Strengthening the UK's Food Security

Innovation and investment in the Food Manufacturing Sector

By Jonathan Statham, Harry Halem and Iain Mansfield

Endorsements

'I welcome this timely new Policy Exchange report. Food security is one of the major challenges policymakers currently face, and the most vulnerable in our society are those who suffer the most. I particularly welcome the focus on innovation to combat food waste, something which I have frequently championed and supported - The Company Shop Group in my constituency is a brilliant example of this innovation at a local level. I urge the Government to carefully take note of the important recommendations contained within this paper.'

Sharon Hodgson MP, former Shadow Minister for Public Health and former Vice Chair of the Food and Drink APPG.

As this Policy Exchange report sets out - food production and food security are vital to the country. I welcome that this work encompasses the entire food ecosystem, from agriculture to food manufacturing, logistics, wholesale, retail and hospitality. Cultivating supply chains that are resilient to climate-change related events will be more important than ever, and we can see from the conflicts around the world that a secure supply of food is critical. I welcome this timely intervention, and I hope it encourages an ever-increasing focus on this crucial topic.

Baroness Bakewell of Hardington Mandeville MBE, Liberal Democrat Lords Spokesperson for Environment, Food and Rural Affairs

'Policy Exchange is right to highlight the critical importance of Food Security – and why the Government must be clearer that this is a strategic priority. Against a backdrop of global uncertainties, we must as a country take seriously the need to tackle both the availability and affordability of our food. It is vital that we recognise the strategic role of this broad and important sector - both in terms of farming, and, food production, the contribution it makes to the UK economy and the need to strengthen our food security. The report places a welcome emphasis on the way a more holistic prioritisation of the food ecosystem would help to support UK farmers and domestic food production, including how greater support for innovation, manufacturing and inward investment can drive investment and productivity in agriculture. I also welcome the call to reduce regulatory uncertainty across the food ecosystem, and the need to review complex and overlapping regulation, in order to provide the conditions for our businesses to thrive.'

Rt Hon Wendy Morton MP, former Government Minister and MP for Aldridge-Brownhills.

'The concept of food security has never been more important. It is paramount that we take a holistic approach to our food supply chain. I endorse the broad and encompassing approach that this Policy Exchange report recommends to support UK farmers and the manufacturing sector. Recent events have brought the concept of food security sharply to the fore, and as I have previously put forward, it should rank alongside energy security in terms of how we prioritise it. I welcome this timely contribution to the debate.'

Andrew Pakes MP, Labour MP for Peterborough

'This report from Policy Exchange highlights the vital importance of food manufacturing to both food security and the UK economy and the key role that the sector plays in ensuring that our food is safe, nutritious and affordable. Associated British Foods believes that a pro-growth environment needs to be fostered thereby enabling the UK's food and farming sector to decarbonise while simultaneously stimulating UK growth and investment, jobs and exports. This report sets out some practical recommendations for government, regulators, academics and businesses to work together to deliver a prosperous and secure food and farming sector.'

George Weston, Chair of Associated British Foods plc

'Strengthening UK food security must be a national economic priority along with defence and energy security. Our food system has shown itself in recent years to be efficient and resilient, maintaining UK food supply through a series of major challenges, including Covid-19, Russia's invasion of Ukraine, and new trading arrangements by leaving the European Union. But against the backdrop of increased geo-political instability and climate change, we cannot assume that our food system will always withstand shocks. The UK Government should take forward these specific recommendations, including the development of a National Food Security Strategy, in collaboration with the entire food value chain to deliver a more secure and resilient food system that invests for the future.'

Dame Fiona Kendrick DBE, Former Chair and CEO of Nestle UK and Ireland and PwC Public Interest Board, and founding member of the Food and Drink Sector Council.

