nesta

The future of food

Opportunities to improve health through reformulation

January 2023

About Nesta

We are Nesta, the UK's innovation agency for social good. We design, test and scale solutions to society's biggest problems. Our three missions are to give every child a **fair start**, help people live **healthy lives**, and create a **sustainable future** where the economy works for both people and the planet.

For over 20 years, we have worked to support, encourage and inspire innovation. We work in three roles: as an **innovation partner** working with frontline organisations to design and test new solutions, as a **venture builder** supporting new and early stage businesses, and as a **system shaper** creating the conditions for innovation.

Harnessing the rigour of science and the creativity of design, we work relentlessly to change millions of lives for the better.

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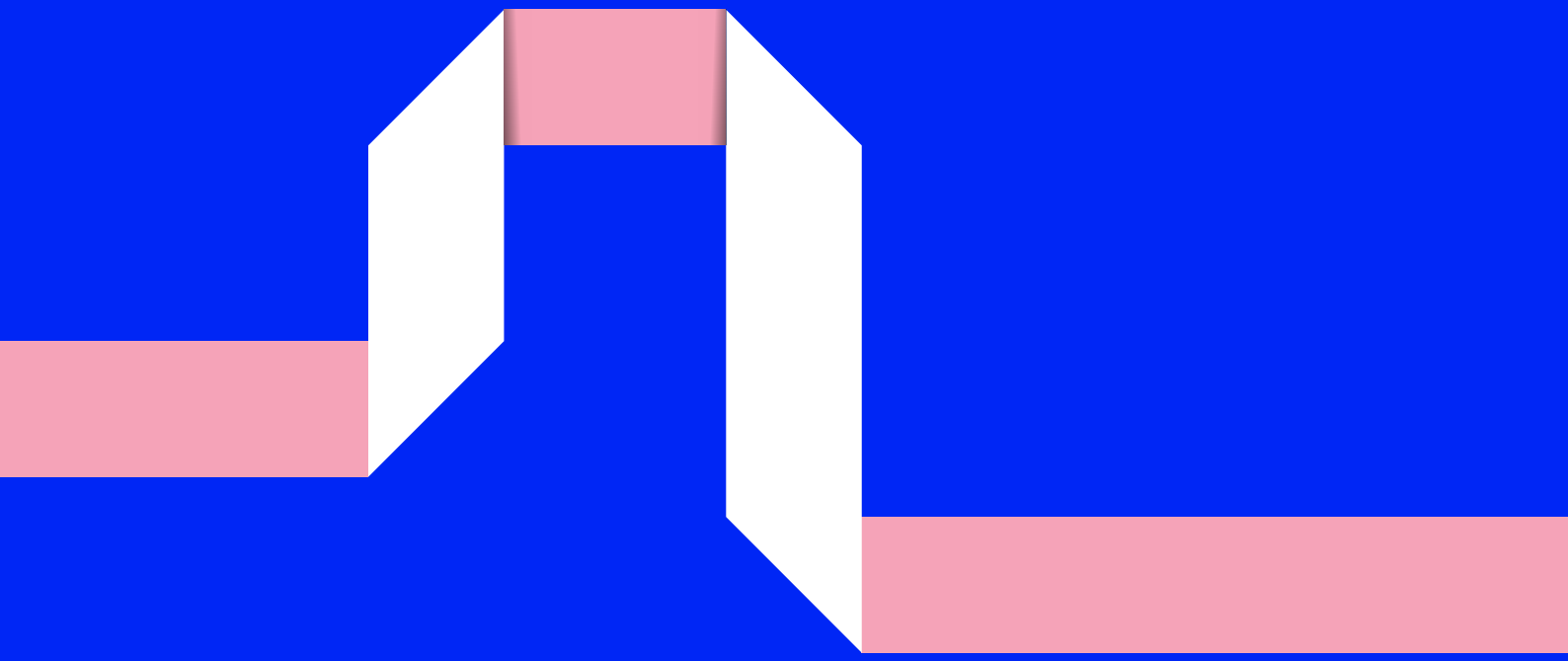

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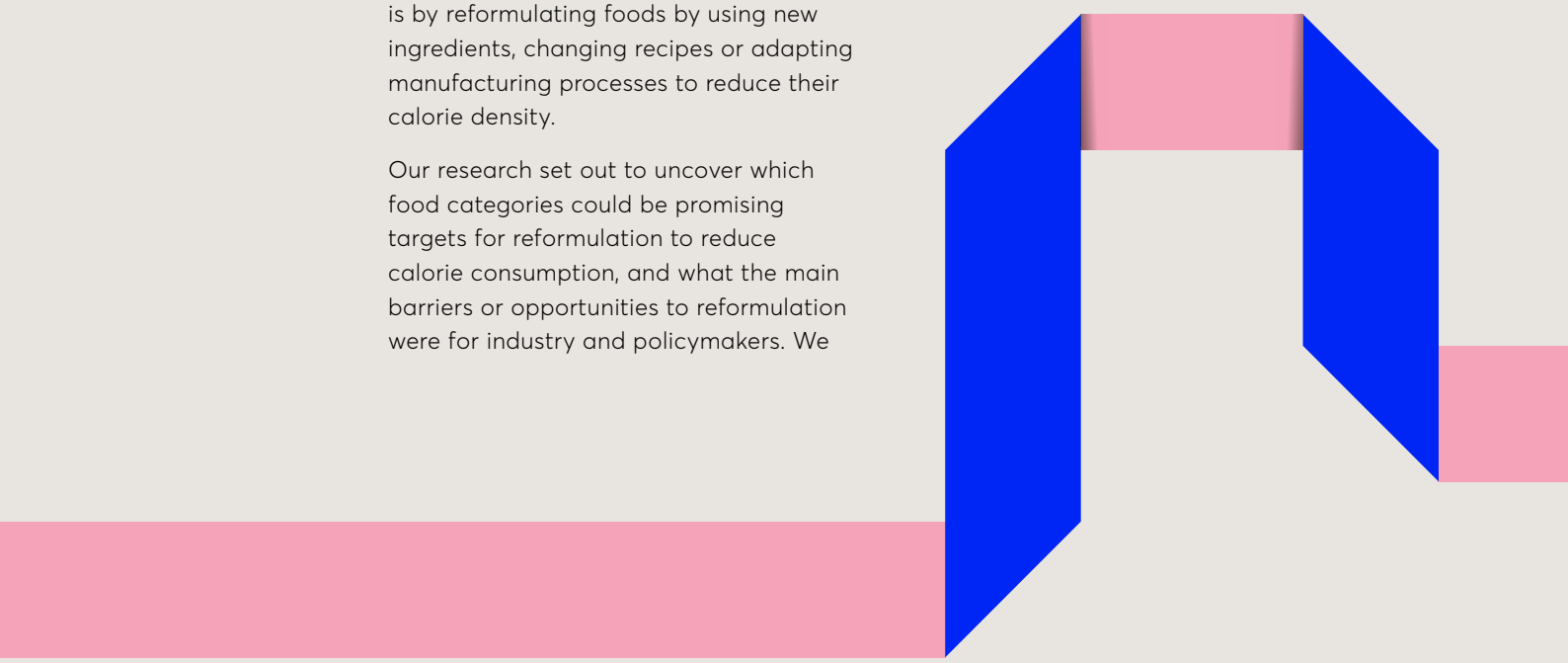
Executive summary

Nesta's healthy life mission is committed to increasing the number of healthy years lived across the UK. We know that unhealthy diets and excess weight increase the risk of disease and other health problems[1]. Nesta's goal is to help people live longer, healthier lives by halving the number of people with obesity in the UK over the ten years to 2030.

Currently, our environments are flooded with too many products that are high in fat, sugar, salt and calories. There are many ways to improve the quality of our diets, and one is to address the calorie density of food. Calorie density is the number of calories per gram of food, with higher calorie-dense food providing more energy in smaller quantities than less calorie-dense food. Reducing the calories in common foods has the potential to impact the prevalence of obesity in the UK. One way to reduce the amount of calories is by reformulating foods by using new ingredients, changing recipes or adapting manufacturing processes to reduce their calorie density.

Our research set out to uncover which food categories could be promising targets for reformulation to reduce calorie consumption, and what the main barriers or opportunities to reformulation were for industry and policymakers. We conducted mixed methods research that included: a) interviews with food industry representatives and public health stakeholders; b) an expert report from food product development consultancy, Bingham and Jones; and c) analysis by Nesta of in-home food and drink purchases for over 29,000 households in Great Britain using data provided by an international market research company[2].

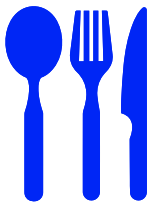


Our analysis shows that 38 calories per person per day could be removed from diets if the food categories we identified in this research as contributing the most to consumption were reformulated to reduce their calorie content by 10%. This is equal to removing 1 billion calories daily across the whole population of Great Britain. An average 38 calories daily reduction could save around 300,000 Quality Adjusted Life Years (QALY) over a 25 year period across the population (one QALY is one year of life in perfect health)[3]. **These QALY savings are equivalent to a monetary value of around £23 billion**, when using the Government's estimate of the monetary value of a single QALY at £70,000[4].

From further Nesta analysis[5], we know that men need to cut 165 calories per day from their diets and women 115 calories on average to meet the goal of halving obesity prevalence by 2030. This is higher for adults living with obesity, where a reduction of 307 calories per day for men and 222 calories per day for women is needed[6]. Reformulation is one intervention which can help to achieve some of the daily calorie reductions needed to reduce obesity prevalence. However, it needs to be accompanied by other interventions to change food environments to enable us to turn the tide on rising obesity rates.

Finding 1:

Reformulation efforts should be focused on the food categories that will have the greatest impact on calorie consumption[7]. Most of these categories can be classified as 'discretionary' foods, which contribute little to no nutritional value to people's diets.



Recommendation A

Our data analysis found that reformulation should focus on the following ten categories to maximise impact on calorie consumption:

- **Ambient cakes and pastries, such as mince pies and malt loaves**
- **Chocolate confectionery, such as bars of chocolate**
- **Everyday biscuits, such as digestives and custard creams**
- **Savoury pastries, such as sausage rolls and quiches**
- **Morning goods, such as crumpets and croissants**
- **Treats, such as chocolate digestives, jaffa cakes and cookies**
- **Salad condiments, including mayonnaise**
- **Chilled ready meals**
- **Crisps**
- **Chilled cakes, such as cheesecake**.

Reducing the calorie content by 10% of the categories listed above would remove 38 calories per person per day. Further details on the analysis can be found in Section 3.

Summarising our work

We analysed:

29,000 households

36 million food transactions

1,750 food categories

STEP 01

Build indicators of reformulation suitability

We analysed each category based on:

- Impact on diet – the volume of calories purchased within the food categories across the population.
- Feasibility – whether reformulating a product is commercially and technically feasible.
- Inclusion – whether certain groups in society would benefit more or less from reformulating certain products or categories.

STEP 02

Create a single measure of reformulation suitability

We combined our indicators into a single measure of suitability for reformulation and ranked them to identify the top ten categories which would be most suitable for reformulation.

STEP 03

Identify key products in the top categories

We picked five items within each category to provide example of products that are a target for reformulation and looked at how the macro-nutrients varied between products within the same category.

STEP 04

Calculate the impact of reformulation

We worked out the potential population impact (in terms of per-person calorie consumption) of reformulating the top ten food categories.

We identified these food categories by creating three indicators that took into account the most important factors in deciding whether a product should be reformulated. We combined our indicators into a single metric of reformulation suitability by averaging scores within each of the criteria[8]. Our three indicators were:

1. **Impact on diet**: the volume of calories purchased and consumed within these categories across the population.
2. **Feasibility of reformulation**: metrics to indicate whether reformulating a product is commercially and technically feasible, which included the variance of calorie density within a category (e.g. there is a range of other products within this category that have lower calorie density, thus showing the ability for similar products to be created with lower calorie content).
3. **Inclusion**: to understand whether reformulating certain products or categories may impact different groups across society more or less, and especially those who are most disadvantaged.

Finding 2:

Lower calorie options are not always available and accessible to all consumers. This is predominantly driven by lower calorie, reformulated options being less available as they are often not stocked by all stores in all areas.

