Food and drink manufacturing water demand projections to 2050

Methodology Report - EBPLW12033

October 2013

LIT8886

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1. Introduction

The Environment Agency is working with Defra, WRAP, and the Food and Drink Federation to improve their understanding of how the food and drink manufacturing sector's demand for water will change in the future.

The outputs of this project will provide additional narrative on the Food and Drink Industry to supplement the information already provided to Defra's programme of work to evaluate the options for abstraction reform. It will also help to deliver against the commitment in Defra's Water White Paper, Water for Life[1] to 'develop demand scenarios in partnership with different sectors, and use the outputs to develop a common understanding of the future risks to both the abstractors and the environment and provide advice to Government'.

This project uses a set of socio-economic scenarios to explore how water demand within the sector may change under different consumption patterns and levels of governance, between now and 2050. The Environment Agency has previously used socio-economic scenarios to support projections of long-term demand for water in the Water Resources Strategy and the Defra Water White Paper. These socio-economic scenarios have also been used to provide a more detailed assessment of the water demand within the electricity generating sector and the agricultural sector, both of which use large amounts of water.

This report accompanies the Results Report (LIT 8767, October 2013) and details the methodology used in projecting demand for water from the food and drink manufacturing sector to the 2050s. Section 2 outlines how initial sub-sectors were chosen for the first workshop and Section 3 details the process behind selection of demand indicators. The outputs from the first workshop are detailed in Section 4 followed by outputs from the check and challenge event in Section 5. Finally, the modelling approach and assumptions used to develop the projections following the workshops is detailed in Section 6.

[1] Defra, 2011, Water for Life.

2. Selection of sub-sectors

The aim of this task was to identify four representative sub-sectors from within the food and drink manufacturing sector to which the model to project water demand can be developed around. The model will then be applied more widely to the rest of the sector.

Baseline water consumption data has been provided by WRAP. The sub-sectors have been assessed according to total water use, total production and water use intensity, water use type categorisation, and industry representation at the expert workshop.

Total water use

The four highest water using food and drink manufacturing sub-sectors are meat processing, spirits, brewing, and fruit and vegetables (Table 1-1).

Table 1-1 Comparing average water use for food and drink manufacturing sub-sectors

UK 2010	Average total water use (m3)
Spirits	44854328.71
Meat processing	38789736.8
Brewing	20355004.95
Fruit and Vegetables	19308367.49
Soft drinks and beverage	13136040.51
Dairy	12301671.95
Pre-prepared foods	10545541.1
Maltings	5242933.3
Fish processing	4657839.315
Pet food	4175768.805
Snack foods	3948757.185
Confectionery	3217965.2
Cider	2744700
Bakery	2716561.288
Cereal Manufacturers	2275428.722
Animal feed	1239788.46
Wine	704060
Milling	418193.7718

Total production - water use intensity

Total production is considered within the frame of water use intensity to aid selection of the representative sub-sectors. The top four water use intensity sub-sectors are spirits, fish processing, fruit and vegetables and pre-prepared foods (Table 1-2).

Table 1-2 Comparing production and water use intensity for food and drink manufacturing sub-sectors

UK 2010	Production	Water Use Intensity
Bakery	2,530,086	1.07
Cereal Manufacturers	592,314	3.84
Confectionery	959,492	3.35
Dairy	9,880,861	1.25
Animal feed	20,663,141	0.06
Fish processing	480,681	9.69
Fruit and Vegetables	2,925,510	6.60
Meat processing	7,245,646	5.35
Milling	6,123,323	0.07
Pet food	1,278,867	3.27
Pre-prepared foods	1,779,808	5.93
Snack foods	1,212,882	3.26
Spirits	1,286,618	34.86
Soft drinks and beverag	7,425,938	1.77
Wine	214,000	3.29
Cider	816,875	3.36
Brewing	4,337,880	4.69
Maltings	1,417,009	3.70

Water use categorisation (process use, in-product)

A simple way of categorising food and drink manufacturing according to water use is to divide it into the manufacturer of food and the manufacturer of beverages, where the major demand from beverage manufacture is for in-product use. Food can then be further divided into the following:

- Process use where the majority of water is used for washing raw materials and cleaning and includes the fish processing, dairy, fruit and vegetables, and meat processing sectors.
- Other in-process use typified by the pet-food and pre-prepared food sectors; and,
- ‘Dry’ food product manufacture including the milling, animal feed, cereals, bakery, confectionary and snack foods sector which all have similar water uses including both in-product use and process use.

The highest water using sub-sectors for these four categories are (Figure 1-1):

- Drink manufacturers – Spirits
- Dry foods – Snack foods
- Processing focussing on wash down – Meat processing
- Other processing – Pre-prepared foods

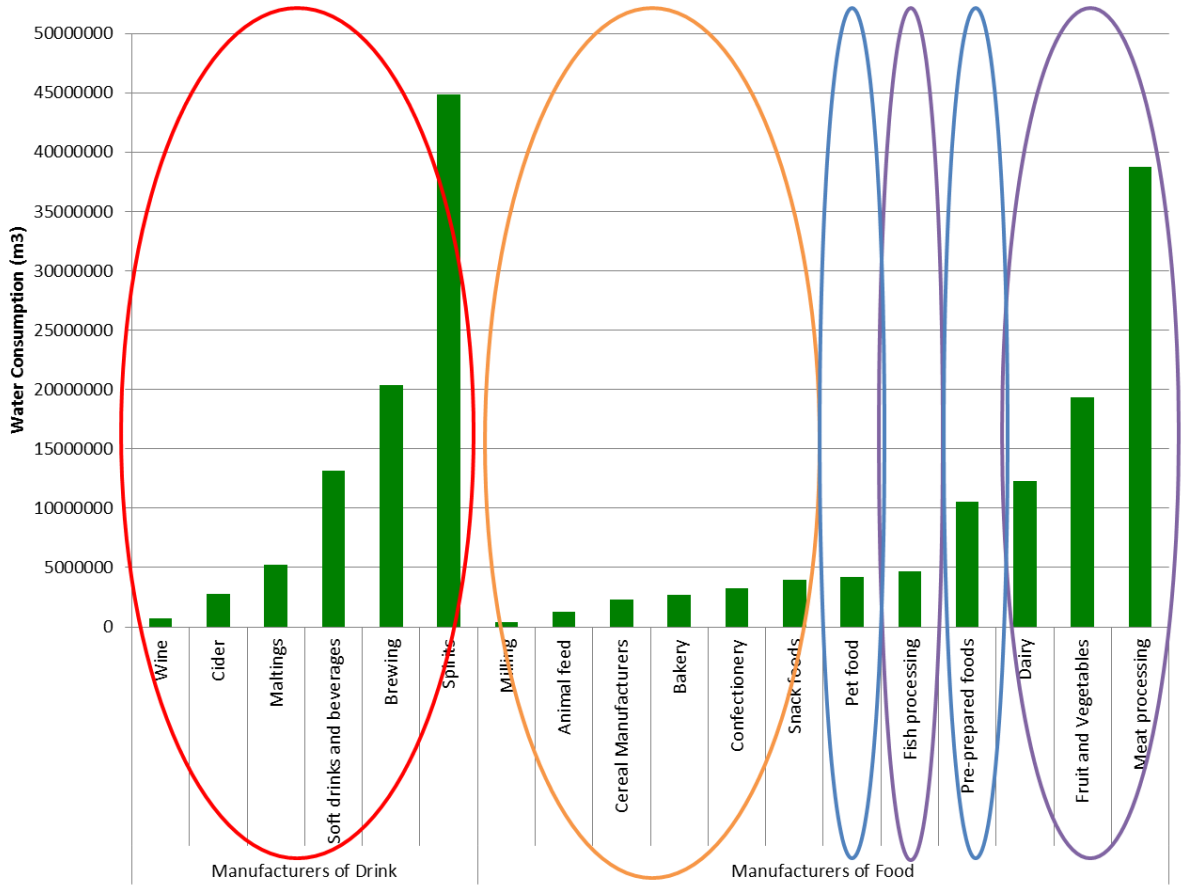

Figure 1-1 Categorisation of food and drink manufacturing subsectors based on type of water use

Industry representation at workshop

An initial review of industry representation at the expert workshop held in March 2013 was undertaken. This highlighted good representation across the meat processing, pre-prepared foods, dairy, and fruit and vegetables sectors.

Final sub-sectors

The four representative sub-sectors chosen for the analysis and justification for their inclusion is provided in Table 1-3. In terms of water use these sectors provide sufficient coverage across the wider food and drink sector such that the outputs from the expert workshop combined with expert knowledge within Ricardo-AEA and outputs from the literature review in Task 1 will enable a robust projection of water demand to the 2050s.

Table 1-3 Overview of final sub-sectors chosen for the expert workshop

Sub-sector	Category (by use type)	Reasons
Brewing	Drinks manufacturer	3rd highest water use overall 6th highest water use intensity Representation at workshop is broad across alcoholic drinks Representative of the overall category
Meat Processing	Processing (wash use)	Highest water use 5th highest water use intensity Very strong representation at workshop Representative of category based on micro-component water use
Pre-prepared foods	Other process use	7th highest water use 4th highest water use intensity Good representation at the expert workshop Representative of use category and higher production (tonnes) than pet food
Snack Foods	Dry foods	Highest water use in dry food category – representative of process and in-product use. Good representation at expert workshop.

3. Developing demand indicators

Task 1 entailed familiarisation with key documents and an initial literature review to support subsequent tasks. The demand indicators approach used in the agricultural and energy generation tailoring processes were explored. Additionally, wider literature was assessed to support discussion in the first Steering Group meeting.

Agriculture report - demand indicators

A long list of 13 indicators was used at the start of the expert workshop for agriculture (Table 2-1). Voting on the top 3 drivers for change resulted in the selection of 7 for subsequent analysis.

