nesta

Targeting the health of the nation: technical appendix

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Contents

Background

This technical appendix accompanies *Targeting the health of the nation: a policy brief* and provides detail on our research, with a focus on the analytical approach used to model the impact of retailer targets on calories purchased, value sales and obesity outcomes. The overall aim of the project was to design a target for retailers that would improve the healthiness of their food product portfolio. We assumed these improvements would be achieved through reformulation, reductions in sales of unhealthy foods and increases in sales of healthy foods across both own brand and branded food products.

Summary of the project methodology

This research consisted of three core components.

1. Background research and literature review: we analysed existing UK food environment policy, international mandatory targets policy in the food industry and targets policy from other sectors (such as energy and climate) to establish effective implementation methods for industry targets.
2. Expert engagement and testing: we engaged with several expert advisors across the system and held a workshop with more than 20 key stakeholders from the food industry, policy arena, NGOs and academia across the UK to test implementation methods for multiple industry target options. Findings from this research and engagement have informed our recommended target and implementation options.
3. Quantitative data analysis: we measured the healthiness of retailer product portfolios and carried out modelling work to estimate the impact of various target options on calorie purchasing, value of sales and obesity prevalence.
4. Implementation plan development: we detailed the main policy options, our recommended approach and a comprehensive timeline for putting the policy into action. This report is designed to be supplementary material for use by the Government and civil servants tasked with executing the policy. For more information, see *Targeting the health of the nation: an implementation plan for government.*
5. Economic assessment: we commissioned an appraisal of the policy's impact on business costs and consumer prices. The assessment explores whether the policy is likely to significantly increase costs for businesses and subsequently affect consumers. For more information, see *Targeting the health of the nation: an economic assessment.*

The rest of this appendix provides details on the analysis and modelling steps taken to create the specific targets recommendations within *Targeting the health of the nation: a policy brief.*

Quantitative analysis methodology

The quantitative analysis helped shape our retailer target proposal by showing how UK retailers' product portfolios differ in terms of healthiness under various definitions. It also showed the potential economic and health benefits of retailers improving their healthiness profiles through strategies such as reformulation and sales adjustments, and aligning with our proposed target.

To carry out this analysis we used data from Kantar's Worldpanel Division, an international market research company. The dataset comprises food and drink purchases taken into the home in 2021 for a sample of approximately 30,000 British households. All analysis and interpretation was conducted independently of Kantar Worldpanel. Kantar has not independently verified the findings. To ensure estimates in our analysis are representative of the British population, we transformed the sample estimates using statistical weights supplied by the data owners.

Box 1: preparing the dataset for analysis

We carried out several steps of data cleaning to prepare our dataset for analysis. Firstly, we needed the weight in grams for all products. This was not available for all products and in these instances we did the following.

1. Obtained extra data from the data provider where this was available.
2. Used an imputation algorithm where the mean weight for a food category was used to impute missing data.
3. Manually added product weight, for example eggs are measured in unit numbers so we have assumed an average weight for all eggs, depending on egg type.
4. Used specific gravity values, published in Table 4 of the Government's 2018 NPM review, to convert volumes to grams for some products, such as yoghurts and ice cream, that were measured in litres.

Nutritional information (for example, calories, saturated fats, sugar etc) in Kantar's dataset is taken from a variety of different sources, including collecting known values, fieldwork, web scraping and a third party, which collectively account for about 69% of take-home food and drink volume. For products where the information was not available through one of these methods, the information is either cloned from similar products (approximately 16% of take-home food and drink volume), compiled using the McCance and Widdowson dataset (approximately 1.4% of take-home food and drink volume), or imputed from a category average (approximately 14% of take-home food and drink volume). Products with implausible values (such as calorie density higher than 900 kcal/ 100g) were excluded from the analysis.

Businesses and products in scope of our analysis

We made three core decisions regarding what and who would be in scope of our target proposal.

1. Targets would focus on retailers and not manufacturers

We recommend that these current targets only apply to grocery retailers. This is because the vast majority of products purchased are for in-home consumption and over 90% of all products purchased for in-home consumption come from just 11 retailers (according to Nesta analysis of Kantar data). Therefore, any changes in retailer behaviours would likely be passed onto manufacturers. Grocery retailers also sell a diverse but relatively similar range of products, meaning that a single target can be feasible as they have flexibility to make changes across their whole portfolio. Many manufacturers focus on producing a relatively small range of product categories (such as only confectionary or dairy products) and the variation in healthiness metrics between manufacturers is wider than that for retailers. One would, therefore, need more bespoke targets that tackled each type of manufacturing business, making the policy much harder to design and implement. The out-of-home (OOH) sector is another key component of the food system and it is estimated that, in the UK, 27% of adults and 19% of children consume foods outside of the home at least once a week. Nesta is exploring how targets could be designed and implemented for the OOH sector, with findings to be published in spring/summer 2024.

2. Targets would only apply to large retailers with >1.5% market share

We defined large grocery retailers as those that have at least 1.5% market share of purchases within our dataset, totalling 11 retailers representing over 90% of total calories purchased in Great Britain (GB). Market share was calculated by adding up the yearly value of all food purchases at a retailer. This decision was based on two justifications: the diversity of product ranges within each business, and the relative similarity in healthiness scores between stores, which create practical implementation issues.

