].

In the UK, in 2008, food emissions made up 19% of our territorial carbon emissions (closer to 30% including imports – not shown here)



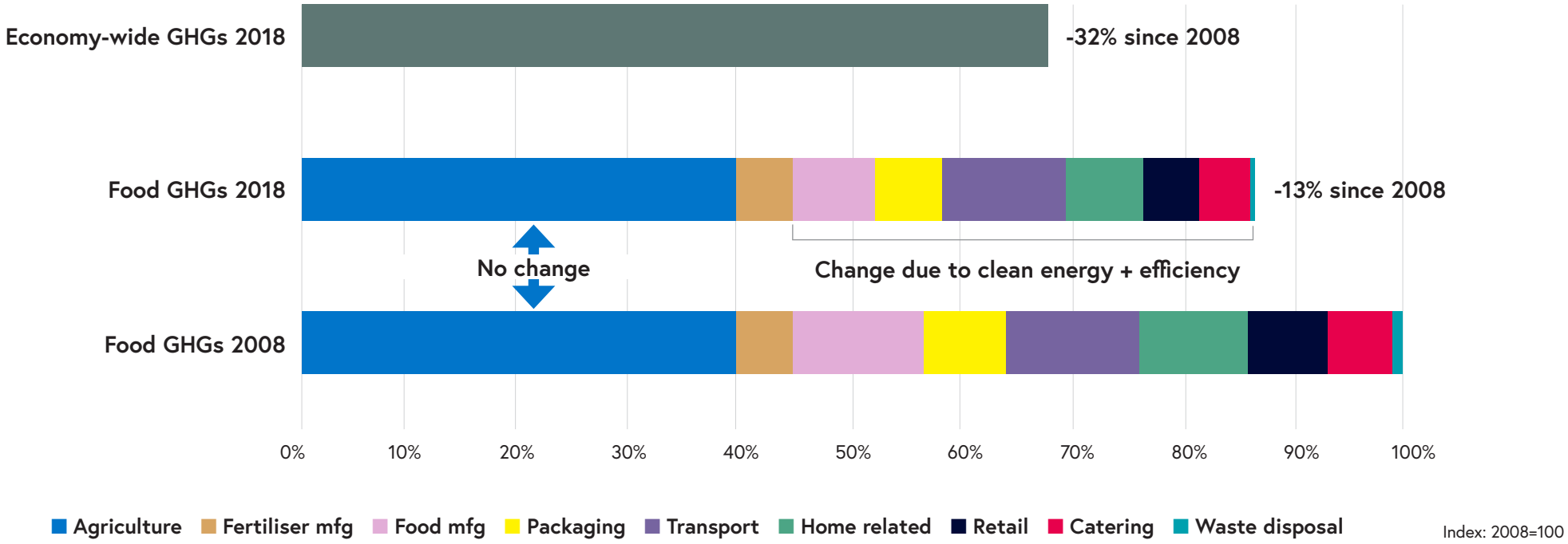
The largest single source of food emissions is agriculture (and land use - not shown).

This is NFS's focus because other sectors won't help it to hit net zero.

SOURCE: Garnett, T. (2008). Cooking up a storm. In: Food, greenhouse gas emissions and our changing climate. Food Climate Research Network, Centre for Environmental Strategy. [online].

Food emissions have fallen at 1/2 the rate of the wider economy – mainly because agriculture emissions have not fallen at all

FOOD SYSTEM EMISSIONS HAVE FALLEN DUE TO CLEAN ENERGY, NOT CLEANER FARMING OR EATING

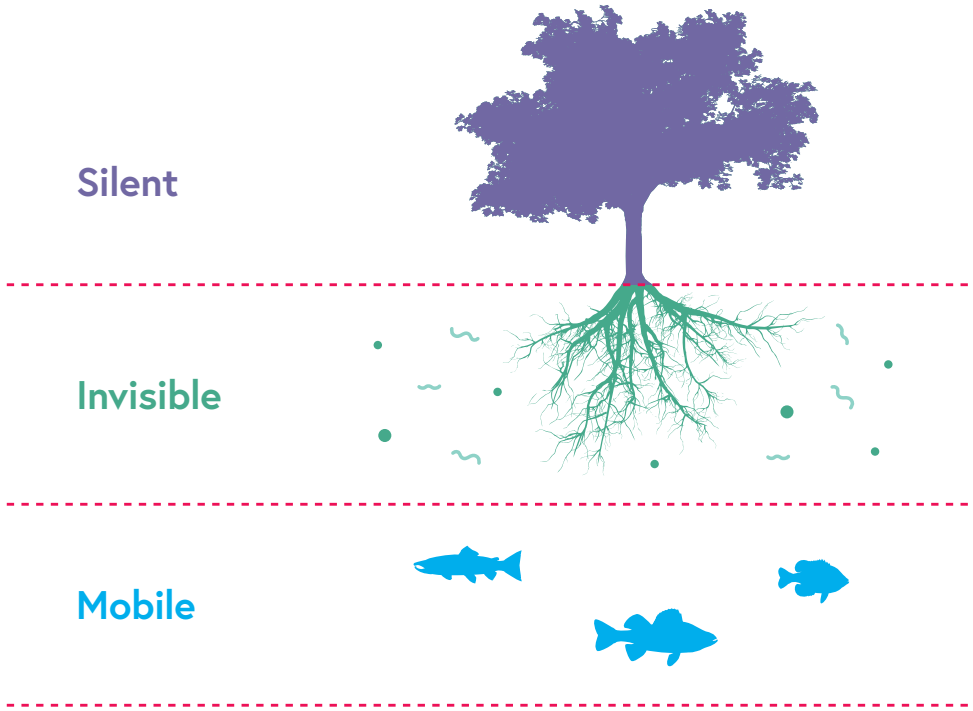


Index: 2008=100

SOURCE: National Food Strategy analysis based on: Garnett, T. (2008). Cooking up a storm. In: Food, greenhouse gas emissions and our changing climate. Food Climate Research Network, Centre for Environmental Strategy. [online]; BEIS. (2019) Final UK greenhouse gas emissions national statistics. Data Tables. [online]; WRAP. (2020). Courtauld Commitment 2025, 2020 Annual Report. [online].

THE INVISIBILITY OF NATURE

Nature is undervalued in our economic systems because it is largely silent, invisible or mobile



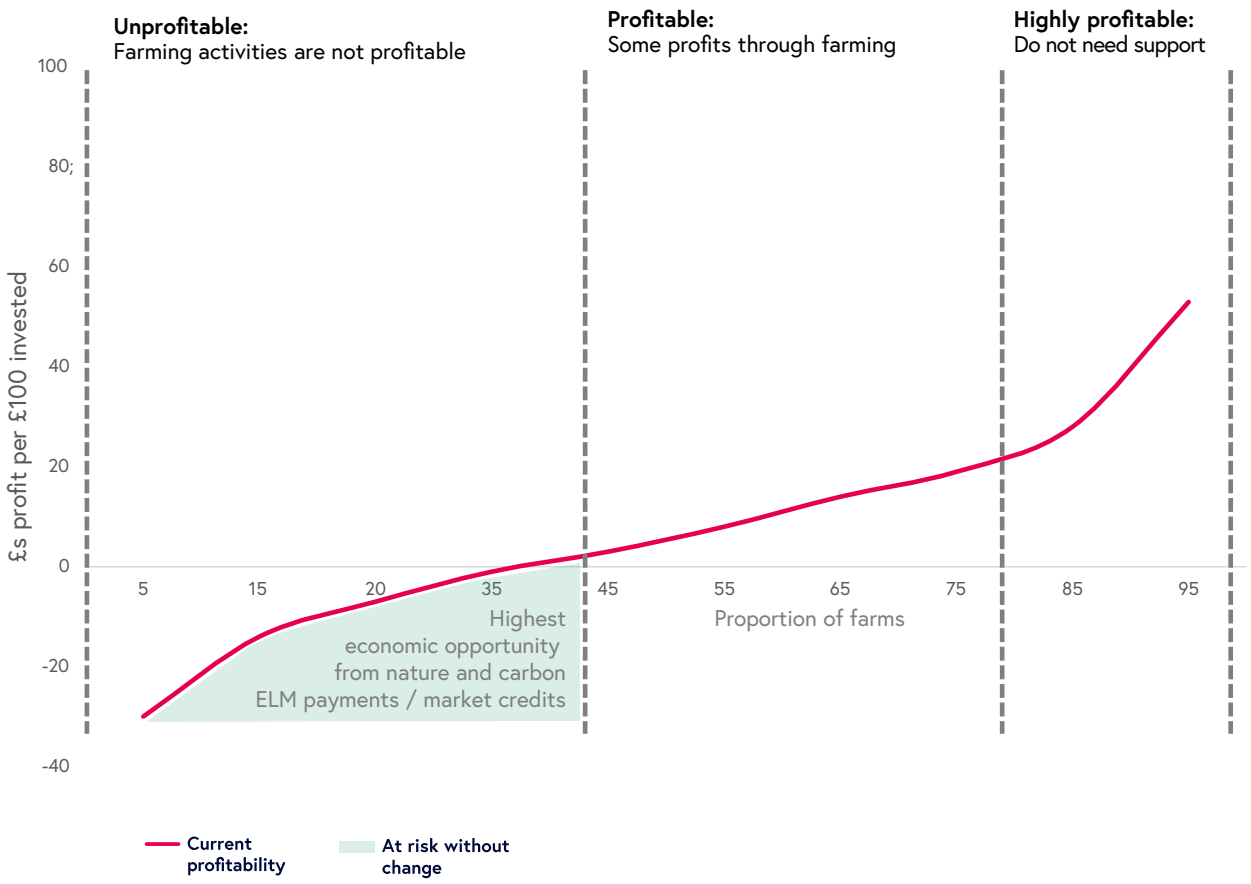
Professor Partha Dasgupta's 610 page report shows that nature doesn't fit our decision making frameworks:

1. **Not measured:** e.g. carbon
2. **Not plausible to measure:** e.g. mycelium
3. **Hard to pin down:** e.g. migratory fish
4. **Not possible to value:** e.g. the idea of the Amazon

Only (1) can theoretically fit into a market feedback framework

SOURCE: Dasgupta, P. (2021). The Economics of Biodiversity: The Dasgupta Review. HMT [online].

38% of farms would make a loss without direct payments (BPS). Payments for nature and carbon projects could fill the gap



Farm profits shown here exclude BPS payments but include agri-environment schemes and diversification. Without these, even more farms are unprofitable (~75%).

Unprofitable farms are environmentally risky: they are least able to keep up with improvements to regulations and best practice (e.g. slurry storage, nutrient management plans, integrated pest management).

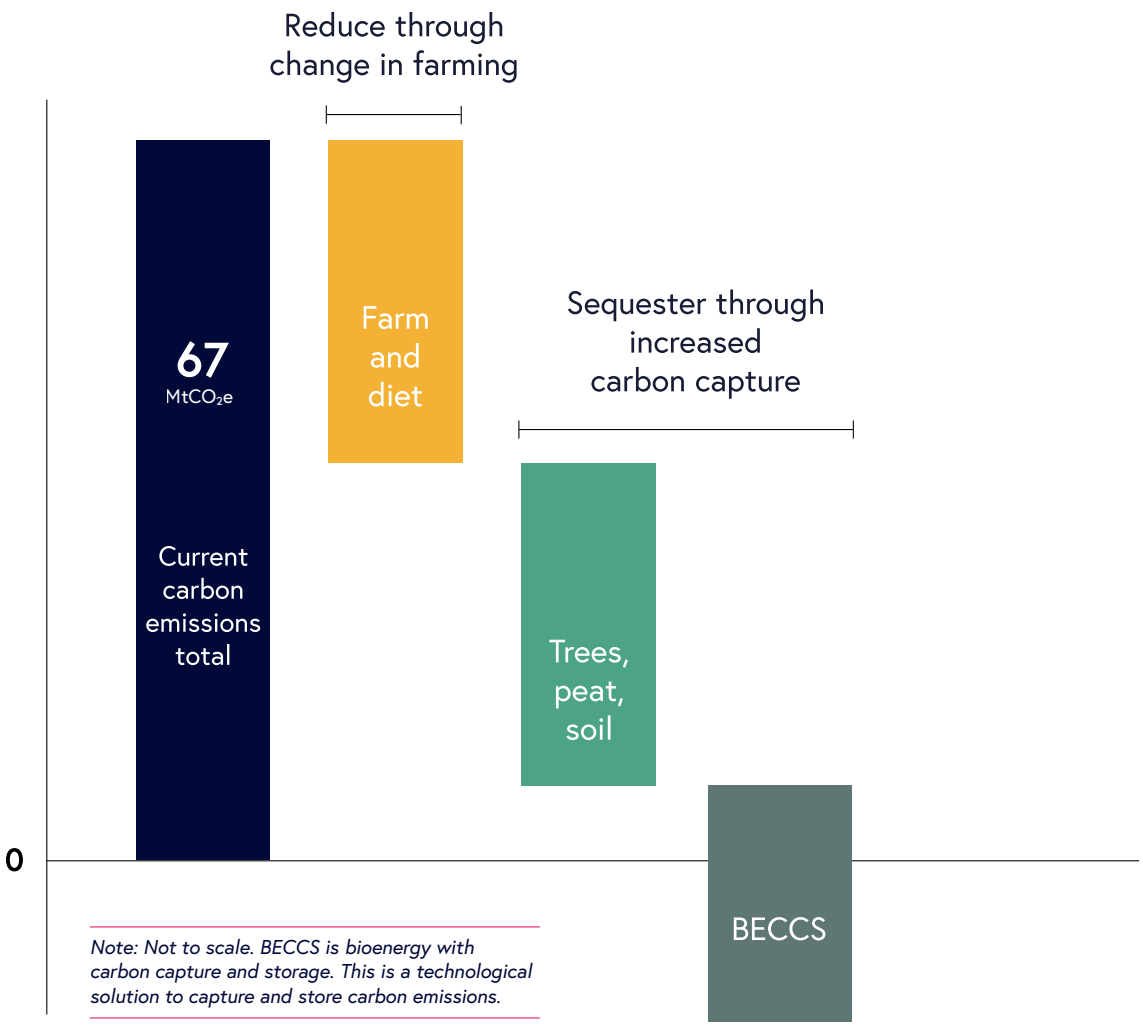
Highly profitable farms may only opt to join ELM if its requirements do not affect their farm profits as 'income foregone' is high. Regulation may be more important here.

SOURCE: Defra (2019) Farm Evidence Compendium 2019

Nature and climate

WE CAN CHANGE LAND USE TO IMPROVE THE ENVIRONMENT

Land has three roles in decarbonising

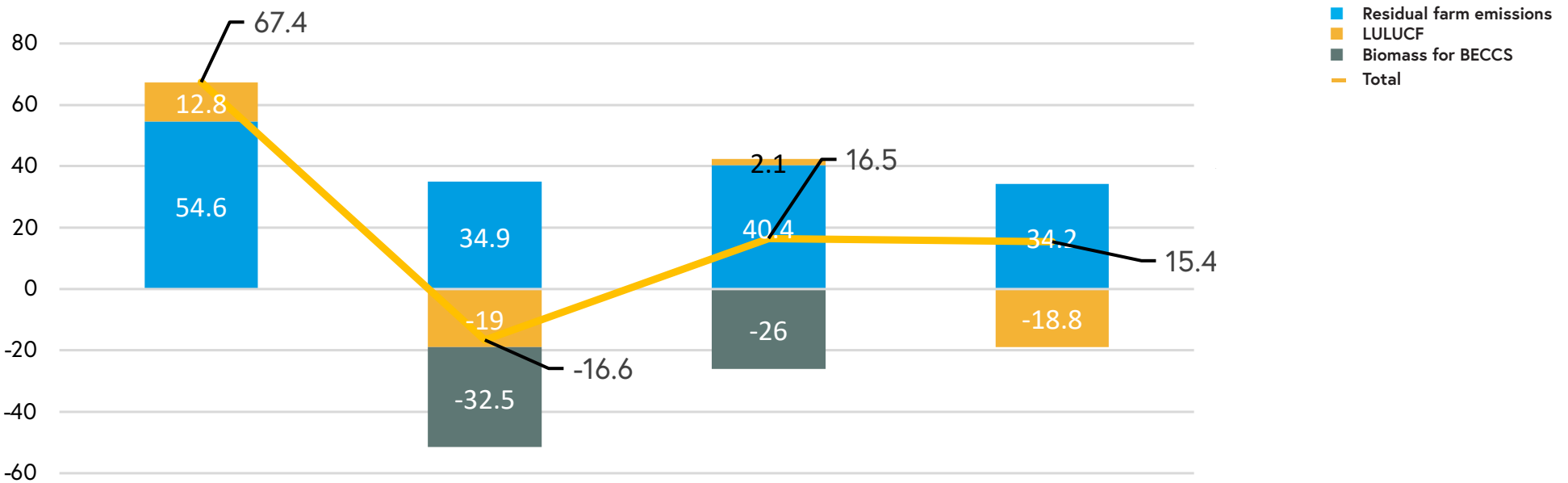


SOURCE: NFS Analysis based on Committee on Climate Change. (2020). The Sixth Carbon Budget, The UK's path to Net Zero. [online]

To achieve UK net zero targets, we must:

1. Approximately halve emissions from farming – leaving residual emissions.
2. Grow forests and restore peat and soils to sequester these residual emissions (turning land from a net emitter to net carbon sink).
3. Grow extra biomass for BECCS to further offset residual emissions from industry, farming, and flying.

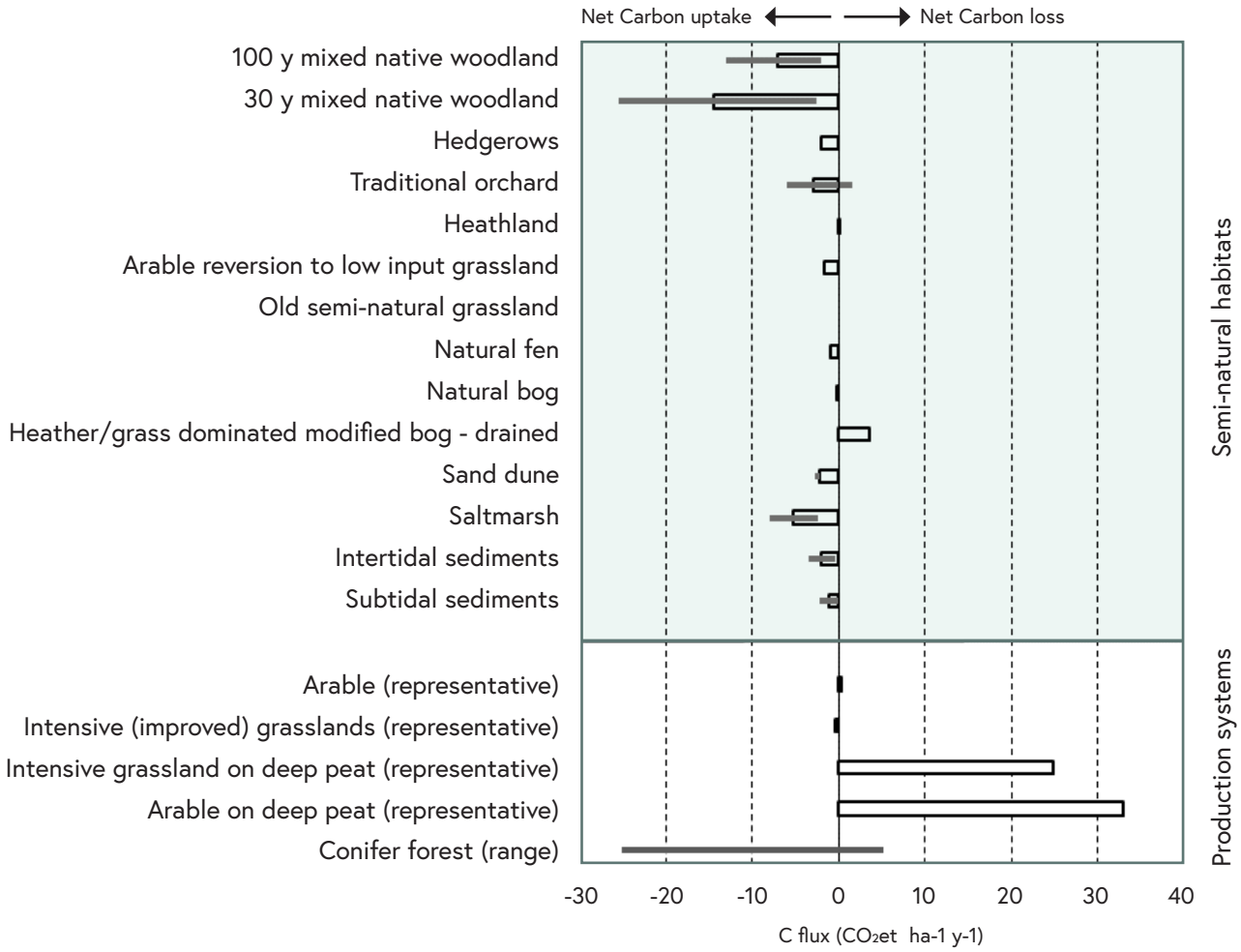
Land must be net-negative for the whole economy to achieve net zero



Note: pathways adjusted to AR5 GHG weighting to make them comparable but not assessed by the NFS team for plausibility; LULUCF is Land Use, Land-Use Change and Forestry.

SOURCE: National Food Strategy analysis based on: Committee on Climate Change. (2020). The Sixth Carbon Budget, The UK's path to Net Zero. [online]; NFU. (2019). Achieving Net Zero, Farming's 2040 goal. [online]; IDDRI. (2018). An agroecological Europe in 2050: multifunctional agriculture for healthy eating, Findings from the Ten Years For Agroecology (TYFA) modelling exercise. [online].

Natural and semi-natural habitats remove emissions, while most food-producing landscapes release them

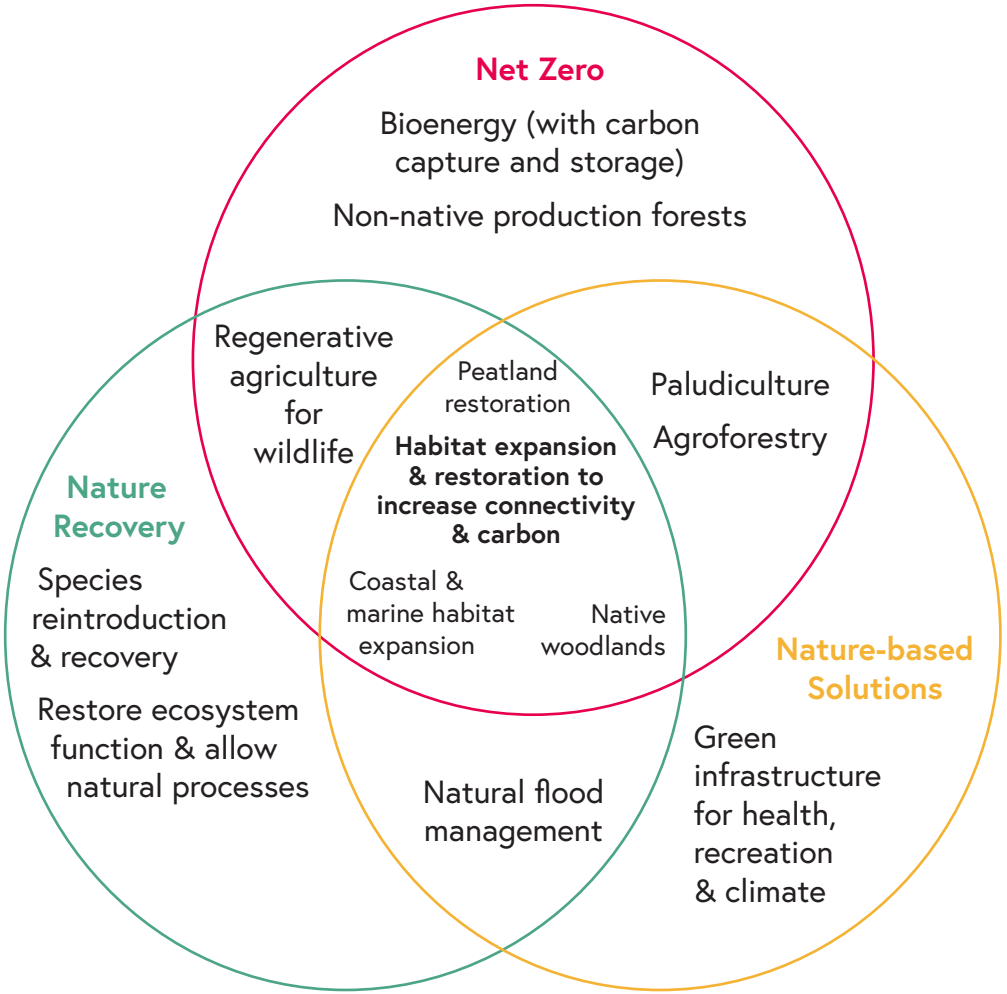


To hit net zero we need more semi-natural habitats.

To achieve our nature goals, we also need more semi-natural habitats.

SOURCE: Natural England. (2021) Carbon storage and sequestration by habitat: a review of the evidence (second edition). [online].

A carbon-only strategy will fail to meet our nature goals: we need a joined up approach

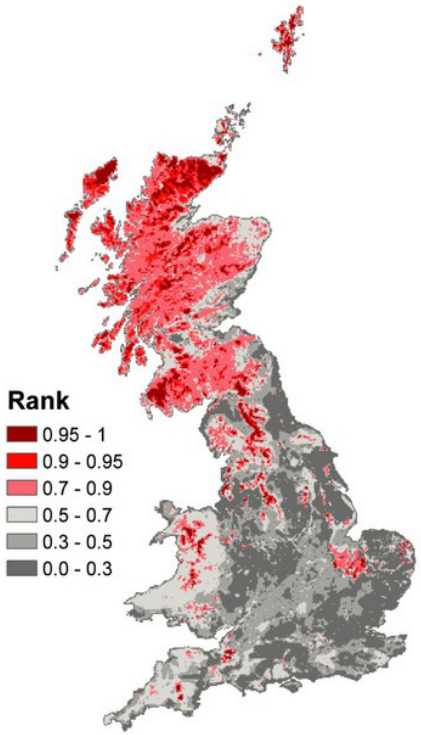


"A joined-up approach that addresses both climate change and biodiversity decline together is the only realistic way of meeting the multiple demands on our environment."

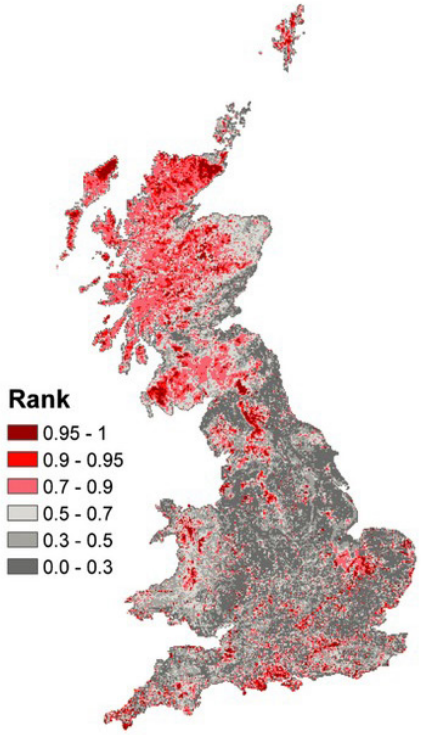
SOURCE: Natural England. (2021) Carbon storage and sequestration by habitat: a review of the evidence (second edition). [online].

Mapping of priority areas for biodiversity and carbon storage show that we can protect the two together

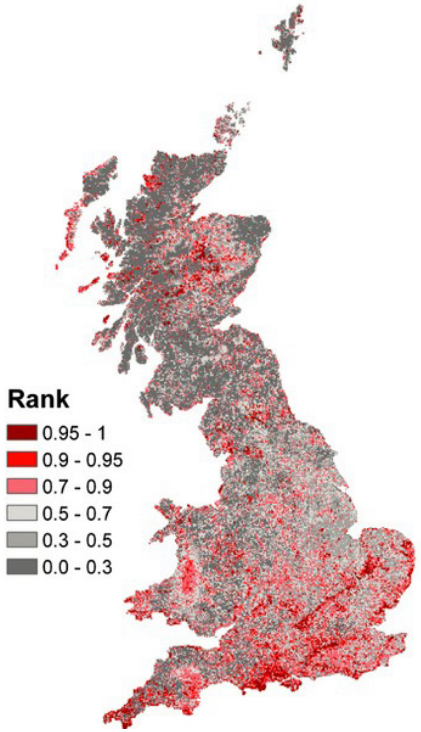
Option 1. Priority regions for carbon restoration only



Option 2. Priority regions for both carbon and biodiversity



Option 3. Priority regions for biodiversity only



There is a large spatial overlap in GB nature and carbon priorities.

A carbon and biodiversity strategy protects 90% of our highest priority carbon storage, and 91% of our highest priority nature areas.

Note: Biodiversity is based on all species in the UK Biodiversity Action Plan for which data was available. Distributions of species were derived from the Centre for Ecology and Hydrology Biological Records Centre, Butterfly Conservation and the British Trust for Ornithology. Carbon is based on vegetation carbon from NERC Centre for Ecology and Hydrology, and soil carbon density estimated using soil parameter, land use and soil series data from the National Soil Resources Institute. All derived with 2km x 2km grids. There are additional priorities for natural capital, and planning of any land strategy will need to account for more than just carbon and nature.

SOURCE: Thomas, C. D., B. J. Anderson, A. Moilanen, F. (2013). Reconciling biodiversity and carbon conservation. Ecology Letters. 16 (s1), 39-47. [online].

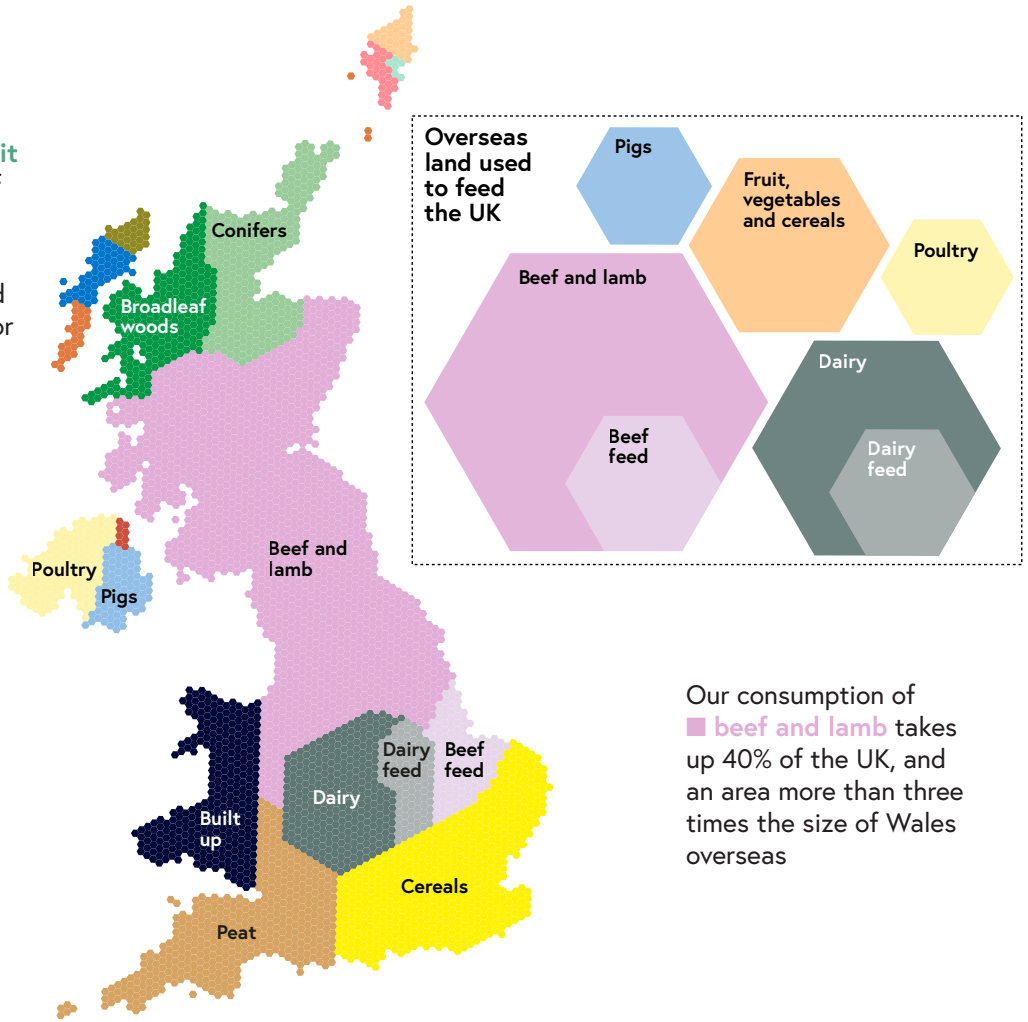
Our land footprint for food is larger than the UK

All the plants we eat including ■ potatoes, ■ fruit and veg, and all imported ■ cereals, fruit and veg use just 15% of our total land footprint.

We use 5x as much land for ■ golf courses as for ■ orchards

■ Pigs and ■ poultry combined use 5% of UK land, mostly for feed crops, but a larger area overseas

■ Beaches
■ Inland water
■ Christmas trees



Our consumption of ■ beef and lamb takes up 40% of the UK, and an area more than three times the size of Wales overseas

This map shows the areas used to grow different types of food we eat.

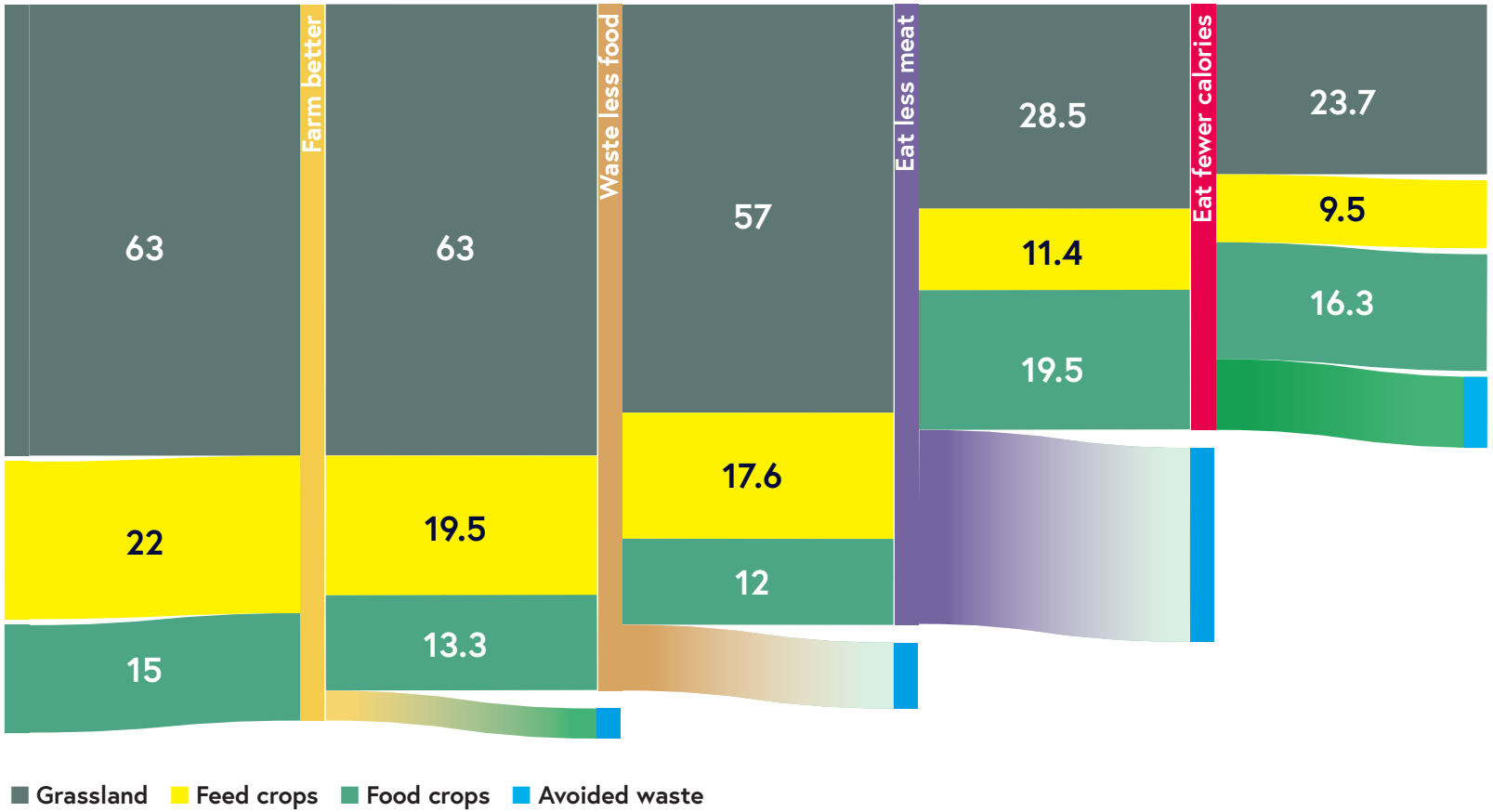
Overall, around 70% of UK land, and an area about this size overseas, is used to grow our food.

Of this whole area, only 15% is used to grow the grains, fruit, and vegetables we directly consume.

Note: this analysis draws on de Ruiter et al (which uses a top-down methodology) and Poore and Nemecek (which uses a bottom-up methodology). These have a high degree of agreement other than for total land footprint and share of land footprint overseas. The overall size area of land associated with UK diets is estimated to be between 24 and 38 million ha, and the relative share of this land that is in the UK versus overseas is around 50% (range 43-54%).

SOURCE: National Food Strategy based on: Poore, J. and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science 360:987-992. [online]; de Ruiter, H. Macdiarmid, J, Matthews, R. Et al. (2017). Total global agricultural land footprint associated with UK food supply 1986–2011. Global Environmental Change. 43. 72 - 81. [online]; ONS (2019). UK natural capital: urban accounts. [online]. WWF (2020). Bending the Curve: The Restorative Power of Planet-Based Diets. [online]; Forestry Commission. (2020). Forestry Statistics 2020: A compendium of statistics about woodland, forestry and primary wood processing in the United Kingdom. [National Statistics. [online]; CEH (2000). LAND COVER MAP 2000. [online; Corine Land Cover (2012); BBC (2017). [online].

We can use less land and have a healthier, more sustainable diet



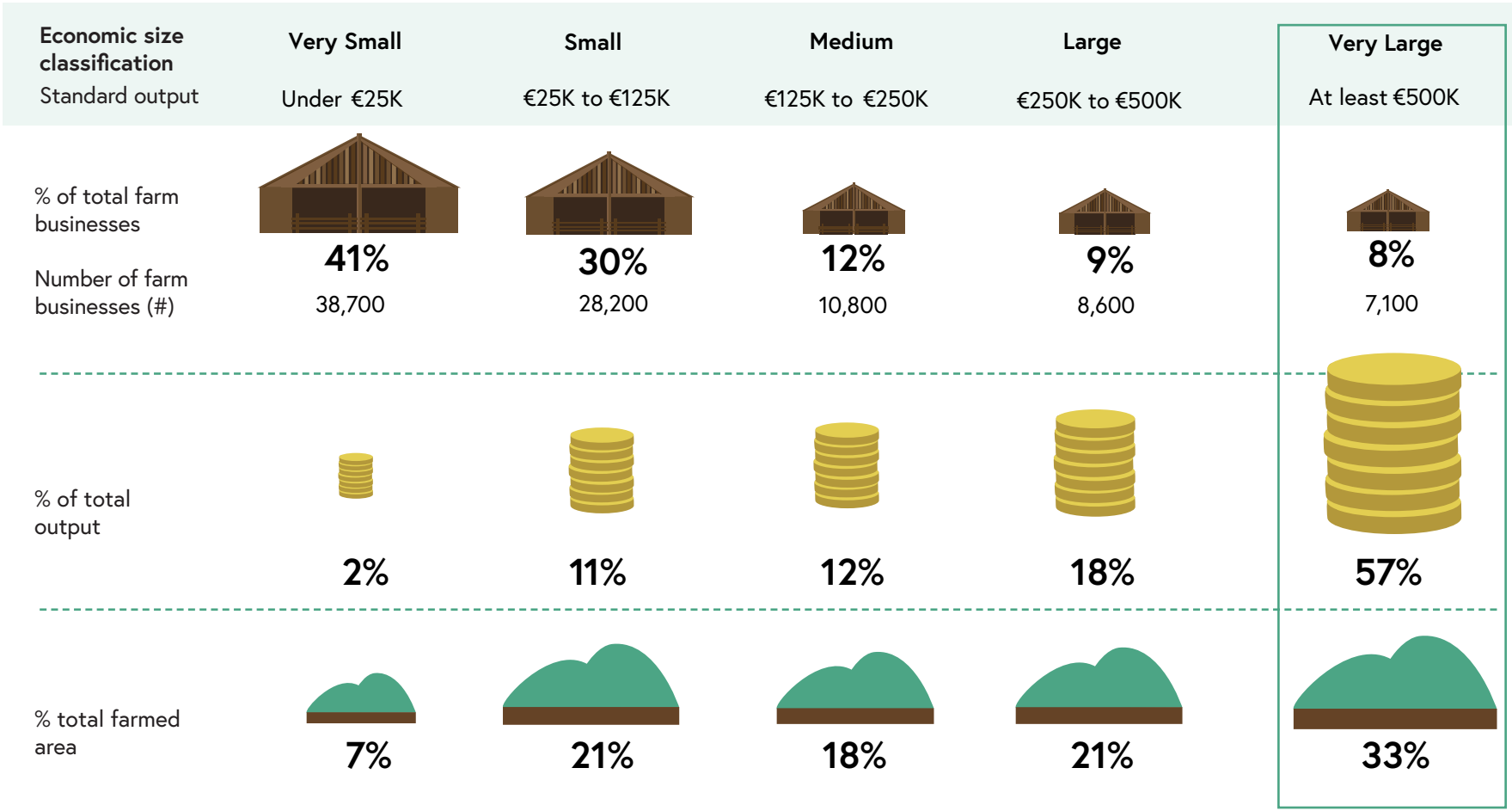
Four steps could, in theory, halve the UK's land footprint for food:

- Closing arable yield gaps,
- halving food waste,
- limiting our meat consumption, and
- eating enough to maintain a healthy weight.

Note: all figures percentages of the UK's global land footprint for food.

SOURCE: National Food Strategy analysis based on: de Ruiter, H. Macdiarmid, J, Matthews, R. Et al. (2017). Total global agricultural land footprint associated with UK food supply 1986–2011. Global Environmental Change. 43. 72 - 81. [online]; Schils, R. Olesen, J. E. Kersebaum, K. Et al. (2018). Cereal yield gaps across Europe, European Journal of Agronomy, Volume 101, 109-120. [online]; Defra. (2019). Agriculture in the Uk, 2019. [online]; CEH. (2018). Quantifying the impact of future land use scenarios to 2050 and beyond - Final Report. [online]; Committee on Climate Change. (2020). The Sixth Carbon Budget, The UK's path to Net Zero. [online]; WRAP (2020). Food surplus and waste in the UK – key facts. [online]; Data Science Campus (2018). Evaluating Calorie Intake. [online].

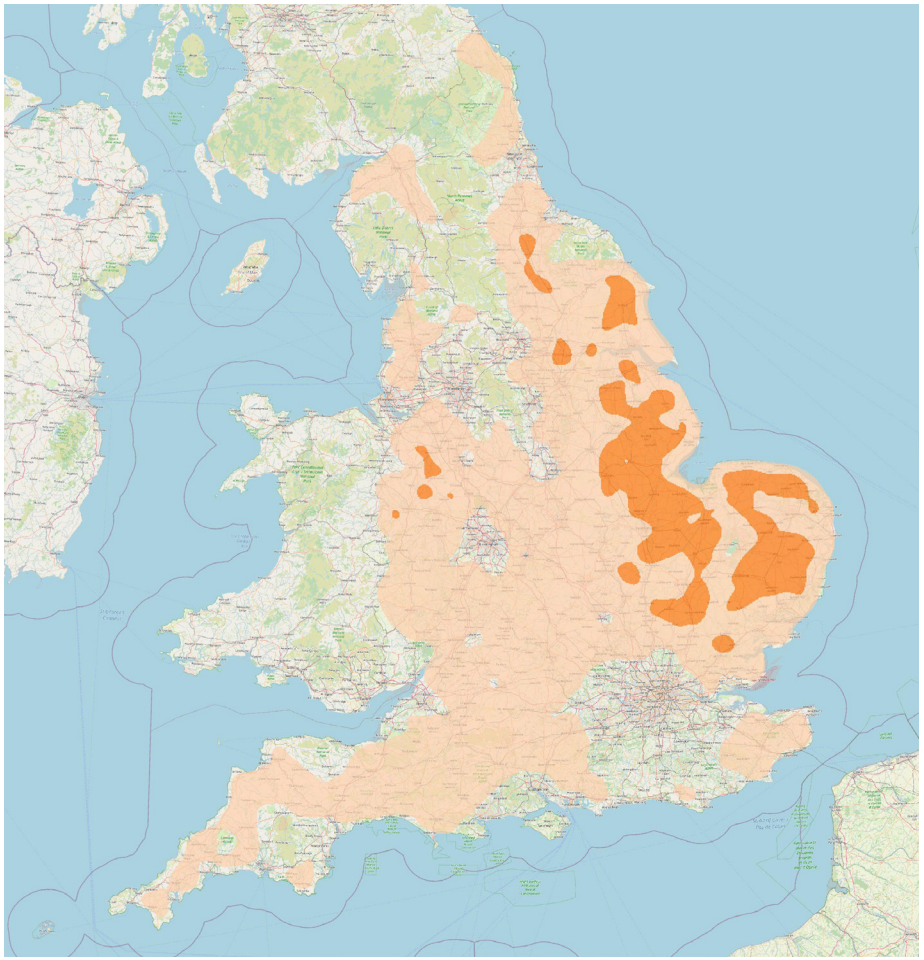
The largest 8% of UK farms produce 57% of agricultural output



Note: This effect has been driven by intensification of farms over time. Standard output is a measure of total value of output of any one enterprise – per head for livestock and per hectare for crops; Number of farm businesses does not split out multiple farm holdings within same farm business.

SOURCE: Defra. (2019). The Future Farming and Environment Evidence Compendium. Government Statistical Service. [online].

Our food production is geographically concentrated



The productivity of the England's land varies widely:

The area in **dark orange** grows ⅓ of total calories.

The area in **dark** and **light orange** grows ¾ of total calories.

The **unshaded** areas could – in theory – not be farmed at all if we reduced waste in the system.

Giving 9% of the least productive farmland to nature would mean we produce 1% less calories.

Giving 21% of the least productive farmland to nature would mean we produce 3% less calories.

Calorie production based on Defra data – for England only.

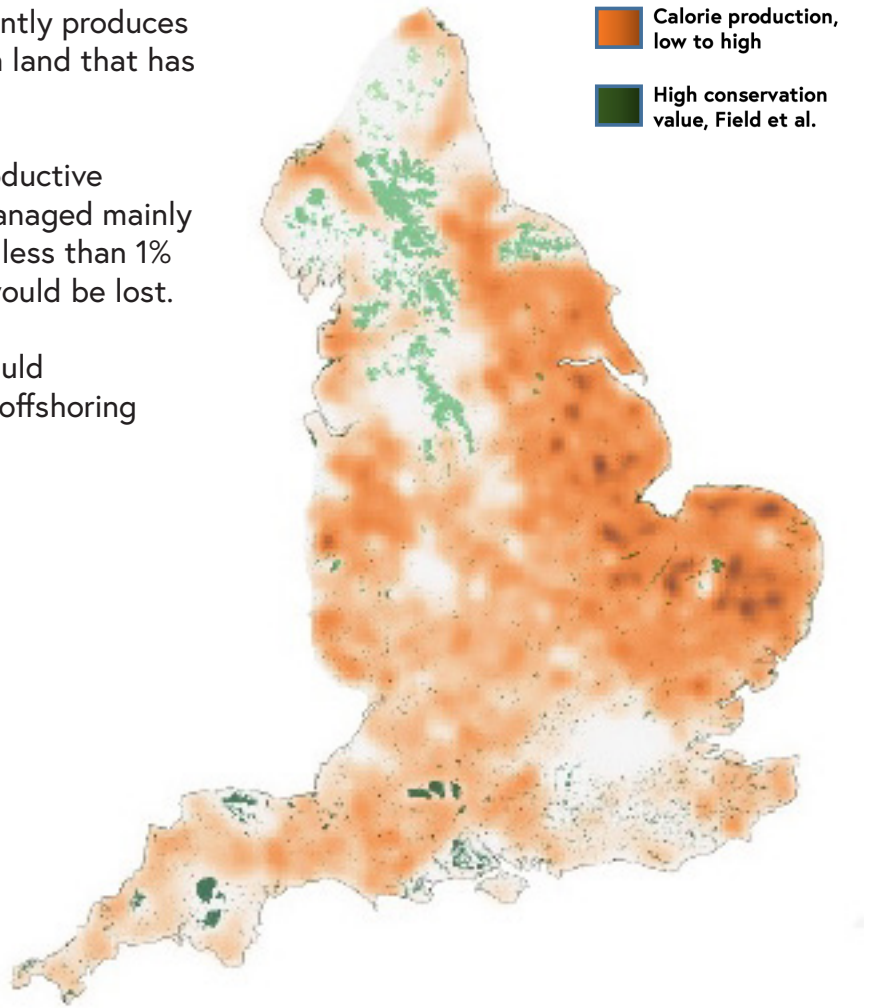
SOURCE: NFS Analysis based on: June Agricultural Survey Holding Data, (2019); USDA, Economic Research Service, USDA ERS - Food Availability (Per Capita) Data System, [online]. Accessed 2020; Defra. (2019). Agriculture in the United Kingdom data sets - GOV.UK (www.gov.uk) [online]; Defra (2019) Monthly statistics on the activity of UK hatcheries and UK poultry slaughterhouses (data for December 2019). [online]; Defra. (2020); UK Slaughter Statistics, December 2019. [online]; AHDB, UK milk yield | AHDB. [online]; FAO. FOOD BALANCE SHEETS - A Handbook (fao.org). [online] accessed December 2021; Meat Promotion Wales. (2014). Feeding the ewe for lifetime production. [online]; Hyde RM, Green MJ, Sherwin VE. Et al. (2020). Quantitative analysis of calf mortality in Great Britain. J Dairy Sci. 2020 Mar;103(3):2615-2623. [online]; Defra. (2020). Horticulture Statistics 2019. National Statistics. [online].

We can farm less land without imperilling our self-sufficiency

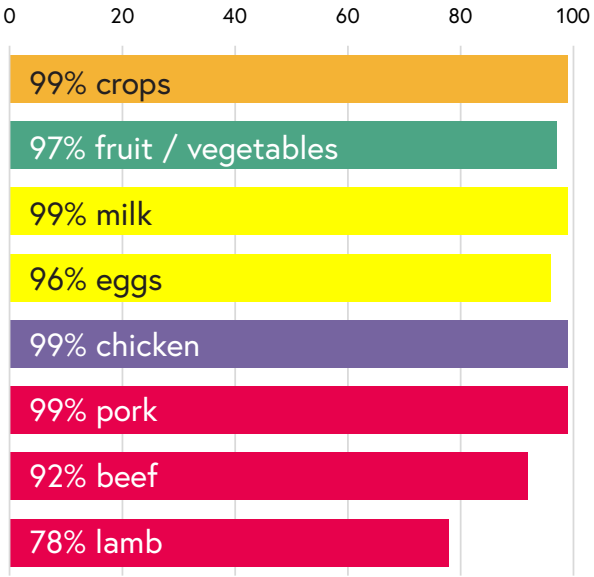
The agricultural land that currently produces the least calories overlaps with land that has high conservation value.

If, by 2035, 9% of the least productive farmland (transparent) were managed mainly for carbon capture and nature, less than 1% of England's food production would be lost.

Very limited dietary change would enable this to happen without offshoring production.

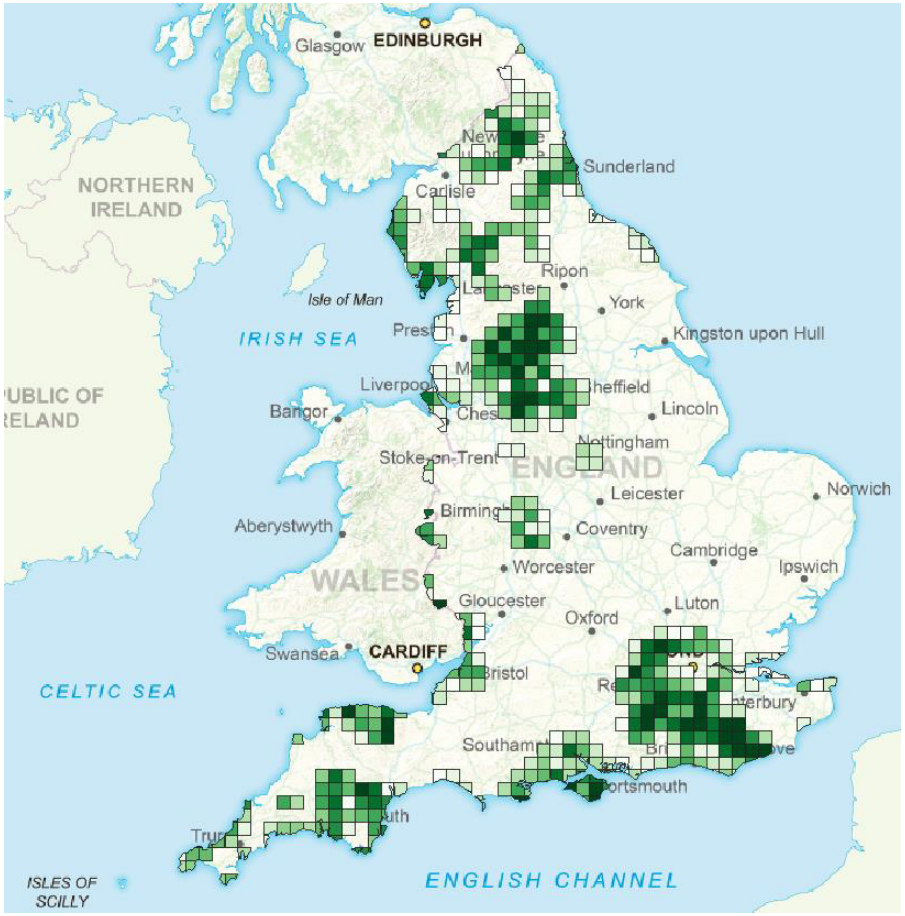


Converting the least productive 9% of farmland would retain:



SOURCE: NFS Analysis based on June Agricultural Survey Data (2019); FOOD BALANCE SHEETS - A Handbook (fao.org); USDA ERS - Food Availability (Per Capita) Data System; Field et al (2020) High Nature Carbon Map dataset, RSPB Centre for Conservation Science.

A limited transition from farm to forest – for nature and climate – is feasible



This map takes the least productive 14% of farmland in England (providing less than 3% of calories produced in England) and shows – within this area – the suitability for forest planting. The underlying analysis takes place at farm scale.

The assessment excludes a large range of land due to physical suitability, planning constraints (all peat, protected habitats, and areas unlikely to receive planning permission are excluded), and future climate suitability.

Darker = greater proportion of land suitable.

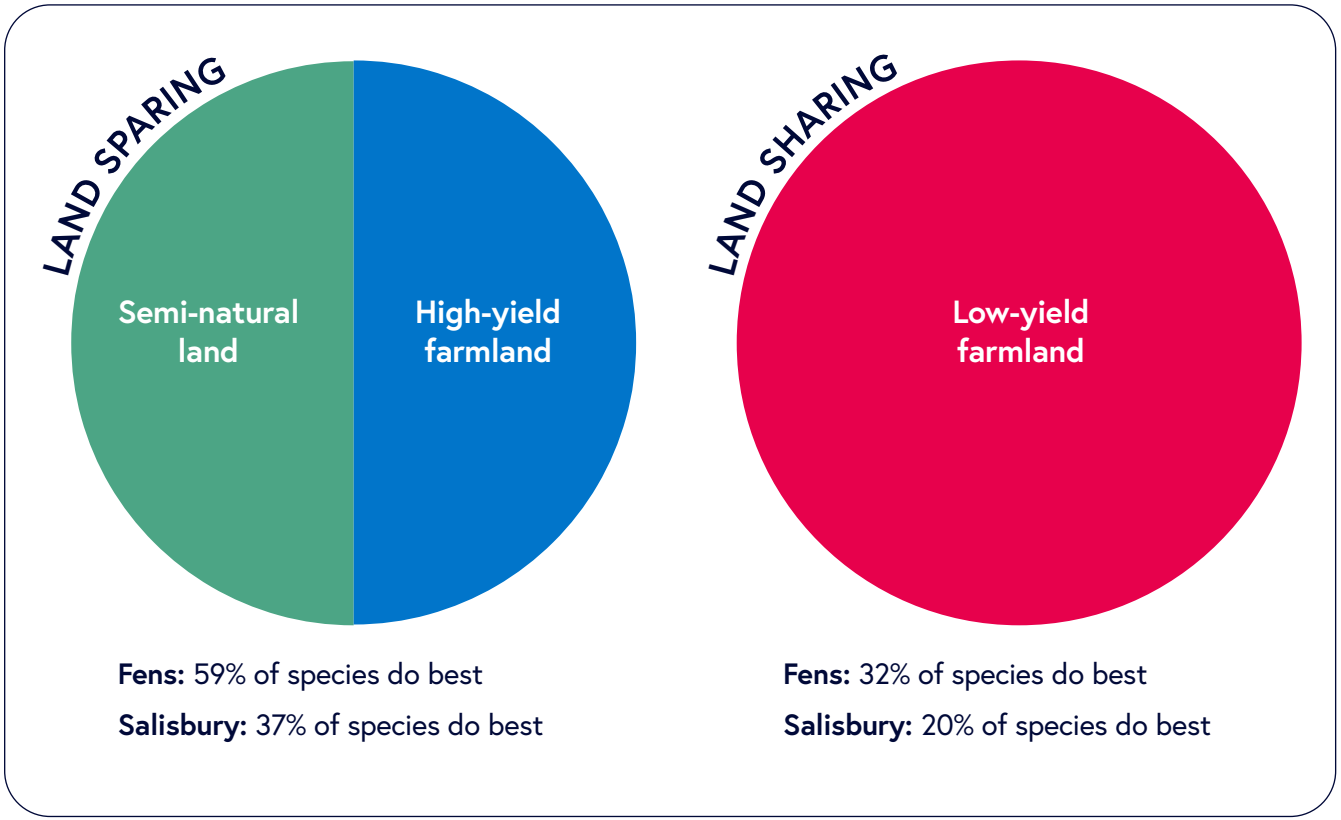
In total, 424,456 ha within this area (17.5% of the least productive area identified above) are plantable.

This does not consider other impacts to rural communities.

ADDITIONAL RESOURCES AVAILABLE

SOURCE: Forest Creation Partners – commissioned for the National Food Strategy

A mix of sustainable intensification, low-yield farming and land restored to nature woulmost benefit UK wildlife



Fens: 59% of species do best

Salisbury: 37% of species do best

Fens: 32% of species do best

Salisbury: 20% of species do best

Fens: 80% larger population across all food production levels

Salisbury: 60% larger population at high food production levels; similar populations at current production level

UK biodiversity studies show a combination of land sparing and land sharing produces the best outcomes.

A '3 compartment model' integrates previous land sharing and land sparing approaches.

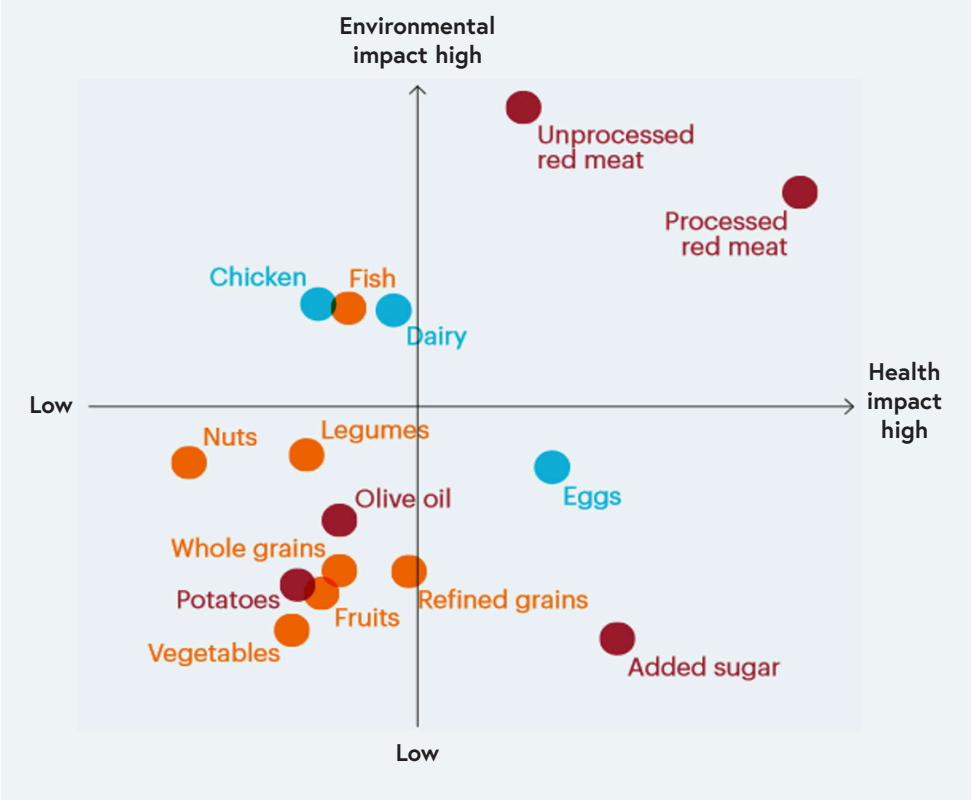
SOURCE: Finch, T. Gillings, S. Green, R. Et al. (2019). Bird conservation and the land sharing-sparing continuum in farmland-dominated landscapes of lowland England. Conservation Biology. 33. 10.