About the Authors

Jonathan Statham is Chief Executive at RAFT Solutions, an innovation led sustainable food technologies company. He is Professor of Sustainable Livestock Health & Welfare at Harper and Keele Veterinary School and chairs the InSHAW research group there. As a Fellow and Specialist of the Royal College of Veterinary Surgeons, he is still a practicing independent farm veterinary surgeon, graduating from Cambridge University in 1996 and is a partner and chair of Bishopton Veterinary Group. In 2015 he was awarded the UK Dairy Vet of the year. He has held a range of representative or policy linked roles and is currently chair of the Animal Health & Welfare Board for England at Defra. He has published widely in the field of sustainable food.

Harry Halem is a Senior Research Fellow in the National Security Unit at Policy Exchange. He specialises in grand and maritime strategy, defence industrial issues, and strategic history, particularly of British strategy from 1890 to 1945. Mr Halem holds an undergraduate degree in Philosophy and International Relations from the University of St Andrews, and a postgraduate degree in Political Theory from the London School of Economics, where he specialised in comparative intellectual history.

Iain Mansfield is Director of Research and Head of Education and Science at Policy Exchange. He is a former Special Adviser to three Education Secretaries. Prior to that he held a variety of senior

positions in the private and public sector, including as a Senior Civil Servant at the Department for Education, as Director of UK Trade and Investment, The Philippines in the Foreign and Commonwealth Office and as Head of Public Sector at the Association of Chartered and Certified Accountants. He has served as a University Governor and as a Director of a British Chamber of Commerce.

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Executive Summary

Food is central to all of our lives – so much so that many of us take it for granted. Recent events, however, from the COVID-19 pandemic to the war in Ukraine have brought the concept of food security to the fore, as manufactures and retailers have grappled with disrupted supply chains and consumers have noticed empty shelves, while experiencing periods where prices increased dramatically. Climatic events, from droughts to floods, regularly put further pressure on our food security and, due to climate change, the frequency and severity of these extreme weather events is only due to increase.

In a developed nation, such as the UK, we demand more from our food than what is safe and the minimum necessary to sustain life. We wish for it be varied, affordable, nutritious and good for our health; with products available year round. Accordingly, the term food security has multiple facets, comprising elements of both *availability* and *affordability.*

- *Availability* refers to the fact that food should be available, in the wide variety of products and ingredients we expect, when we want them and without disruption.
- *Affordability* refers to the fact that, at an individual household level, healthy and sufficient food should be accessible, including to the poorest and most vulnerable in society, and that supply shocks or cost increases should never cause families to go hungry.

In this report, food security will be considered to encompass both of these elements – and where there are tensions between them, these will be explored and drawn out.

Although domestic food production is one important component of food security, the UK imports around 40% of the food it consumes. It would be imprudent, impractical and undesirable to seek to rely on domestic production alone for food security. Instead, UK food security depends equally heavily on maintaining a robust and resilient network of international trade, for both economic and security purposes. In an uncertain world where supply chains are vulnerable to disruption, cultivating supply chains that are resilient to geopolitical and climate-change related events will be more important than ever. Food manufacturing is also a key contributor to UK food security, both as a significant investor and major customer for UK agriculture, as well as an importer of critical ingredients needed for food production. Food manufacturing is a driver for domestic food production by adding value to domestic agricultural produce alongside imported raw materials and by supporting export opportunities.

Ensuring the UK's food security therefore requires action across the whole of the food production, manufacturing and distribution system, from agriculture through manufacturing to logistics, wholesale, hospitality and retail. To date, however, activity and analysis has largely focused on primary production – an essential part of the story, without question, but not the whole picture. In this report we will focus primarily upon the food and drink manufacturing sector – and its place in the wider food ecosystem – to consider how actions in this area could enhance British food security and support UK economic growth and prosperity.

Exclusive polling for Policy Exchange by the Food and Drink Federation shows that over half (53%) of food and drink manufacturers consider that mitigating supply chain risks from natural disasters or geopolitical events is a significant concern for their business, with the top three actions they are

taking to mitigate that risk being to diversify suppliers (68%), adapting or simplifying supply chains (50%) or investing in product innovation (38%). 56% of large suppliers are increasing stockpiles, while 54% of SMEs are increasing the share of UK inputs in their supply chain.