Large grocery retailers sell a diverse but relatively similar range of products and account for most of the population-wide calorie consumption. By contrast, retailers with smaller market shares have greater between-store variation in the types of products they stock, often focusing on a specific type of product, which limits the implementability and scope of a single whole portfolio target for these stores. For example, the average (unweighted) calorie density across the large retailers is around 226 kcal/100g with a standard deviation of around 13 kcal/100g. However, the average (unweighted) calorie density across the small retailers is higher at around 304 kcal/100g with a larger standard deviation of 98 kcal/100g.

From a practical implementation point of view, while the 11 large retailers identified make up over 90% of the market share, the remaining 10% is shared between more than 20 retailers, many of which are small and independent and so for whom sales reporting may be a considerable burden. To incentivise improvements in the healthiness of food at these smaller independent stores without placing excessive operational burden on them, a target for the largest UK wholesalers who supply the majority of these stores could be considered.

3. The targets would only apply to food

We chose to design and model targets that focused only on food because:

- industry is already subject to effective drink-specific policies such as the Soft Drinks Industry Levy (SDIL) and alcohol excise duties
- healthiness definitions for food products differ from drink products. For example, the calorie density of a bottle of cola or an average beer is around 40 kcal/100g, while the calorie density of an apple is around 50 kcal/100g, which makes it difficult to apply the same calorie-based healthiness metrics and targets across both food and drink products. This means that different criteria would be needed for target design.

Food purchases were defined according to the 2018 UK NPM technical documentation (Appendix I - table 2). This means our modelling excluded any non-food purchases, such as soft drinks, milk, fruit juices and cooking oils.

How we measured the healthiness of retailers' portfolios

Once our core decisions on the businesses and products in scope of targets were made, we reviewed health metrics that could be used to measure retailer portfolios. We used three metrics to summarise the healthiness of a retailer's product portfolio (branded and own-brand products):

- sales weighted average calorie density (kcal/100g) (also known as energy density)
- sales weighted average converted nutrient profiling model (NPM) score

- sales weighted average proportion of products sold that are high in fat, salt or sugar (HFSS).

All the health metrics in our analysis were weighted by volume (measured in kilos). We call this sales weighting. Sales weighting ensures that products that have a higher volume of sales contribute more to average scores than those that are less frequently purchased. Another advantage of sales weighting by volume in kilos is that it accounts for changes in portion size and multipacks (see Box 2 for a worked example). Weighting health metrics by sales volume is standard practice among government and academic publications.

Box 2: how does sales weighting work in practice?

Consider an example of three products with the following calorie density values: product A is 50 kcal/100g, product B is 250 kcal/100g, product C is 600 kcal/100g. The unweighted average is the sum of these values divided by three, which is 300 kcal/100g. However, imagine that only 10kg of product A are sold, 50kg of product B and 200kg of product C. The sales weighted average is computed by multiplying the calorie density value of each product by total weight sold in kg, summing the result and dividing by the sum of all kg sold (260kg), which yields 511 kcal/100g. The weighted figure is higher than the unweighted one as it reflects the fact that the higher calorie density product has a much higher sales volume.

One of the advantages of sales weighting is that it also accounts for changes in portion size. Using the same example above, imagine that product C used to be sold in packs of 100g which means that 2,000 units were sold. Imagine the size of the pack has been reduced to 95g. If 2,000 units continue to be sold, the total volume sold becomes 190kg. Under this scenario the sales weighted average is 506 kcal/100g which is lower than the one calculated when product C had a larger pack size (511 kcal/100g).

The targets are designed to achieve a change in the sales-weighted average of these metrics. Our main interest at Nesta is overall reduction in calorie intake and obesity. The metric of calorie density has a direct link to overall calories, while the converted NPM and HFSS metrics are calculated with reference to a wider range of nutrient components, such as salt and fibre, in addition to calories. Therefore, for these metrics, additional assumptions are needed to understand the relationship with calories purchased.

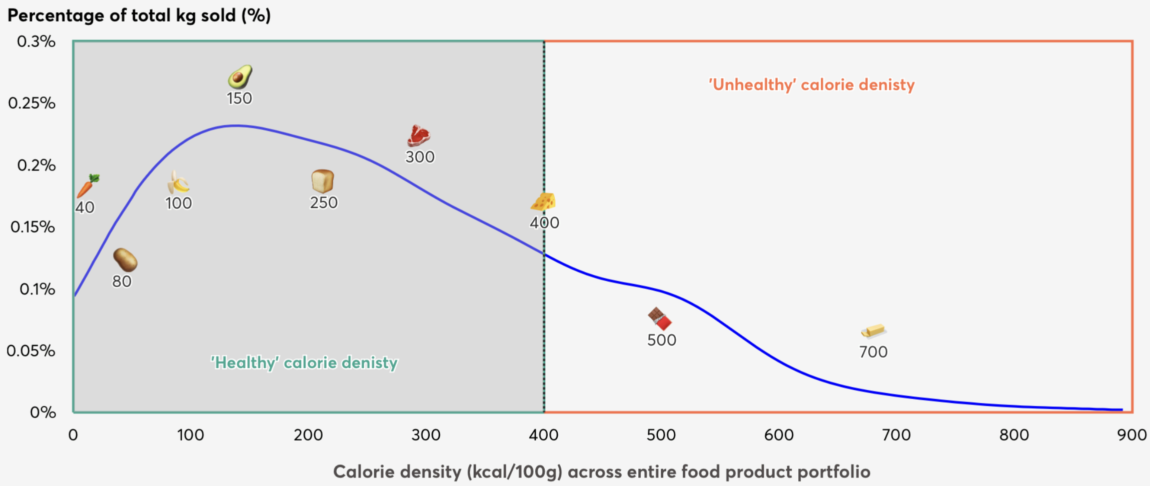
We provide more information on each of these metrics below.

