

## Foresight for Food and Drink

### Alcoholic Drinks

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# Foresight For The Alcoholic Drinks Sector

The UK's Foresight programme was first announced in the 1993 White Paper *Realising our Potential*. Its aim is to create sustainable competitive advantage and enhance the quality of life, by bringing together business, the science base and Government to identify and respond to emerging opportunities in markets and technologies.

The Foresight programme is spearheaded by 16 panels set up to explore opportunities in different sectors of the economy. In 1995, the panels published their first reports following widespread consultation. These reports aimed to identify:

- the likely social, economic and market trends that will affect the UK in the medium to long term;
- the developments required in science, engineering and technology to best address future needs; and
- the implications for policy and infrastructure and for business investment strategies.

The Food and Drink panel has since looked in further detail at six sub-sectors:

- Alcoholic Drinks
- Cereals
- Dairy
- Fruit and Vegetables
- Meat
- Soft Drinks

The groups involved were asked to perform Foresight analyses for each of their sectors, to challenge the original panel findings and to make recommendations for further action aimed at involving industry and academia in debate about priorities for the future.

This report summarises the work of the Alcoholic Drinks Sector Group.





# Executive Summary

## Background

The UK fermented drinks industry had a turnover of around £30 billion at the consumer level in 1993, representing around 25% of expenditure on food and drink. In the UK most of the drinks market is growing slowly. Both imports and exports (£3 billion) are growing, more rapidly than the home market.

UK maltsters use around 2 million tonnes of barley for malt for brewing and distilling. There is a strong export market for UK malt, based on its superior quality; the value of malt exports is around £120 million, equivalent to over 500,000 tonnes of barley.

The drinks industry is itself a major employer and supports substantial further employment in its suppliers in farming, malting etc., and in the retail trade. It is particularly socially important in some rural areas, notably in Scotland.

The UK alcoholics drinks industry tops the list for product introductions in the European food and drink industry. The drinks sector's R&D spend is around 0.3% of turnover at the production level, similar to that of the food and drink sector as a whole. UK companies' R&D is similar in scale to their main European and North American competitors. With a few exceptions, there is a world-wide trend to downsize R&D manpower, focus on short payback activities, and make greater use of outsourcing.

## **Top Drivers of change**

The major business drivers are seen as concentration of the industry, the global market, the evolving retail structure in the UK, consumer focus on quality and choice. These dictate an increased emphasis on product quality and innovation, on ensuring consumer confidence in brands, on products, packaging and distribution systems for changing lifestyles and drinks purchase patterns.

The technology drivers indicate the immense potential impacts of information technology and biotechnology on all aspects of the chain: improving the quality of raw materials, reducing costs, increasing the efficiency of asset use.

Although seen and presented as a highly traditional industry driven by the structural changes in the supply chain and the resultant pressures on cost and innovation, many elements of the processing and distribution chain are being radically reviewed and redesigned by some producers.

Health considerations and consumer confidence in the product are of fundamental importance to individual manufacturers, confidence in whose brands is essential for market success, and for the well-being of the industry as a whole. Thus understanding of the risks and benefits of components of fermented drinks, including alcohol, is important to guide

both consumers and manufacturers.

Consumer appreciation of the 'technology' of foods and drinks is sometimes a barrier to innovation, as for example currently with the use of genetically modified cereals and yeasts. Confidence in such innovative technologies is needed if the choices are to be made available to consumers and if the UK industry is to remain competitive in the face of innovation elsewhere. Measures to promote people's understanding of the science and the ability to make educated choices are therefore important.

 **Top Recommendations**

The research implied from the above analysis requires that the UK industry and its research associations can access competencies in a range of areas for which they look to the universities and institutes: biology, chemistry and physics of raw materials; yeast molecular biology and physiology; flavour chemistry and sensory analysis; physical chemistry of colloids, foams etc.; process modelling; plant breeding and molecular biology; nutrition, health and toxicology. Specific recommendations are made to public sector research funders in each of these areas.

There is a large number of small and medium sized brewers, distillers and cidermakers for whom achieving best practice levels would enhance competitiveness. The trade associations and research associations referred to at the end of this report should extend their bench-marking and other services to disseminate best practice.



