UKRI Innovate UK

Food industry priorities for a sustainable food system – 2023

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Introduction

Our 20th Century UK food system successfully met the need to deliver safe, affordable and available food. Today the food system and wider society face a number of challenges, from ingredient and energy costs to increasing incidence of diet-related disease. Now, we must create the solutions needed for a 21st Century food system. Crucially, we need to deliver healthier affordable food that meets the changing needs of consumers. Nutrition for long term health as well as short term satiation is key, as is integrating sustainable sources of raw materials and energy, across the whole interdependent and connected food system.

Innovation will play a critical role in achieving this. The UK food industry is both capable of and committed to creating and deploying those new technologies required to realise our ambition of a vibrant sustainable UK food system that meets the complex needs of society as a whole.

As the UK's largest and most geographically diverse manufacturing sector, food manufacturing is essential to realising net zero and growth across the UK. It has a track record of attracting inward investment, creating thousands of new jobs and delivering growth in both domestic and export markets. This has been consistently achieved in partnership with the UK's world leading technical universities and institutes, and shows that the UK manufacturing system is capable of delivering. UK Research and Innovation (UKRI) has a critical role to play in supporting the creation and development of pre-competitive technologies and innovative commercial solutions across the sector. This, in turn, will enable world leading transformation and the successful realisation of exciting growth opportunities for the UK food industry.

It is timely therefore, to review and update this collation of industry needs in the food sector as UKRI embarks on its latest strategy. Innovate UK is committed to inspire, involve and invest in innovation, supporting businesses to grow rapidly and to use responsible innovation to achieve wider societal benefits. This refresh of **'A Pre-Competitive Vision for the UK's Food & Drink Industries'** outlines some of the key priorities of the sector to achieve a sustainable food system fit to deliver for all.

Ian Noble

Chair of Innovate UK Food Sector Group

Kathryn Miller

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The 2022 Food and Drink sector in numbers

Industry output valued at

£33bn

Up 8%

£128bn
Total turnover
Up 14.4%

£113bn
Domestic sales
Up 13.2%

Industry total business investment

£4.3bn

Up 8%

Over Half

Food and Drink Federation (FDF) members identified new products and healthy food as investment opportunities

Food and drink exports valued at

£25bn

Up 22.5%

Sold to over **200** export countries

Top export markets
Ireland, France, USA

The Food and Drink industry provided

457k jobs

Up 0.9%

Across every region and nation, with **4.3m workers** in the farm-to-fork food chain

Source: Courtesy of Food and Drink Federation (FDF), statistics from Office for National Statistics (ONS), February 2023

Overview

The production of this document was coordinated by Innovate UK and the Food Sector Group.

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The Innovate UK Food Sector Group is made up of key stakeholders across the food supply chain, from industry, academia, UK Research and Innovation (UKRI) and government departments.

The group is currently chaired by Ian Noble, VP R&D – Research, Analytical & Productivity at Mondelēz International. The Food Sector Group focuses on how the food manufacturing sector can best work together within a pre-competitive framework, for the benefit of the whole sector and the UK.

This document builds on previous work to reflect the key areas where the industry can work together for a UK food system that produces nutritious, desirable and affordable food.

This document sets out nine priority areas across three themes: **Net Zero, Healthy Living & Agriculture,** and **Technologies.** Within the nine priority areas we highlight the underpinning technologies and the challenge to be addressed, the manufacturer benefit as well as benefits to the food system as a whole.

What's needed to create a UK food system that produces nutritious, desirable and affordable food