1. Calorie density

Calorie density is defined as the calorie content in 100g of food. We have used a cut-off of at least 400 kcal/100g to define products as high calorie density, or 'unhealthy'. There is no official definition of a threshold for classifying a food as high calorie density, but the threshold of 400 kcal/100g has also been used in academic research. Figure 1 shows the distribution of sales weighted calorie density with some examples of products that fall below and above this threshold. In our dataset (consisting of food purchases from the 11 largest GB retailers), high or 'unhealthy' calorie density foods make up around 12% of weighted sales but 35% of total calories sold.

Figure 1: distribution of sales weighted (in kg) energy density across entire food product portfolio

Below 400 = 'healthy' calorie density and **above 400** = 'unhealthy' calorie density



Source: Nesta analysis of Kantar's Worldpanel Division Data (2021)

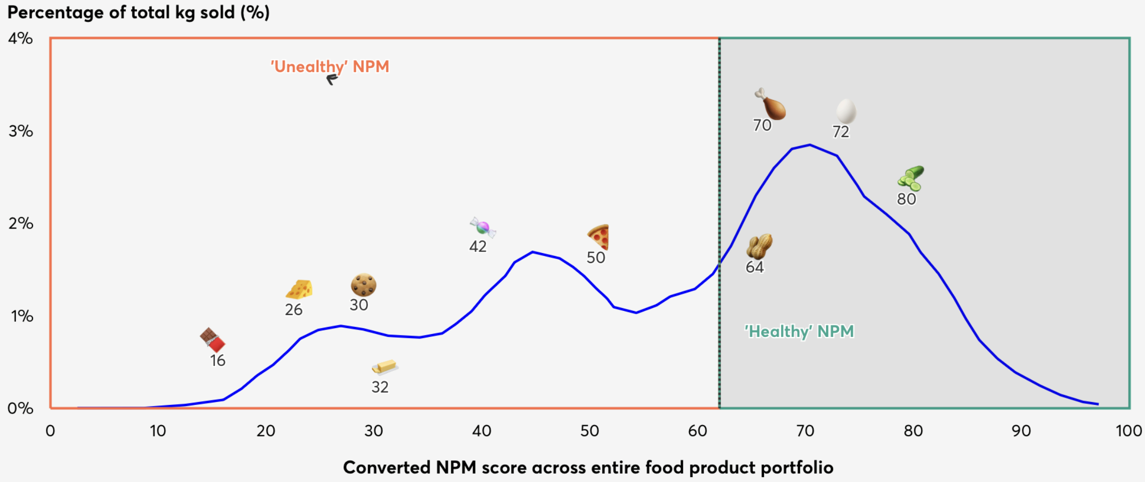
2. Nutrient profiling model score

Nutrient profiling is a holistic approach to evaluating the healthiness of foods. In this analysis, we have used the nutrient profiling model (NPM), as developed by the Food Standards Agency. This model was developed to identify products that should not be advertised to children. It assigns products a score by adding points relating to calories, sugar, saturated fat and salt/sodium density, and subtracting points relating to protein, fibre and fruit, vegetable and nut content. Higher NPM scores on the raw scale indicate unhealthier products and scores can be any integer between -15 and 40. A raw NPM score of four is the threshold used to define a product as 'unhealthy' according to current Government regulations. NPM scores are regularly used in academic research as proxy measures of healthiness.

The raw FSA/Ofcom NPM scale can be difficult to interpret as it ranges from negative to positive numbers with a lower score indicating a healthier product. Therefore, to ease the interpretability of the NPM, we have scaled the raw NPM scores to be between 0-100, where the healthier the product, the closer to 100 the score is. To do so, we followed a formula developed by the University of Oxford, which involves multiplying the raw NPM score by -2 and adding 70. Using this formula, the raw NPM score of 4 is equal to a converted NPM score of 62 (the threshold for a low converted NPM score or 'unhealthy' classification) (Figure 2). We have used the term 'converted NPM score' to refer to this scaled NPM score, and all subsequent mentions of an NPM score will pertain to converted NPM scores. In our dataset (consisting of food purchases from the 11 largest GB retailers), low converted NPM score or 'unhealthy' NPM products make up approximately 28% of weighted sales but 55% of total calories sold.

