

Report

# **Working Group 6 - July 2022 Interim Report**

FSA Science Council

Working Group 6

Food Safety and Net Zero Carbon

July 2022 Interim Report

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## 1. Foreword

The UK has a legal commitment to reach net zero carbon (NZC) emissions by 2050. This is a topic that has recently been building momentum, with clean growth being one of [the four Grand Challenges set out by the UK Government](#).

The ways we grow, process and transport food are major contributors to climate change, accounting for more than a quarter of all greenhouse gas emissions. Reducing this will require substantial changes in agriculture, manufacturing, and transport.

Consequently, the Science Council and FSA Chief Scientific Adviser (CSA) agreed that a deeper understanding of the potential implications of achieving net zero on food systems, together with identification of areas of uncertainty, would be of considerable value to FSA in pre-empting future policy and evidence needs in this area.

In early discussions to scope the work required, Defra indicated to the FSA Science Council Secretariat that there are many new developments and changes to activity in primary production aimed at achieving net zero. The Science Council agreed, therefore, to concentrate its first investigations on changes expected in primary food production.

Primary production is the production of chemical energy in organic forms by living organisms. The main source of this energy is sunlight. For the purposes of this review, primary food production includes the growing and harvesting of plants as food for humans or feed for animals, and the rearing and slaughter of animals including livestock, fish and a wide variety of aquatic and marine organisms.

A Science Council Working Group 6 (WG6) began work in summer 2021, led by Science Council members [Mrs Claire Nicholson](#) (WG6 Chair) and [Prof Jonathan](#)

[Wastling](#) (WG6 Deputy Chair). The brief for WG6 is to investigate the potential food safety implications arising from changes to primary food production practices and technologies that reduce carbon emissions in the next 10 years. The work programme (described in this report) covers 4 phases, with phases 1 and 2 now complete.

The work so far has drawn diverse, wide-ranging, sometimes slightly conflicting, views and opinions from across academia, the FSA, Defra, industry bodies and individual food producers.

This interim report summarises:

- The work undertaken to date (phases 1 and 2)
- What has been learnt including changes to practice already underway or imminent
- Issues arising from the changes that the FSA should be aware of
- Further work planned by WG6 to understand the nature of the risks in more depth (phases 3 and 4)

The Science Council aims to complete its investigations by the end of 2022 and present its findings to the FSA Board as soon as possible afterwards.

## **2. Executive Summary**

There will be significant changes in primary food production practice and technologies in the next decade to achieve the UK's net zero carbon ambition. The Science Council established a working group (WG6) to investigate the potential food safety risks that may arise from these changes.

This interim report summarises what has been learnt during phases 1 and 2 of the project and outlines the work planned in phases 3 and 4.

Phases 1 and 2 have revealed significant changes intended to deliver net zero that might have implications for food safety of which the most important are:

New technology farming systems which may be vulnerable to pathogens entering the systems; they may face challenges as the systems re-use water and inputs many times; and there are concerns about how the systems will age with dust and possible microbial and biofilm accumulations.

Innovations in animal feed and supplementation which could affect animal health (positively and negatively) with possible changes to the nutritional composition of meat with eventual effects on human health.

Sustainable primary production methods which promote the circular use of waste and by-products in agriculture and aquaculture. These may change the nature and balance of food risks entering the food chain. Some current risks may recede, but, others, which have been well controlled by conventional production, may re-emerge, requiring re-appraisal of surveillance and risk management

Changes made in anticipation of consumer trends to primary production may require additional consumer information about food safety (e.g. allergens associated with plant proteins), dietary health (because new products are not necessarily nutritionally equivalent) and ensuring sustainability claims made to sell products are not misleading.

Potential (regulatory) food safety questions that are already emerging at this interim stage include:

1. Is the regulatory framework for animal feed fast and agile enough to assess and manage potential risks arising from current and planned innovations in animal feed and supplements?
2. Can current surveillance systems adapt to changes in the types of microbiological/chemical risks expected?
3. What microbiological and chemical risk profiles may emerge (or re-emerge) as a consequence of livestock grazing on arable/forestry land, increasing wild margins in agricultural land, and closer contact between wild and farmed plants and animals?
4. With new uses of waste, are new categories of fertiliser/compost needed to reflect possible changing risk profiles as part of the regulatory framework?