MEAT PRODUCTION AND THE ENVIRONMENT

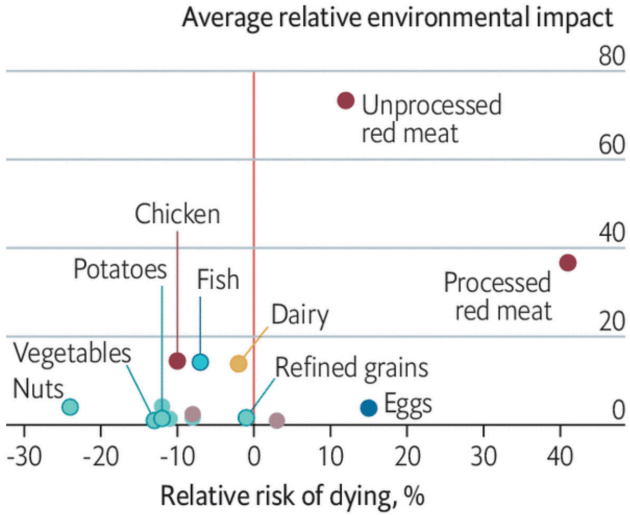
Reducing our consumption of red and processed meats would be good for both us and the planet

HEALTH AND ENVIRONMENTAL IMPACT ON VARIOUS FOODS

The health and environmental impacts of various food. Overconsumption of red and processed meats increases the risk to both human health and the environment. Plant foods tend to be good for both people and planet. Added sugar is a major driver of poor health but has much lower environmental impacts.



HEALTH AND ENVIRONMENTAL IMPACT OF ONE EXTRA SERVING PER DAY

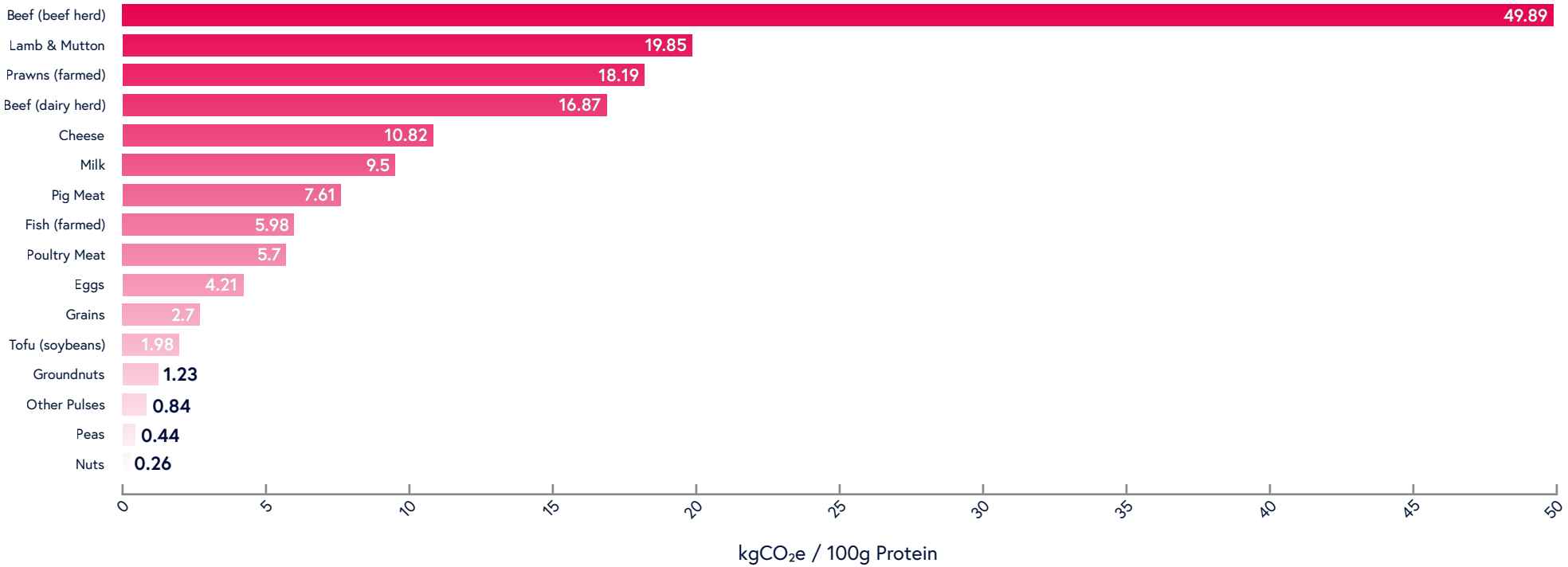


SOURCE: : Clark MA, Springmann M, Hill J & Tilman D. Multiple health and environmental impacts of foods. Proc Natl Acad Sci U S A. 2019 Nov 12;116(46):23357-23362.

Ruminant livestock is the big GHG emitter: globally, beef is 25 times more carbon intensive than tofu per 100g of protein

GREENHOUSE GAS EMISSIONS PER 100 GRAMS OF PROTEIN

Greenhouse gas emissions are measured in kilograms of carbon dioxide equivalents ($kgCO_2eq$) per 100 grams of protein. This means non-CO_2 greenhouse gases are included and weighed by their relative warming impact.

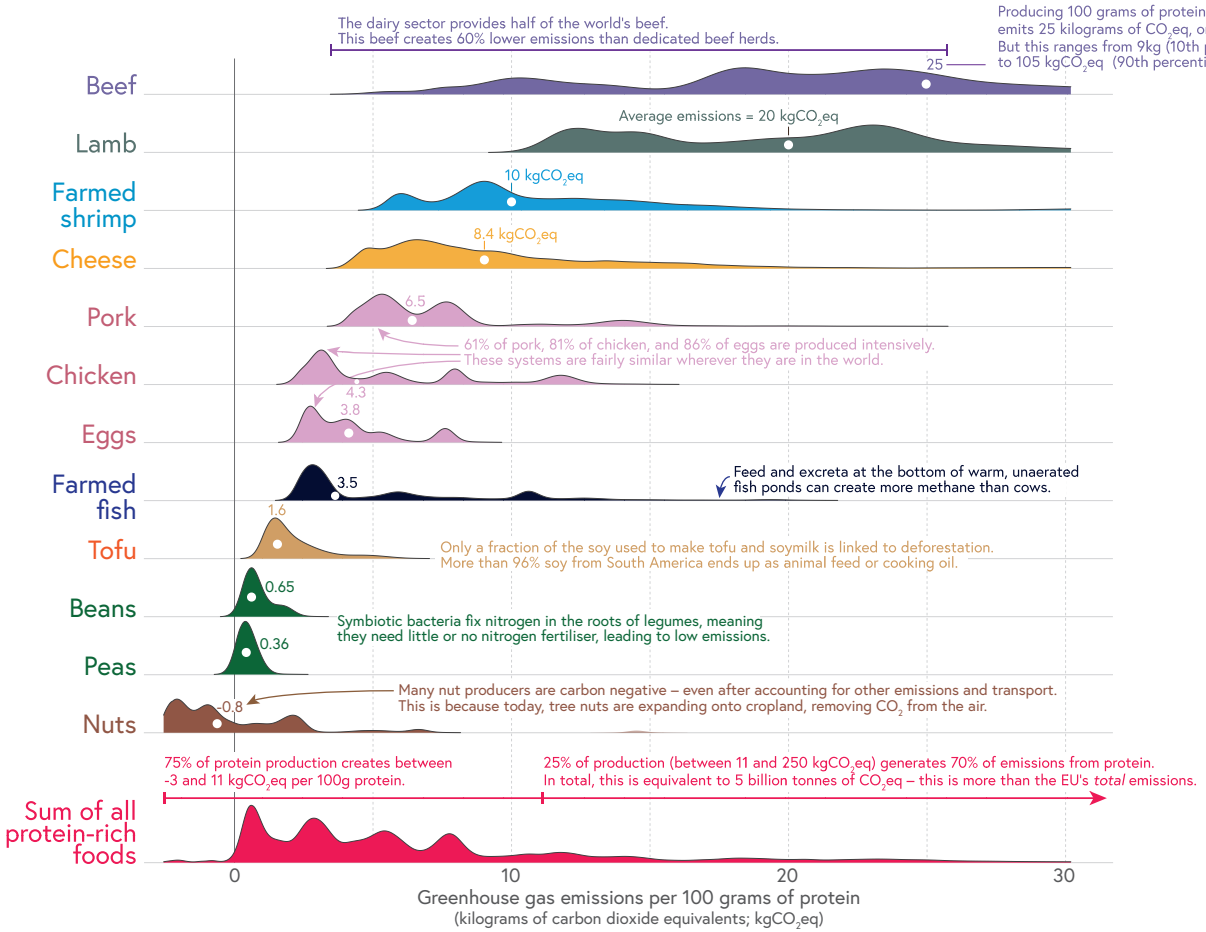


Note: Data represents the global average greenhouse gas emissions of food products based on a large meta-analysis of food production covering 38,700 commercially viable farms in 119 countries.

SOURCE: Poore, J. and Nemecek, T. (2018). Additional calculations by Our World in Data• CC BY. Reducing food's environmental impacts through producers and consumers. Science 360:987-992. [online];

Different production systems have different carbon footprints, but animal proteins are still much higher than other proteins

HOW DOES THE CARBON FOOTPRINT OF PROTEIN-RICH FOODS COMPARE?

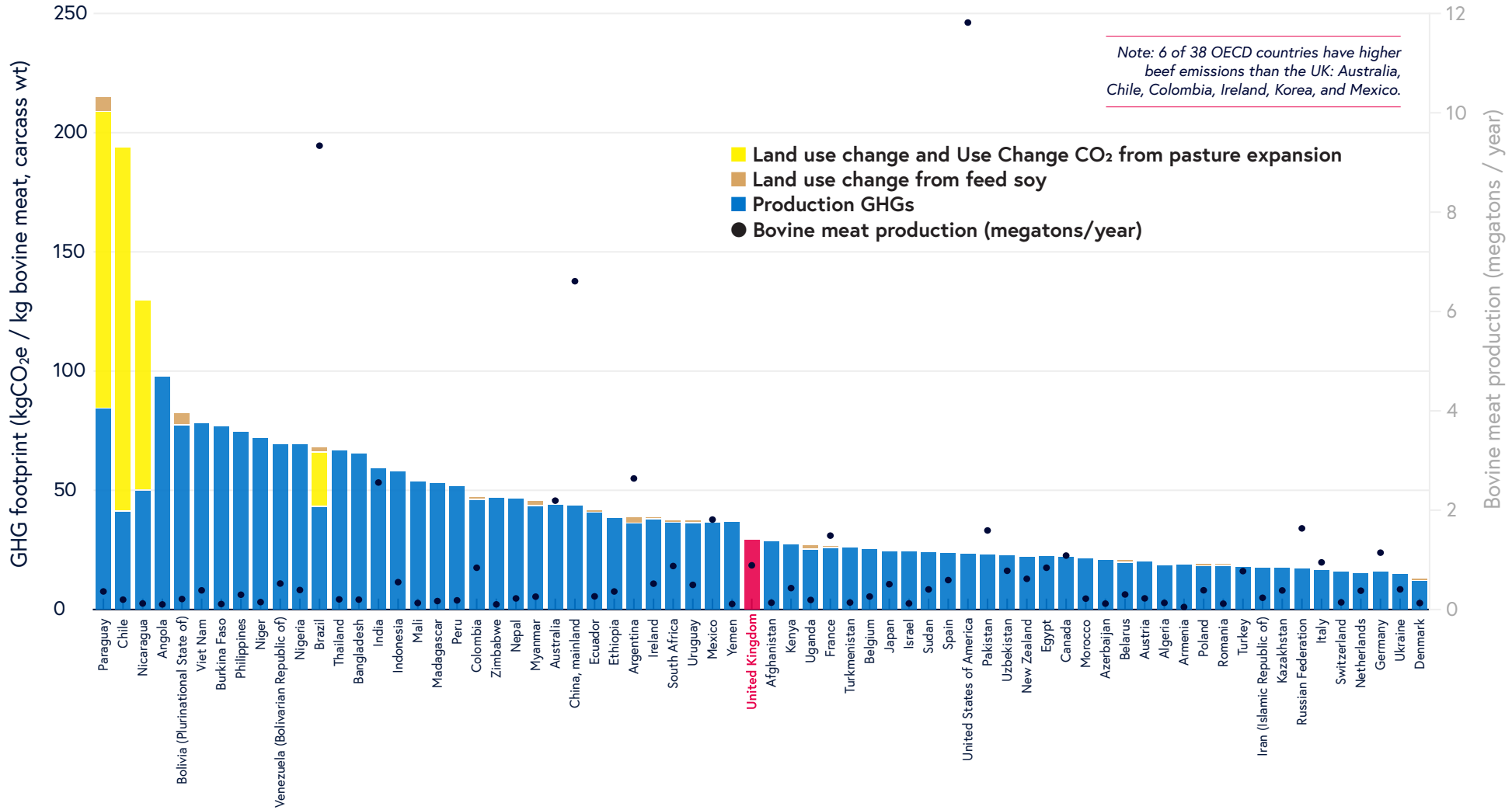


Greenhouse gas emissions from protein-rich foods are shown per 100 grams of protein across a global sample of 38,700 commercially viable farms in 119 countries. The height of the curve represents the amount of production globally with that specific footprint. The white dot marks the median greenhouse gas emissions for each food product.

Note: Data refers to the greenhouse gas emissions of food products across a global sample of 38,700 commercially viable farms in 119 countries. Emissions are measured across the full supply-chain, from land use change through to the retailer and includes on-farm, processing, transport, packaging and retail emissions.

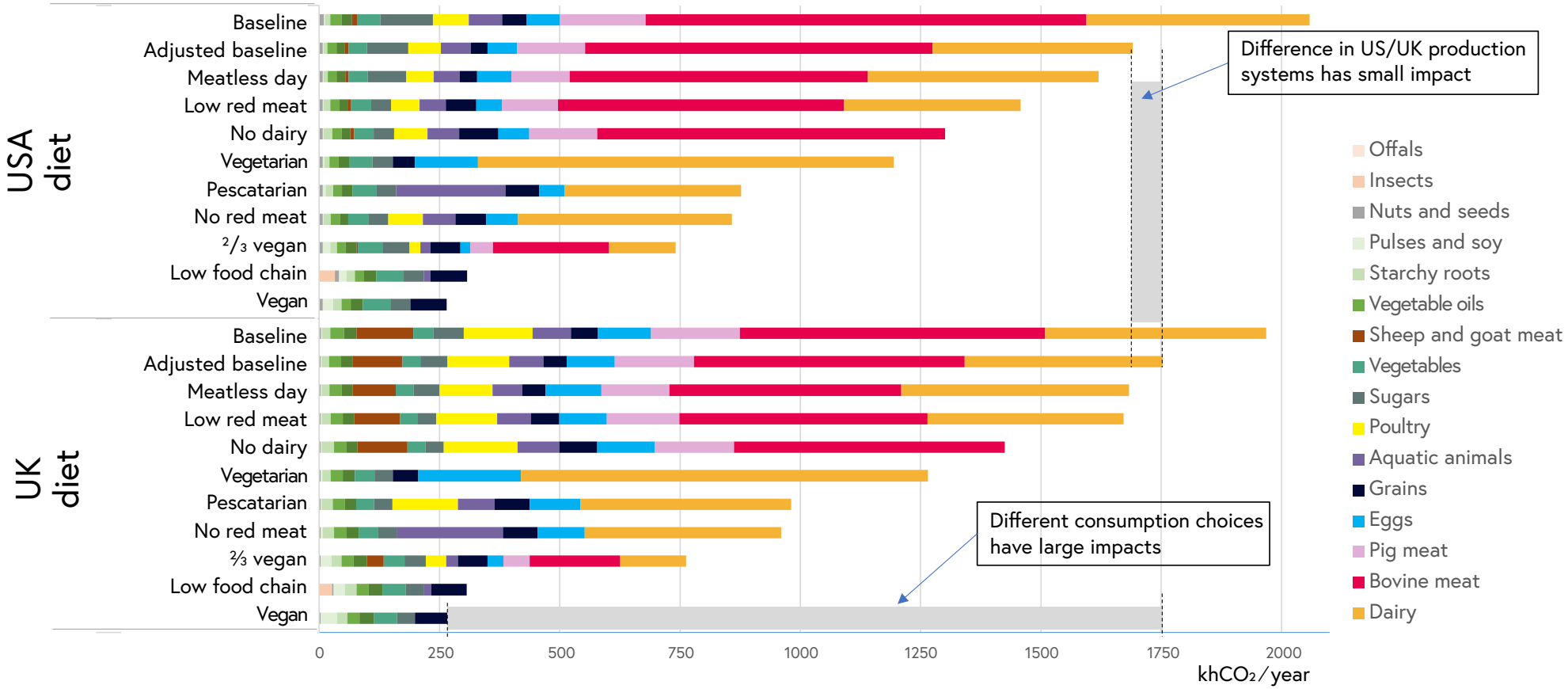
SOURCE: Ritchie, H. (2020). Our world in data. [online]. Data source: Joseph Poore and ThomasNemecek (2018). Reducing food's environmental impacts through producers and consumers. Science. OurWorldinData.org – Research and data to make progress against the world's largest problems. Licensed under CC-BY by the authors Joseph Poore & Hannah Ritchie.

UK beef has a smaller carbon footprint than the global average but is bigger than most OECD countries



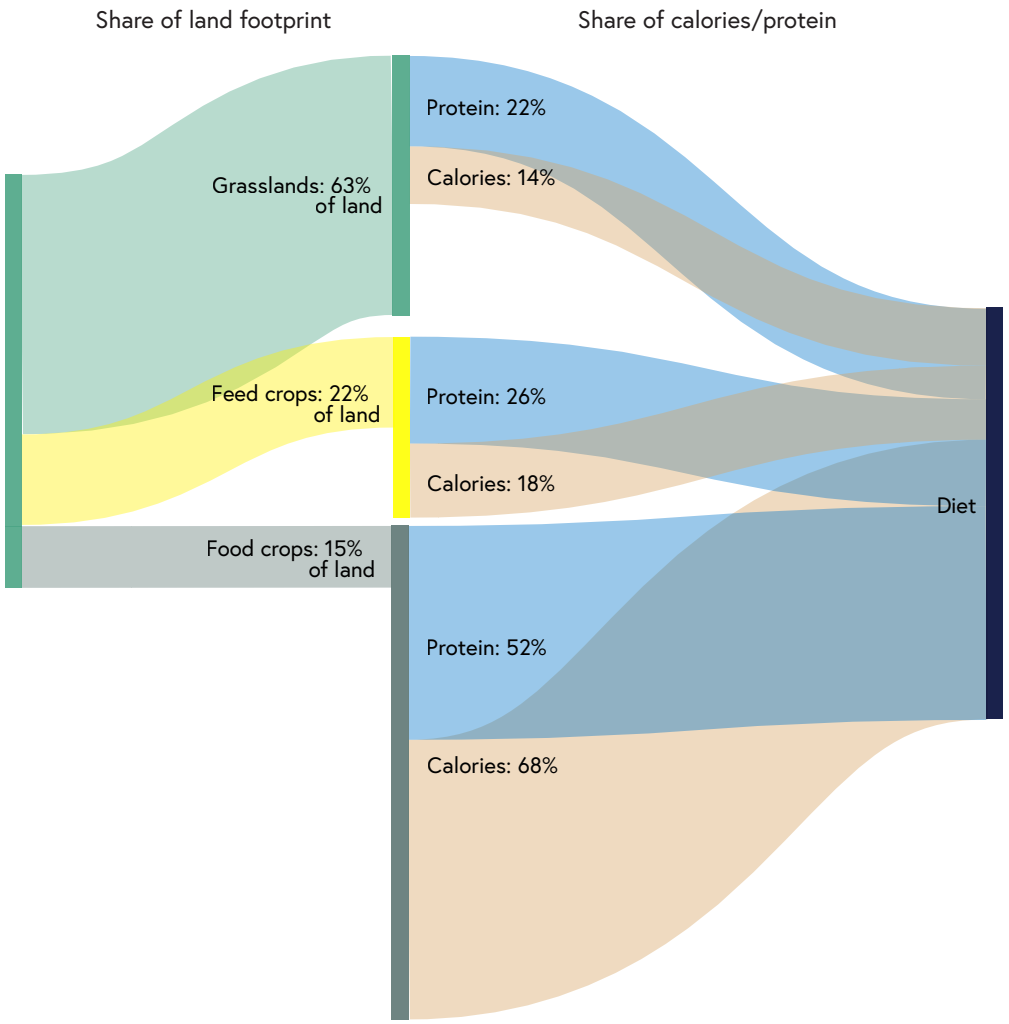
SOURCE: Kim,B.F. Santo, R.E. Scatterday, A.P. Et al. (2020). Country-specific dietary shifts to mitigate climate and water crises, Global Environmental Change, Volume 62

It's what we farm, more than how we farm, that causes the environmental impact of our diet



SOURCE: Kim,B.F. Santo, R.E. Scatterday, A.P. Et al. (2020). Country-specific dietary shifts to mitigate climate and water crises, Global Environmental Change, Volume 62

Livestock takes up 85% of the UK's total land use for food but gives us just 32% of our calories

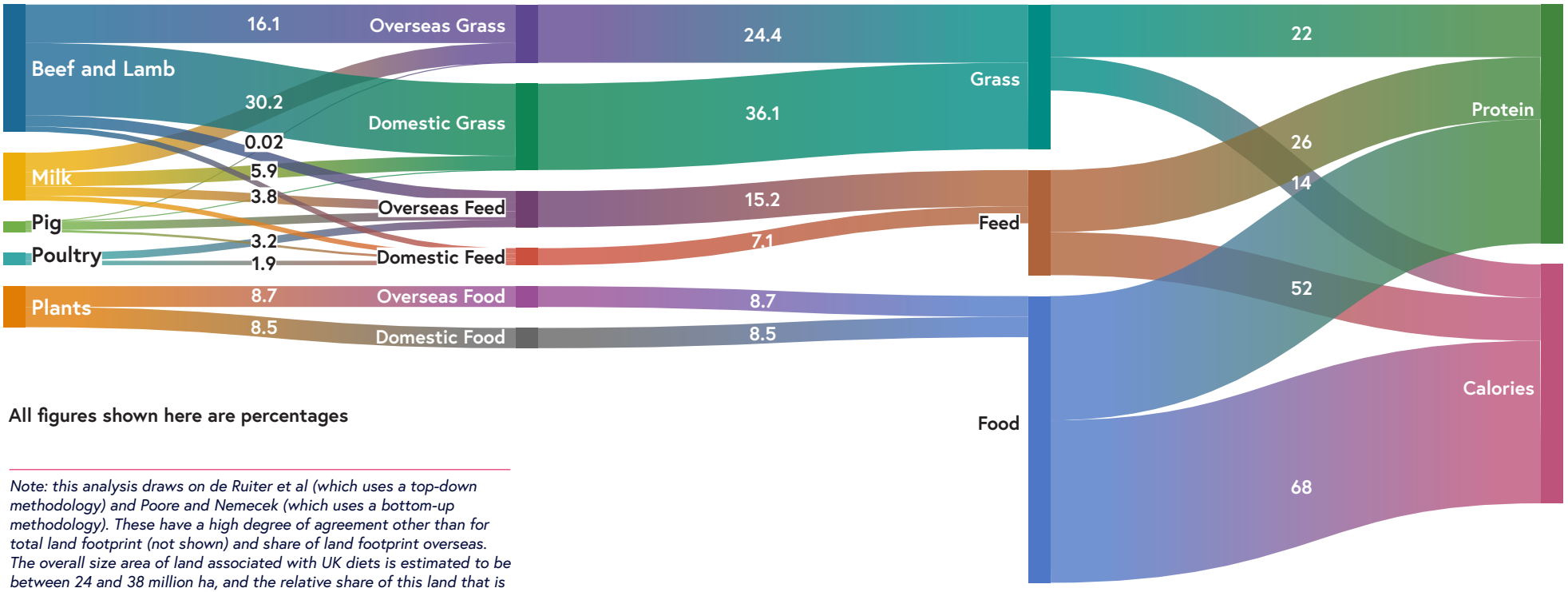


Note: includes overseas land used to grow food consumed in the UK.

SOURCE: de Ruiter, H. Macdiarmid, J, Matthews, R. Et al. (2017). Total global agricultural land footprint associated with UK food supply 1986–2011. Global Environmental Change. 43. 72 - 81. [online];

Most farmland used to feed the UK, domestically and abroad, is used for beef, lamb or dairy

OUR OVERSEAS IMPACT IS DOMINATED BY RUMINANTS – EVEN FOR OVERSEAS FEED CROPS



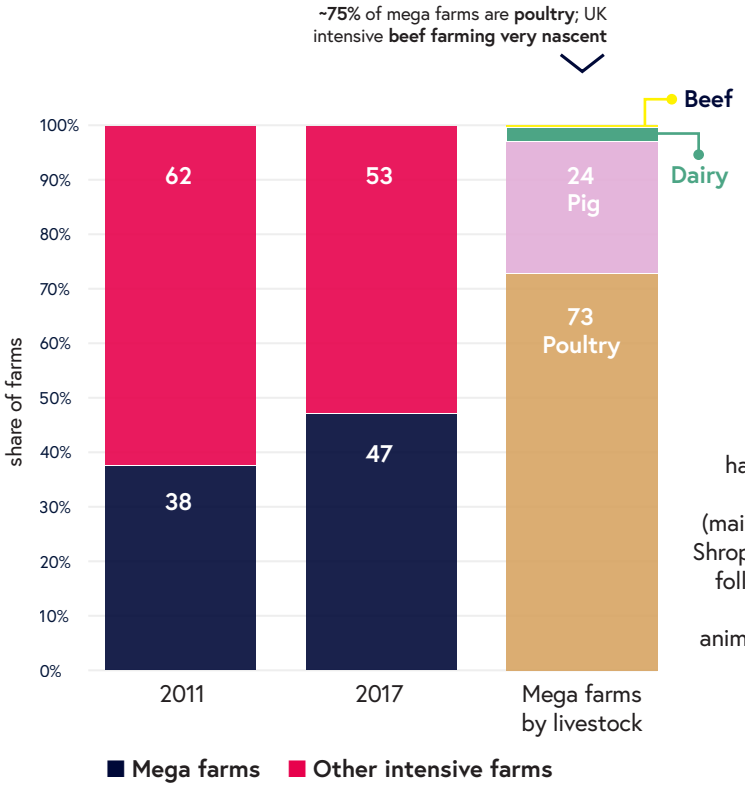
All figures shown here are percentages

Note: this analysis draws on de Ruiter et al (which uses a top-down methodology) and Poore and Nemecek (which uses a bottom-up methodology). These have a high degree of agreement other than for total land footprint (not shown) and share of land footprint overseas. The overall size area of land associated with UK diets is estimated to be between 24 and 38 million ha, and the relative share of this land that is in the UK versus overseas is around 50% (range 43-54%).

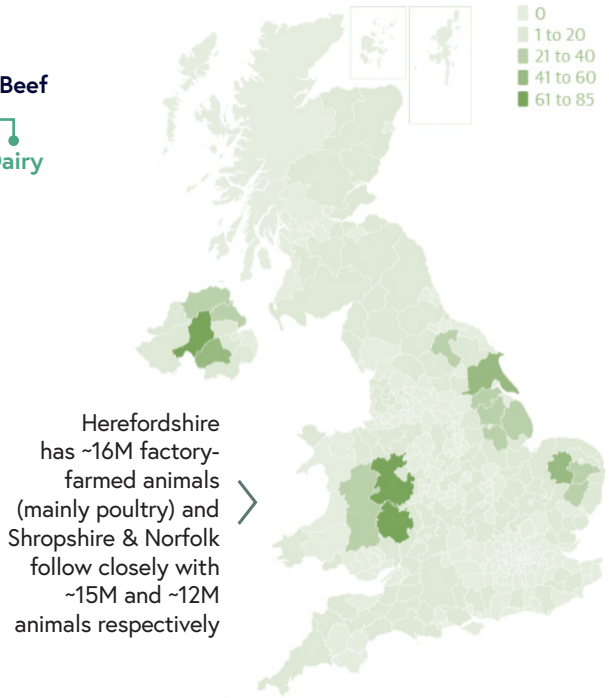
SOURCE: National Food Strategy analysis based on: de Ruiter et al. (2017). Total global agricultural land footprint associated with UK food supply 1986–2011. Global Environmental Change. 43. 72 - 81. [online]; Poore, J. and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science 360:987-992. [online]; private correspondence with Joseph Poore and Pete Smith.

There are a growing number of intensive farms in the UK

THERE HAS BEEN A ~25% INCREASE IN INTENSIVE FARMS SINCE 2011



GROWTH IS CONCENTRATED WHERE MAJOR FOOD COMPANIES OPERATE



Intensive farming has increased as **Britain's demand for cheap meat**, especially chicken, rose.

The number of farms in the UK is falling. About **4,000 farms closed between 2010 and 2016**, of which three quarters were in the smallest category (<20 hectares of land).

*"Farmers have to operate intensive systems to **compete with cheap European imports**, and there is a lack of consumer demand for free-range meat."*

DR ZOE DAVIES, CEO NATIONAL PIG ASSOCIATION

*"The increased land price combined with falling goods' prices meant **family farmers couldn't compete with larger farms**, who can make far more profit thanks to scale economies."*

PIPPA WOODS, FAMILY FARMERS' ASSOCIATION

Note: The Environment Agency - and its regional counterparts in Northern Ireland, Scotland and Wales - classify livestock farms as "intensive" if they have capacity for housing at least 40,000 poultry birds or 2,000 pigs grown for meat or 750 breeding pigs (sows).

SOURCE: Bain commissioned for the National Food Strategy based on: The Bureau of Investigative Journalism; Literature search

ADDITIONAL RESOURCES AVAILABLE

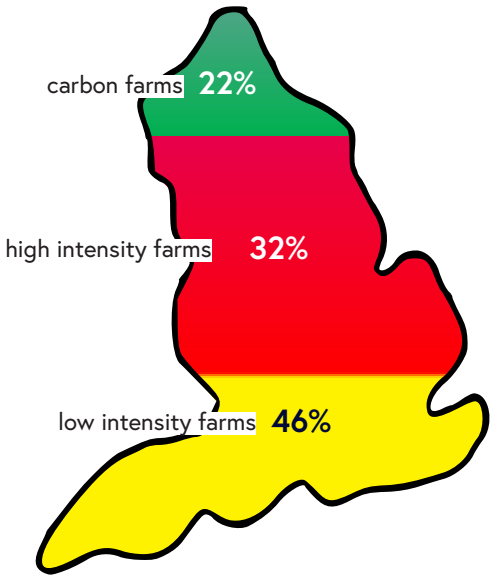
Our livestock consumption determines how much land we can spare for nature in England while reaching net zero

MODELS OF AGRICULTURAL LAND USE TO REACH NET ZERO

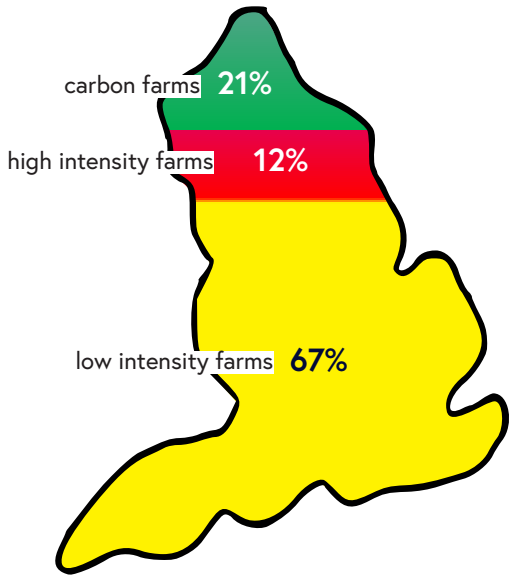
If we continue current import/exports and consume similar types of meat, then overall meat consumption determines how much land needs to be used for high intensity farming (to grow more land-intensive meat and feed). Depending on alternative meat tech, this allows ⅔ to ¾ of land to be used for low intensity farming. NB assumes all 'spared' land becomes low intensity farms.

Proportion of land needed for:
- **Low intensity farms**
- **Carbon farms**
- **High intensity farms**
- **Plant/cultured meat**

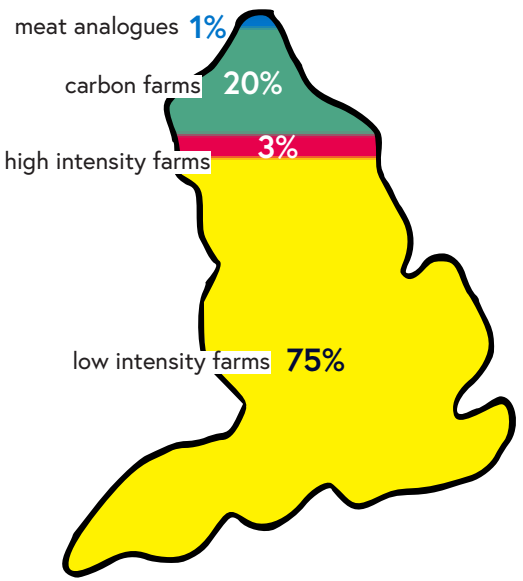
Option 1. Keep current meat consumption



Option 2. Eat 30% less meat

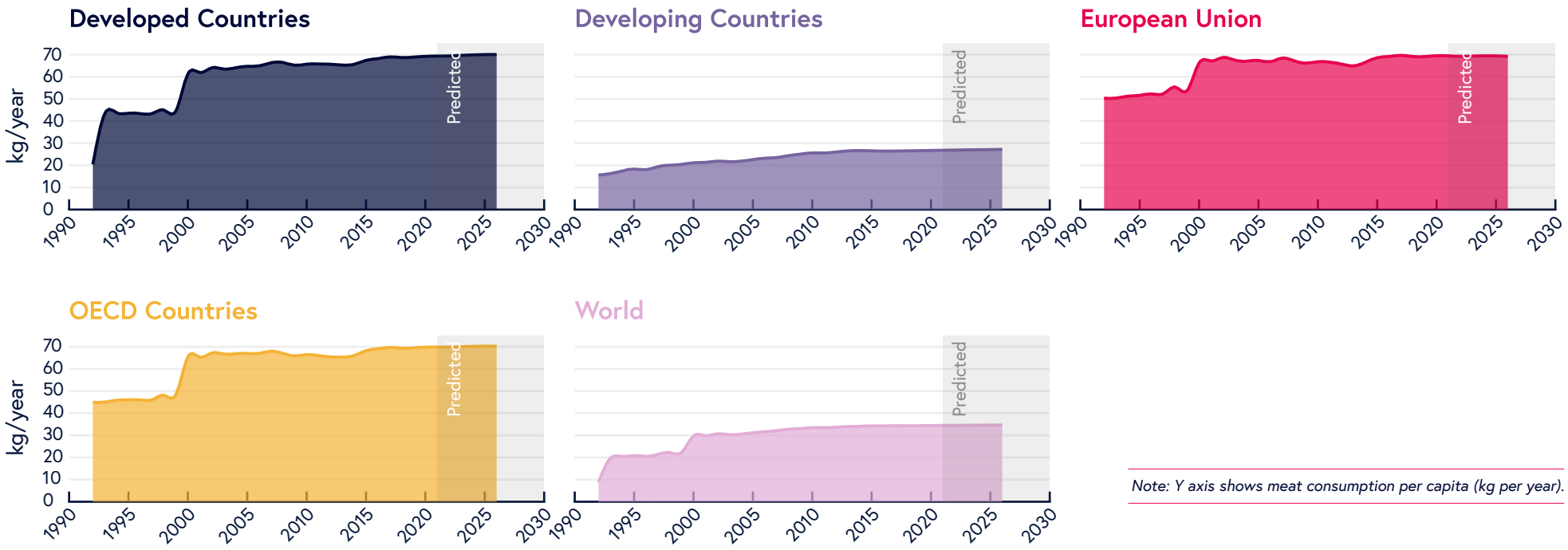


Option 3. Alternative proteins and 30% less meat



SOURCE: National Food Strategy analysis based on: Committee on Climate Change. (2020). The Sixth Carbon Budget, The UK's path to Net Zero. [online]; IDDRI. (2018). An agroecological Europe in 2050: multifunctional agriculture for healthy eating, Findings from the Ten Years For Agroecology (TYFA) modelling exercise. [online].

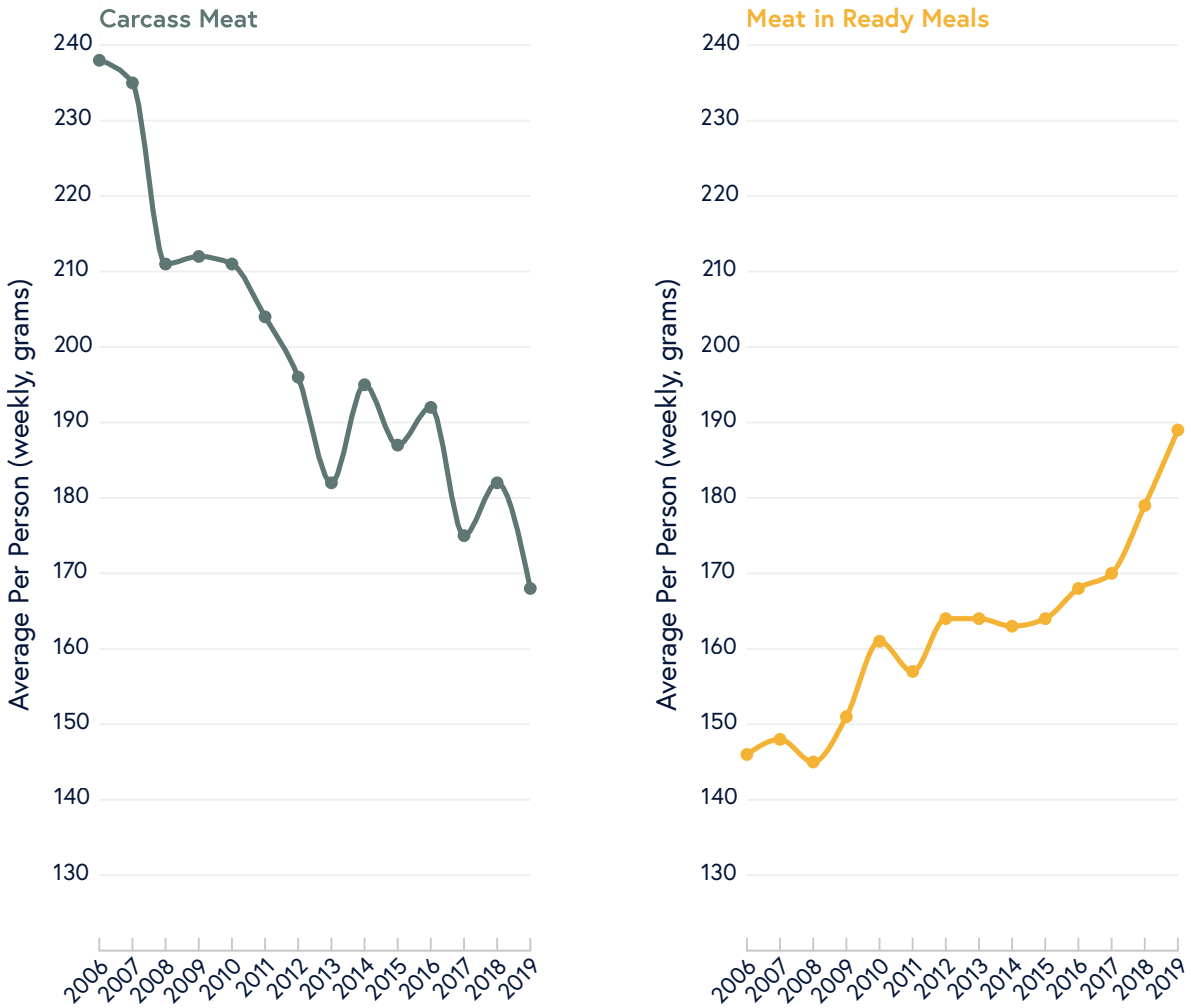
The increase in meat consumption has started to slow and developed nations may be approaching 'peak meat'



Note: Y axis shows meat consumption per capita (kg per year).

SOURCE: OECD. OECD-FAO Agricultural Outlook. Meats – 1992 – 2028 [online]. Accessed 2021.

Around half the meat we eat is used as an ingredient in ready meals



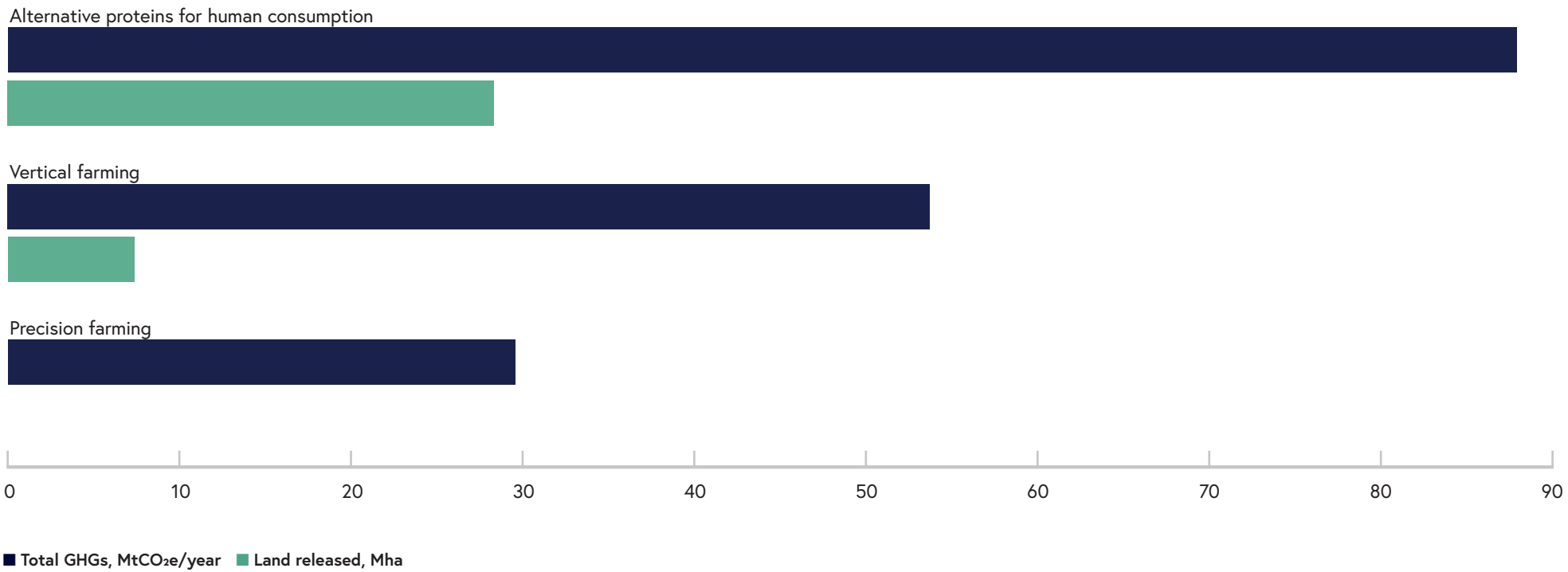
Per-capita meat consumption has been stable over the past 15 years, but we are replacing carcass meat with ready meals – offering the opportunity for reformulation.

SOURCE: National Food Strategy analysis based on: Defra, Family Food Statistics, 2018/19, National Statistics. [online].

The technical potential of alternative proteins is high for carbon emissions and land use

MAXIMUM TECHNICAL POTENTIAL GHGs SAVED AND LAND RELEASED

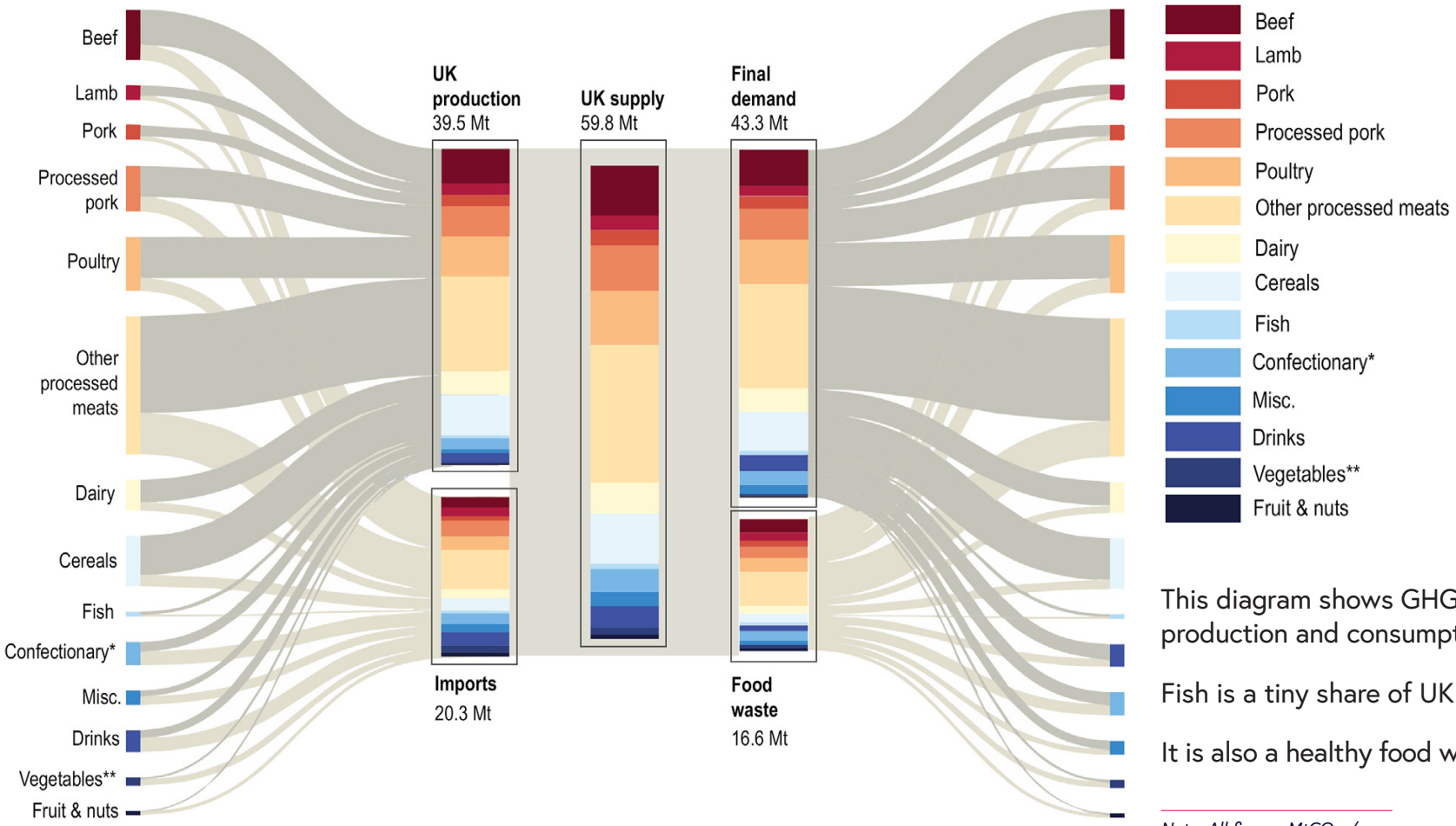
Reduction for alternative proteins for feed not calculated because this is less efficient than direct feed from plants, but may have other benefits (e.g. displacing unsustainable fishmeal).



SOURCE: NFS analysis based on: Poore, J. and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science 360:987-992. [online]; Swartz, E. (2021). Anticipatory life cycle assessment and techno-economic assessment of commercial cultivated meat production. The Good Food Institute.

THE IMPACT OF FISHING

Fish is a small share of our dietary carbon footprint



This diagram shows GHGs from UK food production and consumption.

Fish is a tiny share of UK dietary footprint.

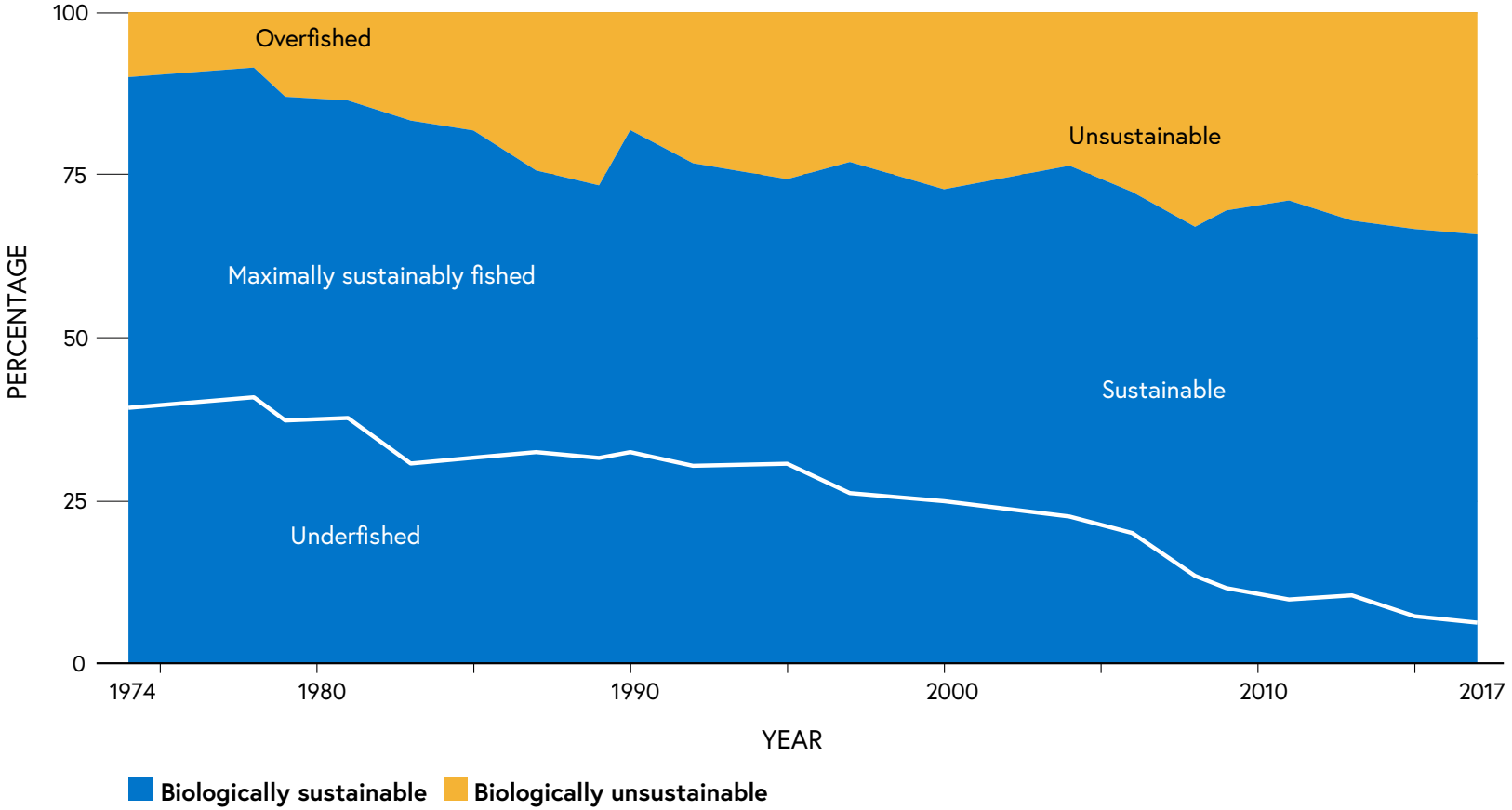
It is also a healthy food we should eat more of.

Note: All figures $MtCO_2e$/year.

SOURCE: Garvey et al. 2021, Towards net zero nutrition: The contribution of demand-side change to mitigating UK food emissions, Journal of Cleaner Production

Global fishing levels are increasingly unsustainable

GLOBAL TRENDS IN THE STATE OF THE WORLD'S MARINE FISH STOCK 1974 -2017



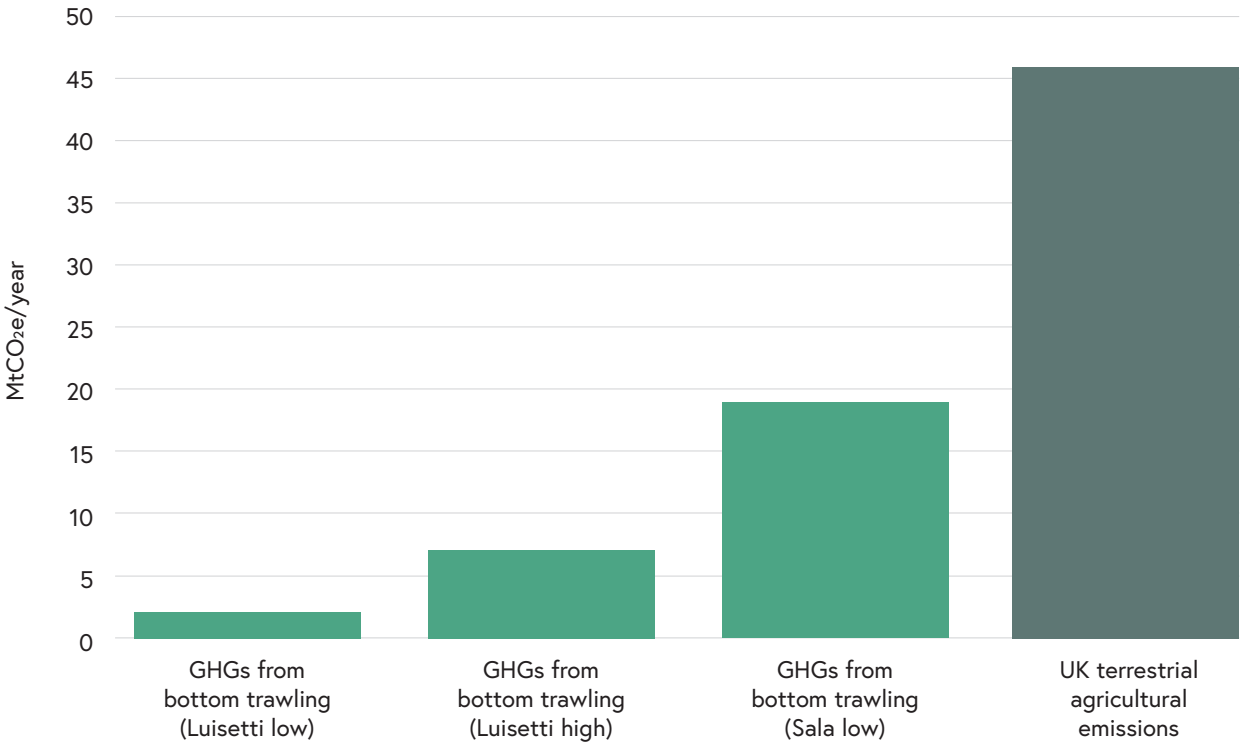
The Food and Agriculture Organisation of the UN estimates that 35% of stocks globally are being fished at unsustainable levels, up from 10% in 1974.

Nearly 90% of marine fish stocks are fully exploited, overexploited or depleted (white line).

SOURCE: FAO, (2020). The State of World Fisheries and Aquaculture 2020. Sustainability in action. [online]

Bottom trawling raises the carbon footprint of fishing

ESTIMATED RELEASE OF SEABED CARBON FROM BOTTOM TRAWLING



Trawling (stirring up carbon on the seabed) may increase UK food production emissions by about 19MtCO2e – a rise of ~40%.

However, **this is uncertain**: recent, UK specific assessments suggest the carbon released by trawling is much lower.

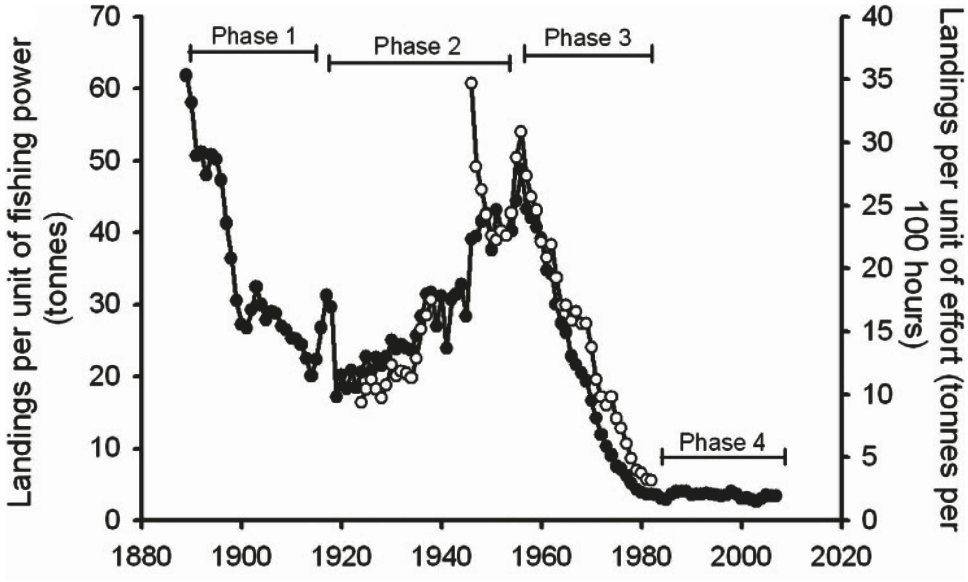
Note: Sala et al estimate reflects their model, with an assumption that all UK seabed areas have been previously trawled, lowering the carbon released from additional trawling.

SOURCE: Sala et al. (2021) Protecting the global ocean for biodiversity, food and climate. Nature.; private correspondence with report authors; Luisetti et al (2019) Quantifying and valuing carbon flows and stores in coastal and shelf ecosystems in the UK. Ecosystem Services.

Unselective fishing has devastated fish stocks

In the UK there has been a 94% reduction in fish abundance since 1890 – the period of fossil powered bottom-towed fishing. For some species like halibut, the fall is 99.8%.

TRENDS IN THE PRODUCTIVITY OF BOTTOM FISHERIES LANDINGS INTO ENGLAND AND WALES



● Closed circles = fishing power O Open circles = fishing effort

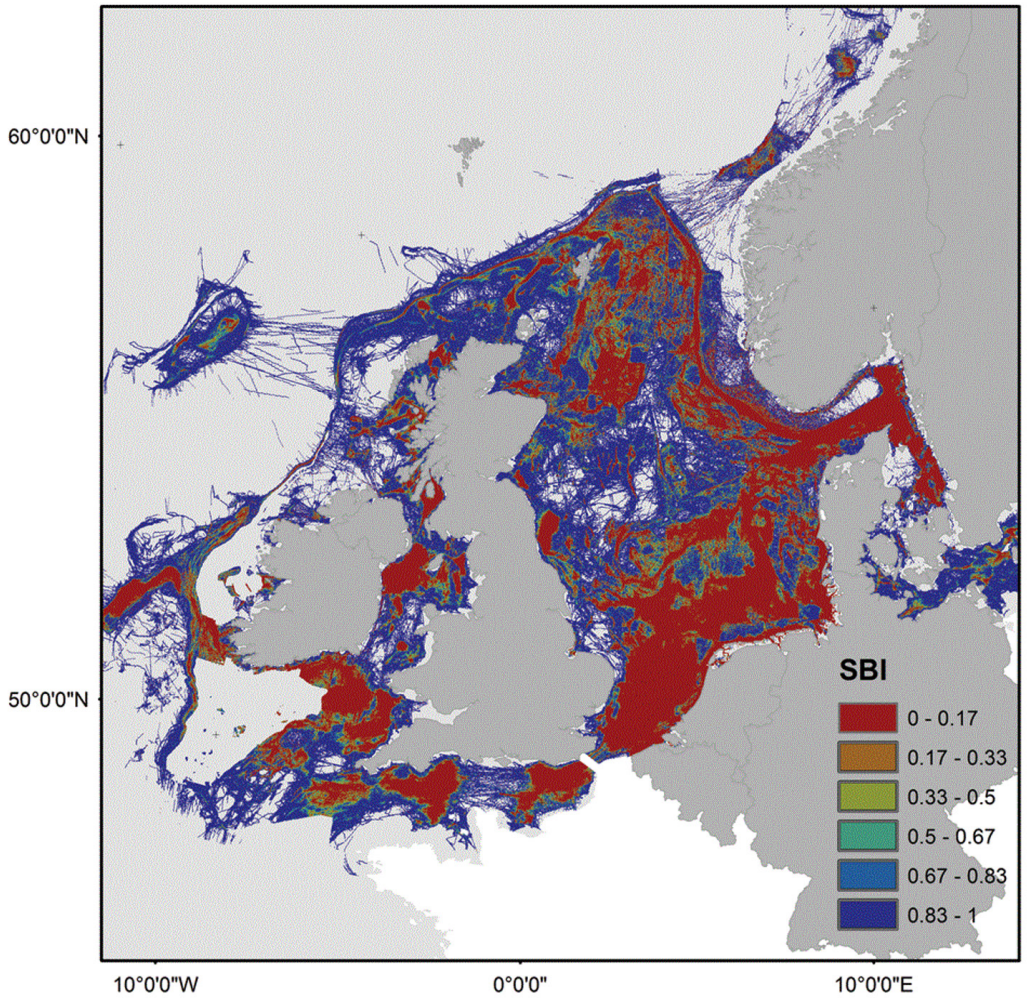
SOURCE: Thurstan, R., Brockington, S. & Roberts, C. (2010). The effects of 118 years of industrial fishing on UK bottom trawl fisheries. *Nat Commun* **1**, 15

It also threatens whole ecosystems

BOTTOM TRAWLING:

- Destroys 6-41% of marine macrofaunal invertebrates (per trawl).
- Destroys 35-85% of marine meiofauna (living in sandy/gravelly sea bottoms).
- Covers 70-99% of UK shallow sea areas; up to 50% deep sea areas.
- Decreases sensitive species (sharks, rays, skates) by 69% in heavily trawled areas.

The map shows the effects of trawling on nature, with **red** areas showing very low seabed integrity (SBI), in which all benthic species are disrupted.