Table 2-1 Drivers for change developed for the Environment Agency's application of socio-economic scenarios to demand from agriculture

Driver for change	Included (✓) for discussion (no of votes)
Water use and availability	✓ (12)
Price and availability of resources, including energy, land, etc.	✓ (12)
Price and availability of staple crops	✓ (10)
Land use and productivity	✓ (9)
Global demand for food products	✓ (8)
Global food markets	✓ (8)
Environmental quality and biodiversity	✓ (8)
Technology approaches in the UK - bio and non bio	× (4)
Public food health concerns and liability	× (3)
Agricultural structure in the UK	× (2)
State of the global economy	× (2)
Demand for energy crops	× (1)
Global policy and regulation frameworks	× (0)

Energy report - demand indicators

The energy generation report highlighted 4 themes and 21 indicators in total (Table 2-2). As these are at a higher level and more specific to energy generation they had less relevance for the food and drink industry.

Table 2-2 Drivers for change developed for the Environment Agency's application of socio-economic scenarios to demand from the energy generation sector

Theme	Structural Indicators
Demand	Level of electricity demand compared to 2010 baseline, per capita or total
	Scale of electrification of transport and heating
	Proportion of manufacturing as share of UK economy
	Level of behaviour change around energy consumption
Generation	Scale of electricity distribution/production (international, national, regional, local)
	Efficacy of 'greening' fossil-based generation
	Attractiveness of fossil fuels
	Level of nuclear energy production and investment in replacement nuclear capacity
	Share and mix of renewable energy
	Level of Intermittency
	Electricity Market Reform
Distribution	Speed of infrastructure change, level of investment in new generation and distribution infrastructure
	Efficiency of grid-based distribution
	Level of whole system intelligence, telematics in energy system, capability of remote management
Policy and Regulation	Regulatory focus covering electricity sector
	Technical/economic feasibility & social acceptability/affordability
	Security/Availability
	Environmental Protection relative priorities and preferences (in so far as they affect generation sources)

Literature review

The literature review identified a range of demand drivers from key published reports which are considered below.

A study by University of Cambridge identified 20 indicators and undertook an assessment of impact vs uncertainty (Figure 2-1). The key indicators were technology efficiency, climate change impacts, increasing regulation and water stress and management. Some of these drivers are captured within the Environment Agency socio-economic scenarios already[2].

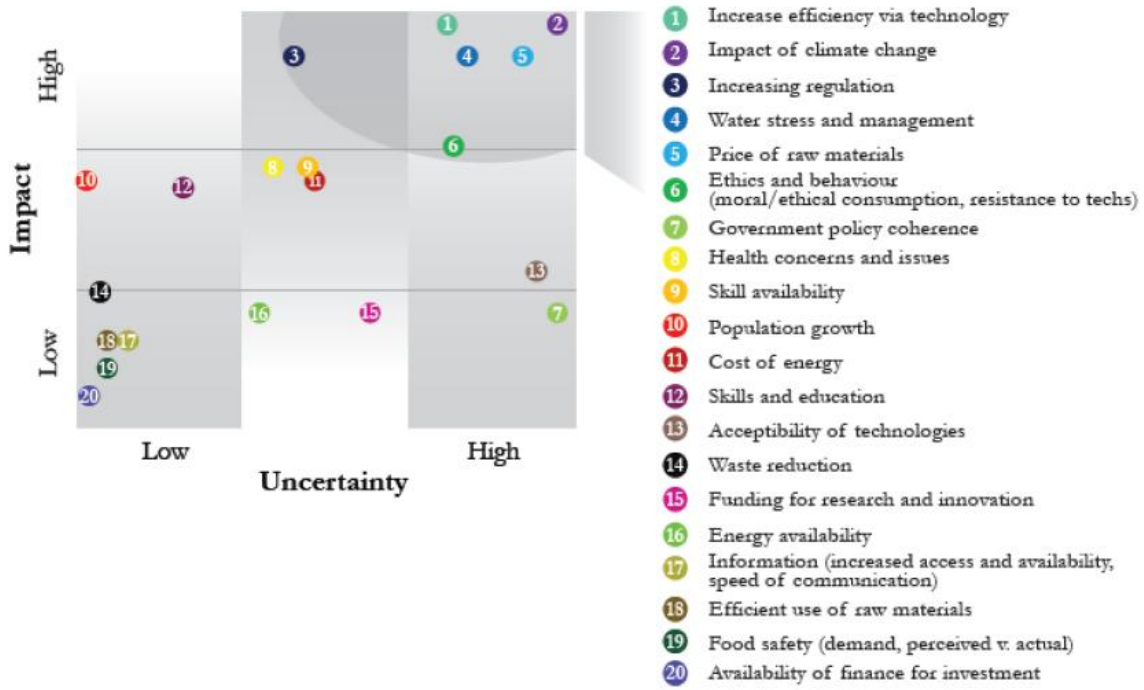

Figure 2-1 Ranking drivers for change

Taken from: Fibarr Livesey et al., 2010, Future Scenarios for the UK Food and Drink Industry, University of Cambridge

The Food for Wales: Food from Wales strategy identified five key drivers of change[3]:

- Market development
- Food culture
- Sustainability
- Supply chain efficiency
- Integration

A recent assessment of the future of food and farming also identified six key drivers with a range of factors affecting these[4]:

[2] The Futures Company, Socio-economic Scenarios for Water to 2050 - review and updated March 2012 (Environment Agency 2012)
[3] Welsh Government, 2010, "Welsh Government | Food for Wales, Food from Wales 2010:2020 - A Food Strategy for Wales."
[4] Foresight, 2011 *The Future of Food and Farming - Final Report*..

- **Global population increase: – factors affecting population size:**
  - GDP growth
  - Education
  - Access to contraception
  - Gender equality
  - Female education
- **Size and nature of per capita demand: – factors affecting:**
  - Dietary changes – converge those of high income countries
  - Consumption rise in Africa
  - Regional differences
  - The extent to which increased GDP is correlated with reduced population growth and increased per capita demand
- **Future governance of the food system at both national and international levels:**
  - globalisation of markets
  - emergence and continued growth of new food
  - trend for consolidation in the private sector
  - Production subsidies, trade restrictions and other market interventions
  - Extent to which governments act collectively or individually to face future challenges
  - control of increasing areas of land for food production
- **Climate change**
- **Competition for key resources:**
  - Land for food production
  - Global energy demand
  - Global water demand
- **Changes in values and ethical stances of consumers**

The Cabinet Office (2008) report Food: an analysis of the issues focussed on seven areas of key trends, the drivers behind them and the issues arising. These are:

- Consumer demand
- The UK food chain
- Global markets
- Health
- Safety
- Security
- Environment

Demand indicators for food and drink

The demand indicators from prior projects and a summary of the outputs from the literature review were presented at the first project steering group. This led to discussion around four themes for the demand indicators and a facilitated brainstorming exercise was undertaken to record relevant demand indicators under these themes onto a flip chart (Table 2-3).

Table 2-3 Demand indicators developed with the project steering group

Category	Demand Indicator
Demand	Fresh vs processed
	Global/Markets/Supply
	Climate impacts behaviour
	Pricing
	Value/ Ethics
	Food poverty
	Lifestyle
	Religion
Policy and Regulation	UK/EU Quality Standards/food safety
	UK/ EU Environmental Standards
	GM Crops/ Organic
	Local/Regional/International - Sourcing Policy
	Abstraction Regulation
	Transport
	Investment -Multi-nationals
	Value of Water - Overall
	Health Policy
	Water Efficiency - Labelling
	UK Finance – VAT
	Procurement
	Education Policy
	Waste policy (i.e. food waste) and resource efficiency
	Water Policy
Technology	Water Efficiency
	Source of Water
	Energy Technology - Carbon Target
	Chemicals
	Economics - Raw Materials
	Packaging – Waste
	Packaging - Embedded Water
Environment	Water Availability
	Quality – Location
	Environmental Conscientious/CSR

4. Report from expert workshop

Introduction

A stakeholder workshop was held on 21 March 2013, to develop water demand projections to 2050 for food and drink manufacturing. Attendees included representatives from the food and drink industry. They helped identify the factors that influence how businesses currently use and consume water and how that might change in the future using four socio-economic scenarios.

This section of the report presents the outputs from the workshop and is divided into the sessions from the day. These are:

- Exercise - 'looking back to look forward'.
- Produce a narrative for food and drink manufacturing for each scenario.
- Decide demand indicators (water consumption drivers).
- Describe impacts of the scenarios on four sub-sectors of the food and drink industry.
- Quantify change in production and water use intensity for each sub-sector.

Outputs from workshop sessions

1. Looking back to look forward

To support the participants in thinking about the future scenarios, this session focussed on looking back over the past 100 years to identify the major changes that have occurred within the food and drink sector.

Participants identified that attitudes towards food have changed, people don't have time to prepare a meal and they want it fast and cheap. Alongside affluence and social changes, media, branding and advertising have changed choice; leading to a lack of understanding about food production and a move towards large retail stores rather than locally based markets.

With free trade and improved transport, more varieties of food are now available and non-seasonal food is offered all year from all over the world. Our growing population and demands have given rise to supermarkets, compelling agriculture to improve and food technology to develop in an increasingly competitive market. Refrigeration, packaging and food preservation have also led to major changes in consumption and operation in the food and drink sector.

2. Narrative for each of the future scenarios

An exercise was used to familiarise participants with the Environment Agency's socio economic scenarios (Figure 3-1) in the context of the food and drink sector. Then, for each scenario, teams agreed a description for the food and drink industry. A summary of comments is provided in Table 3-1.