In addition, food manufacturing has absorbed additional costs over the last couple of years, including increased energy and input costs, inevitably reducing available funds for future investment. The burden of regulation has been substantial with the sector exposed to a complex landscape of requirements including changing trading rules, environmental and packaging legislation, and food labelling requirements as well as standard consumer regulation, where even if the policy goals are important, the repetitive and duplicatory nature of reporting becomes a burden.

Well-functioning and flexible free markets have historically been the best guarantor of food security at both a national and global level. Yet the impact of well-intentioned regulation means that we risk de-commoditising commodities within the food sector by turning standard products into bespoke ones, reducing flexibility and increasing costs for consumers. In an increasingly uncertain world, increasing UK food security will require action across the whole of the food ecosystem to support innovation and investment, streamline regulation and strengthen the operation of robust and resilient markets.

Attracting Private Capital Investment

The importance of the UK food and drink manufacturing sector in supporting food security has been too often overlooked. It plays a vital role in driving production and value in UK agriculture, as well as importing key ingredients and adding value to raw materials through manufacturing and processing. Not only that, food and drink is the largest manufacturing sector of the UK, delivering an estimated industry turnover of £142 billion, as well as providing exports valued at over £24 billion[1].

Despite this important contribution to the UK economy, the sector has largely been overlooked in terms of its potential economic contribution and has instead been exposed to the acute regulatory and supply chain pressures that have characterised recent years. Global food and drink manufacturers often face intense competition for investment internally, in which the UK operations contest with their European and foreign counterparts for funds for new production lines, products and packaging. An appropriate regulatory regime and targeted funding could help attract private investment into the food manufacturing sector to raise sustainable productivity improvements and to create a secure and resilient supply chain, as well as supporting wider objectives including sustainability, healthy eating, consumer choice and Net Zero and reduce the risk of food production being off-shored.

The report identifies regulations that act as barriers to secure and sustainable manufacturing, as well as hindering pull-through from primary production and the maintenance of flexible global supply chains. We consider these within the context of the wider drive to improve regulation and increase growth, and how Government can create a more attractive investment environment across the food ecosystem, with a particular focus on manufacturing to deliver greater returns on investment, ensuring the sector remains competitive and thousands of jobs across the UK are retained.

Innovation in Food Production and Manufacturing

[1] Office for National Statistics, 'Monthly Business Survey turnover in production industries', 11th July 2024, link

The theme of **innovation** in food production includes a review of the current policy mechanisms and levers which support innovation, including Research and Development (R&D) Tax Credits, the work of UK Research and Innovation (UKRI) and Innovate UK, regulatory barriers and incentives and the role of the Food and Drink Sector Council. Government has not recognised food and drink manufacturing as a strategic advanced manufacturing sector and therefore policy and funding priorities are not geared accordingly, for example in the High Value Manufacturing Catapult centre.

In 2022, Government contributed 0.3 per cent (£3m) to the sector's R&D Spending, whilst the automotive and aerospace sectors received respectively 1.0 per cent (£38m) and 15.8 per cent (£322m)".[2] In 2023 a House of Commons library research briefing reporting public sector R&D by socio-economic objective does not specifically show food security as an objective [3].

UK government expenditure on R&D in percentage share[4]

Socio-economic objective	2022
TOTAL	100
General advancement of knowledge: R&D financed from General University Funds	23
Health	19
General advancement of knowledge: R&D financed from other sources	13
Defence [note 7]	13
Transport, telecommunication, other infrastructure	8
Energy	5
Industrial production and technology	4
Exploration and exploitation of the earth	4
Political and social systems, structures and processes	3
Agriculture	2
Environment	2
Culture, recreation, religion and mass media	1
Exploration and exploitation of space	1
Education	1

Global best practice in this area offers examples of opportunities for innovation in the sector; other countries such as Ireland, South Korea and Israel have created more supportive environments and these are discussed. In the UK, three Agri-tech centres have been established, now merged into the UK Agri-Tech Centre, as well as the development of a number of centres of excellence in different universities. The potential use of data, digital monitoring and AI to optimise distribution networks

[2] Office for National Statistics, 'Business enterprise research and development, UK: 2022', 27th February 2024, link

[3] House of Commons Library, 'Research & Development spending', 11th September 2023, link

[4] Office for National Statistics, 'Business enterprise research and development, UK (designated as official statistics)', 27th February 2024, link

and supply chains and the potential of biotech are underexploited in a sector exposed to the risks of supply chain uncertainty.