5. What is the likely role of aquaculture in contributing to NZC and what are the possible shifts in microbiological / chemical risks to consumers?
6. Do new entrants to primary food production in areas such as vertical farms / urban farming and innovations in protein production need to be able to access additional specific support and advice on managing food safety risks?

Further assessment to understand the nature of the risks associated with net zero based changes in primary production will be undertaken during phases 3 and 4 of WG6's work with the aim of prioritising them and reaching conclusions by the end of the year.

### **3. Purpose of this report (objectives and aims)**

The purpose of this report is to update the FSA Executive Management Team on progress and provide an outline of the next steps for phases 3 and 4.

WG6 has completed the first two phases of a four-phase work programme. Phase 1 involved orientating the work through in-depth interviews with five experts coupled with a survey of the possible range of decarbonisation changes gathered from experts in academia, the FSA, Defra, industry bodies and individual food producers.

Phase 2 was a full-day workshop to gather a wide range of opinions of possible food safety issues due to changes in primary production identified by the survey and interviews. Follow up interviews were held to gain further insights.

The expert survey and workshop carried out in phases 1 and 2 highlighted several changes affecting primary food production and processing being made ostensibly for the purposes of contributing to achieving net zero carbon. Many of these changes are happening now or imminently.

The Science Council therefore feels it is important at this stage to assess the list of decarbonisation activities raised during Phase 1 and 2 and identify:

- What has been learnt so far

- Issues that the WG think the FSA should be aware of

This interim report summarises:

- The work undertaken to date (phases 1 and 2)
- What has been learnt including changes to practice already underway or imminent
- Issues arising from the changes that the FSA should be aware of
- Further work planned by WG6 to understand the nature of the risks in more depth (phases 3 and 4)

Sustainability is frequently referred to in this report and is worth defining here.

Sustainable development overall can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs ([Resolution 42/187 of the United Nations General Assembly](#)).

The [UN Food and Agricultural Organization \(FAO\) describes](#) a sustainable food system as “a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised. This means that:

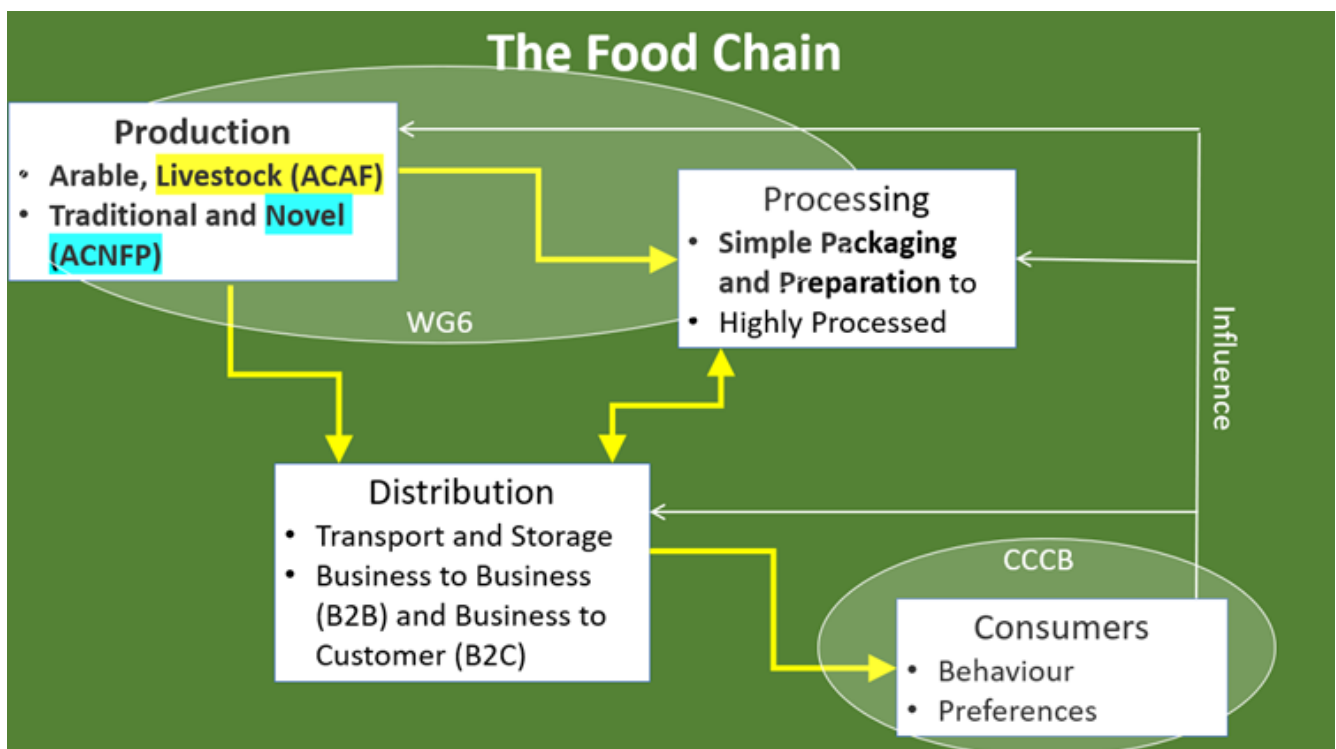
- It is profitable throughout (economic sustainability);
- It has broad-based benefits for society (social sustainability); and
- It has a positive or neutral impact on the natural environment (environmental sustainability).”