Figure 3-1 The socio economic scenarios in relation to consumption patterns and governance

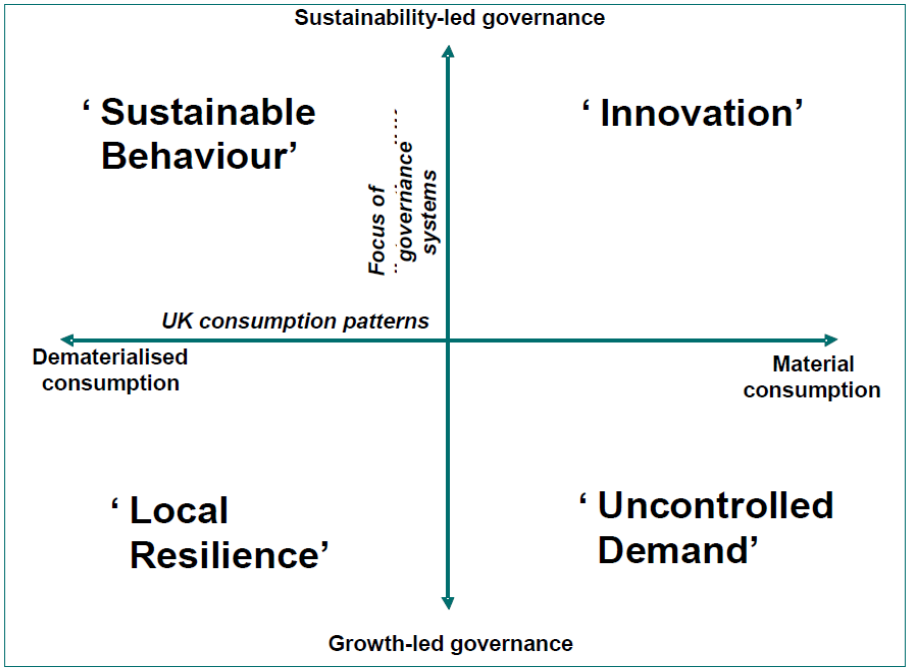

Table 3-1 Summary of session on developing the food and drink sector narrative for each scenario

Sustainable Behaviour: • Water taxation – driving technological change • EU taxation increase • Increased prices • Polarisation of food infrastructure • Recycling	**Innovation:** • Increased food production • Globalisation of the market • Higher quality standards • More regulation
Local Resilience: • Rise of localism • Localised production • Reduced diversity • Back to basics	**Uncontrolled Demand:** • Increased polarisation of everything • Maximise profits • Low sustainability • Short term planning for economic gain • Increased production of high value good for export (UK, EU)

3. Demand Indicators – voting results

An initial list of demand indicators, developed prior to the workshop by the project steering group, was shared with the workshop attendees. These indicators were listed under four broad categories according to their impact as follows:

- demand (for food)
- policy and regulation
- technology
- environment

Attendees were then invited to vote on their top three indicators within each category according to their relative importance. Table 3-2 provides the results of the voting exercise and the top two demand indicators from each category were subsequently used for describing the impacts for each scenario.

Table 3-2 Ranking of the demand indicators by voted by workshop attendees

Category	Demand Indicator	Votes
Demand	Fresh vs processed	5
	Global/Markets/Supply	16
	Climate impacts behaviour	0
	Pricing	16
	Value/ Ethics	1
	Food poverty	1
	Lifestyle	13
	Religion	0
Policy and Regulation	UK/EU Quality Standards/food safety	12
	UK/ EU Environmental Standards	3
	GM Crops/ Organic	2
	Local/Regional/International - Sourcing Policy	3
	Abstraction Regulation	2
	Transport	
	Investment -Multi-nationals	1
	Value of Water - Overall	12
	Health Policy	1
	Water Efficiency – Labelling	1
	UK Finance – VAT	2
	Procurement	2
	Education Policy	0
	Waste policy (i.e. food waste) and resource efficiency	8
	Water Policy	12
Technology	Water Efficiency	9
	Source of Water	8
	Energy Technology - Carbon Target	6
	Chemicals	2
	Economics - Raw Materials	7
	Packaging – Waste	5
	Packaging - Embedded Water	1
Environment	Water Availability	25
	Quality – Location	6
	Environmental Conscientious/CSR	3

4. Impacts of future scenarios on representative sub-sectors within the food and drink industry

Four sub-sectors (snack foods, meat processing, pre-prepared foods and brewing) were chosen to represent food and drink manufacturing and to use outputs as indicators for the rest of the industry. The decision was based on how much water they use, how they use water (in-product or process) and water intensity (m3/tonne product). Industry representation at the workshop was also taken into consideration.

Participants were divided into ‘expert groups’ and rotated through four tables, each discussing the impacts of the scenarios on their sectors. The outputs for each scenario are summarised in the tables below.

Sustainable Behaviour

Snack food	Meat processing	Pre-prepared food	Brewing
Demand for food and drink			
Global markets result in greater UK exports due to sustainable production Rise in demand for healthy snacks Local demand increases Exports may increase, although all locally sourced production Snack tax increases prices – reducing demand	Global markets result in increased exports of sustainably produced UK meat Meat volume produced decreases with pricing increases	Local synthetic and value added foods increase in production Locations optimised based on demand Demand increase for sustainable pre-prepared foods Cost of compliance increase	UK raw materials used Locally produced / reduced imports Process specialities result in exports Availability of ingredients means location will shift to the North East Smaller microbreweries Taxation higher with sustainability – links with agriculture High value product – increases prices
Policy and Regulation			
Legislation - snack tax / calories Value of water increases Tax for inefficient water use/ water budgets	Increased regulations - carbon footprint, animal welfare, water footprint, standards for appropriate use Value of water increases	Food waste recycling increases Labelling - water/ carbon and websites Value of water increases CO2 budget increases production price and linked to water budgets	Health vs. quality Decreasing alcohol vs. high strength Value of water increases Packaging – ingredients – 95% beer is water ingredients
Technology			

Snack food	Meat processing	Pre-prepared food	Brewing
Water efficiency in process increases New sources – rainwater harvesting Closed loop systems – public perception issues may be negated in this scenario	Water efficiency in wash down and process Closed loop systems (i.e. diary sites have demonstrated this) Source of water – reverse osmosis > 75% max possible re-use, desalinisation	Water efficiency increases Recycling – closed loop systems implemented Hierarchy of water use – hygienic vs process Rainwater harvesting Recycling – public perceptions changed	Re-use of process water Alternative cleaning tech Alternative catchment sources Recover heat and water – closed loop systems Local water storage increased and sources optimised Re-use of water Rainwater harvesting
Environment			
No more impact than the rest of the industry Less/ not in product	Reduced availability may stop production and affect investment Seasonality – major impacts on demand May relocate on quality and availability	Water availability – not located near water scarcity Cost effective / type of water considered	Different quality sources can be used – ingredient vs. Process

Local Resilience

Snack food	Meat processing	Pre-prepared food	Brewing
Demand for food and drink			
Significant reduction in demand as low priority food stuff Diversity significantly reduced due to lack of global ingredients Survival depends on creativity Rise in co-operatives for ingredient availability Low pricing to stimulate growth required Varies due to availability of ingredients Small batch processing increases cost	Growth of small independents UK market only, with limited diversity depending on suitability of local environment Increase in farming intensity (e.g. poultry) Competing use of land for animal feedstock High value product important commodity (trading) Increase infrastructure costs	Increase creativity for shrunken market Preserving important for both high and low value products Skills availability/niche expertise limiting factor Ingredient availability limited, especially fresh Small patch production / short supply chain Seasonal availability limits diversity of goods Rise in value goods due limited product availability Economies of scale increase production costs	Brew for UK market only Growth of micro-breweries Variety of ingredients can be used for brewing Possible franchise development Pricing dependant on ingredient availability, vary depending on location Price increase due to competition with other food stuff Pricing effected by local standards
Policy and Regulation			
Protection of water not high priority Industry standard still apply with little effect on water value	Increase regulation on land use Access to water essential but not quality	Local protection of resources established at local level Water policy has low impact on competition	High water quality standards remain Conflict with other essential users
Technology			
No change, using existing technology as this sub-sector declines Water treatment growth	Development reflects changes in farming intensity and size of units.	Water use efficiency and reuse high priority depending on location Water treatment infrastructure essential	Social behaviour gives rise to low tech home grown breweries Water efficiency not an issues due to smaller brewery scale

Snack food	Meat processing	Pre-prepared food	Brewing
Environment			
Low importance on water availability due to nature of processing Water reuse high	Strong geographical variation due to suitability of environment (need to be close to farms) and level of water availability Pronounced regional differences effect location	Water availability limiting factor on food production, implications for pre-prepared foods Water quality not high level impact for processing	Quality of water important, give rise to distribution of breweries Some risk on water availability and quality

Innovation

Snack food	Meat processing	Pre-prepared food	Brewing
Demand for food and drink			
Market will become more global – technology allow for increased logistics Health aspects not really an issue since highly regulated industry and alternatives to many of the unhealthy ingredients. Increased demand for variety Price will increase but only modestly. Raw material prices may rise but offset by a decrease in production costs – process efficiencies	Demand to increase significantly. Due to changing lifestyles. Less ethical issues around food as quality standard increased – driver for demand Market will drive production to where meat is most efficient to process Split between rich and poor – rich will eat premium products whereas poorer will eat synthesised (cheaper) products	Increased globalisation of pre-prepared foods, more demand. Increased export Greater variety, choices of food. Longer shelf life may reduce demand but not significantly Pricing – reasonable with good profit margins. Premium products – higher prices Added value products – lower prices	Demand will continue to grow – despite current backdrop of pubs closing etc. Globalisation of sector but locally in terms of production and distribution Technology / processes will become globalise. Export / imports may shrink – production nearer to markets. Price likely to decrease – apart from investment phases. We will lose the small producers and move to larger producers who are more efficient. This will lead to more efficient water use but more consumption