SOURCE: Dureuil, M. Boerder, K. Burnett, K.A. Et al. (2018). Elevated trawling inside protected areas undermines conservation outcomes in a global fishing hot spot. Science. 362 (6421). 1403 – 1407. [online]; Eigaard, O.R. Bastardie, F. Hintzen, N.T. Et al. (2016). The footprint of bottom trawling in European waters: distribution, intensity, and seabed integrity. JF ICES Journal of Marine Science. 74 (3) . 847 – 865. [online].

CAN WE AFFORD TO CHANGE OUR APPROACH TO FARMING?

Different farming systems have different impacts

Alternative Farming System*	General principles	Implications for food production	Implications for GHG emissions	Implications for biodiversity	Implications for jobs and livelihoods
Current state			44 Mt CO_2e from agriculture in the UK (~8% of total)**		~460,000 farm workers in the UK
Intensification 	Intensify and free up land for nature or carbon farming elsewhere (or on same farm – not modelled), keeping overall production constant	Net neutral as land is restored to nature	-34 $MtCO_2e$ (~24% for methane)	Off farm On farm	Not modelled explicitly, studies in other countries suggest that job losses in intensive meat production may be balanced by jobs created or preserved in environmental land management
Agroecology*** 	Eliminate synthetic input use and restrict antibiotics, decrease stocking density in grass-based systems		May increase if replaced by imports		
Resource Efficiency 	Reduce but do not eliminate synthetic inputs, integrate livestock into crop rotations	Shift from cereals to pulses and vegetables			

**See slide 39 (in SYSTEMIQ pack) for more detailed description of each farming system*
*.**Detailed breakdown is 25$MtCO_2e$ from methane (livestock), 13$MtCO_2e$ from nitrous oxides (fertiliser), 6Mt from CO_2. See model to tweak assumptions for GHG mitigation potential.*
****We are using agroecology rather than organic as we are referring to changes in production practices only, not the separate branding, certification and marketing channels associated with organic food now.*

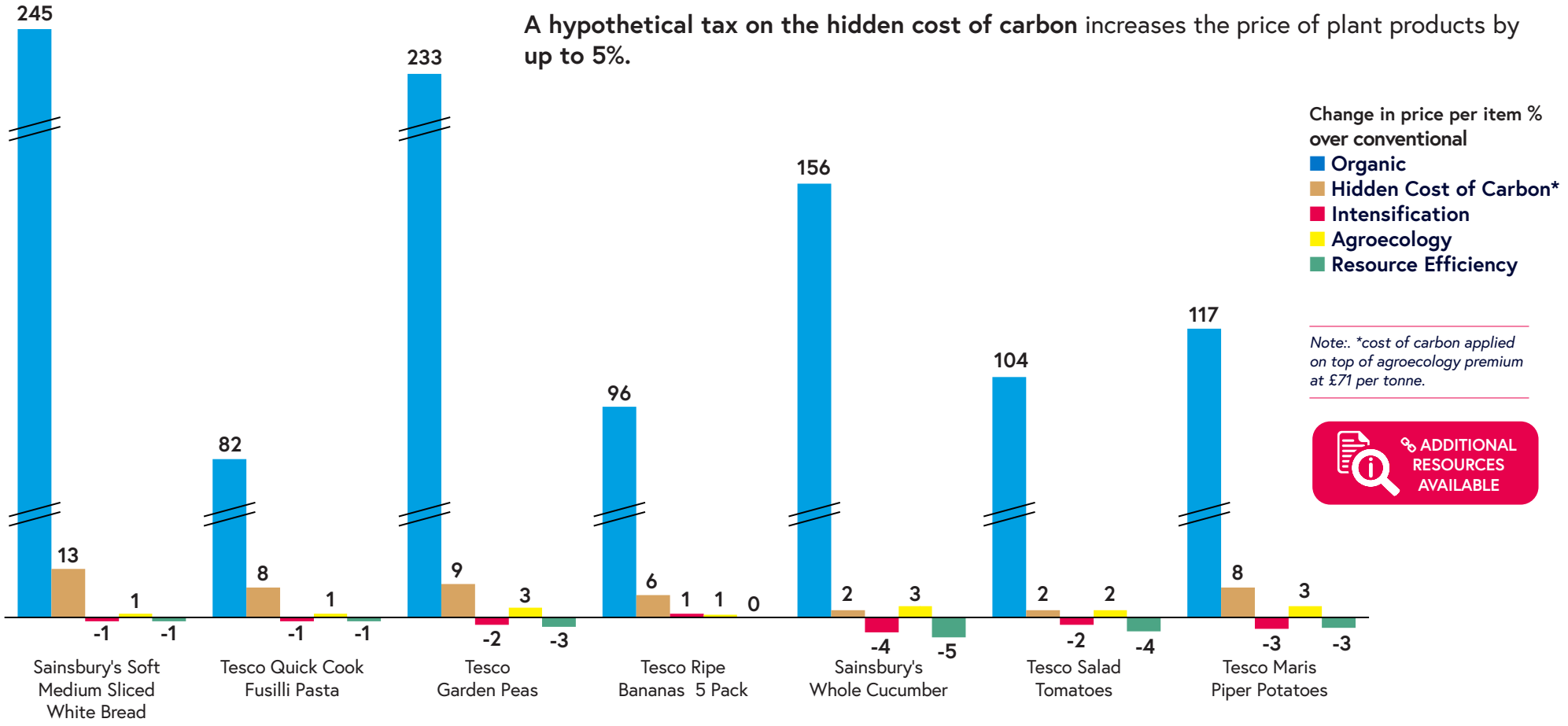
ADDITIONAL RESOURCES AVAILABLE

SOURCE: SYSTEMIQ analysis commissioned for the National Food Strategy

Changing to certain sustainable methods would have little or no effect on the price of plant products

Changing farming practices does not have a significant impact on prices (+/- 5%). This compares with an organic price premium of 100% or more for many products.

A hypothetical tax on the hidden cost of carbon increases the price of plant products by **up to 5%.**

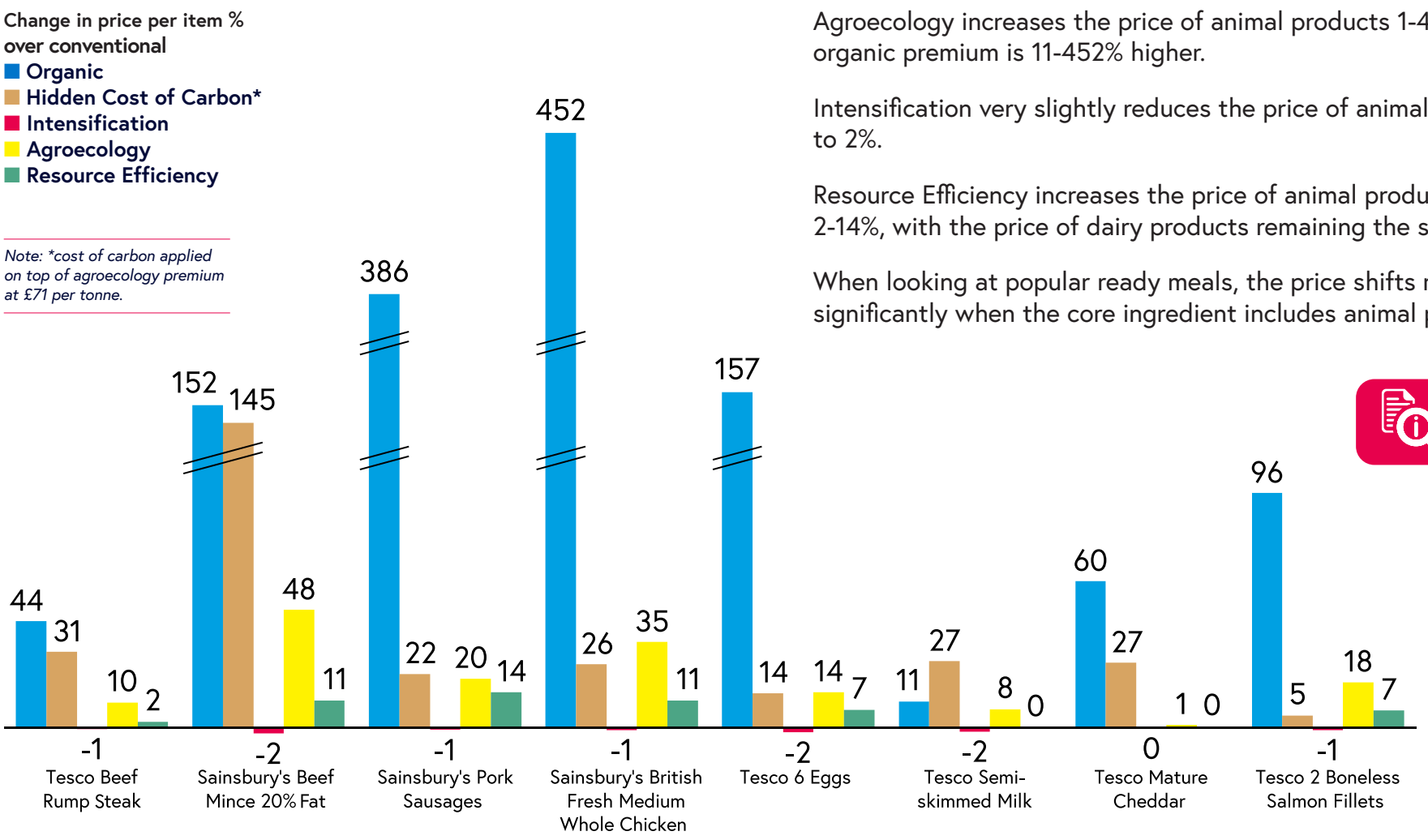


*Note:. *cost of carbon applied on top of agroecology premium at £71 per tonne.*

ADDITIONAL RESOURCES AVAILABLE

SOURCE: SYSTEMIQ analysis commissioned for the National Food Strategy, based on Tesco.com and Sainsburys.com, accessed 23 March

Price changes are more significant when looking at animal products



Agroecology increases the price of animal products 1-48% whereas organic premium is 11-452% higher.

Intensification very slightly reduces the price of animal products, up to 2%.

Resource Efficiency increases the price of animal products between 2-14%, with the price of dairy products remaining the same as today.

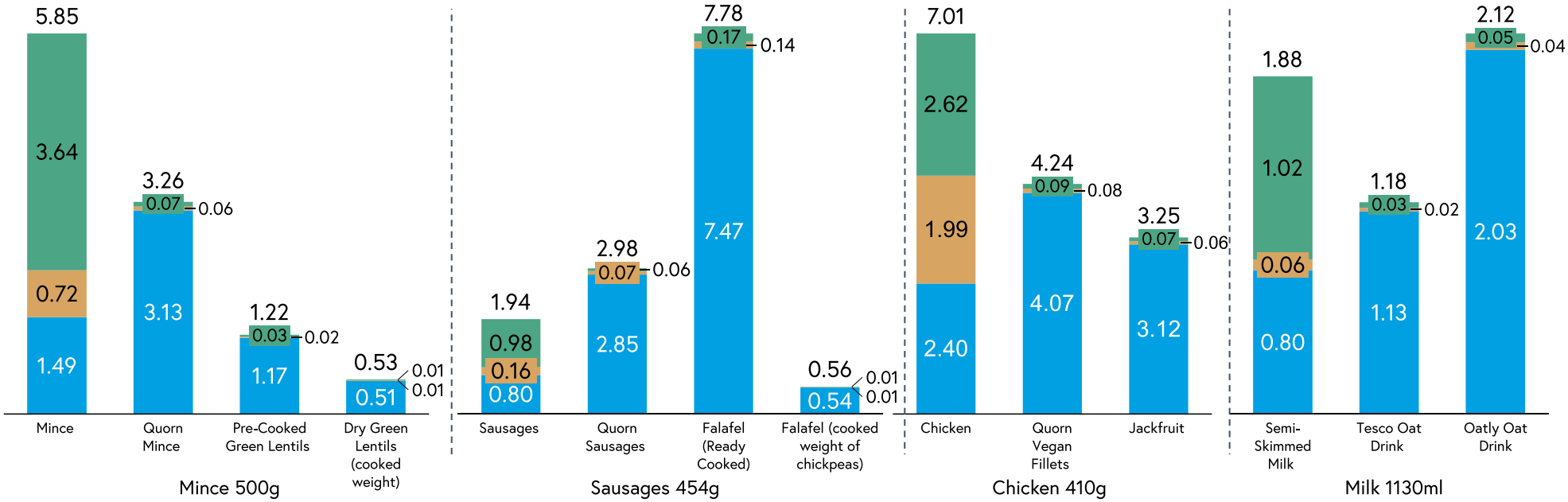
When looking at popular ready meals, the price shifts more significantly when the core ingredient includes animal products.

ADDITIONAL RESOURCES AVAILABLE

SOURCE: SYSTEMIQ analysis commissioned for the National Food Strategy, based on Tesco.com and Sainsburys.com accessed 23 March

If the hidden costs of farming are included, non-meat proteins become more cost effective

This analysis shows that, for example, the production cost of agroecologically reared chicken, facing a carbon price, would be much higher than quorn or jackfruit substitutes. However, today's chicken is cheaper than either because it does not include these costs.



*Note: *cost of carbon applied on top of agroecology premium at £71 per tonne*
*.**Price with Agroecology which is the farming scenario that raises the price the most.*

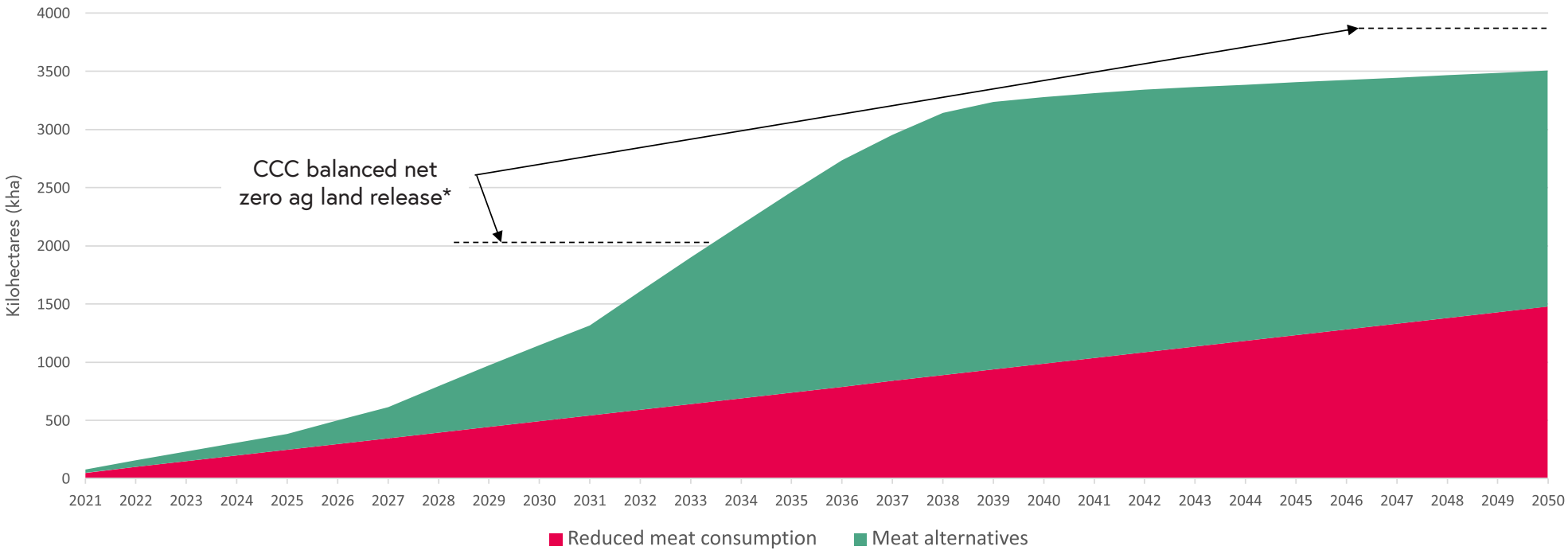
ADDITIONAL RESOURCES AVAILABLE

SOURCE: SYSTEMIQ analysis commissioned for the National Food Strategy

WE NEED ACTION TO REACH OUR TARGETS

If we reduce total meat consumption and take up alternative proteins we can release land for nature

LAND RELEASED
Chart shows land released from the nfs's three-pronged protein transition.
Methane suppression does not release land so is not shown here.

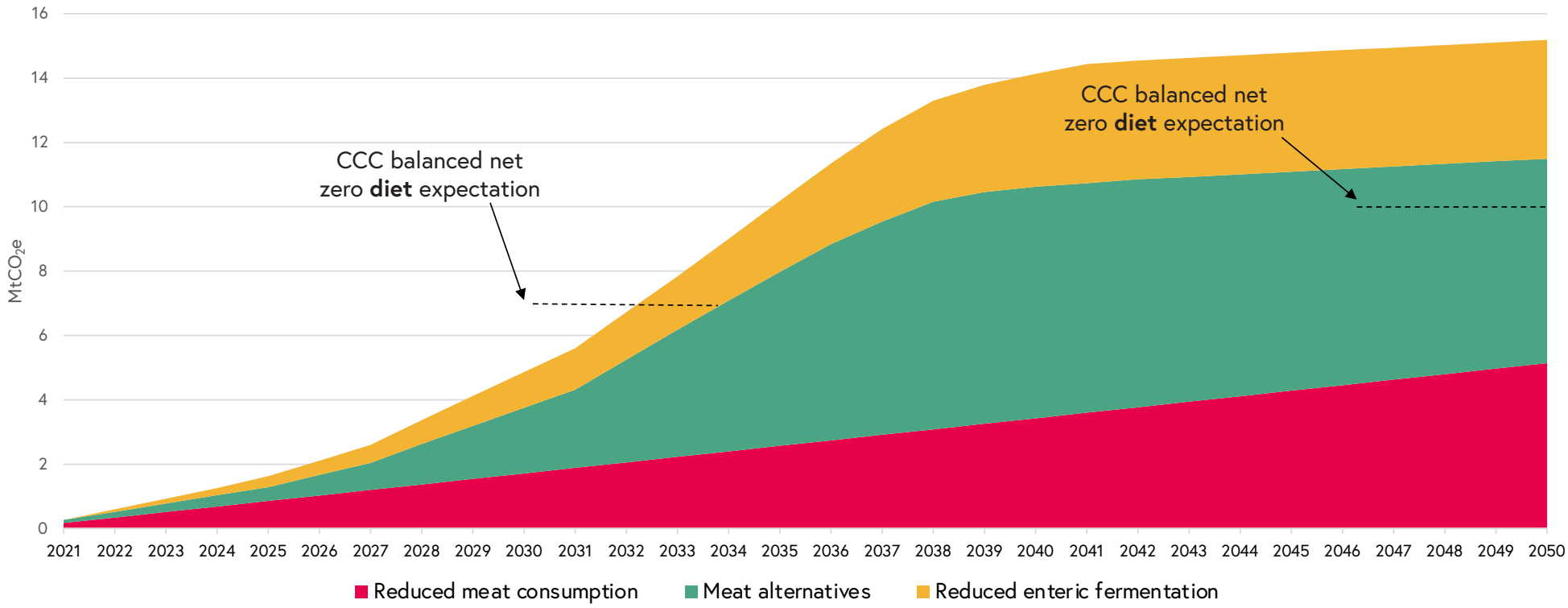


*Note: *CCC's (Climate Change Committee) land release expectation includes yield increases on cropland, which isn't covered here and would release more land.*

SOURCE: NFS analysis based on data from Poore, J. and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science 360:987-992. [online];

Reducing meat consumption, taking up alternative proteins, and reducing methane emissions from ruminants helps reach net zero

POTENTIAL REDUCTION IN AGRICULTURAL GHGs
Chart shows emissions reductions from the NFS's three-pronged protein transition.



SOURCE: NFS analysis based on data from Poore, J. and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. Science 360:987-992. [online];

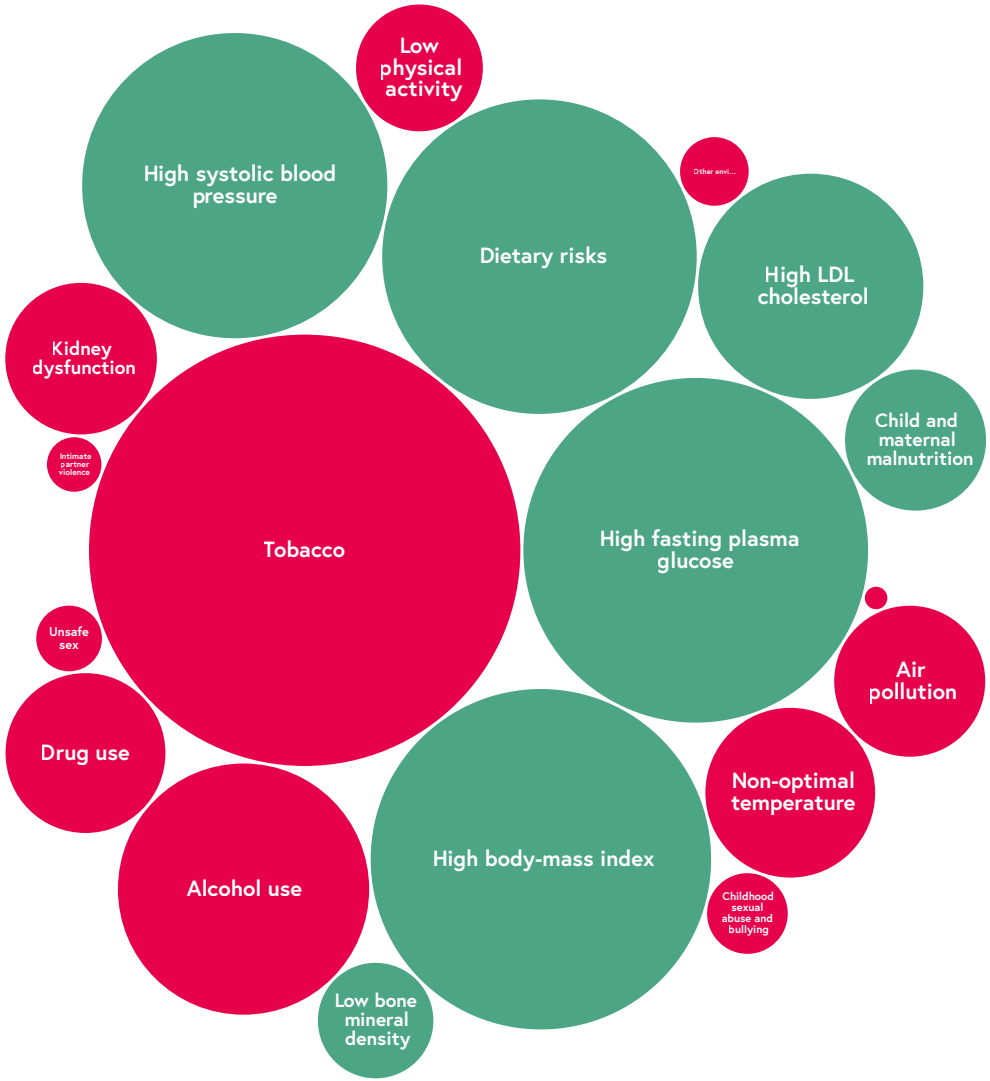
National
Food Strategy

HEALTH

Health

WHY IT MATTERS

Four of the top five risk factors for all-cause DALYs are related to diet



Note: Bubble size is proportional to DALYs. Diet related risks shown in green.

SOURCE: Global Burden of disease, 2019 data. Accessed March 2021 GBD Results Tool | GHDx (healthdata.org)

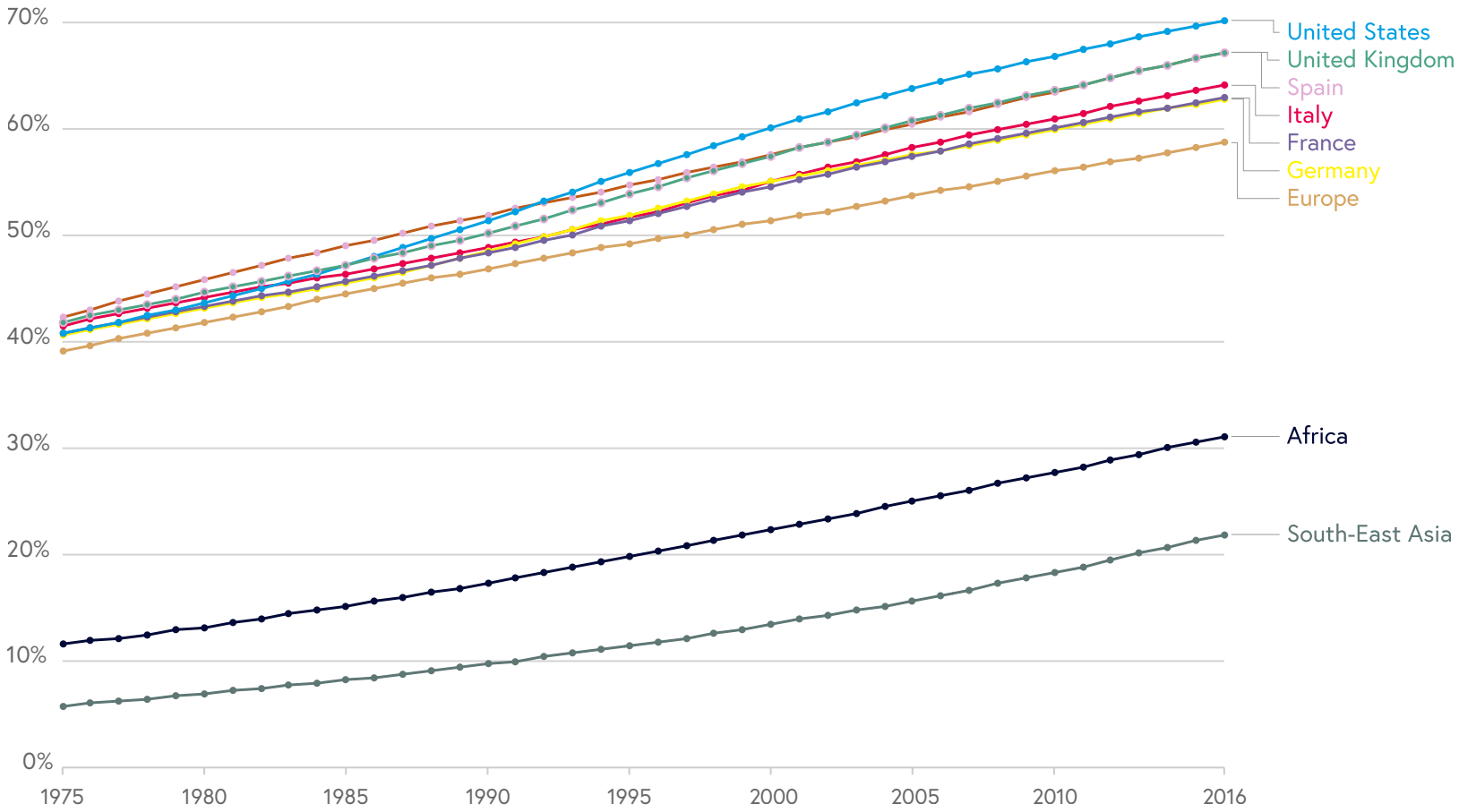
DALYS = disability adjusted life years

DALYs measure the total years lost to early death, ill-health and disability – thus combining mortality and morbidity.

They show that for England, diet is the leading cause of avoidable harm to our health.

The UK has one of the highest rates of obesity in Europe

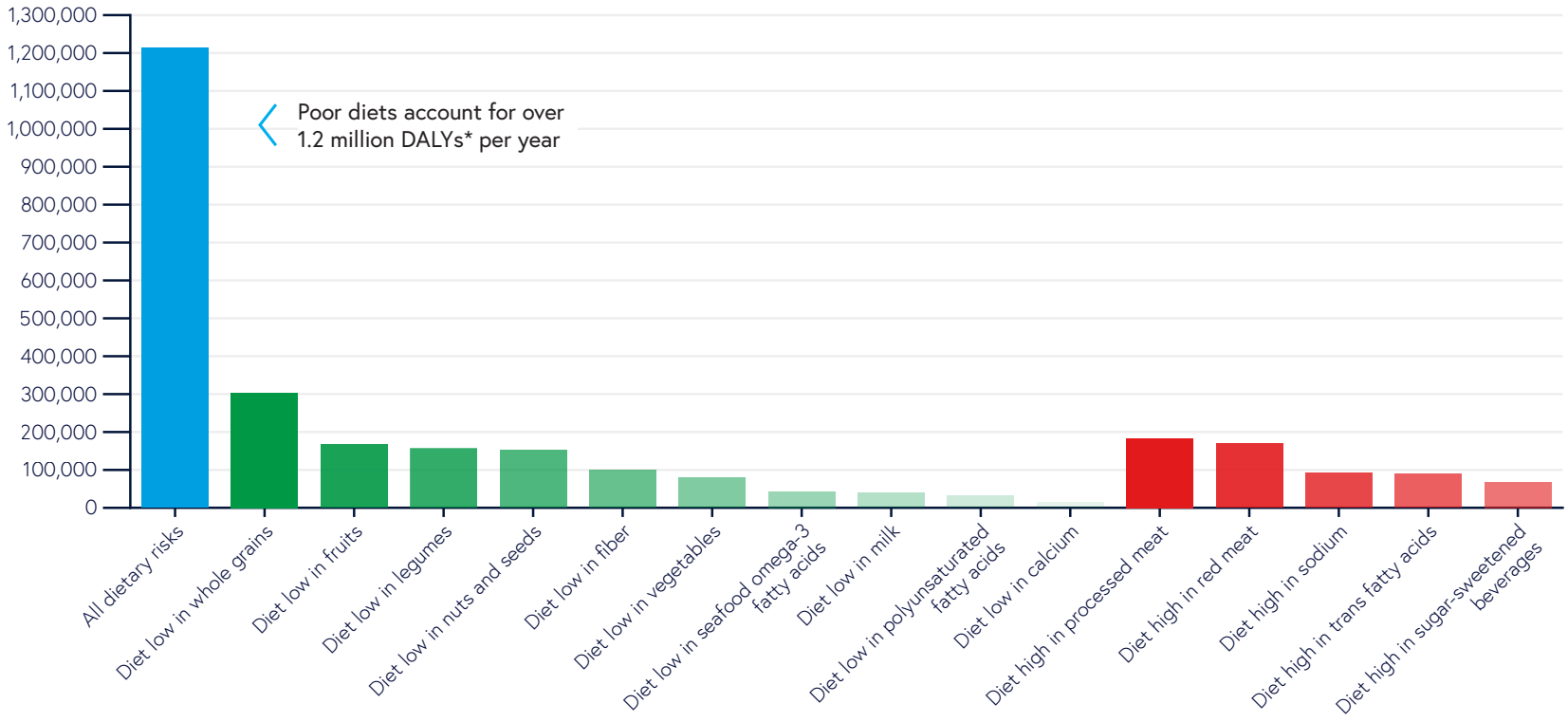
SHARE OF ADULTS THAT ARE OVERWEIGHT OR OBESE, 1975 TO 2016



Being overweight is defined as having a body-mass index (BMI) greater than or equal to 25. Obesity is defined by a BMI greater than or equal to 30. BMI is a person's weight in kilograms divided by his or her height in metres squared.

SOURCE: Ritchie, H. and Roser, M. (2017). "Obesity". OurWorldInData.org. [online]. WHO, Global Health Observatory.

The problem is not just obesity, but poor diet. Both result in considerable disease risk

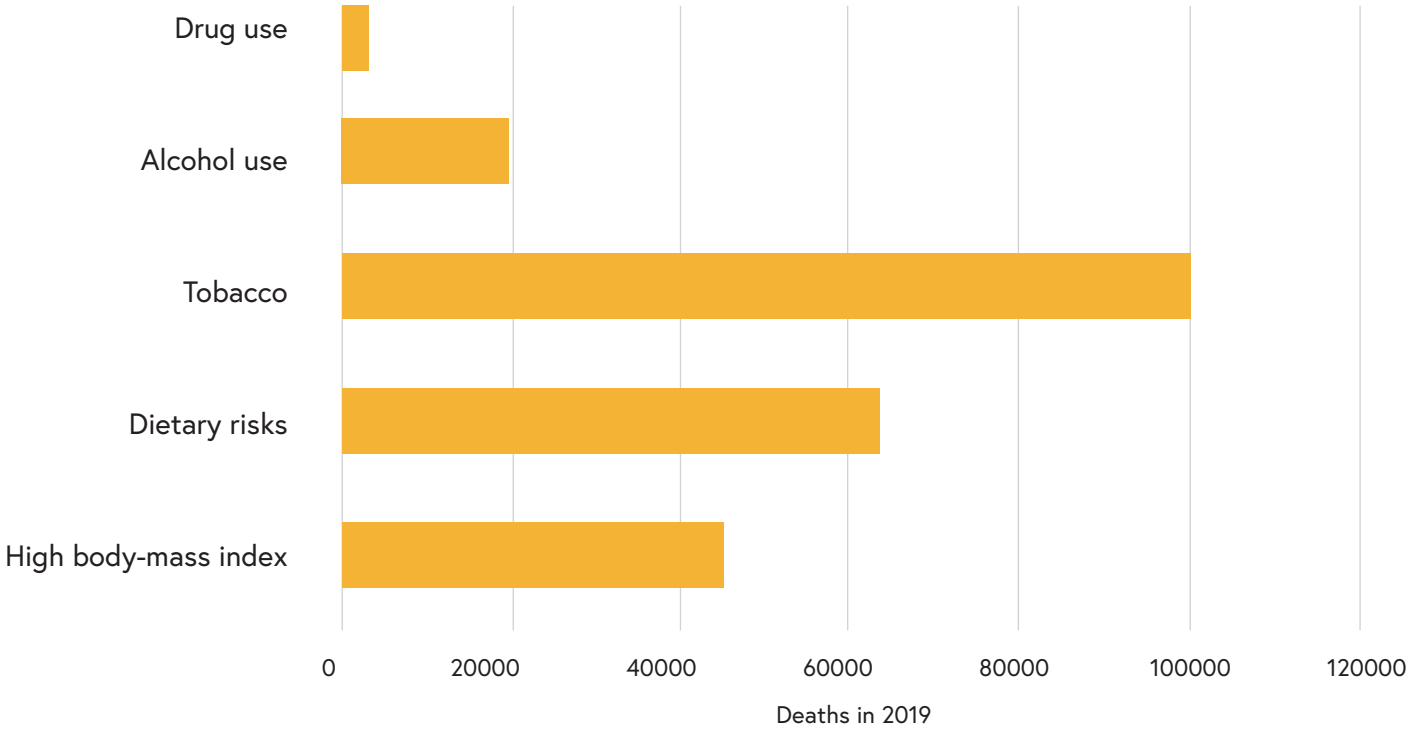


High BMI accounts for over 1.4 million DALYs (not on chart).

Several other disease risks, in addition to high BMI and specific diet risks, also have strong diet-related causes such as High plasma glucose and High blood pressure which are not captured here.

SOURCE: Global Burden of disease, 2019 data. Accessed March 2021 GBD Results Tool | GHDx (healthdata.org)

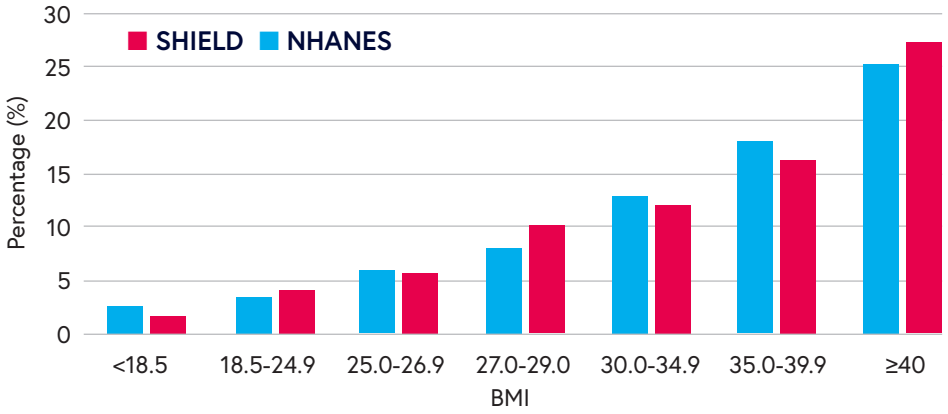
High BMI and poor diets account for many more deaths than alcohol and drug abuse



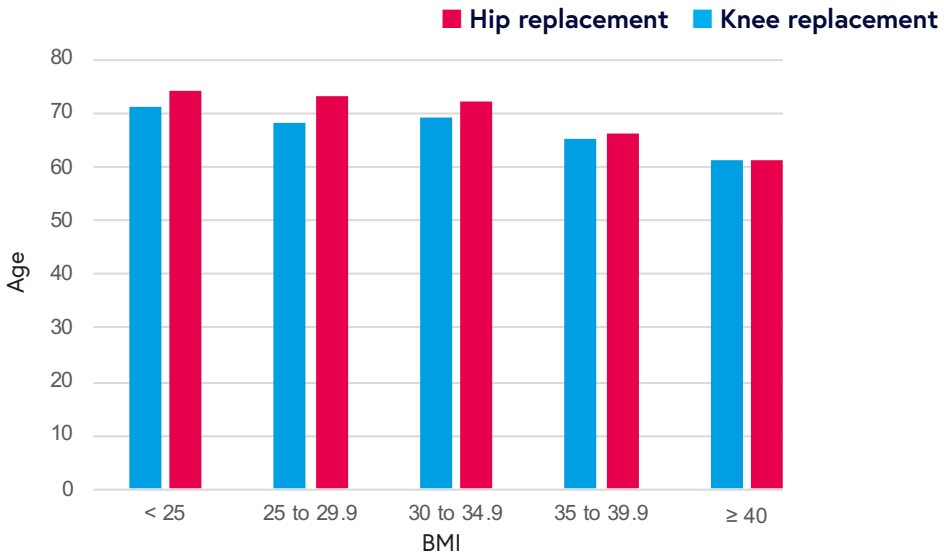
SOURCE: Global Burden of disease, 2019 data. Accessed March 2021 GBD Results Tool | GHDx (healthdata.org)

Obesity is strongly related to type 2 diabetes and musculoskeletal ill-health

THERE IS A STRONG CORRELATION BETWEEN DIABETES AND BMI*



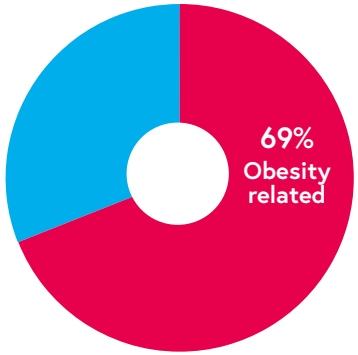
OBESITY MEANS YOU ARE LIKELY TO NEED SURGERY AT A YOUNGER AGE FOR A HIP OR KNEE REPLACEMENT



DIABETES DIAGNOSES DOUBLED BETWEEN 1998-2019

The number of people diagnosed with diabetes has **more than doubled in 20 years**

THE MAJORITY OF KNEE REPLACEMENT SURGERY IS RELATED TO OBESITY

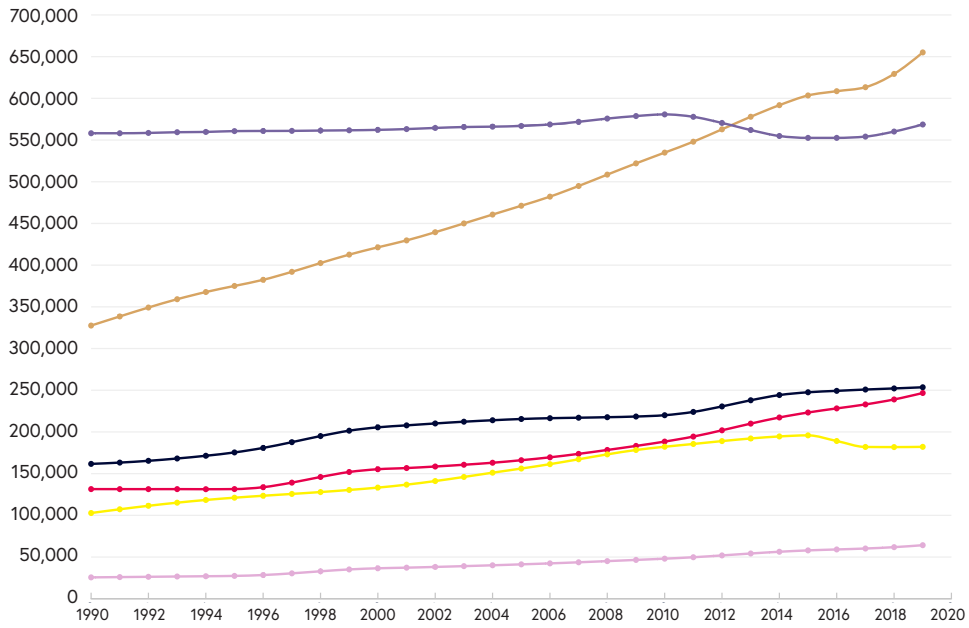


*Note: *Prevalence of diabetes mellitus (types 1 and 2). Comparison of data from two national surveys Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes (SHIELD) and National Health and Nutrition Examination Surveys (NHANES).*

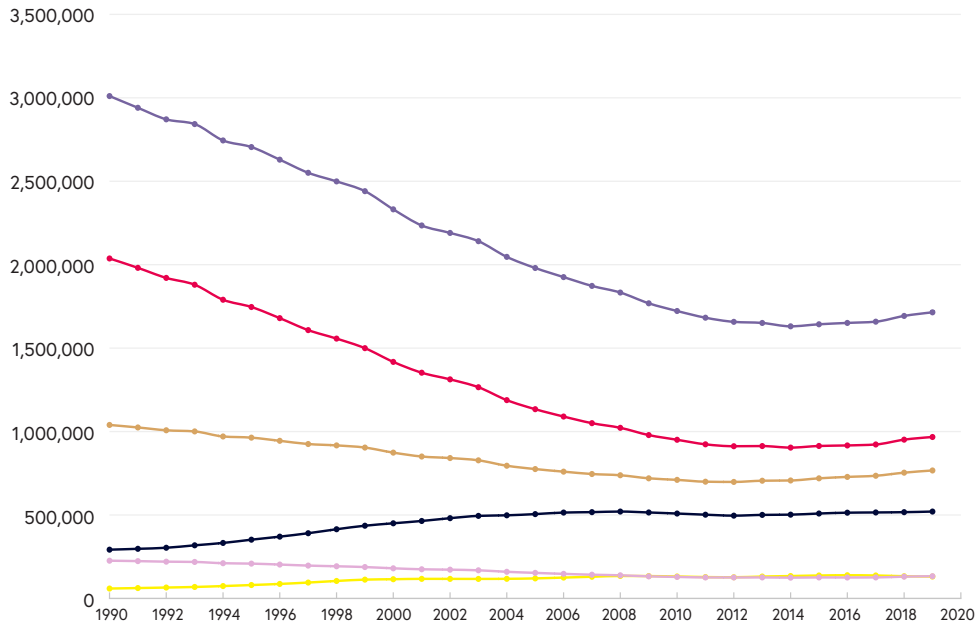
SOURCE: Bays, H.E., Chapman, R.H. and Grandy, S. (2007). The relationship of body mass index to diabetes mellitus, hypertension and dyslipidaemia: comparison of data from two national surveys. International Journal of Clinical Practice, 61(5), pp.737–747. Changulani, M., Kalairajah, Y., Peel, T. and Field, R.E. (2008). The relationship between obesity and the age at which hip and knee replacement is undertaken. The Journal of Bone and Joint Surgery. British volume, 90-B(3), pp.360–363. Diabetes UK. (2018). Number of people living with diabetes doubles in twenty years. [online] Whitty, C. (2020). What Can We Do About Rising Obesity?. Gresham College. [online].

The health impacts of poor diets are escalating

YLDs (years lived with disability), number



YLLs (years of life lost), number



The **disability associated with high BMI has been increasing** while the disability associated with other risk factors has stayed largely the same.

Today, disability from BMI has overtaken that caused by tobacco.

The years of life lost due to dietary risks have been decreasing due in part to improved medical treatments.

This is expensive and the **gains are diminishing**. The focus must now be on prevention.

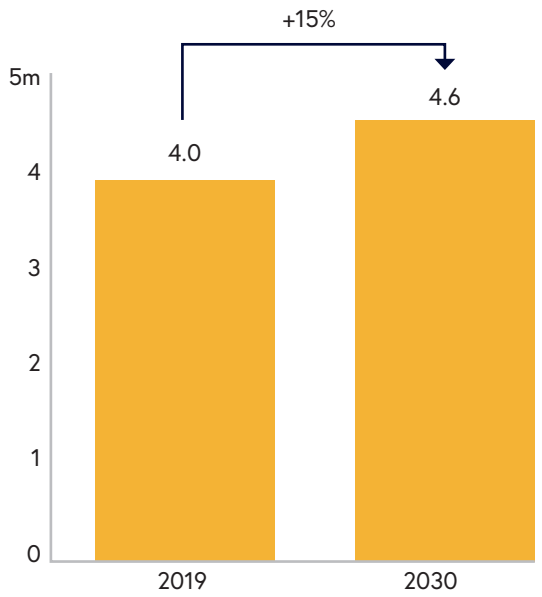
- **England, Both sexes, All ages, All causes, risk: Tobacco**
- **England, Both sexes, All ages, All causes, risk: Low physical activity**
- **England, Both sexes, All ages, All causes, risk: Alcohol use**
- **England, Both sexes, All ages, All causes, risk: Drug use**
- **England, Both sexes, All ages, All causes, risk: High body-mass index**
- **England, Both sexes, All ages, All causes, risk: Dietary risks**

SOURCE: Global Burden of disease, 2019 data. Accessed March 2021 GBD Results Tool | GHDx (healthdata.org)

Caseloads of specific diet-related diseases are rising fast

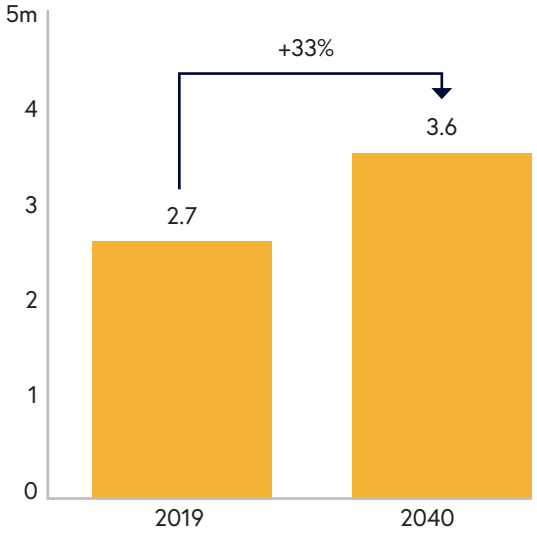
GROWING 1.3% EACH YEAR FOR NEXT 10 YEARS

People in the UK with type 2 diabetes



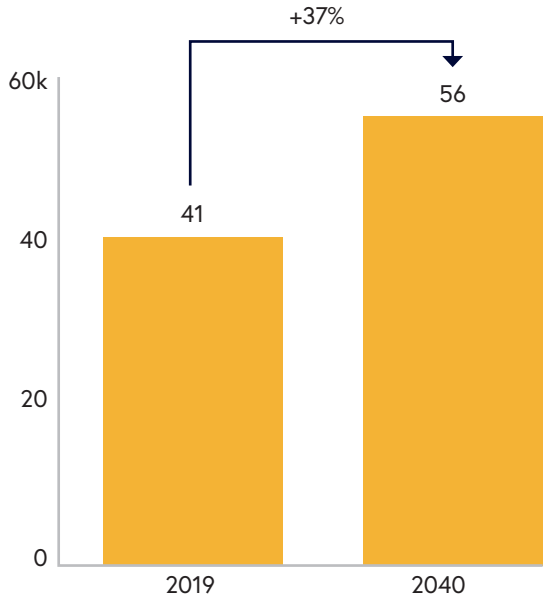
GROWING 1.4% EACH YEAR FOR NEXT 20 YEARS

People in the UK with coronary heart disease



GROWING 1.4% EACH YEAR FOR NEXT 20 YEARS

People in the UK with colorectal cancer



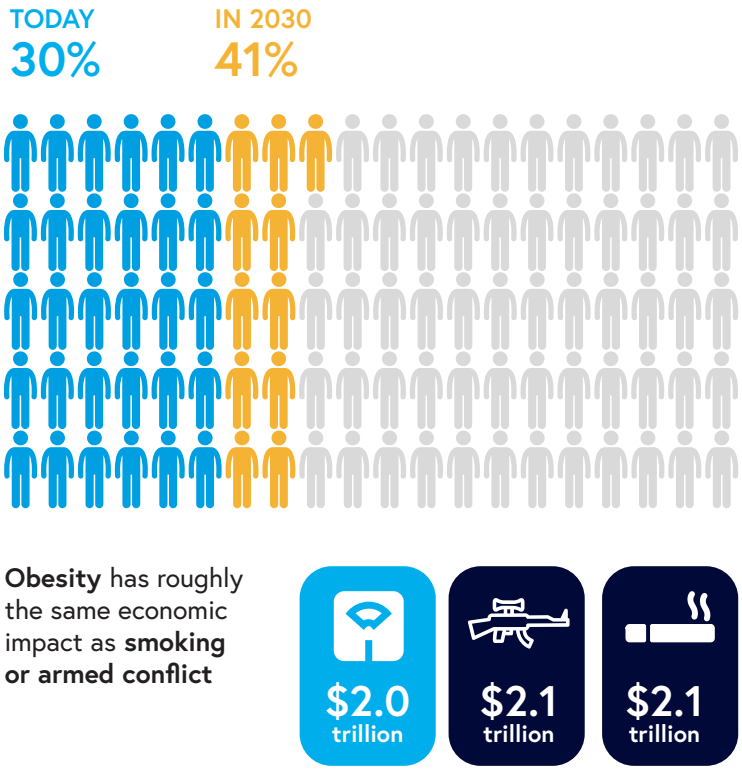
Notes: Diabetes estimates based on Health Survey for England data. Future projections of the number of prevalent cases are due to changes in the composition, obesity rates, and size of the overall population. CHD estimates based on Health Survey for England data. Estimate have taken diagnosed prevalence as constant for age and gender groups. As such, the prevalence projections are due to changes in the size and composition of the overall population. Colorectal estimates based on ONS and UN data. Forecasts for colorectal cancer take into account a combination of lifestyle changes (diet, exercise, obesity, and smoking) and screening. A conservative declining age and gender-specific trend based on historical data is used, and expectations about the changes in screening test used, coverage, and uptake over the period are included.

ADDITIONAL RESOURCES AVAILABLE

SOURCE: Decision Resource Group, 2013-2015; 2019 taken as today's figure

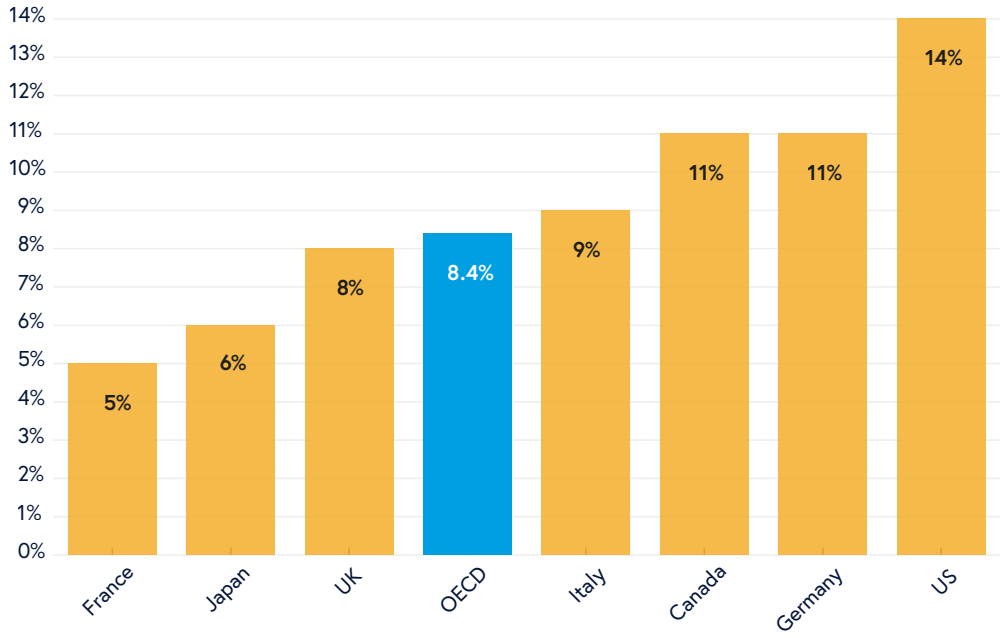
Treating illnesses resulting from poor diets has a huge cost

ADDRESSING RISING GLOBAL OBESITY
(5% of all deaths each year)



Obesity has roughly the same economic impact as **smoking or armed conflict**

% OF HEALTH EXPENDITURE SPENT ON OVERWEIGHT AND RELATED CONDITIONS, 2020-2050

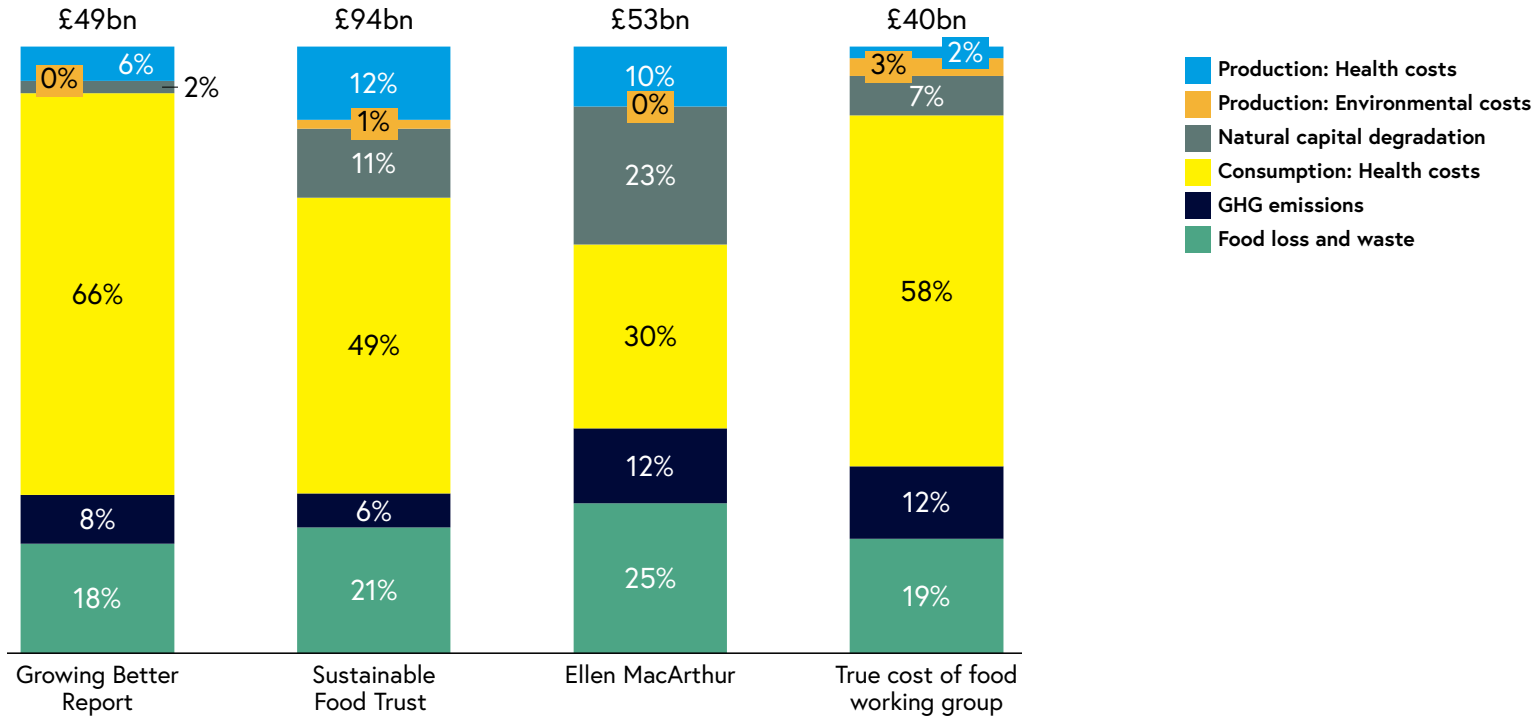


Obesity across the world is set to rise and will be lead to huge negative economic impacts

SOURCE: British Medical Association. 2018. Prevention before cure: Securing the long-term sustainability of the NHS. BMA.; OECD (2019), The Heavy Burden of Obesity: The Economics of Prevention, OECD Health Policy Studies, OECD Publishing, Paris.

The largest 'hidden costs' of food arise from the cost of diet-related ill health†

HIDDEN COSTS BY SOURCE, GBP BILLION % OF TOTAL HIDDEN COSTS



† *NB this is partly because health costs (to the NHS, in death/ disability) are readily monetised while nature isn't*

ADDITIONAL RESOURCES AVAILABLE

SOURCE: SYSTEMIQ analysis based on FOLU (2019), Sustainable Food (2017), Ellen MacArthur Foundation (2019), WBCSD (2021)

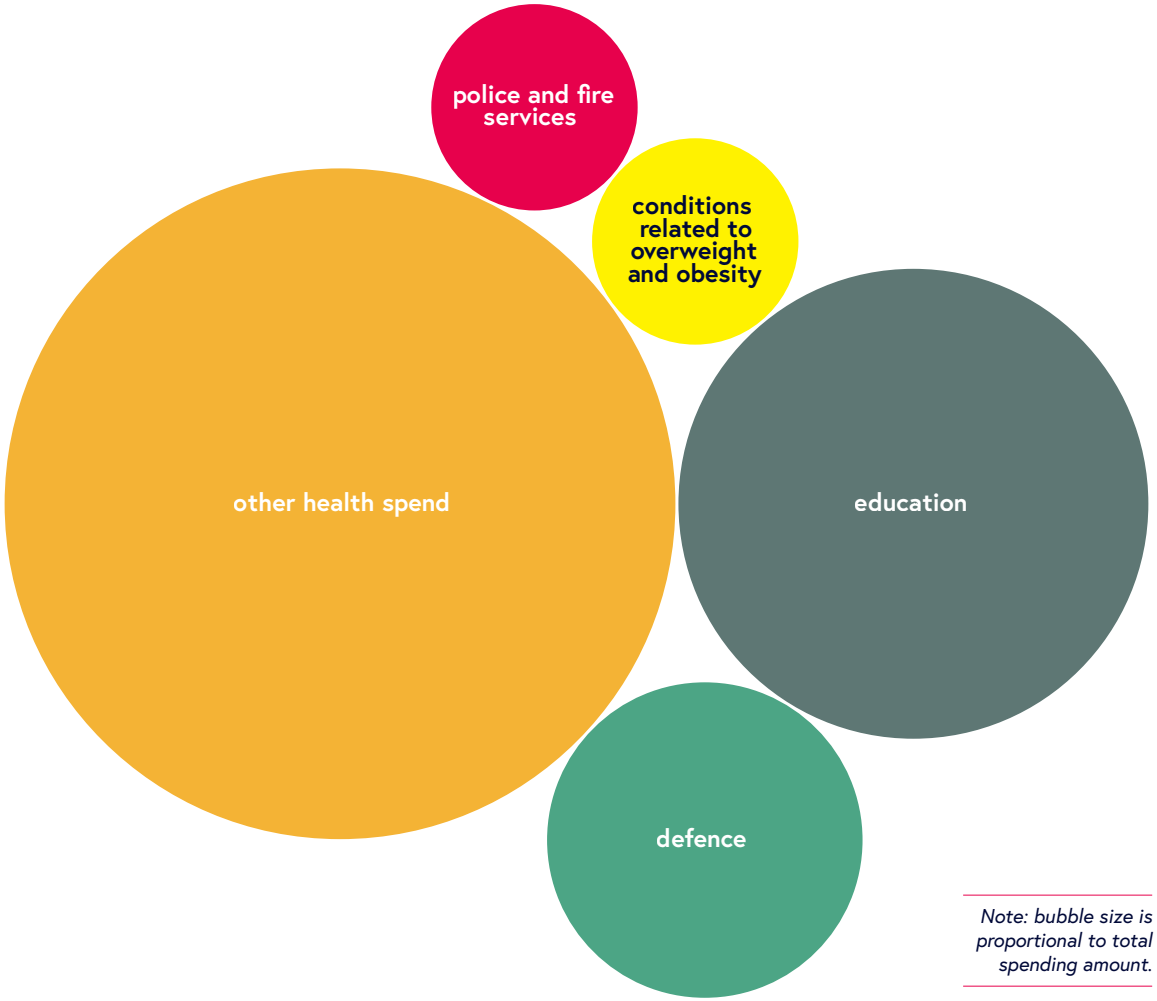
Increasing diet-related disease is costing the taxpayer a fortune

The UK currently spends about **£18 billion** a year on the direct medical costs of conditions related to being overweight or obese. This does not capture other diet related conditions, e.g. high blood pressure from salt overconsumption.

This is **equivalent to the United Kingdom's combined budget for the police and fire services**; a fifth of education spending; and about half of the country's defence budget.

A **small share of the overall cost of obesity comes from investment to mitigate or prevent it**, compared with other health- or non-health-related burdens.