## **4. Work Programme (completed and planned)**

At the 9th Science Council in June 2021, the Council agreed an initial work plan for this review, with [Terms of reference](#) established in October 2021.

WG6’s investigations have been undertaken with reference to areas covered by other Scientific Committees, most notably the ACCS and their work on “The impact of climate change on consumer food behaviours: Identification of potential trends and impacts”.

The diagram below shows the interconnectivities and common areas of work:



The diagram above is a simplified representation of the food chain, showing the flow of product. The bold text in each part is what is covered by this review, and it also shows the parts covered by the ACSS Climate Change and Consumer Choice (CCCB) review, and highlighted text shows specific topics which overlap with FSA SACs. Note that ACMSF and COT have a remit that covers the whole food chain and so they are not shown for clarity. This diagram also shows how consumers can influence production and that this does fall within the remit of this work.

WG6 has four phases. Phases 1 and 2 are complete and the specifications of phases 3 and 4 have been adapted in the light of what has been learnt in phases 1 and 2. Some of the decarbonisation changes use new approaches/technology so that very limited published research exists, so that conventional Rapid Evidence Assessments, as had been originally planned, will not necessarily be suitable in all cases.

Phase 1 established the current landscape via a small number of expert interviews, followed by a wider expert survey of key decarbonisation changes to achieve NZC that will take place in or affect the food system over the next decade. (Completed October 2021)

Phase 2 was a workshop of experts in November 2021 with a focus on decarbonisation changes relevant to primary production (and basic on-farm processing such as milling grains, packaging fruits/vegetables and pasteurisation). Its objective was to establish which changes may have implications for food safety. This phase was extended to cover follow up expert interviews during March and April 2022.

Phase 3 will be a deeper investigation of those changes identified in Phases 1 and 2 to ascertain the outstanding issues and questions needed to identify food safety risks and priorities for their resolution. These will be explored via methods such as:

- Further expert evidence from academics and practitioners, including, where relevant, input from other FSA Scientific Advisory Committees and committee Chairs.
- Cross-departmental knowledge sharing, including an interdepartmental workshop and follow up work
- Commissioned reviews of published and grey literature.

Phase 4 will draw together the findings from phases 1-3, review with further expert input any areas of ambiguity, and draw final recommendations. Concurrently there will be a review to establish whether there is a need to examine the rest of the food system (from farm to fork) via an extension to this review or a follow-up study (subject to need and available resources).

The aim is to complete phase 4 by the end of 2022 with publication of the report soon thereafter.

## **5. Summary of the methodology employed in Phases 1 and 2**



## 5.1 Phase 1

The early scoping Phase 1 (interviews and survey) sought expert input on activities over the next decade to achieve net zero carbon which are being made to primary production practices and technologies and which may, in turn, affect the whole food system. For example, possible changes to animal feed, changes/innovations in soil management for carbon capture, changes to crop growing practices, and restoration of wetlands.