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# Introduction

1. This report has been produced under the auspices of BRF (Brewing Research Foundation) International whose membership includes most of the major brewers and cidermakers in the UK as well as several overseas companies. Dr Renton Righelato, Director-General of BRFI, is a member of the Food and Drink Panel; companies consulted during the preparation of this report are listed on the back page.
2. The drinks industry is a major part of the food chain: in economic terms it creates substantial exports of raw materials and finished products and drives over £30 billion of consumer expenditure. In social terms, fermented drinks are part of our social structure: in moderation providing great enjoyment for a large part of the population and contributing to the nation's health.



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# Industry Statistics

**3.** The UK fermented drinks industry had a turnover of around £30 billion at the consumer level in 1993 <sup>(1)</sup>, representing around 25% of expenditure on food and drink. National Food Survey data used by the Strathclyde Project showed consumption of beer, £13.6 billion; cider, £1.3 billion; spirits, £5.4 billion <sup>(2)</sup>. A further £4.7 billion is spent on wine, largely imported. In the UK most of the drinks market is growing slowly. Both imports and exports are growing, more rapidly than the home market <sup>(2)</sup>.

(1) Central Statistics Office

(2) S Shaw, Strathclyde project; report to BBSRC "Opportunities for British Food Suppliers"

**4.** Three of the four largest drinks businesses in the world are British. UK exports are £3 billion (1995), comparable to North Sea oil, cars or pharmaceuticals. Exports are dominated by whisky, 90% of which is exported (£2.3 billion). There are net imports of beer, largely from Eire and Germany. The UK produces nearly 20% of the total EU beer output. Invisible earnings from repatriation of earnings, licensing etc. have not been estimated.

**5.** The UK maltsters use around 2 million tonnes of barley for malt for brewing and distilling. There is a strong export market for UK malt, based on its superior quality; the value of malt exports is around £120 million, equivalent to over 500,000 tonnes of barley <sup>(3)</sup>.

(3) Data from the Maltsters Association of Great Britain

The drinks industry is itself a major employer and supports substantial further employment in its suppliers in farming, malting etc., and in the retail trade. It is particularly socially important in some rural areas, notably in Scotland.



# Drivers for change

## **Concentration and advantages of scale**

6. As in much of the rest of the food industry, the fermented drinks sector has polarised into a small number of large companies. Four brewing companies in the UK account for about 80% of beer volume and several hundred smaller producers account for the remainder. Similar concentration exists in whisky and cider making.

## **Global brands, global manufacturing**

7. In much of the world global companies dominate (e.g. Anheuser Busch, Heineken, Interbrew, Guinness, Carlsberg). This is less true for the moment in the UK, where the larger companies have often focused on associated leisure activities. However, with brand licensing and contract manufacture a strong feature of the industry, brewing-centred companies may re-emerge to dominate in the UK.

8. International trade is growing; UK beer exports are smaller than imports. Inward and outward licensing is also growing. Although relative latecomers (except for Guinness), some of the larger UK brewers are beginning to develop significant overseas investments (e.g. Bass in China and Eastern Europe; Scottish Courage).

9. Effective competition in international markets demands (i) highly efficient, low cost operations and an ability to construct or convert capacity quickly and cheaply, (ii) management of quality of raw materials supplies and (iii) management of the distribution chain and the quality of a relatively labile product.

## **UK retail market structure**

10. Within the UK the structure of the market is changing, with the proportion of beer drunk in pubs falling and growth in consumption at home, leading to greater participation of the multiple food retailers. With the weakening of the control of brewers over the products available in their pubs and the growth of a number of non-brewing pub and restaurant chains, the market is becoming increasingly diverse and competitive at both the production and distribution levels.

## **Product and package innovation, time to market, flexible manufacturing**

11. In developed markets such as the UK, product innovation has become, and is expected to remain, an important factor in competitiveness. In 1995, the alcoholic drinks sector had the highest number of product introductions in the European food and drink market, and within that the UK market was the most innovative<sup>4</sup>. This is predicted to continue, placing a premium on time to market and with contingent demands for flexible manufacturing operations.