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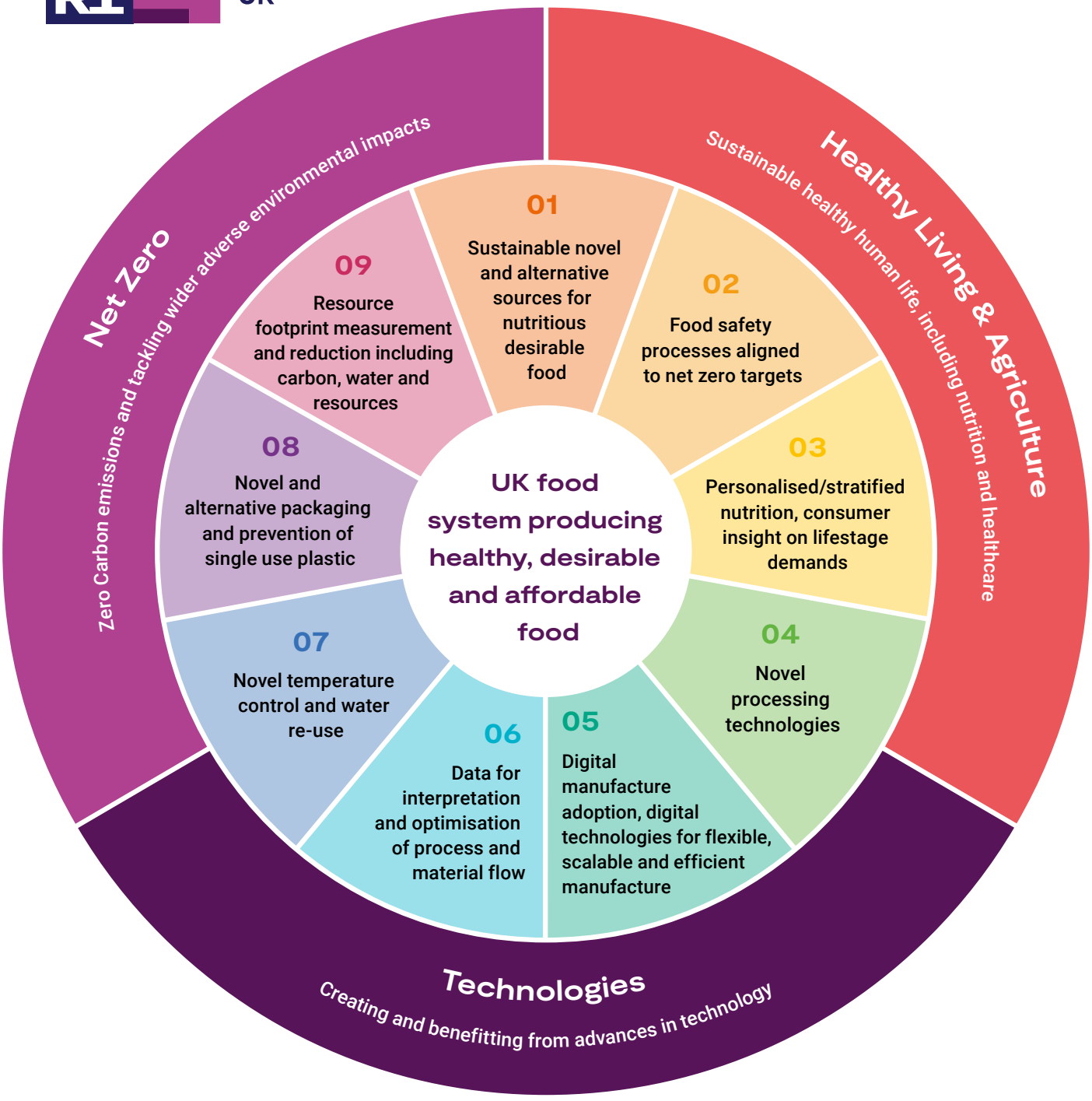


01 Sustainable novel and alternative sources for nutritious desirable food

Food manufacturer benefit

Increased diversity of sustainable food sources through the growing and transformation of a wider range of crops, including more fruit and vegetables and valorisation of side-stream materials, the use of biotechnology and aquaculture to produce sustainable, high- value, nutritious food ingredients.

Help address the UK trade deficit in food and reduce waste across the supply chain.

Focus areas

- Bioconversion technologies to identify sustainable sources of affordable, low calorie food sources (including bulk replacement).
- Bioconversion technologies for high value ingredients at lower cost: natural colours, flavours, functional high value ingredients.
- Flexibility and resilience of ingredient source through understanding how to process diverse raw materials to standard manufacturing and nutritional specifications.
- Mapping of protein for the future including new or existing sources of protein (e.g. plant, aquaculture, fermentation technologies) with required functional and nutritional attributes, as well as new breeding innovations to boost functional protein levels.
- New processes for coping with alternative, sustainable sources of staples (particularly high value protein) – algae, insects, protein from fermentation and from plant material to create organoleptically acceptable products (flavour, texture, appearance) addressing anti-nutritional factors.
- Exploiting under-utilised crops that suit UK agronomy under changing climatic conditions.
- Understanding of satiety levers (structure, texture, taste, consumer behaviour): predictive modelling combining all inputs.
- Approaches that improve nutritional composition including increasing fibre and micronutrient content whilst reducing fat/salt/sugar.

Food system impact

- Nutritious food for all.
- Connected and new supply chains / healthier and sustainable eating.
- Food security and sustainable production.
- Reducing waste in the food system.