Five key experts were interviewed about the broad landscape of carbon emissions reduction for the food system in July and August 2021:

- Prof Tim Benton (Chatham House): Director, Environment and Society Programme and is an IPCC and CCRA author.
- Prof Jonathan Scurlock (NFU) who has over 30 years' experience as a specialist in environmental science and energy policy, with particular expertise in bioenergy and other renewable energy technologies, climate change and the global carbon cycle.
- Emma Piercy (FDF): Head of Climate Change and Energy Policy at the Food and Drink Federation (FDF), which recently announced their roadmap to net zero by 2040.
- Prof Bob Doherty (University of York) Professor of Marketing and Chair in Agrifood at the University of York Management School.
- Prof Peter Smith (University of Aberdeen): Science Director of Scotland's Climate Change Centre of Expertise

The WG6 Chair (Mrs Claire Nicholson) and deputy Chair (Prof Jonathan Wastling) interviewed these experts with assistance from the Science Council Chair (Prof [Sandy Thomas](#)) and a Science Council Member with expertise in agronomy, [Prof Peter Gregory](#). These interviews helped frame the questions used in the follow-up survey.

A targeted survey of a diverse range of experts was then carried out across a range of disciplines relevant to sustainability, carbon reduction and the food

system. This survey asked them to identify specific NZC changes that will be happening to (or affecting) the food system over the next decade.

The survey was sent to nearly 90 individuals and organisations and was also forwarded to other experts by respondents. There were 31 responses, and these are summarised in several categories (incl. occupation, sector etc) in the Ipsos/MORI report attached as Annex B. Please note the comments in this annex are those of the participants and not necessarily those of the Science Council.

## **5.2 Phase 2**

Phase 2 consisted of a workshop that took place on 18 November 2021 and focused on mapping out the food safety implications of activities in primary food production over the next decade to help achieve net zero carbon. Thirty-one participants took part in the workshop; this included thirteen participants from the FSA and the Science Council, and 18 external experts comprising academics as well as practitioners from agriculture and industry.

The event brought together wide-ranging expertise including food science, allergy and immunology, human and animal infectious diseases, zoonoses, food safety and nutrition, food sustainability, environmental impact of livestock and livestock management, veterinary and livestock industry, meat and seafood industry, land use systems, soil and crops, agriculture and horticulture development.

The Ipsos/MORI written record of the workshop is provided as Annex C.

Please note:

Annex C records, as faithfully as possible, the opinions, thoughts and ideas of the participants as expressed in brainstorming sessions at the workshop.

The opinions recorded do not necessarily reflect the opinion of Science Council.

## **6. What has been learnt?**

The most significant changes to deliver net zero carbon that might have implications for food safety can be grouped into three areas:

1. Novel approaches to primary production systems. There are several completely new growing systems entering primary food production where, as yet, the benefit of time and experience is unavailable to inform the management of potential food risks reliably.
2. Evolution of existing primary production systems to achieve sustainability (and NZC). Many of these changes are not completely new, but involve wider adoption of sustainability practices. The combination of practices (e.g. reverting to mixed arable/animal systems, 'rewilding' etc) may change the balance of risks that the food chain faces. Risks previously largely controlled by conventional modern agriculture could re-emerge, whilst other risks may either increase or decrease.
3. Changes made in anticipation of consumer trends. Consumers appear to be moving towards lower carbon footprint / more plant-based diets for sustainability reasons and for real and perceived health benefits. These trends influence primary food production, so this impact of consumer behaviour is an important element of the present review.

The specific changes in these three areas which may have a bearing on food risks are outlined in more detail below (section 6.1-6.3).

There are, however, three particular developments raised in interviews and the workshop, that are expected to contribute to net zero, but that have a much wider uses and implications beyond net zero. These are:

- Gene editing and genetic modification where the FSA has published research on consumers' views and entry of new products onto the market is already covered by the Novel Food Regulations 2018. The FSA Advisory Committee on Novel Foods and Processes (ACNFP) assesses the safety of novel foods or existing products produced by novel methods before they can go on the UK market.
- Reduced or alternative packaging materials which the FSA is already investigating with work on food contact materials and commissioning research on alternative packaging in 2022/23 under its Areas of Research Interest (ARI): Emerging Challenges and Opportunities.