## Legislation

**12.** As in the rest of the food industry, legislation, codes of practice and quality standards on safety, environmental and other topics bring about change throughout the sector. The alcoholic drinks sector is particularly influenced by excise duties which currently are higher in the UK than much of the rest of the EU.

**13.** Broadly, the business drivers indicate an increased emphasis on product quality and innovation, on ensuring consumer confidence in brands, on integrating into the evolving retail structures and on global competition. The technology drivers indicate the immense potential impacts of information technology and biotechnology on all aspects of the chain.

**14.** Although seen and presented as a highly traditional industry driven by these structural changes in the supply chain and the resultant pressures on cost and innovation, many elements of the processing and distribution chain are being radically reviewed and redesigned by some producers.

**15.** The main strategic research needs identified from foresight discussions held in 1996/7 are outlined below. In addition, there is a wider range of needs for technical information and incremental improvement that are not discussed here.



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# Raw Materials

**16.** Cereals, particularly malted barley, are the key raw materials for brewing and distilling. The UK has an internationally successful malting industry with substantial exports, particularly in the Pacific Rim.

**17.** The biomolecular sciences provide a range of tools which may help substantially to increase conversion and enhance quality of malted barley, and potentially radically change the malting process and the brewing operations.

**18.** At present only a little over half of the biomass in barley grain is converted into beer; the remainder is lost in malting and as spent grains. A number of genetic and enzymic approaches could lead to substantial increase in the proportion of biomass available for fermentation and its quality. For example, identification of specific proteins, phenolics and other quality determinants of barley and malt will enable design of cereals, malts or syrups with key qualities enhanced. This will simplify brewing operations, obviate the need for process aids and offer product stability improvements. Diversion of the flux of photosynthate from the protein to carbohydrate seed stores could substantially increase fermentation yields and control of germination events could greatly increase malthouse efficiencies.

**19.** Resistance to diseases, particularly the fungal disease of hops in the field and barley in the field and in storage, is important if use of agrochemicals is to be minimised. Genetic modification and integrated pest management should be directed to these ends.

**20.** The cider industry is rapidly developing the acreage of cider apple orchards and, with approximately 30% of the UK apple crop being cider apples, there is a need to develop the horticultural methodology. Particular objectives are maximising the yield of sugars and tannins, and resistance to pests and diseases.



# The Production Process

**21.** The demands for flexibility and asset utilisation efficiency (intensive processing) in brewing and cider operations will be met through simplification and elimination of process steps, notably in brewhouse operations and post fermentation maturation and conditioning; so leading to reduced investment and utilities costs. Reconfigurations leading to fundamental reconstruction of the supply chain and manufacturing process can be envisaged, whilst retaining the traditional qualities of the products. These may include substantial process simplification and the use of concentrates and condiment brewing strategies. Such developments will be achieved through developments in barley and malt (see above), and (i) understanding and restructuring the physico-chemical processes involved in extraction and the separation of beer and cider colloids; (ii) biochemical engineering and (iii) yeast genetics. The cider industry has made significant strides in improving process efficiency in recent years through application of biochemical engineering principles and anticipates substantial further progress from malo-lactic maturation development.

**22.** The main limitation on process control is not the control technology, but real-time measurement of key process parameters. New monitoring methods, particularly the application of chemometrics to spectral analysis of signals from light, other electromagnetic and acoustic probes can yield a wide range of information about raw materials and process streams. These will increasingly replace laboratory analyses, empower plant operators and/or allow management of remote plants.

**23.** Around half of the investment and product cost in modern breweries and cidermakers is in packaging and distribution. This proportion is increasing as the market changes from consumption in the pub to the home and package innovation is a growing part of new product development. Some manufacturers are developing primarily as packaging operations, producing and bottling both alcoholic and soft drinks. Thus, competitiveness is increasingly determined by the cost and responsiveness of the packaging and distribution systems. Efficiencies in distribution could be improved significantly through the use of beer concentrates at the point of dispense, so long as this was accepted by consumers.

**24.** The environmental issues in the sector mostly concern energy, water and packaging. Energy and water efficiencies of some modern operations in brewing and distilling is high, though there is considerable scope for moving to best practice levels. This will become increasingly important if climate change puts further premiums on water supplies and quality.