Snack food	Meat processing	Pre-prepared food	Brewing
Policy and Regulation			
Greater traceability of raw materials Value of water will depend on availability – high availability, low value and vice versa Quality of foods will be high – highly regulated	Government led policy / regulation across environment, and health – will lead to increase quality standards for food. Investment in processes / production to meet new standards High standards also driven by retailers. Value of water will increase in the sector	Higher quality standards – policy driven Higher consistency of product The value of water may increase because of quality and quantity issues. May also decrease due to greater availability through alternative sources	Increased quality standards – fewer manufacturers. Value of water may reduce if innovation increases availability.
Technology			
Less water efficiency as water use not as high as in other sectors. Little water in final product – more opportunity for alternative sources	Synthesised foods will become more common place (including GM) Technology will provide alternative water sources. Less concern over water quality issues – technology / sector highly regulated Water efficiency will increase – production will be faster, better and cheaper	Sector will become very efficient. Increased water efficiency Alternative sources offer greater availability	Water efficiency in built. Brewing sector already very efficiency and will become more efficient. Availability of water could drive business location and where products are consumed Alternative sources would become available – investment in obtaining these

Snack food	Meat processing	Pre-prepared food	Brewing
Environment			
Availability – increased growth scenario so will need more water but not so much as other sectors. Location and quality not considered an issue.	Alternative sources will become more available seawater, grey water etc. Better environmental protection through regulation Water availability no longer a concern for location of production As more constrained – increased investment in alternative sources, reuse etc.	More water available due to alternative sources. No real impact on environment – regulations will improve environmental quality Location based on skills, labour market rather than water availability. Maybe closer to logistics. Water quality not perceived as being a problem.	60% currently use groundwater sources – sector will look to use alternative sources Location / characteristics not that important as water treated prior to use in the process.

Uncontrolled Demand

Snack food	Meat processing	Pre-prepared food	Brewing
Demand for food and drink			
Increase in demand for snack food – up 20% There will be a split between healthy and non-healthy snack foods and consumption will be different between the sectors of society Increased demand for variety Water demand will increase as much as production Price will increase with demand, it will depend on the position of the product in the market	Value is high, demand will be high The rich will eat good quality products and the poor will eat 'added value' products There will be a market for meats that that the UK won't touch at the moment – or parts of the animal they won't eat	There will be high and low quality pre-prepared foods There will be the same overall demand but of different qualities Seasonality will be important for people who are not well off Production will take place where the value and of product and the availability is greatest There will be polarity of pricing	The top 20% will demand speciality products and diverse choice The bottom 20% will demand standard beer. It could be high strength (to get drunk quickly) or lower strength as a water replacement. The elite may not want beer at all because they will be drinking champagne Continued polarisation of price Exports will increase to supply the global top 20% with premium brands We will lose the small producers and move to larger producers who are more efficient. This will lead to more efficient water use but more consumption. Breweries will be sited in areas of agricultural production and where the water is available.

Snack food	Meat processing	Pre-prepared food	Brewing
Policy and Regulation			
People can buy what they want or can afford; there are no incentives Process use and water use will increase because of global demand The onus will be on producers to self-regulate and make better products Food quality will decline for poorer people and cheaper foods Low end and un-safe food may reduce the market	Policy will be consumer led for the elite or government led for the poor	Fewer minimum standards, these will be market driven People who can afford a good standard will get it The value of water may increase because of quality and quantity issues	Price could increase if beer is seen as a tax opportunity. If price remains high, it could have an impact on demand.
Technology			
Private well off companies will be able to invest in water efficient technology. Others will have old equipment and make do and mend approach.	Intensification and artificial meat production will increase GM will be everywhere People with less water will develop technology	Technology will be focussed on how products look and taste not on the use of water There may be more water in low grade products Existing technology will continue to be used	Businesses will invest in technology to improve efficiency and profitability Availability of water could drive business location and where products are consumed

Snack food	Meat processing	Pre-prepared food	Brewing
Environment			
Good quality food and sources may help to improve the environment There will be investment upstream to exploit water resources	Ethics of production is irrelevant Water is not important People will adapt to different water quality and availability Every source will be used to exhaustion The rich will go where the water is There will be a risk of water shortages.	Ethics of production is irrelevant Effluent quality is immaterial Factory abstraction derogates the local population	Environment is secondary to production

5. Quantifying impacts from the socio economic scenarios

The next step was to quantify the impacts of the demand indicators on production/ tonnage and water intensity (m3/tonne in the product and production processes). Again the grouped sector experts were rotated through each scenario and scored using the key outlined in Table 3-3.

Table 3-3 Key for quantifying percentage change in production and water use intensity

Symbol	Percentage
↓/↑	-10%/+10%
↓↓/↑↑	-20%/+20%
↓↓↓/↑↑↑	-30%/+30%
=	No change

The results of the quantification exercise for each sub-sector by scenario are provided below. To act as a reminder, we will use the brewing sector as an example:

The uncontrolled demand scenario may result in the following for each key indicator:

- Demand for food and drink: a 30% increase in production (tonnage) with no impact on intensity (m^3/tonne).
- Policy and regulation: a 30% increase in production with no change in intensity.
- Technology: no change in production or water intensity.
- Environment: reduced water availability may force a 20% decrease in production.

Brewing

	Demand for food and drink		Policy and regulation		Technology		Environment	
Brewing	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Uncontrolled Demand	↑↑↑	=	↑↑↑	=	=	=	↓↓	=
Innovation	↑	↓	=	↓	=	↓↓	=	=
Sustainable Behaviour	↑	↓↓	↓↓	↓	=	↓↓↓	↓↓	=
Local resilience	↑	↑↑	=	↑	=	↓	↓↓	↓↓

Meat processing

	Demand for food and drink		Policy and regulation		Technology		Environment	
Meat Processing	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Uncontrolled Demand	↓	↓	↑	=	↑	↓↓	=	=
Innovation	↑↑↑ (x12?)	↓↓↓	=	↓	↑↑↑ (x5/6?)	↓↓	=	=
Sustainable Behaviour	↓↓↓	↓↓↓	=	↓	=	↓↓↓ ↓↓↓ ↓↓	↓↓	↓↓
Local resilience	↓↓↓ ↓	↑↑	=	=	↑↑↑↑ ↑	↓↓↓	↓↓	=

Snack foods

	Demand for food and drink		Policy and regulation		Technology		Environment	
Snack Foods	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Uncontrolled Demand	↑	=	=	↑↑	↑	↑	=	↑
Innovation	↑	↓	=	↓	↑	↓	=	=
Sustainable Behaviour	↓	=	↓↓	↓	=	↓	=	=
Local resilience	↓↓↓ ↓↓↓ ↓	↑↑↑	↑↑	=	↓	↑↑	↓	↑

Pre-prepared foods

	Demand for food and drink		Policy and regulation		Technology		Environment	
Pre-prepared Foods	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Uncontrolled Demand	↑↑↑	↑↑	↑	=	=	↑	↑/=	↑
Innovation	↑↑↑	↓↓	=	=	↑	↓↓	=	=
Sustainable Behaviour	↑↑	↓	=	↓↓	↑↑	↓	=	↓
Local resilience	↓↓↓↓↓↓	↑↑↑↑↑	=	=	↓	↑	↓	=

Next steps

The percentage changes for production and water consumption were applied to the most recent water use data available for the food and drink manufacturing sector to project water demand to 2050. Details of this are found in section 6; Modelling approach behind the 2050s projections.

The water demand projections were presented at the Check and Challenge event on 15th May. This event was essential to ensure we had captured the narrative developed for each scenario and that the quantitative outputs still reflected this. The potential impacts to the wider food and drink sector were also discussed.

5. Report from check and challenge event

Introduction

The following is a report produced for the workshop attendees.

Thank you for attending the Check and Challenge Event on 15th May 2013. Your input was very much appreciated.

There were a number of changes made to the narratives and quantification for production and water use intensity for each scenario. This report presents these changes for you to check and is structured as follows:

1. Check and challenge of the narratives describing the impacts of scenarios on each sub-sector.
2. Check and challenge of the quantification (percentage changes) for production (tonnage) and water use intensity (m^3/tonne) for each sub-sector.
3. Revision of scenario narratives, and quantification for the wider food and drink manufacturing sub-sector.

This report is a little long so we suggest you comment on those sessions you were involved in. We welcome any additional inputs. Please add your comments as tracked changes and email to: sandra.hasler@ricardo-aea.com by 14 June so they can be incorporated in the final report.

1. Check and challenge of the narratives

During this session we updated the narratives describing impacts of the scenarios on each sub-sector. Changes to the narrative from the March workshop are in **bold**.