- The risks arising from food shortages; food insecurity, food fraud and rising prices. The FSA is working on food scarcity with the new Office for Health Improvement and Disparities to examine food issues that are associated with low income such as simply not having enough food, having enough but it not being nutritionally viable, and using foods past use by dates.

For the purposes of this review, the Science Council will remain in touch with the FSA's work across these three areas, but they will not be major elements of WG6's work on NZC.

## **6.1 Novel approaches to primary production systems**

### **6.1.1. New technology farming;**

Enclosed indoor systems, urban farming and vertical farms which reuse water and reduce human contact with the crops, reduce some risks but potentially bring others, for example:

- New systems may reduce conventional plant exposure to 'open air' risks, but water re-use and the substrates used could also concentrate pathogens/toxins as inputs are recycled and reused many times;
- Closed systems with plant monocultures could be very vulnerable should a pathogen enter the system;
- With more robotics, current risks from human contact may be reduced, but, with less human oversight of the crops, disease, moulds, or other unexpected events may not be noticed as quickly and/or could enter the food system;
- So far there is limited experience of how new systems will age. Dust or other matter accumulating over time be an issue including the formation of biofilms;

- New enclosed systems may not have hygiene built in by design and/or have elucidated what hygiene routines are needed?
- Some vertical/indoor techniques may be commercialised by entrepreneurs with limited experience of food production who need additional support to identify and manage food safety risks.

### **6.1.2. Changes to livestock and fish feeds**

There are potential developments in animal and fish feeds to reduce carbon footprints by replacing traditional protein sources like soy, using food waste as feed, and employing supplements to reduce methane from livestock. The FSA has a review underway to consider the future of animal feed. Issues noted so far during this review are:

- Novel proteins used to replace soy may affect animal health and ultimately the nutritional profile of animal products; there could be benefits as well as risk, and further work to investigate is underway.
- Use of food waste as animal feed has a history of animal health problems for livestock farming such as Foot and Mouth and African Swine Fever, but some food wastes, with robust risk controls, may be suitable
- Across Defra and FSA, there is a question as to whether the existing regulatory framework is currently agile enough to provide assurance across many new animal feed and supplement developments that are moving quite rapidly.

## **6.2 Sustainable primary production methods**

### **6.2.1. Aquaculture and ocean farming**

Changes to feed mixes may introduce safety issues in farmed fish whilst 'wild' farming brings different risks

- Fish farming, like livestock farming, is seeking ways to reduce soy protein use. Many alternative proteins are being explored and some are already being used, including animal by-products, plant by-products and insects.
- Seaweed has potential for carbon sequestration and might be a source of by-products for protein.
- Farming of seafood for example molluscs or seaweed where the food source is from the wild and therefore susceptible to accumulating contamination in the ocean (so placement is important).

Whilst larger importers say they would only source from large-scale producers who are certified as following good practice (e.g. on antibiotic use), they could not provide assurance for smaller importers who might source food products from smaller overseas producers who use antibiotics to manage problematic livestock conditions.

### **6.2.2. Sustainable and regenerative agriculture**

More mixed arable and livestock farming, rewilding, restoration of wetlands, reduced synthetic fertiliser and pesticide use and circular use of waste streams/by-products are all aspects of regenerative agriculture which are underway. These developments may affect the balance and types of food risk to be managed, for example:

- Managing persistent pathogens (such as *Escherichia coli*, *Clostridium botulinum*) and possible risks from antimicrobial resistance when manure and animal waste is used as fertiliser, or for soil improvement.
- Increased wildlife contact with food production may change risk exposure from zoonoses and, by livestock eating a wider variety of plants, from natural toxicants in wild plants.

- Crop rotation (and livestock) practices to improve soil, requiring gaps between rotations to ensure food safety, and managing risks of mycotoxins (for example if growing wheat soon after maize on the same land).
- Changes to runoff and leaching in response to land use changes with nutrients potentially causing toxic algal blooms and risk to aquatic life.