02 Food safety processes aligned to net zero targets

Food manufacturer benefit

Safety by design approaches for future manufacturing (ingredients, processes and packaging).

Focus areas

- New paradigms in preservation without sugar / salt / added ingredients and processes for safety (by design).
- Novel processing to decrease / remove the need for cleaning.
- Safety of reusable packaging.
- Developing rapid methods for identification and quantification of toxins, allergens and pathogenic organisms across the food chain.
- Understanding the epidemiology of microorganisms through the food environment.
- Preventing the transfer of antimicrobial resistant (AMR) organisms to the food chain e.g. in fermentation processes.

Food system impact

- An efficient food system / transparent food system.

03 Personalised/stratified nutrition, consumer insight on lifestage demands

Food manufacturer benefit

Solutions to address consumer requirements for premium, personalised and lifestage nutrition, and associated health benefits (e.g. healthy ageing).

Insights to enable reduction in energy (calorie) density (responsible great tasting products / maintaining customer enjoyment in line with nutritional guidelines).

Focus areas

- Stratification / link between consumer demographic and food products.
- Gut microbiome understanding and influences on interaction with existing and new products and materials.
- Gut microbiome and its effect on host metabolism and energy balance. In the longer term, understanding and predictably influencing these interactions.
- Product structure design for targeted nutrient delivery.
- Food materials science, processing, and smart formulation to hit a number of targets and remain compatible with existing processes. These targets include generating multiple outcomes from simple core ingredients, and ingredients with desired flavour / taste properties.
- Consumer behavioural psychology and effective communication / education of nutritional benefits throughout life.
- Flavour modulation through manipulation of components.

Food system impact

- Healthier diets.
- Healthier eating.

04 Novel processing technologies

Food manufacturer benefit

Novel solutions to address climate adaption of raw ingredients, lower energy inputs and minimal processing trends.

Focus areas

- Predictive modelling to forecast impact of ingredient type / format / processing changes.
- “Right-first-time” manufacturing including sensor development, fast prototyping (additive manufacturing), traceability and measuring of raw material quality throughout the supply chain.
- Integration of packaging with food manufacturing process (e.g. in-line packaging labelling/printing), improved properties for labels(e.g. recycling, biodegradable).
- Minimal mechanical processing to improve bioconversion efficiency.

Food system impact

- More resilient supply chains.
- Less processed food.
- Food security and sustainable production.
- Transparent food system.
- Maintain high standards of food safety.

05 Digital manufacture adoption, digital technologies for flexible, scalable and efficient manufacture

Food manufacturer benefit

Optimisation of labour and resource productivity for food manufacturers and processors.

Focus areas

- New manufacturing paradigms to deliver flexibility and agility, decrease downtime and enable local manufacture.
- Sensors to determine 'healthy', in process, product and digestion.
- 'Healthy' by design - Processes for creating products with maximum bioavailability of nutrients during digestion.

- Advanced robotics, including collaborative robots, human safe robotic interactions, novel actuators to control and food safe design.
- Novel and rapid sensors to monitor and control food systems (including quality, nutrition and safety).
- Factory measurement systems that feedback into primary production to provide data and on-farm measures that will improve yield and product quality.
- Co-robotics improving the human:machine interface.
- Adaptive manufacturing (feedback / feed forward).

Food system impact

- An efficient food system / transparent food system.