Recommendation B

Industry should ensure that all consumers can access lower calorie options. Industry should look to reformulate their main default products rather than creating two-tiers of products where one is the healthier alternative to the existing or default option. Where that is not possible, we would encourage lower calorie versions of foods consumers already purchase being made widely available. By reformulating the existing or default product, there is a higher chance of impact, as you are not placing demands on the consumer to change their purchasing behaviour. Our analysis above shows that 38 calories could be reduced daily from diets if calories were reduced in the identified categories by 10%. However, this is dependent on consumers not changing their purchasing behaviour and, therefore, reformulating the existing or default product would best guarantee this calorie reduction could be achieved.

Finding 3:

A 'level playing field' across the food sector is needed. The lack of transparency, accountability, and parity across the sector means that it is difficult to assess progress, and good or poor performance is not identified. There is limited available public data, targets have been voluntary and no one body is responsible for holding all sectors to account. Industry needs to be united behind a collective endeavour to maximise reformulation opportunities for health benefits.

Recommendation C

Set mandated calorie reduction targets for specific food categories, as outlined in recommendation A. **Track progress towards achieving these and issue fines where businesses fail to meet the targets**. Calorie reduction targets should be a minimum of 10% for all categories recommended in this report and higher for categories where this is feasible. While the focus of this report has been on reformulation, portion-size changes to reduce calories would also be welcomed to help achieve the targets.

Alongside category-specific targets, there should also be wider organisation-level targets for retailers, manufacturers and the out of home sector. This would aim to reduce the overall amount of calories sold and rebalance sales towards lower calorie options. For example, this target could be a percentage shift in the share of total calories sold from higher calorie dense products to lower calorie dense ones.

These organisation-wide targets should be dynamic and increase as the feasibility for reformulation across categories increases and should be continuously reviewed.

Recommendation D

Develop a robust data infrastructure that mandates in legislation the collection and public reporting of health metrics and food reformulation targets. This will ensure transparency across the food sector on how they are performing, and provide the opportunity to hold poor performers to account on their failure to meet targets. The Government should not delay bringing in reporting on health metrics as part of the Food Data Transparency Partnership, as stated in the UK Government's Food Strategy[9]. This must be a mandatory requirement, include metrics on reformulation, and cover both retail and out of home sectors to be effective.

Recommendation E

An organisation or body should be given the statutory powers to design, set and monitor the targets. The body should lead on tracking and reporting progress on achieving the targets, and be able to enforce penalties or fines for non-compliance. It should be independent with transparent decision-making but work collaboratively across Government, industry and civil society. A model akin to the role the Food Standards Agency played in the salt reduction programme could be adopted[10].

Finding 4:

The risk and upfront investment required for industry to prioritise reformulation for health, without a level playing field, is a significant barrier. This includes the time and resources taken to fit new manufacturing equipment, sourcing new ingredients, and running sensory and safety trials that can take years.

Recommendation F

Government should incentivise industry to reformulate and de-risk the upfront investment. This could be achieved through fiscal incentives that should be used to help offset the upfront costs associated with reformulation. For example, HM Revenue and Customs (HMRC) could encourage or make it easier for more companies to claim research and development (R&D) tax credit for food development and innovation, or the Government could fund a Challenge Prize to encourage the development of reformulation in categories which have historically been harder to reformulate. More detail on how financial incentives, such as R&D tax credits, could be used will be included in Nesta's upcoming *Innovation Sweet Spots: Food innovation, obesity and food environments* report.

Broader non-financial incentives should also be considered, such as developing a badging or ranking system to allow brands to publicly communicate their efforts to reformulate and provide healthy options. This is recommended along with other fiscal measures to ensure all parts of the sector take action, such as a **salt and sugar tax as stated in the National Food Strategy**[11]. This means that the financial risk and incentive for investing in reformulation is shared across all organisations, as they are all subject to the same fiscal measure, helping to level the playing field. This approach has been shown to be successful through the Soft Drinks Industry Levy, which has led to 35% less sugar in soft drinks[12] and raises around £300m of revenue a year for the Government[13].

1. Introduction

Where we live, work, shop and learn can affect the food we eat and how healthy we are. We call this the food environment. It could be your neighbourhood, workplace, or even online, and it includes everything you experience in those places relating to food.

Figure 1 The food environment

Our food environments are flooded with products that are high in fat, salt and sugar (HFSS). This makes it harder for people to access and choose healthy food options. As a population, we are consuming too many additional calories, leading to high rates of excess weight: 63% of adults in the UK are overweight or obese[14].

Nesta's goal is to help people live longer, healthier lives by halving the number of people with obesity in the UK over the ten years to 2030. **Our research[15] shows that to meet the goal of halving obesity prevalence, on average at population level men need to cut 165 calories per day from their diets and women 115 calories per day. This is higher for adults living with obesity, where a reduction of 222 calories per day is needed for women and 307 for men**. We are committed to building the evidence base on how we can make it easier, more accessible, and more convenient for everyone to access healthy options.

Reformulating products to reduce the amount of calories they provide per serving has the potential to create small but sustained changes to our diets. Reformulation is the process of using new ingredients, changing recipes or manufacturing processes to alter the food or drink we consume, which can lead to increased health benefits.

This, along with other measures to reduce unhealthy food consumption and sales could transform our food environments. The foods we choose to purchase are shaped by the options available to us. Currently, about 40% of the food we purchase from retailers is HFSS[16], leading us to consume additional calories with little nutritional benefit and increasing the risks of excess weight. As well as reducing the amount of excess calories we consume, reformulation could help to alleviate the economic costs caused by obesity. Diet-related illnesses, such as cancer and diabetes, have significant economic costs. A 2022 study[17] estimated that the annual costs of obesity to UK society is around £54 billion. Reducing our excess calorie consumption is one important way of boosting health and the economy.

Reformulating foods which are particularly high in calories and reducing levels of salt, sugar and fat is one area where the food industry can proactively help to improve diets by making it easier for everyone to access and choose healthier options. We have chosen to focus on reducing overall calorie consumption in this phase of our reformulation research by reducing the calorie density of foods. Although calorie density is not a perfect measure of the healthiness of food, it is a clear and consistent metric that can be compared across categories. Interventions which focus on improving food environments and which make it easier for individuals to choose lower calorie options are more likely to lead to 'sustained changes in weight at population level'. Reformulation has the potential to make a real difference to health. By changing the formulation of food, instead of asking consumers to make changes to their diets, it is easier for people to reduce their consumption of HFSS foods and reduce the amount of calories they eat.

2. Current reformulation landscape

Over recent decades, the UK Government has set a series of reformulation targets for industry to improve the healthiness of food. These have involved a range of voluntary targets and fiscal measures, such as the sugar and salt reduction programmes and the Soft Drinks Industry Levy (SDIL)[18]. Most reformulation programmes have focused on voluntary targets[19].

While these programmes have led to some improvements, these have been short-term and limited. Some state this is due to the voluntary nature of the targets, poor data collection methods to monitor progress, and a lack of consistency as focus areas or metrics have shifted between sugar, salt and calories. The Soft Drinks Industry Levy was introduced in 2018 to incentivise manufacturers to reduce the amount of sugar in their soft drinks by implementing a staggered tax on drinks with five or more grams of sugar per 100 ml. The levy has led to 35% less sugar in soft drinks in 2019 than 2015, and sales have increased by 15% over the same period[20]. The levy is raising around £300m of revenue a year for the Government[21].

Other Government programmes across the UK include the Scottish Government, which is currently delivering practical support and grant funding to industry to encourage reformulation[22], and the Welsh Government's commitment to developing support through the Food Innovation Centres to enable Welsh businesses to reformulate food and drink[23].

Large food manufacturers and retailers reformulate continuously for many reasons, including fluctuating ingredient availability and cost reduction. Many of these companies are able to explore reformulation for health if there is adequate support in place to encourage this. However, industry faces barriers to reformulating and need to ensure they still operate within the tight profit-margins of the food sector. We know that some retailers are committed to developing healthier offers and playing their part in improving consumers' health. According to ShareAction[24], retailers representing 60% of the UK grocery retail market have made commitments to increase healthier sales across at least some of their products. Some retailers have made public commitments to improve their products and are introducing health-focused ranges. For example, Tesco has removed 50 billion calories across their lines since 2018, with ambition to remove another 50 billion by 2024[25]. **A key part of accelerating more reformulation is ensuring that there are the right conditions for change to occur**. We know that the opportunities for reformulation are high, but we need to put the conditions in place to encourage further reformulation to reduce calorie consumption.

3. Our reformulation research and analysis

This report explores opportunities for the reformulation of discretionary food bought from retail to reduce calorie consumption.

Our research aimed to answer two key questions:

What are the main barriers and opportunities to increase food reformulation to reduce calorie consumption for industry and policymakers?

What are the food categories that could lead to the greatest impact on overall population calorie consumption if they were reformulated?

To answer these questions we conducted mixed methods research including:

- Data analysis of in-home food and drink purchases for over 29,000 households in Great Britain in 2021, using data provided by an international market research company commissioned by Nesta[26].
- 39 interviews with experts across the food retail and manufacturing sector[27].
- A policy design workshop attended by stakeholders from retail, manufacturing, advocacy, and industry bodies.
- A technical report on opportunities and barriers for reformulation to reduce calorie consumption, produced for Nesta by product development consultants Bingham and Jones[28].

Our data analysis: How we analysed household purchases

Our data analysis was the main method we used to identify the food categories that could lead to the greatest impact on overall population calorie consumption if they were reformulated. This involved a comprehensive and phased approach to our data analysis. More technical information on the analysis and our findings can be found in the appendix.

STEP 01

Build a metric for reformulation suitability

We identified and built a set of metrics to rank food categories that took into account what we identified as the most important factors in deciding whether a product should be reformulated. This led us to three criteria:

- **Impact on diets**: the extent to which reformulating products in a category will reduce the volume of calories consumed in the population.
- **Feasibility of reformulation**: whether reformulating a product is commercially and technically feasible. To assess this we looked at the variability of levels of calorie density across products within the same category. More variability indicates that it is possible to have lower calorie dense products within a category, and, therefore, that commercial and technical barriers to reformulation might be lower.
- **Inclusion**: whether reformulating certain products would benefit more groups across society and especially those who are most disadvantaged.

We combined our indicators into a single metric of reformulation suitability by averaging scores within each of the criteria and then taking a weighted average at food category level[29]. Figure 2 shows how each category has scored across the three domains outlined above. We report the top 30 categories, sorted by overall aggregate score where the categories at the top are those with the largest overall score. The colour gradient gives an indication of how far each category is from the average score across all categories, which is expressed by the z-score[30]. If a category scores around the sample average then it will assume a white colour, whilst positive scores indicate being above the sample average and take on a red colour. Negative z-scores tell us that a category has a below average score and they take on the blue colour. Whilst the colour gives an indication of the direction of the score, the size of the circles indicates how much higher or lower than the sample average each score is. A large circle indicates a score that is much higher than the sample average if red, or much lower if blue.

Figure 2 Indicators for the top 30 food categories

STEP

02

Identifying food categories that are targets for reformulation

We identified the food categories that scored most highly across the three criteria. We ranked food categories based on their degree of potential for reformulation and their contribution to calories within shopping baskets.

From this ranking we selected the top 10 categories that were most suitable for reformulation. These categories make up nearly 18% of the overall calories of an average shopping basket.

Figure 3 shows food categories sorted from high to low on the score for reformulation suitability, alongside the cumulative sum of calorie contribution to average shopping baskets.

