

## **Climate Change and Food. What's for Dinner in 2050?**

A Food Climate Research Network report for *Tomorrow's England*  
By Tara Garnett  
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## General overview

Climate change and associated policies will be only one of the influences on consumer eating patterns, in 2025 at least. Health concerns, convenience and food industry innovations will have at least as strong an influence and these other trends may contradict shifts towards more sustainable patterns.

In 2025, policies aimed at addressing climate change will be more significant influences on how and what people in the UK eat than the actual physical aspects of climate change.<sup>1</sup> By 2050 however, the impacts of climate change will start to hit home and start seriously to threaten the continuation of the food supply system that we know today. The extent to which we can adapt to this change will very much depend on the robustness of policies that need to be put in place from now on.. These include not only policies to reduce GHG emissions but also policies to enable society (especially farmers) to adapt to the impacts of a warming climate.

Some of the possible future outcomes envisaged below may be contradict one another. This is because various possibilities may occur (or none) depending on the direction that policy, industry and consumer attitudes take.

An note on terminology: Strictly speaking, we should be talking about greenhouse gas emissions. The full basket of greenhouse gases includes not just carbon dioxide but also methane, nitrous oxide and refrigerant gases. The last three are disproportionately dominant in the food systems. A food product's 'embedded greenhouse gas emissions' or 'greenhouse gas' count refers to the total quantity of greenhouse gas emissions associated with its agricultural production, processing, transport, storage and so forth. As 'embedded GHGs' the phrase embedded carbon, carbon count or climate count is sometimes used. These phrases should be taken to be interchangeable.

## 1. THE BASE LINE: THE SITUATION TODAY

### a. How is the climate changing?

By 2025 under a Business as Usual scenario global temperatures are expected to have risen globally by about 0.8°C. By 2050 they could have risen by 1.7 °C or more (assuming A2<sup>2</sup> scenario – source: IPCC fourth assessment report summary working group 1). Sea levels could have risen by 20-30cm.

### b. General climate related policies

These include: the EU Emissions Trading Scheme, the Climate Change Levy / Climate Change Agreements, Energy Performance Commitment (out for consultation), Climate Change Bill (out for consultation).

### c. Where does most of our food come from today?

We're currently 60% self sufficient (73% in indigenous type foods)

- *Meat and dairy*: we're between 60% - 100% self sufficient, depending on the meat type
- *Horticultural produce*: In vegetable it is 62% and in fruit only 9%. Bananas are the UK's most popular fruit – they come largely from the Caribbean and South America.
- *Wheat and other cereals*: this is largely home grown (except rice)
- *Fish*: fish from Atlantic / UK coastal fisheries in decline; fish are imported from fisheries from all over the world.

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<sup>1</sup> This may not be the case in other more vulnerable parts of the world

<sup>2</sup> High growth high level of globalisation scenario

- *Oils*: soy and palm oil are imported. Rape and sunflower seed from the UK or EU.
- *Sugar*: Cane sugar from developing world; beet sugar is home grown.
- *Coffee, tea, cocoa etc*: all imported
- *Alcoholic drinks*: wine largely imported, beer largely produced in the UK; spirits present a mixed picture.

## 2. PHYSICAL IMPACTS OF CLIMATE CHANGE

### a. General global agricultural projections

Note that in addition to the projections summarised here, the spread of pests and diseases may affect crops and livestock in unpredictable ways. These may affect productivity even in areas which are projected to benefit (initially) from climate change.

**Northern Europe (including the UK)**: Climate change is initially projected to increase crop productivity at temperature increases of up to 1-3°C depending on the crop, and then decrease beyond that in some regions. Increase in irrigation demand projected to increase by around 20% by the 2020s and around 30% by the 2050s.

**IMPLICATIONS FOR UK FOOD**: UK and Northern Europe likely to increase their competitiveness with respect to food production. By 2025 horticultural produce may be commercially viable in the UK that cannot be now, eg. grapes, peaches, and apricots etc. The South of England may emerge as a leading wine growing area.<sup>3</sup> While energy costs (eg. from requirements to heat greenhouses) may decline, the UK's competitiveness will still depend on labour costs. The requirement to import horticultural produce (bearing in mind economic provisos) may decline – this holds for 2025 but by 2050, water shortages will increasingly become an issue, especially in the South East and East, (including the large food producing areas of East Anglia and Lincolnshire). Areas currently unsuitable for cereal production may become suitable and may be used for food, for animal feed or for biofuels. For the UK and other high latitude (generally wealthy) countries, there will be increasing pressure to grow food not just for home demand but also for overseas. As regards livestock, with climate change bringing fluctuations in the productivity of livestock (compounded by the spread of livestock related diseases) there may be increasing importing of dairy products, particularly from parts of Eastern Europe (see below). This will increase the refrigeration dependence of the supply chain. Competition for land from arable and biofuels production may also threaten livestock production.