06 Data for interpretation and optimisation of process and material flow

Food manufacturer benefit

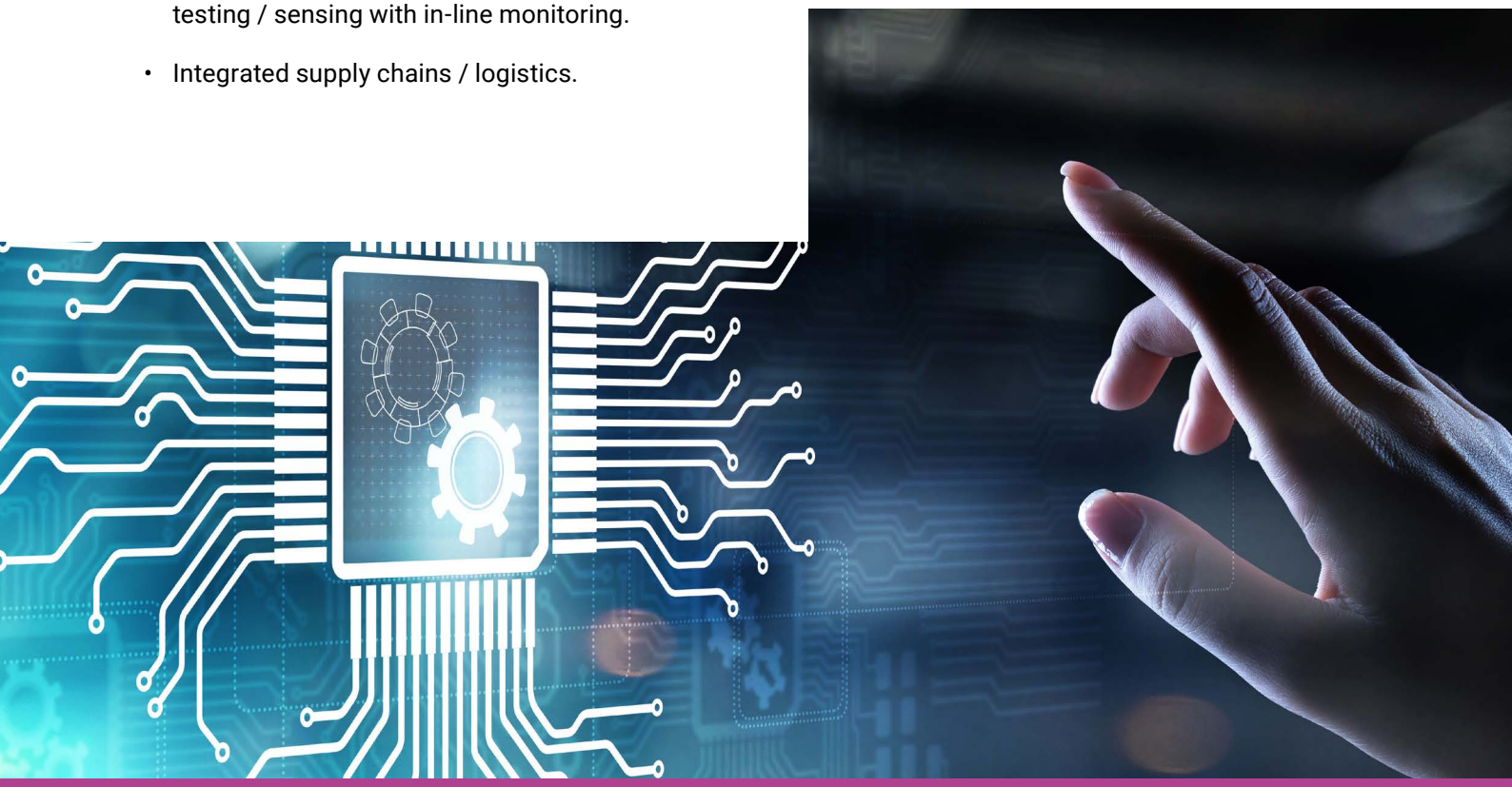
Reduction in manufacturing costs and increases in productivity.

Focus areas

- Blockchain or other technologies applied to track, trace and authenticate supply chains.
- Machine learning to optimise process efficiency.
- Predictive modelling to forecast impact of ingredient type / format / processing changes.
- Natural, minimally-refined ingredients processed for optimal functionality using non-destructive testing / sensing with in-line monitoring.
- Integrated supply chains / logistics.

Food system impact

- An efficient food system / transparent food system.
- Maintain high standards of food safety.
- Reducing waste in the food system.



07 Novel temperature control and water reuse

Food manufacturer benefit

Progression towards net zero and increases in productivity.

Focus areas

- Water recovery and re-use technologies.
- Low energy and low / intermediate water processing.
- New heating and cooling technologies that do not use fossil fuels.
- Improve resource efficiency with reduced greenhouse gas emissions in reimagined food processing (e.g. reduction of heating then cooling or wetting then subsequent drying steps across the food chain).

Food system impact

- A clean and green food system / transparent food system.
- Sustainable production.
- Reducing waste in the food system.

08 Novel and alternative packaging and prevention of single use plastic

Food manufacturer benefit

Improvement in safety and carbon footprint.

Focus areas

- Smart materials – react to stimuli (e.g. environmental conditions) and adjust their protective functions accordingly (e.g colour change, barrier, chemical scavenging).
- Flexible packaging.
- Value added packaging solutions that once finished turn into a value-added side-stream e.g building blocks for housing.
- Improving durability – making packaging more reusable.
- Advanced mono-materials that facilitate (on-site) recycling or increased biodegradability.
- Reusable packaging solutions.

Food system impact

- Decrease in environmental impact / sustainable production.
- Transparent food system.
- Maintain high standards of food safety.
- Reducing waste in the food system.