BREWING

Brewing – Uncontrolled Demand

Demand for food and drink	• Polarisation in type and quality of alcoholic beverage linked to wealth – poorer people consume more beer (both high strength and low-strength as a replacement for water). **Rich people go for specialty beers – production could increase or decrease because of emerging markets and impacts of more people drinking champagne etc.** • Exports increase • Move towards larger producers that while more efficient are producing more and increasing total consumption
Policy and regulation	• **Not tax driven**
Technology	• Technology improves water efficiency – **this would be polarised**

	(could increase or decrease)
Environment	• Secondary to production – consumption will increase regardless, however water availability may drive location

Brewing – Innovation

Demand for food and drink	• Demand increases despite pubs closing and globalisation of sector but with local production **(labels globalise but produce locally)** • Exports and imports shrink with more local technology • Price decreases following investment phase • Lose small producers with a move to larger more efficient producers, although increase in consumption overall. **Only large producers can afford the technology.**
Policy and regulation	• Increase quality standard result in fewer manufacturers • Value of water may reduce if innovation increases availability
Technology	• Water efficient increases and built into the sector • Alternative sources become available through investment in technology
Environment	• Currently 60% groundwater – looking to alternative sources • Location/ characteristics not important as water treated prior to use in the process

Brewing – Sustainable Behaviour

Demand for food and drink	• High value products increase prices and reduce consumption **(consumption may not be reduced?)** • Increased local production using UK raw materials and reduced exports • Taxation higher linked to sustainability and to agriculture – reducing consumption • **Demand for different types of beer**
Policy and regulation	• Value of water increase – reducing consumption
Technology	• Reduced water use with re-use of process water, alternative cleaning technology and heat recovery in closed loop systems • New sources of water include rainwater harvesting, alternative catchments
Environment	• Different quality sources are used depending on ingredient vs process water use

Brewing – Local Resilience

Demand for food and drink	• Prices increase due to competition with other food stuffs for raw materials. Production is dependent on ingredient variability and depends on location, price overall higher and reduced consumption. **(consumption may not decrease)** • **Alternative ingredients may be used (applies, pears and other fruit and veg – potatoes)** • **Price may not increase but if the materials are not available production may decrease.**

	• Brewing for a UK market only with a focus on micro-breweries
Policy regulation	• High water quality standards • Conflict with other essential uses
Technology	• Social behaviour gives rise to low tech home grown breweries – as lower technology **(possibly no net change in consumption)** • Water efficiency considered less due to smaller scale breweries **(may be neutral because small breweries use manual washing rather than automated processes in large breweries)**
Environment	• Quality of water changes distribution of breweries

MEAT PROCESSING

Meat Processing – Uncontrolled Demand

Demand for food and drink	• High value and demand for meat products • Rich eat good quality whilst poor eat 'value-added' processed products • Markets for meats that UK currently doesn't consume
Policy and regulation	• Policy consumer led for elite and government led for the poor
Technology	• Intensification and artificial meat production increase • GM everywhere • Less water availability may result in investment in technology for efficiency
Environment	• Ethics of production irrelevant – just increased production • Adaptation to water availability • Risk of water shortages

Meat Processing – Innovation

Demand for food and drink	• Demand increases significantly due to change in lifestyle • Less ethical issues and food quality increases – drives demand • Market drives production to where most efficient • Split between rich and poor – rich eat higher quality compared to synthesised meat products for poor •
Policy and regulation	• Government policy leads to increased quality standards • Investment in processes and production to meet these standards • High standards driven by retailers – value of water increases in sector
Technology	• Synthesised and GM foods more common • Technology provides alternative water sources • Less concern on water quality • Water efficiency increases – production faster, better cheaper
Environment	• Alternative sources more available – greywater, seawater • Better environmental protection through regulation • Water availability not a concern for location • More constraints on water availability lead to greater investment in alternative sources

Meat Processing – Sustainable Behaviour

Demand for food and drink	• Global markets result in increased exports of sustainable UK meat products • Meat volumes produced decreased with increasing prices
Policy and regulation	• Increased regulation – carbon footprint, welfare, water footprint, standard for appropriate use • Value of water increase
Technology	• Water efficiency in wash down and process increased • Closed loops sites – decrease water use • Alternative water sources through new technology – desalination etc.
Environment	• Reduced availability may reduce production and affect investment • Seasonality increasingly impacts on demand • Potential relation based on demand for product and availability of water

Meat Processing – Local Resilience

Demand for food and drink	• Growth of small independents • UK market only, limited diversity depending on suitability of local environment • Increase in farming intensity (e.g. poultry) • Competing use of land for animal feedstock

	• Increased infrastructure costs
Policy and regulation	• Increased land use regulation
	• Access to water essential but not quality
Technology	• Development reflects change in farming intensity and size of units
Environment	• Strong geographical variation due to stability of environment (processors need to be close to farms) and level of water availability
	• Pronounced regional differences effect location

PRE-PREPARED FOODS

Pre-prepared foods – uncontrolled demand

Demand for food and drink **products**	• Overall there will be the same demand but of different qualities – **high value products for rich vs poor**
	• Seasonality important for those less well off
Policy and regulation	• Fewer minimum standards – market driven **(WQ)**
	• Value of water may increase > **driving cost**
Technology	• Focussed on how products look and taste not overall water use – increase in water use intensity
	• More water included in low grade products
	• Existing technology continues to be used
Environment	• Ethics of production irrelevant… **quality of water may have an impact on local sources**
	• Effluent quality immaterial
	• Factory abstraction derogates local population

Pre-prepared Foods – Innovation

Demand for food and drink	• Increase globalisation and demand – **move production? More efficient local production?**
	• Increased export with greater variety and choices of pre-prepared meals **(import growth? Export UK production knowledge)**
	• Longer shelf lives may reduce demand
	• Pricing is reasonable but with good profit margins
	• Premium products with higher prices vs value added products with lower prices **(may be watered down)**
Policy and regulation	• Higher quality standards – policy driven
	• Higher consistency of product – **GM?**
	• May decrease due to greater availability through alternative sources!!
Technology	• Sector becomes very efficient – increase water efficiency
	• Alternative sources utilised
Environment	• More water available **from** alternative sources
	• No real impact on environment
	• Location based on skills and labour market rather than water
	• **Benefit – more water for the environment**

Pre-prepared foods – sustainable behaviour

Demand for food and drink	• Local synthetic and value added foods increase in production **– quality assurance** • Locations optimised on demand • Demand increase for sustainable pre-prepared foods
Policy and regulation	• **Cost of compliance increases** • Increased food waste recycling > decrease food waste to begin with? **– quality** • Labelling water and carbon and websites • Value of water increase • Co2 budget increased production price and linked to water budgets
Technology	• Water efficiency increased • Greater recycling and closed loop systems • Hierarchy of water use – hygienic vs process • Rainwater harvesting • **Recycling** – public perceptions changed **(may be issues with recycling and closed loop vs hierarchy)**
Environment	• Water availability affects location • Cost effective/ type of water considered

Pre-prepared foods – local resilience

Demand for food and drink	• **No actual pre-prepared foods sector – very small scale** • Economies of scale (small patch production and short supply chains) increase production • costs and reduce demand • **Low return on investment – results in cottage industry only** • **Depends on community and local needs**
Policy and regulation	• Water policy has low impact on competition with local protection of water resources
Technology	• Water use efficiency and reuse a high priority **BUT** dependent on location • **Use of existing knowledge vs new innovation** • **Reed bed treatment systems etc.**
Environment	• **Intense pollution in catchment** • **Local WWTW**

SNACK FOODS

Snack Foods – Uncontrolled Demand

Demand for food and drink	• Increased demand (20% min) • Split between healthy and non-healthy foods and demand depending on society • Water demand increases as much as production

	• Price increases with demand – depends on market position of product • Process use and water use increase with global demand
Policy and regulation	• High demand – people buy what they want/ can afford • Self-regulation and making better products – food quality declines for poorer people and cheaper snacks • **GM options for food security (exclude as before farm gate?)**
Technology	• Private and well off companies able to invest in water efficient technologies • Others (majority?) will have old equipment and make do and mend approach – less water efficient • **Centralisation reduces water intensity**
Environment	• Investment upstream **(geographically)** to exploit water resources • **Exploitation leaves impact on water courses**

Snack Foods – Innovation

Demand for food and drink	• Market more global with technology allowing increased logistics – increased demand • Health aspects not an issue – highly regulated industry and new innovative alternatives to unhealthy ingredients • Price increase only modestly - raw material price increases offset by decrease in production costs
Policy and regulation	• **Price** of water depends on local availability • High quality foods – highly regulated
Technology	• **Water efficiency technology is key, significant progress in water technology means process becomes more challenging** • Less water efficiency options – water use already not as high as other sectors **[group disagreed with this statement** • Little water in final product – use of technology for alternative sources in process]
Environment	• Increased growth in production (?) but not as much water required as other F&D manufacturing sectors

Snack foods – sustainable behaviour

Demand for food and drink	• Global markets – increased exports based on UK sustainable production (locally sourced production) **[Group disagreed with this statement]** • **Sustainable production makes exports less competitive on global market but competitive in markets close to shore.** • Rise in demand for healthy **products** and increased local demand • Reduce demand of unhealthy options
Policy and regulation	• Legislation – increases demand for sustainable practices • Value of water increases

	• Industry targets efficient water use/ water budgets
Technology	• Water efficiency in process increases
	• New sources – rainwater harvesting and close loop systems
Environment	• **Comparable** impact to rest of the industry
	• Less/ not in product

Snack foods – local resilience

Demand for food and drink	• Significant reduction in demand – low priority food stuff [Delete when applied across dry foods)
	• **Demands favours nutritional foods [added when applied across dry foods]**
	• Diversity reduced – lack of global ingredients
	• Small batch processing – increases costs (reduced demand and increased water use intensity)
Policy and regulation	• **Local standards apply** –value of water **increases**
Technology	• No change – using existing technology as sub-sector declines
	• Growth in water treatment
Environment	• **High** importance of availability due to nature of processing
	• High water reuse where possible

2. Check and challenge of the quantification

Changes to the quantification from the March workshop are in **bold**. Comments are provided below the table where captured in the workshop. If you make any changes can you also write your reasoning as text below the tables.