**Africa, India, and the Middle East**: (especially seasonally dry and tropical regions), Crop productivity is projected to decrease for even small local temperature increases (1-2°C).

**Southern Europe** High temperatures and drought will reduce crop productivity, reduce water availability and may also increase frequency of wild fires (which could damage crops). **IMPLICATIONS FOR UK FOOD**: Southern Europe declines as a source of horticultural imports to the UK

**Central and Eastern Europe**: Less summer rainfall and more heat waves – crop productivity will vary. It may increase in Northern areas. **IMPLICATIONS FOR UK FOOD**: we may import some of our horticultural produce from CEE.

**China and Russia**: As these countries cover such a vast area, the impacts will vary by region. For some areas the effects on crop productivity are likely to be favourable

although there will be other areas more negatively by, for instance, water shortages. **IMPLICATIONS FOR UK FOOD:** as above. These countries may seek to increase their exports in order to improve their global competitiveness.

**North America:** Climate change is initially expected to be beneficial to crop productivity although it may affect some crops negatively (eg. vines). As climate change continues its negative impacts, (including more frequent winter floods, endangered ecosystems and increasing ground instability) are likely to outweigh its benefits. **IMPLICATIONS FOR UK FOOD:** as above.

**South America:** Yields are likely to decline; hurricanes (which are common in South America) may increase in severity. **IMPLICATIONS FOR UK FOOD:** Imports of South American sugar cane, and horticultural produce may decline. Oilseeds will not suffer and so the UK may continue to import these – they may also increasingly be used for biodiesel production. However this depends on policy / consumer attitudes to the sustainability of oilseed production in South America (see below).

**Australia and New Zealand:** Climate change (particularly drought) poses very major threat. **IMPLICATIONS FOR UK FOOD:** These countries may be one of the first to take steps to reduce the GHG impact of the foods they produce (as they are aware of the impacts of climate change). As such they may brand themselves as 'green' producers and market their produce to the UK as such. BY 2050 the livestock industry in Australia may no longer be viable.

#### **b. Other general climate change effects**

*Pests and disease:* These may spread and develop in unpredictable ways.

*Extreme weather events:* The frequency of droughts and floods will increase; this is likely to have severe negative localised impacts, and will hit tropical subsistence farmers hardest.

*Water shortages/excess:* This has already been highlighted but needs to be stressed.

#### **c. Short versus long term**

In the short term, extreme weather events (drought, flooding, violent storms) will have a more significant impact on crops (and on the food system in general) than the more gradual increase in temperature. However in the longer term the steady increase in temperatures will limit or reduce crop productivity and will increase global food insecurity.

#### **d. Impacts on key crops**

**Wheat:** Wheat production in Northern climates (eg. UK, US, Canada) may benefit but there will be declines in other areas, such as India. In the UK, some areas too wet for arable production may become suitable, while other areas may suffer from drought. How the UK manages the balance between production for home consumption, for livestock feed, for biofuels and for feed will depend very much on the policy climate.

**Rice:** Major rice-exporting countries are Thailand, Vietnam, India, the United States, China, Pakistan, Australia, Italy, Uruguay, Argentina, Egypt, and Spain. Rice yields may well decline as a result of increasing temperatures and reduced water availability, as well as the spread of new pests and diseases.

**Fruit and vegetables:** Climate change may favour production of crops such as peaches, nectarines, tomatoes etc in the UK. Production in countries that

traditionally import to the UK, such as Spain, Italy and South America are likely to suffer, both from increased temperatures and from water shortages.

**Cocoa:** Cocoa is highly susceptible to drought. With average temperatures increasing and rainfall decreasing, this is likely to mean lower yields.

**Fish:** How climate change may affect marine systems is not well understood although impacts are likely to be negative. For example the acidification of the oceans is leading to the loss of coral reefs which provide an essential support system for many marine species. At present, poor fisheries management and resulting over-fishing are certainly more critical factors than the anthropogenic climate change observed so far the future; however, the latter could also cause a considerable additional burden for marine ecosystems.

**Oilcrops:** Yields are not projected to suffer too much in the developing world; in the developed world they are projected to increase up until a certain level of warming.

**Sugar:** Yields in the developing world are projected to decrease, particularly in rain-fed areas. In the developed world yields are likely to benefit up until a certain level of warming. There may be pressures to increase production and productivity for bioethanol.

**Drinks:** For wine, temperature increases will affect not so much the productivity of wine production but the quality – for instance, a period of frost improves the quality. One study says that, if the overall quality of grapes is to remain equivalent to that of the present day, the area suitable for viticultural production may reduce by 40% by the year 2050. Australian, US wine growing areas (California and Oregon) and Southern European wine growing areas likely to suffer. By contrast other regions (including the UK and other northern climates) may well benefit. Areas growing poor quality wine may explore markets for converting the output to ethanol production. Alternatively they may be grubbed up and turned over to other crops. As regards beer, while barley growing in the UK may not be affected, the beer production process is water intensive. This may hamper production in other parts of the globe.