Figure 2: distribution of sales weighted (in kg) converted NPM scores across entire food product portfolio

Below 62 = 'unhealthy' NPM and above 62 = 'healthy' NPM



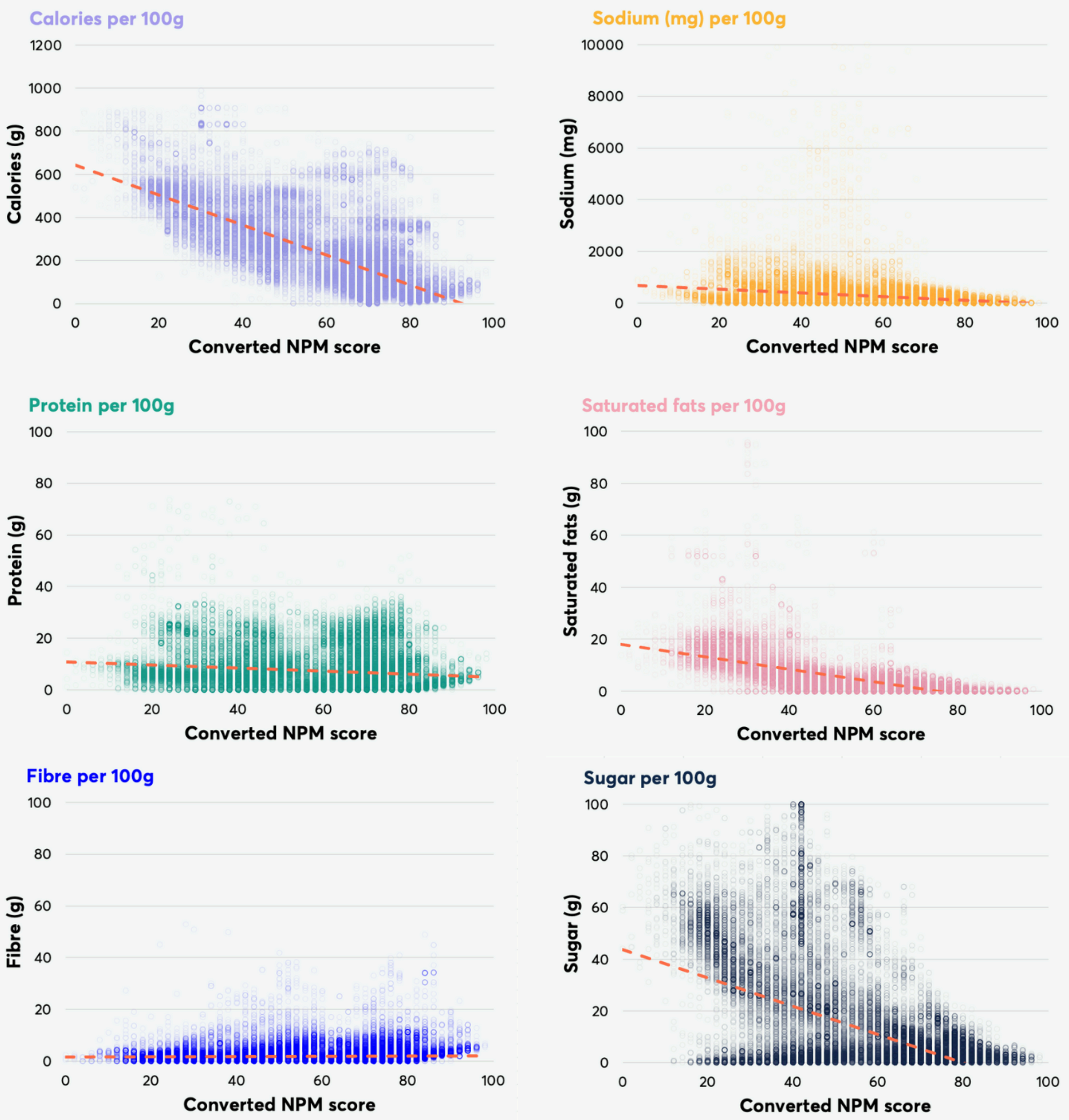
Source: Nesta analysis of Kantar's Worldpanel Division Data (2021)

We built an algorithm to compute converted NPM scores based on the Government's technical guidance. However, estimating the proportion of fruits, vegetables and nuts (FVN) for each product is complex as it is not routinely reported on food packaging. To address this we obtained additional data from our data provider with food category-level estimates of fruit, vegetable and nut content. Therefore, we make an assumption that all products in the same food category accrue the same points for FVN content (for example, all cakes in the ambient cakes category are assumed to have the same FVN points).

To validate our use of average converted NPM scores as a proxy for whole food portfolio healthiness we explored the association between converted NPM scores and individual nutrient components. These relationships are not straightforward as a product's converted NPM score can be increased in several different ways, including without any changes to the nutrient density of 'bad' nutrients. In terms of calorie content, which is the focus of our work, a product could technically be reformulated to have a higher converted NPM score by increasing its calorie density (for example, by adding nuts).

Figure 3 maps the converted NPM score of all food products against the average density of calories, sugar, saturated fats, salt, protein and fibre. The relationship between converted NPM and calories is the strongest of all the components, supporting our model assumptions that increasing average converted NPM scores is likely to result in a lower average calorie density of a product or portfolio of products. For example, the average calories per 100g for a product with an NPM score of 40 is 358 kcal/100g and for a product with a score of 80, it is 122 kcal/100g. In line with expectations, there is also a negative relationship between converted NPM scores and the density of saturated fats and sugar. The association between converted NPM scores and sodium, protein and fibre density is less clear.