Brewing – percentage changes to 2050

	Demand for food and drink		Policy and regulation		Technology		Environment	
Brewing	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Uncontrolled Demand	**10%**	0%	30%	0%	0%	0%	**10%**	0%
Innovation	10%	-10%	0%	-10%	0%	**-30%**	0%	0%
Sustainable Behaviour	10%	-20%	-20%	-10%	0%	**-20%**	**-10%**	0%
Local resilience	10%	**10%**	0%	10%	0%	-10%	**-10%**	**-10%**

Meat Processing – Percentage changes to 2050

	Demand for food and drink		Policy and regulation		Technology		Environment	
Meat Processing	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Uncontrolled Demand	**10%**	-10%	**20%**	**10%**	10%	-20%	0%	0%
Innovation	120%	-30%	0%	-10%	60%	**-50%**	0%	0%
Sustainable Behaviour	-30%	**-10%**	**-20%**	**-20%**	0%	-60%	-20%	-20%
Local resilience	-40%	**40%** **(Base load for water higher)**	0%	0%	**0% (smaller plants)**	**10%** **(smaller plants)**	-20%	0%

EXPLANATION FOR CHANGES

Uncontrolled Demand

- Tonnage under 'Demand for food and drink' will increase due to use of cheaper cuts of meat (although there were polarised views on this).
- Policy and regulation: Felt percentages would be slightly higher

Innovation

- Demand would increase due to increased exports.
- Confirmed the 120% tonnage under 'Demand for food and drink' as this would be driven by the production of synthesised meats
- Technology – felt that technology already in place today could achieve a 20% improvement in intensity thus reduced further to -50%

Sustainable Behaviour

- Felt that consumer choice would reduce tonnages and that there would be larger more efficient factories
- Under demand – felt there would be fewer exports than originally anticipated
- Policy & Regulation: tonnage would decrease due to regulations e.g. the introduction of carbon regulations. However, intensity would improve
- Technology – generally production decreases and intensity increases – size of operations important.
- Environment – event driven rather than seasonality driven

Local Resilience

- Demand – base load would increase due to smaller plants thus intensity likely to increase more substantially.
- Policy and Regulation: Little impact as people won't pay much attention to the policy – Gov won't have major impact as it will all be local.
- Technology – little influence as things would be done more locally – smaller plants also less efficient. Not a great deal of capital available to invest

Pre-prepared foods – percentage change to 2050

	Demand for food and drink		Policy and regulation		Technology		Environment	
Pre-prepared Foods	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Uncontrolled Demand	30%	20%	**0%**	0%	0%	**0%**	**0%**	**0%**
Innovation	30%	**0%**	0%	0%	0%	-20%	0%	0%
Sustainable Behaviour	20%	-10%	0%	-20%	-20%	-10%	0%	-10%
Local resilience	-70%	50%	0%	0%	0%	10%	-10%	0%

Snack foods – percentage change to 2050

	Demand for food and drink		Policy and regulation		Technology		Environment	
Snack Foods	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Uncontrolled Demand	**30%**	0%	0%	20%	10%	**0%**	0%	**0%**
Innovation	10%	-10%	0%	-10%	10%	-10%	0%	0%
Sustainable Behaviour	-10%	0%	-20%	-10%	0%	-10%	0%	0%
Local resilience	**-50%**	30%	**-10%**	0%	-10%	20%	-10%	10%

3. Quantification of wider food and drink manufacturing sub-sectors

Table discussions considered how well the narrative applied to wider sub-sectors. Following this a quantification exercise was undertaken to consider percentage changes in production (tonnage) and water use intensity (water used per tonne of production). Where there was no representation at the workshop (i.e. Milling) or a category was considered too broad (Maltings) they were not quantified.

Changes to the narrative (reflecting wider food and drink sub-sectors) carried over from the morning session are in **bold**. Comments from the afternoon session changing the narrative for the wider sub-sectors are in **blue** text.

DRINKS

Uncontrolled Demand - Drinks

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Brewing	10%	0%	20%	0%	0%	0%	10%	0%
Wine	30%	0%	30%	0%	10%	0%	10%	0%
Cider	10%	0%	10%	0%	0%	0%	0%	0%
Maltings	-	-	-	-	-	-	-	-
Soft Drinks and Beverages	30%	0%	20%	0%	0%	0%	0%	0%
Spirits	20%	0%	30%	0%	0%	0%	0%	0%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink

- Polarisation in type and quality of alcoholic beverage linked to wealth – poorer people consume more beer (both high strength and low-strength as a replacement for water). **Rich people go for specialty beers – production could increase or decrease because of emerging markets and impacts of more people drinking champagne etc.**
- Exports increase
- Wine/ cider are similar in terms of demand

	• Wine concentrate and make-up mainly in UK – potential for more UK grown product • Soft drink – increase in sparkling water • Move towards larger producers that while more efficient are producing more and increasing total consumption
Policy and regulation	• **Not tax driven**
Technology	• Technology improves water efficiency – **this would be polarised (could increase or decrease)** • Wine – traditional less efficient technology in Europe v New World wines with more efficient factor scale processors
Environment	• Secondary to production – consumption will increase regardless, however water availability may drive location

Local Resilience – Drinks

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Brewing	10%	-10%	0%	10%	0%	-10%	-10%	-10%
1 Wine	-30%	0%	0%	0%	0%	0%	-10%	-10%
2 Cider	10%	-10%	0%	0%	-10%	10%	-10%	-10%
3 Maltings	-	-	-	-	-	-	-	-
4 Soft Drinks and Beverages	-20%	10%	0%	0%	-10%	10%	-10%	-10%
5 Spirits	10%	10%	0%	0%	0%	10%	-10%	-10%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink	• Prices increase due to competition with other food stuffs for raw materials. Production is dependent on ingredient variability and depends on location, price overall higher and reduced consumption. **(consumption may not decrease)**
	• **Alternative ingredients may be used (applies, pears and other fruit and veg – potatoes)**
	• **Price may not increase but if the materials are not available production may decrease.**
	• Brewing for a UK market only with a focus on micro-breweries
Policy regulation	• High water quality standards
	• Conflict with other essential uses
Technology	• Social behaviour gives rise to low tech home grown breweries – as lower technology **(possibly no net change in consumption)**
	• Water efficiency considered less due to smaller scale breweries **(may be neutral because small breweries use manual washing rather than automated processes in large breweries)**
Environment	• Quality of water changes distribution of breweries

Sustainable Behaviour – Drinks

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Brewing	10%	-20	-20%	-10%	0%	-20%	-10%	0%
Wine	-30%	0%	-30%	0%	10%	0%	10%	0%
Cider	10%	0%	-20%	-10%	10%	-20%	0%	0%
Maltings	-	-	-	-	-	-	-	-
Soft Drinks and Beverages	0%	-10%	-10%	-10%	10%	-20%	0%	0%
Spirits	0%	0%	-20%	-10%	10%	-20%	0%	0%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink

- High value products increase prices and reduce consumption **(consumption may not be reduced?)**
- Increased local production using UK raw materials and reduced exports
- Taxation higher linked to sustainability and to agriculture – reducing consumption
- **Demand for different types of beer**

Policy and regulation

- Value of water increase – reducing consumption

Technology

- Reduced water use with re-use of process water, alternative cleaning technology and heat recovery in closed loop systems

Environment

- New sources of water include rainwater harvesting, alternative catchments
- Different quality sources are used depending on ingredient vs process water use

Innovation – Drinks

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Brewing	10%	-10%	0%	-10%	0%	-30%	0%	0%
Wine	20%	-10%	-10%	-20%	10%	-30%	0%	0%
Cider	0%	0%	0%	0%	0%	0%	0%	0%
Maltings	-	-	-	-	-	-	-	-
Soft Drinks and Beverages	10%	10%	10%	-20%	10%	-20%	0%	0%
Spirits	10%	0%	0%	-10%	0%	-20%	0%	0%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink

- Demand increases despite pubs closing and globalisation of sector (but combined with local production) **(labels globalise but produce locally)**
- Exports and imports shrink with more local technology
- Price decreases following investment phase

	• Lose small producers with a move to larger more efficient producers, although increase in consumption overall. **Only large producers can afford the technology.**
	• Exports and imports shrink
	• Soft drink = fruit and soft drink – can more fruit be grown in the UK?
Policy and regulation	• Increase quality standard result in fewer manufacturers
	• Value of water may reduce if innovation increases availability
Technology	• Water efficient increases and built into the sector
	• Alternative sources become available through investment in technology
	• Water Efficiency Targets to help progress technology
	• Increased technology = less local production
Environment	• Currently 60% groundwater – looking to alternative sources
	• Location/ characteristics not important as water treated prior to use in the process

DRY FOODS

Uncontrolled Demand – Dry Foods

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	30%	0%	0%	20%	10%	0%	0%	0%
Milling	30%	0%	0%	0%	0%	0%	0%	0%
Cereal Manufacture	10%	0%	0%	0%	5%	0%	0%	0%
Bakery	30%	0%	0%	0%	10%	0%	0%	0%
Confectionary	30%	0%	0%	0%	10%	0%	0%	0%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink

- Increased demand (20% min)
- Split between healthy and non-healthy foods and demand depending on society
- Water demand increases as much as production
- Price increases with demand – depends on market position of product
- Process use and water use increase with global demand

Policy and regulation

- High demand – people buy what they want/ can afford

Technology	• Self-regulation and making better products – food quality declines for poorer people and cheaper snacks • **GM options for food security (exclude as before farm gate?)** • Private and well off companies able to invest in water efficient technologies • Others (majority?) will have old equipment and make do and mend approach – less water efficient
Environment	• **Centralisation reduces water intensity** • **Exploitation leaves impact on water courses** • Investment upstream **(geographically)** to exploit water resources