### **6.2.3 Interactions of the circular economy with food production**

The circular economy has links to regenerative agriculture and changes to components of animal feed. The potential of increased recycling of 'waste'/by-products both directly onto land and for use in animal feed and new packaging raises concerns such as:

- Metals, contaminants, and toxins may become more concentrated as waste is recycled or recycled repeatedly.
- Recycling of food waste and for composting and for animal feed is likely to grow and is already highly regulated. However, additives like shellfish chitin may need to be assessed due to possible allergy risks.
- Any pathogens which survive anaerobic digestion may be very virulent and therefore potentially difficult to manage, bringing new or increased risks.
- The change in food contact materials through the reduced use of plastics and the increased use of alternative packaging materials will change risks from such material and to food safety. The FSA has work underway on this topic.

### **6.3. Changes in anticipation of consumer trends**

Whilst the focus for WG6 is changes to primary food production (agriculture), consumer choice and expectation of consumer trends is a strong driver of change

in the production system. The FSA's Advisory Committee on Social Science (ACSS) is conducting a review called Climate Change and Consumer Behaviour (CCCB) which looks more to consumer behaviour and household food decisions. The Science Council sees this review and the ACSS review as complementary. The food risks raised to WG6 that are associated with expected changes to consumer diets are described in 6.3.1 and labelling issues raised in 6.3.2.

### **6.3.1. Changes to the human diet**

Plant-based and novel proteins produced to respond to trends for sustainable/'healthier' plant-based eating may introduce allergen and toxin risks, as well as possible nutritional deficits, for example:

- Consumers may lack awareness of the nutritional choices made when, for example, a plant-based milk alternative is substituted for cows' milk in the diet; plant-based foods and novel proteins may not have nutritional equivalence to foods they are replacing.
- Proteins may be concentrated as ingredients in plant-based foods consumed instead of meat or dairy causing potential issues with food hypersensitivity and for some people, gastric disturbance associated with high levels of protein per kg.
- Novel proteins such as lab grown meat, insects and other novel proteins may have allergenicity risks and risks associated with production methods, e.g. risk of substrates used to feed insects entering the food system and for lab grown meat possible AMR risks due to use of antibiotics.

### **6.3.2. Labelling changes due to net zero carbon**

Sustainability labelling and allergenicity of novel proteins may require new labelling to inform consumers about:



- Risks from allergens in foods that are reformulated to reduce or remove animal products as part of net zero, for example, use of legumes/concentrated pea protein
- Allergen (and possibly toxin) risks from new proteins such as insect protein which may be not obvious to consumers if used as an ingredient in powdered form to boost the protein content of a product
- The potential for misleading claims about the net zero or sustainability credentials of foods; currently there is no consistent standard for sustainability claims for labelling foods.

FSA work is already underway which covers some of the food safety risks identified. The issues and risks identified in phases 1 and 2 have been mapped alongside existing and current FSA work. This activity is detailed in Annex A. with a summary in the table below:

NZC Theme	Summary of FSA Activity*
Regenerative Agriculture	Older FSA reviews/guidance on use of animal waste for fertiliser. No recent work
New Technology Farming	FSA has a project on urban farming through an SPF Fellow.
Circular Economy	Highly regulated area. No specific FSA work.

FSA review looking at future of animal feed (alternative proteins, and implications for food safety and sustainability and policy and regulatory implications), completing in September 2022.

#### Animal Feed

FSA considering prospective novel food assessments to be ready for new products .

New Advisory Committee on Animal Feeds (ACAF) will be created and will focus on risk assessment.

#### Aquaculture

No current activity.

Very active in all the following areas:

- Novel proteins not previously consumed in the UK
- Existing vegetable proteins being used for vegan products e.g. pea proteins

#### Dietary Changes

- Cultured proteins, e.g. lab grown meat, milk replicas
- Possible safety / nutritional implications for ultra-processed meat alternatives
- Food Hypersensitivity

Advisory Committee on Social Science (ACSS) active through its Climate Change and Consumer Behaviour (CCCB) review.

Labelling  
(Allergy and  
Eco)

There has been a joint FSA/FSANZ International literature review of allergen labelling.

FSA has undertaken an evidence review of the behavioural impact of labelling which covers where novel proteins might need allergen labelling and whether labelling could signpost lower carbon products be used by consumers. In addition FSA's 'Food and You 2' and their wider consumer interests review have briefly considered these issues.