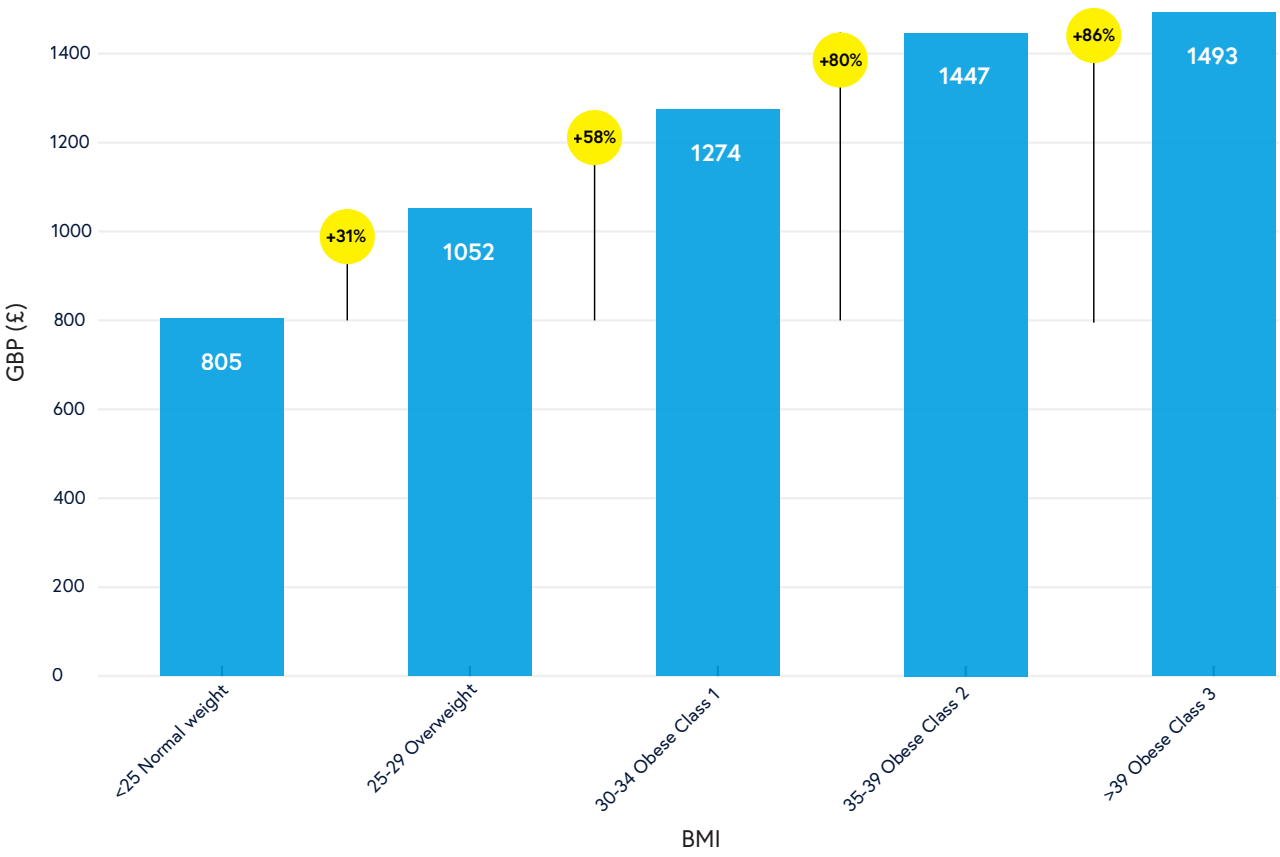
Instead, **obesity spending is weighted towards treatment**. For example, PHE's 'Better Health' diet campaign in 2020/21 cost £9 million. This is equivalent to 0.05% of what the NHS spends on obesity and overweight treatment.



Note: bubble size is proportional to total spending amount.

SOURCE: OECD (2019), The Heavy Burden of Obesity: The Economics of Prevention, OECD Health Policy Studies, OECD Publishing, Paris; and NFS team analysis; Office for National Statistics. (2021). Healthcare expenditure, UK Health Accounts: 2019. ONS.; Home Office. (2020). Policing gets biggest funding boost in decade to put more bobbies on the beat. HMG.; Clark, D. (2020). Government spending on the fire service in the UK 2009-2020. Statista.; Clark, D. (2020). Public sector expenditure on education in the United Kingdom (UK) in 2019/20, by sub-function. Statista; Ministry of Defence. (2020). UK Defence in Numbers 2019. HMG. Data for Changle4Life spend from Public Health England (unpublished)

Hospital admissions and costs increase as BMI rises



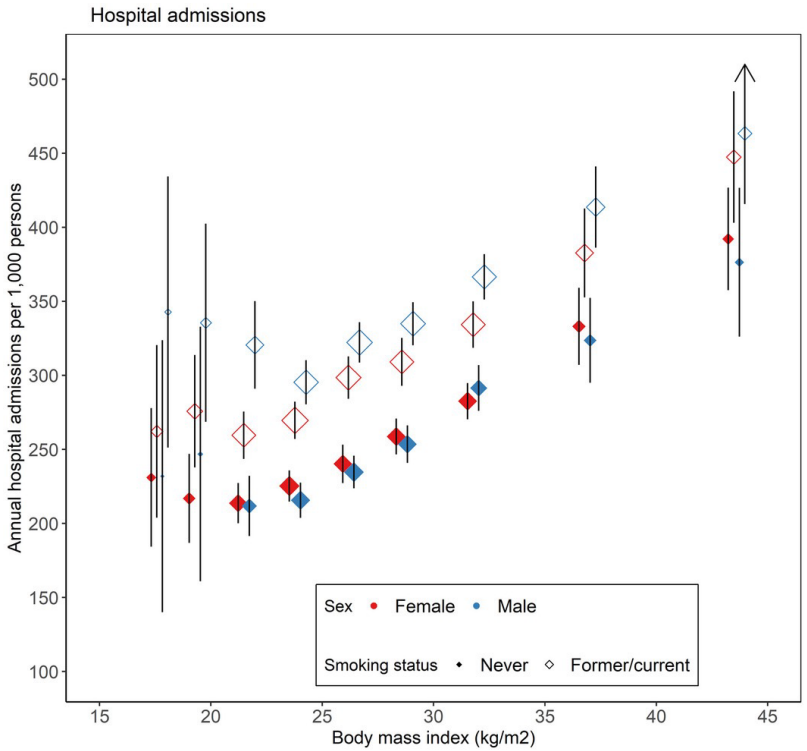
As BMI increases, so do annual healthcare costs – an average of £16 per unit of greater BMI.

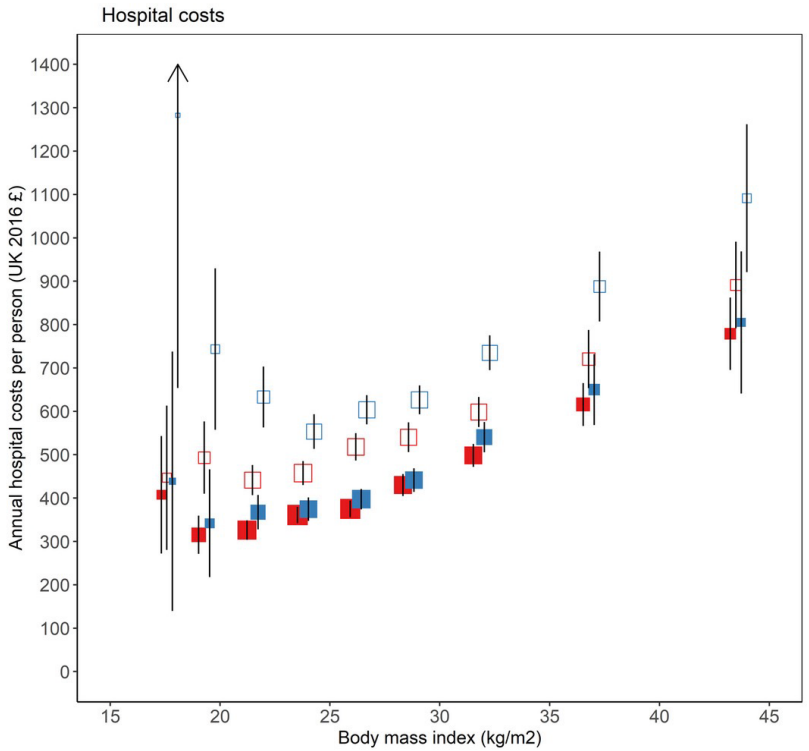
In 2012, the average NHS spend was £1,447 per person with obesity compared to £805 for somebody of a healthy weight.

Includes primary care,general practitioner prescriptions,hospitalisation,accident and emergency, and outpatient care. 2003 values taken from Tigbe et al. (2013) adjusted using 2012/13 Fédération Internationale de Médecine du Sport and Health Examination Survey data on per capita UK costs in each category.

SOURCE: Overcoming Obesity: an initial economic analysis, McKinsey Global Institute, 2014

Hospital admissions and costs increase as BMI rises





More recent hospital data confirms this:

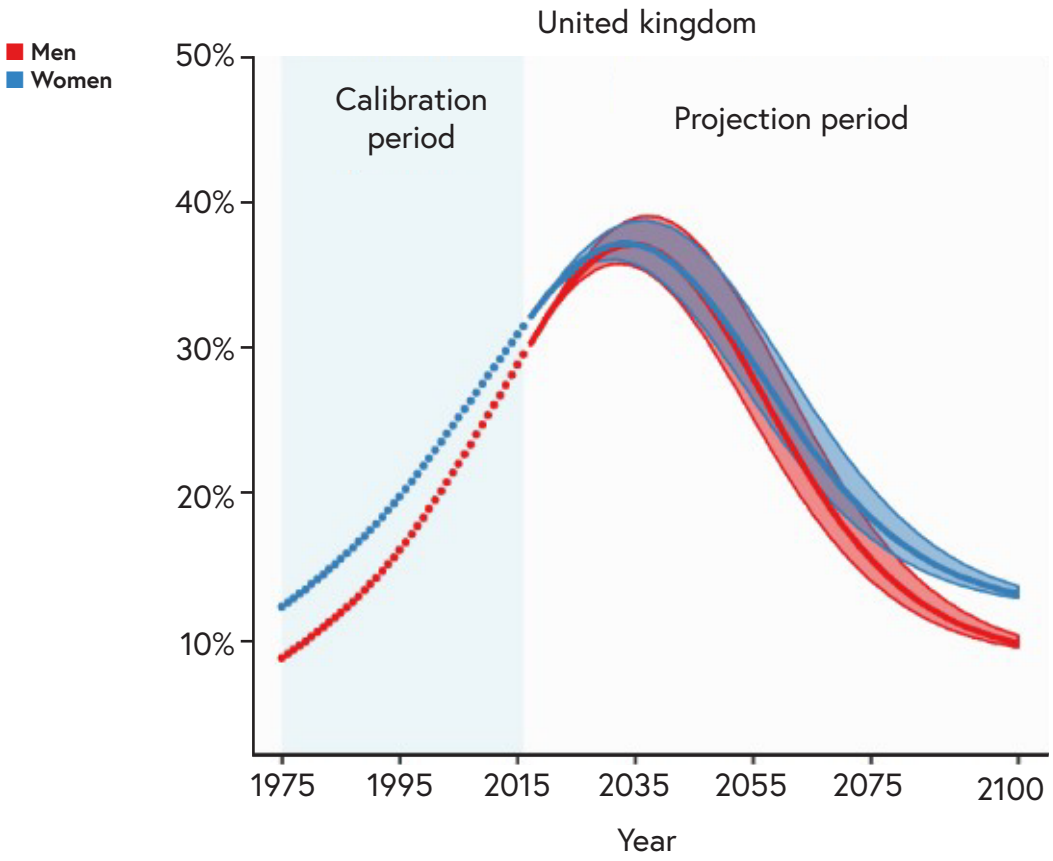
Every 2kg/m2 increase in BMI saw hospital admissions rise by 5.7% (women) and 6.2% (men). Costs also rose by and 8.4% and 8.6%, respectively.

Costs for people with BMIs above 40 are 2.2-2.4x higher than those with a healthy weight.

Musculoskeletal conditions are the biggest contributors to these costs, accounting for 41.3% of the share of the cost.

SOURCE: O'Halloran et al (2020) Obesity. BMI and Cause-Specific Hospital Admissions and Costs: The UK Biobank Cohort Study. Annual (A) hospital admissions and (B) costs (at 2016 UK prices), by sex and BMI, with 99% CI. Data standardised to the UK Biobank analysis sample are plotted against mean measured BMI in the UK Biobank study, with a small offset to separate groups. Size of the square is inversely proportional to the standard error.

Obesity prevalence is projected to increase; it is only likely to fall if Government intervenes



Modelling of obesity in the UK suggests that – if public policy to reduce obesity ratchets up over time – obesity prevalence will peak at 36.9% in 2033/34 and decline to 24.1% in men and 25.7% in women in 2060.

The model assumes similar public policy interventions on tobacco control will be introduced for obesity. Tobacco control policy has spanned 60 years, beginning in earnest in the UK in 1962.

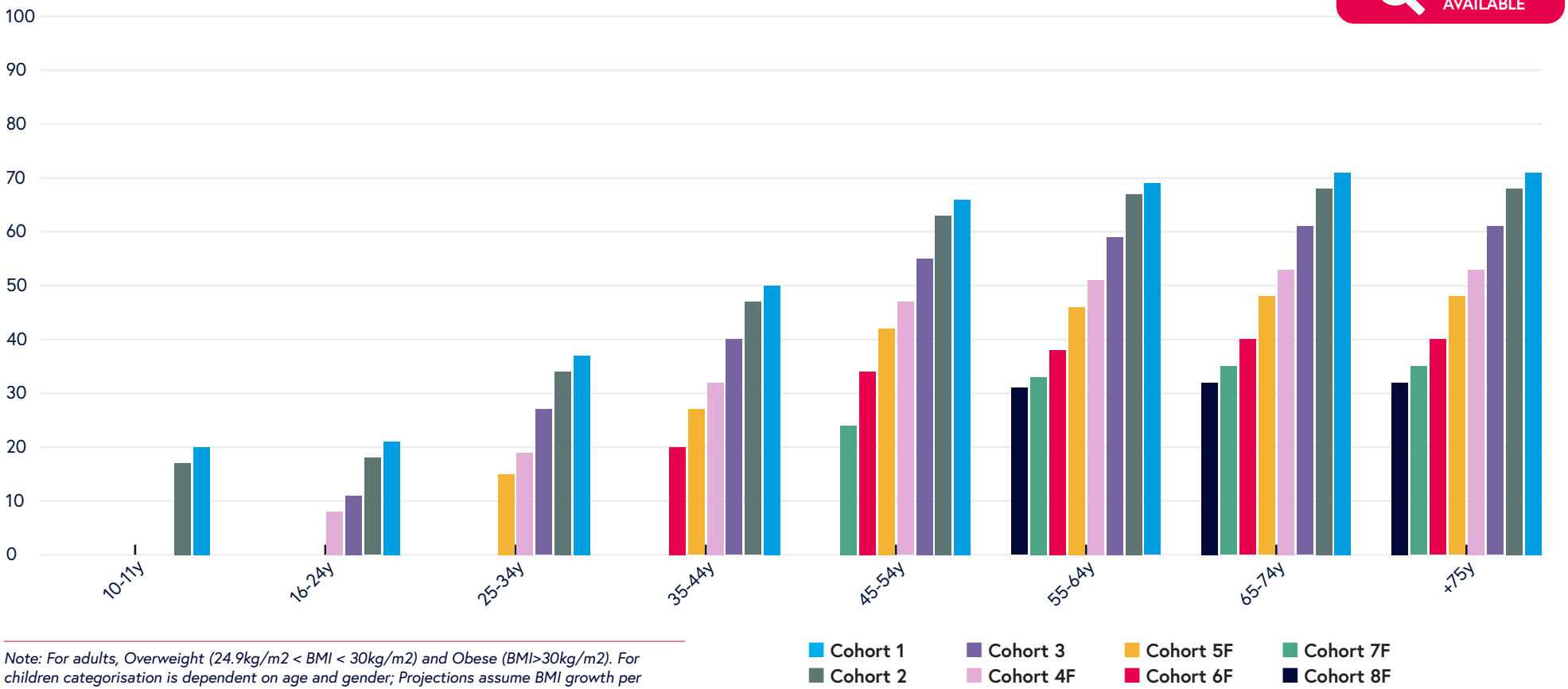
With earlier and faster action on diet, we can lower the peak level of obesity. **Without action, we should not assume obesity rates will peak and decline**.

SOURCE: F. Janssen, A. Bardoutsos, Vidra, N. (2020) Obesity Prevalence in the Long-Term Future in 18 European Countries and in the USA, Obesity Facts 2020, Vol. 13, No. 5; ASH UK, Key Dates in Tobacco regulation. 1962-2020.

If obesity prevalence isn't reduced, by the time current 10-yos are 50, 66% could be obese (~60% higher than in 2017)

OBESITY PREVALENCE PER AGE RANGE AND COHORT IN 1997, 2007 AND 2017 (%)

ADDITIONAL RESOURCES AVAILABLE

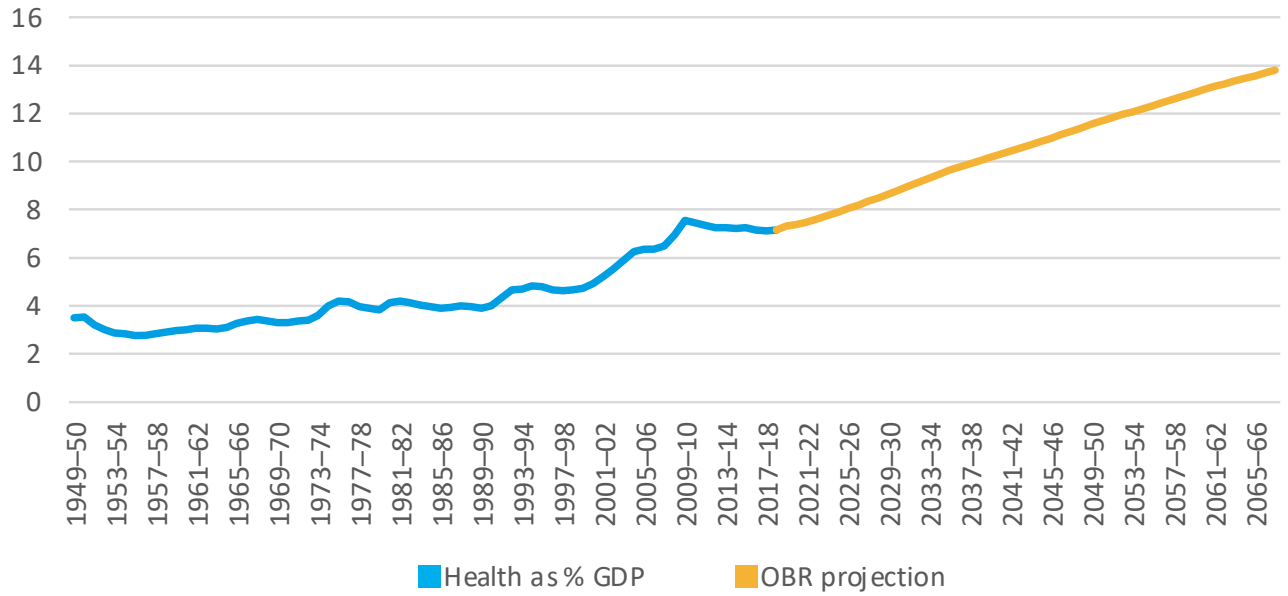


Note: For adults, Overweight (24.9kg/m2 < BMI < 30kg/m2) and Obese (BMI>30kg/m2). For children categorisation is dependent on age and gender; Projections assume BMI growth per period at the same rate as most recent study for that period; Normal distribution of population around the mid point of each age range and 75+ assumed 85 years old on average for projections.

SOURCE: Bain for NFS based on Health Survey of England 2017 for adult cohorts; National Child Measurement Programme for 10-11 year olds

UK health spending as a share of GDP is projected to increase continuously

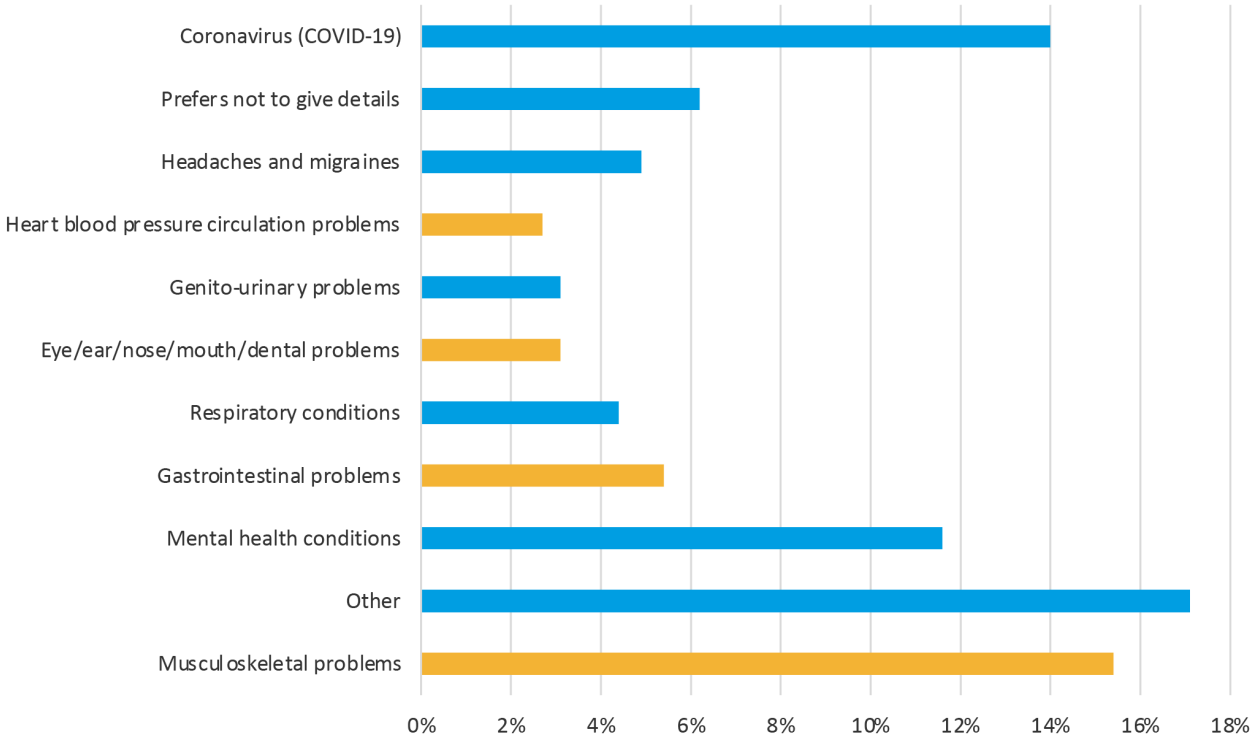
Based on demographic changes and other cost pressures, UK public health spending as a share of GDP/national income is expected to grow over the next 20 years from 7.2% in 2019/20 to approximately 10.2% in 2040, an increase of approximately 40%.



SOURCE: Stoye and Zaranko (2019) UK Health Spending, Institute for Fiscal Studies

There are also non-NHS economic costs

PERCENTAGE OF OCCURRENCES OF SICKNESS ABSENCE BY REASON, 2020



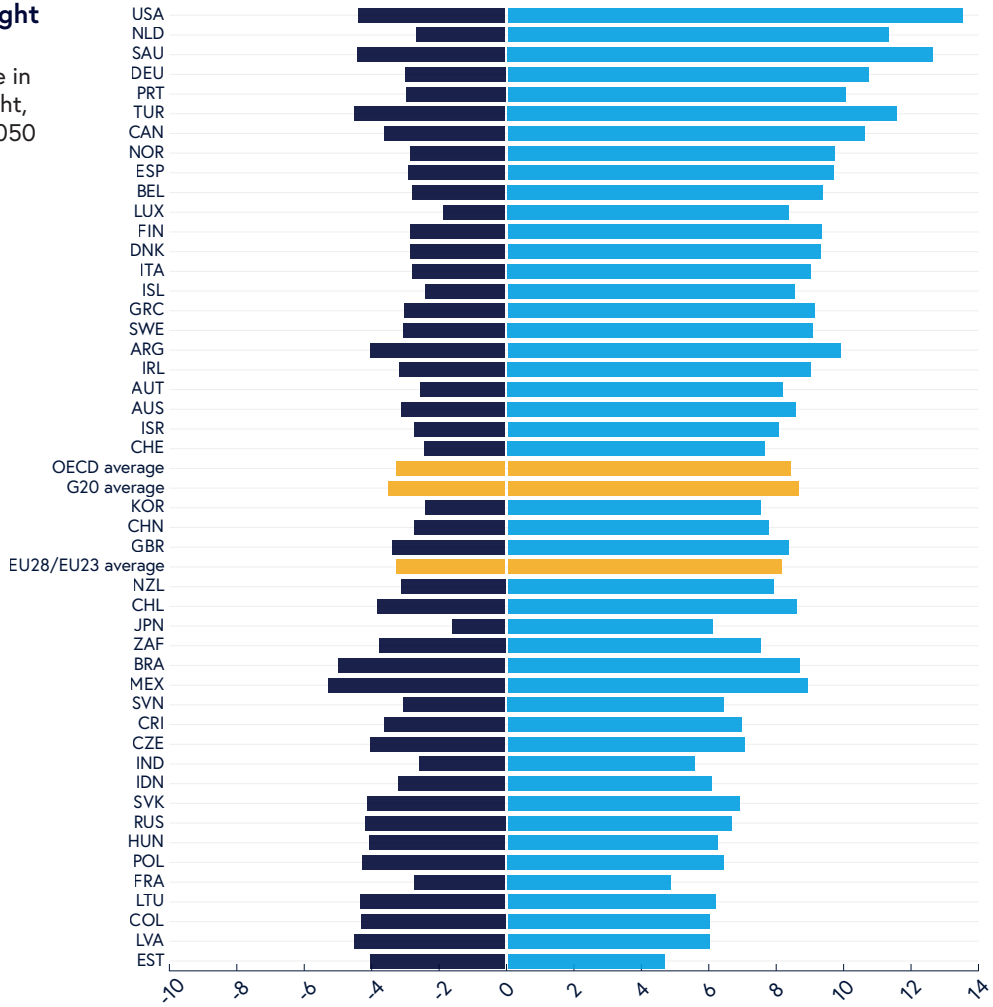
Diet-related diseases are some of the main drivers behind sickness absence (particularly musculoskeletal, gastrointestinal, blood pressure and dental problems) in the UK

Likely diet related

SOURCE: Office for National Statistics. (2020). Sickness absence in the UK labour market

High BMI has a significant impact on GDP due to health spending, reductions in life expectancy and productivity

Impact of overweight on GDP
Percentage difference in GDP due to overweight, average over 2020-2050

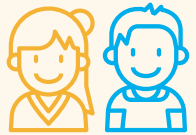


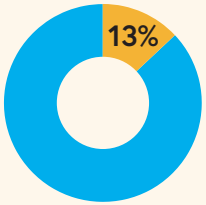
Health expenditure associated with overweight
Healthcare expenditure due to overweight per year, as a percentage of total health expenditure, average over 2020-2050

OECD estimate that future GDP could be, on average, lower by 3.3% across all OECD countries each year and 3.4% for the UK.*

**Average annual costs over 30 years assuming the rates of obesity stay the same*

Even accounting for confounding factors like family affluence, children with a healthy weight are more likely to perform well at school.

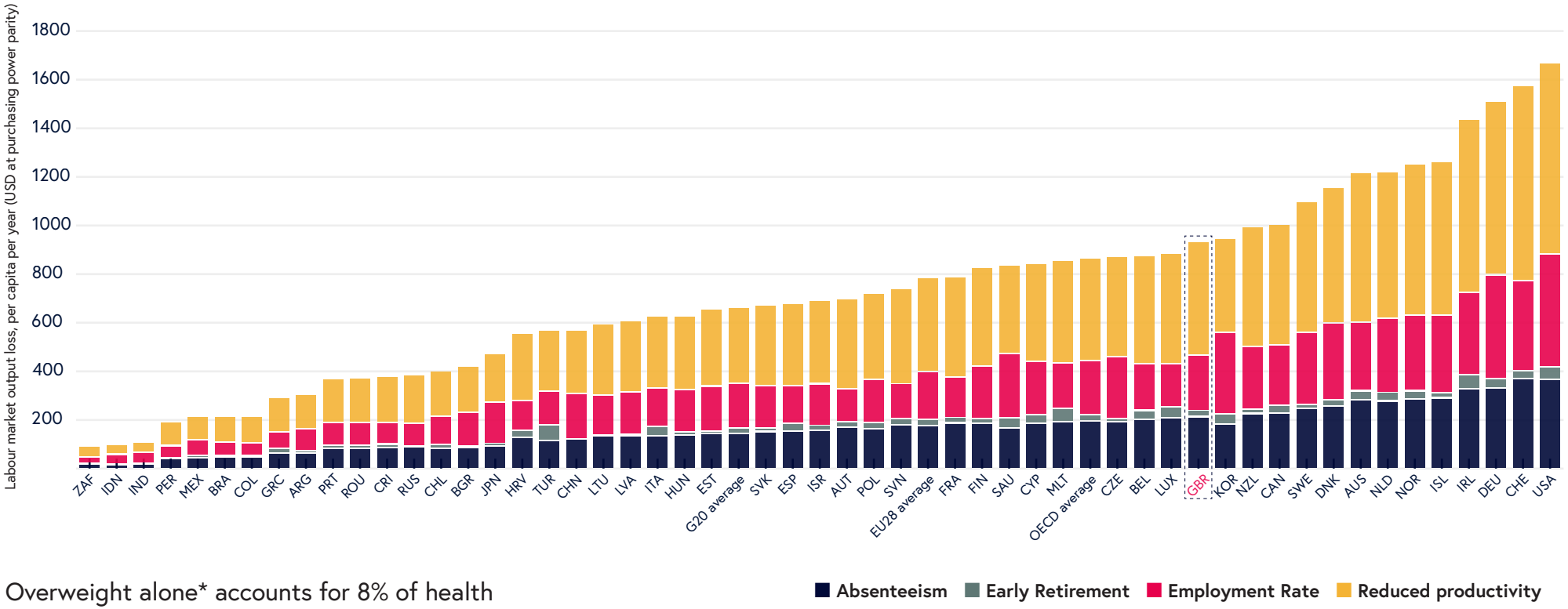




Children are 13% more likely to preform well in school if they have a healthy weight.

SOURCE: OECD. (2019). Heavy Burden of Obesity: The Economics of Prevention A quick guide for policy makers. OECD Health Policy Studies, OECD Publishing, Paris.

Excess weight reduces labour market output

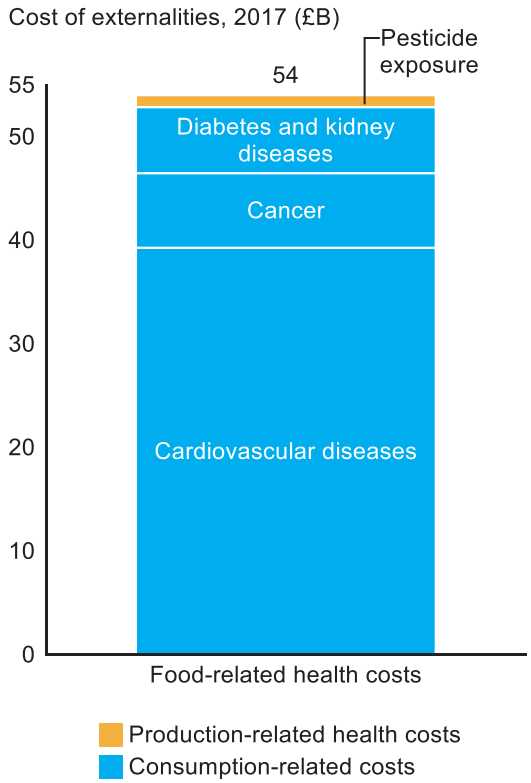


Overweight alone* accounts for 8% of health expenditure; and lowers labour market outputs by the equivalent of 944,000 full-time workers per year. **To cover these costs, each person in the United Kingdom pays an additional GBP 409 in taxes per year.**

*Note: * This does not include other diet related diseases e.g. stroke.*

SOURCE: OECD (2019), The Heavy Burden of Obesity: The Economics of Prevention, OECD Health Policy Studies, OECD Publishing, Paris. Graphic drawn from the UK specific fact sheet.

The UK food system generates ~£54bn in food-related health costs from consumption and production



Externality	Estimate	Key assumptions
Cardiovascular diseases	~£39B ~1.2M DALYs	Consumption-related health costs measured using **disability-adjusted life years** (DALYs) which **measure the burden of diseases** through calculating the number of years of life lost due to death or disability **DALYs attributable to diet** indicated as those resulting from "Dietary risks" risk factor, including diets low/high in certain food groups (IHME GHDx DALY database, 2017) All Level 2 diseases with DALYs resulting from dietary risks included - Cardiovascular, Neoplasms (Cancer), Diabetes and kidney diseases. IHME is an independent global health research centre at the University of Washington, the GHDx is a data catalogue supported by the IHME which forms part of the Global Burden of Disease (GBD) project, supported by WHO Optimal diet based on weighted global mean of diet type with lowest mortality association. **Cost of DALYs** assumed to be UK 2017 GDP per capita in purchase power parity ($PPP*) = $44,497 (£33,119) **~17K tonnes of pesticides** used for Agriculture in the UK (FAOSTAT, 2017) Assumed **2 DALYs per tonne** of pesticide based on average DALY per kg from 6 crop types (Fantke & Jolliet, 2016) Cost of DALY assumed to be UK 2017 GDP per capita in $PPP (as above)
Cancer	~£7B ~220K DALYs	
Diabetes and kidney diseases	~£6B ~193K DALYs	
Pesticide exposure	~£1B ~34K DALYs	

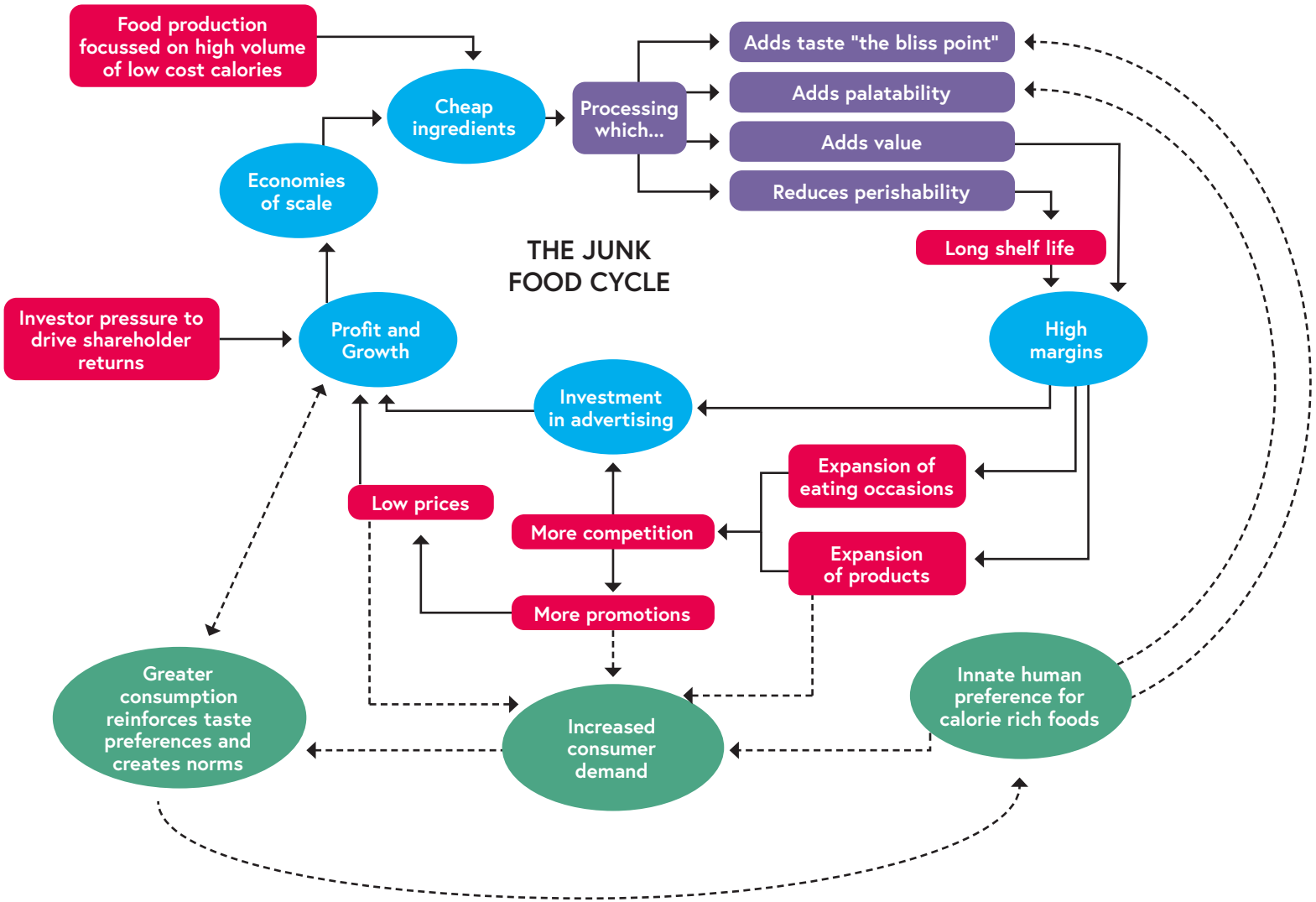
Note: Cost of DALYs assumed to be UK 2017 GDP per capita in purchase power parity ($PPP) = $44,497 (£33,119); GBP to USD conversion rate of 1.34 used; *PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates, an international dollar has the same purchasing power over GDP as the US dollar has in the United States; DALY cost based on GDP PPP as per FOLU report; full details on calculation of diet-related DALYs in Lancet (2019) report.*

ADDITIONAL RESOURCES AVAILABLE

SOURCE: Bain for NFS, based on Institute for Health and Metrics Evaluation Global Health Data Exchange (IHME GHDx), 2017; World Health Organization, 2017; Euromonitor, 2017; NHS, 2019; "Growing Better", Food and Land Use (FOLU) Coalition / Systems IQ, 2018; Pesticide Use, FAOSTAT, 2017; "Lifecycle human health impact of 857 pesticides", Fantke & Jolliet, 2016; Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017, GBD 2017 Diet Collaborators, The Lancet, 2019

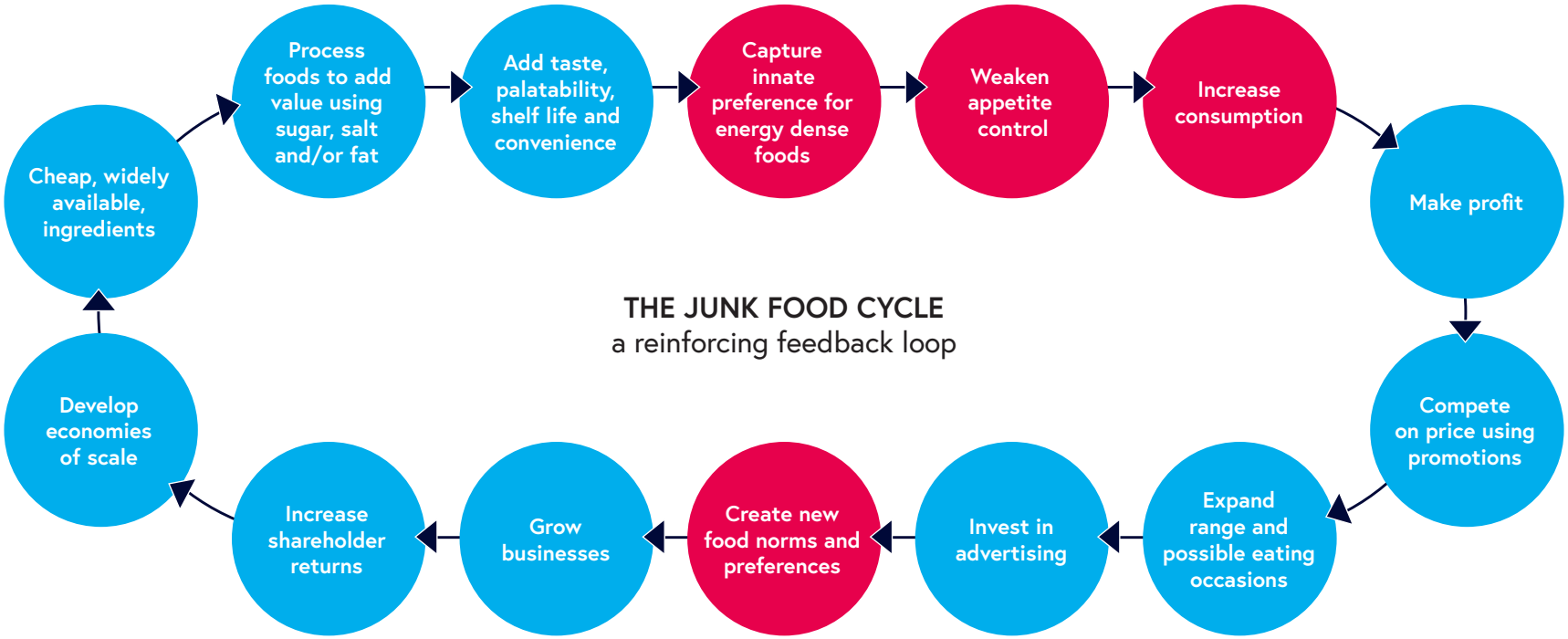
OVERVIEW OF THE JUNK FOOD CYCLE

Overview of the Junk Food Cycle (V1)



SOURCE: National Food Strategy

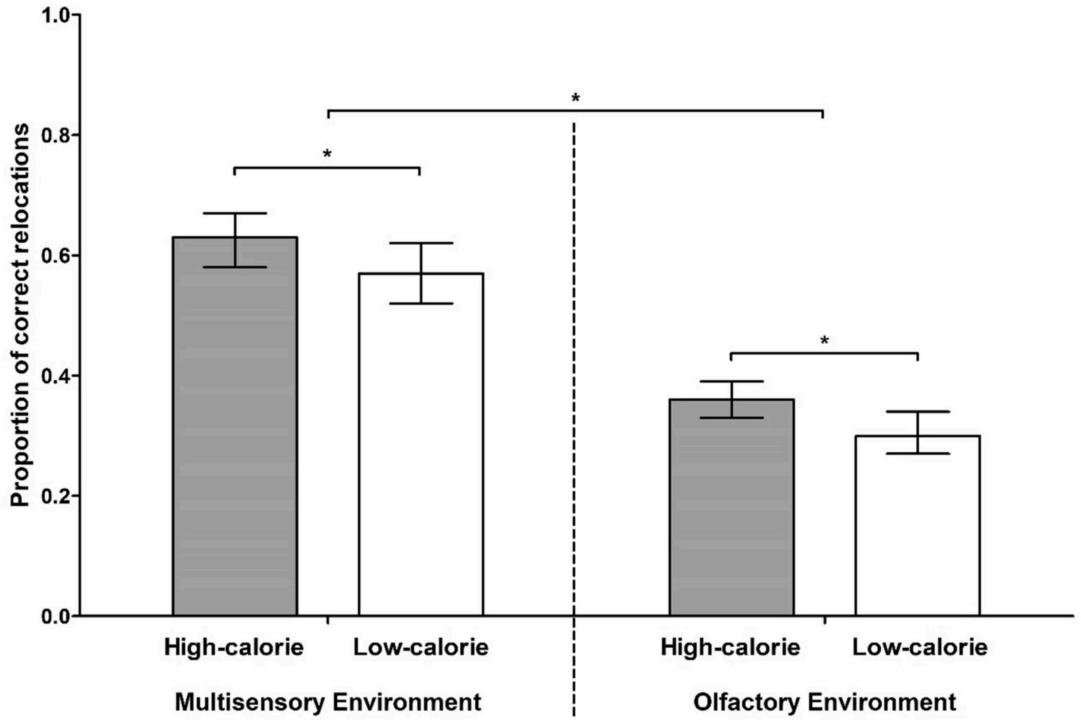
Overview of the Junk Food Cycle – a reinforcing feedback loop (V2)



Our poor diets have evolved as a result of a failure of our appetites (we have an innate preference for calorie dense food) and the economic incentives of a food system focused on volume.

SOURCE: National Food Strategy

We have a genetic predisposition to seek out calorie-dense foods



Food spatial memory accuracy. Human spatial memory for high-calorie and low-calorie food stimuli in two sensory environments, expressed as the proportion of correct food-to-pillar relocations. Error bars represent 95% confidence intervals.

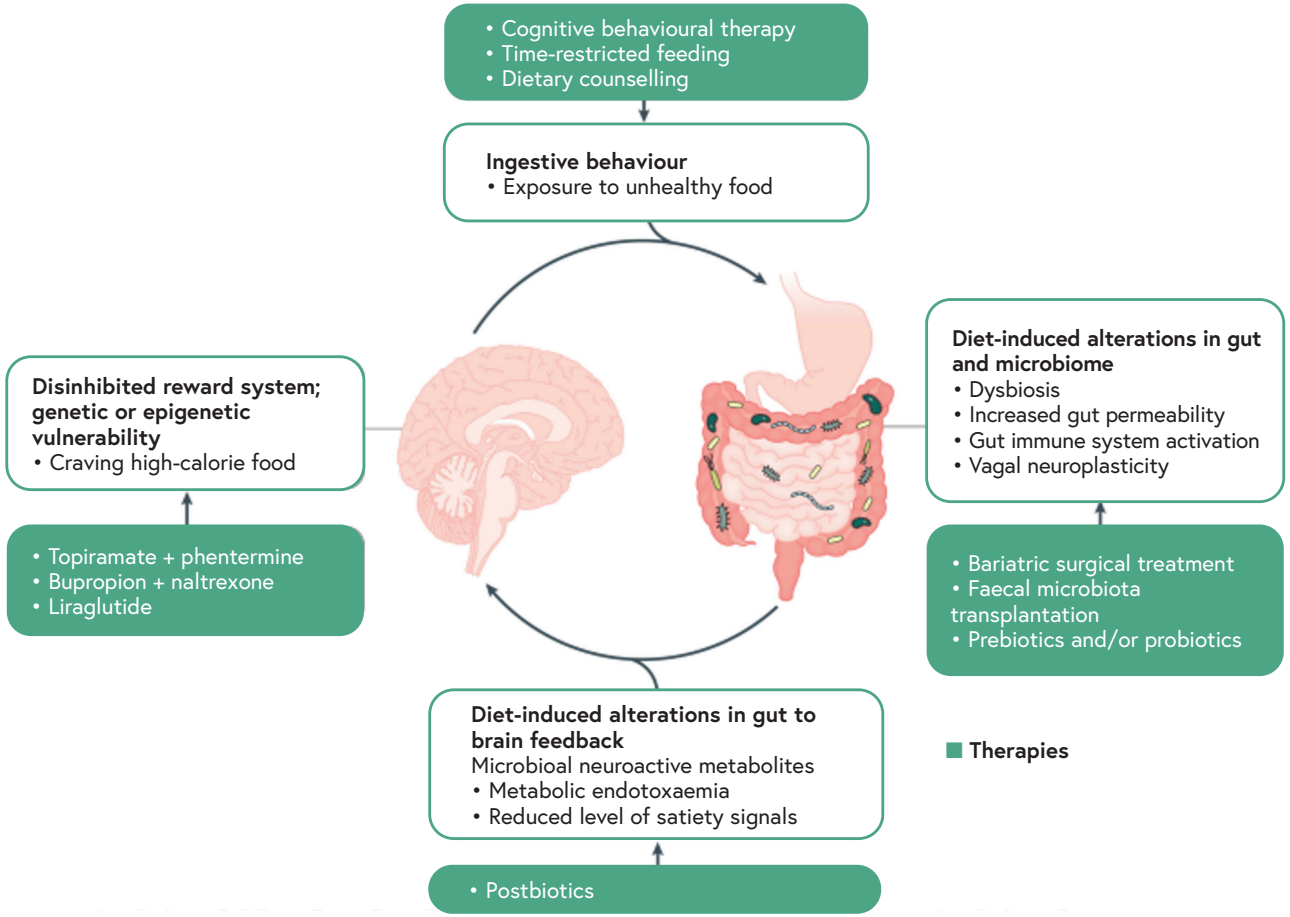
There is a large body of neuroscience which demonstrates our innate preferences for energy dense foods. For example:

"In a naturalistic multisensory experiment, individuals incidentally learned and more accurately recalled locations of high-calorie food stimuli."

The authors conclude: "human minds may continue to house an implicit cognitive system optimised for energy-efficient foraging within the fluctuating ancestral food environments in which memory evolved."

SOURCE: de Vries, R., Morquecho-Campos, P., de Vet, E. *et al.* Human spatial memory implicitly prioritizes high-calorie foods. Sci Rep 10, 15174 (2020).

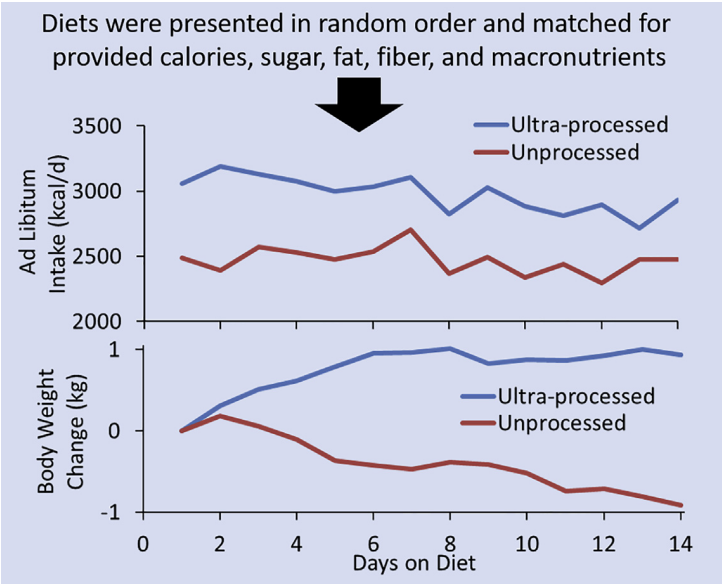
Junk food disrupts our ability to feel full



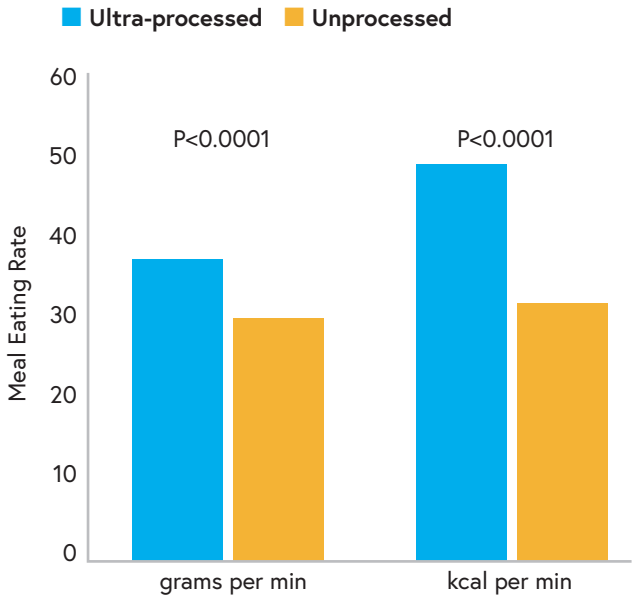
Junk food disrupts the effectiveness of appetite in controlling how much we eat. The mechanisms by which this happens are the subject of extensive scientific research.

SOURCE: Gupta, A., Osadchiy, V. & Mayer, E.A. Brain–gut–microbiome interactions in obesity and food addiction. *Nat Rev Gastroenterol Hepatol* 17, 655–672 (2020).

Ultra-processed food and weight gain



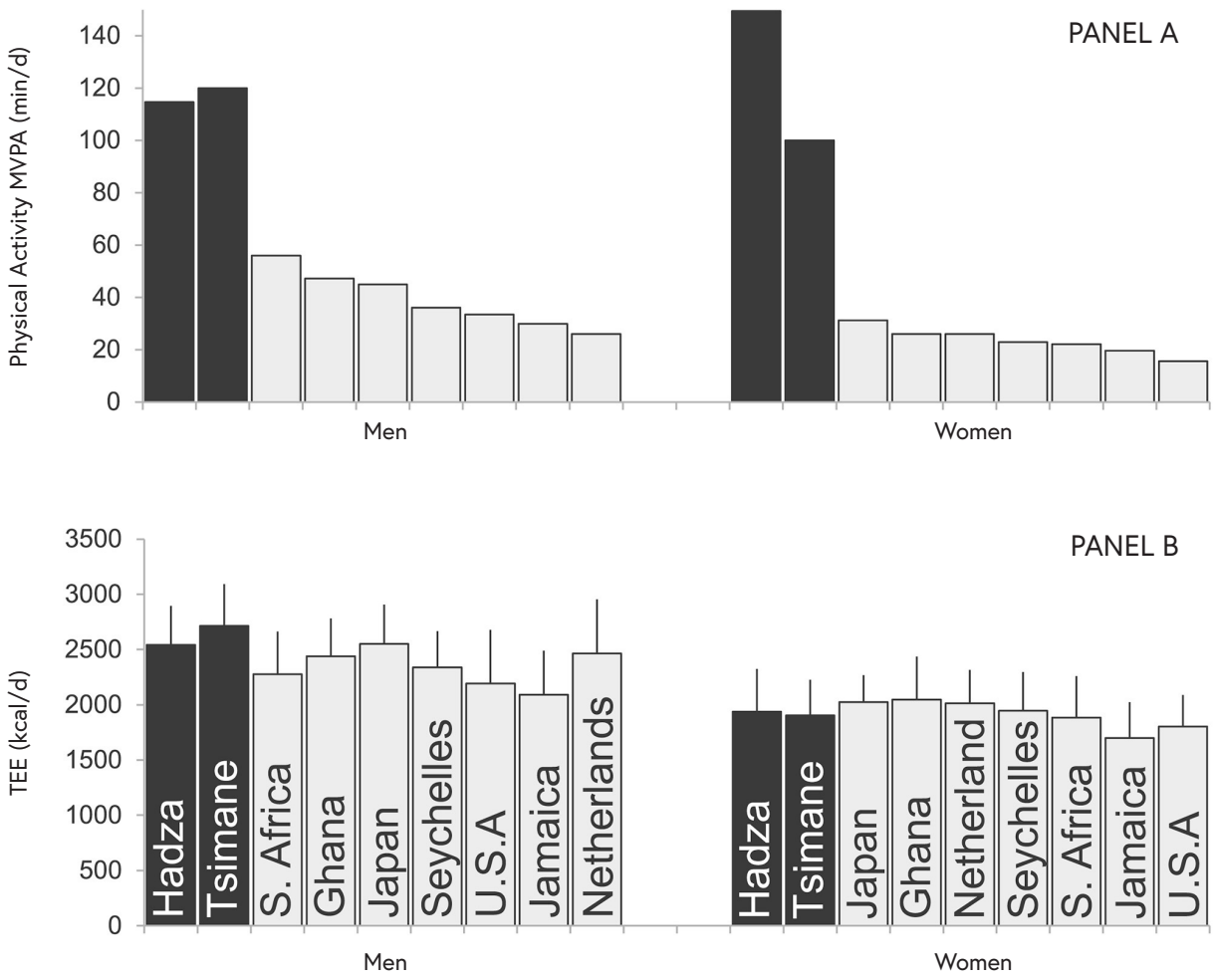
In experiments designed to allow people to choose how much they want to eat, the group of volunteers who were presented with a calorie- and nutrient-matched ultra-processed diet gained more weight that the group of volunteers who were presented with a calorie- and nutrient-matched unprocessed food diet. This is because the group presented with ultra-processed foods ate more calories than the group that was presented with unprocessed foods.



Participants on the ultra-processed diet consumed ~500 extra kcals than when on the unprocessed diet

SOURCE: Kevin D. Hall, et al. Ultra-Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of Ad Libitum Food Intake, Cell Metabolism, Volume 30, Issue 1, 2019

Activity level does not correspond to daily energy expenditure



SOURCE: Pontzer, H., Wood, B.M. and Raichlen, D.A. (2018). Hunter-gatherers as models in public health. Obesity Reviews, 19, pp.24–35.

Even though levels of exercise vary hugely across populations, total energy expenditure (TEE) does not vary much

Panel A shows daily physical activity for male and female cohorts in 7 industrialised populations and 2 subsistence populations. The industrialised groups are rank ordered by activity level.

Hadza and Tsimane cohorts (in black) have 2-10 times more daily activity than those in industrialised populations.

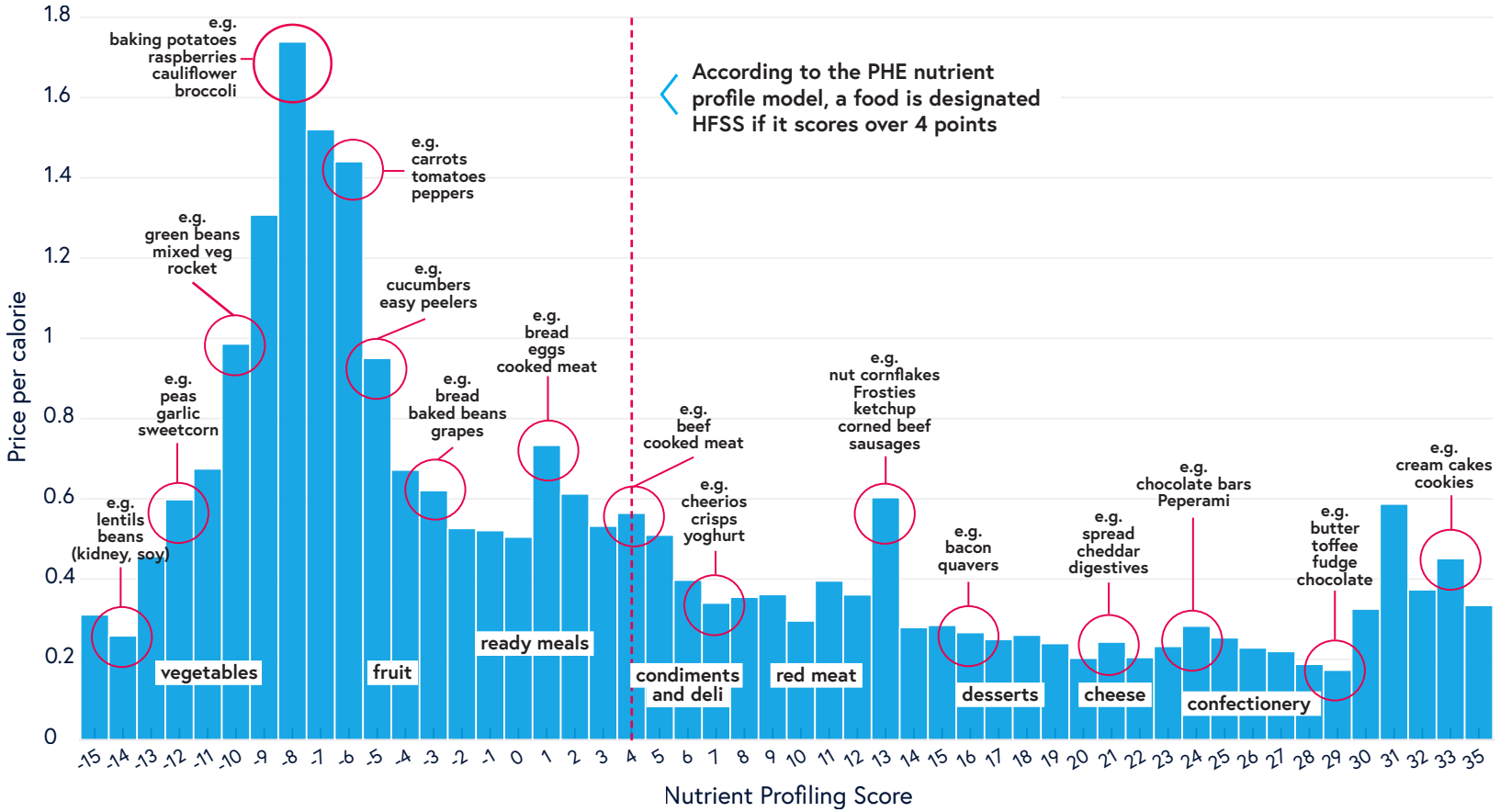
Panel B shows daily energy expenditure in those same cohorts, adjusted for differences in age, body size, and composition.

The Tsimane and Hadza cohorts fall within the range of total energy expenditure as everyone else. Moreover, the rank order in the industrialised cohorts shifts.

Long-term physical activity, while beneficial for health, is unlikely to lead to weight loss if diets do not change.

One outcome of the cycle is that junk food is cheaper...

AVERAGE PRICE OF PRODUCTS WITHIN EACH NUTRIENT PROFILING SCORE



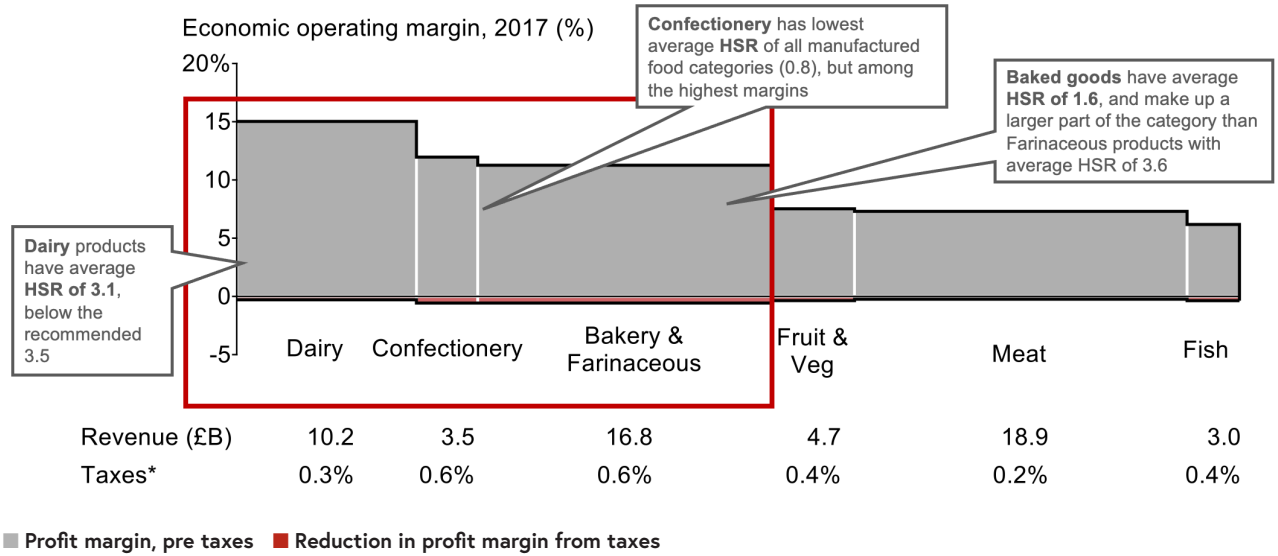
Healthier food tends to be more expensive per kcal than HFSS food

Note: The Nutrient Profile Model scores food and drink according to their overall nutritional composition rather than just calories. Points are awarded for unhealthy qualities (e.g. energy density, saturated fat, sugar and salt) and for healthy qualities (e.g. fruit, vegetables and nut content, fibre and protein). A score is calculated by subtracting the healthy points from the unhealthy points. Foods which score over 4 points, and drinks which score over 1, are defined as HFSS.