Innovation – Dry Foods

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	10%	-10%	0%	-10%	10%	-10%	0%	0%
Milling	-	-	-	-	-	-	-	-
Cereal Manufacture	20%	-10%	10%	-10%	10%	-10%	0%	0%
Bakery	20%	-10%	20%	-10%	10%	-10%	0%	0%
Confectionary	10%	-10%	0%	-10%	10%	-10%	0%	0%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink	• Market more global with technology allowing increased logistics – increased demand • Health aspects not an issue – highly regulated industry and new innovative alternatives to unhealthy ingredients • Price increases only modestly - raw material price increases offset by decrease in production costs
Policy and regulation	• **Price** of water depends on local availability • High quality foods – highly regulated
Technology	• **Water efficiency technology is key, significant progress in water technology means process becomes more challenging** • Less water efficiency options – water use already not as high as other sectors **[group disagreed with this statement]** • Little water in final product – use of technology for alternative sources in process

Sustainable Behaviour – Dry Foods

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	-10%	0%	-20%	-10%	0%	-10%	0%	0%
Milling	-	-	-	-	-	-	-	-
Cereal Manufacture	0%	0%	0%	-10%	0%	-10%	0%	0%
Bakery	20%	0%	0%	-10%	0%	-10%	0%	0%
Confectionary	0%	0%	0%	-10%	0%	-10%	0%	0%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink

- Global markets – increased exports based on UK sustainable production (locally sourced production) **[Group disagreed with this statement]**
- **Sustainable production makes exports less competitive on global market but competitive in markets close to shore.**
- Rise in demand for healthy **products** and increased local demand
- Reduce demand of unhealthy options

Policy and regulation

- Legislation – increases demand for sustainable practices
- Value of water increases
- Industry targets efficient water use/ water budgets

Technology	• Water efficiency in process increases • New sources – rainwater harvesting and close loop systems
Environment	• **Comparable** impact to rest of the industry • Less/ not in product

Local Resilience – Dry Foods

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	-50%	30%	-10%	0%	-10%	20%	-10%	10%
Milling	30%							
Cereal Manufacture	-30%	30%	0%	-10%	-10%	0%	0%	0%
Bakery	50%	20%	0%	-10%	-10%	0%	0%	-10%
Confectionary	-50%	20%	-20%	0%	-10%	10%	-10%	10%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink

- Significant reduction in demand – low priority food stuff [Delete when applied across dry foods]
- Demands favours nutritional foods
- Diversity reduced – lack of global ingredients
- Small batch processing – increases costs (reduced demand and increased water use intensity)

Policy and regulation

- **Local standards apply** –value of water **increases**

Technology

- No change – using existing technology as sub-sector declines
- Growth in water treatment

Environment

- **High** importance of availability due to nature of processing

- High water reuse where possible

WET PROCESSING

Uncontrolled Demand – Wet processing

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Meat processing	10%	-10%	20%	10%	10%	-20%	0%	0%
Fruit and vegetables	30%	-10%	60%	-20%	0	-40%	0%	0%
Dairy	10%	-10%	20%	10%	10%	-20%	0%	0%
Fish processing	10%	-10%	20%	10%	10%	-20%	0%	0%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink

- High value and demand for meat products
- Rich eat good quality whilst poor eat ‘value-added’ processed products
- Markets for meats that UK currently doesn’t consume
- Fish and Dairy - Economic drivers for diary and fish processing would be similar to meat. Investment required for automation also similar to meat. As such similar outcomes for each of the demand
- Fish – high value under uncontrolled demand scenario

	• Fruit and Veg - Increased polarisation – rich eat better quality foods, poor eat value added (maybe more vegetables – cheapest source of sustenance)
Policy and regulation	• Policy consumer led for elite and government led for the poor
	• Fruit and Veg - As we become wealthier protein intake will increase. However, more fruit and vegetables produced with in particular policy and regulation a key driver for demand i.e. through health policy and diet.
Technology	• Intensification and artificial meat production increase
	• GM everywhere
	• Less water availability may result in investment in technology for efficiency
	• Fruit and Veg - Technology will reduce water use significantly – through reuse etc.
Environment	• Ethics of production irrelevant – just increased production
	• Adaptation to water availability
	• Risk of water shortages

Innovation – Wet Processing

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Meat processing	120%	-30%	0%	-10%	60%	-50%	0%	-10%
Fruit and vegetables	10%	-10%	10%	0%	0% (doesn't increase as most of the policy gains will be before farm gate)	-40% (same technology as other sectors but bigger impact)	0%	-10%
Dairy	30%	-20%	0%	-10%	30%	-10%	0%	-10%
Fish processing	10%	-10%	0% (fish will all be farmed so same as now)	-10%	30%	-10%	0%	-10%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink

- Demand increases significantly due to change in lifestyle
- Less ethical issues and food quality increases – drives demand
- Market drives production to where most efficient
- Split between rich and poor – rich eat higher quality compared to synthesised meat products for poor
- Economic drivers for dairy and fish processing would be similar to meat – direction of travel the same but perhaps not the magnitude. Dairy would increase most after meat - Synthesised products would emerge.

Policy and regulation	• Demand for fruit less as more expensive to produce. Demand for veg much higher – averages out overall. • Government policy leads to increased quality standards • Investment in processes and production to meet these standards • High standards driven by retailers – value of water increases in sector
Technology	• Synthesised and GM foods more common • Technology provides alternative water sources • Less concern on water quality • Water efficiency increases – production faster, better cheaper • Investment required for automation also similar to meat. As such similar outcomes for each of the demand
Environment	• Move towards fish farming – changes processor locations • Alternative sources more available – greywater, seawater • Better environmental protection through regulation • Water availability not a concern for location • More constraints on water availability lead to greater investment in alternative sources

Sustainable Behaviour – Wet Processing

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Meat processing	-30%	-10%	-20%	-20%	0%	-60%	-20%	-20%
Fruit and vegetables	20% (to replace protein)	-10%	20%	-10%	0%	-40%	0%	0%
Dairy	-30%	-10%	-20%	-20%	0%	-60%	-20%	-20%
Fish processing (UK same, EU consumption down)	-20% (worse than dairy & meat – fewer fish available)	-10%	-20%	-20%	0%	-60%	0%	0%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink
- Global markets result in increased exports of sustainable UK meat products
- Meat volumes produced decreased with increasing prices
- Dairy and Fish similar drivers to meat but not as pronounced.
- Demand for F&V higher to replace the reduction in available protein.
- More home grown produce

Policy and regulation
- Increased regulation – carbon footprint, welfare, water footprint, standard for appropriate use
- Value of water increases

Technology
- Water efficiency in wash down and process increased

Environment	• Closed loops sites – decrease water use • Alternative water sources through new technology – desalination etc. • Reduced availability may reduce production and affect investment • Seasonality increasingly impacts on demand • Potential relation based on demand for product and availability of water • No environmental impact on fish – they will be caught / farmed locally thus no increase in tonnage

Local Resilience – Wet Processing

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Meat processing	-40%	40%	0%	0%	0%	10%	-20%	0%
Fruit and vegetables	-40% (not so much processing – increase in home grown)	40%	0%	0%	0%	10%	-10%	10%
Dairy	-30%	40%	0%	0%	0%	10%	-10%	0%
Fish processing	-40% (Geographical impact – proximity to sources	30%	0%	0%	-20%	10%	-10%	0%

Additional comments to reflect the wider food and drink sub-sector are provided in **blue** text.

Demand for food and drink	• Growth of small independents
	• UK market only, limited diversity depending on suitability of local environment
	• Increase in farming intensity (e.g. poultry)
	• Competing use of land for animal feedstock
	• Increased infrastructure costs
	• Demand for food goes down – all produced locally but intensity increases.
Policy and regulation	• Increased land use regulation
	• Access to water essential but not quality
	• Policy and regulation – no impact at all.
Technology	• Development reflects change in farming intensity and size of units
	• Technology won't increase tonnage as there will be more home grown produce but intensity will increase. Fish production likely to reduce as move back to traditional methods / technologies. Some increase in intensity for F&V under the Environment driver, not efficient.
	• Reduction in industrialisation – move towards locally produced products.
Environment	• Strong geographical variation due to stability of environment (processors need to be close to farms) and level of water availability
	• Pronounced regional differences effect location

PRE-PREPARED FOODS

Uncontrolled Demand – Pre-Prepared

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Pre-prepared food	30%	20%	0%	0%	0%	0%	0%	0%
Pet Food								

Innovation – Pre-prepared

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Pre-prepared food	30%	0%	0%	0%	0%	-20%	0%	0%
Pet Food								

Sustainable behaviour – pre-prepared

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Pre-prepared food	20%	-10%	0%	-20%	-20%	-10%	0%	-10%
Pet Food								

Local resilience – pre-prepared

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Pre-prepared food	-70%	50%	0%	0%	0%	10%	-10%	0%
Pet Food								

6. Modelling approach behind the 2050s projections

A bespoke Microsoft Excel model was developed by Ricardo-AEA to undertake the calculations to quantify the workshop outputs and produce projections of water demand for the 2050s. The model included a separate baseline data entry spreadsheet that enabled these values to be updated between the draft WRAP report figures and the final report.

Workshop outputs

The final percentage changes from the check and challenge workshop were entered into the model for the sub-sector categories (Table 1). A multiplier approach was then used (1 + percentage change) to produce Table 2. This multiplier approach is consistent with that applied in the demand projections for the agricultural sector.

Table 1 Summary of percentage changes from the workshop for the dry foods category (Innovation scenario)

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	10%	-10%	0%	-10%	10%	-10%	0%	0%
Milling	30%	0%	0%	0%	0%	0%	0%	0%
Cereal Manufacture	20%	-10%	10%	-10%	10%	-10%	0%	0%
Bakery	20%	-10%	20%	-10%	10%	-10%	0%	0%
Confectionary	10%	-10%	0%	-10%	10%	-10%	0%	0%

Table 2 Multipliers derived from percentage changes from the workshop for the dry foods category (Innovation scenario)

Sector	Demand for food and drink		Policy and regulation		Technology		Environment	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	110%	90%	100%	90%	110%	90%	100%	100%
Milling	130%	100%	100%	100%	100%	100%	100%	100%
Cereal Manufacture	120%	90%	110%	90%	110%	90%	100%	100%
Bakery	120%	90%	120%	90%	110%	90%	100%	100%
Confectionary	110%	90%	100%	90%	110%	90%	100%	100%

Projections

The multipliers derived for tonnage or water use intensity for each demand indicator group were multiplied together to produce a final figure and collated in Table 3. Equation 1 details this approach.