**25.** Implementation of environmental legislation, including European Directives on Packaging and Packaging Waste and Integrated Pollution Protection and Control provides an impetus to reduce materials inputs, maximise recovery and reuse, and minimise effluents and emissions.

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# Product Quality And Innovation

**26.** Design of the sensory characteristics of new products is still largely empirical, although new product developments, ranging from relatively simple reformulations to major redesigns of production processes, have become central to competitiveness for many businesses. Furthermore, many efficiency-driven process innovations, and the development of low alcohol products, have failed because it has not been possible to match reliably the drinking characteristics of current products.

**27.** There is therefore a critical need to understand the compositional determinants of flavour, mouthfeel and appearance and their control through the manufacturing process. The complex chemistry of distillation and maturation of spirits, the oxidative and colloidal changes in beers and the control of foam and 'texture' are all areas in which research could lead to substantial benefits. These will: reduce the time and risk in new product development; increase the flexibility of the manufacturing process; and increase product shelf life - becoming increasingly important for beers and ciders as UK companies enter export markets and a greater proportion of beers are sold for home use.

**28.** The pleasure provided by alcoholic drinks is an integral part of the quality of most of our lives. A deeper understanding of individuals' psychological and physiological responses to alcohol, including effects on perception of quality and drinking behaviour, would assist responsible product development, advice provision to consumers, and presentation.



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# Consumer Confidence

**29.** Health considerations and consumer confidence in the product are of fundamental importance to individual manufacturers, confidence in whose brands is essential for market success, and for the well-being of the industry as a whole. Thus identification of hazards, risk assessment and risk management will continue to be a general and vital need.

## Health

**30.** Understanding of the risks and benefits of components of fermented drinks, including alcohol, is important to guide both consumers (dietary advice) and manufacturers (e.g. product development and ethical guidelines). This requires a sophisticated understanding of individuals' eating and drinking behaviour and the effects on their well-being.

## Top **Authenticity**

**31.** For both consumer confidence and protection of brand owners, authenticity of composition and origin are increasingly important, putting further demands on quality, analytical capabilities and control of the supply and distribution chain.

## Top **Technology**

**32.** Consumer appreciation of the 'technology' of foods and drinks is sometimes a barrier to innovation, as for example currently with the use of genetically modified cereals and yeasts. Confidence in such innovative technologies is needed if the choices are to be made available to consumers and if the UK industry is to remain competitive in the face of innovation elsewhere. Measures to promote people's understanding of the science and the ability to make educated choices are therefore important.

## Top **Regulation**

**33.** Whilst regulation is a necessary element in consumer protection, to avoid unnecessary barriers to innovation and burdens on the industry, it should be in response to substantive need and be soundly based scientifically. Given increasing pressures for regulation from the EU, it will be increasingly important to ensure the highest quality informed technical input in analysis of need and drafting. Recent European legislation on additives will inhibit product innovation, as would other restrictions on the use of processing aids etc., which are not based on consumer protection and wholesomeness. In order to satisfy the demand for novel products without additives, research will need to be directed towards altering raw materials properties and process parameters.

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# Research, Technology And Innovative Capacity Of The Industry

**34.** Measures of innovative activity and capability are difficult to make. However, product introductions, research activity and the coherence of the technology supply chain may be useful indicators.

**35.** The UK alcoholics drinks industry tops the list for product introductions in the European food and drink industry<sup>2</sup>. The drinks sector's R&D spend is around 0.3% of turnover at the production level, similar to that of the food and drink sector as a whole. UK companies' R&D is similar in scale to their main European and North American competitors. With a few exceptions, there is a world-wide trend to downsize R&D manpower, focus on short payback activities, and make greater use of outsourcing.

**36.** Suppliers of materials and equipment can be important sources of technology. The UK has a strong supply base for malt, hops and most other ingredients used in brewing, cidermaking and distilling. Equipment is sourced globally, with some significant UK suppliers (e.g. Briggs, APV).