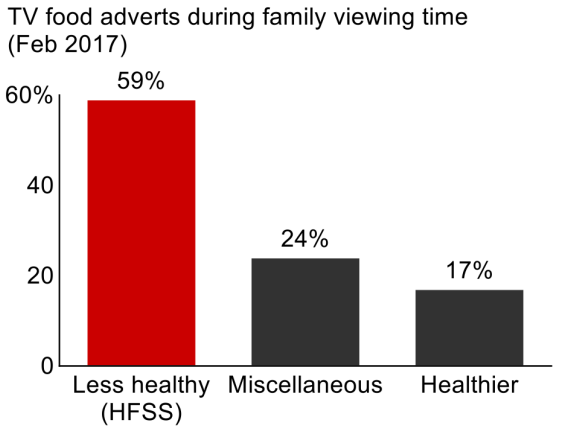
SOURCE: Analysis by Rachel Griffith using data from Kantar Worldpanel. Griffith, R. (2021). How does the price of different food products vary with the healthiness of that product? Institute for Fiscal Studies and University of Manchester. Online. Available at: Policy and work in progress | Rachel Griffith

… and more profitable. Less healthy products are generally more profitable, so manufacturers focus on producing/marketing them

BEING DOWN EXPERIENCE CURVE AND CURRENT ECONOMIES OF SCALE MAKE PROCESSED PRODUCTS RELATIVELY MORE PROFITABLE THAN ALTERNATIVES…



…AND MORE HEAVILY ADVERTISED



- Products classified by Obesity Health Alliance based on overall nutritional content of products shown, using the government's Nutrient Profile Model*

*Note: Bar widths reflect segment revenues; Charts show aggregate of relevant Process and Manufacture value chain segments for each product type; Fruit & Veg excludes potatoes; Economic profit margin calculated from ABS data as: Total turnover – (Employee cost + Total purchases + Taxes + Inventory decrease); Interest and D&A cost not included as not available from ABS; *Taxes shown as % of revenues; Health Star Rating (HSR) ranks product's nutritional profile out of 5, 3.5 considered healthy; revenue shares do not match Euromonitor data due to less granular data cuts available in ABS and inclusion of Processing revenues; Other food groups (condiments, oils, potatoes) with ~£10B revenue not shown.*
**Less healthy' indicates the product advertised would be rated as HFSS by the nutrient profile model; 'Miscellaneous' indicates the advert was not suitable for nutrient profiling (e.g. generic supermarket adverts).*

ADDITIONAL RESOURCES AVAILABLE

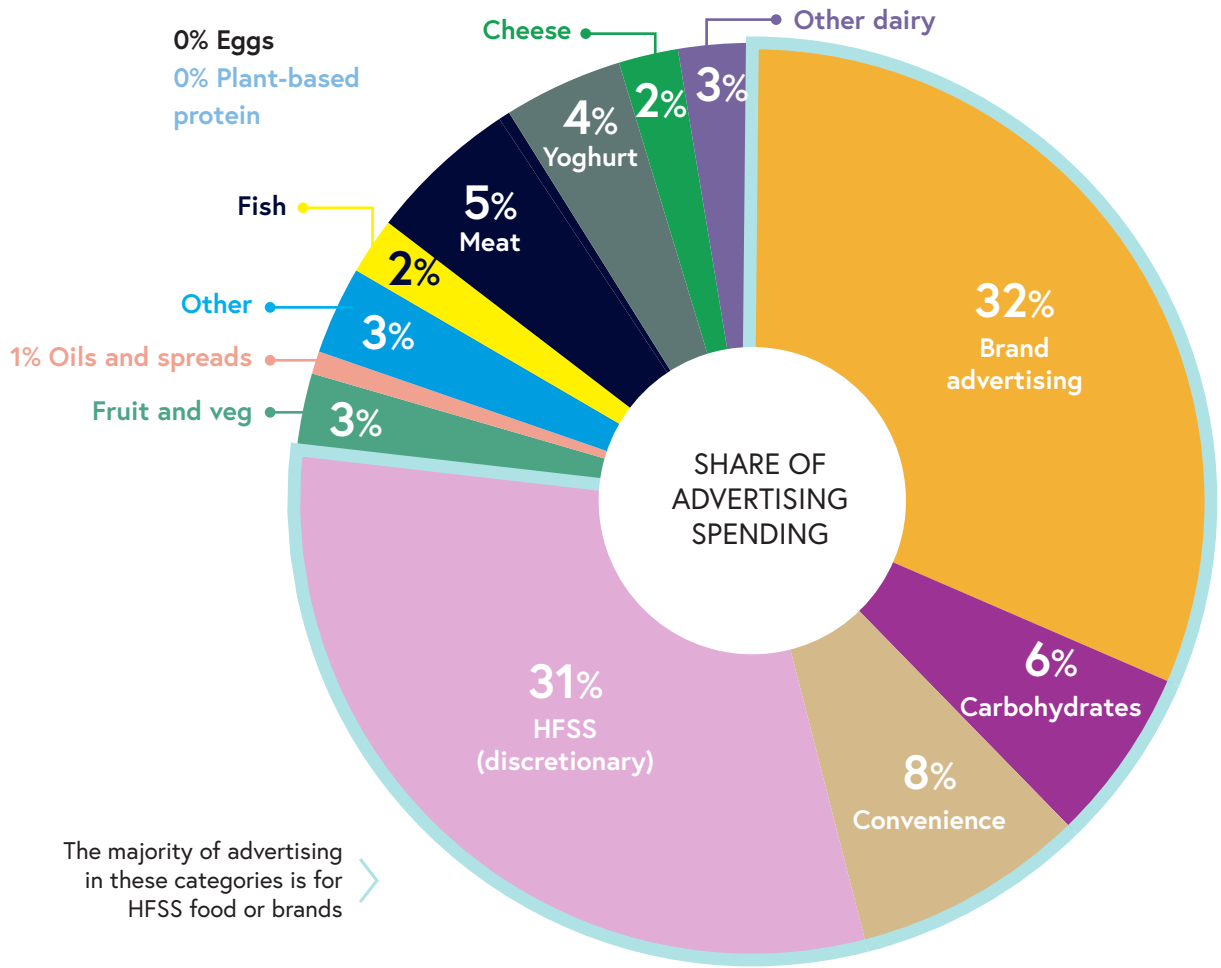
SOURCE: Bain for NFS, based on: Annual Business Survey (ABS), ONS, 2018; UK Product Profile, Access to Nutrition, 2019; Obesity Health Alliance, 2017

HFSS food is advertised more

JUST A QUARTER OF ADVERTISING IN 2019 IS FOR FOODS THAT ARE NOT LIKELY TO BE HFSS

In addition, in 2019, analysis by Nielsen on behalf of Cancer Research UK found almost half (47.58%) of **all food ads shown during September 2019 on ITV1, Channel 4, Channel 5 and Sky1 were advertising HFSS products**.

This proportion rose to **nearly 60% of ads in the 6-9pm slot** on those channels, up from 49% in May 2018.



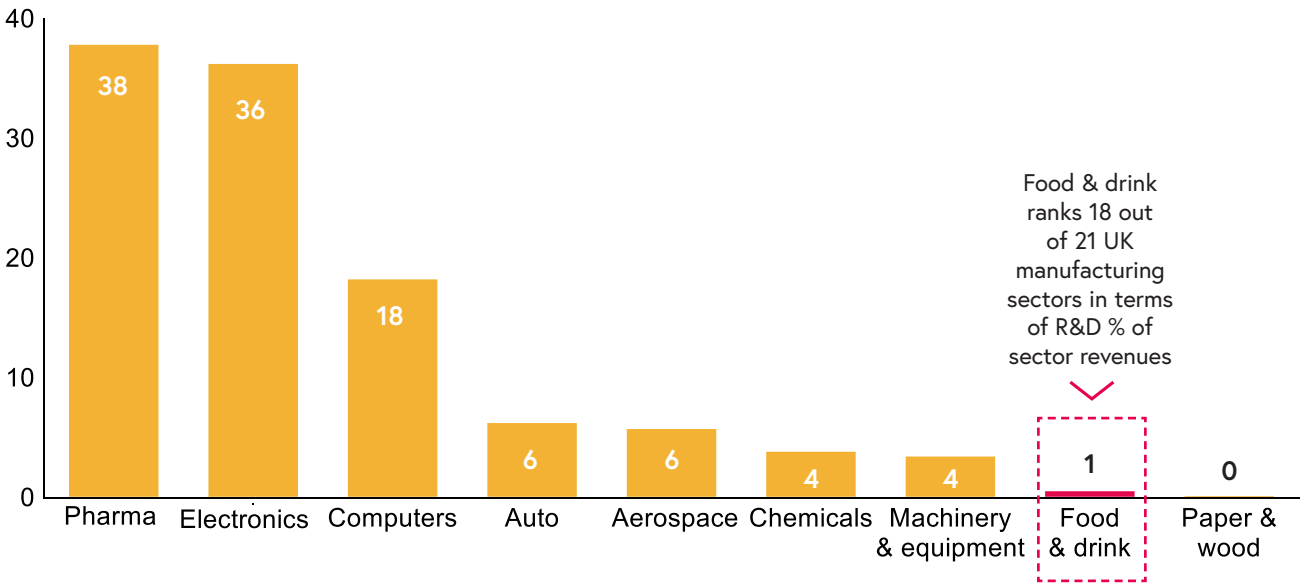
Media type: Cinema, Direct mail, Door Drops, Outdoor, Press, Radio, TV (does not include online).

SOURCE: NFS analysis of Nielsen data; Cancer Research UK (2019) Junk Free TV. Cancer Research UK

The relative profitability of HFSS products makes R&D into healthier products less attractive / higher risk

FOOD & DRINK MANUFACTURING R&D SPEND RANKED 18 OF 21 UK MANUFACTURING SECTORS (AS A % OF SECTOR REVENUES)

R&D Spend as a % of revenues for UK manufacturing sectors, 2017



Note: Food & drink R&D spend includes tobacco.

SOURCE: BAIN for NFS, based on: ONS R&D in UK Businesses, 2017; Food Chain Analysis Network Meeting, OECD, 2019; Company interviews

AND INNOVATION IS NOT INCENTIVISED

*"**Investing to produce healthier and sustainable food is not incentivised** – it is very risky, which makes it difficult for large, profit driven organisations with shareholder responsibilities"*

FOOD MANUFACTURER, OECD FOOD CHAIN NETWORK, 2019

*"I would love to sell healthier [products], but **shifting away from current high profit products is simply too difficult to get board approval for**"*

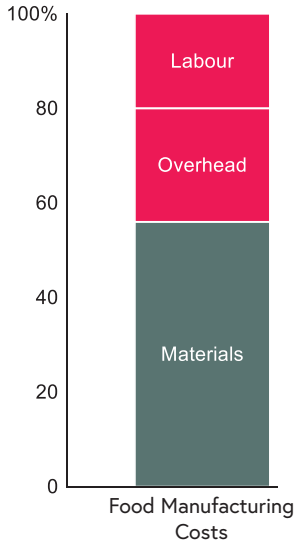
CEO, LARGE FMCG COMPANY, 2019

ADDITIONAL RESOURCES AVAILABLE

Why is it so profitable to sell unhealthy food?

High fixed costs incentivise reducing the cost of ingredients and increasing the volume of sales to minimise cost per unit. This increases profits by widening the margin between what it costs to produce a product, and what can be charged.*

Average split of COGS for Food Manufacturers (%)

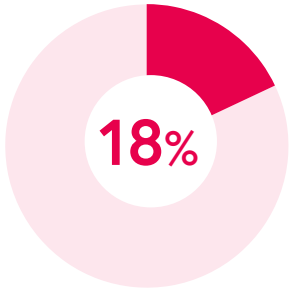


- Manufacturing incurs **high level of fixed-costs**, with overheads and labour costs representing ~45% of COGS
- This encourages manufacturers to **increase volume of sales** and production to **minimise cost per unit.**
- **Non-perishable** products based on low-cost ingredients are suited to high volume production as their **long shelf-life** allows them to be bulk produced and stored.

Retailers compete on price – so revenues are increased by selling more.

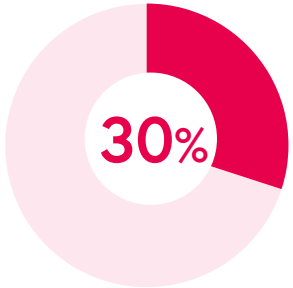
Shopping criteria for shopping at a specific retailer (mentioned as top 3 criteria)

Generally, HFSS food can be **stored in bulk, lasts longer and is more palatable. These play a role in higher sales**.



Of **perishable product** promotions made **positive returns** in 2016

Vs.



Of **ambient / non-perishable** product promotions made **positive returns** in 2016

~60% of grocery foods sold in the UK in 2019 are non-perishable**

ADDITIONAL RESOURCES AVAILABLE

*Note: *Manufacturer COGS split based on ~800 manufacturers, split by industry, 3 year averages used; Assumes labour is fixed cost. **Perishable / Non-perishable products based on Nielsen data where food categories marked as "Ambient", "Frozen", or necessarily non-perishable (e.g. alcohol, chewing gum, couscous) deemed to be non-perishable.*

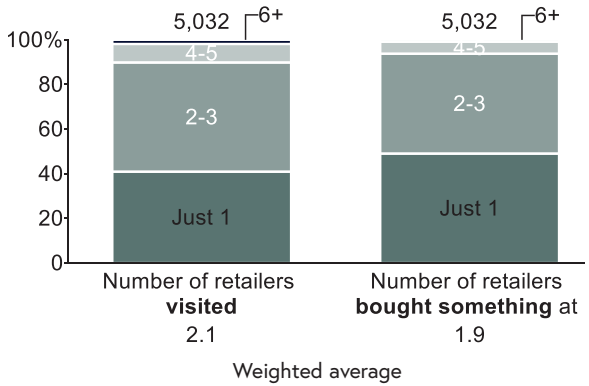
SOURCE: BAIN for NFS, based on North America Manufacturing Benchmarks, MPI Group, 2007; interviews; UK grocery consumer survey 2018 (N=5,032); Trade Promotion performance, Nielsen, 2016; American Journal of Clinical Nutrition, 2015; GB sales by product, Nielsen, 2019

UK consumers shop around to save money – so retailers prioritise promotions and shelf-space for unhealthy products

INTENSE PRICE PRESSURE IN RETAIL INDUSTRY MEANS RETAILERS TEND TO FOCUS ON DRIVING REVENUES THROUGH VOLUME

Shopping criteria for shopping at a specific retailer (mentioned as top 3 criteria)

Average number of retailers shoppers use to browse/shop at (in-store):



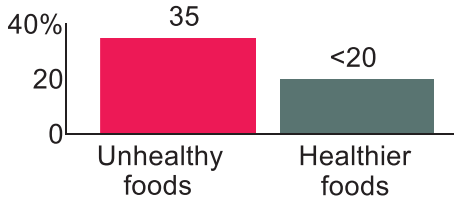
Most common reason for stated in-store shopping preference was "**saves money**"

CONSUMER FOCUS ON PRICES MEANS RETAILERS SEEK TO INCREASE VOLUMES RATHER THAN PRICES

CONSUMERS ARE MORE LIKELY TO ADD VOLUMES OF UNHEALTHY PRODUCTS

- A team of Cambridge researchers found that **consumers are more responsive to promotions on unhealthy foods:**

Sales increase following a 10% increase in frequency of promotions



*"The researchers believe this may be because **products from less healthy food categories are often non-perishable**, while those from healthier food categories – in particular fruit and vegetables – are perishable: **stockpiling during promotion may therefore be more likely to happen in less healthy food categories**…"*

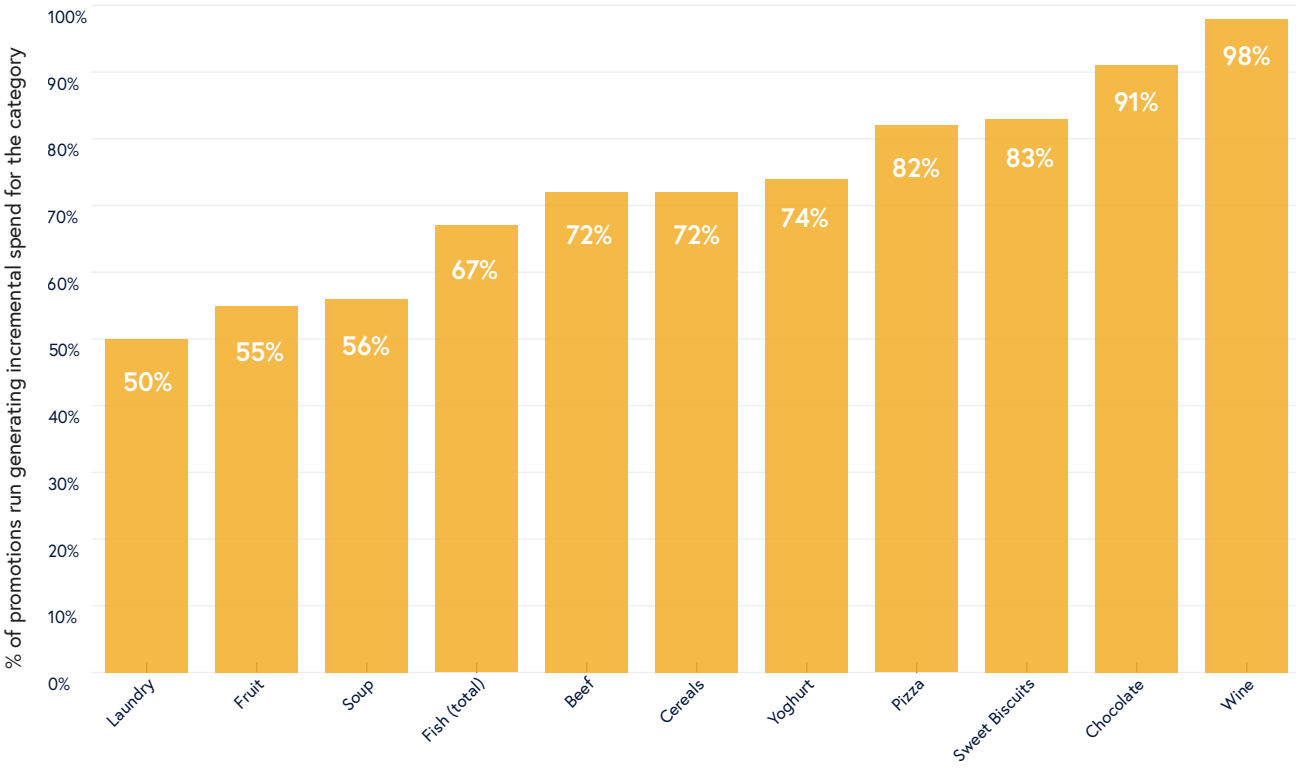
AMERICAN JOURNAL OF CLINICAL NUTRITION, 2015

ADDITIONAL RESOURCES AVAILABLE

SOURCE: Bain for NFS, based on UK grocery consumer survey 2018 (N=5,032); American Journal of Clinical Nutrition, 2015. UK grocery consumer survey 2018 (N=5,032); American Journal of Clinical Nutrition, 2015

Promotions can lead to higher consumption as HFSS foods tend to be "highly expandable" categories

PROMOTIONS RUN ON UNHEALTHIER FOODS ARE MORE LIKELY TO GENERATE INCREMENTAL SPEND



Some products are more 'expandable' than others – particularly HFSS foods which don't go off, are easy to eat too much of, can be bought on impulse and aren't linked to a particular meal time.

The basic rule is: if there's more in the house you get through it quicker. PHE calls this change in buying behaviour 'expansion'.

	Expandability (%)
Chocolate	**93**
Crisps	**80**
Butter & Margarine	**65**
Condiment Sauces (ketchup etc.)	**49**

If you ran a 'buy one get one free' on chocolate so someone bought twice the amount of chocolate they normally would, they'll consume 93% more than normal, and come back to buy chocolate in roughly the same amount of time as they would have normally.

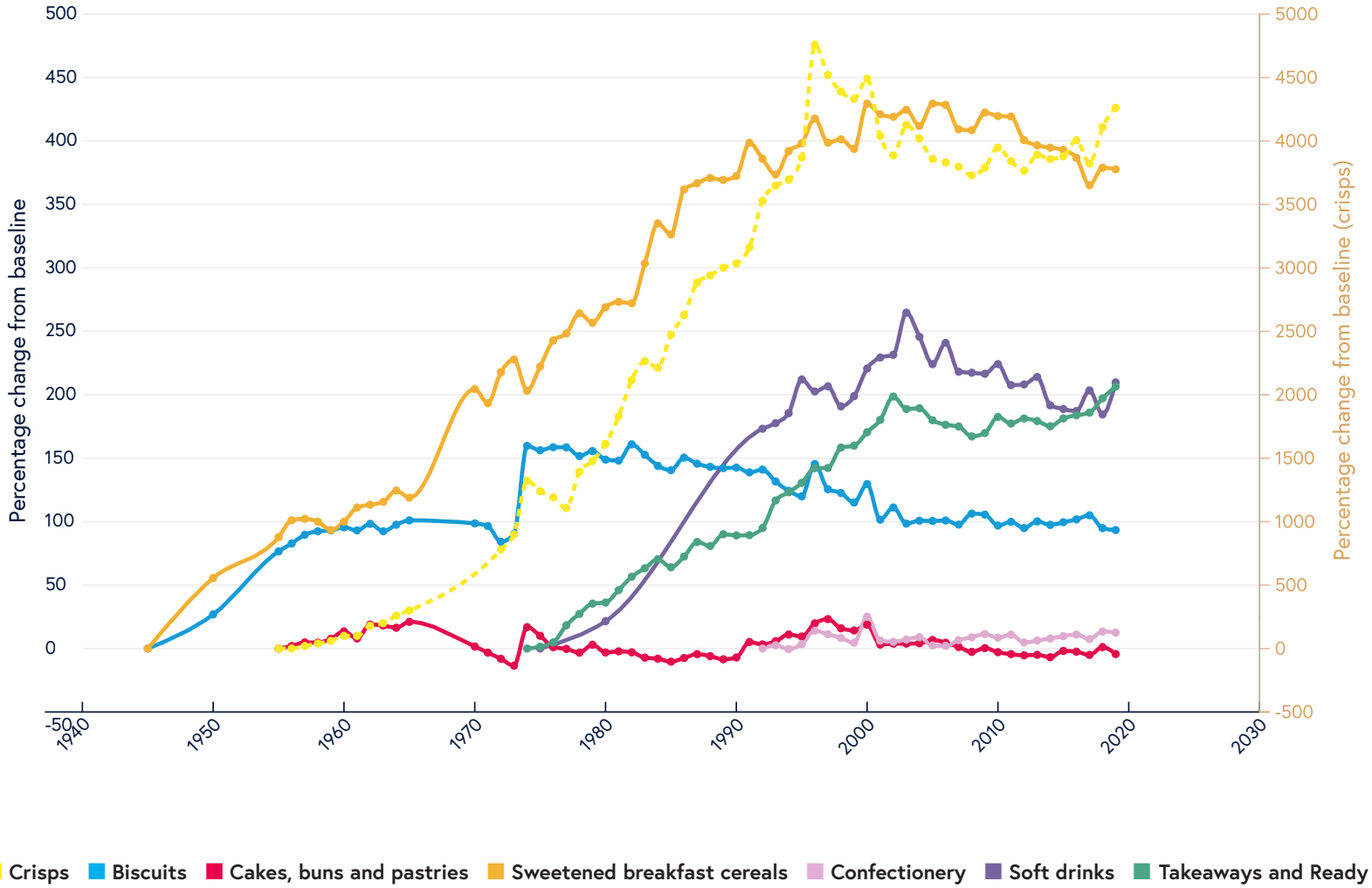
If you do the same with sauces, they'll consume 49% more, and so end up coming back about 1.5x slower than normal.

SOURCE FOR EXPANDABILITY: Kantar, Worldpanel Division, Expandability Study based on FMCG panel, 2016; **SOURCE FOR PROMOTIONS HIT RATE:** Kantar, Worldpanel Division, Modelled Promotion Analysis on FMCG panel, 2019

IMPACT OF THE JUNK FOOD CYCLE ON OUR DIETS

Since WW2, purchases of junk food have dramatically increased

PERCENTAGE CHANGE IN PURCHASES OF JUNK FOOD CATEGORIES (G/PERSON/WEEK)



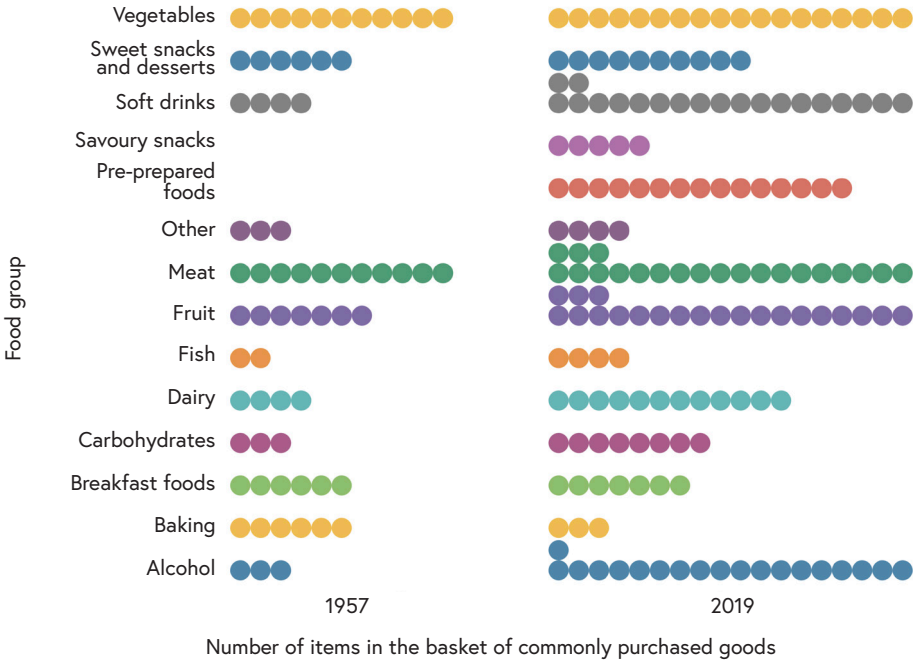
The biggest rises (>100% increase) are seen in crisps, cereals, soft drinks, takeaways and biscuits

Crisps | Biscuits | Cakes, buns and pastries | Sweetened breakfast cereals | Confectionery | Soft drinks | Takeaways and Ready meals

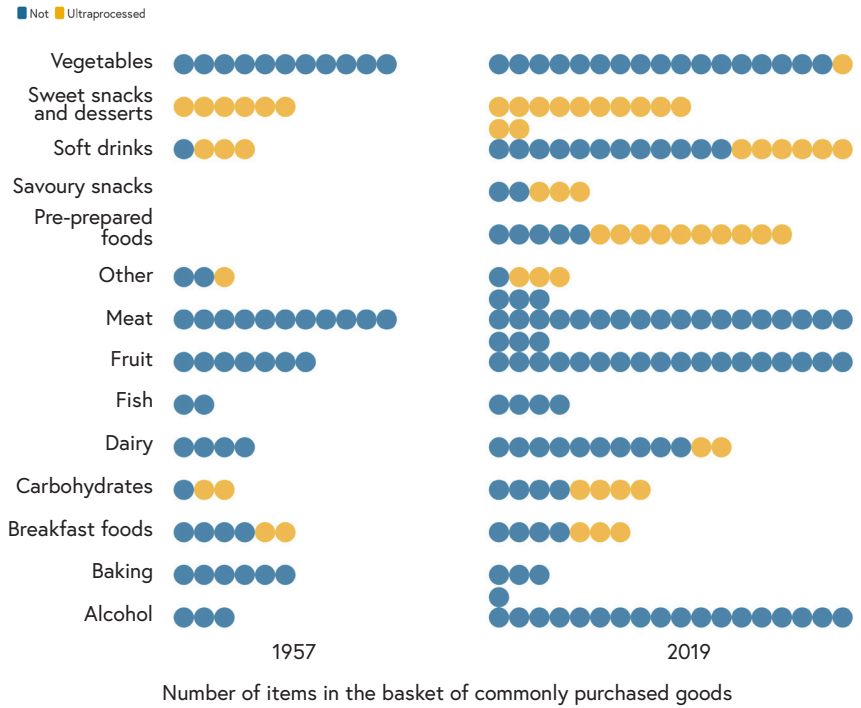
SOURCE: Defra (2020) Family Food Surveys

Since WW2, our commonly purchased foods have become less healthy

IN 1957, WE BOUGHT RELATIVELY FEWER SNACKS, SOFT DRINKS AND PREPARED FOODS THAN IN 2019



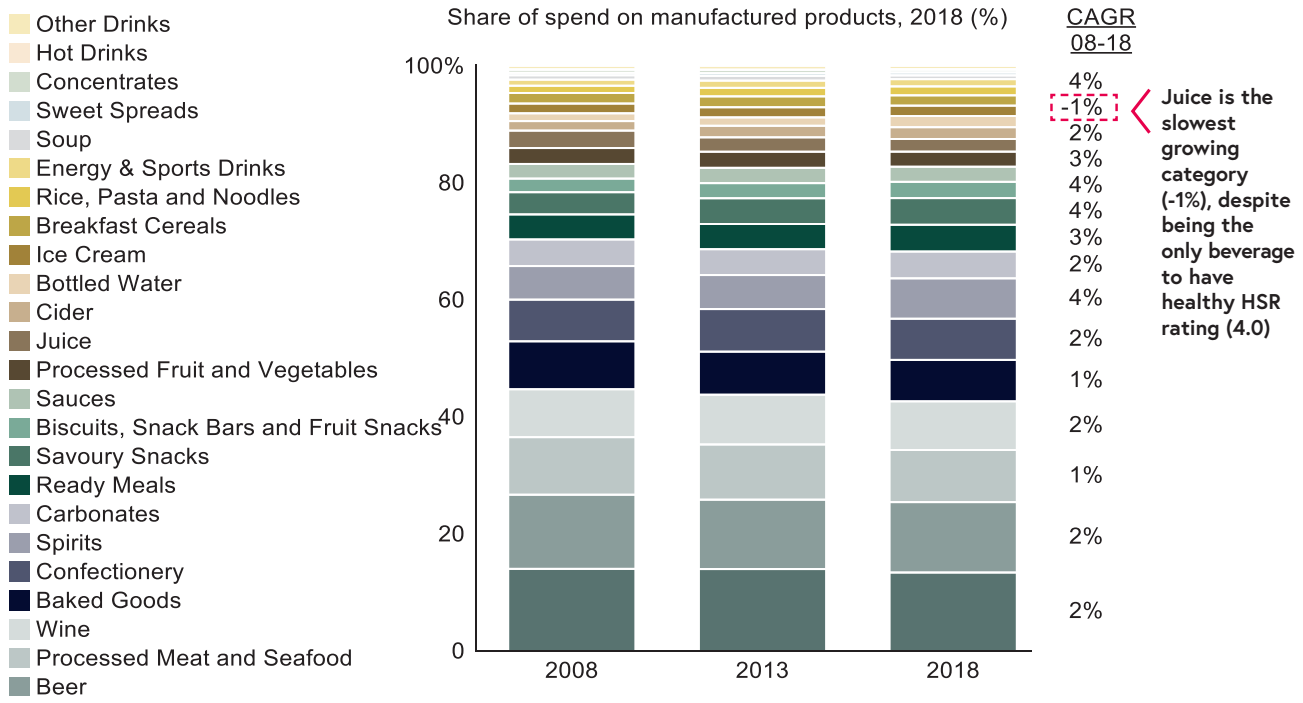
THE SHARE OF ULTRA-PROCESSED FOODS IN OUR PURCHASING HAS ALSO RISEN



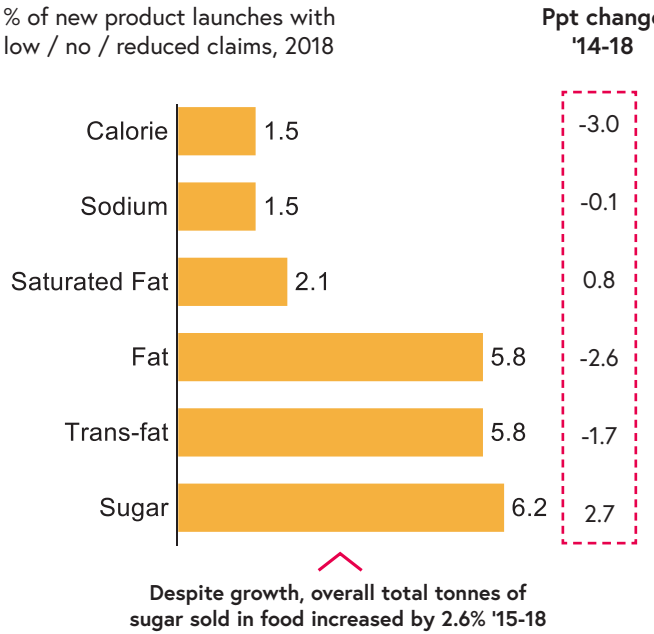
SOURCE: Office of National Statistics, basket of goods 1957 compared to 2019. 1957: Celebrating 60 years of Family Spending; 2019: Consumer price inflation basket of goods and services. Interactive version available.

Food manufacturers have not made their products more healthy

ON A CATEGORY LEVEL, MIX OF MANUFACTURED PRODUCTS HAS SEEN LITTLE CHANGE OVER THE LAST DECADE



WITHIN CATEGORIES, SHARE OF HEALTHIER FORMULATION LAUNCHES IS LOW (AND DECREASING)



*Note: Health Star Rating (HSR) ranks products' nutritional profile out of 5, 3.5 considered healthy; *Not all CAGRs are shown due to size constraints on chart; Other Drinks includes Asian drinks and RTD alcoholic beverages; Alcoholic beverages assigned 0.5 HSR as calories contain no nutritional value; Milk alternatives (e.g. Soy) accounts for 2.2% of Dairy Products and Alternatives; Non/Low Alcoholic beer accounts for 0.8% of Beer category; Cider includes Perry and non-alcoholic Cider products.*

2% Overall CAGR
2% Food CAGR
3% Beverage CAGR

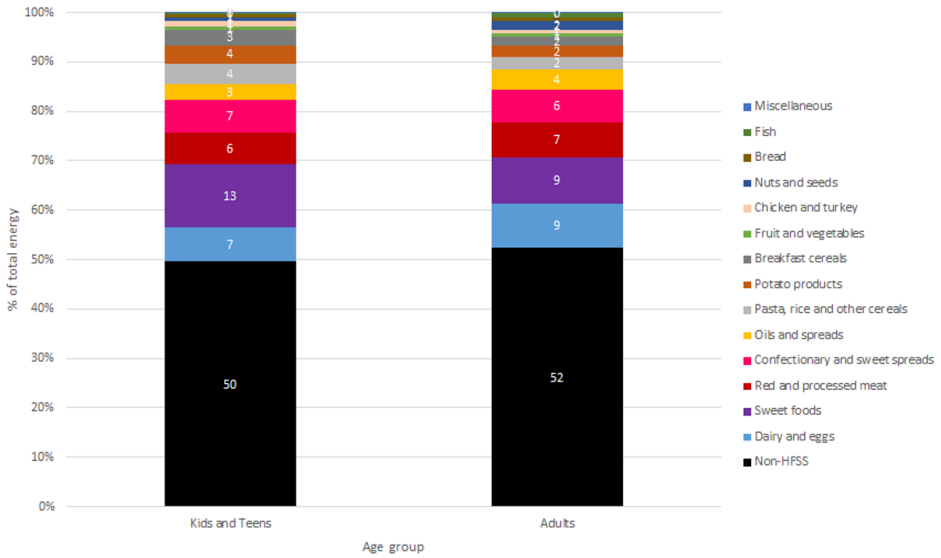
The four fastest growing* categories are Beverages: Hot Drinks (22%), Bottled Water (6%) and Cider (5%), all with average HSR <3.5

ADDITIONAL RESOURCES AVAILABLE

SOURCE: Bain for NFS, based on Euromonitor; UK Product Profile, Access to Nutrition, 2019; Drink Aware

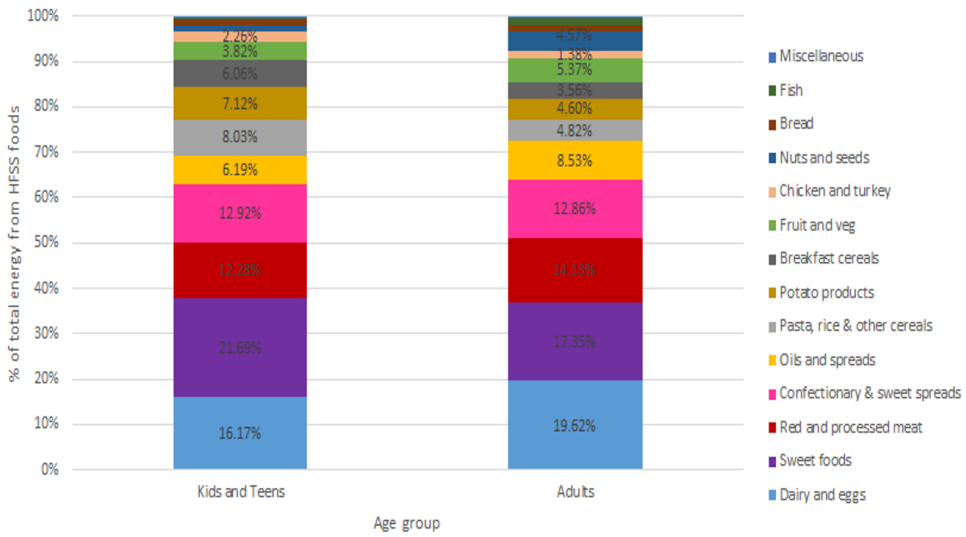
The Junk Food Cycle has taken over our diets: every food category now contributes to our HFSS intake

CONTRIBUTION TO CALORIES BY CATEGORY



HFSS food now makes up around half of our calories. This is consistent across both age and income.

CONTRIBUTION TO HFSS CALORIES BY CATEGORY



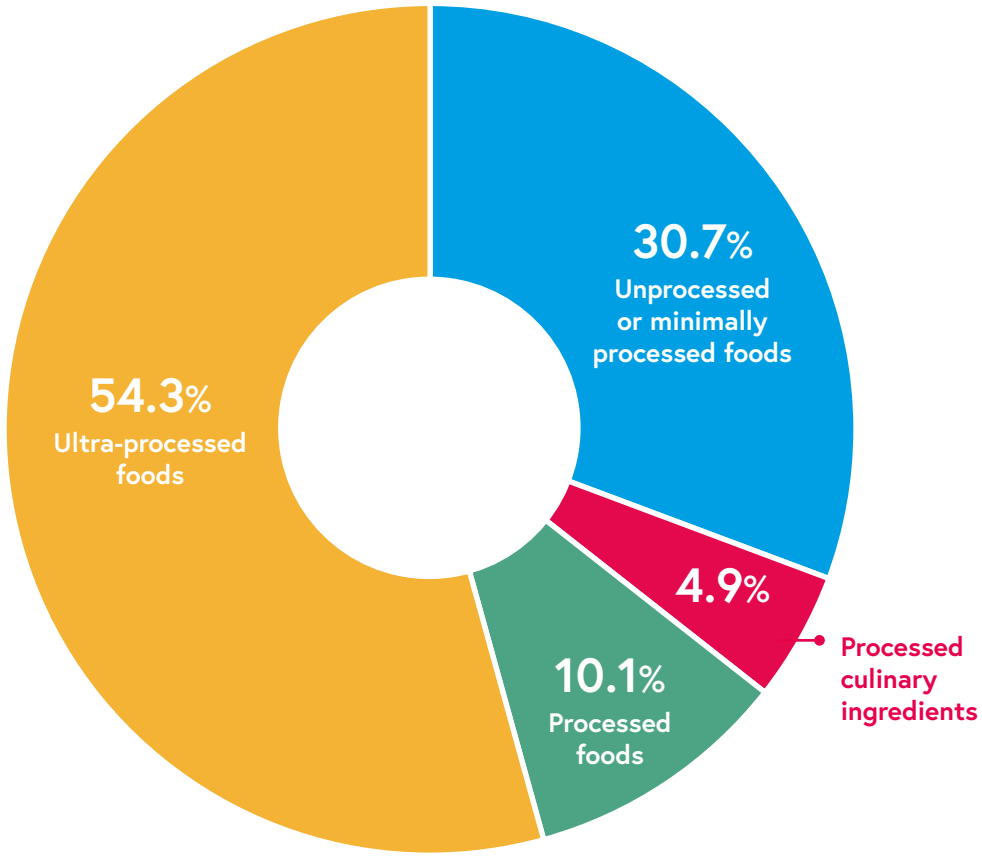
HFSS foods are no longer confined to obvious categories like confectionery – they are now consumed across every category of food.

Note: The Nutrient Profile Model is used to define foods as either High Fat, Sugar and Salt (HFSS) foods or non-HFSS (see slide 107).

SOURCE: NFS analysis of National Diet and Nutrition Survey: time trend and income analyses for Years 1 to 9 (2008 to 2017).

Over half of our diets in the UK are ultra-processed; higher ultra-processed consumption is associated with weight gain

% TOTAL ENERGY INTAKE
Adults sampled by the UK National Diet and Nutrition Survey 2008–16



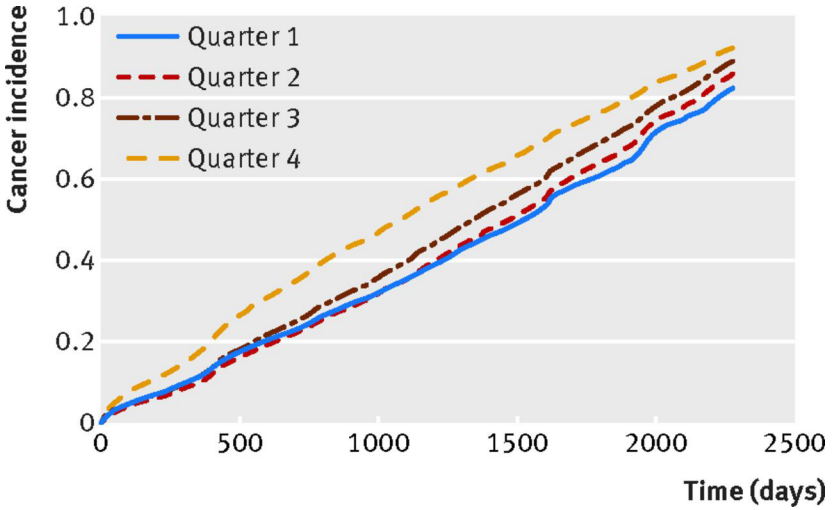
In the UK a 10% increase in ultra-processed food consumption is associated with an increase of 0.38kg/m2 in BMI* and 18% higher odds of being obese.**

*Note: * (95%CI 0.20–0.55) ** (OR = 1.18, 95%CI 1.08–1.28).*

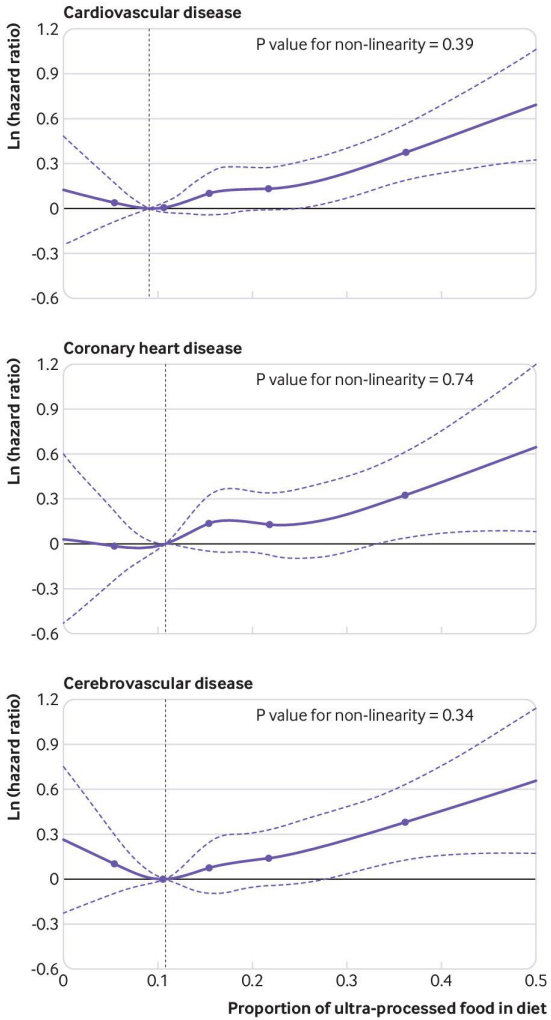
SOURCE: Rauber et al (2020). Ultra-processed food consumption and indicators of obesity in the United Kingdom population (2008-2016). PLoS ONE, [online] 15(5), pp.1–15

Ultra-processed foods are strongly associated with disease

CUMULATIVE CANCER INCIDENCE (OVERALL CANCER RISK) ACCORDING TO QUARTERS OF PROPORTION OF ULTRA-PROCESSED FOOD IN DIET (Q1 = LOWEST PROPORTION)



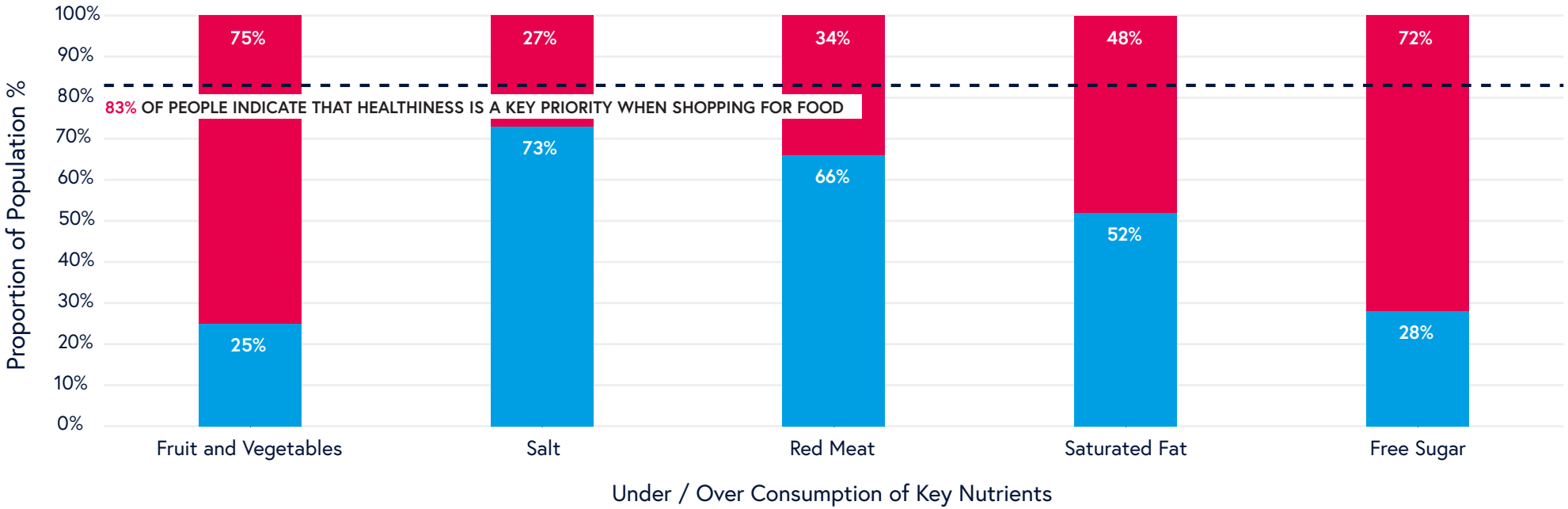
Some ultra processed foods also contain carcinogens (such as acrylamide) and can contain authorised, but controversial, food additives such as sodium nitrite in processed meat or titanium dioxide, for which carcinogenicity has been suggested.



Ultra-processed foods often have a higher content of total fat, saturated fat, and added sugar and salt, along with a lower fibre and vitamin density. These have been associated with cardiovascular and cerebrovascular diseases.

SOURCE: Fiolet et al (2018). Consumption of ultra-processed foods and cancer risk: results from NutriNet-Santé prospective cohort. BMJ, p.k322; Srour et al (2019). Ultra-processed food intake and risk of cardiovascular disease: prospective cohort study (NutriNet-Santé). BMJ, p.l1451.

We mostly fail to meet dietary recommendations

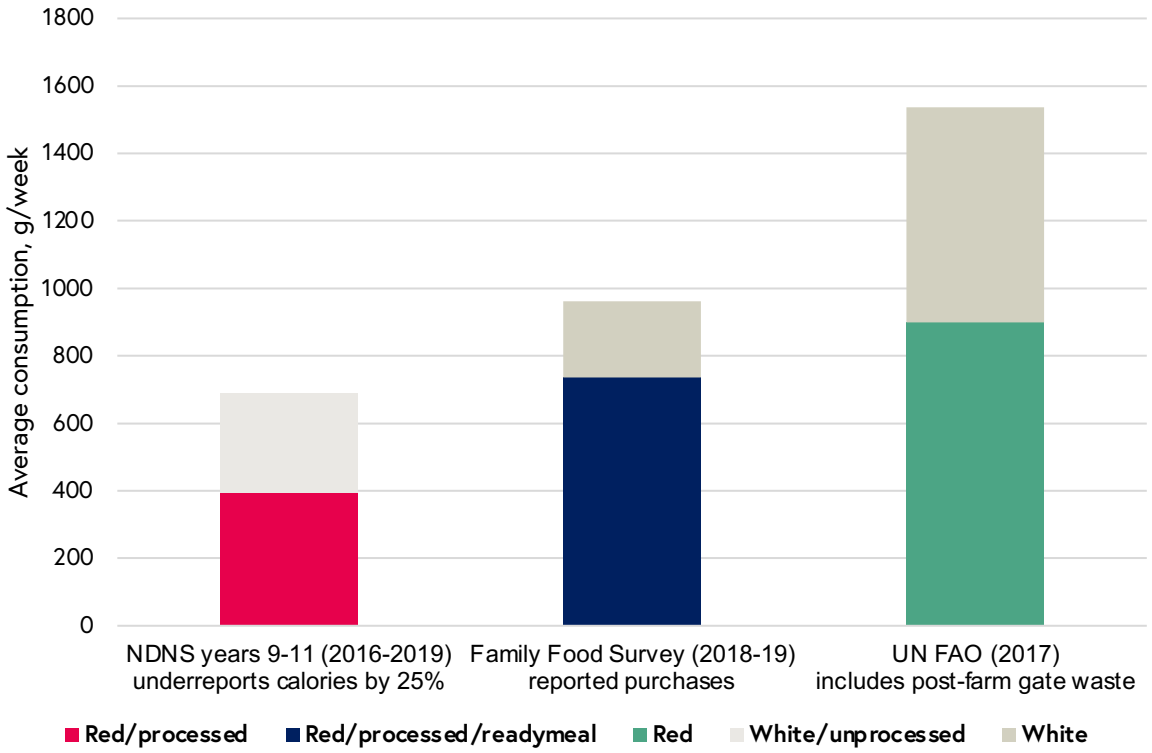


We eat too little fruit and veg, fibre and oily fish.
We eat too much salt, saturated fat, sugar and red meat.
Less than 0.1% of the population meet all elements of the Eatwell Guide recommendations.

SOURCE: NFS analysis of the National Diet and Nutrition Survey: time trend and income analyses for Years 1 to 9

We eat between 700g and 1.5kg of meat per week in the UK, 15% more than in the 1960s

DIFFERENT ASSESSMENTS OF HOW MUCH MEAT WE EAT



Assessments of how much meat we eat, across highly reliable sources, differ significantly.

The National Diet and Nutrition Survey (NDNS) is based on food diaries, and is the most detailed source, but suffers from an under-reporting bias of ~25% for calories.

Defra's Family Food Survey is based on reported purchases, also suffers from under-reporting bias and does not account for consumer food waste.

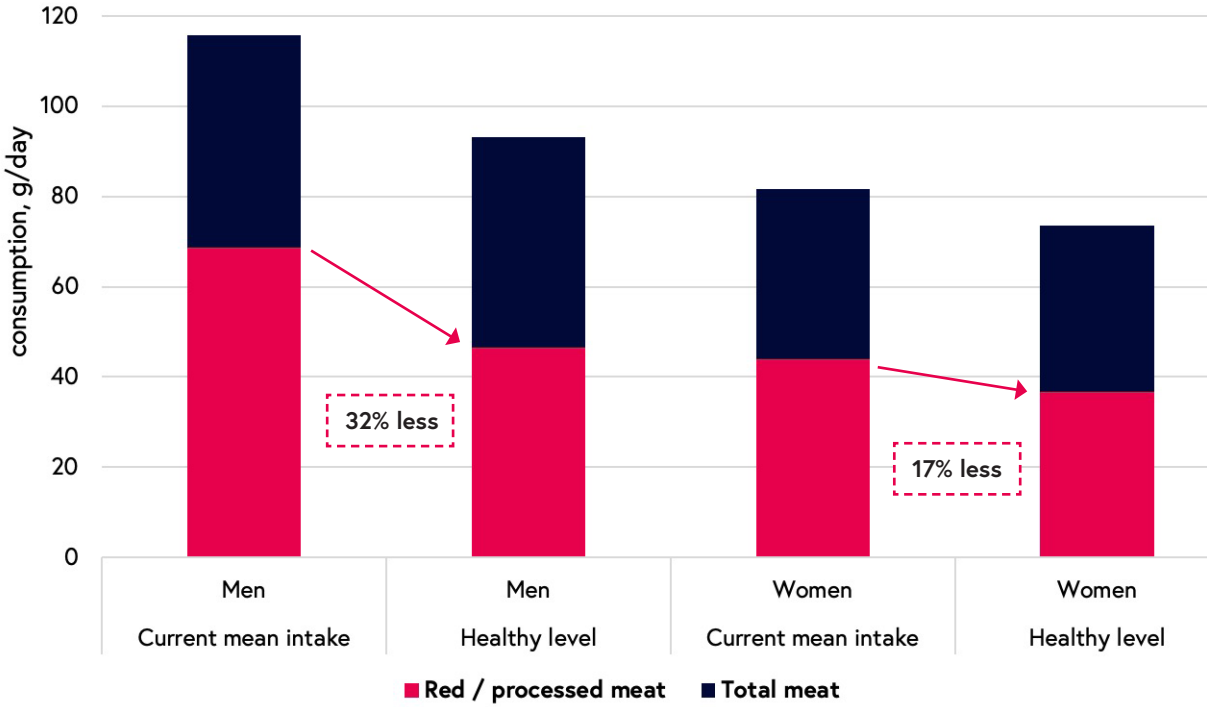
UN Food and Agriculture Organisation (FAO) data reports meat supply available to consumers, and is globally comparable, but does not account for post-farm gate food waste.

For health comparisons, we have used the NDNS survey, but this is likely an underestimate of our meat consumption.

SOURCE: NFS analysis based on Public Health England (2020) National Diet and Nutrition Survey years 9-11; Defra (2020) Family Food 2018/19; UN Food and Agriculture Organisation (2020) Food Balance Sheets

Following healthy eating recommendations would lower total meat consumption by 15% (27% lower red and processed meat)

MEAT REDUCTION IF THE POPULATION ACHIEVES SACN RED AND PROCESSED MEAT GUIDELINES



Note: 'Healthy level' means less than 70g/day of red and processed meat. The UK does not set total meat consumption recommendations; this analysis assumes that consumers switch from red and processed meat to healthy options like vegetables, fruit, and wholegrains.

NDNS data suggests that most of the population is not overconsuming red and processed meat – though it likely underestimates consumption.

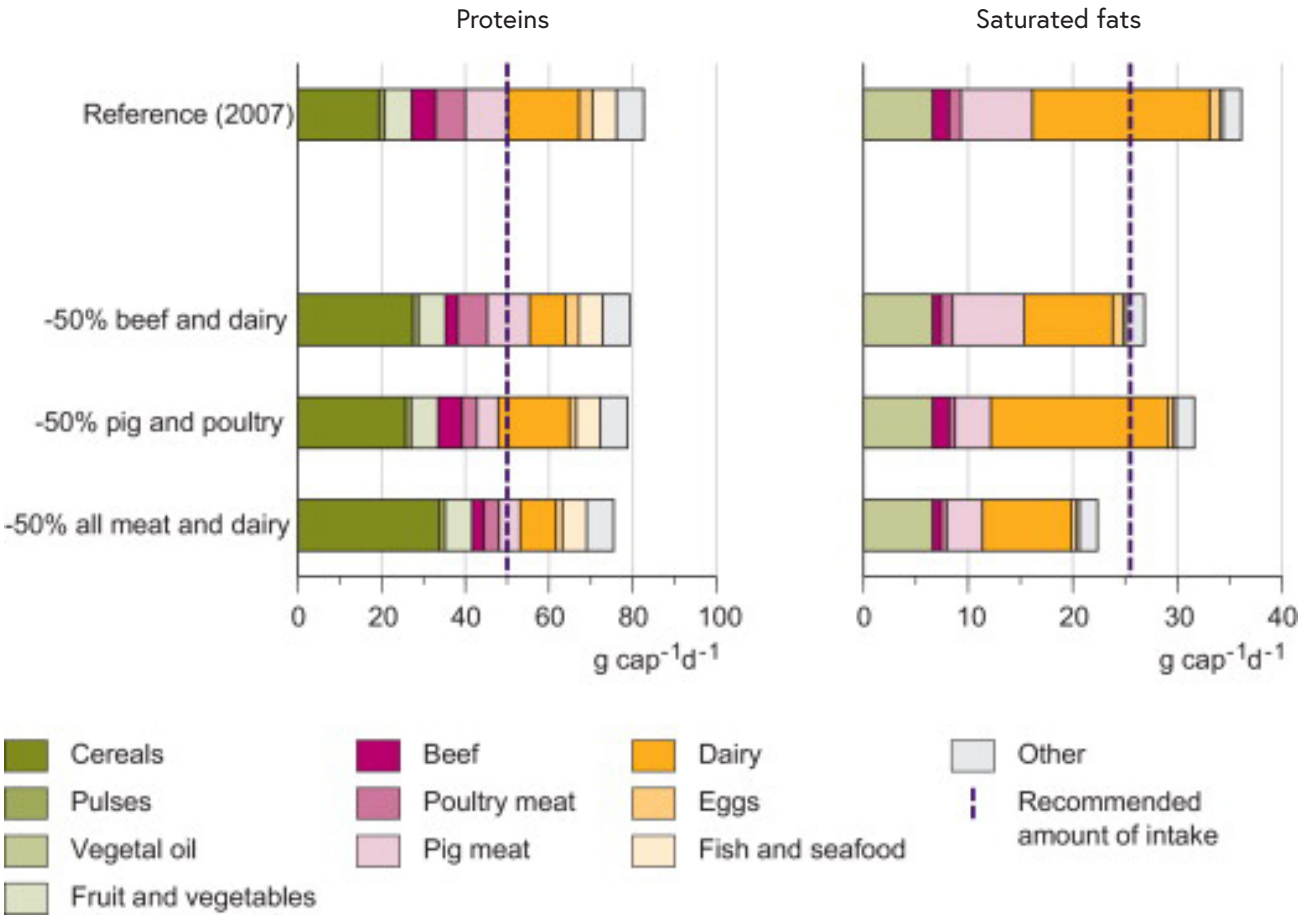
Despite this, NDNS data shows 41% of men and 23% of women do consume more than 70g of red/processed meat per day – the recommended upper limit.

If just these people lowered their consumption to 70g/day – i.e. the whole population met the Scientific Advisory Committee on Nutrition's (SACN) healthy eating guidelines for meat – total meat consumption would fall by 15%, and red/ processed meat consumption would fall by 27%.

Doing so would not likely pose health risks: in the UK, all groups eat more protein than is recommended, with 19-74 year olds consuming 38%-57% excess protein.

SOURCE: NFS analysis based on Public Health England (2020) National Diet and Nutrition Survey years 9-11; Excess protein statistic from Association of UK Dietitians (BDA) (2018) Nutritional considerations for dietitians

~40% lower meat and dairy consumption would lower saturated fat consumption to healthy levels



Dairy is the main source of saturated fat in our diet, followed by meat and then vegetable fats.

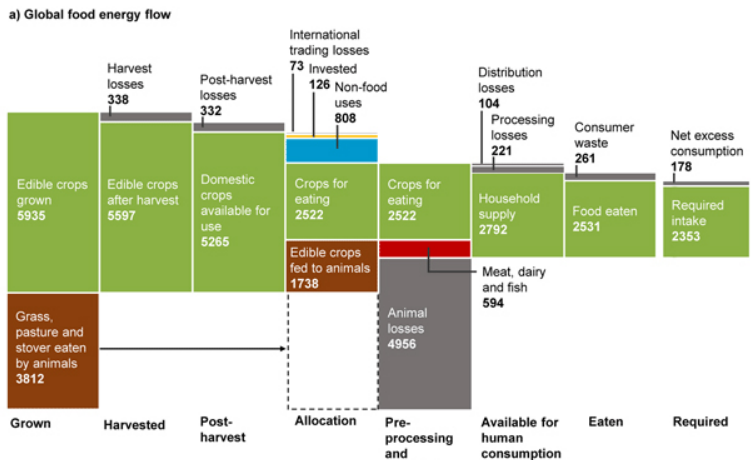
Halving consumption of meat and dairy would more than meet dietary recommendations for all groups.