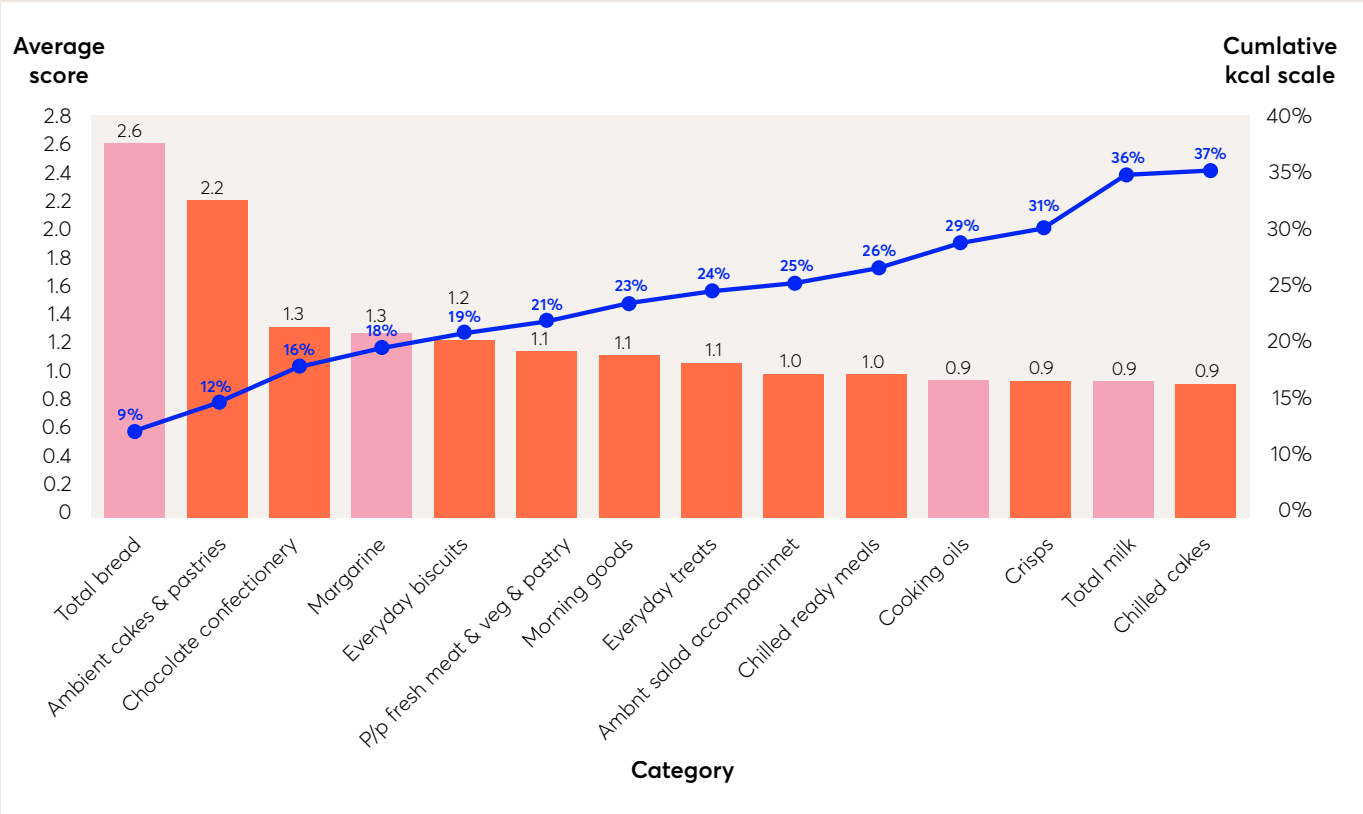


Figure 3 food categories sorted by average score and corresponding cumulative sum of calorie contribution to shopping baskets

Note: pink bars indicate categories of products that are not considered for reformulation either because they are dietary staples or because they would be not suitable for reformulation.

STEP
03

Understanding the targets for reformulation

We have delved deeper into the chosen categories to understand what types of products are represented and what macronutrients contribute the most to their calorie content. This provides some examples of what specific products within each category we may have in mind for reformulation based on our analysis. Rather than considering all the products, we identified the top five products that contribute the most to the calories in shopping baskets within each category, for example chocolate confectionery.

Table 1 below presents those products for the top three categories and Table A2 in the Annex reports the same for all the ten categories.

Table 1 Top five products for calorie contribution within each of the top 3 categories target for reformulation[31, 32]

	Products with largest calorie contribution to category
Ambient cakes and pastries	Small cakes, large whole cakes, mince pies, malt and fruit loaves, small tarts
Chocolate confectionery	Chocolate multipacks, block of chocolate, box of chocolate, bitesize chocolate, chocolate eggs and seasonal chocolates
Everyday biscuits	Digestives, custard creams, cookies, ginger biscuits, other sweet biscuits

We also analysed the macronutrient composition of each category to understand whether products in a category draw the majority of their calories from carbohydrates, fats or proteins. This is an important piece of evidence for suggesting strategies to reduce their calorie content by helping product developers understand which ingredient categories they could target for reduction or substitution within product recipes. Figure 5 reports the macronutrient breakdown for the top three food categories identified as potential targets for reformulation. For ease of presentation, we report results for the top three categories with the remaining categories outlined in the appendix (see Figures A3 and A4).

Calories in foods and drinks come from three macronutrients (carbohydrates, fats and proteins) and alcohol. Overall there are four calories in every gram of protein and carbohydrate, nine calories in every gram of fat and seven calories in every gram of alcohol[33]. Figure 5 shows that all categories have a low proportion of proteins, with carbohydrates and fats being the most significant contributors of calories.

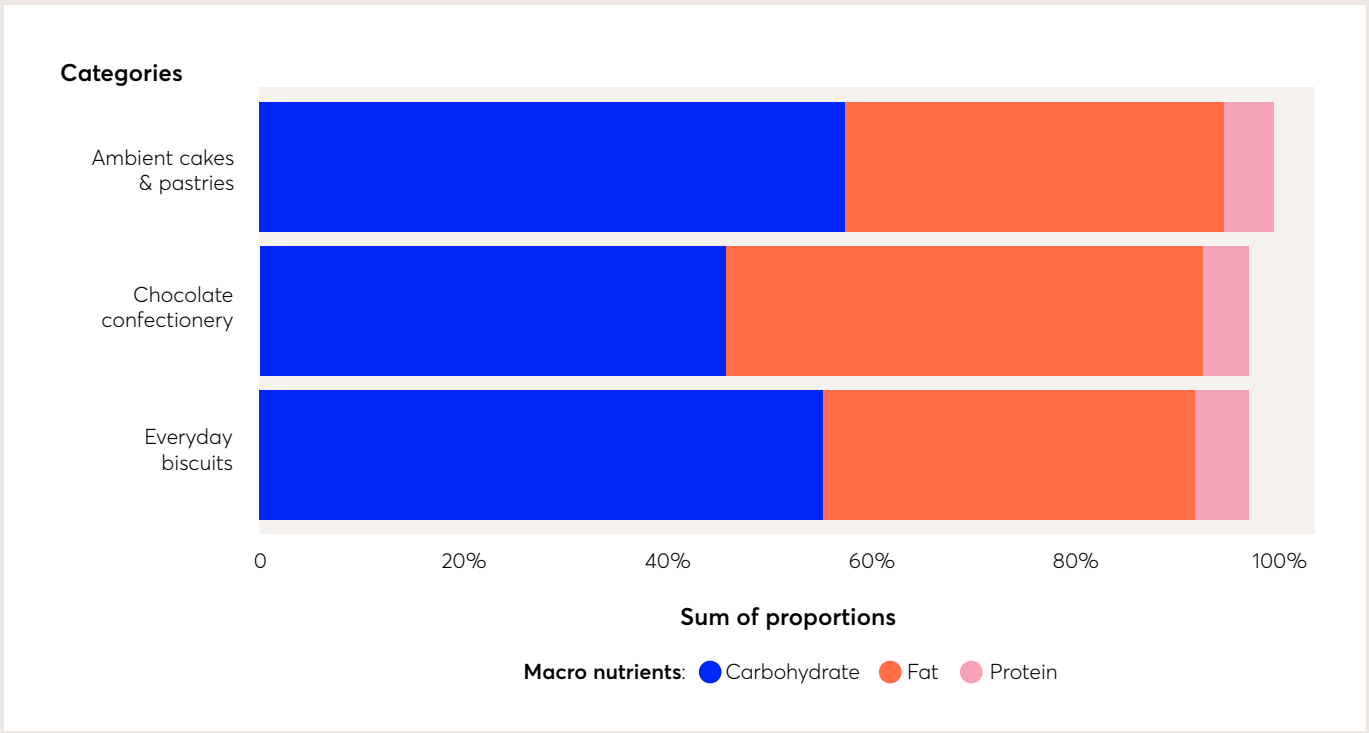


Figure 5 Macronutrient proportions of top three candidate categories[34]

More information on our method and analysis can be found in the technical annex, and all the code underpinning our analysis is available to access.

STEP

04

Impact of reformulation on daily calorie intake

We calculated the potential population impact of reformulating the chosen categories on daily calorie consumption per person. To estimate, we assumed that all discretionary product categories could be reformulated to lose between 5% and 10% of their calories as suggested in previous Public Health England Calorie Reduction Programme analysis[35]. We assumed that no reformulation would be possible for staples such as bread, margarine, milk, and cooking oils.

The plot in Figure 6 shows the impact on daily calorie intake across ten groups of the population (deciles) ordered by their total calorie consumption. For example, the first decile captures the 10% of the population with the lowest daily calorie consumption. We calculated the average reduction in daily calorie consumption for each of these groups that could happen by reformulating the chosen categories at a 10% and 5% calorie reduction. If the suggested categories were reformulated to reduce calories by 10%, it would unlock a reduction of about 38 calories per day for consumers in the median households; for households in the bottom 10% of the calorie intake distribution the reduction would be around 17 calories a day, whilst for households at the top it would be around 91 calories a day.

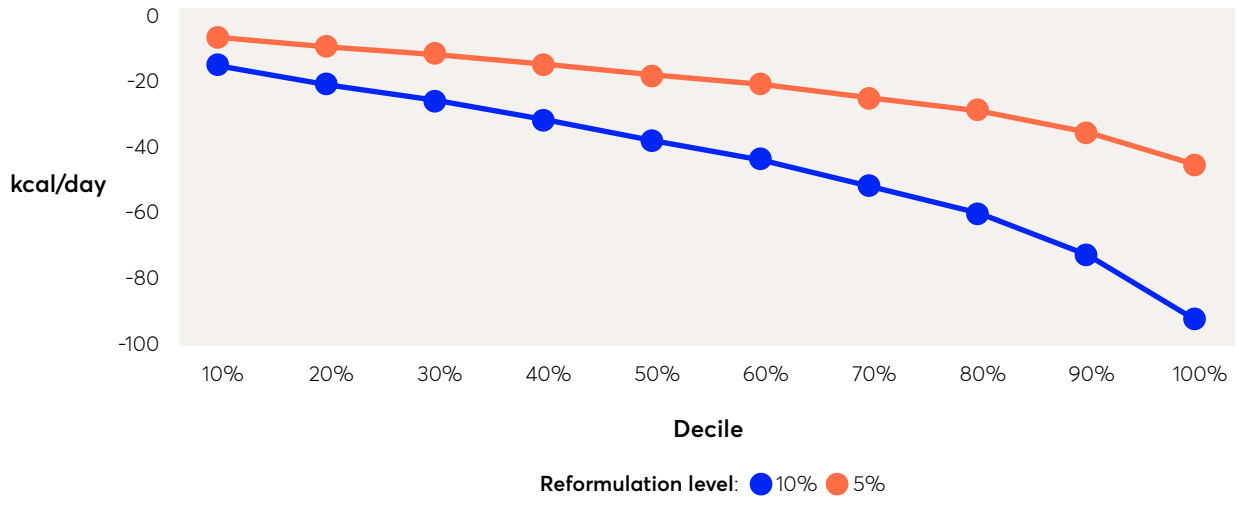


Figure 6 Impact of reformulation on household daily calorie intake

More information on our method and analysis can be found in the technical annex, and all the code underpinning our analysis is available to access[36].

4. Key insights and recommendations

From our analysis, we have uncovered a series of findings on the barriers to and opportunities for reformulation to improve health and reduce excess weight.

Our recommendations below build on previous reformulation work and present a call to action for Government, industry, and the wider health sector to unite to encourage reformulation and turn the tide on obesity. While the focus of our research was reformulation in the retail sector, these recommendations apply more widely and can be used to reduce the number of excess calories consumed across the population.

Finding 1:

Reformulation efforts should be focused on the food categories that will have the greatest impact on calorie consumption.

We conducted analysis of a dataset that captures household purchases from retail in 2021. The food categories that we identified to be the best targets with the strongest potential for reducing calorie intake at population level are:

- **Ambient cakes and pastries, such as mince pies and malt loaves**
- **Chocolate confectionery, such as bars of chocolate**
- **Everyday biscuits, such as digestives and custard creams**
- **Savoury pastries, such as sausage rolls and quiches**
- **Morning goods, such as crumpets and croissants**
- **Treats, such as chocolate digestives, jaffa cakes and cookies**
- **Salad condiments, including mayonnaise**
- **Chilled ready meals**
- **Crisps**
- **Chilled cakes, such as cheesecake**.

We have only included categories where reformulation techniques such as changing ingredients, recipes, and manufacturing processes to reduce calorie density are feasible. This means we excluded bread, margarine, cooking oils and milk[37]. We also consider these products to be dietary staples, whereas the other products listed could be viewed as discretionary products.