#### **e. Transport and trading infrastructures**

*Disruptions:* Extreme weather events could disrupt current infrastructure including roads, air routes and manufacturing sites; this in turn will influence how industry decides to respond (see below).

*Direction of trade:* As climate change (initially) favours agricultural production in the North but damages it in the South, the direction of agricultural trade may change – from today's South-to-North, to North-to-South. The competitiveness of Northern European, US, Russian and Chinese agriculture may grow.

### **3. THE POLICY RESPONSES: WHAT ARE THESE LIKELY TO BE AND HOW MIGHT THEY AFFECT WHAT AND HOW WE EAT?**

#### **a. UK policies**

**Carbon rationing/trading:** This may have been introduced, initially for transport and domestic energy use. By 2025 there may be plans to consider its application to food.

The debate as to whether to do so will focus on the extent to which impacts are covered by measures to address industry emissions. For example if the embedded energy of the food they produce and sell as the responsibility of the food industry then consumers may not be 'charged' for the food they buy. There will also be debates as to how carbon rationing/trading sites with other measures to tackle energy use – eg. road user charging and the cost of fuel (see below).

**Transport:** Road user charging will be in place, and, by 2025, will affect all road vehicles.<sup>4</sup> Moving around may become increasingly costly. Car insurance companies will also charge car owners on pay as-you-go so there may be an incentive to cut car use. The cost of fuel will have gone up substantially 2025. The biofuel content of the fuel mix will have increased. However for many this will not be seen to be a green option as the environmental impacts of biofuels production become increasingly clear. Some garages may offer biofuel mixes from certified 'responsibly grown' biofuel sources. By 2050 clean transport technologies may be in place and commercially viable. Note that the extent to which these measures actually reduce transport use will depend on, among other things, the rate of economic development. If we are all richer as a society then we may well be able to afford the added cost.

**Livestock:** As understanding of the contribution livestock make to GHG emissions grows there'll be increasing policy focus on the issue. By 2025 there'll be a split between those who want to go down technological approach (ie. breeding livestock which produce less methane) and those arguing for less livestock production per se. There'll be major conflicts with the UK farming community – by 2025 most of the smaller farmers will have gone out of business. The bigger players may own farms both in the UK and overseas so production may shift to areas with less stringent policies in place or with more favourable support for agricultural production. All agricultural sectors will be included in the EU Emissions trading scheme (which by 2025 will cover the full basket of greenhouse gases). Consumer response may play a big part in how policy develops (see below). Policies as regards methane production may favour pig and poultry farming.

**Water:** Water will be much more expensive. This will have an effect on agricultural water demand) and people's awareness of water as an environmental issue (see consumer section below). Domestic demand for water may increase or decline depending on the policies and water saving technologies that are put in place.

**Biofuels:** There'll be huge debates about **a.** the extent to which biofuels actually reduce GHG emissions and **b.** whether we should be using land for growing food or fuel. In 2025 biofuels production will be widespread but with the advent of second generation biofuels (made from ligno-cellulosics such as willow) the environmental arguments against oilseed and sugar production may start to receive a more sympathetic hearing to policy makers. This may divert land back to cultivation for food production.

**Immigration:** With the global increase in climate refugees, already pronounced by 2025 but very serious on 2050, the UK and Northern Europe in general will have to develop approaches to tackling the issue. Issues to consider are not just physical space on this island but how this affects the UK's overall GHG emissions. Anti immigration groups will argue that immigrants are 'snatching our carbon allowances' - if there's a cap on total UK emissions then the more people there are, the less per capita carbon there is to go round. Some immigrants are used as cheap labour for the expanding horticultural sector but this is highly seasonal work and does not offer year round employment.

**GM and the agricultural research agenda:** GM re-emerges as a serious policy issue for debate, this time from a climate angle. As genetically modified drought-resistant, heat-resistant or low nitrogen-requiring crops are developed, there is furious debate as to whether the carbon benefits outweigh the potential

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<sup>4</sup> Charging people on a pay-as-you go basis.

environmental risks. Certain parts of the world will embrace them and the UK will have to decide whether to accept imports from these countries. It may be that by 2050, genetic modification emerges as the only option for many parts of the world. This may lead to a two tiered food system (see below). Increasing research efforts and money will be put into developing varieties and strains adapted to warmer drier or more unpredictable conditions.

**Health:** Food and health concerns are very high in 2025. The number of obese adults in the UK has peaked and may be starting to decline. Policies to promote healthy eating may or may not clash with environmental policies.