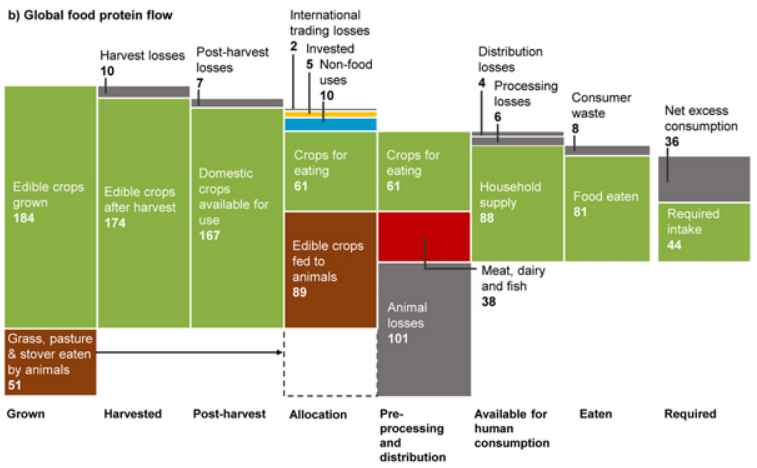
Halving beef and dairy while retaining pork and poultry would see total meat and dairy consumption fall by about 40% and come very close to meeting dietary recommendations.

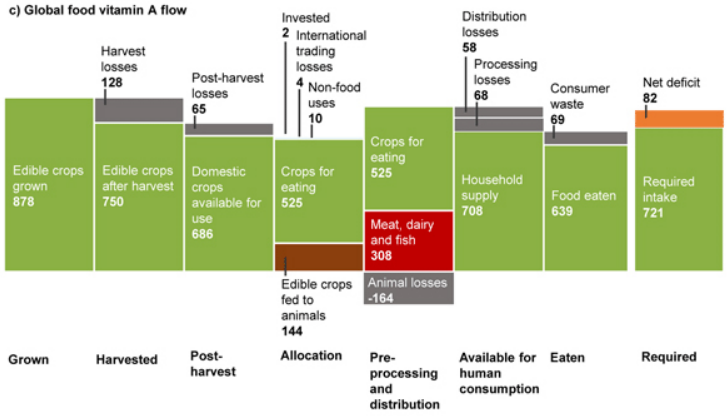
All scenarios see protein continue to be consumed above recommended levels.

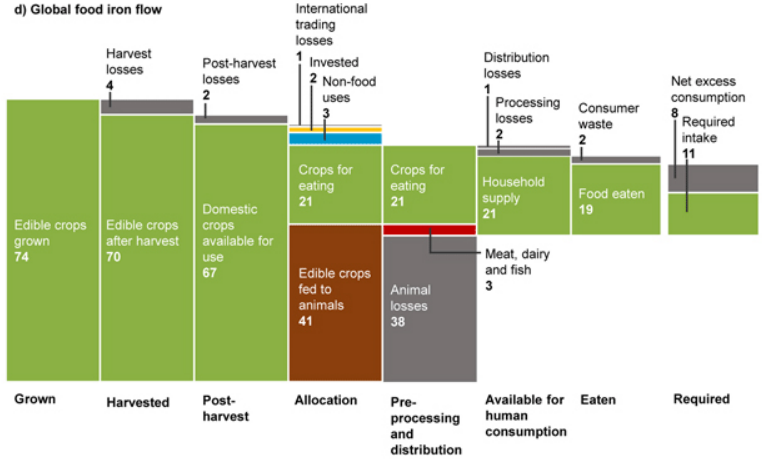
SOURCE: Westhoek et al (2014), Food choices, health and environment: Effects of cutting Europe's meat and dairy intake, Global Environmental Change

Globally, we already produce sufficient nutrition for the population in 2050







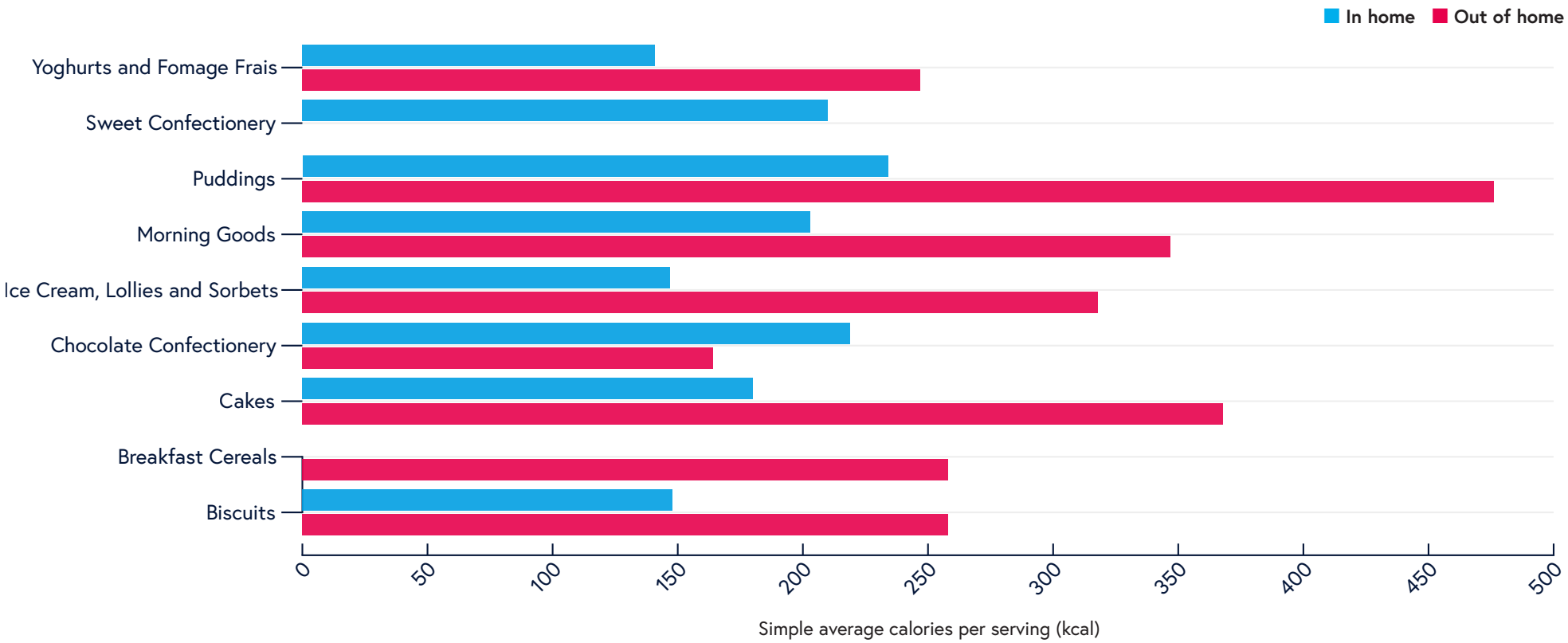


While animal foods are a concentrated source of key nutrients, they are an inefficient way of converting nutrients in plants into nutrients available to people.

Globally, current cropland is sufficient to feed 10bn people an omnivorous, but more plant-based, diet.

SOURCE: Berners-Lee et al (2018) Current global food production is sufficient to meet human nutritional needs in 2050 provided there is radical societal adaptation, Elementa 6:52

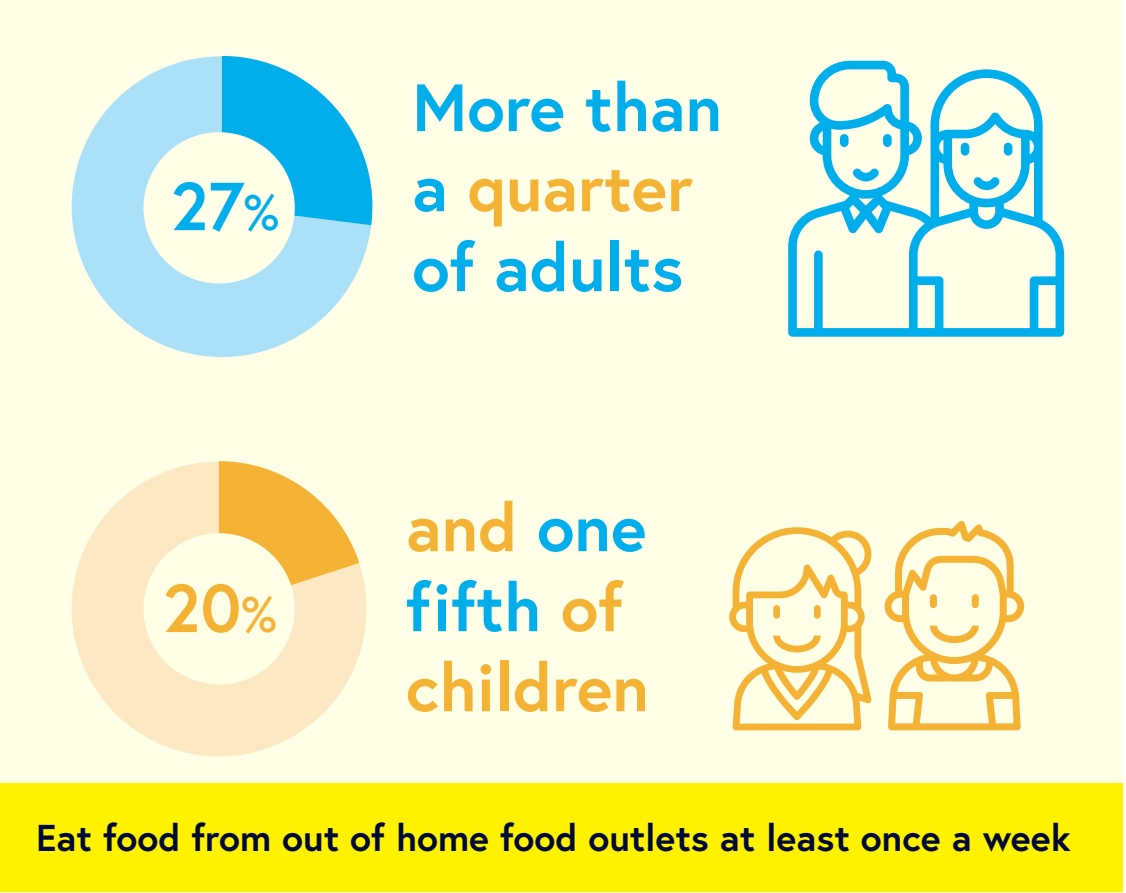
The average calorie content of products on offer out of home is about double that of retail, and salt levels are also on average higher



Note: Data for sweet confectionery has been excluded for out of home as the business providing data for 2019 were quite different to those providing data in 2017 so comparisons were not reliable.

SOURCE: Average calorie content is twice as high: Calorie reduction technical report: guidelines for industry, 2017 (publishing.service.gov.uk); Salt levels are on average higher: PHE, Salt reduction targets for 2024, 2020: Graph: PHE, Third progress report for the sugar reduction programme, October 2020

Eating out of home is no longer a treat

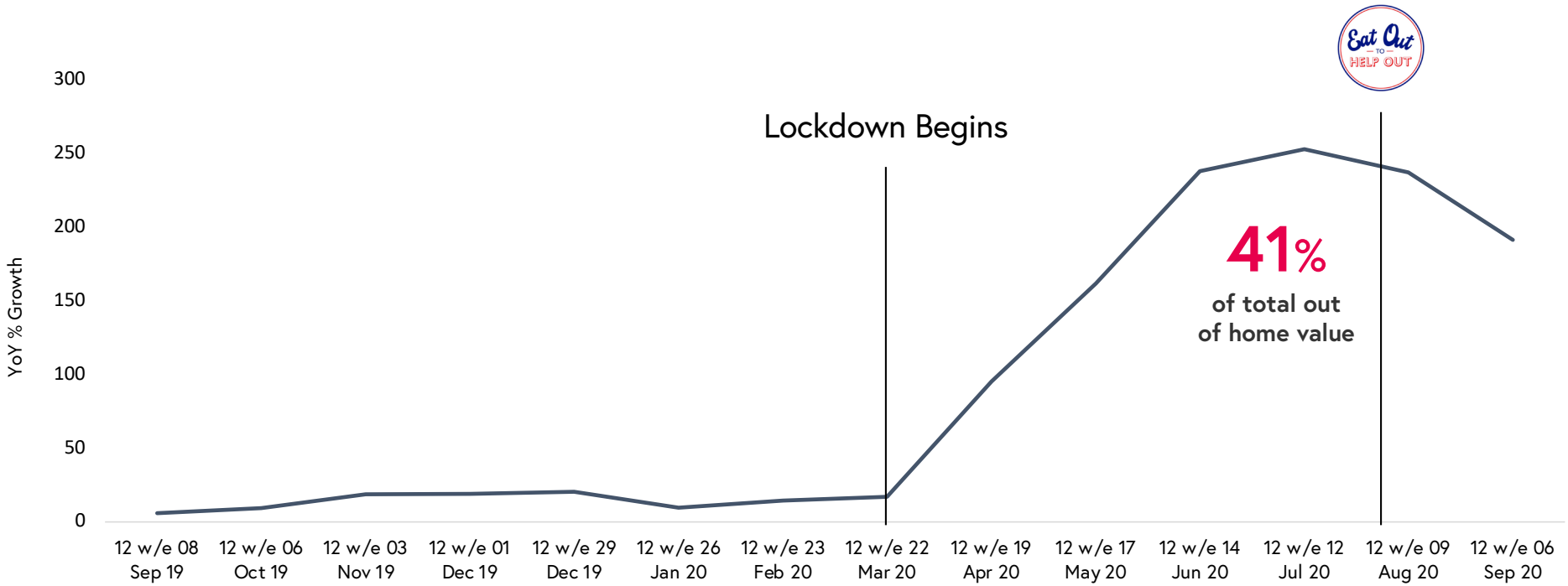


- Eating out of the home (OOH) now more an everyday occurrence
- UK average expenditure on food and drink per week per person was £46.60 and £14.48 (31%) was spent eating out.

SOURCE: Public Health England. (2017). Health Matters: obesity and the food environment; Defra Family Food Survey 2018/19

Delivery has grown massively since the beginning of lockdown

DELIVERY – YOY % GROWTH



SOURCE: Analysis undertaken by PHE based on data from Kantar FMCG

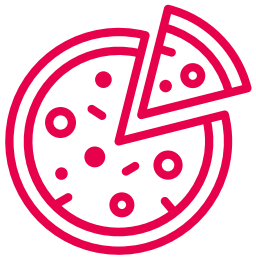
Over half of consumers claimed they'll stick with delivery

54%

of consumers said they would **continue to use food service** delivery as much as they do now or more

…and these consumers account for 80% of spend on delivery

WHO ARE THESE CONSUMERS AND WHAT DO THEY BUY?



PIZZA

33%
OF TRIPS

CHILDREN AT HOME

49%
OF BUYERS

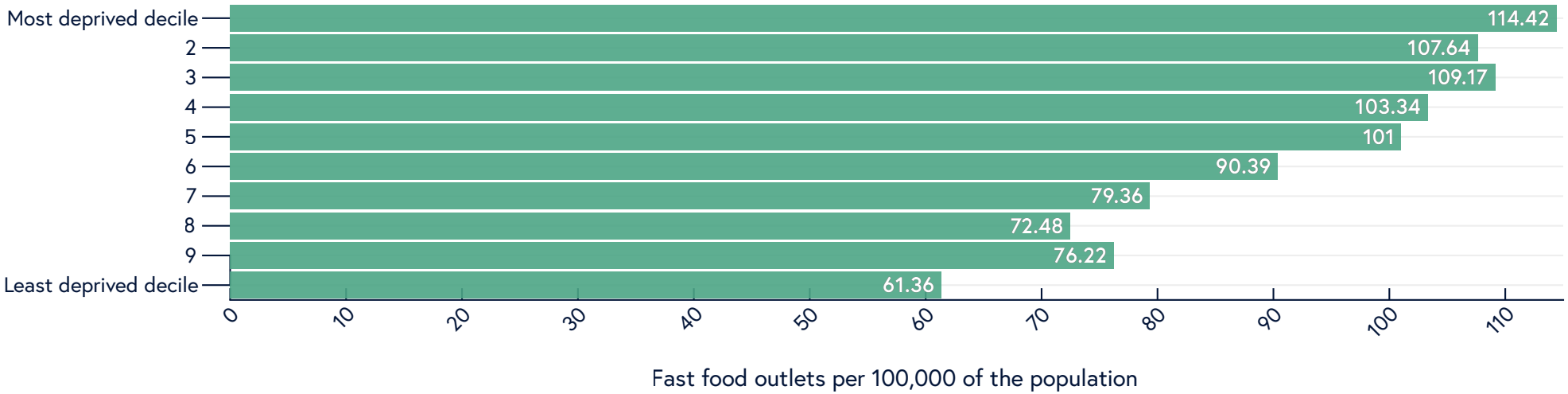
UNDER 55

80%
OF BUYERS

SOURCE: Analysis undertaken by PHE based on data from Kantar FMCG

Unhealthy food is easier to access: deprived areas have a higher density of fast-food outlets

DENSITY OF FAST-FOOD OUTLETS PER 100,000 POPULATION, BY IMD DECILES, ENGLAND, 2014



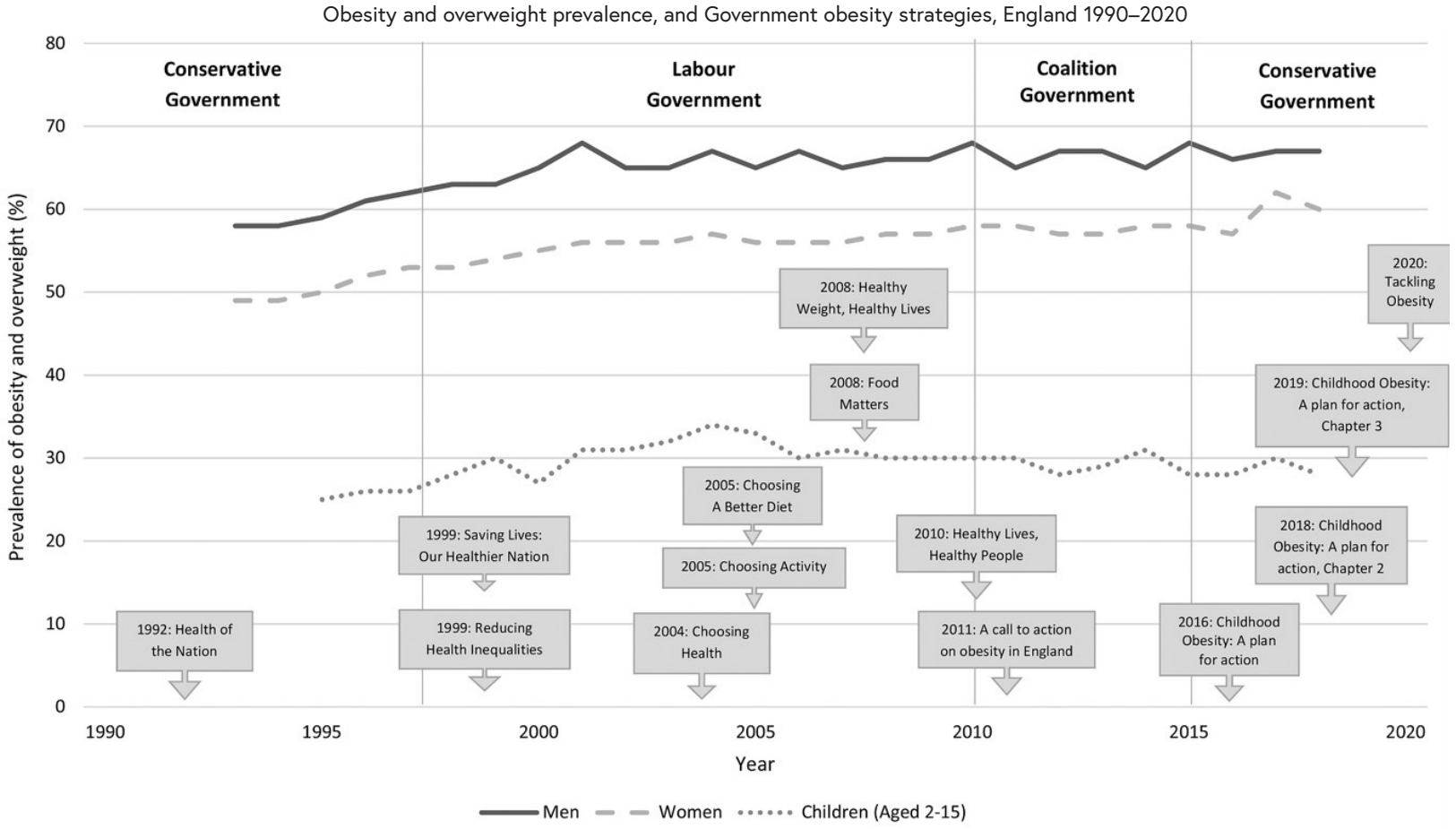
The number of fast food shops also increased by eight perc ent between 2014 and 2017.

SOURCE: Data from PHE. Public Health Profiles 2020.; Presented in HEALTH EQUITY IN ENGLAND: THE MARMOT REVIEW 10 YEARS ON, 2020; Fast food shops increase data from Royal Society of Public Health. Health on the High Street: Running on empty. RSPH: London; 2018

HOW TO SHIFT DIETS

Past government interventions have not achieved systemic change

IS OBESITY POLICY IN ENGLAND FIT FOR PURPOSE? ANALYSIS OF GOVERNMENT STRATEGIES AND POLICIES, 1992–2020



Past interventions: Encouraged **individual behavioural change.**

Relied on **voluntary measures** for industry.

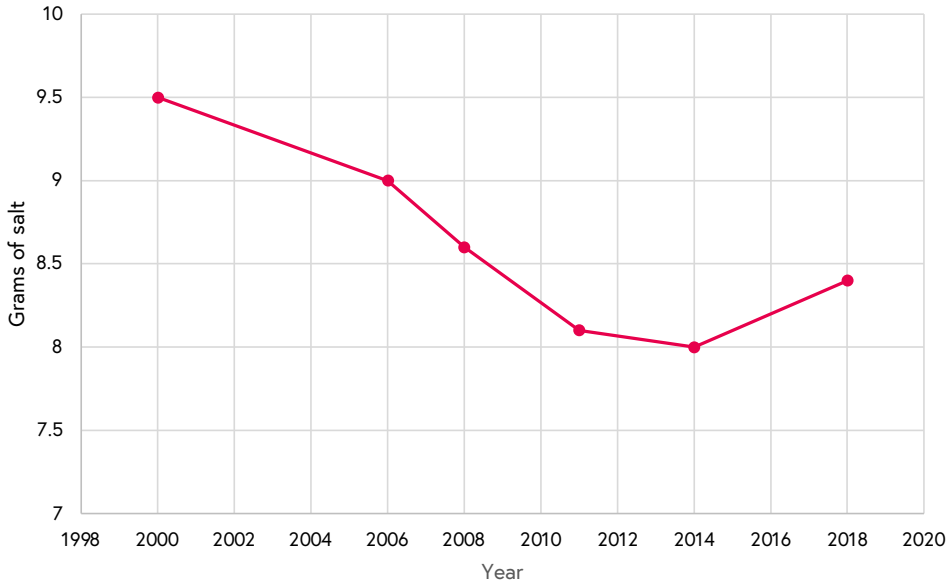
Were **not aligned to the scale of the challenge.**

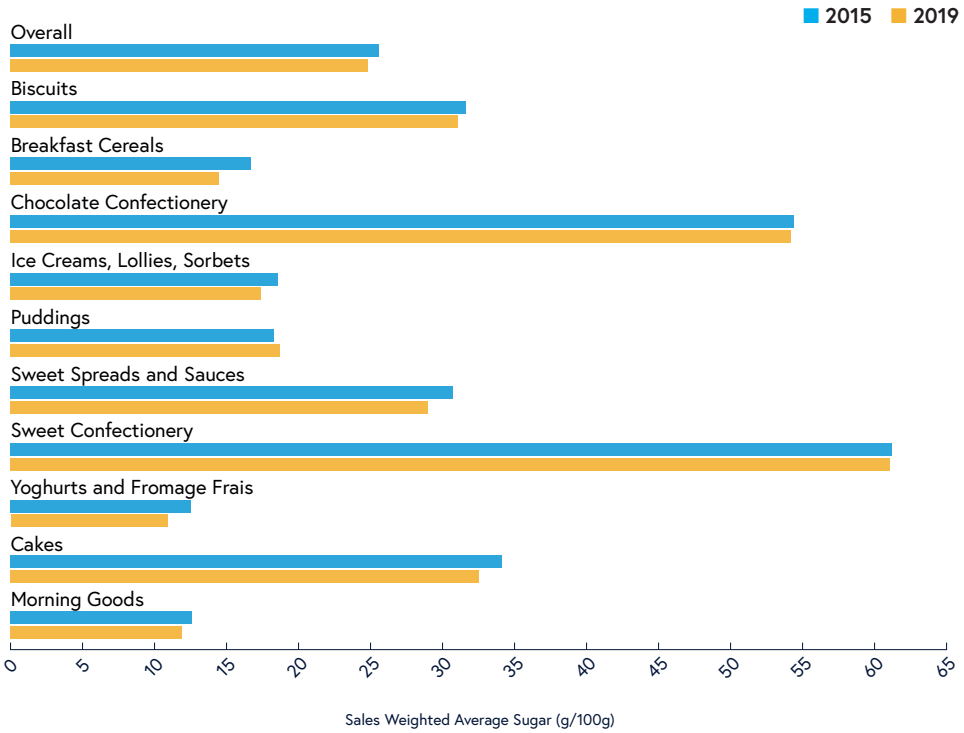
Had insufficient **monitoring and evaluation.**

SOURCE: Theis and White (2021), Is Obesity Policy in England Fit for Purpose? Analysis of Government Strategies and Policies, 1992–2020, Millbank Quarterly, Vol 99 issue 1

Progress on voluntary reduction has been small or has stalled

AVERAGE DAILY SALT INTAKE FOR ADULTS 2000-2018





Progress on voluntary salt reduction has stalled since 2011.

Between 2015-2019, the PHE voluntary sugar reformulation programme achieved an sales-weighted average **reduction of 3%** across all food categories.

SOURCE: Salt intake NFS analysis based on He et al (2013). Salt reduction in the United Kingdom: a successful experiment in public health. Journal of Human Hypertension, 28(6); Public Health England. (2014). National Diet and Nutrition Survey: assessment of dietary sodium Adults (19 to 64 years) in England, 2014; Public Health England. (2020) National Diet and Nutrition Survey: Assessment of salt intake from urinary sodium in adults (aged 19 to 64 years) in England, 2018 to 2019. Sugar intake Public Health England (2020). Sugar reduction: progress report, 2015 to 2019. HMG.

This is, in part, because food governance is fragmented

SOURCE: Graphic drawn from Parsons et al / foodresearch.org.uk

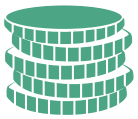
Small weight losses at an individual level could have massive impacts

A **20%** reduction of calorie content in energy-dense foods* could lead to...

1.1 million
cases of non-communicable diseases avoided per year

1.4 million
additional full-time workers per year

13.2 billion
(USD PPP) saved every year due to reduced healthcare expenditure



0.5%
increase in GDP

In obese adults, ~5% weight loss will relieve some joint pain, but a >10% loss is associated with moderate to large clinical improvements in joint pain.

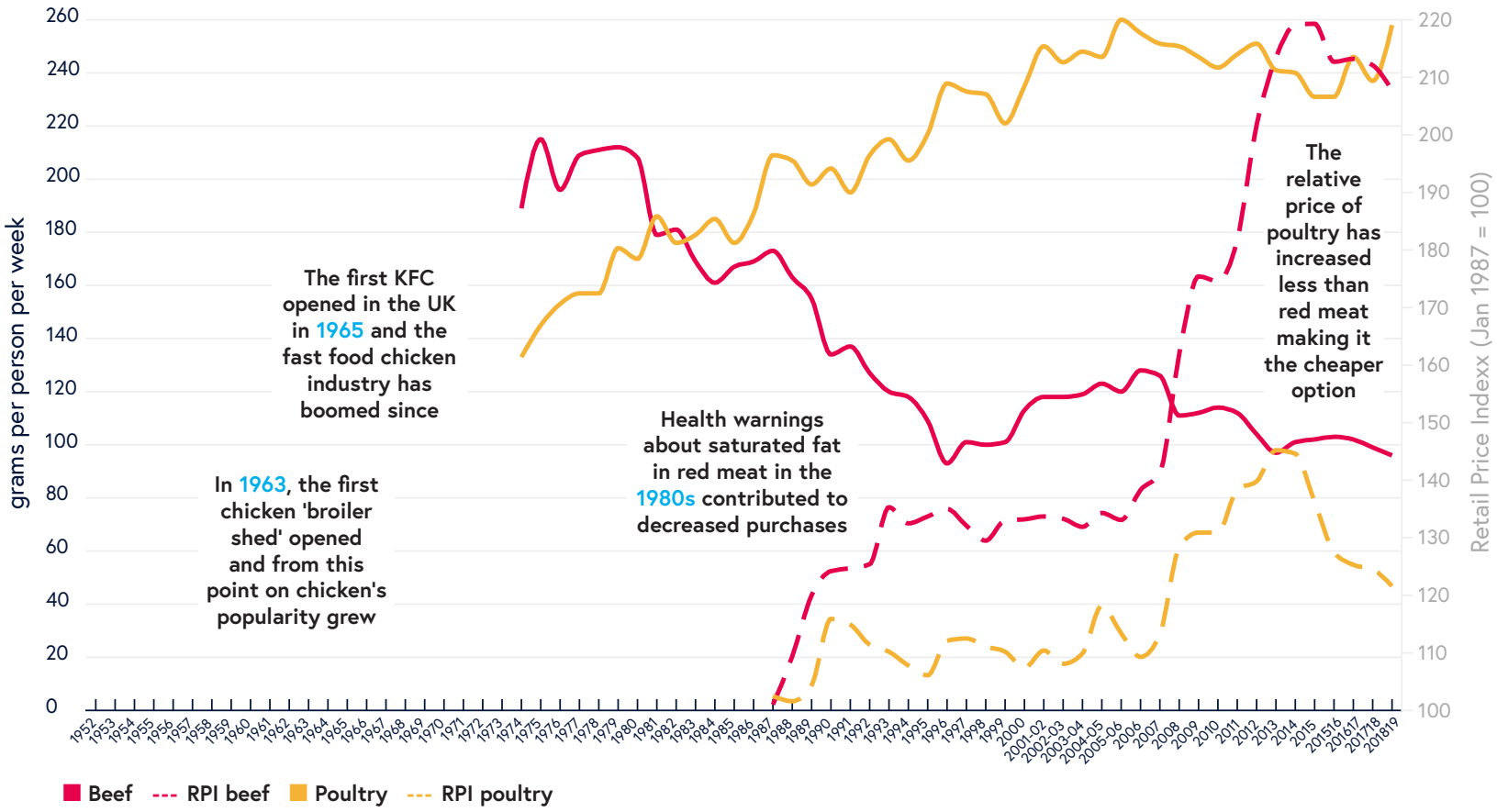
If mean population weight could be shifted downwards by between 1.0 and 2.0kg/m2, 2 in 5 diabetes cases could be prevented.

**Across 42 selected countries.*

SOURCE: Image: OECD, The Heavy Burden of Obesity and the Economics of Prevention, 2019; joint pain: Vincent, H. K., Heywood, K., Connelley, J., Hurley, R. W. Weight Loss and Obesity in the Treatment and Prevention of Osteoarthritis, 2013; diabetes: Feldman, A.L., Griffin, S.J., Ahern, A.L. et al. Impact of weight maintenance and loss on diabetes risk and burden: a population-based study in 33,184 participants. BMC Public Health 17, 170 (2017).

Price is a big factor in creating dietary change

HOUSEHOLD PURCHASE AND RELATIVE PRICE

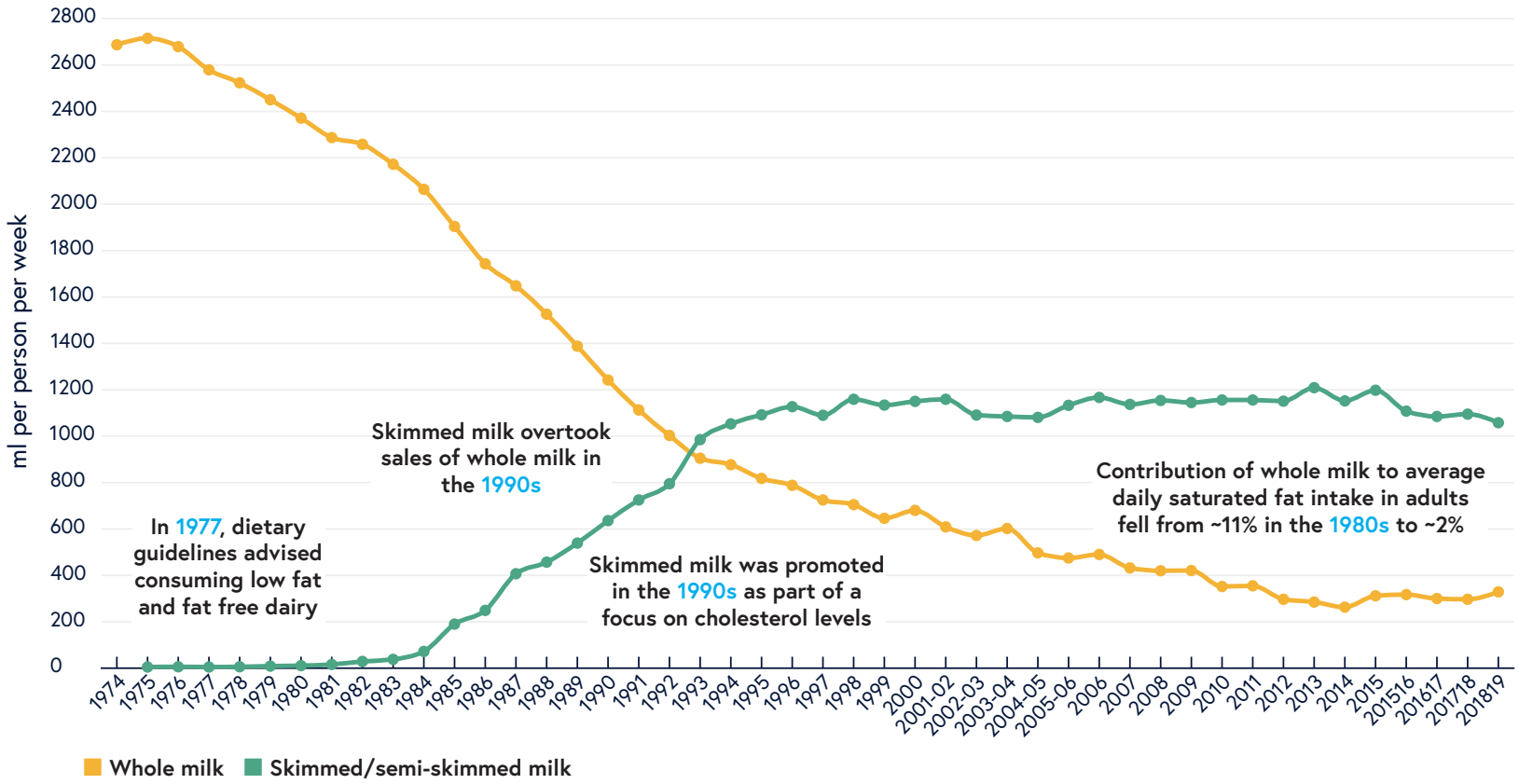


The **protein shift** from red meat to chicken shows the importance of **resolve price** (compared to red meat) and increased **availability** (the start of rearing chickens for meat, not just eggs; antibiotics enable production of more and bigger chickens in less space).

SOURCE: Defra Family Food Survey and ONS Consumer price inflation time series

Public health campaigns can also shift consumer behaviour

HOUSEHOLD PURCHASES

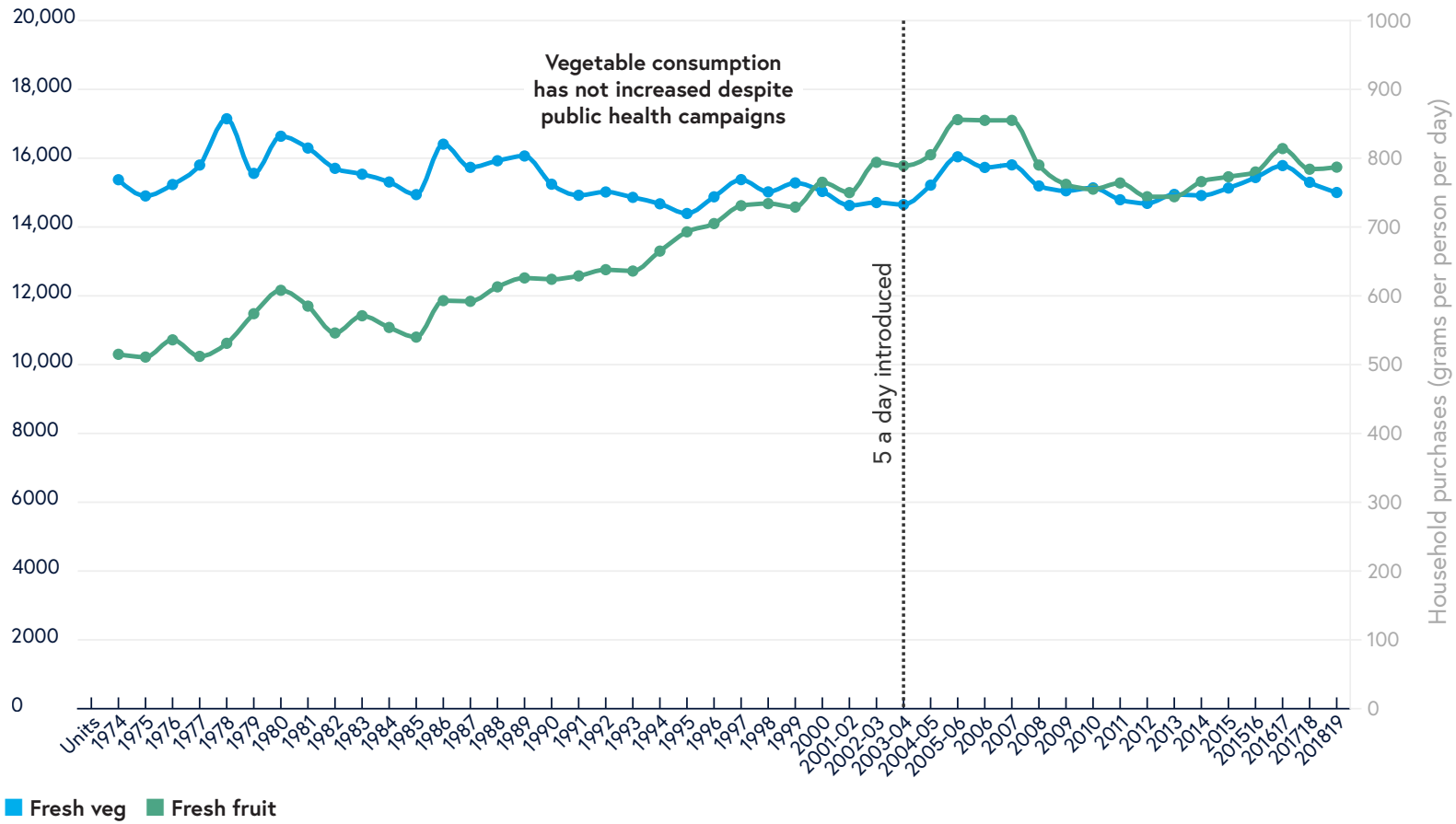


The **milk shift** from whole to skimmed milks shows the effects of **marketing** in the form of public health campaigns (high fat diets and cardiovascular disease) combined with **relative price** effects (skimmed milks similar price/ cheaper than whole milk).

SOURCE: Defra Family Food Survey 2018/19

But their effect can stall

HOUSEHOLD PURCHASES AND TOTAL SUPPLY

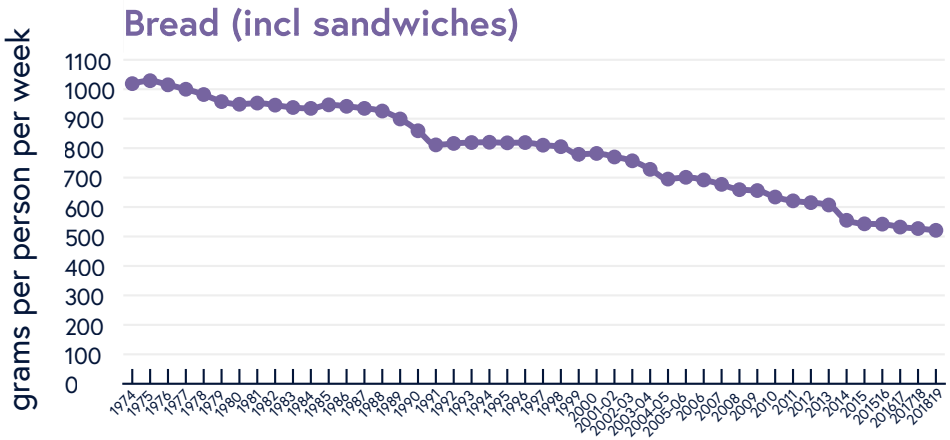


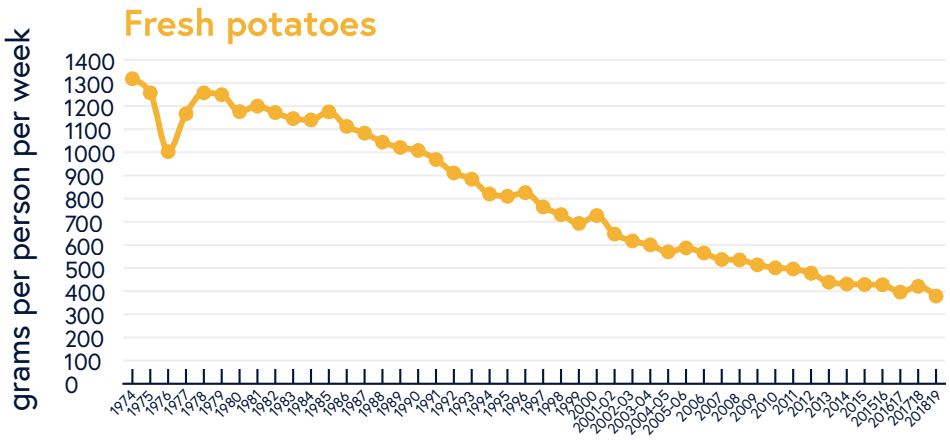
SOURCE: Defra Family Food Survey and Horticulture Statistics

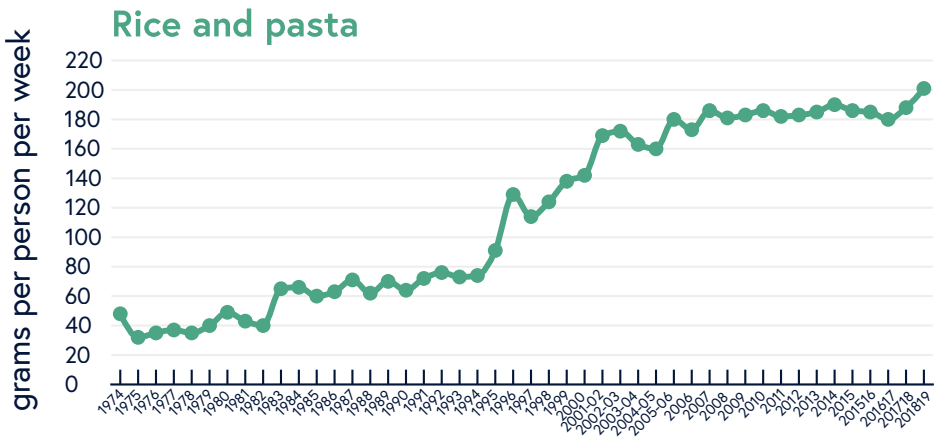
By comparison, vegetable consumption has not increased, despite high levels of awareness of 5-a-day and a public health campaign.

Unlike for milk, this required more purchasing, rather than a simple switch with no cost implications.

We have changed the carbs we eat because of increased choice



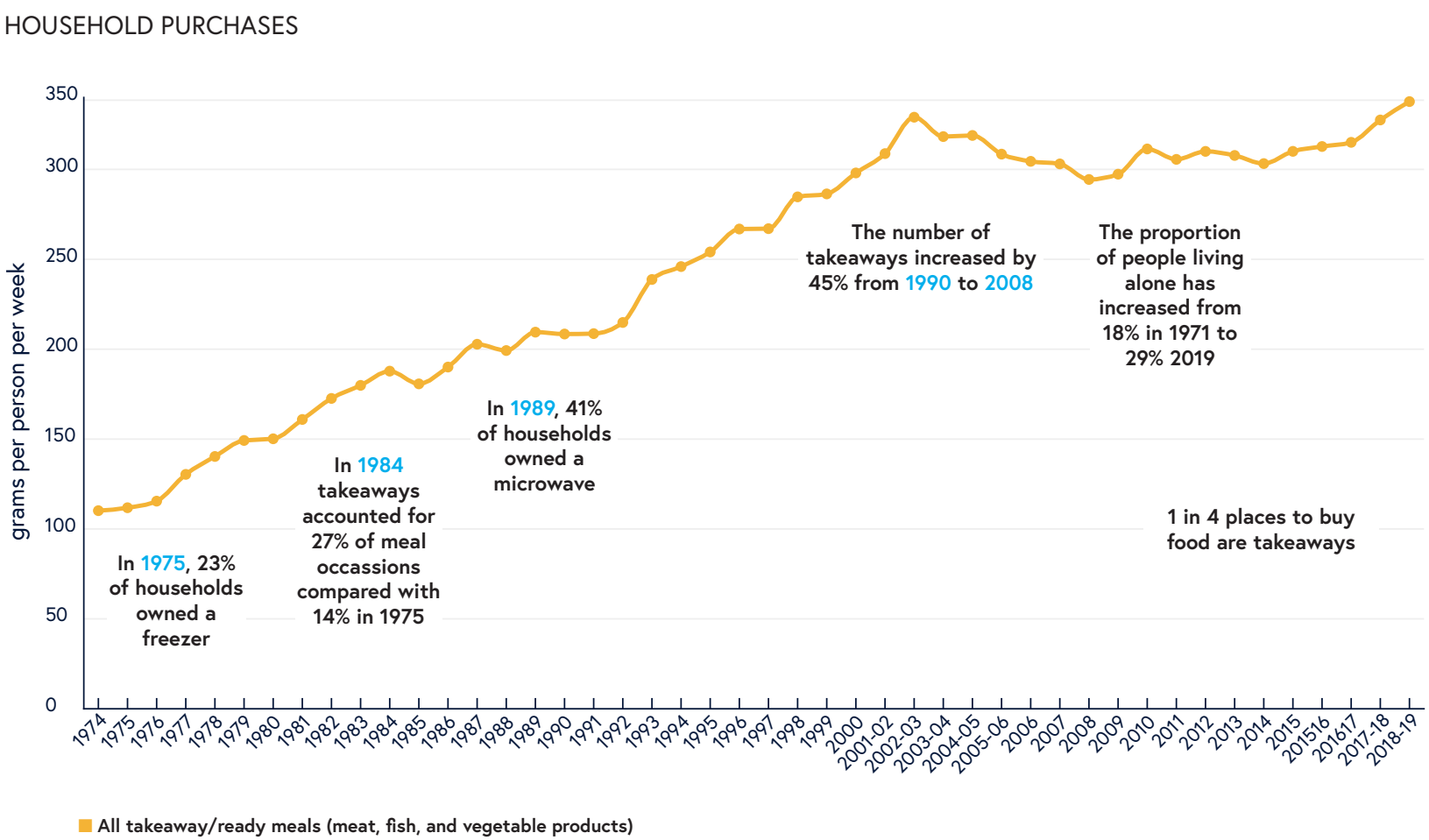




The **carb switch** from bread and potatoes to pasta and rice shows the effects of changes in **availability** (more diverse offerings) and shifting **taste** in favour of international cuisines.

SOURCE: Defra Family Food Survey

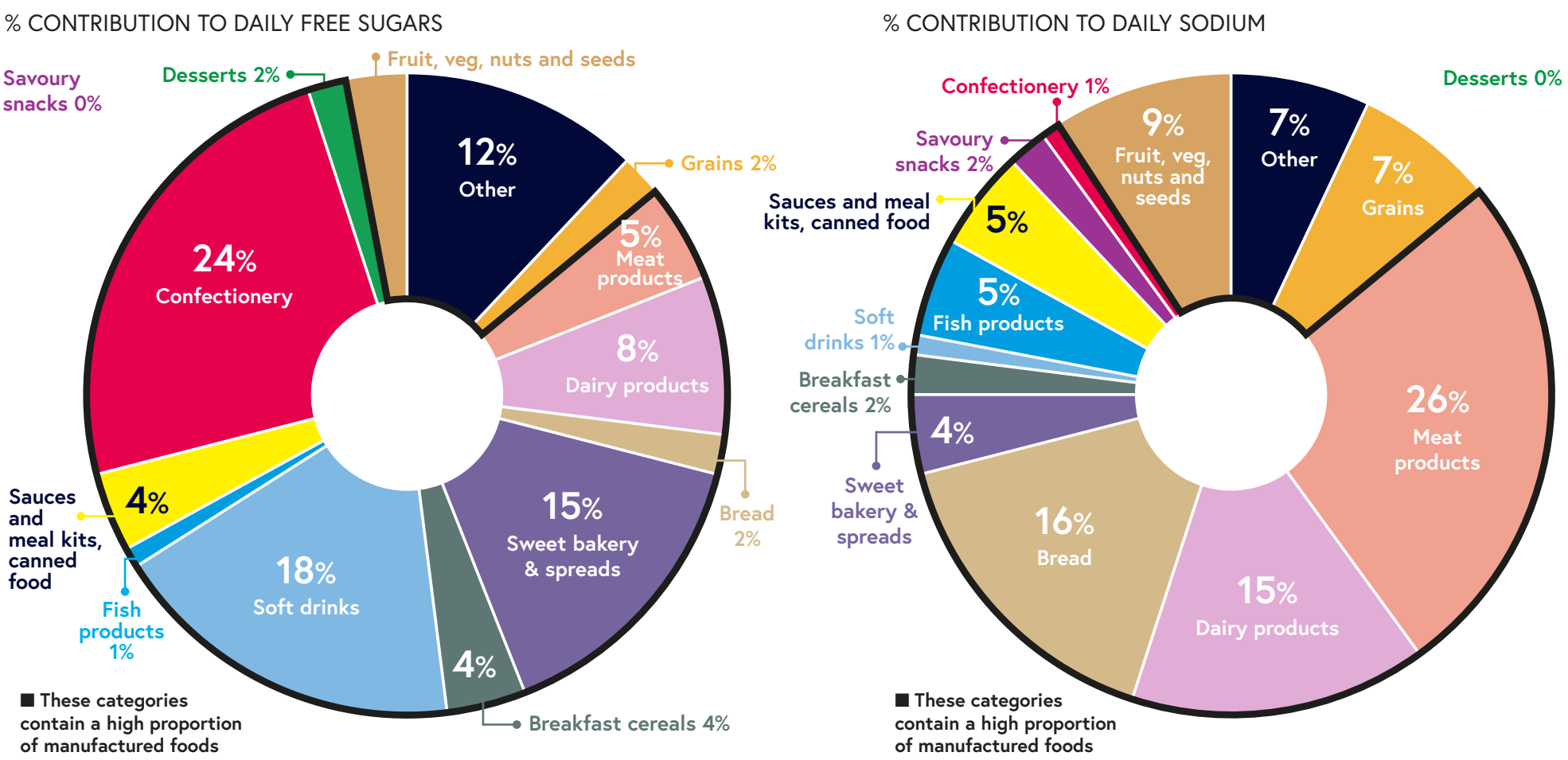
Convenience is a major factor in what we eat



The **convenience shift** (rise of ready meals and takeaway) shows the effects of social changes affecting time (women working, more people living alone, new technologies of freezers and microwaves), as well as changes in availability driven by product innovation (ready meals/long shelf-life products).

SOURCE: Family Food Survey; Crossley, T. F., Griffith, R., Wenchao, J., Lechene, V. (2020) Structural analysis of the decline in home cooked food; #RES2021: Past President's Address (Dame Rachel Griffith)

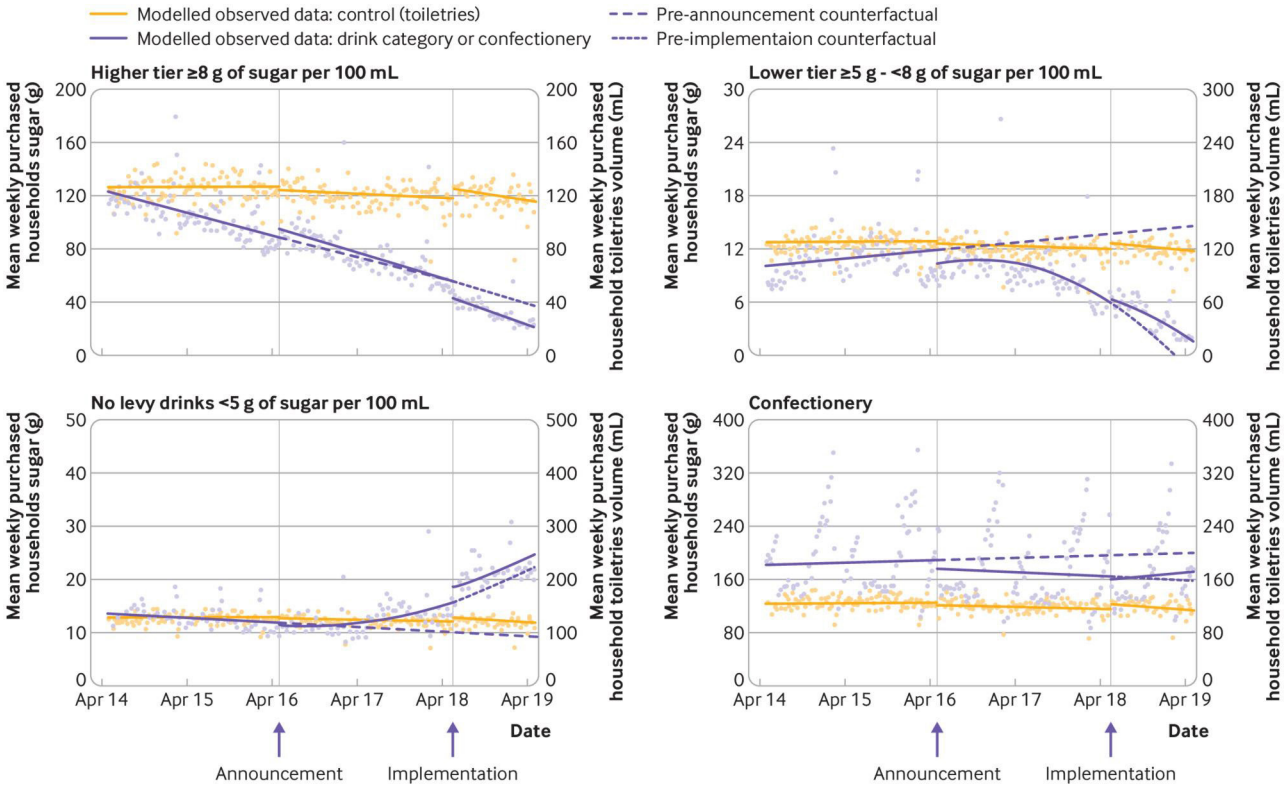
Tackling the escalation of highly processed food is a priority



Sugar and salt are core ingredients in highly processed foods and these foods contribute the bulk of sugar and salt to our diets.

SOURCE: NDNS Y9 and PHE salt report https://www.gov.uk/government/statistics/ndns-assessment-of-salt-intake-in-adults-england-2018-to-2019

The Sugary Drinks Industry Levy delivered good results through reformulation



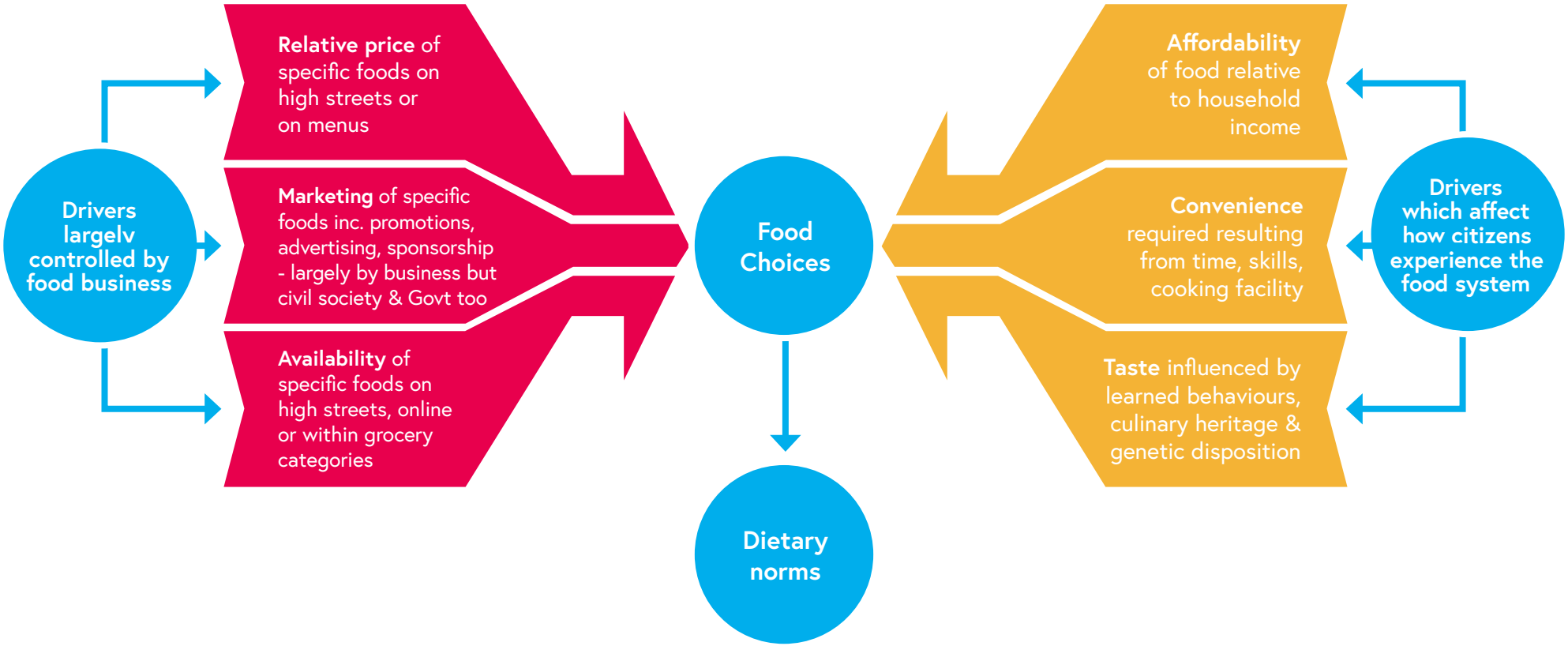
One year after the SDIL was implemented, the volume of soft drinks purchased did not change.

The amount of sugar in those drinks was 30g, or 10%, lower per household per week – equivalent to one 250ml serving of a low tier drink per person per week.

SOURCE: Pell et al (2021) Changes in soft drinks purchased by British households associated with the UK soft drinks industry levy: controlled interrupted time series analysis, BMJ

We need multiple interventions to make healthy and sustainable diets the new normal

DRIVERS OF FOOD CHOICE



SOURCE: National Food Strategy.