If these categories were reformulated to reduce calories by 10%, it would unlock a reduction of about 38 calories per day for consumers in the median households. This is equal to removing 1 billion calories daily across the whole population of Great Britain. A 5% calorie reduction would lead to a reduction of 19 calories per day[38], the equivalent to removing 540 million calories daily across the whole population of Great Britain.

An average 38 calories daily reduction could save around 300,000 Quality Adjusted Life Years (one QALY is one year of life in perfect health) over a 25 year period across the population. These QALY savings are equivalent to a monetary value of around £23 billion, when using the Government's estimate of the monetary value of a single QALY at £70,000. We have calculated the QALY savings using the Department of Health and Social Care's Calorie Model[39]. The DHSC Calorie Model looks at the long-term benefits of Government policies designed to reduce excess calorie consumption at a population level and benefits are modelled over 25 years.

We have carried out further analysis to explore the connection between calorie intake and obesity prevalence in the UK[40]. **From this analysis, we found that men need to reduce 165 calories per day from their diets and women 115 calories on average to halve obesity rates by 2030. This is higher for adults living with obesity, where a reduction of 307 calories per day for men and 222 calories per day for women is needed**.

Achieving this significant drop in obesity prevalence will require a range of interventions which make our food environments healthier and make it easier for consumers to choose lower-calorie options. Reformulation to reduce calorie density is one intervention which will help to achieve some of the daily calorie reductions needed to reduce obesity prevalence.

Recommendation A

Reformulation should focus on food categories which will lead to the greatest reductions in excess calorie consumption across the population

Our data analysis[41] found that you should focus on the following categories to maximise impact:

- **Ambient cakes and pastries, such as mince pies and malt loaves**
- **Chocolate confectionery, such as bars of chocolate**
- **Everyday biscuits, such as digestives and custard creams**
- **Savoury pastries, such as sausage rolls and quiches**
- **Morning goods, such as crumpets and croissants**
- **Treats, such as chocolate digestives, jaffa cakes and cookies**
- **Salad condiments, including mayonnaise**
- **Chilled ready meals**
- **Crisps**
- **Chilled cakes, such as cheesecake**.

Reformulating these categories to reduce their calories by 10%, it would lead to a median reduction of 38 calories per day. It would lead to 1 billion daily calories being removed across the population. An average 38 calorie daily reduction would save around 300,000 Quality Adjusted Life Years (one QALY is one year of life in perfect health) over a 25 year period across the population.

Finding 2:

Lower calorie options are not always available and accessible to all consumers.

Our research found that consumers most value cost, quality and price when purchasing food in retail settings. However, they face barriers to selecting lower calorie options, such as availability and affordability of products in all retail settings, meaning some consumers are unable to choose healthier options.

Research suggests that the public report being in favour of their food being reformulated to make it healthier[42], but often this does not translate into purchases. When new, lower calorie options are bought to market, without reformulating the mainstream version, it can lead to two tiers of options available. For some products, the healthier option is not as widely available or affordable to consumers across a range of stores, or only appeals to more health conscious consumers. For example, lower calorie options for some categories may not be available in smaller convenience stores with limited stock. For some categories like confectionery, consumers can be reluctant to try a lower calorie version over the existing or default product. This limits the impact of such reformulation efforts as reaching a smaller group of consumers.

Recommendation B

Industry should ensure all consumers can access lower calorie options

Lower calorie options should be made available and attractive to all consumers across all food categories. **Industry should look to reduce the excess calories in the existing or default version of their products to increase the impact of reformulation on calorie consumption**. Consumers also need to be encouraged to change purchasing behaviour, and this could be incentivised, for example **if retailers offered promotions or other merchandising strategies on lower calorie products**.

Finding 3:

A 'level playing field' across the food sector is needed. The lack of transparency, accountability, and parity across the food sector means that it is difficult to assess progress, and good or poor performance is not identified.

There is limited available public data, targets have been voluntary, and no one body is responsible for holding all sectors to account. Industry needs to be united behind a collective endeavour to maximise reformulation opportunities for health benefits.

Industry representatives told us that there is a lack of level playing field across the sector, and this is exacerbated by limited publicly available data shared by companies. We heard from some retailers and manufacturers that data on past reformulation is not always accurately tracked, even within companies. There is also a lack of parity in the data collected and shared across the sector, with less data available on the nutrition and sales of out of home food outlets. This lack of information and transparency on the food being purchased across both retail and out of home sectors make it challenging to understand how businesses are performing on health metrics and where reformulation efforts are succeeding.

Robust, accurate and up-to-date data on sales and agreed health or nutrition metrics should be the cornerstone for any further policy development. This data is necessary to enable accurate tracking of changes to products and to direct regulation to food categories where more progress could be made. Clear and sustained policy from the UK Government would help to bring parity across the sector (manufacturing, retail and out of home) that would enable all to prioritise investing in improving diets. It also provides a mechanism to publicly recognise and champion companies or sectors that are leading and pioneering. This would help to ensure that progressive businesses are not disadvantaged by making changes to their products if their competitors do not take similar action. This data could be collected and made publicly available through a mechanism such as the Food Data Transparency Partnership, as referenced in the Government's Food Strategy[43].

There is also a lack of collaboration and knowledge sharing across the sector, as much innovation and knowledge about best practice is held within individual companies. Competition between companies prevents the sharing of new strategies to reformulate effectively. It would be beneficial for this information to be shared across organisational boundaries to improve the understanding of new technologies and innovations.

To create this 'level playing field', we recommend the following:

Recommendation C

Set mandated calorie reduction targets for specific food categories outlined in recommendation A. Track progress towards achieving these and issue fines where businesses fail to meet the targets

Category targets should be set at a minimum of **10% calorie reduction**, and greater for those categories which contribute the most to excess calorie consumption. **Category targets should aim to be met by 2030**, when they should be revised and increased as progress is made and new innovations emerge. While the focus of this report has been on reformulation, portion-size changes to reduce calories would also be welcomed to help achieve the targets. **Targets should be developed in collaboration with industry** to ensure they take into account the feasibility of reformulation in different food categories and link to existing targets, such as those on sugar and salt reduction.

Broader organisation-level targets should also be considered to maximise the impact of reformulation by reducing sales of higher calorie dense foods. For example, this target could be a percentage shift in the share of total calories sold from higher calorie dense products to lower calorie dense ones, or a reduction in the proportion of HFSS sales. **Organisation-wide targets should be dynamic** with regular reviews and revisions to continue to push for further progress. This could follow a similar model to the Top Runner programme in Japan, which continuously revises energy efficient targets for manufacturers as new technology comes onto the market[44].

Mandatory targets have been brought in by some governments. These have mainly focused on reducing the sugar in soft drinks by imposing a levy based on sugar per volume in sugary drinks. Soft drinks levies have been implemented by countries such as Chile, which began implementing a tax in 2014, resulting in a 22% reduction in the volume of higher-taxed drinks sold a year later[45]. Other Governments have gone further and also introduced taxes on the salt, sugar and fat levels in foods: for example in 2014 Mexico brought in an 8% sales tax on non-essential food products that contained more than 275 calories per 100g. In the first year of implementation, household purchases of taxed food reduced on average by 25g per household per month, with greater reductions seen in lower-income households[46].

Recommendation D

Develop a robust data infrastructure that mandates in legislation the collection and public reporting of health metrics and food reformulation targets

Mandating legislation data reporting about health metrics and reformulation is necessary to:

- **Ensure transparency across the food sector on how they are performing,**
- **Track implementation and understand the impact of policy, and;**
- **Provide the opportunity to hold poor performers to account on their failure to meet targets.**

The Government should not delay bringing in reporting on health metrics as part of the Food Data Transparency Partnership, as stated in the UK Government's Food Strategy[47]. However, for this programme to be impactful and resolve the issues highlighted in this report, data reporting must be mandatory, include information on reformulation and cover both the retail and out of home food sectors.

Public data will also give companies the incentive to benchmark themselves against their competitors and promote their standing as a business which takes action on health. This could be an extension to a public platform such as the Access to Nutrition Initiatives' UK Retailer Index[48] which would report on reformulation progress across both the retail and out of home sector. An additional benefit is that it would enable analysis of the impact of reformulation on sales, improving the evidence base about the financial risks of reformulation in different markets and within different categories.

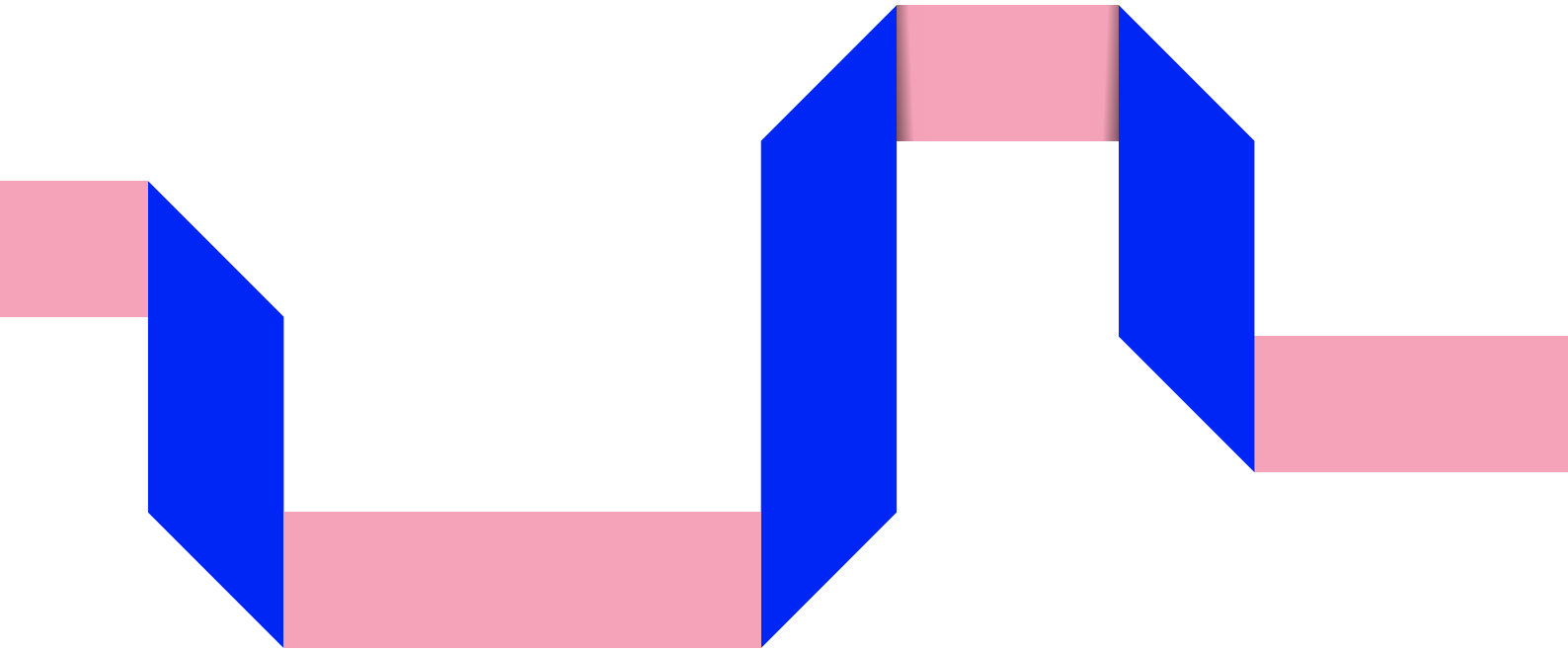
Recommendation E

An organisation or body should be given the statutory powers to design, set and monitor the targets. The body should lead on tracking and reporting progress on achieving the targets, and be able to enforce penalties or fines for non-compliance

Specifically this organisation or body must have the following features:

- **Be independent with transparent decision-making that brings together industry, academia, policymakers and health advocates** to build a coalition of support for meeting the reformulation targets.
- **Ability to define and set ambitious targets across retail and out of home**, and set a clear definition of calorie reduction to be used collectively across the sector.
- **Provide a platform to collect and report data to monitor progress towards achieving and enforcing targets**. The body should publish an annual report on progress towards targets, highlighting progressive companies and gaps where more action is needed.
- **Develop guidance and advice for businesses on how they can meet the targets, and for Government on any further policy measures that may be required.**
- **Powers to trigger or enforce penalties or fines for non-compliance** to ensure that industry knows they must take action and that all companies will be subject to the same penalties or fines if they fail to act.