**International development policy:** By 2025, the Department for International Development will have acknowledged that its support for the Sub Saharan African horticultural export industry is having a negative effect on emissions and will be seeking ways of supporting development in more sustainable exports. It will be funding research into the economic viability of food and other industries where the products can be transported at sea, preferably at ambient temperatures.

## **b. International policies**

**International climate change agreements:** By 2025 the international community is likely to have formally recognised that to keep temperature rise to below 2°C, we need to keep the concentration of all gases (not just CO<sub>2</sub>) in the atmosphere down to 450 parts per million equivalent. This will mean a 90% reduction in emissions for the UK by 2050. International aviation and shipping will by 2025, and after major wrangling, be included in national greenhouse gas inventories. Inventory making will shift away from national greenhouse gas production and by 2050 or sooner nation states will now be required to report on imports associated with their consumption.

Refrigeration: Hydrofluorocarbons (HFCs) will be banned by 2025

**EU ETS:** Post-2012 the scheme will include not just CO<sub>2</sub> but the other GHGs. Aviation and shipping will also be included. The inclusion of the other GHGs will have an effect on the agricultural sector especially in countries such as Ireland, where agriculture accounts for a significant proportion of total GHGs.

**World Trade Organisation:** By 2025 the WTO is starting to consider environmental issues in its trading rounds – by 2050 environmental standards are incorporated. The merits of GM crops modified to be less GHG intensive will be judged to outweigh the environmental risks and hence restrictions on the import of GM goods will be banned. The EU may or may not decide to go along with this ban.

**The US:** Will finally start to do something about climate change and may start going to war with countries that aren't pulling their weight in terms of CO<sub>2</sub> reduction.

**China and India:** By 2025 they will come on board and recognise the need to do something about climate change. They will also be obliged to cut their emissions as signatories of the Kyoto Protocol. Since China will already have invested very heavily in coal-fired power stations, the task of retrofitting and generally unpicking the investments of the previous years will be immense. There will be political wrangles about how much support should be given to these countries to shift to cleaner technologies.

**Transport:** Aviation is unlikely to be curbed by the EU ETS and by 2025 the sector is continuing to grow. By 2050, despite advances in technology, aviation is accounting for a significant proportion of global emissions and finally curbs are being made on its expansion.

**Global trade:** By 2050 global trade will be needed more than ever now to cope with increasing food insecurity. However the flows are likely to go from developed to developing world as the environment in many of the poorest countries will simply not be able to sustain crop production. With transport and other infrastructure increasingly disrupted by the impacts of climate change, ensuring the reliable and

equitable distribution of foods in the developing world will be very hard to achieve. Moreover post 2050, as food availability begins to decline it may be that the developed world becomes increasingly reluctant to share its agricultural outputs with others.

### c. Other trends to take into account

#### UK

- **Changing demographics:** The UK population on average will be older and richer, with more people living alone. Income inequalities may grow.
- **Rural shift:** As cities becoming increasingly hot and unpleasant, people will move out to the countryside but continue to commute in for work, meaning that despite transport policies in place, there is an increased risk of transport. Remote communications and home working may counter this trend to an extent. In some rural areas new food businesses will set up for local population but in most cases people will continue to drive to large supermarkets, either because there are no local shops or because the supermarkets are cheaper (see below for more on shopping)
- **Eastern influence:** Economic growth in China and India will increase our awareness of and exposure to far eastern customs, tastes and so forth. This may also have an influence on our food culture. For manufacturers and retailers (some of whom, such as Tesco, have stores in the Far East) it is possible that the far eastern business practices might influence the way they do business here in the UK.
- **Influence of religion is set to grow:** Halal and other foods will become mainstream in all stores. This growth in religious feeling may or may not have positive environmental implications; if it goes hand in hand with a sense that people have an obligation to be 'stewards of God's earth' then the impacts may be positive. On the other hand, given that many of the world's poorest who will suffer the worst effects of climate change are Muslim, then religion is likely to be increasingly politicised, with climate change becoming an additional cause for conflict.
- **Influence of investment community:** Increasingly (and this is also a global trend) the investment community will be assessing businesses not just on the basis of the risks that climate change poses to their viability (eg. whether they are in a flood prone area) but also on the basis of the contribution that the businesses make to climate changing emissions. By 2050, climate-contribution risk assessment will be mainstream.