Eco labelling is an area of Defra interest: FSA working with Defra on eco-labelling to provide consistency.

\*As of Feb 2022

## **7. Issues to raise from phases 1 and 2**

Work so far has highlighted a number of areas where food risks may change as a result of activities aimed at achieving NZC. A more detailed understanding of the food safety implications of activities to achieve NZC in primary production will be developed over phases 3 and 4. However, many changes are already underway in primary production that may change the nature of food risks entering the 'farm to fork' food chain.

The Science Council expects to be able to provide a more detailed assessment of the nature of risks arising after phases 3 and 4. But there are some potential food safety implications already foreseen at this interim stage of the review in areas which are developing very rapidly. It is suggested the FSA should not wait for the Science Council to conclude its work, but consider the following issues now:

Please note: Because work to assess priorities has not yet taken place, these issues are not listed by priority at this stage.

1. Ensure the regulatory framework for animal feed is fast and agile enough to assess and manage potential risks arising from many innovative net zero

developments, covering innovative uses of proteins, food waste recycling and by-product/co-product use and new supplements.

2. Review surveillance systems to check resilience/ability to adapt to changes to the types of microbiological risks expected as actions to achieve net zero are implemented to ensure that lessons learnt from managing historic risk are considered along side new risk when managing regenerative farming and new technology farming systems.
3. Undertake an assessment of the changed microbiological and chemical risk profiles that may emerge (or re-emerge) from livestock grazing on arable/forestry land, increasing wild margins in agricultural land, and closer contact between wild and farmed plants and animals.
4. Review the existing regulatory framework for uses of animal waste in fertiliser, to consider whether new categories of fertiliser/compost are needed and whether new products and additives going into existing animal waste products have new or changing risk profiles.
5. Investigate of the likely role of aquaculture to contribute to NZC and related possible shifts of microbiological / chemical risks to consumers from this.
6. Ascertain whether microbusinesses and new entrants to primary food production in areas such as vertical farms / urban farming and innovations in protein production can easily access support and advice on managing food safety risks. Whether these systems have hygiene built in by design needs to be considered.

## 8. Next steps

This review will now move into Phase 3, which will involve:

**Establishing the outstanding questions and issues needed to ascertain risk and priorities for risk management.** A multifaceted approach (including, as appropriate, desk studies of priority activities and additional expert interviews) will be adopted. This will aim to develop a clearer picture of the impact of changing practices and technologies and possible ways to address them. This deeper investigation might be commissioned via a contract for the Science

Council, depending on the investigations required and timescales available.

**Work with Defra, EA, and other government departments on cross-cutting issues affecting decarbonisation and food safety.** A cross-departmental workshop will be scheduled in June 2022 to share knowledge and discuss the findings from phases 1 and 2. The aim is to link to any work already underway by government that will contribute to the FSA’s knowledge of food risks arising from NZC activities in primary production. The ACSS will also be invited to the workshop.

**Collaboration with Government Scientific Committee Chairs and committee members to gain specialist insights** on risks relating to activities driven by NZC. Initial discussions have already been held with the chairs of [ACNFP](#), [COT](#), [ACMSF](#), [ACSS](#) and the Scientific Advisory Committee on Nutrition (SACN) to discuss early findings and input that the scientific committees could provide.

As well as linking WG6 to the ACSS work on “The impact of climate change on consumer food behaviours: Identification of potential trends and impacts”, the Science Council will work with the ACSS to identify the key actors, enablers and barriers in this area (i.e. what changes affect or are driven by which groups, what would enable change in those groups and what barriers exist to that change).

Phase 4 will draw together the findings from phases 1-3, review with further expert input any areas of ambiguity, and draw final recommendations. Concurrently there will be a review to establish whether there is a need to examine the rest of the food system (from farm to fork) via an extension to this review or a follow-up study (subject to need and available resources). Phase 4 should be completed by the end of 2022 with publication of the report soon thereafter.

## **Annex A**

Table of main Net Zero Carbon (NZC) themes and issues/activities and FSA action in each theme found [here](#)

## **Annex B**

Ipsos/MORI Report of the Working Group 6 Expert Survey found [here](#)

## **Annex C**

Ipsos/MORI Report of the Working Group 6 Expert Workshop (18 Nov 2021) found [here](#)