Figure 3: association between converted NPM scores and density of each of its constituent nutrients (calories, sodium, protein, saturated fats, fibre and sugar) for food products only



Source: Nesta analysis of Kantar's Worldpanel Division Data (2021). Fruit and vegetable content not included in this analysis, see technical appendix (page 12) for further details

Note: we have applied separate scales for calories and sodium to account for the varying ranges of these two components

3. Share of high in fat, salt or sugar (HFSS) sales

Food products are categorised as HFSS, or 'unhealthy', in our analysis if they have a converted NPM score of less than or equal to 62 and they belong to a category that is within scope of current HFSS location restriction regulations. The categories that are used to determine if a product is HFSS are those identified as being of most concern for childhood obesity.

Although the majority of the volume (in kg) of products sold in our dataset (consisting of food purchases from the 11 largest GB retailers) is not HFSS (83%), HFSS products make up about a third of total calories sold. As previously mentioned, we have weighted the sales data used in our analysis by volume (measured in kilos). If we were to instead calculate the share of HFSS products measured in the number of unique products sold, we find that the not-HFSS product share is 71% and the HFSS product share is 29%.

How we modelled the impact of healthiness targets on purchased calories and spend

We developed an analytical model to estimate the impact that different retailer targets, if achieved in full, could have on daily per capita calorie purchasing and spending. The model worked by simulating how businesses could achieve different targets using a combination of the following three mechanisms.

1. Reformulation of a proportion of randomly selected products within high calorie density, low converted NPM, or HFSS groups.
2. An increase in sales of 'healthy' (low calorie density, high converted NPM, non-HFSS) products.
3. A decrease in sales of 'unhealthy' products (high calorie density, low converted NPM, HFSS).

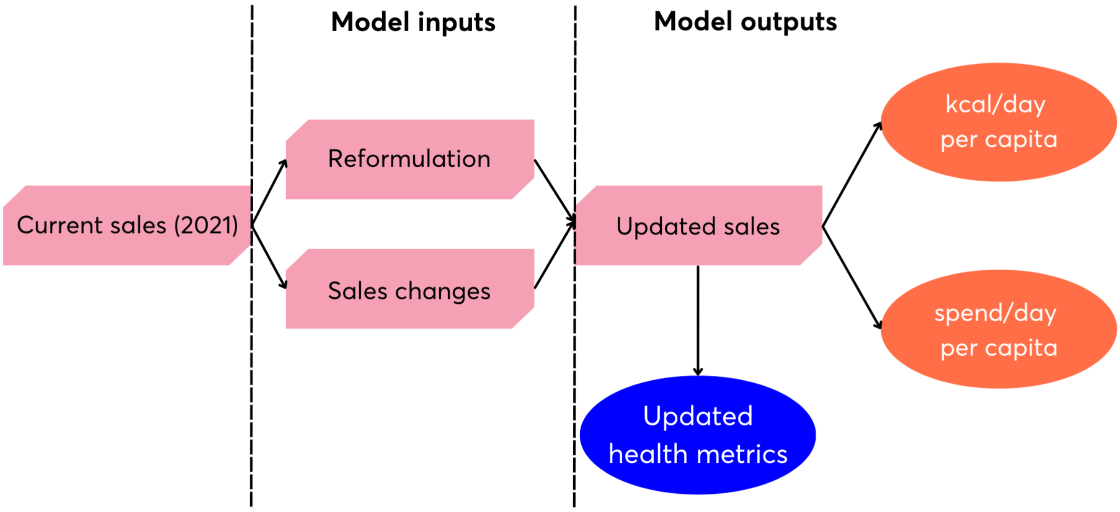
We believed it was important to ensure our modelled targets did not lead to an increase in overall calories consumed and that businesses should not experience a loss in revenue. To account for this in the analysis, we applied the following two criteria to the model.

- Targets should lead to a decrease in total calories purchased – to avoid the unintended outcome of an improvement in the healthiness metric while the total calories sold and consumed increases (in excess of sales increases related to population growth). This was seen with the voluntary sugar reduction programme whereby sales weighted average total sugar per 100g in products decreased by 3.5% but total volume of sugar sold in those same product categories increased by 7.1%.

- Targets should not result in a loss in revenue for retailers (as far as we were able to estimate this from the available data on daily spend per capita) – to ensure we modelled targets that were viable for businesses and accounted for their goal of commercial growth.

Different model scenarios were developed within these criteria by adjusting the extent to which the three mechanisms were enacted. These scenarios underwent numerous iterations, with varying random product selections in each iteration. The final results for each scenario were determined by averaging the outcomes of all iterations within that specific scenario (Figure 4).

Figure 4: graphical representation of approach to model the impact of a sales target on portfolio healthiness metrics, calories purchased and values of product sold



We built a separate model for each health metric, each of which relied on a different set of assumptions and model parameters (Table 1). Some parameters were kept static across different simulations (for example, the share of products that sales changes were applied to), while for others we tested a range of values (for example, extent of reformulation of 'unhealthy' products). The outputs from this modelling allowed us to recommend target scenarios that met our criteria of a reduction in daily per capita calorie purchased and no change in sales value (as estimated by daily spend per capita) across the dataset.

The method for calculating daily per capita calorie purchases and spend were as follows.

1. We calculated daily per capita kcal purchases by summing the calorie content of all food product purchases in our dataset and dividing this by 65 million (the estimated size of the British population in 2021) and the number of days in a year.