#### Global

- **Global insecurity:** This is very likely to increase – the importance of climate related impacts on land and water may lead to 'climate wars' and 'water wars.' This will disrupt food supplies further.
- **Global labour:** The cost of labour overseas will be very cheap relative to UK; but if agriculture becomes less viable then agricultural employment opportunities in developing countries will decline.
- **Supply chain vulnerability:** There will be other pressures on the supply chain such as the risk of terrorism (bioterrorism in food chain) and food safety outbreaks (eg. avian flu) as well as weather-related transport disruptions. These may put into question the safety of globalised systems of sourcing and supply.
- **Economic development:** Rapid development in many parts of the developing world will lead to massive demand for fuel and its outputs. A two tier system of

excessive consumption among the rich and extreme poverty – and often displacement from lands due to drought, flooding etc – by the poor. In short the rich will become richer and the poor, poorer. Obesity among the rich in the developing world is likely to grow rapidly, partly due to increasing consumption of meat and dairy products.

- **Population growth:** This is projected to grow to about 8 billion in 2025 and 9.4 billion in 2050 and will exacerbate all the problems above.

## 4. UK FOOD SECTOR RESPONSE

### a. The infrastructure

**Agricultural production:** By 2025 in the UK the bigger farmers (there may not be any small ones left anyway) will be planting crops adapted to climate change. These will not necessarily be GM (this will depend on how consumer attitudes change) but they will be bred for adaptation to drier warmer conditions. Also see above. The overall number of livestock will be reduced in number. There will be a dualistic approach to livestock rearing; some farmers will decide to go down the technological route (eg. breeding cattle for low-methane traits) whereas others will go for the extensive route. The latter will be more expensive, while the former will be used in value and cheaper lines.

**Refrigeration:** There will be massive increases the energy efficiency of the big manufacturers and supermarkets. Many will be using trigeneration (combined heat, power and refrigeration). HFCs will no longer be in use (see above). The chilled section in shops will be very different – no more open cabinets – all chilled food will be behind doors. On the other hand as the climate warms the need to use refrigeration (and air conditioning) is set to grow.

**Manufacturing:** See trigeneration above. Decentralised biomass-fuelled heat and power systems start to be developed; they will be growing in popularity by 2025 and by 2050 they'll be mainstream. Woody biomass may start to be trialled as a fuel source by 2025 and will be commonplace by 2050.

**Lighting:** Ultra low energy lighting will be the norm in all supermarkets and stores either due to voluntary action by the retailers themselves or because of legislation.

**Transport:** Is a major energy user in 2025 – the relative importance of transport to whole food life cycle GHG emissions set to grow as refrigeration and other areas of concern are tackled (see above). The possibility of low-carbon transport emerges as a commercially viable option in the 2040s. As regards air freight, there may be a breakthrough in food storage/packaging technology which means that produce which currently needs to be air freighted may be able to go by ship.

**Waste:** Food and packaging waste emerges as a serious concern as the cost of landfill soars. All food packaging is reduced to a minimum. Compostable packaging is well developed by 2025 and much waste food can be thrown together with its packaging straight into the compost bin. All supermarkets have a zero waste policy – any leftovers are used as inputs to localised food waste biogas generators. These will be commercially viable by 2025 and ubiquitous by 2050.

### b. Food sourcing

**Domestic vs. international:** By 2025 a higher proportion of produce may well be sourced from the UK although cheap labour in China, Russia and Eastern Europe will limit the competitiveness of the UK agricultural/horticultural sector. Biosecurity / supply chain vulnerability issues will influence the decision too. Dual sourcing systems may emerge to spread risks and ensure backup in case something goes

wrong. This may lead to overproduction which may in turn generate waste unless unwanted produce finds its way into the domestic wholesale markets. A shift to domestic sourcing for some foods may be part of a package of approaches to spreading risks.

**Supply chain relationships:** This could go both ways. One outcome of the dual sourcing approach may be that suppliers become even more vulnerable to supermarket decisions – if another source emerges as of better quality, or if crops fail, they may have no back up. Alternatively, growers and suppliers who are in ecologically favourable areas or who have established energy efficiency/irrigation systems may be in demand from supermarkets and they may be able to dictate favourable terms of trade. It may be that both possibilities arise depending on the product, the supermarket policy and so forth.

**Extreme weather events** Will increasingly disrupt supply chains. Up until 2025, the commercial goals will still be to ensure constant availability of supply. This may increase the industry's reliance on air freight for emergency 'top ups.'<sup>5</sup> On the other hand, as food manufacturers increasingly market themselves on their low-GHG credentials, they will be anxious to ensure that their manufacturers overseas adopt energy efficient practices. Whether manufacturers choose to locate in a country may be in part determined by their record on energy efficiency. One option might be for manufacturers to locate in countries where the fuel mix is highly dependent on nuclear, as this is carbon neutral. Food manufacturers will increasingly make use of the Clean Development Mechanism to invest in cleaner technologies as a means of offsetting their carbon emissions

**Just in time and lean logistics:** Unpredictabilities in supply and transport infrastructure puts into question the just-in-time approach. As part of their approach to planning for supply chain disruptions, manufacturers and retailers may stock pile goods. This in turn will increase storage requirements and may increase energy use in manufacturing and retail sites.