Equation 1 Calculation of the final multiplier for use in projections (tonnage example) and worked example

Final multiplier for tonnage = Demand for food and drink (tonnage) x Policy and Regulation (tonnage) x Technology (tonnage) x Environment (tonnage)

Worked example:

Aggregated change in tonnage for snack foods under innovation (121%) = Tonnage for demand indicator group (110%) x Tonnage for policy and regulation (100%) x Tonnage for technology (110%) x Tonnage for Environment (100%).

Table 3 Multipliers collated for the dry foods category

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	143.00%	120.00%	121.00%	72.90%	72.00%	81.00%	36.45%	171.60%
Milling	130.00%	100.00%	130.00%	100.00%	130.00%	100.00%	130.00%	100.00%
Cereal Manufacture	115.50%	100.00%	145.20%	72.90%	100.00%	81.00%	63.00%	117.00%
Bakery	143.00%	100.00%	158.40%	72.90%	120.00%	81.00%	135.00%	97.20%
Confectionary	143.00%	100.00%	121.00%	72.90%	100.00%	81.00%	32.40%	145.20%

The multipliers were then used to produce a new tonnage and water use intensity for the 2050s (Table 4). A population growth factor was applied to tonnage as the assumption within the workshops was that this was included within the projections. Equation 2 outlines the approach for tonnage and intensity.

Equation 2 Calculation of tonnage and intensity in the 2050s

Tonnage 2050s = (Tonnage multiplier x Baseline tonnage) + (Population growth factor x Baseline tonnage)
Intensity 2050s = Intensity multiplier x Baseline intensity

Table 4 Projecting tonnage and intensity in the 2050s

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	2,243,831.70	3.91	1,855,709.46	2.37	1,127,980.26	2.64	660,414.25	5.59
Milling	10,532,115.56	0.07	9,919,783.26	0.07	9,246,217.73	0.07	9,062,518.04	0.07
Cereal Manufacture	932,894.55	3.84	1,049,580.41	2.80	716,699.94	3.11	479,774.34	4.49
Bakery	4,680,659.10	1.07	4,817,283.74	0.78	3,567,421.26	0.87	3,871,031.58	1.04
Confectionary	1,775,060.20	3.35	1,468,022.76	2.44	1,160,985.32	2.72	483,583.97	4.87

A final projection of water demand in the 2050s was derived by multiplying the new tonnage by the new water intensity (Table 5). Percentage changes were then assessed and the data grouped and graphed for interpretation. The full set of calculation tables are included in Appendix 1.

Table 5 Final demand for water in the 2050s

Sector	Uncontrolled Demand	Innovation	Sustainable Behaviour	Local Resilience	Baseline
Snack foods	8,766,240.95	4,404,325.30	2,974,598.79	3,689,568.66	3,948,757.19
Milling	719,293.29	677,473.91	631,472.60	618,926.78	418,193.77
Cereal Manufacturers	3,583,800.24	2,939,371.52	2,230,147.69	2,156,423.80	2,275,428.72
Bakery	5,025,638.38	3,770,630.53	3,102,584.65	4,039,961.29	2,716,561.29
Confectionery	5,953,235.62	3,589,221.84	3,153,927.69	2,354,932.68	3,217,965.20

7. Appendices

Appendix 1 – Calculation tables from final projections model

AGGREGATE Multipliers

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Brewing	145%	100%	110%	57%	79%	58%	99%	80%
Wine	204%	100%	119%	50%	59%	100%	63%	90%
Cider	121%	100%	100%	100%	97%	72%	89%	89%
Maltings								
Soft Drinks and Beverages	156%	100%	151%	77%	99%	65%	65%	109%
Spirits	156%	100%	110%	72%	88%	72%	99%	109%

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	143.00%	120.00%	121.00%	72.90%	72.00%	81.00%	36.45%	171.60%
Milling	130.00%	100.00%	130.00%	100.00%	130.00%	100.00%	130.00%	100.00%
Cereal Manufacture	115.50%	100.00%	145.20%	72.90%	100.00%	81.00%	63.00%	117.00%
Bakery	143.00%	100.00%	158.40%	72.90%	120.00%	81.00%	135.00%	97.20%
Confectionary	143.00%	100.00%	121.00%	72.90%	100.00%	81.00%	32.40%	145.20%

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Meat processing	145%	79%	352%	28%	45%	23%	48%	154%
Fruit and vegetables	208%	43%	121%	49%	144%	49%	54%	169%
Dairy	145%	79%	169%	58%	45%	23%	63%	154%
Fish processing	145%	79%	143%	66%	64%	29%	43%	143%

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Pre-prepared food	130%	120%	130%	80%	96%	58%	27%	165%
Pet Food	130%	120%	130%	80%	96%	58%	27%	165%

Projection to 2050 - new tonnage and intensity (population growth factors applied)

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Brewing	8,120,512.23	4.69	6,159,790.26	2.66	4,346,556.23	4.69	4,988,562.54	3.76
Wine	527,488.60	3.29	322,712.00	1.66	171,820.60	3.29	169,060.00	2.96
Cider	1,331,506.25	3.36	1,078,275.00	3.36	962,278.75	3.36	858,535.63	2.99
Maltings								
Soft Drinks and Beverages	14,703,357.24	1.77	13,608,031.39	1.36	8,911,125.60	1.77	6,000,157.90	1.93
Spirits	2,547,503.37	34.86	1,826,997.36	25.10	1,402,413.47	34.86	1,479,610.54	37.96

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Snack foods	2,243,831.70	3.91	1,855,709.46	2.37	1,127,980.26	2.64	660,414.25	5.59
Milling	10,532,115.56	0.07	9,919,783.26	0.07	9,246,217.73	0.07	9,062,518.04	0.07
Cereal Manufacture	932,894.55	3.84	1,049,580.41	2.80	716,699.94	3.11	479,774.34	4.49
Bakery	4,680,659.10	1.07	4,817,283.74	0.78	3,567,421.26	0.87	3,871,031.58	1.04
Confectionary	1,775,060.20	3.35	1,468,022.76	2.44	1,160,985.32	2.72	483,583.97	4.87

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Meat processing	13,563,849.31	4.24	27,823,280.64	1.52	4,767,635.07	1.23	4,782,126.36	8.24
Fruit and vegetables	7,313,775.56	2.85	4,476,030.64	3.21	4,827,091.87	3.21	2,106,367.36	11.18
Dairy	18,496,971.79	0.99	19,860,530.61	0.73	6,501,606.54	0.29	8,003,497.41	1.92
Fish processing	899,833.99	7.67	841,190.96	6.36	408,578.47	2.79	294,176.50	13.86

Sector	Uncontrolled Demand		Innovation		Sustainable Behaviour		Local Resilience	
	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity	Tonnage	Intensity
Pre-prepared food	3,061,269.76	7.11	2,883,288.96	4.74	2,082,375.36	3.46	800,913.60	9.78
Pet Food	2,199,651.24	3.92	2,071,764.54	2.61	1,496,274.39	1.90	575,490.15	5.39

FINAL 2050 Projection - total water use

Sector	Uncontrolled Demand	Innovation	Sustainable Behaviour	Local Resilience	Baseline
Brewing	38,104,569.27	16,388,628.69	20,395,714.96	18,771,080.24	20355004.95
Wine	1,735,437.49	535,108.13	565,289.77	500,586.66	704060
Cider	4,473,861.00	3,623,004.00	3,233,256.60	2,570,249.61	2744700
Maltings					
Soft Drinks and Beverages	26,009,360.20	18,487,137.97	15,763,248.61	11,558,559.67	13136040.51
Spirits	88,811,570.84	45,859,065.67	48,891,218.29	56,173,318.56	44854328.71

Sector	Uncontrolled Demand	Innovation	Sustainable Behaviour	Local Resilience	Baseline
Snack foods	8,766,240.95	4,404,325.30	2,974,598.79	3,689,568.66	3,948,757.19
Milling	719,293.29	677,473.91	631,472.60	618,926.78	418,193.77
Cereal Manufacturers	3,583,800.24	2,939,371.52	2,230,147.69	2,156,423.80	2,275,428.72
Bakery	5,025,638.38	3,770,630.53	3,102,584.65	4,039,961.29	2,716,561.29
Confectionery	5,953,235.62	3,589,221.84	3,153,927.69	2,354,932.68	3,217,965.20

Sector	Uncontrolled Demand	Innovation	Sustainable Behaviour	Local Resilience	Baseline
Meat processing	57,510,594.73	42,228,059.07	5,880,648.23	39,425,888.48	38,789,736.80
Fruit and vegetables	20,853,036.88	14,357,315.89	15,483,379.89	23,550,029.65	19,308,367.49
Dairy	18,238,754.07	14,420,413.51	1,864,972.83	15,345,105.58	12,301,671.95
Fish processing	6,905,824.36	5,348,014.66	1,140,239.06	4,076,354.65	4,657,839.31

Sector	Uncontrolled	Innovation	Sustainable	Local Resilience	Baseline
Pre-prepared foods	21,765,996.84	13,667,021.27	7,195,686.70	7,830,064.27	10,545,541.10
Pet Food	8,618,786.81	5,411,796.37	2,849,310.79	3,100,508.34	4,175,768.80

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