09 Resource footprint measurement and reduction including carbon, water and side-stream valorisation

Food manufacturer benefit

'Level playing field' for product comparison.

Focus areas

- Solutions for turning current waste streams into useful cost neutral or higher value commodities.
- Standardisation of tracking and benchmarking, and harmonised data and metrics, measuring scientifically robust full life cycle analysis.
- Cooperative, regional and local collaborations around fermentation, local sourcing, transport and logistics.
- Technologies for improved processing, pasteurisation, electrification and monitoring of energy use in processes. Technology around elimination of energy needs in the first place.
- Consumer psychology, behaviour change and education for increased acceptance of sustainably sourced foods.
- Process design – build circular economy thinking into existing facilities and how to separate waste streams.
- Eco-systems: Understanding the connections between companies, processes and products (and links to valorisation).
- Cascading useful materials from food/packaging waste into value streams.
- Data and evidence to assist with emerging regulation such as deforestation and sustainability.

Food system impact

- Decrease in environmental impact / sustainable production.
- Transparent food system.
- Reducing waste in the food system.

How Innovate UK is supporting innovation around these priorities

The priorities identified by the Innovate UK Food Sector Group align with Innovate UK's three domains to support the future economy:

- **Healthy Living and Agriculture**
- **Net Zero**
- **Digital and Technologies**

Innovate UK funding has supported innovation across these themes and will continue to provide opportunities for UK businesses and research organisations to work together on the priorities identified.

Healthy Living and Agriculture

Building on the Government's Life Sciences Vision, our vision is to enable people in the UK to live longer healthier lives by driving transformational change in food production, wellness, early detection and treatment of disease.

This supports UKRI's strategic themes:

- Securing better health
- Ageing and wellbeing
- Tackling infections
- Building a green future
- Creating opportunities, improving outcomes

Innovate UK's £20m *Better Food for All* programme (launched in 2022) will fund over 50 collaborative projects across a broad portfolio, including enhancing food quality; functional foods; stratified nutrition; fortified and biofortified foods; plant-based and alternative proteins and preservation, packaging and storage technologies to increase shelf life including healthy convenient foods and nutritious perishable foods.

Innovate UK is also investing in the BBSRC-led *Diet and Health Open Innovation Research Club (OIRC)* to support our investment in *Better Food for All*. Together these programmes will provide funding to support strategic, collaborative research and development between businesses and researchers, policy makers and wider stakeholders in the important area of diet and health, helping to bridge the gap between research and translation.

Net Zero

Our vision is for the UK to prosper from being the fastest transitioning economy to net zero, and address UKRI's strategic theme Building a Green Future.

As part of an overall investment of over £1.2 billion in net zero over the spending review 2022 to 2023 to 2024 to 2025, we will ensure focus on key challenges and technologies through Catapults, UKRI Challenge Fund challenges, and our targeted programmes.

The Novel Low Emission Food Production Systems competition is part of Innovate UK's funding support for growing the future economy. This funding will support the development of novel food production systems that create new sources of resource efficient, low-emission foods, particularly proteins, while delivering healthy and sustainable diets. £16m funding will support over 30 projects across controlled environment agriculture, aquaculture and alternative protein production.

Digital and Technologies

Building on the government's innovation, national AI and cyber strategies, as well as the Integrated Review, our vision is to:

- Identify and catalyse digital and other technologies
- Support their deployment and adoption to transform existing sectors and companies
- Enable the emergence of new sectors and companies to meet new societal and environmental needs.

Bridge AI is a £100m programme that will help bridge the gab between innovation and implementation of AI technologies. BridgeAI's mission is to help businesses in high growth potential sectors such as agriculture and food, construction, creative and transport industries, to harness the power of AI and unlock their full potential.

Delivered by Innovate UK and strategic partners, BridgeAI will deliver funding and support by:

- **Connecting businesses in priority sectors with AI experts** - Building an innovation community to help businesses adopt AI through collaboration with developers
- **Developing new trusted AI services and technologies** - Supporting the development of cutting-edge AI technologies through co-creation between both the supply and demand side of the AI ecosystem
- **Elevating high growth potential sectors** - Building new capabilities in businesses through training and up-skilling in AI providing access to scientific expertise.

Contributing and supporting organisations

A wide range of industry and research providers provided input into the development of this work. Supporting and contributing organisations to this document are listed below.

The relevance of this work was reviewed by the Professional Food Science, Engineering and Technology Group (ProFSET). To find out more about their input, visit iuk.ktn-uk/org/perspectives/food-and-drink-funding-priorities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