### c. Product development and marketing

**Labelling:** By 2025, supermarkets offer 'climate counted' ready meals and other products. This information may initially be available on the packet but with changes to packaging the supermarkets move over to supplying customers with hand-held eco-scanners. These devices enable you to scan the bar code, and see the GHG content of the food in question. As you go round the shop you can tot up the climate content of your total basket. In 2025 providing such information will be voluntary but by 2050, if it isn't in any case ubiquitous, it will be mandatory. The scanner will also be able to offer information on other ethical issues such as fair trade, virtual water (see below) and animal welfare issues as well as nutritional information, serving suggestions (including low carbon options) and so forth.

**GM:** Cheaper 'economy' and 'value' lines may also be formulated to meet low carbon limits but this may be achieved through the use of GM ingredients (ie. ingredients that are low in embedded GHGs because they have been genetically modified in some way).

**Communication:** Supermarkets will offer suggestions for planning low-carbon menus. There will be leaflets and recipe books in store but also specially trained staff in store to offer advice. As supermarkets move more and more into offering non-food goods, these staff will increasingly become known as 'carbon management

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<sup>5</sup> Nb: this is a trend that is already happening

advisors (CMAs).’ They will offer tailored ‘carbon management services’ - information on managing your carbon budget in all areas of life from travel, to home energy use to food. Initial quick consultations may be free but you may be able to pay for a full blown one or get one on your club card points (see below).

**Club card and nectar points:** Supermarkets may offer green club cards for those who consistently make low carbon choices. The ‘reward’ may either be financial or in the form of some kind of low carbon treat eg. in-store aromatherapy massage, free carbon management consultations etc.

**Food types:** In the drinks market, concentrates will be back. Ready-to-drink squash is too climate-intensive to carry around (because the lorry is carrying mainly water). Concentrates will be promoted as the low-climate alternative. Bottled water becomes the next big villain although by 2050, as water shortages emerge people may stock up on bottled water as a back-up measure. One alternative to current bottled water retailing is to offer some kind of purified water which has been purified on site. Fresh fruit juices will be targeted as high in GHG intensity (they have not been produced from concentrate and they need total supply chain refrigeration). There will be conflicts between the climate and the health lobby on the benefits of fresh as opposed to concentrated or ambient food (see below).

**Choice editing:** Retailers and manufacturers may decide not to offer some products. They may do this multilaterally (eg. general agreement not to stock air freighted US blueberries). Alternatively one supermarket may decide to go it alone and turn this green action to competitive advantage ‘we’re so concerned about the environment that we’ve deliberately decided not to stock x.’ In order to keep food product GHG emissions down, manufacturers of ready meals may gradually reduce the meat content of a product (eg. shepherd’s pie). Unless managed properly will face accusations from health and consumer organisations of reducing the quality of their products.

**Buy-more promotions:** By 2025 supermarkets will have succumbed to pressure to stop BOGOFs<sup>6</sup> because they encourage people to buy too much and hence waste food).

**Vegetarian offerings:** Supermarkets will increasingly promote meat-free offerings. This will fit partly with the low carbon agenda (ie. less meat) and also because of the health benefits of a lower-meat diet. Promotional days eg. meat-free Mondays will be promoted. While meat consumption is projected to decline, there may be an increase in highly perishable or air freighted fruit and vegetables, which will counter to some extent at least the carbon reducing impacts of a lower meat diet.<sup>7</sup>

**Ambient alternatives:** Some foods that are currently sold as chilled (eg. soup) will be increasingly offered in ambient format. Retailers will have to work hard to overcome perceptions that ambient food is of a lower quality than refrigerated. By 2050 dehydrated foods may also be seeing a revival. On the other hand retailers may also stock foods with ‘smart’ chill technology – ie. foods that are packaged and stored at ambient temperature may have a device whereby you twist the packet, it releases some chemicals which in turn chill the product. These may have a very high embedded carbon content but could nevertheless sell well on particularly hot days when people are prepared to spend a lot of their carbon budget just to stay cool.

**Marketing variability:** One of the impacts of climate change may be that the quality of produce may be more variable owing to more extremes in weather conditions. Where supplies are simply not available, substitute products may have to be used. Successful supermarkets will be those who are able to market variability, inconsistency and non-availability. This will be quite a challenge since at present

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<sup>6</sup> Buy One Get One Free offers

<sup>7</sup> Meat and dairy consumption in China and India is projected to increase substantially, however.

their USP is largely because they offer consistent quality, whatever the time and place. By 2025 supermarkets will have started to market themselves in this manner; by 2050 the situation may have started to move beyond this point and variability will become the norm simply because we will not be able to consume as we do now.