This approach would draw on the successes of the role of the Food Standards Agency in setting the salt reduction targets[49] and build on the work undertaken by Public Health England to work collaboratively with industry. The role of the independent body should draw on similar bodies in other fields, such as the Climate Change Committee[50].



Finding 4:

The risk and upfront investment required for industry to prioritise reformulation for health, without a level playing field, is a significant barrier.

Reformulation involves upfront investment, such as updating manufacturing equipment or sourcing new ingredients. This is a risk for businesses if consumers then do not buy the reformulated product, and it causes them to hesitate to make changes. There are currently limited incentives for industry to reformulate voluntarily. Restrictions on labelling mean that reformulation needs to occur at quite a significant rate, for example levels of sugar and fat need to be reduced by 30% for a label to say a product is reduced sugar or fat[51]. For some HFSS products, this is not possible. This inability to communicate with consumers limits their motivation to make products marginally more healthy.

Manufacturers need to consider multiple factors, such as cost, health, quality, and safety when reformulating products. The length of time required to develop a new version of a product can be extensive and require significant investment. We heard that this risk is not held evenly across the sector, with small or medium businesses (SMEs) sometimes facing greater challenges as they need to source much smaller amounts of alternative ingredients and may need to pay for external technical expertise. Fiscal and non-fiscal support which enables industry to prioritise reformulation, alongside regulation, would be an effective way to increase reformulation efforts and draw industry into more collective action.

Recommendation F

Government should incentivise industry to reformulate and de-risk the upfront investment. This could be achieved through fiscal incentives that should be used to help offset the upfront costs associated with reformulation

Fiscal incentives could be used to prompt action from those not making sufficient progress while rewarding progressive and pioneering companies. For example, HMRC could encourage or make it easier for companies to claim research and development (R&D) tax credits for food development and innovation. More detail on how R&D tax credits could be enhanced, for example allowing companies to claim a higher proportion of their R&D costs back, can be found in Nesta's upcoming *Innovation Sweet Spots: Food innovation, obesity and food environments* report. Beyond this, there is still space to develop new incentivising fiscal measures. For example, the Government could fund a Challenge Prize to encourage the development of innovative reformulation techniques and progress in categories which have historically been harder to reformulate.

Broader non-financial incentives should also be considered, such as developing a badging or ranking system to communicate publicly which companies are making strides in their efforts to reformulate and provide healthy options. Ranking companies on their health metrics has seen success through the Access to Nutrition Index's UK Retailer Index, which ranks supermarkets on a range of nutrition topics. Publishing a league table allows progressive retailers to share their action and highlights those which are falling behind. To be effective, this needs to be underpinned by accurate and relevant data on what reformulation is taking place across the sector, helping to level the playing field by providing more transparency to both companies and consumers.

This is recommended along other fiscal measures to ensure all parts of the sector take action, such as a salt and sugar tax, as stated in the National Food Strategy (NFS)[52]. This means that the financial risk and incentive for investing in reformulation is shared across all organisations, as they are all subject to the same fiscal measure. This also puts the onus for change on manufacturers rather than consumers. The NFS recommended creating a tax of £3/kg on sugar and a £6/kg on salt, which would reduce the average calories eaten per person per day by 15-38 calories and raise an estimated £2.9-£3.9 billion per year. Revenue from mechanisms such as taxes could help to offset the costs to the NHS of treating diet-related illness, currently estimated to cost £6.5 billion a year[53]. Academic research on the efficacy of fiscal measures is underway[54], and has been shown to be successful through the Soft Drinks Industry Levy. This led to 35% less sugar in soft drinks[55] and raises around £300m of revenue a year for the Government[56].

5. Next steps for Nesta

In this stage of our reformulation work we have focused on the retail sector, understanding what households purchase and which foods contribute most to overall calorie consumption.

Moving forward, we will be looking to:

- **Explore food consumption within the out of home sector to understand the impact this is having on calories consumed and identify opportunities to make it easier for consumers to access healthier options.**
- **Collaborate with policymakers to further develop the identified policy options and explore how they could be implemented to maximise real-world impact.**
- **Partner with industry to trial new ways to leverage reformulation to meet industry ambitions to improve health, whilst building out the evidence base.**

At Nesta, we always seek to work in partnership and collaborate across sectors to achieve impact. If you would be interested in exploring any of these areas with us, please contact the team at lauren.bowesbyatt@nesta.org.uk or lydia.leon@nesta.org.uk

Appendices

Appendix 1: Data analysis

Data source description

The data source for our analysis has been provided by an international market research company commissioned by Nesta. The data covers purchases of all food and drinks (including alcohol) brought into the home by a sample of 29,000 households living in Great Britain. Households record all products via a barcode scanner and they also send their receipts directly to the market research company. For each transaction it is possible to observe quantity, volume, expenditure and product characteristics (including nutritional information). We observed over 36 million transactions for the year 2021.

Alongside information on transactions, the dataset also includes background information about the households belonging to the panel such as age, gender, ethnicity, income, region of residence and social class. However, the data does not cover out of home purchases such as takeaways, on-the-go food or restaurants/cafe meals.

Metrics

We calculated a total of 19 indicators representing three criteria that capture the suitability and potential of a food category as a target for reformulation. The criteria we looked at are: Impact on Diet, Feasibility and Inclusion.

> The **Impact on diet** indicators try to capture the contribution that different food categories make to population calorie purchases. This includes the average calorie density of products in a category, calorie density weighted by product sales, and contributions to overall calories purchased by all households. We have also included indicators that adjust household consumption volumes by the size of the household taking into account the age and sex of the people in it. According to this criterion a category that contributes a large share of calories is a good target for reformulation because if reformulated it would have a large impact on overall calorie intake.

> The **Feasibility** indicators try to capture the financial and technical feasibility of reformulation by considering the variation in energy density of products within a category. A larger variation is an indication that lower calorie alternatives within a category are already on the market, and is a signal that reformulation is already happening and is therefore technically and financially possible. According to this criterion a category with a high variation in calorie density is a good target for reformulation because technical and financial barriers may be lower. We have also calculated robust versions of these metrics where we sample the same number of products inside a category with the goal of reducing biases caused by differences in the number of products in different categories.

> The **Inclusion** indicators are based on a clustering analysis of household consumption patterns in the data: we cluster households based on the composition of their shopping baskets using two strategies (share of total calories accounted for by different products purchases, and share of per-capita calories accounted for by different product/category purchases).

We then report the number of clusters that have above average purchases in each product category, and the number of clusters with a strong presence of lower income households with above average purchases in each product category. A category that contributes significantly to the calorie intake of more disadvantaged groups may be a good target for reformulation because it has the potential to improve diets of households that have the least healthy diets in the population. However, a category that is consumed homogeneously across the population may also be considered a good target as reduction in calories may impact a larger number of people.

Below are the criteria and indicators chosen[57] and further metrics definitions are in Table A1.

Table A0 Reformulation criteria and metrics

Criteria	Description	Metrics
Impact on diet	Contribution that different food categories make to population calories purchases	High energy density products share weighted by sales Calorie contribution share adjusted by size
Feasibility	Financial and technical feasibility of reformulation by considering the variation in energy density of products within a category	Calorie density variance normalised Calorie entropy normalised
Inclusion	Extent to which a category has a significant contribution to the calorie intake of specific groups, including more disadvantaged groups	Clusters low income impacted clusters share

Table A1 Metric summary

Metric	Definition	Interpretation
	Impact on diet	
Energy density (ED) average	Average ED (calories per 100 grams/millilitres) of a category	A high value indicates that the category contains either a high number of products with high ED and/or a few products with very high ED
Energy density average weighted by sales	Average Energy Density (ED): calories per 100 grams/millilitres) of a category calculated by weighting the ED of individual products by their volume sales	A high value indicates the category contains high ED products that are also highly purchased. A high selling product with high ED drives the average upwards, while a high selling product with low ED drives the average downwards
High energy density products share	Percentage of products in a category that are high Energy Density (ED): more than 400 calories per 100 grams/millilitres)	A high value indicates the category contains a large number of products that are high ED. Categories with a high percentage of high ED products could be targets for reformulation
High energy density products share weighted by sales	Percentage of products within a category that are high ED (more than 400 calories per 100 grams/millilitres) weighted by their sales	A high value indicates that the category contains a large number of high selling high ED products
Calorie contribution share	Calories purchased in a category as a share of total calories purchased across all categories	A high value indicates that purchases from the category contribute a large share to the total number of calories bought
Calorie contribution share adjusted by size[58]	Per-capita calories purchased in a category as a share of total per-capita calories purchased across all categories adjusted by household size	This metric is computed from the distribution of purchased calories after it has been standardised to account for household structure, so that it can be interpreted as the per-capita calories purchased. A high value indicates that purchases from the category contribute a large share to the total number of per-capita available calories. With the household size adjustment applied we can have a clearer picture of categories where calories are over/under purchased
Median calorie sales adjusted by size[59]	Median per-capita calories purchased for a category	This is the middle point of the distribution of per-capita daily calories purchased from all products in a category. It should be compared to the recommended daily calorie intake guidelines of 2,000 calories per day for adult women and 2,500 for adult men
Median calorie sales adjusted by size[60]	Median per-capita calories purchased for a category	This is the middle point of the distribution of per-capita daily calories purchased from all products in a category. It should be compared to the recommended daily calorie intake guidelines of 2,000 calories per day for adult women and 2,500 for adult men
Median calorie sales adjusted by size	Average per-capita calories purchased for a category	This is the average of the distribution of per-capita daily calories purchased. It should be compared to the recommended daily calorie intake guidelines of 2,000 calories per day for adult women and 2,500 for adult men
Interquartile range calories	Interquartile range of the distribution of per-capita daily calories purchased for a category	It is calculated as the difference between the 75th and 25th percentiles and is therefore the spread observed in the middle half of the distribution. A larger value indicates that there is large variation of per-capita daily calories purchased in a category
	Feasibility	
Calorie density variance	Variance of ED in a category	It represents the variation in ED among the products in a category. A high value indicates that there is heterogeneity in ED among products, while a low value indicates that products have similar ED. Low variance could indicate that little reformulation is happening in a category and it could be an indication of higher barriers to reformulation
Calorie density variance normalised[61]	Variance of ED in a category robust to the number of products in a category	It represents the variation in ED among the products in a category in a way that is not affected by the number of products in it. A high value indicates that there is heterogeneity in ED among products, while a low value indicates that products have similar ED. Low variance could indicate that little reformulation is happening in a category and it could be an indication of higher barriers to reformulation
Calorie entropy[62]	Diversity of ED profiles in a category	It represents how concentrated is the ED of products within a category. A smaller value indicates higher concentration in few ranges, therefore a larger number of products with similar ED and potentially less scope for reformulation
Calorie entropy normalised[63, 64]	Concentration of ED in a category robust to the number of products in a category	It represents how concentrated is the ED of products within a category in a way that is not affected by the number of products in a category. A smaller value indicates higher concentration, therefore a larger number of products with similar ED

Table A1 Metric summary (continued)

Metric	Definition	Interpretation
	Inclusion	
Share of population in clusters that consumes category significantly more than average	Percentage of the GB population that belongs to clusters that consume the category statistically significantly (at 5% level) more than the average. Clusters calculated based on the share of calories consumed	A high value indicates that this category contributes significantly more to calories purchased of some clusters than others. A small value indicates that consumption is homogeneous across clusters (i.e. the category contributes to a similar percentage of calories of all clusters)
Clusters impacted clusters share	Number of clusters that consume the category statistically significantly (at 5% level) more than the average. Clusters calculated based on the share of calories consumed	A high value indicates that this category contributes a lot more to purchased calories of some clusters than others. A small value indicates that consumption is homogeneous across clusters (i.e. the category contributes to a similar percentage of calories of all clusters)
Clusters impacted clusters volume	Number of clusters that consume the category statistically significantly (at 5% level) more than the average. Clusters calculated based on the share of calories consumed adjusted for household size	A high value indicates that this category contributes a lot more to calories of some clusters than others. A small value indicates that consumption is homogeneous across clusters (i.e. the category contributes to a similar percentage of calories of all clusters)
Clusters low income impacted clusters share[65]	Number of low income clusters that consume the category statistically significantly (at 5% level) more than the average. Clusters calculated based on the share of calories consumed	This number should be compared with the overall number of clusters impacted. A larger number indicates that reformulating this category may have a positive effect on reducing dietary inequalities because of the positive association between income and diet quality
Clusters low income impacted clusters volume	Number of low income clusters that consume the category statistically significantly (at 5% level) more than the average. Clusters calculated based on the share of calories consumed adjusted for household size	This number should be compared with the overall number of clusters impacted. A larger number indicates that reformulating this category may have a positive effect on reducing dietary inequalities because of the positive association between income and diet quality

Robustness checks

When selecting the metrics, we have tried to be inclusive with the goal of ensuring that our results are not skewed by a single strategy for implementing an indicator or method.