2. We calculated daily spend per capita as a proxy for the economic impact of the policy on retailers. We recognise that this is not the same as estimating changes in revenue or profit due to this policy but, without securing access to commercially sensitive profit margin data for each product in a retailer's portfolio, this is the best proxy we have available (for an assessment of the economic impact of this policy, see *Targeting the health of the nation: an economic assessment*). We calculated daily spend per capita by summing the values of all food purchases and dividing this by 65 million (the estimated size of the British population in 2021) and the number of days in a year.

Model assumptions

We made the following assumptions when running our models.

- Reformulation costs are not passed on to consumers and do not affect product demand, thus leading to no price changes for the reformulated products.

- If a new reformulated product is launched then the old one is completely retired and the demand shifts entirely to the new product.

- For the converted NPM and HFSS models, the relationship between converted NPM and calories is linear and negative. To estimate this relationship we ran linear regression models of calorie density over converted NPM scores for all products within a category.

- For the HFSS model, a product can be reformulated to become non-HFSS only by changing its converted NPM score.

Table 1: range of model parameters tested for impact on target outcomes

Parameters tested	Calorie density	Converted NPM	HFSS share
Share of products reformulated	Random sample of 50% of 'unhealthy' (≥400 kcal/100g) products	Random sample of 50% of 'unhealthy' (converted NPM ≤ 62) products	The size of the random samples vary between 100% and 25% depending on the converted NPM score
Share of products to which sales changes were applied	All products within healthy or unhealthy category	All products within healthy or unhealthy category	All products within healthy or unhealthy category
Extent of reformulation of 'unhealthy' products	Between 5% and 12.5%	Converted NPM score increases between 2 and 10	Converted NPM score increased to 64
Decrease in unhealthy sales	Between -1% and -15%		
Increase in healthy sales	Between +1% and +15%		

Model outcomes

Our model outputs showed that there was a clear trade-off between choosing reasonable sales and reformulation changes, achieving ambitious decreases in kcal purchases per capita, and minimising the impact of these shifts on the total value of products purchased. The target designs we analysed, and the illustrative scenarios by which they could be achieved, are summarised in Table 2. These represent just one example of a target and potential scenario that could achieve this level of calorie reduction, while having minimal impact on the value of products sold.

We tested the robustness of these figures by applying a statistical method that helps us understand how much the results can change with small, random variations in the model assumptions or methodological choices. This exercise enhanced our confidence in the recommendations as it revealed that the estimated average reduction in kcal purchased, sales weighted average target for all retailers and change in monetary value of total products sold are consistent and accurate. For example, when looking at the average decrease in calories purchased for the entire population, we found that about half of the estimated values fall within the range of -49 to -52. For more information on the statistical methods, our modelling and code, see the Targeting the health of the nation Github repository.

Table 2: final target parameters chosen, model inputs and model outputs

Metric	Calorie density	Nutrient profiling model (converted NPM) score	HFSS
Target parameters			
Average sales weighted average baseline across in scope retailers (2021 data)	184 kcal/100g	67	17%
Sales weighted average target (2030 goal) for all retailers	≤ 174 kcal/100g	≥ 69	≤ 7%
Model inputs *(estimated requirements for each retailer will vary dependent on baseline)*			
Average decrease in sales of 'unhealthy' products (≥400 kcal/100g or ≤ converted NPM score 62)	- 15%	- 10.5%	- 12.5%
Average increase in sales of 'healthy' products (<400 kcal/100g or > converted 62 NPM score)	+ 5%	+ 9%	+ 2.5%
Average reformulation changes	Calorie density across 50% of high calorie density (≥400 kcal/100g) products decreases by: 10%	Converted NPM scores across 50% of low converted NPM (≤62) products increases by: 6	100% of HFSS products with a converted NPM score 54-62, 50% with score 40-52 and 25% with score 30-38 are reformulated to be non-HFSS
Model outputs			
Change in value (£) of total products sold	**~ +1%**	**~ +1%**	**~ 0%**
Average reduction in kcal purchases across whole population	**~ 50 kcal per person per day**		**~ 40 kcal per person per day**
Average reduction in kcal purchases across the population living with excess weight	**~ 80 kcal per person per day**		**~ 62 kcal per person per day**

For the calorie density and converted NPM targets, the target designs that we analysed could reduce calorie intake among overweight and obese populations by approximately 80 kcal per person per day, alongside a +1% increase in the value of sales. We consider the model inputs outlined in Table 2 to achieve this level of impact to be ambitious but achievable.

The modelling outputs showed that achieving a similar level of impact using an HFSS target would only be possible under extreme reformulation or sales change scenarios. This is largely because retailers can only reduce their HFSS sales proportions by shifting products across the HFSS 'boundary' (converted NPM=62) from one category to another, which is only likely to be feasible for a subset of products that sit close to that boundary (products with a converted NPM score of 62 or slightly lower). Therefore, businesses would not be incentivised to take action that reduced sales or improved the offer of products in the most unhealthy range of their distribution, or to encourage sales to shift from quite healthy to very healthy products. For these reasons we decided not to recommend an HFSS target for this policy.

We then conducted further research into, and engagement with, the calorie density and converted NPM metric to determine the optimal measure (see Table 3). Our analysis showed that both measures could be equally impactful, yet each comes with its own benefits, as outlined below.