**Virtual water content:** By 2025, water use is starting to emerge as a key area of concern. The embedded water, 'virtual water'<sup>8</sup> in a product (high for washed salads, for meat etc) will be highlighted, perhaps with a label. Water will become the new big ethical issue

**The multiple labelling problem:** As ethical issues move up the consumer agenda, manufacturers, retailers and consumers will have to grapple with a whole multitude of issues including fair trade, embedded GHGs, virtual water, biodiversity-care and health. One or two products will tick all the boxes but very few. Attempts will be made to rank these issues in order of importance but these will be very controversial and ultimately unsuccessful.

**Food prices:** The cost of food will go up. Whether the cost hits people's carbon budget or economic budget will depend on how carbon rationing / trading develops. If the embedded carbon costs are to be borne by the retailer and manufacturer (rather than the consumer who has to 'spend' his/her carbon budget) then they may reflect this in the prices they charge for high GHG foods.

#### **d. Other retail developments 'the retail experience'**

As retailers move into non-food areas (eg. televisions, clothing etc) they will also seek to extend their appeal as a destination food experience. They may open restaurants which, among other things, offer carbon counted menus (see below).

#### **e. Food industry structure**

The number of smaller players manufacturers and retailers is likely to decline. This will be for a number of reasons, one of which will be their lack of resources and expertise to cope with the energy efficiency demands placed on them. However, there will be a few who survive because they have a particular market advantage. As ethical issues grow in importance for consumers, being climate or water neutral may count as market advantages. Local farmers markets, box schemes and so forth will be popular for a niche section of the population. Their benefits as regards the contribution they make to tackling food GHG emissions will become increasingly challenged though as people move beyond the food miles issue. They may continue to advocate their credentials on the basis of their socio-economic and cultural value. With the biosecurity/ food safety risks growing in importance as a concern, they will also point out their value in terms of spreading supply chain risks. Decentralised food safety outbreaks will have less of an impact than globalised outbreaks.

### **5. THE CONSUMER RESPONSE**

#### **a. Awareness and high profile issues**

- By 2025 there'll be very high general awareness of the impacts of climate change.
- There'll be an increasing awareness that climate change is not just about CO<sub>2</sub> but about the other greenhouse gases, particularly methane and nitrous oxide, and their importance in the food chain.

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<sup>8</sup> The embedded water associated with the production and manufacture of a product

- As regards food the focus will move beyond food miles to 'embedded climate impacts'
- There'll be a strong interest in reducing emissions as carbon rationing/domestic carbon trading comes into being in around 2025. Food may or may not be part of any trading/rationing scheme but the carbon impacts of the food will be reflected in the cost and so there will be an incentive to consume lower carbon foods.
- Virtual water becomes the next big issue:
- People may make their own decisions on how to 'spend' their carbon budget and so some people will splash out on food while others will eat low carbon in order to be able to travel (if carbon rationing extends to food)
- There'll be debates on the conflicts / win-wins as regards the climate vs. health agenda
- Food waste emerges as a big issue and the subject of major campaigns etc.
- Climate change patented crops – consumers have to trade off the ethics of buying rice which is low in embedded GHGs with the fact that it's patented by a big agriceuticals company who won't give free seeds to poor farmers.
- There will be groups in society or areas in the UK which adopt a fairly radical response to climate change – going for zero as it were (see below).
- Backlash dining: In 2025 there will certainly be a group of Jeremy-Clarkson equivalent people who resent the fact that food has (yet again) become a moral issue. High-carb dining may be seen as a post-post modern form of rebellion. Alternatively it will be the chosen path of revolt by young people. By 2050 there'll probably be a black market in high climate foods
- More people will become vegetarian. The high embedded GHG content of dairy foods may put more societal pressure on people to reduce their consumption of dairy products.

### **b. Shopping for food**

A dual system of shopping may emerge. Internet shopping may dominate for the bulk shop (dry goods, loo roll etc) and people will combine the food shopping with purchases of other goods such as clothes etc, which can in any case be bought from a supermarket.

Supermarkets may team up with one another or with other (non-food) retailers to optimise the efficiency of their internet drops. For example Waitrose and Tesco will use the same delivery vehicle to deliver to a particular area if the volume of drops doesn't justify two individual branded vehicles.

For fresh produce shopping will be undertaken in person. The majority of the population internet shops by around 2025. For non-internet shopping, the bulk of trips are likely to be taken on foot in urban areas. This is because congestion is likely to reduce the desirability of travelling by car and also because for single people living alone, they may not need to carry much (the bulk has in any case been taken care of by the internet shop). Most people will have a supermarket outlet very near to where they live or work.

### **c. Food preferences**

- Cold foods will grow in popularity (placing a greater burden on refrigeration energy use). Hot 'hearty traditional' style foods will be in decline. Demand for cold drinks is likely to grow.