When we estimate pairwise correlations between indicators in our inventory we find a strong degree of consensus between groups of indicators. This is visible in Figure A1, where we visualise these correlations: the almost perfect correlations between groups of indicators clustering along the diagonal suggest a strong level of agreement between groups of indicators regarding which products might have a strong impact on diets, be feasible targets for reformulation, and benefit more clusters (we note that the correlations between indicators 'off the diagonal' are weaker, suggesting that different groups of indicators are capturing different dimensions of products that are relevant for reformulation).

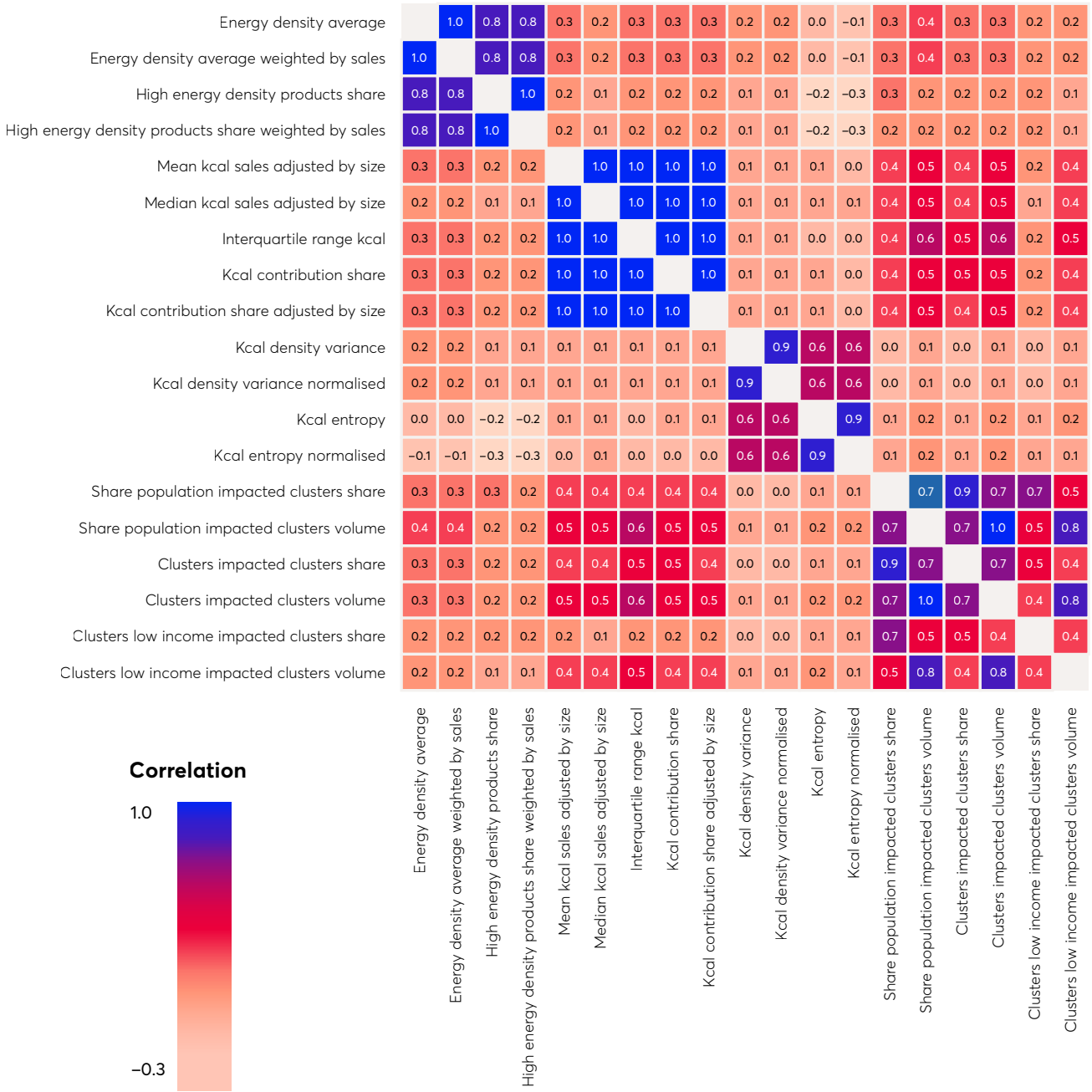


Figure A1 Pairwise correlations between indicators in our measurement framework

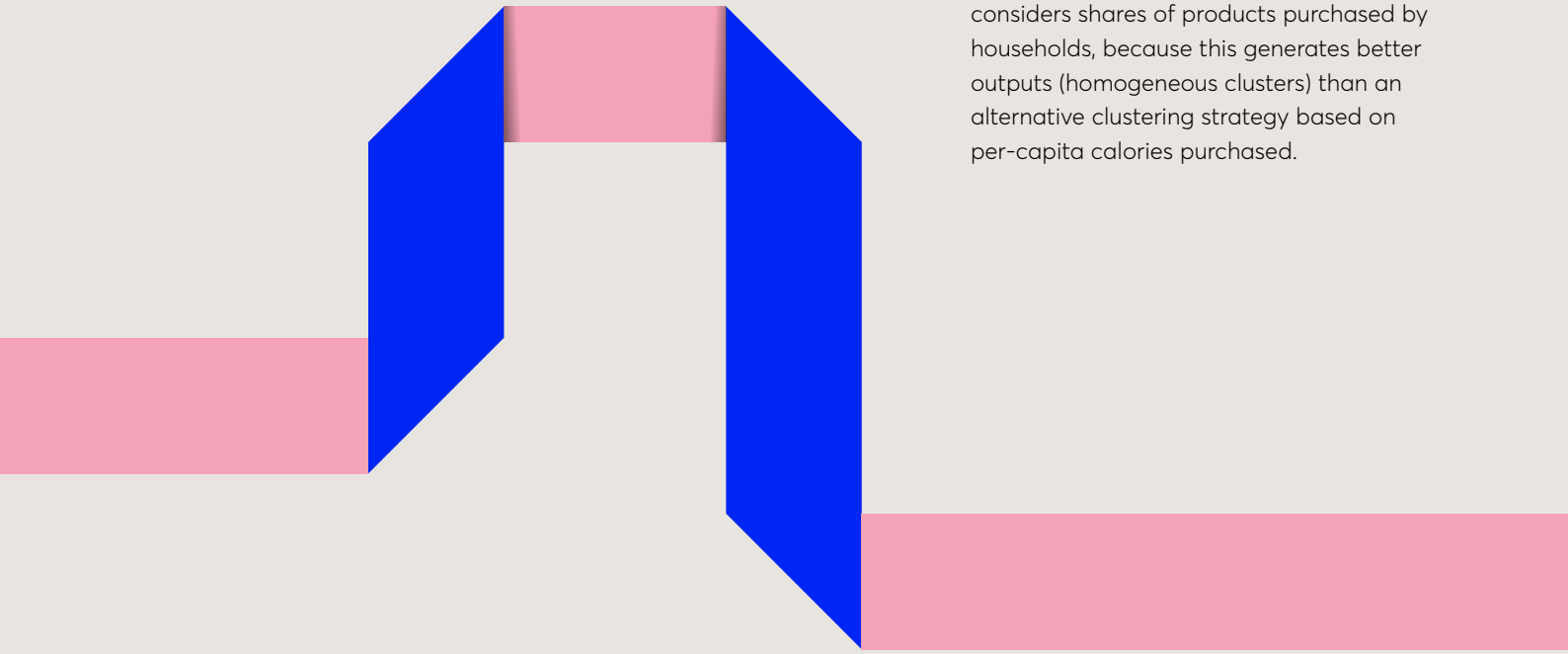
Note: Indicators are ordered by the decision criterion they belong to. Clusters of strong correlation along the diagonal capture consensus between indicators in each category.

Inside the **Impact on diet** category, we find a cluster of indicators capturing the contribution of high energy density products to the offer and purchases within a food category, and another cluster capturing a category's contribution to the share of calories brought home. There is a positive but weak correlation between the sets of indicators in both clusters, indicating that categories with a high share of high energy density products and sales are only to a small extent categories that make up a large share of calories brought home by households.

Inside the **Feasibility** criterion, we find a strong positive correlation inside our two main variables (variance and entropy) but positive yet weak correlation between them, suggesting they capture different dimensions of reformulation feasibility.

Inside the **Inclusion** criterion, we find overall strong correlations between different metrics although we note that the two clustering strategies wield slightly different results.

There is therefore a strong degree of robustness (but also redundancy) between indicators, so we have filtered them out to focus on those capturing key distinct sources of variation in the data:



- **High energy density share weighted by sales**: this measure of the sales-weighted share of high energy density products in a market sector is used as a summary of the highly correlated indicators, capturing the distribution of high energy density products within a category.
- **Calorie contribution share adjusted by household size**: this measure of the contribution of all sales in a market sector to per-capita calories purchased is used as a summary of correlated indicators, measuring the calorie contribution of categories to overall calories purchased.
- **Calorie density variance normalised**: this measure of the variance in calorie density in market sectors is used to summarise highly correlated indicators of reformulation feasibility.
- **Calorie density entropy normalised**: this measure of the concentration of ED in the products in a category is used to summarise highly correlated indicators of reformulation feasibility.
- **Low income impacted share clusters**: the inclusion criterion is summarised with an indicator capturing the number of clusters with many low income households that would be impacted by reformulation in a product category. This indicator is based on a clustering strategy that considers shares of products purchased by households, because this generates better outputs (homogeneous clusters) than an alternative clustering strategy based on per-capita calories purchased.

Comparing food categories

In order to compare categories in a way that is not skewed by differences in the unit of analysis across indicators, we normalised all of them by calculating their z-score.

For each observation of an indicator, this subtracts the mean and divides by the standard deviation of the distribution. The score captures how many standard deviations from the mean of the distribution (i.e. how much of a positive or negative outlier) is an observation. A higher z-score indicates a better performing indicator within each of the three criteria (i.e. higher contribution to calories purchased, higher energy density, larger variation indicating stronger feasibility and more chances of generating benefits to diets of disadvantaged groups). After having calculated the z-scores of each for the five indicators we have averaged them to obtain a single measure for each of the criterion of Impact on Diets, Feasibility and Inclusion. We have then constructed a composite measure by taking a weighted average of the scores for each of the three dimensions, where the Impact on Diets score has been given a weight of 0.5 and the remaining two weights of 0.25 each.