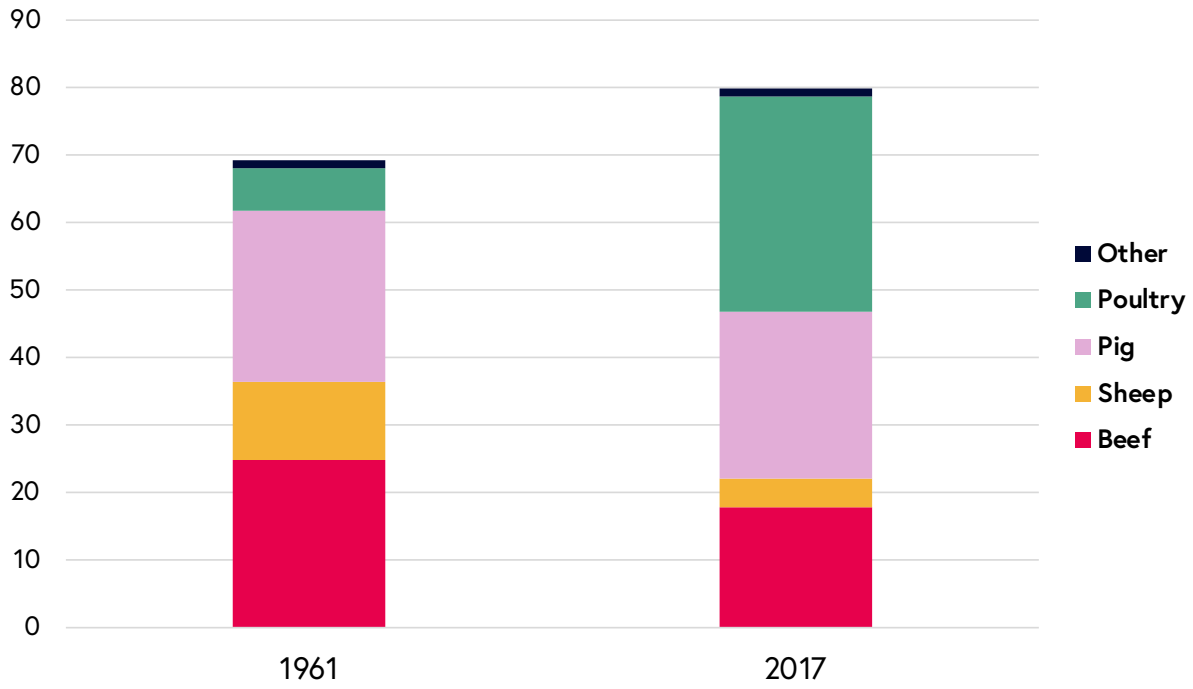
Replacing some meat with alternative proteins would be good for our health and the planet

	General principles	Implications for GHG emissions*	Implications for biodiversity	Implications for health	Implications for convenience
Current diets	High consumption of processed food, red meat, excessive protein and calorie intake	~2.77 $kgCO_2e$ per adult per meal	Inefficient use of land for grazing and growing crops for feed	Overconsumption of red meat, processed food and kcals correlated with non-communicable disease	Easily accessible and cooking methods are part of cultural norms
 **Protein Rich Plants** 'healthy alternative'	Nutritious raw ingredients that are high in protein e.g. lentils, tofu, chickpeas, wholegrains	68-94% decrease in emissions			Decrease can be mitigated through greater use in ready meals and cooking skills improving
 **Meat Mimicking Alternatives**	Processed foods to match conventional meat taste and texture. Usually through precision fermentation	54-93% decrease in emissions		Potential improvement in health outcomes with innovation and fortification, depending on product quality	

SOURCE: SYSTEMIQ Analysis: *average taken from modelling of 8 conventional meat based meals and their plant based alternatives

Our diets aren't fixed; over the past 60 years we have quadrupled consumption of chicken and reduced consumption of beef and lamb

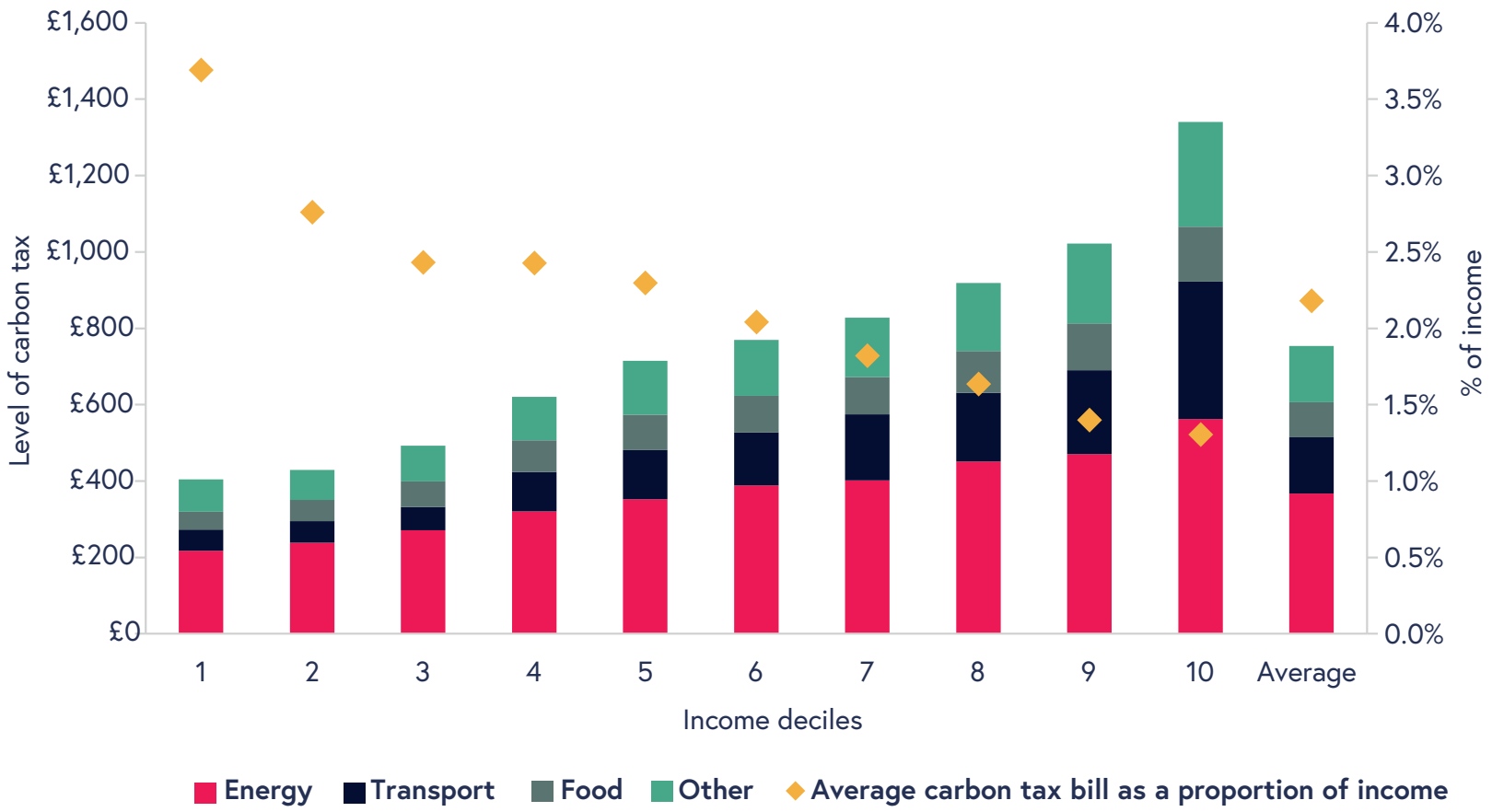
MEAT CONSUMPTION 1961 VS 2017



Note: includes meat that is purchased but is wasted post farm gate.

SOURCE: FAO meat food supply quantity – food available for human consumption (2020)

A carbon-based food tax would be regressive

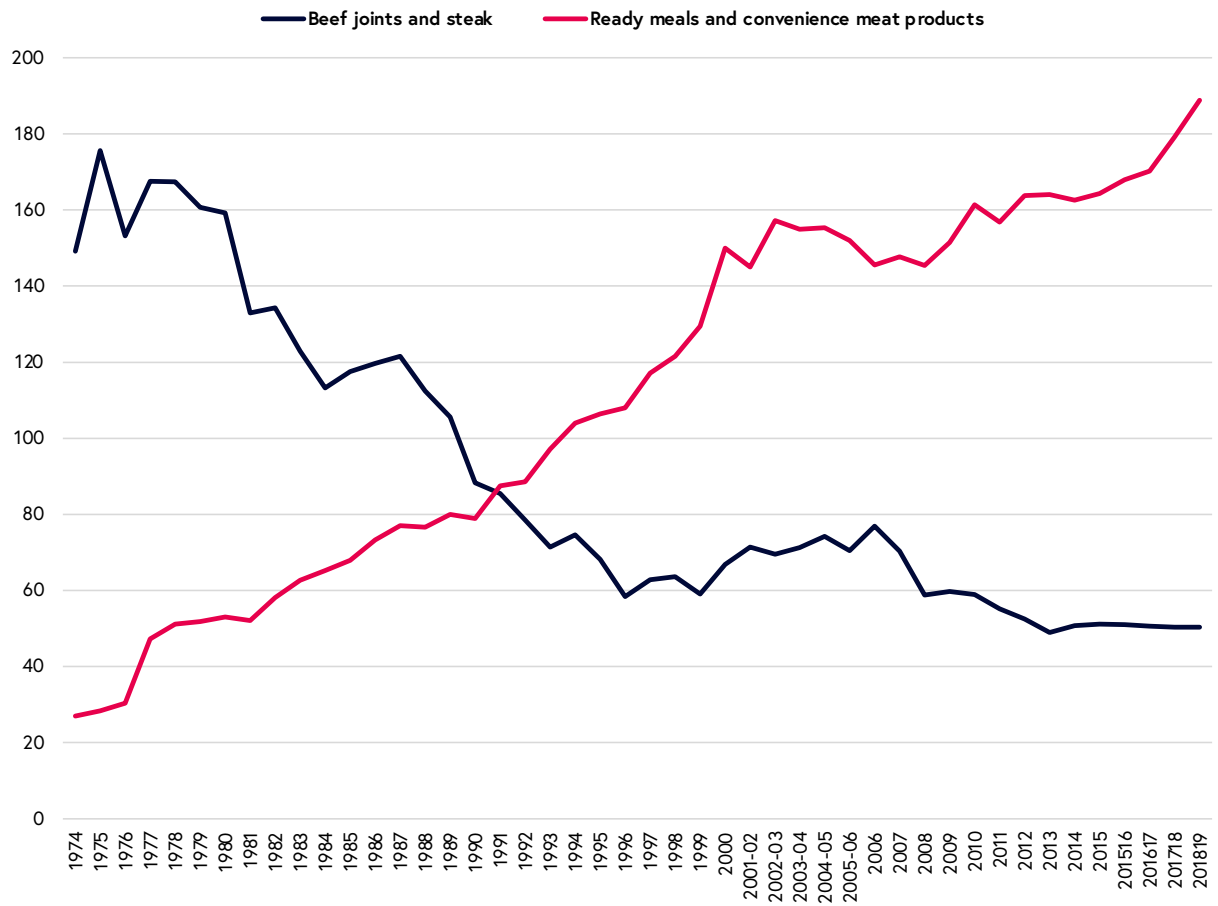


- Tax at £75/tonne is regressive for food
- The top decile eats food with 3.3x more carbon than the bottom, but spends about 2x on food, and has 9.4x more income.
- For the poorest decile, tax on food would be ~£125/year.
- The tax would see food spending rise by between 6%-10%.

SOURCE: London School of Economics, Distributional Impacts of a Carbon Tax in the UK. Report 2: Analysis by Income Decile, 2020

The way we eat meat has changed – creating the space for reformulation

WE ARE CONSUMING FEWER JOINTS AND MORE READY MEALS

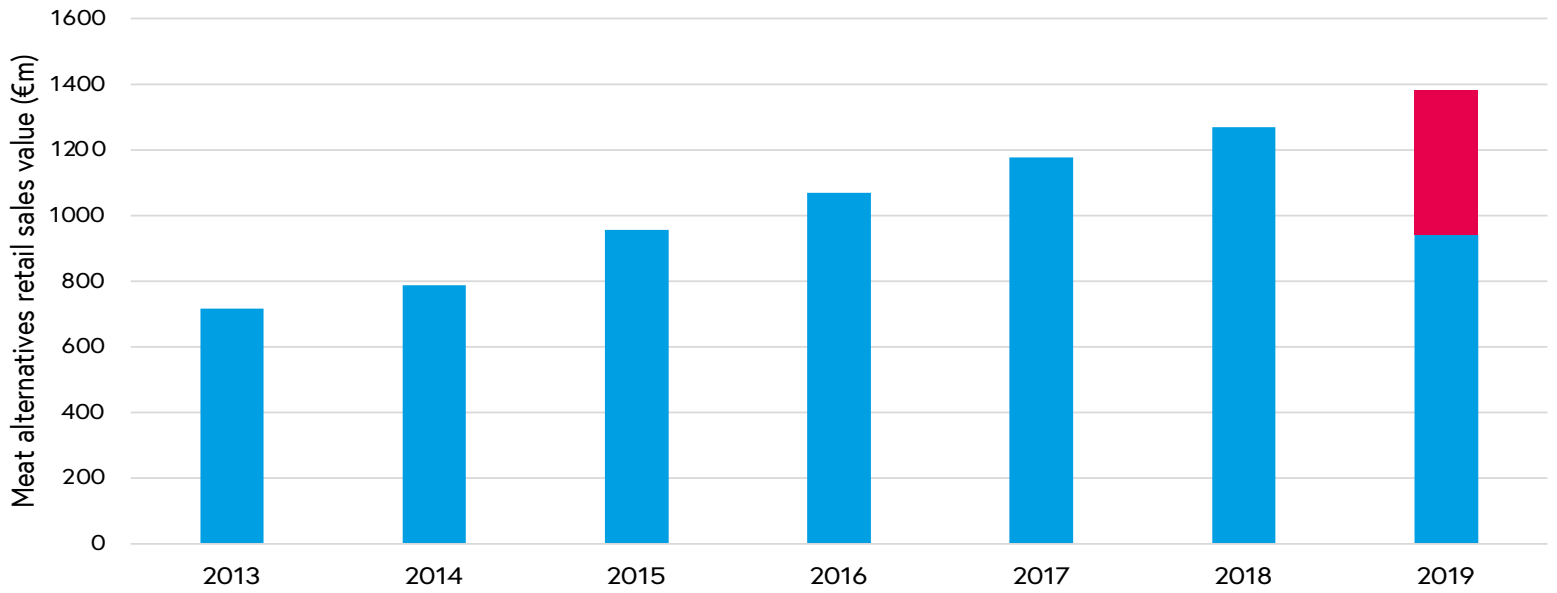


SOURCE: Defra Family Food Survey 2020

Over the last 50 years we have reduced our consumption of joints and steak while increasing our consumption of ready meals.

The UK is well placed to become a leader in alternative proteins

THE EUROPEAN SALES MARKET FOR ALTERNATIVE PROTEINS IS GROWING STEADILY



And the UK has the largest proportion of this market - €440m

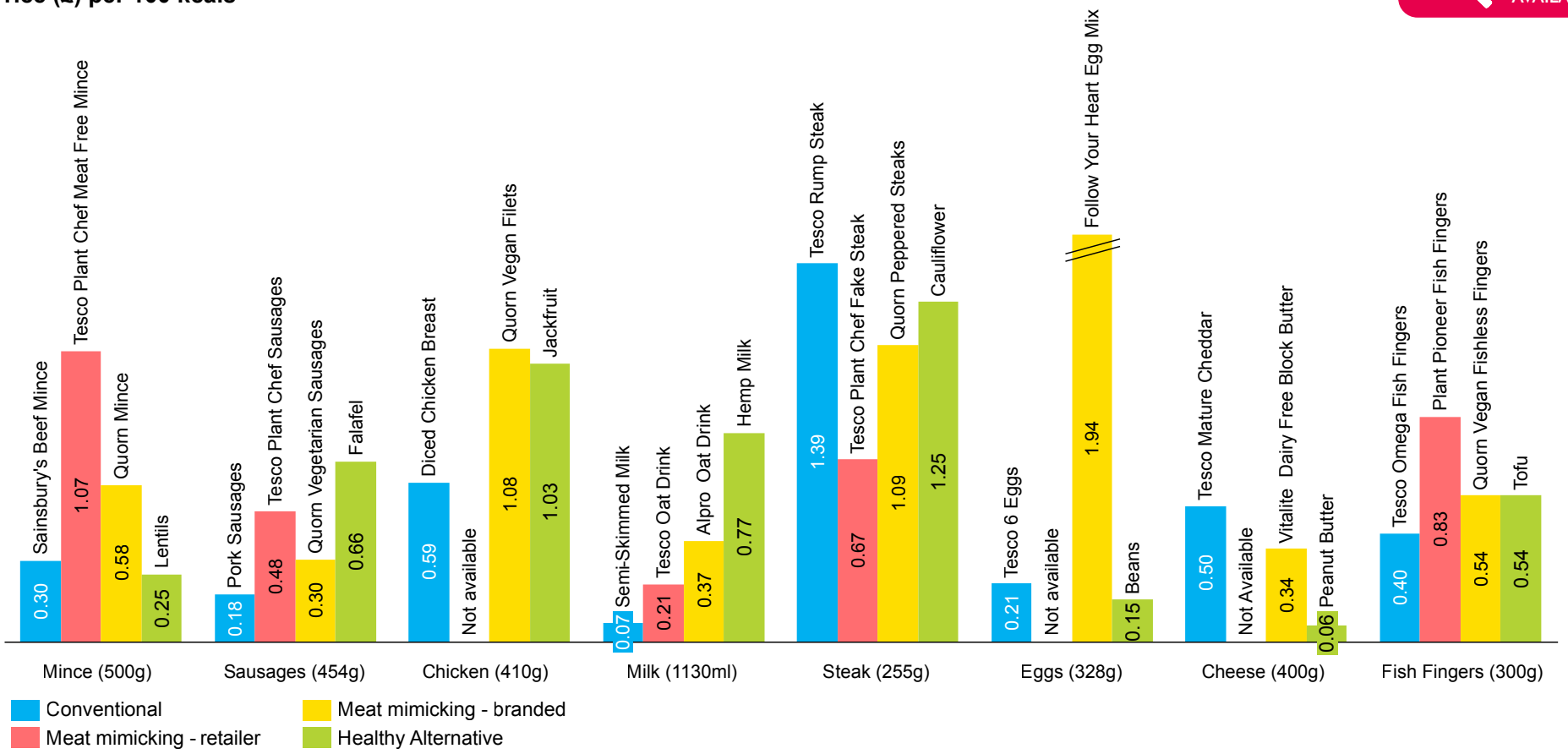
SOURCE: ING Research (2020) Growth of meat and dairy alternatives is stirring up the European food industry

But alternative proteins are currently expensive

CONVENTIONAL MEAT AND HEALTHY ALTERNATIVES TEND TO BE THE CHEAPEST SOURCE OF CALORIES

ADDITIONAL RESOURCES AVAILABLE

Price (£) per 100 kcals



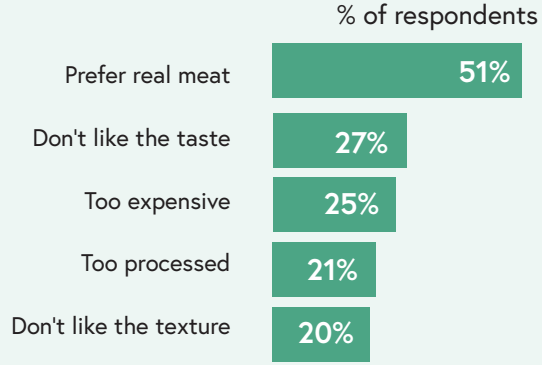
all products price adjusted to equal weight of conventional meat product.

SOURCE: SYSTEMIQ analysis commissioned for the National Food Strategy, based on Tesco.com and Sainsburys.com, accessed 23 March.

There are barriers throughout the alternative protein production process

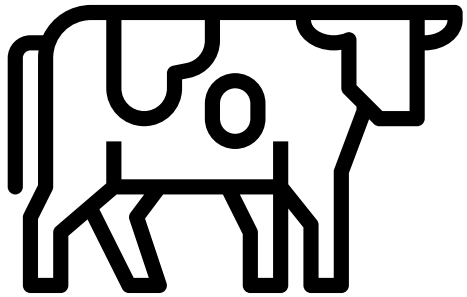
Alternative proteins, produced from plants, microorganisms (like yeast), or from animal cells have different routes to reducing their costs. Surmountable barriers to consumption focus on flavour/texture, cost, and level of processing.

Why don't you eat plant-based meat substitutes?

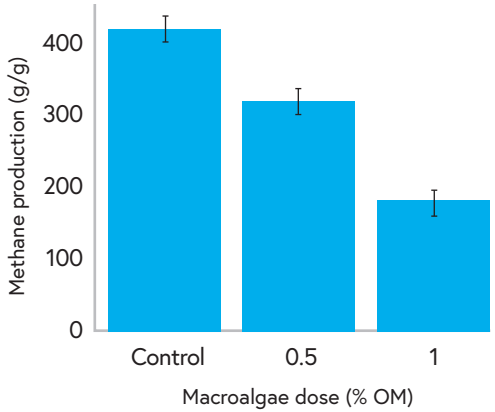


SOURCE: Boston Consulting Group (2021) Food for thought. The protein transformation; Consumer preference data from Mintel (2020) via Good Food Institute.

Adding seaweed to dairy cows' diet reduces enteric methane emissions by over 50%



Fed at 0.5 and 1% feed intake



Note: The active ingredients in asparagopsis is Bromoform, which is a known ozone depleting compound. It is also toxic and has been found in the milk and urine of animals it has been administered to, so further research is needed. Muizelaar, W., Groot, M., van Duinkerken, G. et al. (2021). Safety and transfer Study: Transfer of bromoform present in Asparagopsis taxiformis to milk and urine of lactating dairy cows. Foods. 10(3). [online]. Available at: https://www.mdpi.com/2304-8158/10/3/584.

SOURCE: Roque et al (2019) Inclusion of Asparagopsis armata in lactating dairy cows' diet reduces enteric methane emission by over 50 percent Journal of Cleaner Production, Volume 234

DETAILED ANALYSIS OF THE IMPACT OF POOR DIETS ON HEALTH OUTCOMES

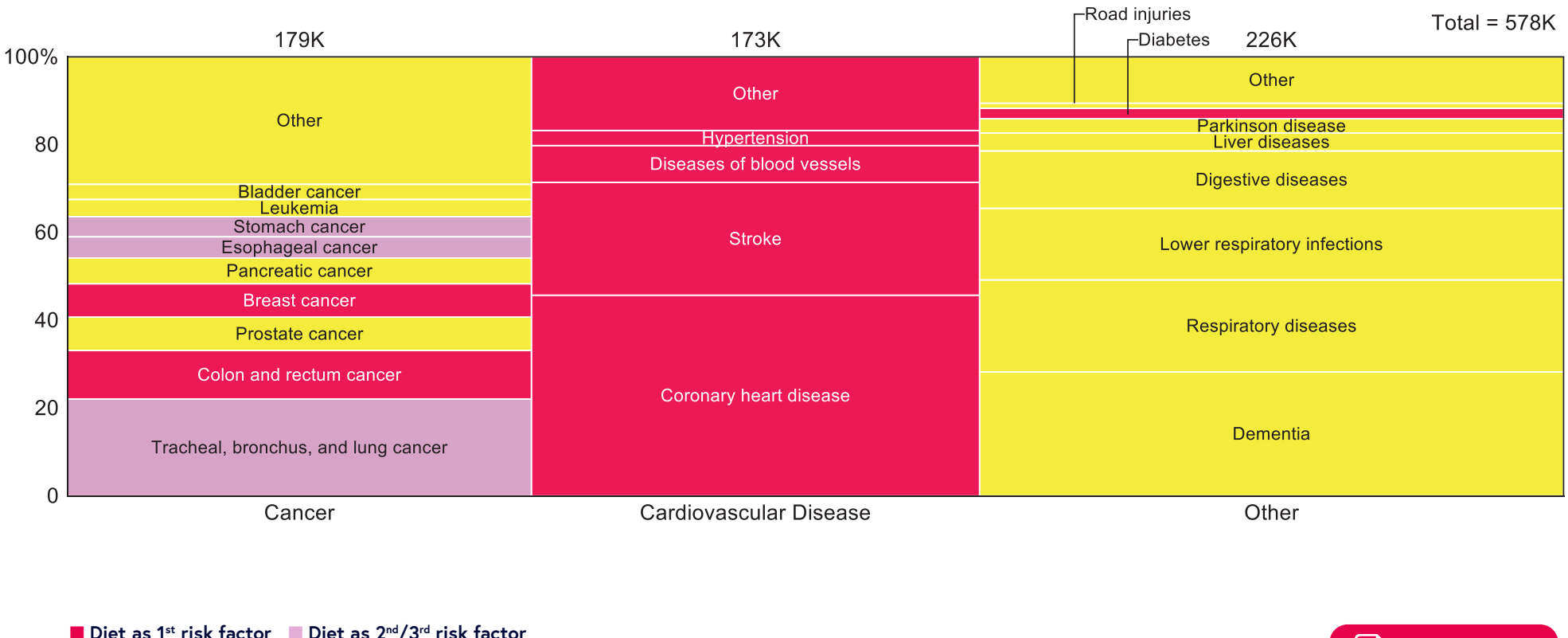
Detailed graphs outlining the impact of poor diets on health outcomes

- The following charts set out the impact of poor diets on health using the best available population level health data from the Global Burden of Disease.
- They set out the number of Disability Adjusted Life Years (DALYs) that are lost due to poor diets.
- DALYs measure the **total years lost to early death, ill-health and disability – thus combining mortality and morbidity.**
  - To give a crude example: if you were to die of heart disease ten years before the average lifespan for your sex, and were also severely disabled by the condition for the last three years of your life, your DALYs would be shortened by thirteen.
- A higher number of DALYs indicates a larger negative health impact.

SOURCE: Xxxxx

Many of the major causes of death have dietary risk as one of the main risk factors

UK DEATHS BY CAUSE, 2016

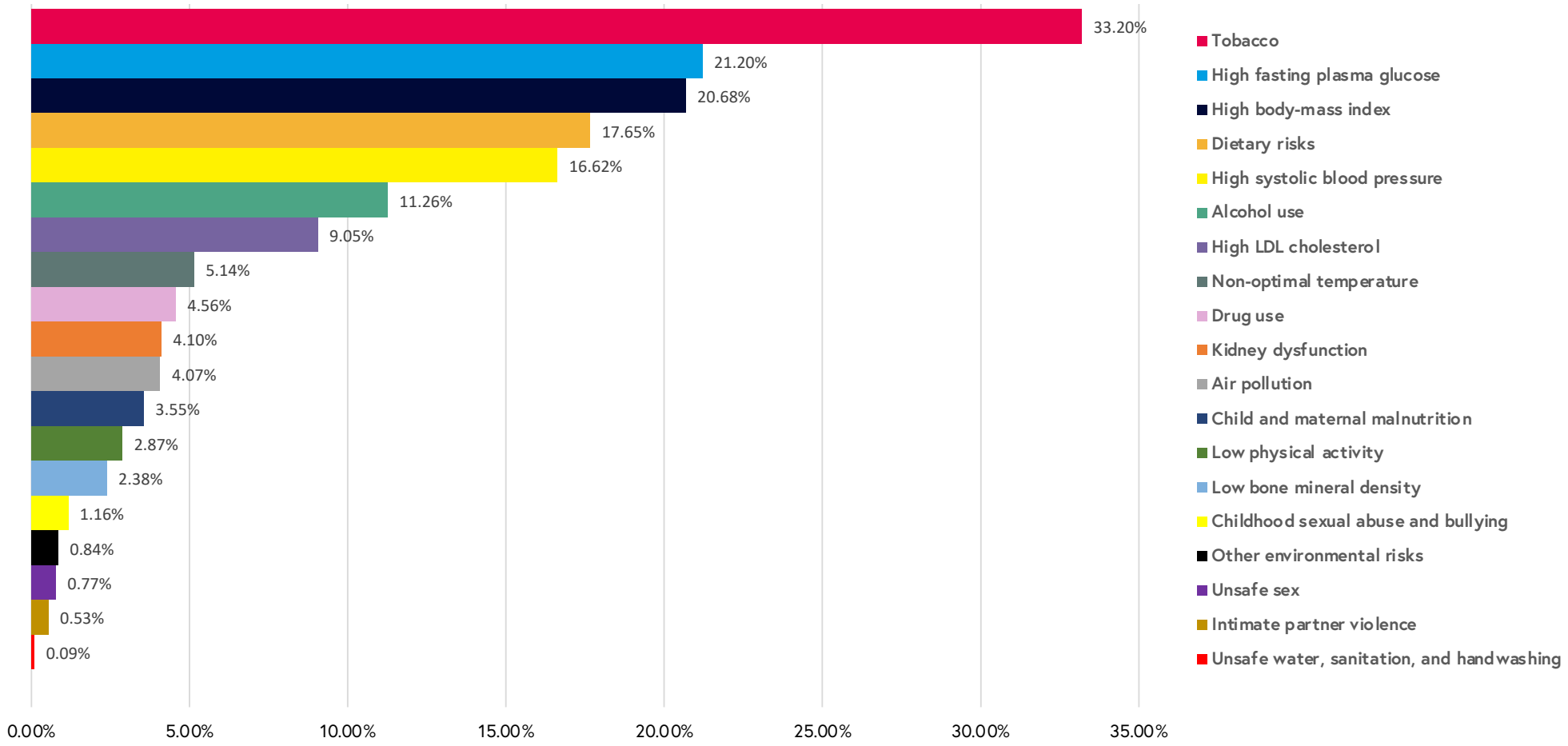


ADDITIONAL RESOURCES AVAILABLE

SOURCE: Bain for NFS, based on Death tolls taken from "Our world in data, causes of death", 2016; Breakdown of CVD's from "Cardiovascular Disease Statistics", BHF, 2014; Risk factors associated with diet from Global burden of disease risk factors, Institute of health metrics and evaluation, 2006

Four of the top five risk factors for all-cause DALYs are related to diet

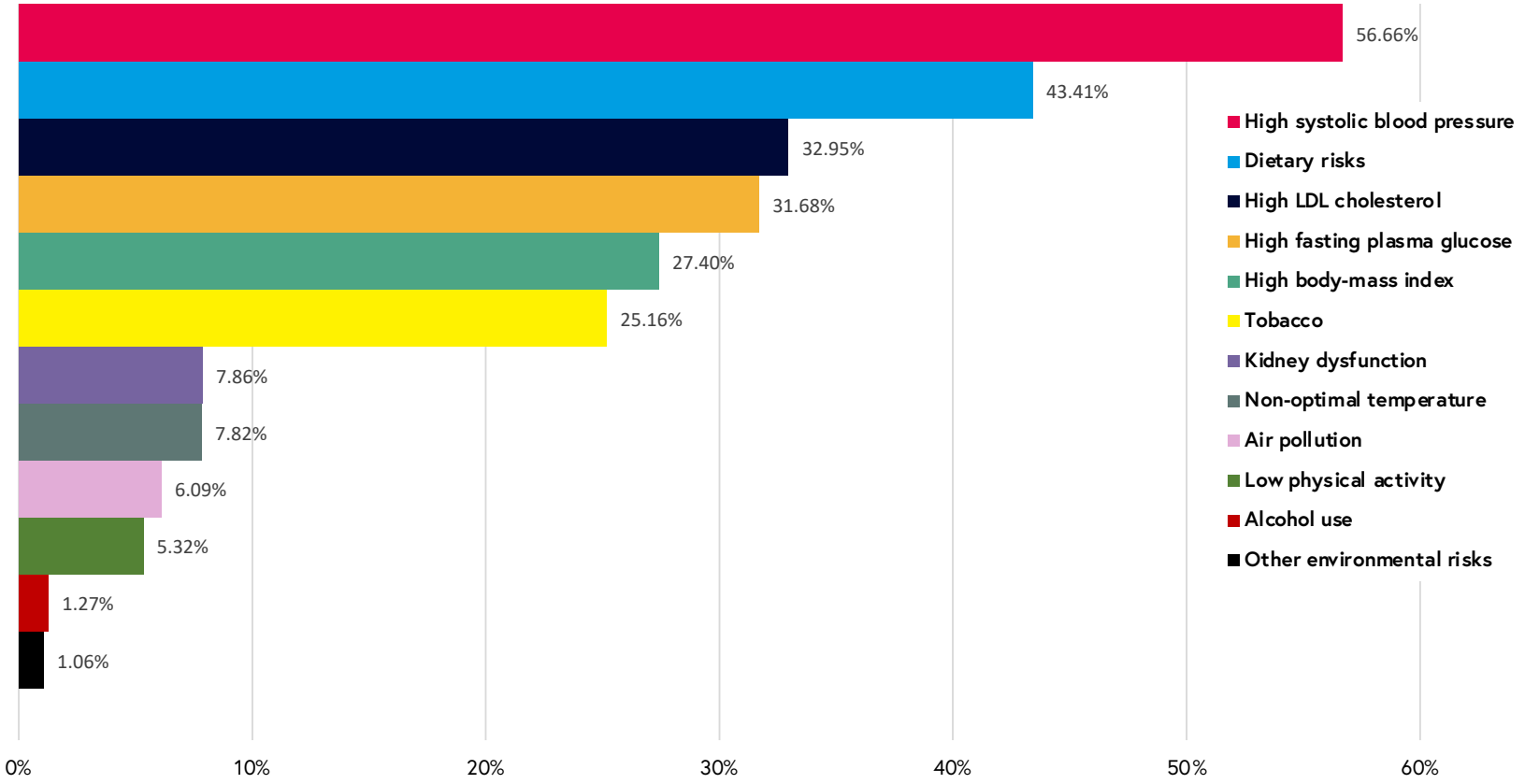
ALL-CAUSE DALYs IN ENGLAND BY RISK FACTOR



SOURCE: Global Burden of disease, 2019 data. Accessed March 2021. GBD Results Tool | GHDx (healthdata.org)

The risk factors that contribute to cardiovascular DALYs

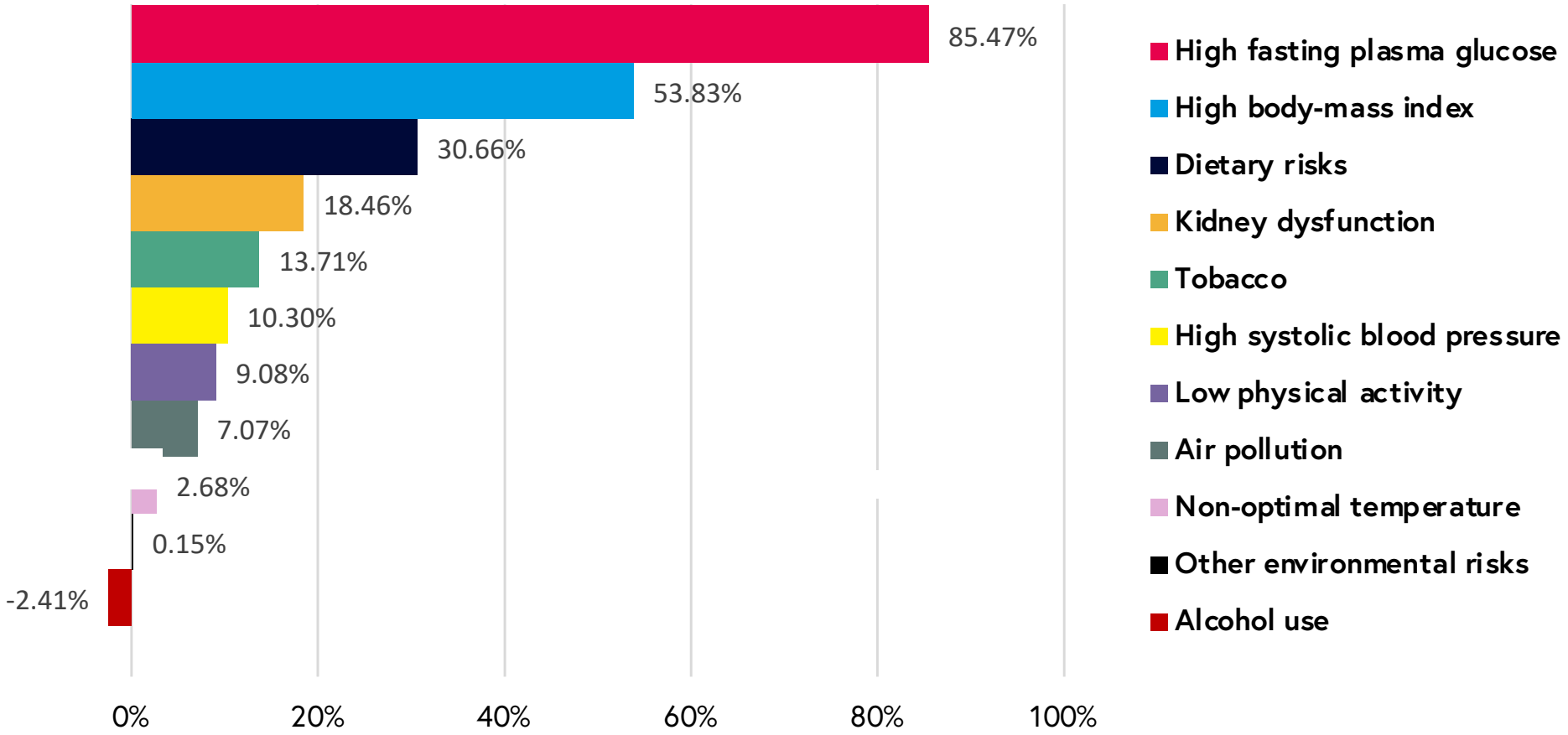
CVD DALYs IN ENGLAND BY RISK-FACTOR



SOURCE: Global Burden of disease, 2019 data. Accessed March 2021. GBD Results Tool | GHDx (healthdata.org)

The risk factors that contribute to diabetes and kidney disease

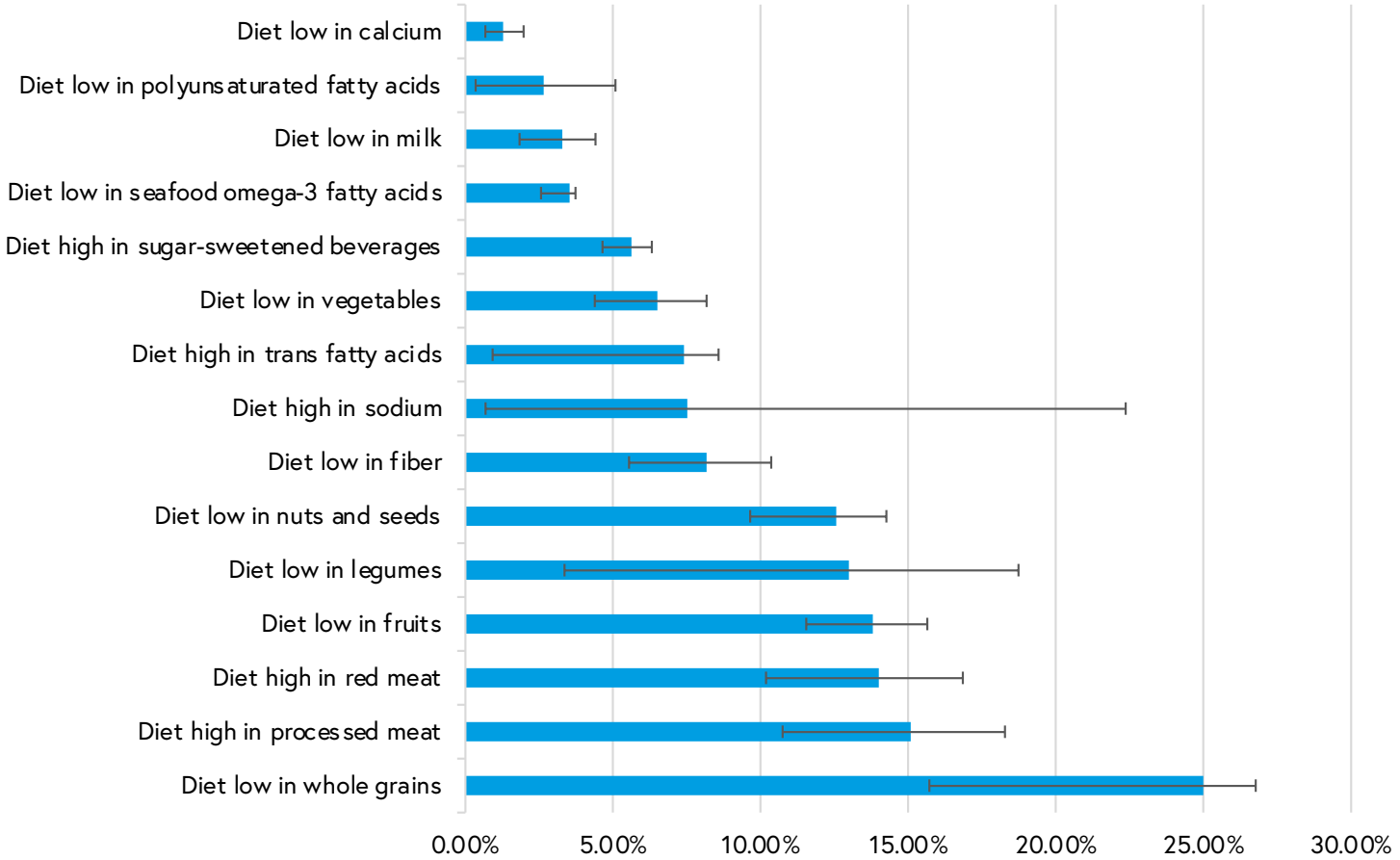
DIABETES AND KIDNEY DISEASE DALYs IN ENGLAND BY RISK-FACTOR



SOURCE: NFS analysis of Global Burden of disease, 2019 data. Accessed March 2021. GBD Results Tool | GHDx (healthdata.org)

The dietary risk factors for all-cause DALYs

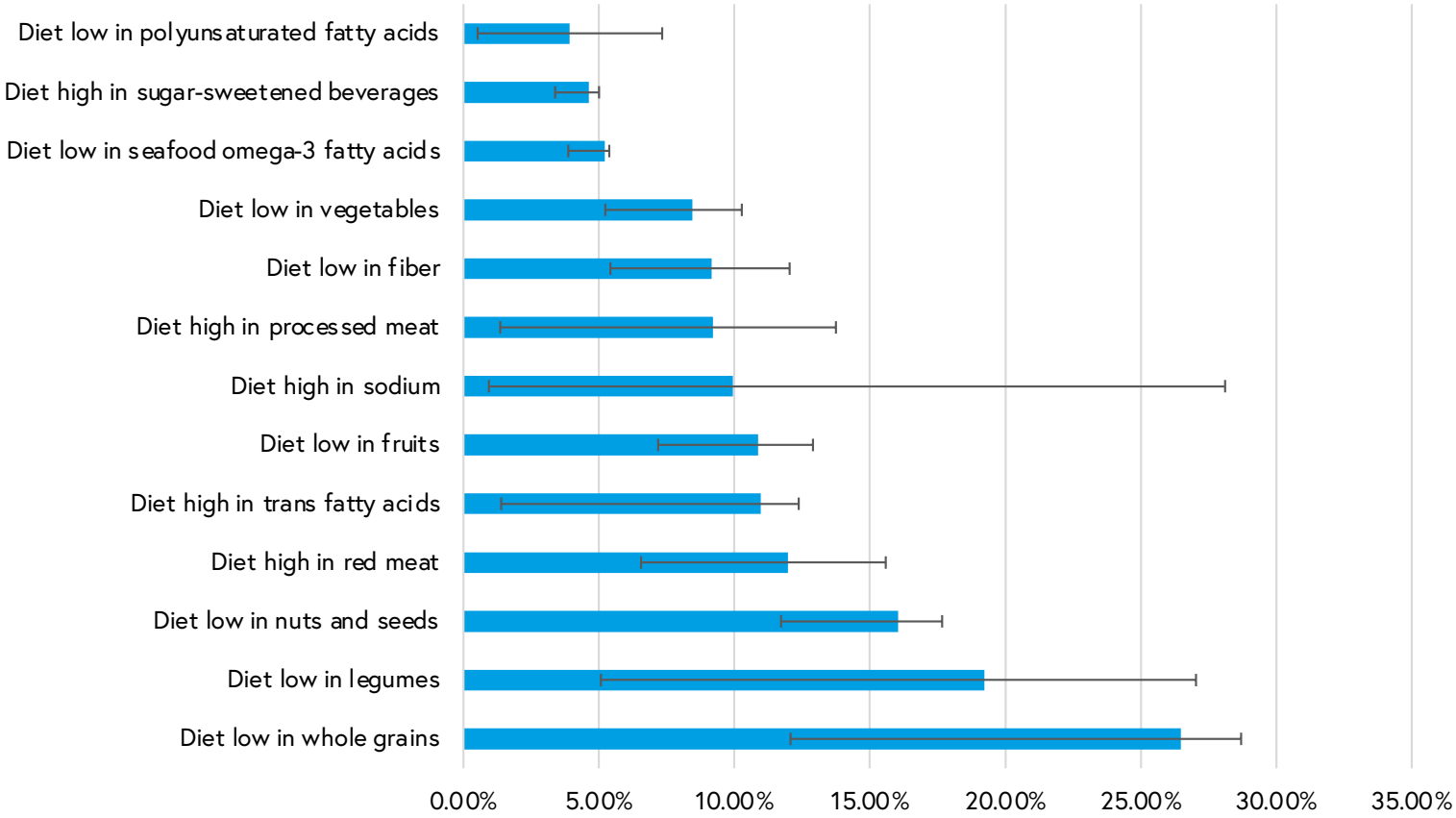
PERCENTAGE DIETARY DALYs (ALL CAUSES)



SOURCE: Global Burden of disease, 2019 data. Accessed March 2021. GBD Results Tool | GHDx (healthdata.org)

The dietary risk factors that contribute to cardiovascular disease

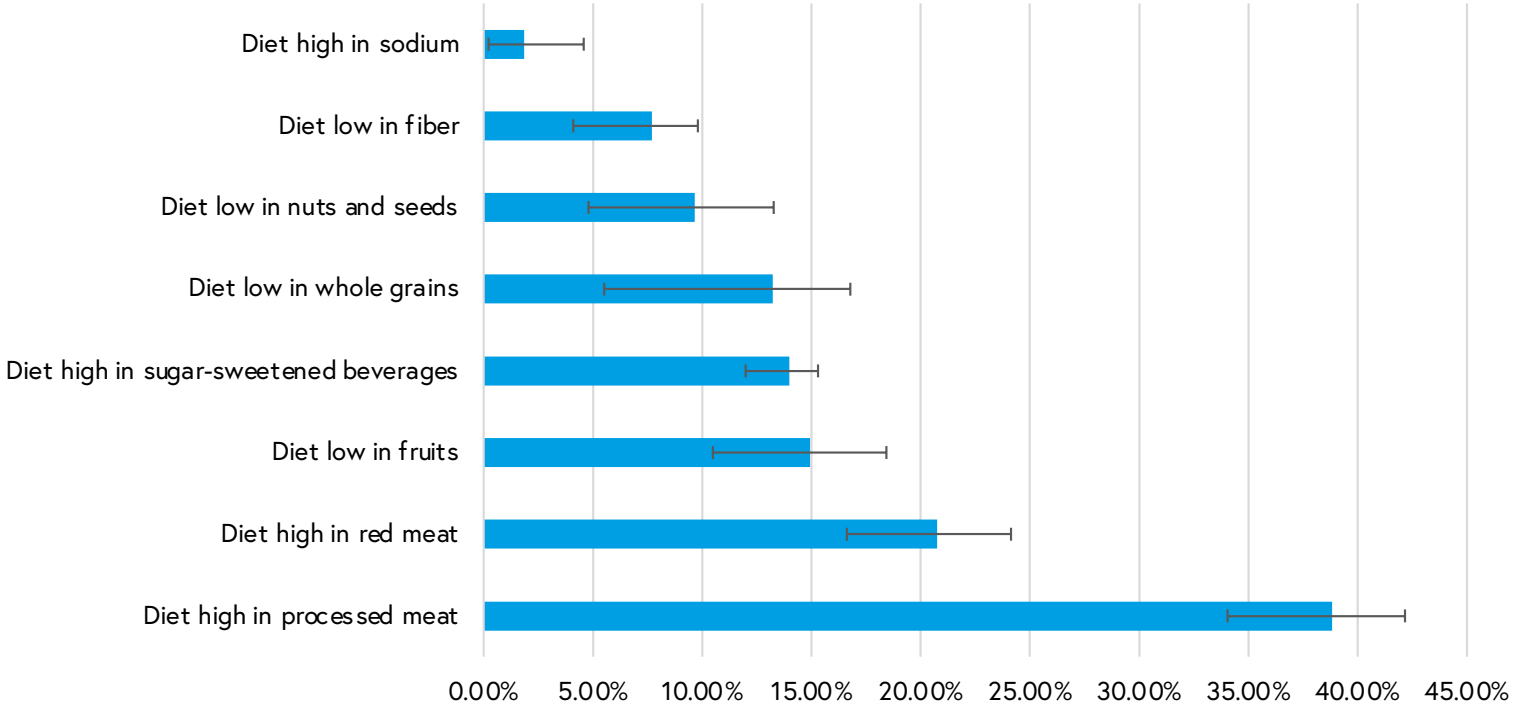
PERCENTAGE DIETARY DALYs (CVD)



SOURCE: Global Burden of disease, 2019 data. Accessed March 2021. GBD Results Tool | GHDx (healthdata.org)

The dietary risk factors that contribute to diabetes and kidney disease

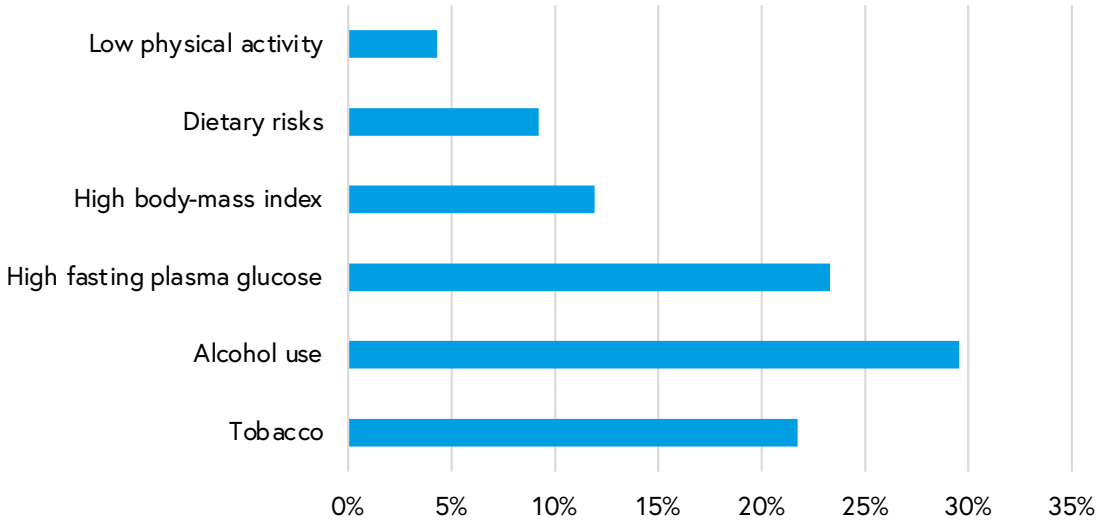
PERCENTAGE DIETARY DALYs (DIABETES AND KIDNEY DISEASE)



SOURCE: Global Burden of disease, 2019 data. Accessed March 2021. GBD Results Tool | GHDx (healthdata.org)

Risk factors that contribute to breast cancer

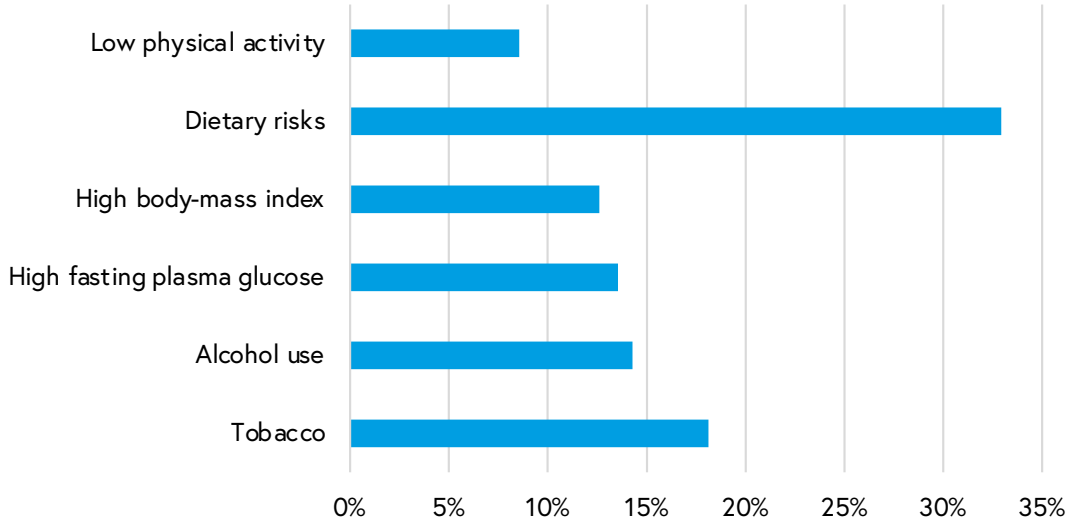
RISK FACTORS FOR BREAST CANCER DALYs IN ENGLAND



SOURCE: Global Burden of disease, 2019 data. Accessed March 2021. GBD Results Tool | GHDx (healthdata.org)

Risk factors that contribute to colorectal cancer

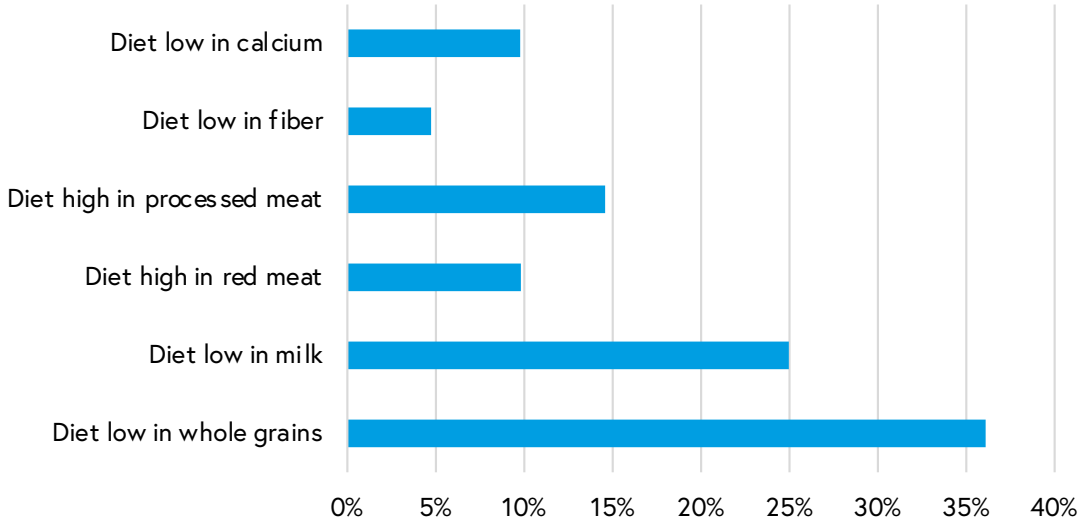
CAUSES OF COLORECTAL CANCER DALYs IN ENGLAND



SOURCE: Global Burden of disease, 2019 data. Accessed March 2021. GBD Results Tool | GHDx (healthdata.org)

The dietary risk factors that contribute to colorectal cancer

DIETARY RISK FACTORS FOR COLORECTAL CANCER DIETARY DALYs IN ENGLAND

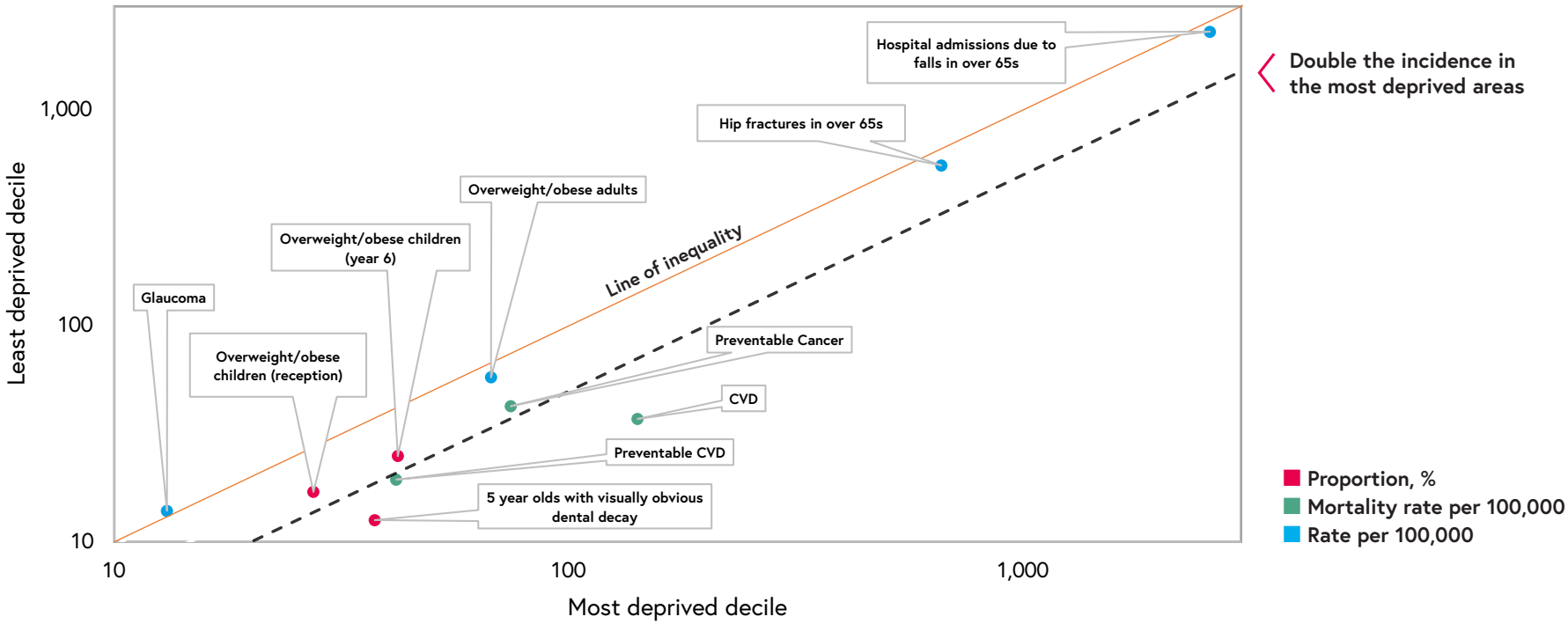


SOURCE: Global Burden of disease, 2019 data. Accessed March 2021. GBD Results Tool | GHDx (healthdata.org)

National
Food Strategy

INEQUALITY

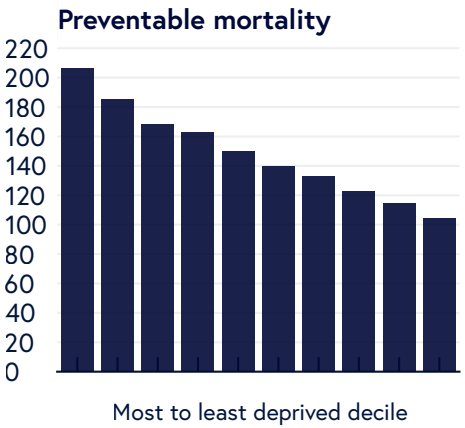
There is a strong correlation between deprivation, weight and diet-related ill health

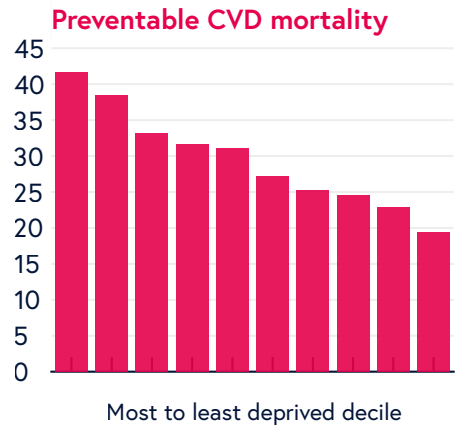


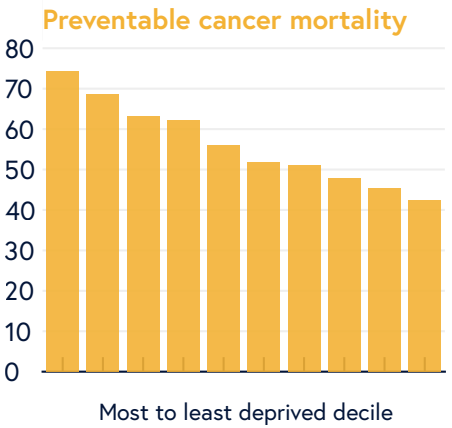
Most diet-related health outcomes fall below the line of equality: health outcomes for those in the most deprived areas of England are worse than for people in the most affluent areas (least deprived). For some diet-related outcomes such as 5-year-olds with visual dental decay, the proportion in the most deprived decile is more than double the proportion in the least deprived decile.