Table 3: appraisal of the strengths of calorie density and NPM metrics

Calorie density	NPM
• Most direct route to tackling obesity through total reductions in calories sold. • Could transfer to the out-of-home (OOH) sector where businesses with over 250 employees are already required to display calorie content per portion on their menus. • While calorie density may be a less familiar metric to industry, this should not be a barrier given it is a constituent part of any NPM calculation To know a product's NPM score, a business must also know a product's calorie density.	• A converted NPM score metric is a less direct route to tackling obesity, but it is strongly correlated with calories (see technical appendix). However, average increases could be achieved through changes to other nutrient components (such as salt), reducing the impact on obesity. • NPM scores are the basis of existing legislation (such as location restrictions regulations) and are protected in law, so may garner greater support from stakeholders. • For many in the public health sector, obesity is not the only diet-related outcome of interest. For these groups, an NPM-based target may be preferred as it captures a more holistic view of 'healthiness'. • Several businesses already use converted NPM as the basis of their commitments to improve healthy sales.

If your goal is to reduce obesity, a calorie density target provides a direct route to weight loss. However, a converted NPM-based target would also provide a viable route to tackling obesity, as well as the potential to deliver wider dietary health benefits. Ultimately, we determined that a converted NPM based target would be the most feasible option to implement while also achieving an equally impactful reduction in calories purchased. For these reasons, we recommend the introduction of the proposed converted NPM target.

How we modelled the impact of healthiness targets on obesity prevalence

We employed an in-house model, which is based on the commonly used Hall et al model, to estimate the impact of the proposed converted NPM target on daily calorie consumption and obesity rates within various BMI subgroups. Subgroups were defined according to the NHS BMI thresholds for underweight, healthy weight, overweight, obese and severely obese.

Model assumptions

Our model produced estimates of changes in calories purchased, but to determine the impact on health outcomes we require an estimate for calories consumed. In reality, calories consumed are likely to be fewer than those purchased because of food waste. Evidence suggests that around 25% of the weight of all food purchased is wasted. However, there is no agreement or evidence regarding how food waste varies by nutrient, so there is no reliable estimate of the number of calories that end up as food waste. Additionally, as we are looking at changes in consumption, rather than absolute levels, absolute waste is less of a concern. Therefore we followed previous research outputs, including analysis conducted for the National Food Strategy, in making the assumption that food waste is zero and all calories purchased are consumed.

We also assumed that there is no compensation made for reductions in calories purchased in retailers leading to more purchases in the out-of-home sector. Compensation would happen when reducing calorie intake from one source or on one occasion leads a person to consume more calories from another source or occasion. We assume that compensation would only occur if people who are underweight or a healthy weight consume fewer calories. However, evidence suggests food environment interventions such as this would be unlikely to affect this population given the proportion of the population living with underweight has remained stable in the past 30 years, and the metabolic functions in place to maintain weight would ensure a reduced calorie intake is not sustained for those with a healthy weight. We also anticipate that target-induced changes in retailers would occur gradually over multiple years across many products in their food portfolio. These changes should be imperceptible to the consumer, hence we assume that meaningful compensatory behaviours will not occur. Furthermore, the evidence of calorie compensation is mixed. In the absence of reliable evidence specifically about the role of the out-of-home sector in creating opportunities for compensatory behaviours, we assume no compensation effects in our model. Therefore, the amount of calories purchased and consumed from the out-of-home sector remains the same across all groups and is not affected by the introduction of a target in the retail sector. Nesta is developing new evidence to explore how out-of-home food consumption contributes to diets, along with specific targets to improve the healthiness of this sector's offer.

Model outcomes

For our recommended converted NPM target, we estimated an average decrease in calorie purchases of 50 kcal per person per day across the whole population or 80 kcal per person per day for those with excess weight (Table 4). We know that calorie purchases, and the impact of food environment interventions, are unlikely to be evenly distributed across the population. While we envision these targets to be a population-wide intervention that would impact the purchasing behaviours of all groups, we have only modelled the impact of the estimated decreases in calories purchased for excess weight groups. This is because we have a static population model which does not capture the likely weight gain over time in the healthy weight population group. Therefore, to avoid an overclaim of impact in our obesity prevalence model, we assumed no impact of our targets on calories purchased by underweight and healthy weight groups.

Since our model only accounts for the impact of changes in calorie purchases for the excess weight population (people living with overweight, obesity and severe obesity) we needed to work out the expected change in calorie purchases for the excess weight population only. To do so we upscaled the figure by first considering that, according to the Health Survey for England wave of 2019 (the last published version with objectively measured weight and height information), 64.2% of the adult population has a BMI within the excess weight category. Based on this, we calculate that the overall figure for the excess weight category is 78 per person kcal/day (calculated as 50/64.2/100). We then disaggregated it within each excess weight BMI group by considering the relative contribution of each group to the average estimated calorie intake, which we calculated using validated formulas relating body weight, height, sex and age to intake. This provided an estimate for the average impact of target options for each BMI sub-group (Table 4).