Table A2 Top 5 products for calorie contribution within each of the top 10 categories target for reformulation

	Products with largest calorie contribution to category
Ambient cakes and pastries	Small cakes, large whole cakes, mince pies, malt and fruit loaves, small tarts
Chocolate confectionery	Chocolate multipacks, block of chocolate, box of chocolate, bitesize chocolate, chocolate eggs and seasonal chocolates
Everyday biscuits	Digestives, custard creams, cookies, ginger biscuits, other sweet biscuits
Savoury pastries	Pork pies, sausage rolls, hot pies, pasties, quiches/flans
Morning goods	Crumpets/pikelets, hot cross buns, croissants, scones, pain au chocolat
Everyday treats	Chocolate digestives, biscuit creams, jaffa cakes, shortbreads, cookies
Salad accompaniments	Mayonnaise salad dressing, salad cream, pourable dressing
Chilled ready meals	Complete meals, meal centre, vegetable accompaniments, burger in a bun, breaded chicken kievs
Crisps	Multi-packs, family packs, maxi packs, standard packs
Chilled cakes	Small cakes, small tarts, cheesecakes, large tarts, large whole cakes

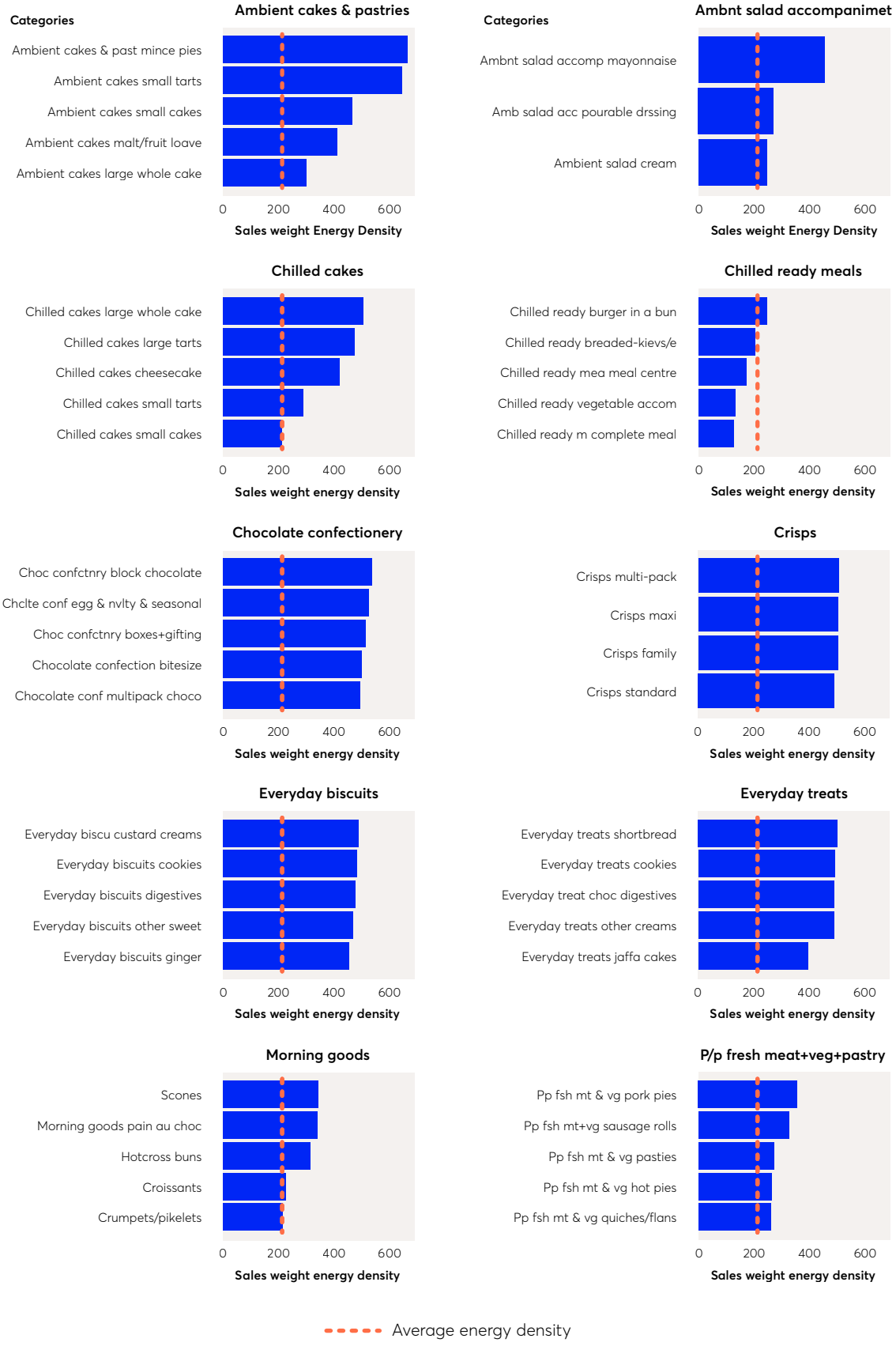


Figure A2 Sales weighted energy density for selected products and compared to the average sales weighted energy density in the population of products

Macronutrient composition

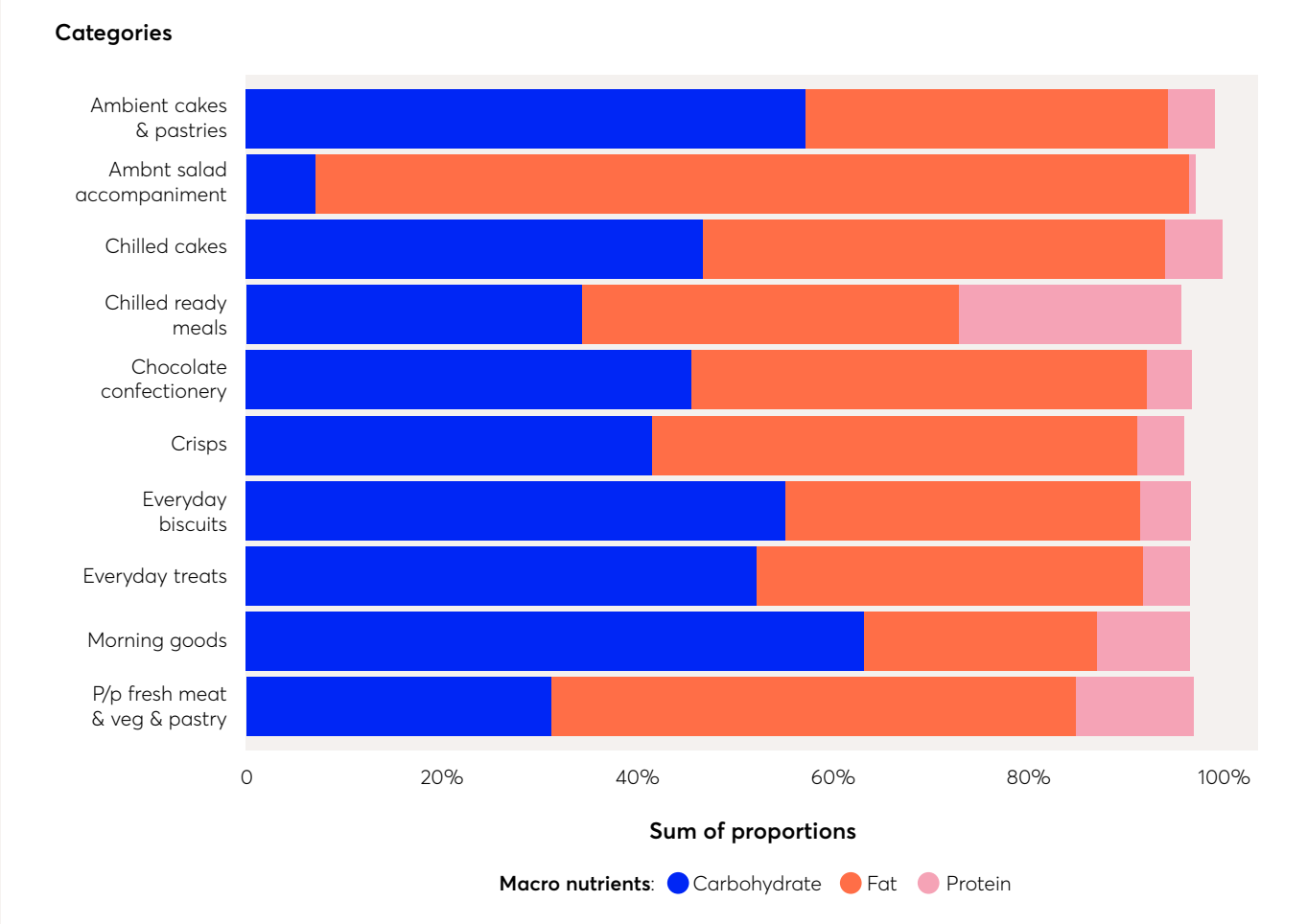


Figure A3 Macronutrient proportions of candidate categories

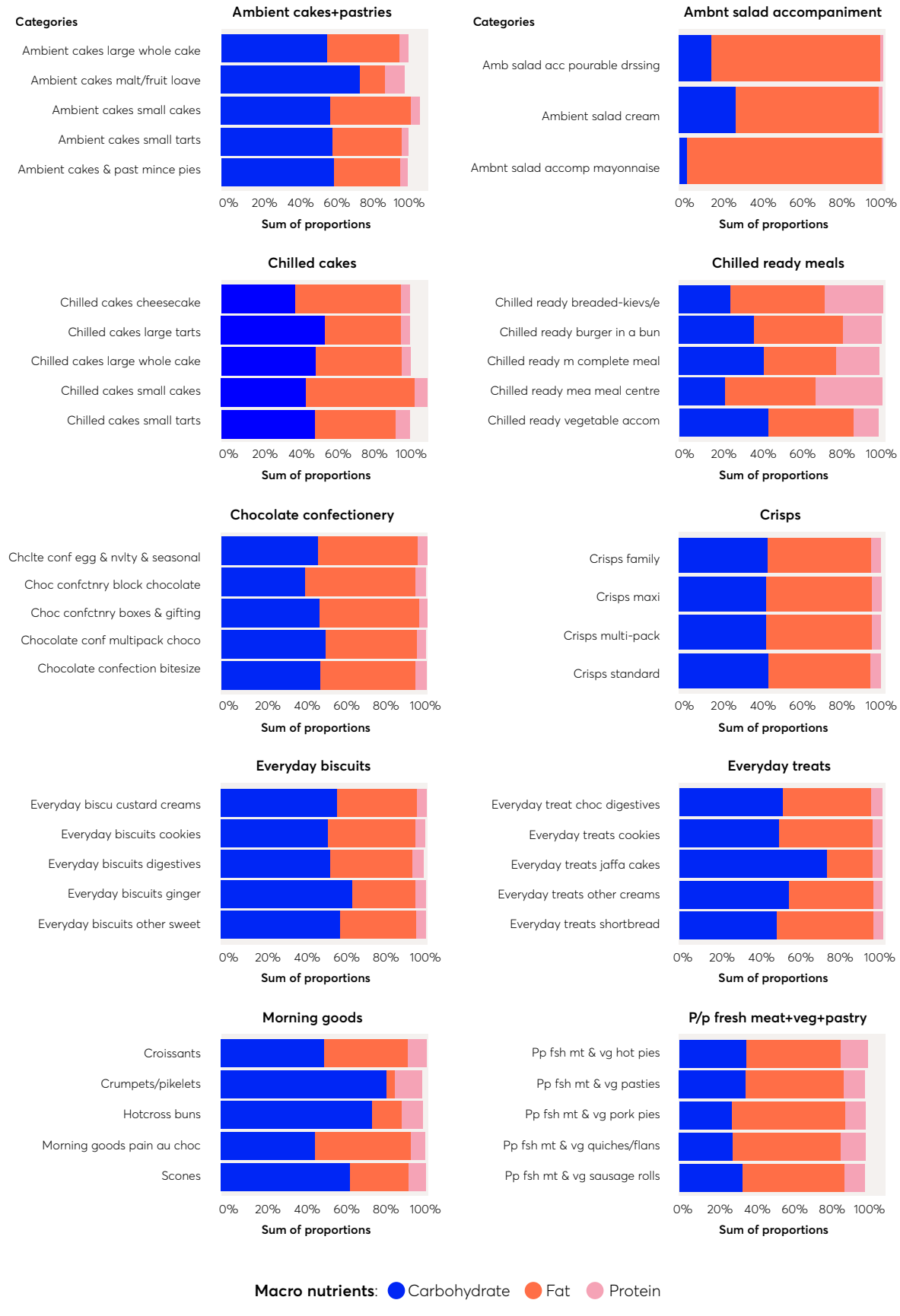


Figure A4 Macronutrient proportions of top 5 products in top 10 categories

Estimating the Impact of reformulation

To estimate the impact on the potential population level reduction in calories from reformulating the products in the target categories, we have developed a procedure that entails computing the current daily per capita calories available to each household (adjusted by household size) and then recomputing this value under the assumption that all products in the target categories have reductions in calories of either 5% or 10% and that there are no changes in demand.

To calculate the total impact at population level we multiply the estimated reduction at household level by the gross demographic weight that each household represents and sum this to obtain a representative figure for the total number of households in Great Britain (28 million).

The plot in Figure A5 shows the cumulative distribution of the difference in daily calorie intake between each scenario of reformulation and no reformulation.