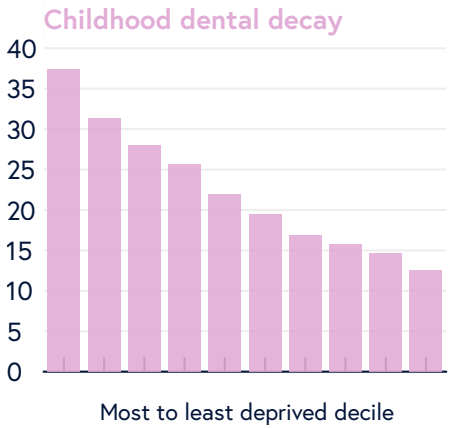
SOURCE: NFS analysis of PHE Health outcomes framework data

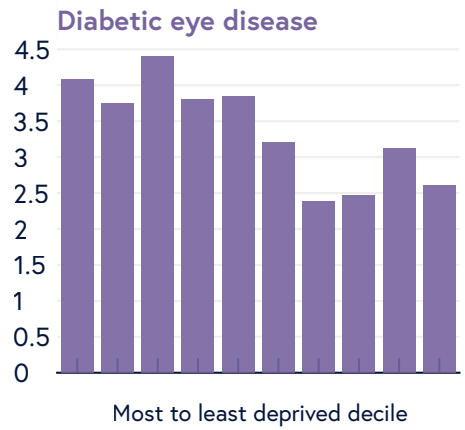
Inequalities in incidence of, and death rates from, diet-related disease

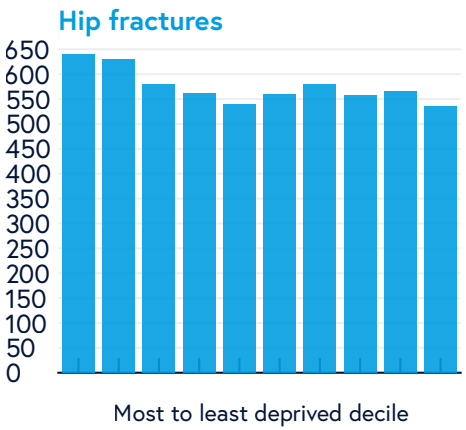


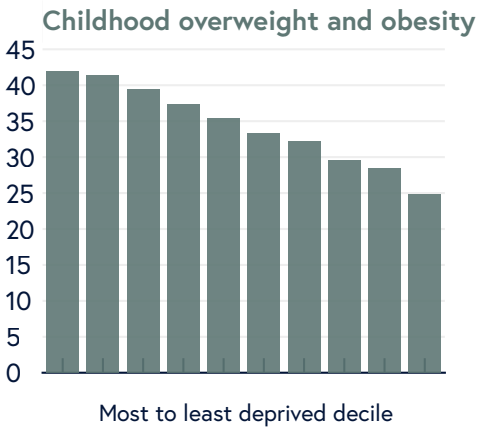












Childhood overweight and obesity = Year 6 childen

Dental decay = children aged 5

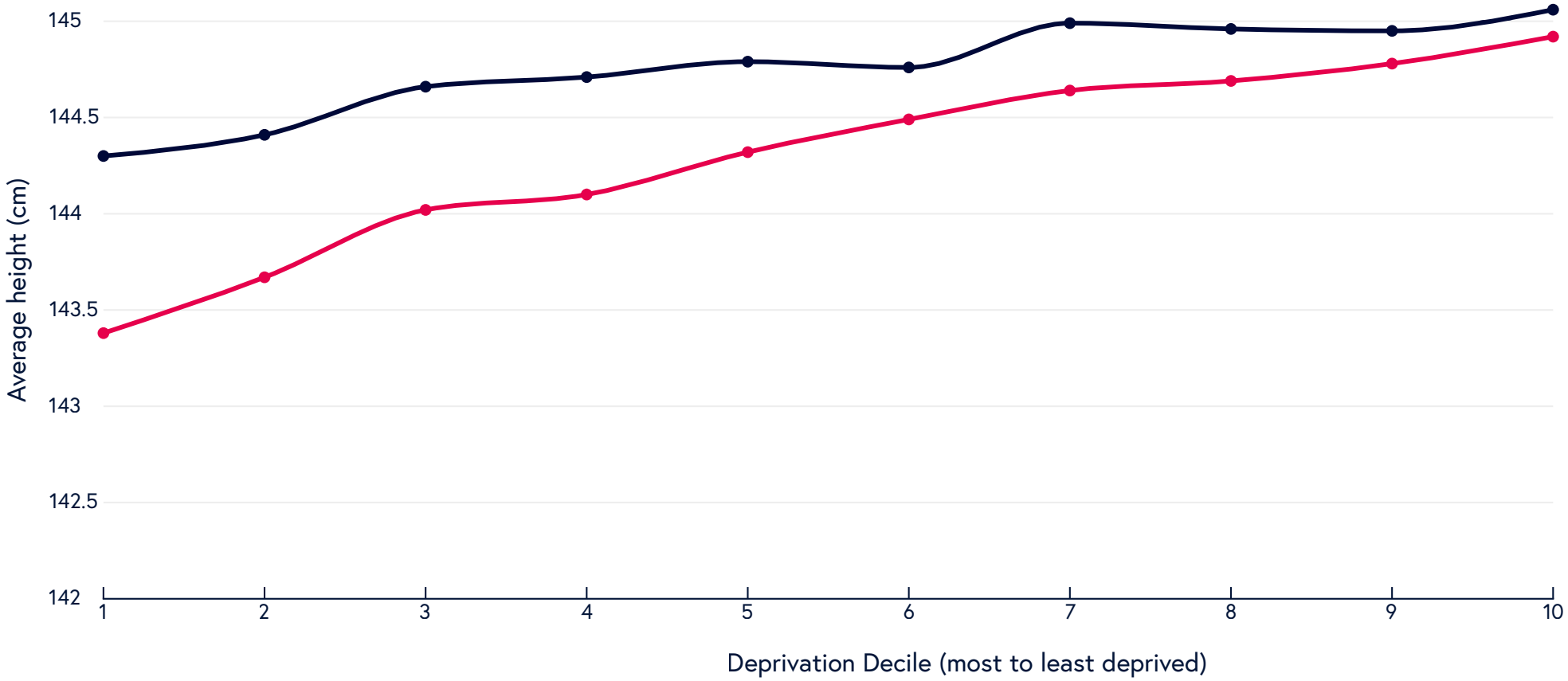
Note: Y axis in all charts shows relative risk, expressed as percentages, rate per 100,000 people, or mortality per 100,000 people.

SOURCE: NFS analysis of PHE Health outcomes framework data

Children living in deprived communities are on average shorter than those in wealthier communities by the time they reach age 11

AVERAGE HEIGHT OF WHITE BRITISH CHILDREN IN YEAR 6, BY DEPRIVATION GROUP, 2019- 2020

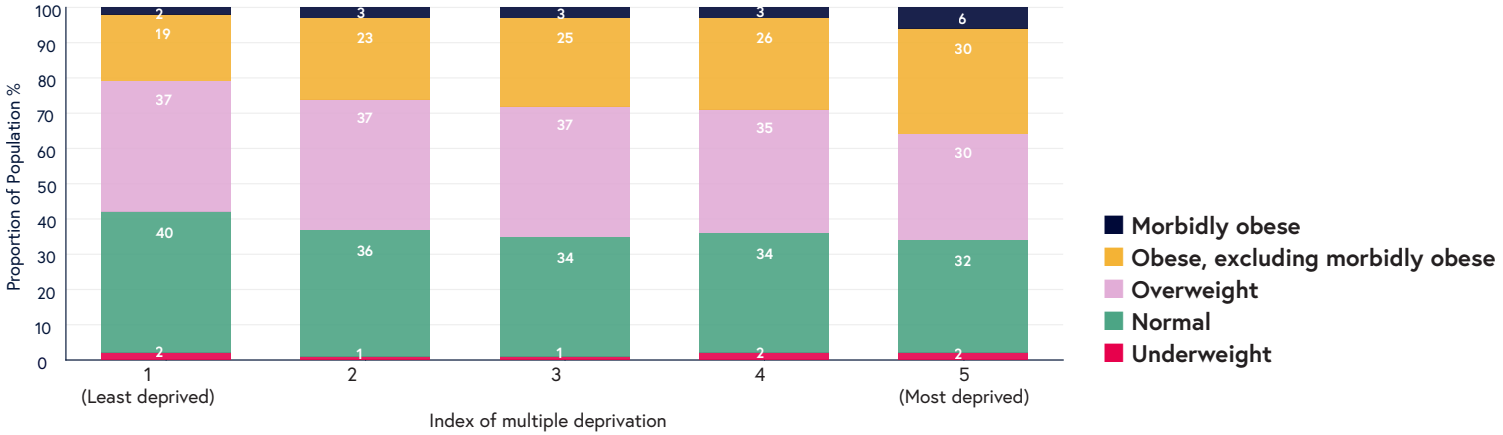
Having low height is a measure of poor nutrition and living environment, and is highly predictive of health outcomes in later life.



SOURCE: Food Foundation analysis of the National Child Measurement Programme, 2019-2020; Andrea Rodriguez-Martinez et al.(2020) Height and body-mass index trajectories of school-aged children and adolescents from 1985 to 2019 in 200 countries and territories: a pooled analysis of 2181 population-based studies with 65 million participants. *The Lancet*, 396 (10261)

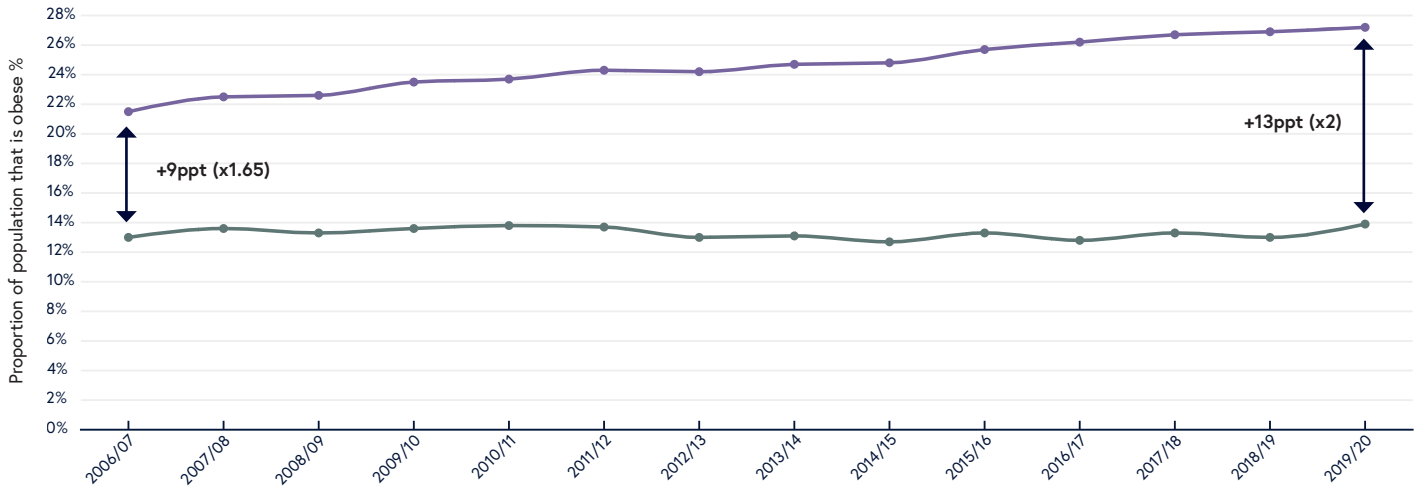
Lower-income deciles have worse health outcomes, particularly for obesity in children and severe obesity in adults

ADULTS: THOSE IN LOWEST QUINTILE TWICE AS LIKELY TO BE MORBIDLY OBESE



Note: BMI: Body Mass Index; Adults: Obesity (BMI>=30kg/m2), Overweight (25<BMI<30), Underweight (BMI<18.5) Children: obese was defined as >95th UK National BMI percentile established by the cross sectional stature and weight reference curves for the UK, 1990; Index of Multiple Deprivation accounts for income inequality but also for skills & education inequality, crime among other variables.

CHILDREN: MORE VULNERABLE TO INEQUALITY THAN ADULTS WITH GROWING LIKELIHOOD OF OBESITY AMONG MOST DEPRIVED

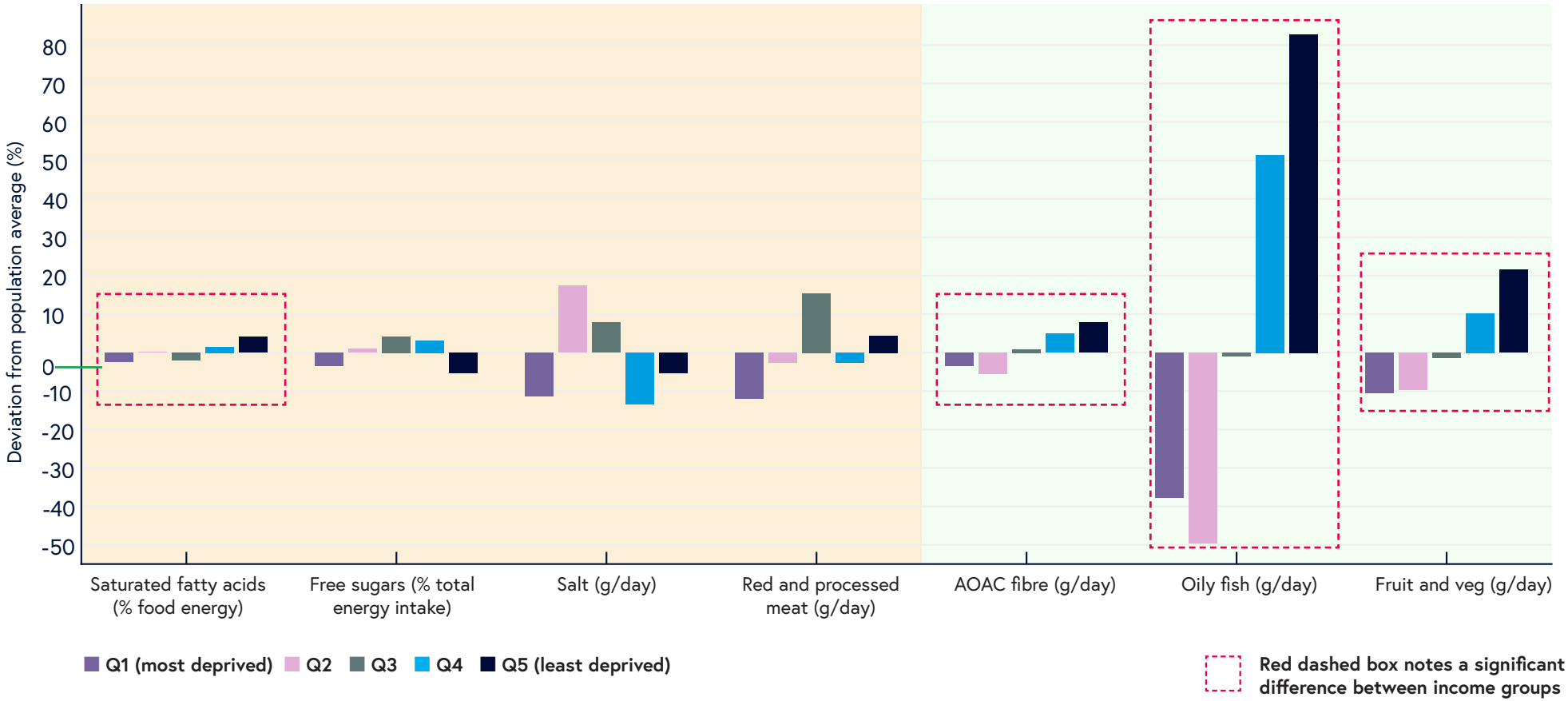


SOURCE: NHS Digital, Health Survey for England: adult and child overweight and obesity 2019, 2020; National Children Measurement Plan trend data for Year 6 children (aged 10-11) from 2006/2007 to 2018/2019

The Junk Food Cycle doesn't impact children equally

UK DIETARY INDICATORS BY EQUIVALISED INCOME: **CHILDREN**

Children on low incomes are more likely to have diets which are low in fibre, fruit, vegetables and oily fish

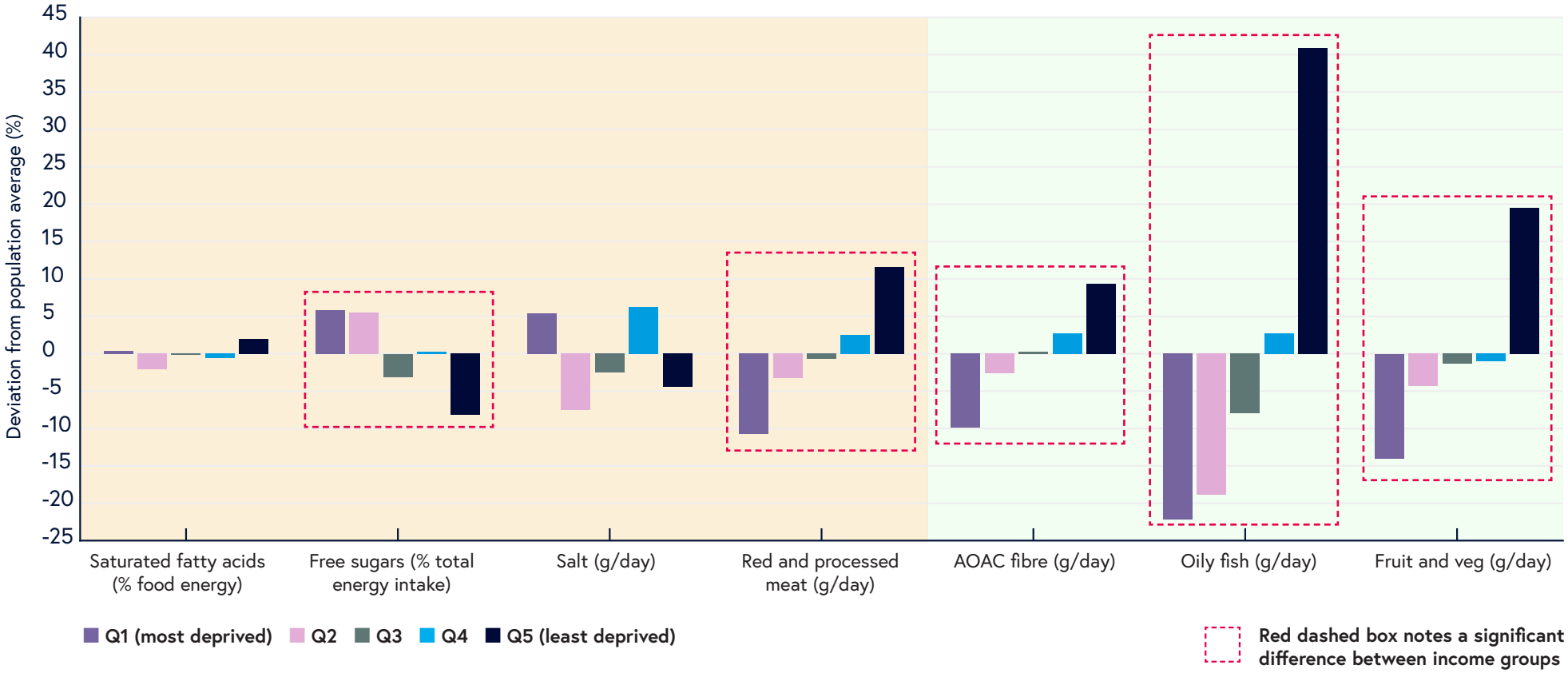


SOURCE: National Diet and Nutrition Survey, Years 7-8. NFS Analysis.

...this is also true of adults

Adults on low incomes are more likely to have diets which are higher in sugar, and low in fibre, fruit, vegetables and fish.

UK DIETART INDICATORS BY EQUIVALISED INCOME: **ADULTS**



SOURCE: National Diet and Nutrition Survey, Years 7-8. NFS Analysis.

Income and education correlates to diet

SUGARS & DESSERTS

Everyone eats too much sugar but those with low socioeconomic status eat slightly more.

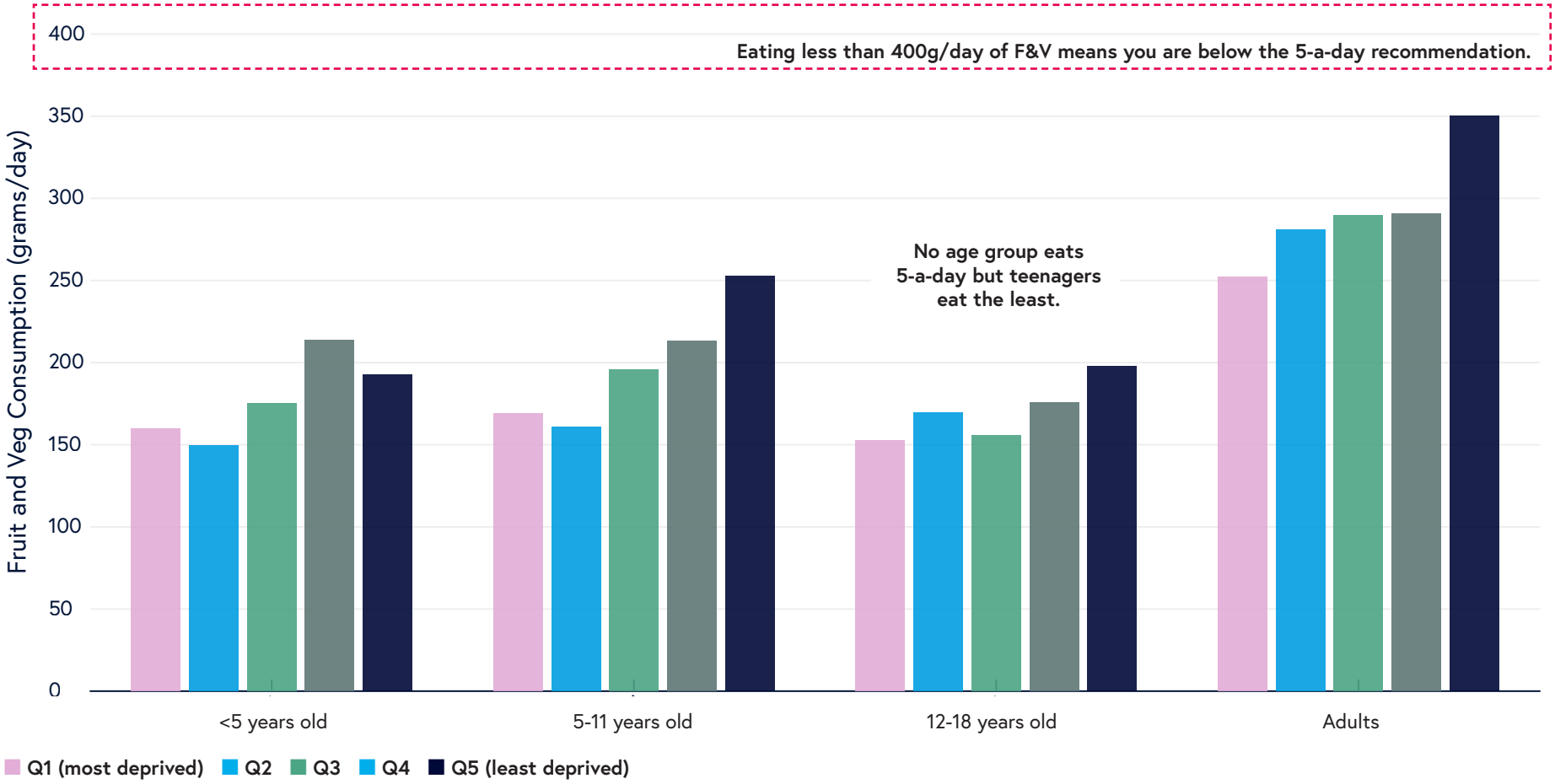
FRUIT & VEG

Those with high socioeconomic status eat more fruit and veg.

SOURCE: The Centre for Diet and Activity Research. (2014). Food, income and education: who eats more of what? [online]. Methodology note available at source link.

People on lower incomes eat fewer fruit and vegetables

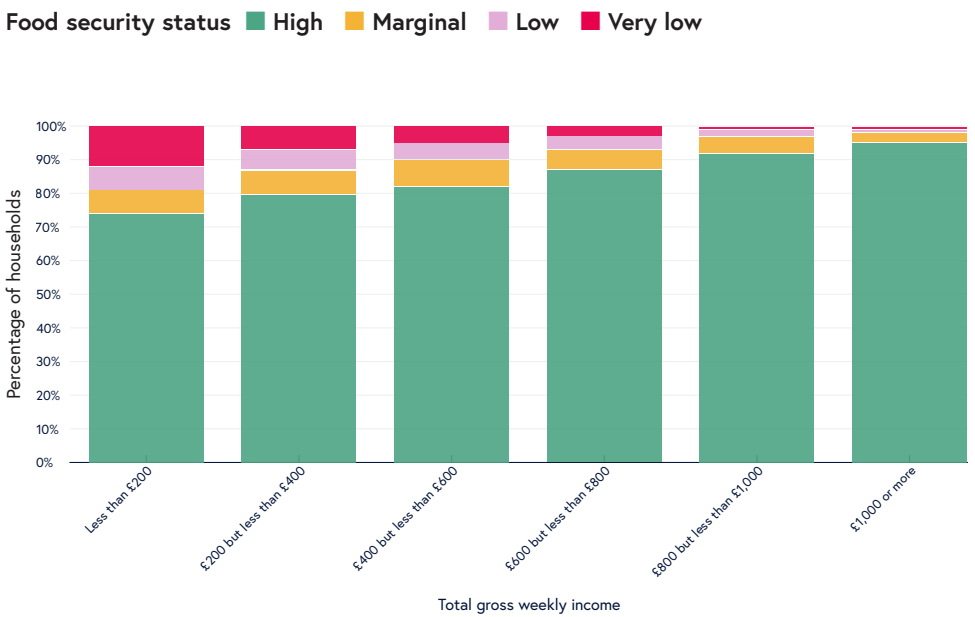
FRUIT ADN VEG CONSUMPTION BY EQUIVALISED INCOME



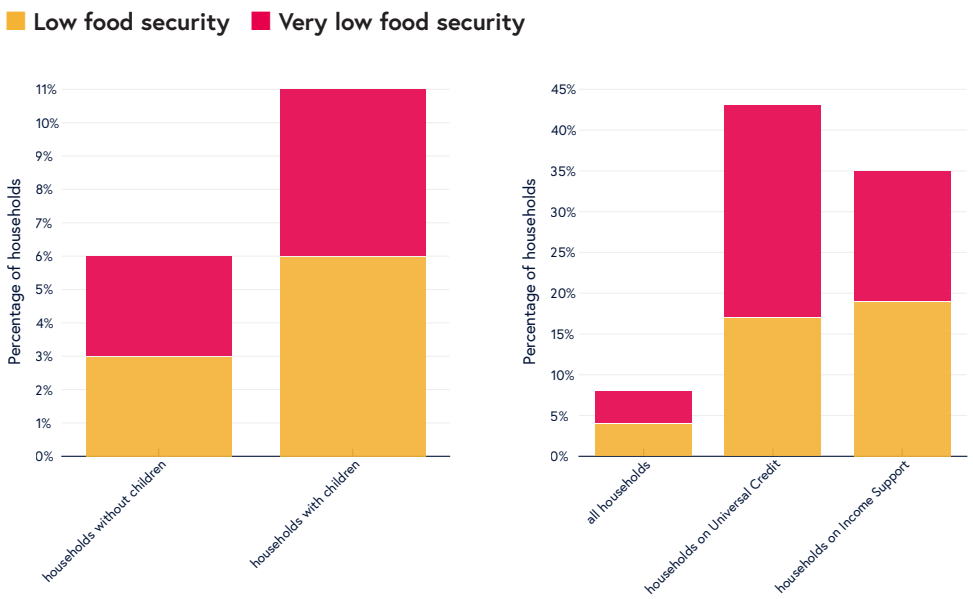
SOURCE: National Diet and Nutrition Survey, Year 7-8: NFS analysis.

As income decreases, households are more likely to be food insecure

HOUSEHOLDS BY TOTAL GROSS WEEKLY INCOME AND FOOD SECURITY STATUS



HOUSEHOLD FOOD SECURITY

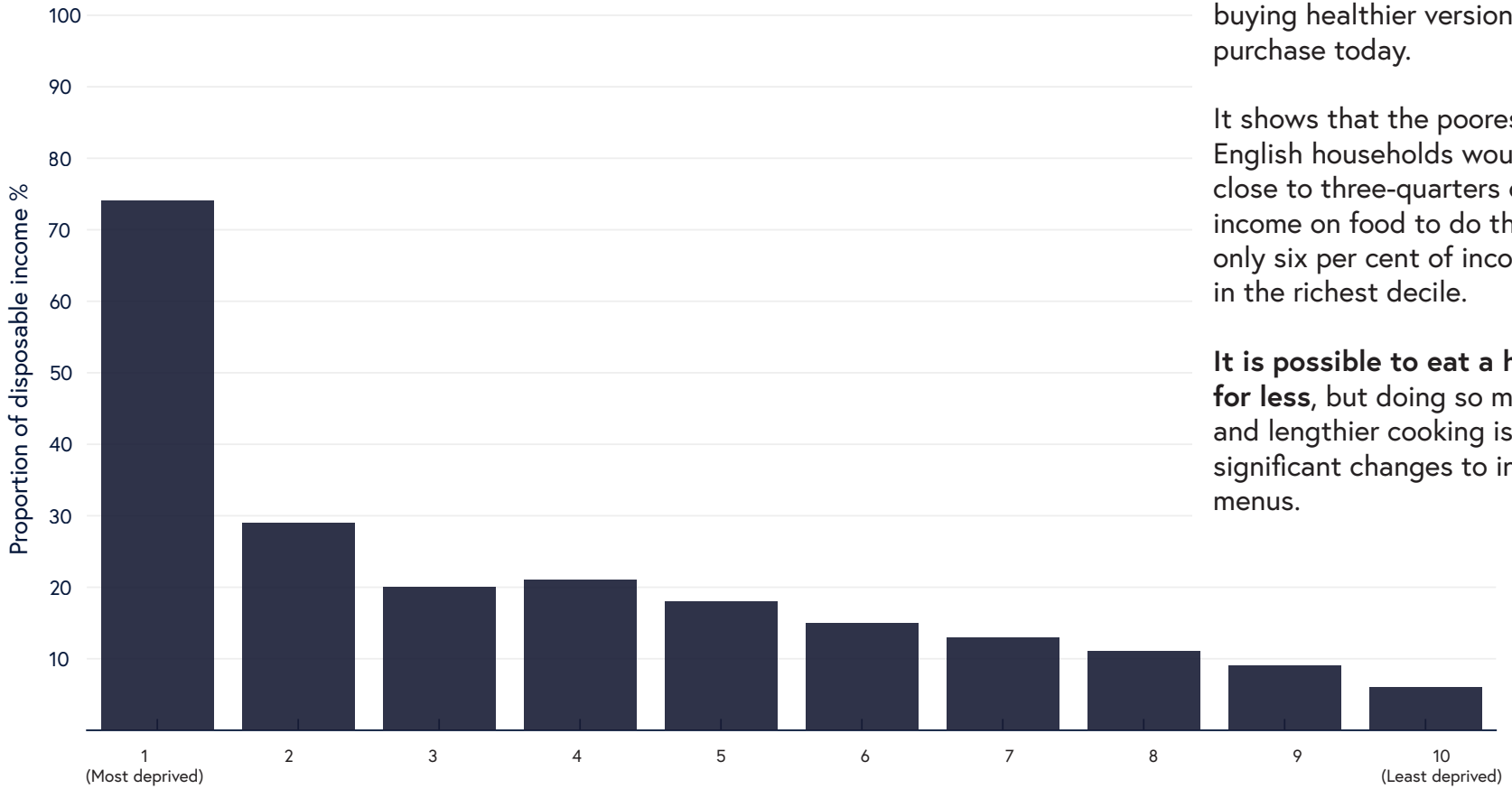


Low food security indicates the household reduced the quality, variety and desirability of their diets but the quantity or normal eating patterns were not substantially disrupted. Very low food security indicates the household experienced disrupted eating patterns or reduced their food consumption due to a lack of money or resources.

SOURCE: Family Resources Survey: financial year 2019 to 2020, 2021

Meeting the Eatwell Guide diet requires money, time and skills

PROPORTION OF DISPOSABLE INCOME (AFTER HOUSING COSTS) USED IF THE EATWELL GUIDE COST WAS SPENT BY ALL HOUSEHOLDS IN ENGLAND, BY INCOME DECILE 2016/17



This graph shows the costs of eating an Eatwell Guide diet while seeking to minimise behaviour change – i.e. by buying healthier versions of the goods we purchase today.

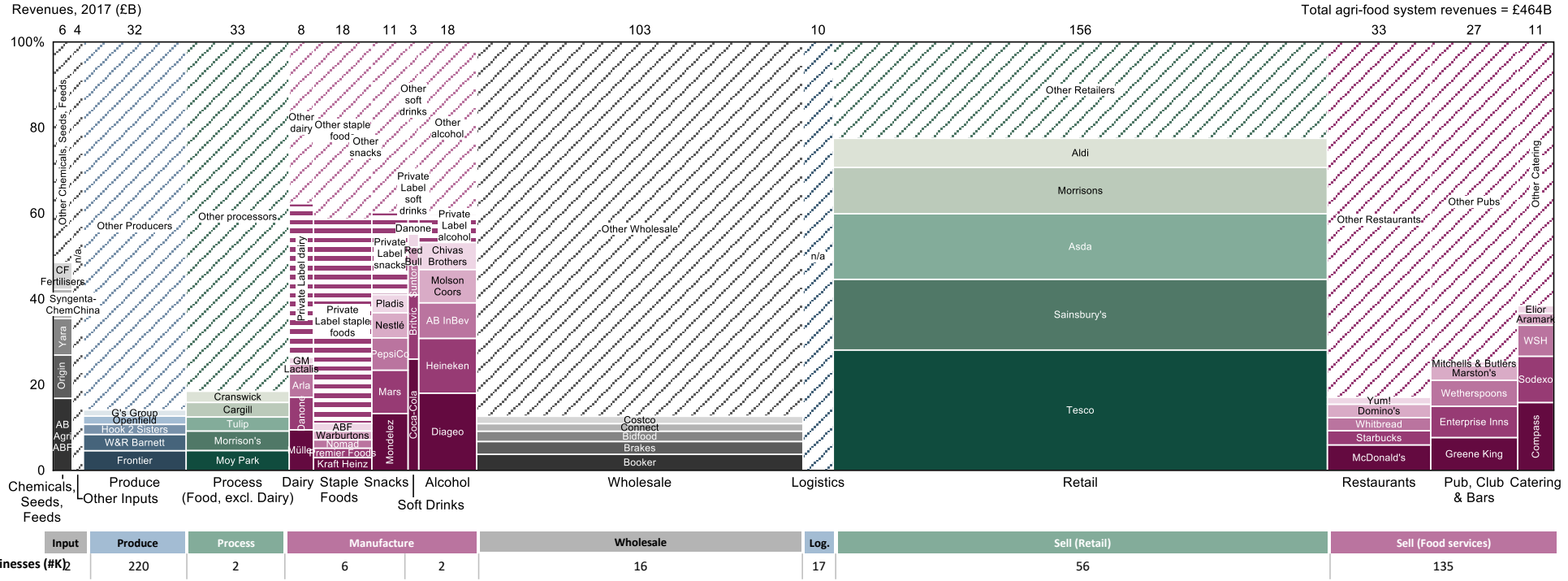
It shows that the poorest 10 per cent of English households would need to spend close to three-quarters of their disposable income on food to do this, compared with only six per cent of income for households in the richest decile.

It is possible to eat a healthy diet for less, but doing so may mean more and lengthier cooking is needed, with significant changes to ingredients and menus.

SOURCE: Food Foundation (2019) The Broken Plate

Market concentration varies widely across sectors, resulting in differences in bargaining power

ADDITIONAL RESOURCES AVAILABLE



	Input	Produce	Process	Manufacture		Wholesale	Log.	Sell (Retail)	Sell (Food services)
Businesses (#K)	2	220	2	6	2	16	17	56	135

Note: Top 5 players shown in each market; Overall market sizes from Annual Business Survey (excl. Produce), Produce market size based on Agriculture in the UK and Euromonitor; Chemicals, Seeds, Feeds: reported company financials from Capital IQ (CIQ) and Amadeus, companies shown based on global players identified in IPES (2017) report and CIQ data; Other inputs includes wholesale of live animals and agents involved in wholesale of agricultural goods, no players identified; Produce: share shown as latest reported company revenues 2017 – 2018; Process: shares based on CIQ revenues of processing subsidiaries (based on SIC code) of top 15 UK food manufacturers (Grocer report), some overlap with manufacturing as not split out in company financials, Dairy and Beverage processing included in manufacture as ABS and company financial data does not differentiate between activities; Manufacture: share shown as % of total sales in product category, not actual revenues, staple foods includes cooking ingredients, majority of private label is from large branded players but revenues not available; Alcoholic Drinks: reported revenues shown including exports, data provided by Defra; Wholesale: company revenues from Amadeus; Logistics breakdown not available as key players generate revenues in markets other than food; Retail market shares shown as 12 weeks ending 31th Dec 2017 from Kantar; Foodservices: reported company revenues from Global Data; Revenue data from CIQ and Amadeus is for UK-operating companies, but may include some non-UK revenue depending on company reporting structure; Source: Annual Business Survey (ABS), ONS, 2018; Agriculture in the UK, Defra, 2018; Top 150, OC&C / The Grocer, 2018; Kantar Worldpanel; Global Data; Company Reports; Euromonitor; Company financials from Capital IQ (CIQ), Companies House, Amadeus, Fame; Defra analysis; Too big to feed, International Panel of Experts on Sustainable Food Systems (IPES), 2017.

SOURCE: Bain for NFS.

Bargaining power imbalance can lead to excessive risk transfer & unexpected costs

RETAILERS HAVE USED BUYER POWER TO TRANSFER EXCESSIVE COSTS AND RISKS TO SUPPLIERS

- The Competition Commission has conducted two major enquiries into the UK grocery market over the last two decades, focused on the relationships between large supermarkets and their suppliers.

*"…any supermarket that [has] s**hares of more than eight per cent** of grocery purchases for resale from their stores are, for the most part, **able to control their relationships with suppliers to their own advantage**, whilst the smaller multiples are not able to do so to anywhere near the same extent"*

COMPETITION COMMISSION, 2000

*"…[When] grocery retailers **transfer excessive risks or unexpected costs to their suppliers, this is likely to lessen suppliers' incentives to invest in new capacity, products and production processes**. If unchecked, we conclude that these practices will ultimately have a detrimental effect on consumers."*

COMPETITION COMMISSION, 2008

ADDITIONAL RESOURCES AVAILABLE

Note: The Code refers to the Groceries Supply Code of Practice.

THE CODE WAS INTRODUCED IN 2009 TO PROTECT SUPPLIERS FROM ABUSE OF BUYER POWER

*"The Code sets out how grocery retailers treat their suppliers and aims to **make sure that they do not abuse their commercial power**."*

COMPETITION AND MARKETS AUTHORITY, 2008

- The code, enforced by the Grocery Code Adjudicator (GCA) since 2013, applies to retailers with annual UK groceries turnover exceeding £1B – currently 12 supermarkets:

TESCO, ASDA, Sainsbury's, Morrisons, M&S, ALDI, Iceland, LIDL, co-op, Waitrose, ocado, B&M

THE CODE COVERS ONLY PART OF VALUE CHAIN – CONCERNS RE UNFAIR PRACTICES REMAIN

- The Code **applies only to suppliers who contract directly with designated retailers**, meaning majority of farmers are not covered.
- **Calls to extend the GCA remit was rejected** by HMG in 2018, following a Call for Evidence:
- *"Although there are clearly **a number of concerns** relating to the experience of some farmers and growers in the supply chain, there is **no clear evidence of systematic widespread market failures**."*

HMG, 2018

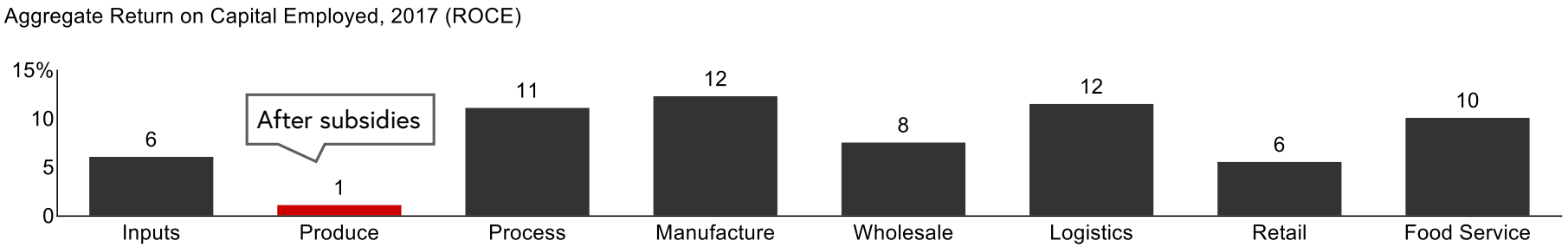
- **The review did, however, introduce new measures to enable primary producers to "survive and thrive"**, including a plan to introduce compulsory written contracts in the dairy sector and a £10M collaboration fund for farmers.
- The NFU welcomed the new measures, but found them to be **insufficient**:

*"The measures that have been announced to address [the imbalance of power within UK food supply chains] **do not go far enough**, and it's an opportunity missed"*

NFU PRESIDENT, FEBRUARY 2018

SOURCE: Bain for NFS, based on 'Supermarkets – A report on the supply of groceries from multiple stores in the United Kingdom 2000', Competition Commission; 'Notice of designation of TJ Morris Limited under the Groceries (Supply Chain Practices) Market Investigation Order 2009', Competition & Markets Authority, 2019; GfK, Research on suppliers to the grocery market: A Report for the Competition Commission; 'Groceries Code Adjudicator Review: Part 2', 2018

Returns on capital employed (ROCE) vary widely; farmers on average see lowest returns



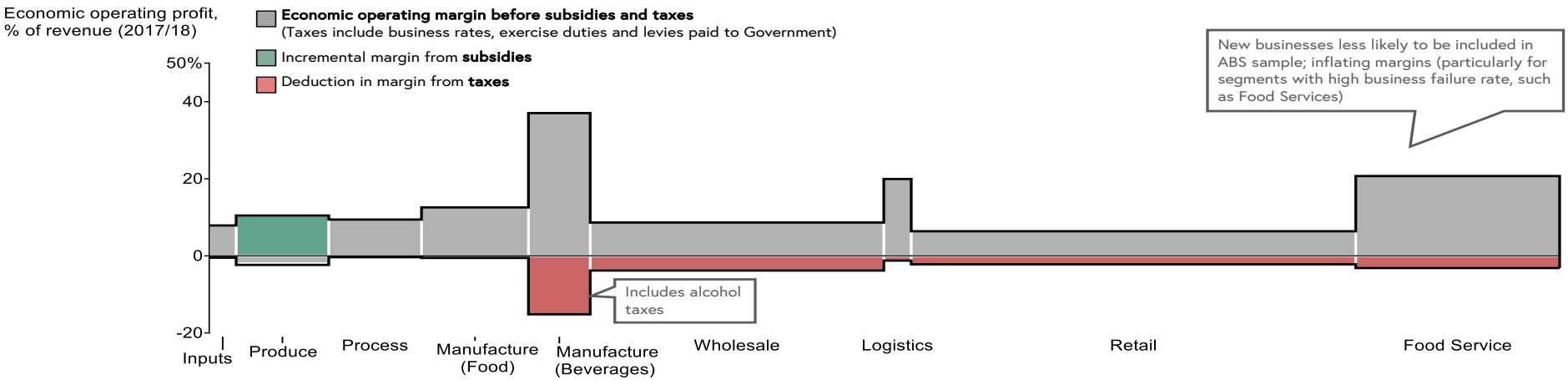
	Inputs	Produce	Process	Manufacture	Wholesale	Logistics	Retail	Food Service
Revenue, (2017, £B)	9	32	33	59	103	10	156	72
Key players ROCE snapshot (2017-18)	• Syngenta UK: 32% • Origin UK: 23% • Yara: 23% • Nufarm: 4% • Devenish Nutrition: -2%	• Very large farms: 2.6% • Large farms: 1.5% • Medium farms: 0.7% • Small farms: 0.2% • Part-time farms: -0.1%	• Tate & Lyle: 16% • Olam UK: 11% • Cranswick: 10% • Cargill: 4% • Tulip: -20%	• Coca-Cola: 38% • Greencore: 25% • Mars: 20% • Diageo: 7% • Kellogs: 2%	• Bookers: 26% • Dhamecha: 16% • Bestway: 5% • Lineage Yearsley: -5% • Blakemore: -14%	• DHL: 14% • Eddie Stobart: 7% • Reed Boardall: 1% • Lineage Yearsley: -5%	• Tesco: 11% • Lidl: 11.% • Aldi: 9% • Sainsbury's: 8.5% • Morrisons: 8% • Asda: 4% • McColl: 4%	• McDonalds: 26% • Compass: 25% • Sodexo: 18% • Greggs: 14% • Greene King: 8.5% • Nando's: 3%

Note: Produce ROCE is for England; Company ROCEs are 2018 unless only 2017 available; Overall ROCE %s for Inputs, Process, Wholesale, Logistics, Retail and Food Service sectors are based on CIQ database of ~2,000 companies; Manufacturing sector ROCE is from OC&C report; Key player ROCEs calculated from Companies House Report and Financial Statements for UK business, based on Operating Profit after adjusting for exceptional items.

ADDITIONAL RESOURCES AVAILABLE

SOURCE: Bain for NFS, based on Company Annual Reports, Companies House; OC&C and The Grocer Top 150, 2018; Capital IQ; Annual Business Survey, ONS, 2017; Agriculture in the UK 2018

In aggregate, farmers rely on subsidy to make a profit



	Inputs	Produce	Process	Manufacture (Food)	Manufacture (Beverages)	Wholesale	Logistics	Retail	Food Service
Revenue (£B)	9	32	33	38	22	103	10	156	72
# Businesses (K)	2	220	2	6	2	16	17	56	135
Business failiure rate (%)	8%	3%	9%	9%	9%	10%	17%	10%	14%

*Note: Bar widths reflect segment revenues (excl. VAT); For segment other than 'Produce', economic profit margin calculated from ABS data as: Total turnover – (Employee cost + Total purchases + Taxes + Inventory decrease); ABS data does not include interest and D&A cost as not available; Taxes include business rates, exercise duties and levies paid to Government, but VAT, corporation tax, capital gain tax, capital allowance and water rates are not included; Produce margin represents aggregate of Farmers and Fisheries, Farmers' profit margin calculated as (Output at market prices + Total subsidies on product) – (Compensation of paid employees + Rent + Intermediate consumption + Total consumption of fixed capital + Imputed cost of unpaid labour); Imputed cost of unpaid labour for Farmers removed from Produce operating margin, assumed to be 10% of revenues (incl. diversified income and subsidies), inline with unpaid labour as % of England Farm Business Income; *Subsidies and taxes shown as % of revenues pre Government interventions; Input includes chemicals, animal feed and seeds and live animals – animal feed and seeds assumed to be 5% of Wholesale of grain, unmanufactured tobacco, seeds and animal feeds (SIC 46.21) based on farmer spend reported in AUK Data; Logistics assumed to be 34% of total revenue for freight transport in the UK, equivalent to % of total freight transport for food; Most recent data used for each source: 2018 for AUK and 2017 for ABS; Revenues and number of businesses in 'Produce' relate to farm holdings (as opposed to farm businesses) and fisheries businesses. Diversified activities (e.g. letting buildings, sport and recreation, tourism) generally increase profits on farms.*

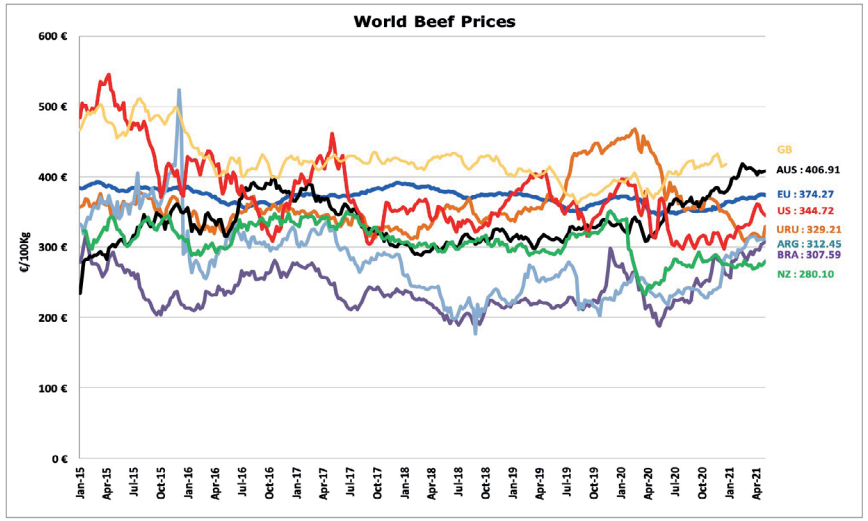
ADDITIONAL RESOURCES AVAILABLE

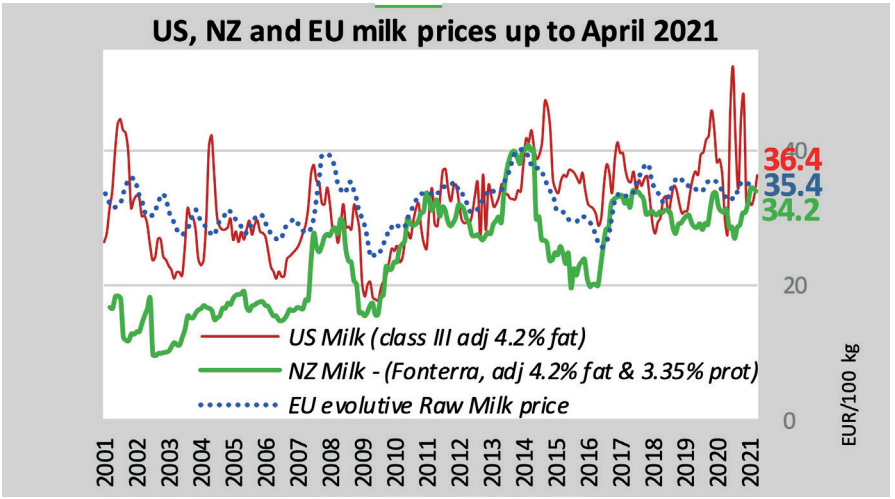
SOURCE: Bain for NFS, based on Annual Business Survey (ABS), ONS, 2017; Agriculture in the UK (AUK), Defra, 2018; Euromonitor; OC&C and The Grocer Top 150, 2018; Capital IQ database of ~2000 companies; Domestic freight moved by commodity, Department for Transport, 2017

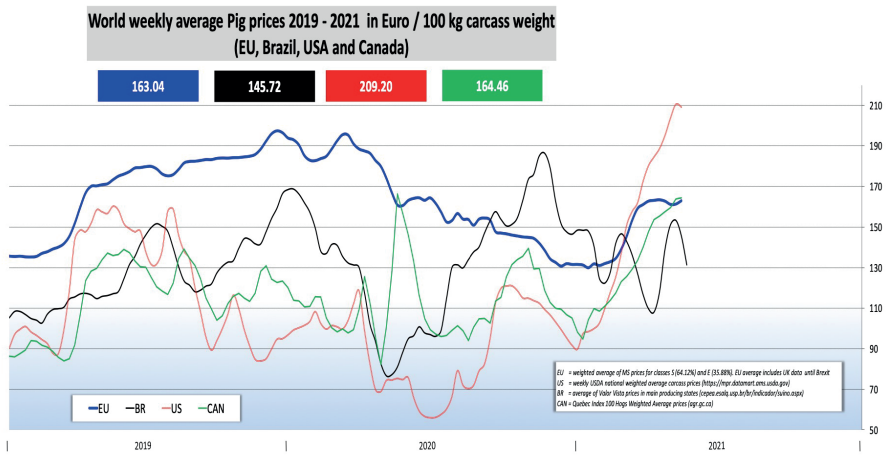
National
Food Strategy

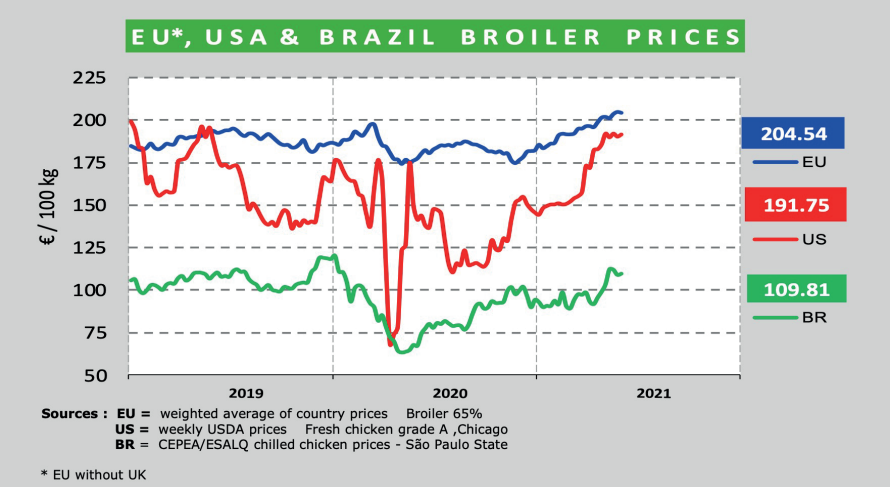
TRADE

The UK/EU has consistently higher prices for many key commodities than overseas producers





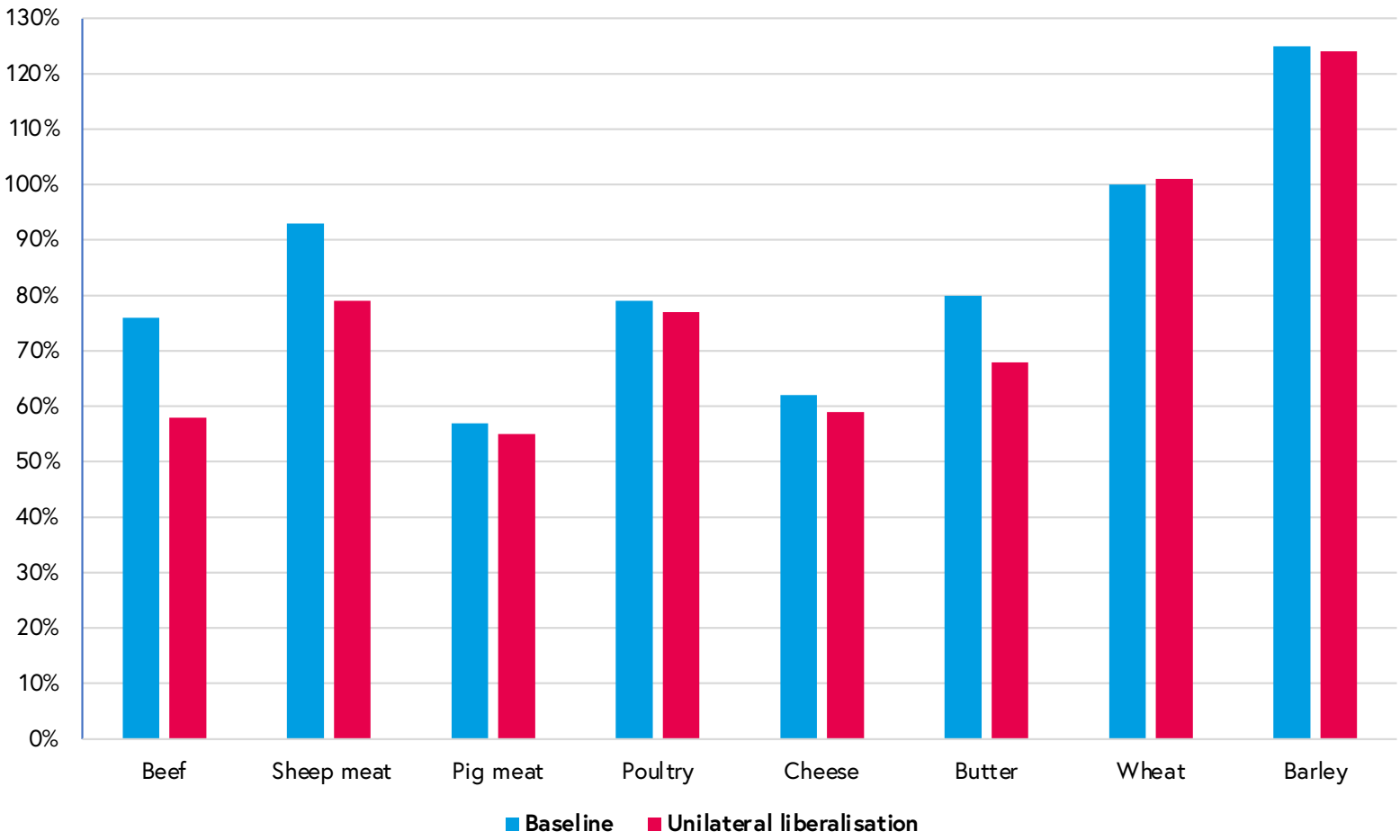




SOURCE: European Commission market observatories; https://ec.europa.eu/info/food-farming-fisheries/farming/facts-and-figures/markets/overviews/market-observatories/meat_en

Imports would be likely to increase and self-sufficiency fall in some sectors if the UK cuts its tariffs

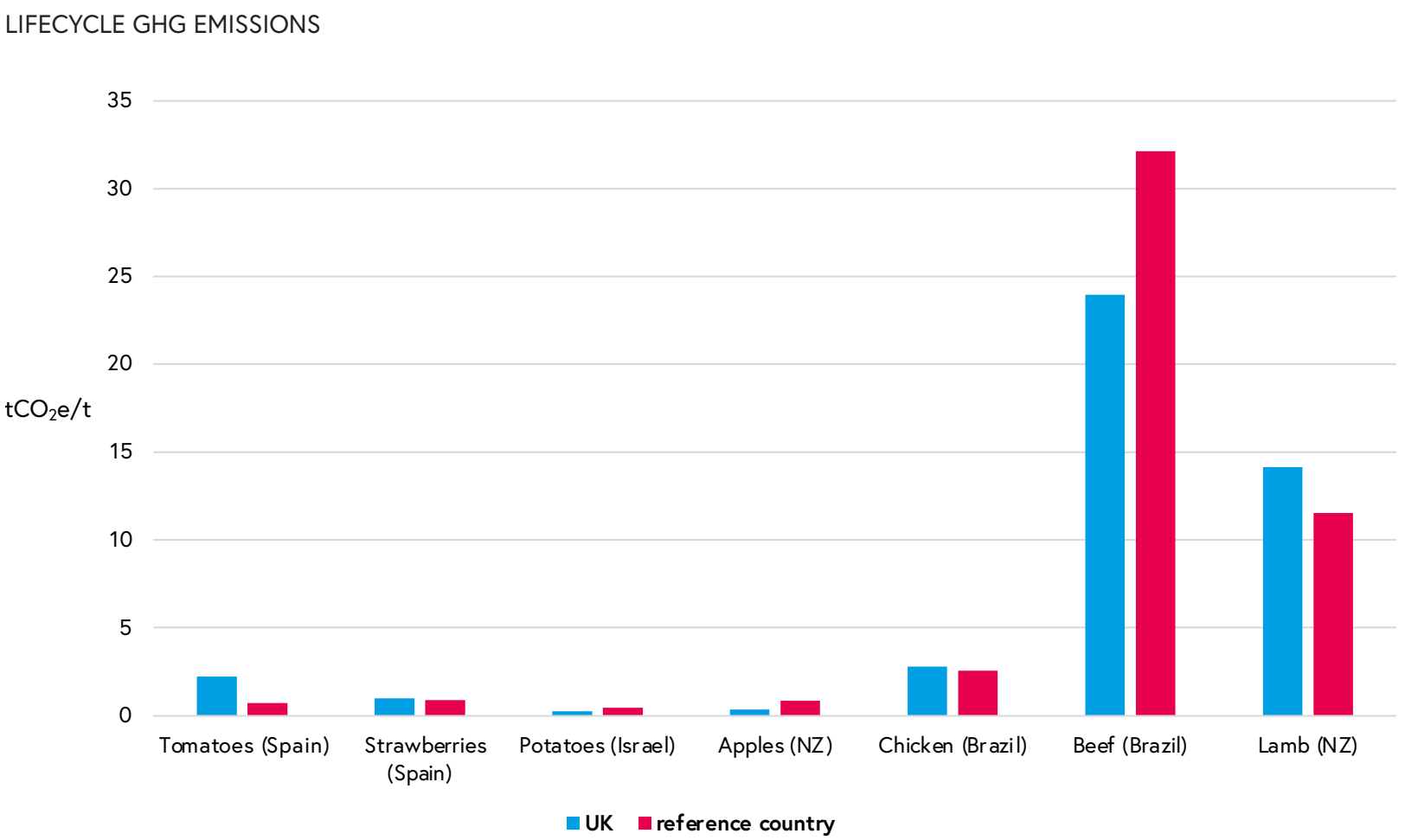
UK SELF-SUFFICIENCY RATIO



Note: this scenario assumes that current agricultural subsidies in the UK remain the same.

SOURCE: adapted from Hubbard et al (2019) https://onlinelibrary.wiley.com/doi/pdf/10.1111/1746-692X.12199

Environmental impacts are sometimes but not always greater from imported products



SOURCE: adapted from Williams et al (2008), Final Report for Defra Project FO0103

UK standards are higher than many exporting countries

	UK standard	US standard	Australian standard	Brazilian standard
Laying hens	All cages must have a perch, nest box and litter and provide at least 750 cm^2 of space per bird.	No federal standard; voluntary guidelines suggest cages should be at least 432 cm^2. But California will require entirely cage-free housing from 2022, with other states expected to follow.	Legally binding federal standards for poultry welfare are in the final stages of development. Current voluntary guidelines suggest cages should have at least 550 cm^2 of space per bird.	No legislation. Space standards as low as 357 cm^2 per bird are seen.
Broiler chickens	Stocking density may not be higher than 39kg/m^2. Chemical washes banned.	No federal legal maximum stocking density. Chemical washes widely used.	Voluntary guidelines suggest stocking density should not be higher than 46kg/m^2.	No legislation.
Beef cattle	Growth hormones banned since 1981.	Growth hormones widely used.	Growth hormones used on about 40% of cattle.	Use of hormones in beef cattle prohibited by Normative Instruction No 55 of 2011.
Dairy cattle	Bovine somatotropin (BST) hormone banned since 1990. Maximum somatic cell count (SSC) 400,000/ml.	BST widely used. SCC maximum 750,000/ml.	BST banned. Industry standard maximum SCC 400,000/ml (but not in federal law and may vary).	BST widely used.
Sheep	Tail docking with rubber rings permitted in lambs under 7 days without anaesthesia. Castration without anaesthetic permitted in lambs under 3 months. Mulesing and other mutilations prohibited.	No federal legislation; the American Sheep Industry Association's Sheep Care Guide suggests that castration and tail docking may be performed without anaesthesia up to 8 weeks.	Castration and tail docking may be performed without anaesthetic up to 6 months. Mulesing practised in sheep for wool production; anaesthesia should be used "where practical and cost-effective".	No legislation or guidance.
Animals in organic systems	Antibiotic use permitted for therapeutic use on a veterinarian's prescription.	Total ban on antibiotic use.	Antibiotic use permitted for therapeutic use on a veterinarian's prescription, but the meat cannot then be sold as organic and products (such as milk) may be sold as organic only after a waiting period.	Antibiotics may be used therapeutically, but the animal products may not be sold as organic before a waiting period.
Pigs	Sow stalls banned since 1999. Ractopamine (beta-agonist used as growth promoter) banned.	Sow stalls legal in 41 states (but banned in California and several others). Ractopamine used in 60-80% of pigs.	Sow stalls banned in 2 states; elsewhere sows may be confined in stalls for no more than 6 weeks. Voluntary phase out in place. Ractopamine use legal.	No legislation on sow stalls. Ractopamine in use.
Welfare in transport	Maximum legal journey time 12 hours; livestock density set by law.	Maximum journey time 28 hours; no maximum legal stock density.	Maximum journey times vary: e.g. 48 hours for adult sheep and cattle; 24 hours for pigs. Loading densities set nationally, implemented in state law.	Regulated by National Traffic Council Regulation No 675 of 2017. Basic standards for vehicles but no maximum journey time and no maximum stocking density.
Antibiotic use	Average antibiotic use in food animals limited to 29.5mg/kg.	Average antibiotic use in food animals limited to 160.7mg/kg. (Except organic.)	Use of antibiotics as growth promoters legal. Some high-priority human antibiotics banned for use in animals. Use concentrated in domestically focused pig and poultry farms.	Antibiotics widely used as growth promoters, but many categories prohibited. Average use reported lower than some EU countries, but data is patchy.

SOURCE: NFS analysis