**37.** A significant part (around 10%) of the UK industry's R&D activity is in collaborative, precompetitive, strategic research: brewing and cidermaking at BRF International, whisky at the Scottish Whisky Research Institute. Additionally, the International Centre for Brewing and Distilling at Heriot Watt University provides training and research. These organisations provide a conduit between academic science and the industry. They and the larger companies draw on basic and strategic publicly-supported research and expertise. The research implied from the above analysis requires that the UK industry and its research associations can access competencies in a range of areas for which they look to the universities and institutes:

- Biology, chemistry and physics of raw materials
- Yeast molecular biology and physiology
- Flavour (bio)chemistry and sensory analysis
- Physical chemistry of colloids, foams etc.
- Process modelling

- Plant breeding/molecular biology
- Nutrition, health and toxicology

**38.** There is a large number of small and medium sized brewers, distillers and cidermakers for whom achieving best practice levels would enhance competitiveness. The trade associations and research associations referred to at the end of this report provide benchmarking and other services to disseminate best practice.



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# Conclusions - Strategic Research Priorities For The Alcoholic Drinks Sector

**39.** The following tables analyse the strategic technological priorities of the alcoholic drinks sector alongside the general priorities in the UK Food & Drink Foresight Panel's 1995 report. The priorities presented in bold are recommended as areas of strategic research for the public sector, where appropriate in collaboration with companies in the alcoholic drinks sector and its supply chain.

## Food & Drink Panel Recommendation

## Strategic Research Needs

### Diet & health

Diet & disease/human metabolism

- Generally relevant
- **Effects of eating/drinking patterns on health**
- **Alcohol (including higher alcohols) & micronutrients effects on health**

Food poisoning

- **Control of natural contaminants in supply chain**
- **Bacterial food poisoning not an issue**

Genetic effects on differences in response

### Genetics & molecular biology of raw materials

- Fundamental to understanding and advice
- **Functionality and developmental physiology of cereals and apples (enhanced process yields and qualities)**
- **Pest/disease resistance in cereals, hops and cider apples**

Product quality

- **Yeast functional genomics**
- **composition, structure and perception of quality (aroma, taste, appearance etc.)**
- **assessment methodology including genetic differences**

**Psychology of choice**

- **psychology of eating/drinking**

Perception of risk/benefit

- **tradition and technology** including socio-political influences on choice
- **acceptance of Genetically Modified Organisms**

*New topic*

- **alcohol/behaviour (psychology, sociology, physiology)**

**Food & Drink safety**

Multidisciplinary approach to surveillance

- supply chain approach to safety needed

Quality assurance

- primary production strategies for elimination of natural and agro-chemical toxicants, e.g. pest/disease resistance in raw materials

Hygienic processing

- effects of minor components of drinks

Microbiological, chemical and physical safety

- in line methodology for monitoring quality including microbiological status

**Unit operations**

Process equipment

- adaptation/transfer of technology from other sectors (cereals, pharmaceuticals etc.)

Preservation

- adoption of technology developed outside UK

Packaging

- new concepts in packaging and distribution systems (including recycling)

**Multivariate modelling in:**

materials in process

- virtual R&D

consumer perception

supply chain

- manufacture/packaging/ distribution logistics

climate/weather,

distribution

- anti-counterfeiting measures

chemometrics

Databases/information networks:

- raw materials properties (harvest, climate, storage etc. effects)

materials properties

new technologies

dietary/food information

Materials science

- manufacture/packaging/distribution logistics  
physico chemical bases of texture (e.g. creaminess, foam, 'drinkability')

Colloid science

- manufacture/packaging/distribution logistics in relation to extraction/separation and to stability in distribution, separations



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# Organisations Consulted

This report has been drawn up with inputs from people from a wide range of companies, trade associations and research groups involved with the sector.

## Representative organisations

- Brewers and Licensed Retailers Association
- Maltsters Association of Great Britain
- National Association of Cidermakers
- Institute of Brewing
- Scotch Whisky Association

## Research organisations

- BRF International
- International Centre for Brewing and Distilling (Heriot Watt University)
- Scotch Whisky Research Institute

## Companies

- Brewers
- Asahi (Japan)
- Bass
- Carlsberg (DK)
- Carlsberg Tetley
- Guinness
- Heineken (NL)
- Scottish Courage
- Shepherd Neame
- Whitbread
- Cidermakers
- Bulmers
- Maltsters
- Hugh Bairds (Conagro)
- Pauls Malt

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