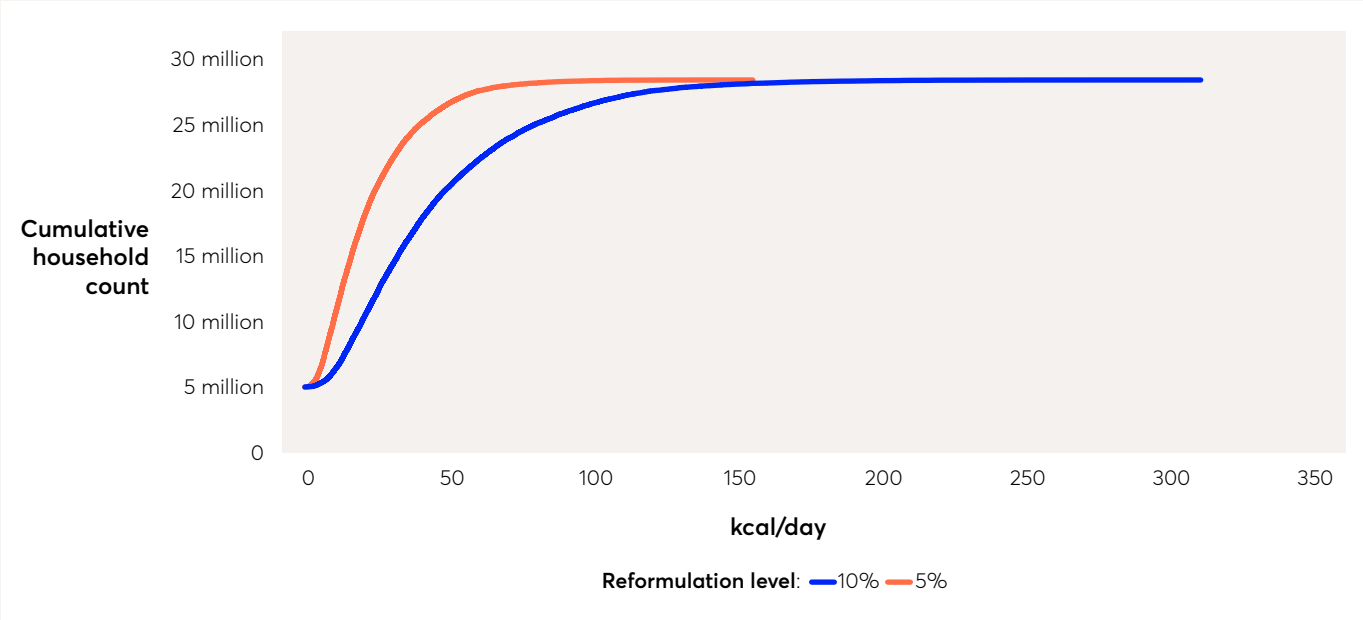


Figure A5 Cumulative distribution of household daily calorie intake

To estimate the QALYS saved by the daily calorie reduction, we used the model set out in Table 3 of the Department of Health and Social Care's Technical Consultation Document: Calorie Model. The model assumes QALY gains are linearly distributed across the model's 25 year timeframe.

Appendix 2: Stakeholder engagement

We conducted primary research to listen to and learn about experiences and perspectives from both actors and stakeholders in the food retail and manufacturing system. We intended to identify factors leading to the current state of the system, as well as possible change opportunities. We identified subject matter experts in Government, academia, industry, health advocacy and consultancy. Where appropriate, we further categorised individuals by the following areas of specialism: technical; financial; consumer research; policy. We purposefully sought out experts that were likely to represent a wide variety of views on the subject matter in order to explore varied perspectives and competing goals.

The objective of the subject matter expert interviews was to:

- **Deepen Nesta's understanding of the reformulation space**.
- **Understand what role subject matter experts hold and their perspectives of the topic, as well as their perceived needs, goals and barriers**.
- **Identify factors, positively and negatively, influencing the current state of the system**.
- **Understand the relationships that exist in the area**.
- **Assess for commonalities and identify organisations or individuals with similar motivations including to assess for suitability for expert advisor roles**.
- **Gather intelligence on further subject matter experts for engagement**.

Subject matter experts identified as being relevant to the research were approached by email, and the purpose and process of the study was explained. A small number of participants were offered remuneration for their time if it were deemed necessary to their involvement. Referrals were requested from interviewees to other relevant organisations and individuals.

Interviews with participants were conducted via video call by the researcher. Each interview included the same open-ended questions as well as questions appropriate to their sector, role and any specialisms. A semi-structured interview guide was designed by the project team to reflect the research questions the team identified when we set out to learn more about the opportunities in reformulation for calorie reduction.

The researcher summarised each interview, using initial knowledge synthesis to prioritise key data. The researcher subjected the resulting text to thematic analysis to draw out key themes from the research. However, points of conflict or other contributions, including direct quotes, that were deemed valuable were maintained for further exploration. The findings, once analysed and synthesised, were shared with an appointed advisory board for further engagement, critique and validation. Once the themes were discussed in full, a prioritisation exercise identified themes that were considered possible opportunity spaces for Nesta .

Endnotes

1. Excess weight (or a high BMI) was the third highest risk factor for death and disability in the UK in 2019. High blood pressure, type-2 diabetes, heart disease, stroke, and cancer are all diseases linked to obesity and diet. GBD 2019 Risk Factors Collaborators (2020) *Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019*. Access at: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30752-2/fulltext

2. The data source for our analysis is from 2021. The data covers over 36 million transactions for purchases of all food and drinks brought into the home by a sample of 29,000 households living in Great Britain, alongside demographic and socio-economic background data. This dataset does not cover out of home purchases such as takeaways, on-the-go food, or restaurants/cafe meals.

3. We have calculated the QALY savings using the Department of Health and Social Care's Calorie Model. Using version 2 of the DHSC calorie model, 1 calorie reduction/ day = 8,720 QALYs saved over 25 years, therefore a 38 calorie reduction per day saves 331,360 QALYs over 25 years. The DHSC Calorie Model looks at the long-term benefits of Government policies designed to reduce excess calorie consumption at a population level. Benefits are modelled over 25 years, a period deemed long enough to see significant health benefits from policies. For more detail please see the Technical Consultation Document, Department of Health and Social Care (DHSC) Calorie Model: https://www.gov.uk/government/publications/department-of-health-and-social-care-dhsc-calorie-model

4. For more information on the how the monetary value of a QALY is calculated, refer to the HM Treasury Green Book 2022: https://www.gov.uk/Government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020

5. Nesta (2022). Investigating calorie intake and obesity reduction. Access at: https://www.nesta.org.uk/project/investigating-calorie-intake-and-obesity-reduction/

6. Nesta (2022), Modelling ways to improve our health. Access at: https://www.nesta.org.uk/project-updates/modelling-ways-to-improve-our-health-what-would-be-required-to-half-obesity

7. The analysis looked at the in-home food and drink purchases for over 29,000 households in Great Britain for 2021. See full report for further details on the analysis.

8. You can find more information on our data analysis in Section 3 and in the Appendices of the report.

9. Government Food Strategy (2022). Access at: https://www.gov.uk/government/publications/government-food-strategy/government-food-strategy

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12. Public Health England (2020). Sugar Reduction Report on progress between 2015 and 2019. Access at: https://www.gov.uk/government/publications/sugar-reduction-report-on-progress-between-2015-and-2019

13. HMRC (2022). Soft Drinks Industry Levy statistics commentary 2022. Access at: https://www.gov.uk/government/statistics/soft-drinks-industry-levy-statistics/soft-drinks-industry-levy-statistics-commentary-2021#:~:text=Release%3A%20Autumn%202023.-,Headline%20statistics,million%20in%202019%20to%202020

14. Cancer Research UK (2018/19). *Overweight and Obesity Statistics*. Access at: https://www.cancerresearchuk.org/health-professional/cancer-statistics/risk/overwei

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18. UK Parliament Post (2021). *Food and drink reformulation to reduce fat, sugar and salt*. Access at: https://researchbriefings.files.parliament.uk/documents/POST-PN-0638/POST-PN-0638.pdf

19. Voluntary targets from PHE programmes include the increasing targets from the salt reduction programme, the 20% reduction in the sugar reduction programme and the 10% reduction for retail and 20% reduction for out of home in the calorie reduction programme.

20. Public Health England (2020). *Sugar Reduction Report on progress between 2015 and 2019*. Access at: https://www.gov.uk/government/publications/sugar-reduction-report-on-progress-between-2015-and-2019

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24. ShareAction (2021). *Tracking for Health Update*. Access at: https://shareaction.org/reports/tracking-for-health-2021-update

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26. The data covers over 36 million transactions for purchases of all food and drinks brought into the home by a sample of 29,000 households living in Great Britain for 2021, alongside demographic and socio-economic background data. This dataset does not cover out of home purchases such as takeaways, on-the-go food or restaurants/cafe meals.

27. These interviews included representatives from major food retailers and manufacturers, product development specialists, nutritionists and public health advocates.

28. https://www.binghamandjones.co.uk/

29. Details on the exact metrics used in the analysis can be found in Table A1 in the Appendix.

30. Z-score is calculated by subtracting the sample average from each value and dividing by the sample standard deviation. A z-score is interpreted in terms of how many standard deviations away from the mean a value is.

31. We have also explored the sales weighted energy density for selected products and compared to the average sales weighted energy density in the population of products. See figure A2 in the annex for a full list of top 10 categories.

32. See Annex for detailed description of indicator and figure A3 for results for the top 10 categories.

33. The dataset does not record the breakdown of carbohydrates within products so we make the assumption that all carbohydrates contribute 4 calories per gram. This may overestimate the total contribution of carbohydrates to the total caloric content of foods. Moreover, the data does not report the alcohol content of foods and drinks. For these reasons, when summing the percentage contributions of the three macronutrients it might not add up to 100. Furthermore, the content of free sugars is not captured in the data so we are not able to distinguish free sugars from other types of sugars.

34. See Table A2 in the annex for results for top 10 categories.

35. Public Health England (2020). *Calorie reduction: guidelines for the food industry*. Access at: https://www.gov.uk/Government/publications/calorie-reduction-guidelines-for-the-food-industry

36. https://github.com/nestauk/ahl_food_reformulation

37. The full list of food categories which came up during the analysis can be found in Section 5: Analysing household purchases

38. A 5% calorie reduction would see a calorie reduction variation between 8 calories per day and 45 calories per day for the top and bottom deciles.

39. Department of Health and Social Care (DHSC) (2018). *Calorie Model*. Access at: https://www.gov.uk/government/publications/department-of-health-and-social-care-dhsc-calorie-model

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41. The data covers over 36 million transactions for purchases of all food and drinks brought into the home by a sample of 29,000 households living in Great Britain in 2021, alongside demographic and socio-economic background data. This dataset does not cover out of home purchases such as takeaways, on-the-go food or restaurants/cafe meals.

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50. https://www.theccc.org.uk/

51. Diabetes UK (2022). *Understanding Food Labels*. Access at: https://www.diabetes.org.uk/guide-to-diabetes/enjoy-food/food-shopping-for-diabetes/understanding-food-labels

52. National Food Strategy (2021). Access at: https://www.nationalfoodstrategy.org/

53. Frontier Economics (2022) *Estimating The Full Costs Of Obesity*. Access at: https://www.frontier-economics.com/media/5094/the-full-cost-of-obesity-in-the-uk.pdf

54. Academic groups at Oxford, Imperial and Sheffield University are exploring the impact of a range of fiscal measures, including taxes. This work is funded by NIHR.

55. Public Health England (2020). *Sugar Reduction Report on progress between 2015 and 2019*. Access at: https://www.gov.uk/government/publications/sugar-reduction-report-on-progress-between-2015-and-2019

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57. The complete tables are available and can be accessed following the links: food category table and product table.

58. To obtain per-capita calories purchased figures we take the total number of calories purchased from products in a category by one household and divide that by a conversion factor that takes into account the number of people in the household, their sex, and their age. Values obtained after applying these adjustments allow us to compare figures across households that have different structures and may be interpreted as the per-capita calories purchased.

59. See endnote 58.

60. See endnote 58.

61. The number of products within each category varies substantially across categories (from 166 products in the Frozen Meat category to over 12,500 in the Chilled Convenience category). Estimates of variance and entropy may not be directly comparable across categories because categories with a larger number of products may have a tendency to have larger variation in ED. Therefore, we produce a robust measure of variance and entropy by taking five random samples of 50 products from each category, computing the relevant metrics, and reporting the average of the computed metrics.

62. Entropy is worked out by first calculating the deciles of the ED distribution of products across all categories and computing the probability distribution over the deciles within each category; secondly entropy is computed from the probability distribution within a category.

63. See endnote 61.

64. See endnote 62.

65. A cluster is defined as low income if households have a higher likelihood to belong to the bottom 25% of the household income distribution (income of the main shopper lower than £20K per year).

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