Table 4: disaggregation of the population level impact on calories by BMI subgroup

BMI sub-group	Average estimated daily intake	Relative prevalence weight *	Impact estimate **
Overweight	2,434	0.95	74.2 kcal
Living with obesity	2,652	1.04	80.9 kcal
Living with severe obesity	3,102	1.22	94.6 kcal

* Relative prevalence weight is calculated by dividing each average estimated daily intake value by the overall average for the excess weight group (2,553 kcal/day).

** Impact estimate is calculated by multiplying the average estimated daily intake by the relative prevalence weight.

We then used these calorie estimates to model the impact of our proposed converted NPM target on the adult population prevalence of overweight and obesity using the Nesta calorie model. This model simulates how the population BMI distribution changes for a given one-off permanent reduction in calories across different groups. We used the impact estimates in Table 4 to simulate a daily reduction in calorie intake for everyone belonging to the excess weight groups. We used adult HSE data from 2019 as baseline data for our model and assumed that weight loss would occur over a three-year period.

Our modelling estimates that a sustained calorie reduction of this magnitude among excess weight groups would lead to an approximate 23% reduction in the prevalence of adult obesity in the UK (obese and severely obese, from 28.0% to 21.4%) and a 14% reduction in people living with excess weight (from 64.2% to 54.9%) (see Figure 5).

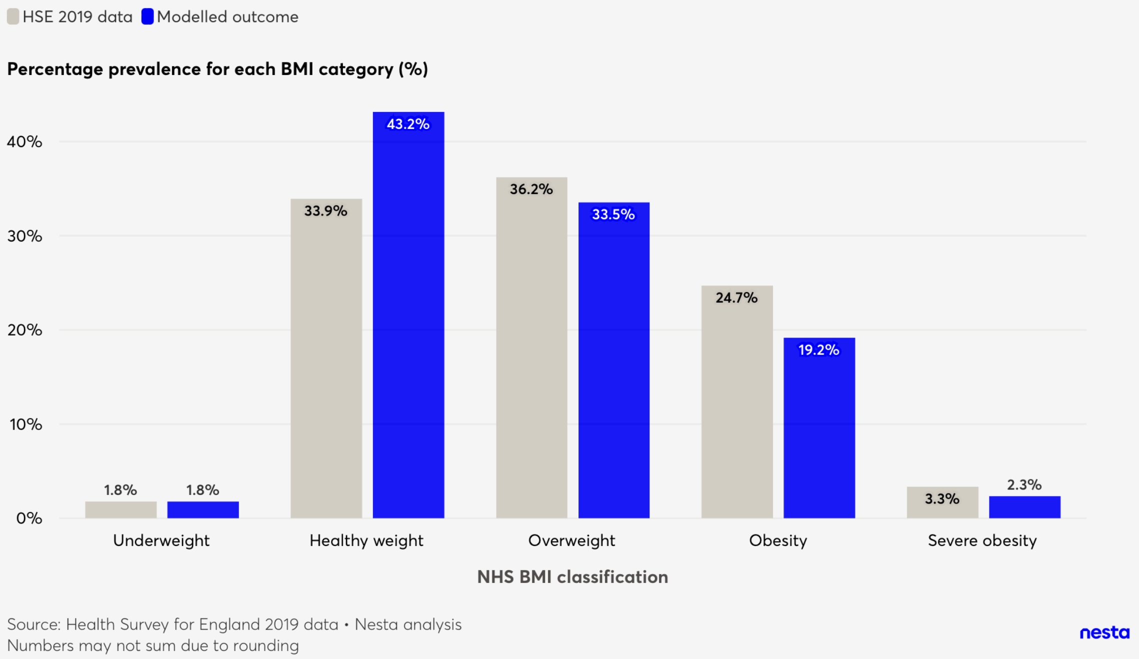


Figure 5: adult BMI prevalence in 2019 compared to scenario where target is met in full

Source: Health Survey for England 2019 data • Nesta analysis
Numbers may not sum due to rounding

It might at first appear counterintuitive that a reduction of ~80 kcal per person per day among the population with excess weight leads to a ~25% reduction in obesity prevalence when a [216 kcal reduction] is required to halve obesity. This is because the decrease in obesity prevalence is not directly proportional to the reduction in calorie intake, as their relationship is not linear. This happens because the BMI distribution in England ([and several western countries]) has a positive skew resulting from a relatively small number of very large BMI values. This means smaller values of calorie deficit are effective at shifting the BMI distribution but progressively larger calorie deficits are needed for larger shifts of the BMI distribution.

To understand the impact of our model inputs (see Table 2) on calories purchased, we've established a linear relationship between calorie density and NPM scores by food category to calculate the expected calorie reduction for each point decrease in the NPM score of products. This relationship is modelled from the observed patterns of calorie density and NPM scores (Figure 3). However, in practice, retailers or manufacturers might not prioritise reducing calorie density to meet these targets.

Given the NPM's design, they might opt to reduce salt levels or increase the content of fibre, protein or fruits and vegetables instead. If they choose these alternatives, the actual reduction in calories purchased – and therefore in obesity – might be smaller than our model predicts. It is important to note that our model has been conservative in its impact estimates as it has only evaluated the value of obesity reduction stemming from calorie reductions and not the benefits from sugar, salt or saturated fat reduction. As such, the overall positive impact on public health, stemming from improvements in the various nutrient components of food, would align with our estimates regarding the broader benefits of the Targets policy as a result of the reduction in the prevalence of broader health conditions.