- Salads and fruits will grow in popularity (see comments above about air freight as well as refrigeration)

#### **d. In the kitchen**

- Many people will cook very infrequently. Instead they may order in 'total food solutions. These include a week's worth of planned eating delivered to the door (calorie counted and carbon counted). Alternatively they will continue to buy ready meals from the local store. Some communities and neighbourhoods will experiment with communal cooking and dining but these are unlikely to take off except for a few of the more radical groups (see below). By 2050 most households will not have an oven.
- By 2025 visible energy metering will be in place in most council owned and many private homes in the country. Meters will be placed in the kitchen and there may be metres showing energy use by individual appliances (eg. the kettle or microwave). This visibility will increase awareness of people's behaviour as regards food preparation and may lead to more efficient behaviours.
- The market for stay-cool food gadgets – icemakers, mini fridges etc will grow. These will be highly energy intensive but as temperatures increase they may nevertheless become popular.
- The thermos will be remarketed as a low carbon way of keeping food cool.
- The pressure cooker will still be seen as too intimidating for most people in 2025. By 2050, they may become popular as a low energy cooking appliance (and they will also have become more user friendly).

#### **e. Eating and drinking out and about**

Restaurant chains offering low-carbon food will start to be rolled out by 2025. Some of these chains will be owned and run by supermarkets as part of an attempt to promote their climate friendly image.

Virtual dining may be popular in 2025. The virtual dining concept enables an individual to dine virtually with a friend or relative in another country. Person A goes to a restaurant with sophisticated video conferencing type infrastructure in place. Person B, in another country, does the same. Some restaurants will have a global network so that while Person A is eating a pizza in a video-linked Pizza Express (say) in London, Person B is also eating in a Pizza Express in Delhi and they can as if were dine 'together.' Where time zones are an issue, one of them will be eating lunch and the other dinner.

#### **f. Waste in the home**

By 2025 all local authorities will collect green and kitchen waste. Some local authorities will decide to turn this into compost while others will go down the biogas generation route (which feeds into the decentralised heat and power system). Some people will compost their own waste at home but for many urban dwellers this is not an option. In addition, there is increasing awareness that a poorly managed compost heap can be highly methanogenic and in effect create more problems than it solves.

### **G. WHAT'S FOR DINNER?**

#### **a. In 2025**

In 2025 the policies put in place by government and the decisions made by the food industry are likely to have more or an influence on the type of food people eat than the actual physical impacts of climate change itself.

What's for dinner in 2025 will very much depend on who you are – how old you are, how rich you are, what your culture and attitudes might be.

In 2025 a dual attitude and approach to food and eating is likely to emerge. Climate change will be one of the influences; others include health, income, time availability and so forth.

The majority of people will continue to consume convenience foods. This may be because they don't want to cook for themselves but it may also be because they don't know how to. These convenience foods will be similar to the foods with which we are familiar today, although by 2025 they may be carbon counted. There may be a lower meat content in ready meals and sandwiches, and the proportion of indigenously grown fruit and vegetables may be higher than it is today. The proportion of foods which are air freighted may be similar too: while the routine air freighting of produce may start to decline (thanks in part to public pressure) by 2025, the use of air for emergency topping up supplies may grow. People will start to accept some variability in quality and supply.

A minority of people will take a more radical approach to reducing their carbon footprint. They are likely to make a deliberate effort to eat lower down on the food chain and may be largely or entirely vegan. They may also grow their own food, and adopt radical cooking / food storage methods such as haybox cooking, and not owning a fridge.

#### **b. In 2050**

By 2050 the physical impacts of climate change will be strongly felt. How hard they hit us as a society will depend on the strength and effectiveness of policies in place from 2007 onwards.

The bulk of the population will be eating far lower down on the food chain. Meat and dairy products will be more expensive. Fish could be a rare luxury. Alternatively sustainable systems of aquaculture will have been developed, in which case fish may emerge as an important source of protein in the diet. There may be intensive public information campaigns either run by supermarkets or by government (or both) showing people how to cook and eat lower carbon foods such as cereals and pulses. This may be aided slightly by the strength of cultural influences from India and elsewhere in Asia (although rich people in these countries will by contrast, be rapidly adopting Western diets). As highlighted there is likely to be a black market in high-carbon foods.

Kitchen technology – fridges, kettles and so forth - will be much more efficient than today.

Waste food may, by 2050, be digested in a home biogas digester. This will either be used as cooking fuel or fed into the local district/community grid.

Many sources of supply will simply not be possible because of climate wars, water wars, and sanctions in imports.

Some sources of supply will not be possible because of climate wars / water wars / sanctions on imports.

Food carbon inequality may emerge as a serious issue – the rich will be able to invest in and afford lower carbon appliances (and will also be able to afford black market food). The poor may be stuck with the higher carbon appliances and will not be able to supplement their diet with luxuries.

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Have we already abandoned our attempts to prevent dangerous climate change?  
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