Public sector net expenditure on R&D in 2022 was £16 billion. This was an increase of over £1bn from 2021. It should be noted that government R&D spend in 2021 included £6 million through the Food Standards Agency (FSA) and £131million across Defra vs £1,444 million through the Department of Health and Social Care and the NHS.

Specific policy measures – regulatory, fiscal, spending and diplomatic - are important for Government to pursue in order to encourage further innovation in food and drink manufacturing.

The Global Dimension

Defining the problem set, both in terms of broader geopolitics and in the context of the strategic challenge the UK faces – requires the development of policy that builds UK resilience to supply chain disruption whilst also shaping the international environment to its benefit. Identifying the most probable failure points that could disrupt UK food supply and understanding the manner in which simultaneous crises can increase systemic stress is crucial for maintaining food security.

The report rejects the position that the UK should be self-sufficient in food production, an unrealistic aim of which pursuit would be both unachievable and counterproductive. For an island nation such as the UK, autarky is never the answer. Rather we consider the ways in which vulnerabilities and risks to food security can be minimised and mitigated through a balanced approach: a flexible, agile and robust trading ecosystem, as well as the unrealised benefits of international trade in food and drink to UK prosperity, alongside a commitment to maintain and enhance domestic agricultural production in the face of environmental and energy demand conflicts. Several potential solutions are offered, including a revamped strategic approach to trade policy.

Summary of Recommendations

Overarching recommendations

1. **Government should develop a National Food Security Strategy that encompasses the entire food ecosystem,** including agriculture, food manufacturing, logistics, wholesale, retail and hospitality. To achieve the necessary impact, this should be led by Cabinet Office working alongside the Department of Food, Environment & Rural Affairs, Department for Business and Trade, Department for Energy Security and Net Zero, Foreign, Commonwealth and Development Office, Department for Science, Innovation and Technology, Food Standards Agency and UK Research and Innovation – as well as the devolved governments.

2. **A Cabinet Committee or ministerial working group** should be formed to connect cross-government and oversee the development of the Strategy, resolve interdepartmental policy differences and drive delivery.

3. **The Triennial UK Food Security Report should be reformed so that it drives a greater focus on actions and delivery.** Each report should be accompanied by a clear set of actions and a delivery plan, which would be overseen by the above-mentioned Cabinet Committee or ministerial working group. An annual implementation report should also be published, and each UK Food Security Report should clearly assess progress on implementation and progress against the previous report's delivery plan.

4. **Government programmes, policies and funding opportunities aimed at enhancing food security should incorporate the whole food ecosystem rather than being narrowly focused on agriculture.** This should include food manufacturing, logistics, wholesale, retail and hospitality.

Investment

5. **Future Industrial Strategies and Advanced Manufacturing Strategies should explicitly include Food and Drink Manufacturing as a priority sector.** Food manufacturing is the largest manufacturing sector of the economy and integral to food security.

6. **The Government's Agri-tech Strategy should be broadened to become a Food Security Strategy, explicitly including Food and Drink Manufacturing**, as well as other parts of the food ecosystem such as logistics and retail.

7. **Defra and the Department for Energy Security and Net Zero should specifically include the food ecosystem in supporting a transition to renewables and 'green' energy schemes**, recognising the fundamental role of the food ecosystem in the journey to Net Zero. This should include both agriculture and food manufacturing**.**

8. **The British Business Bank should establish a new Food Security Transformation Fund focused on technology investment across the food ecosystem** to help de-risk expensive

capital investments and promote novel solutions across the food ecosystem that could contribute to food security, from farming through manufacturing to logistics, wholesale, retail and hospitality. This would support uptake of robotics, automation and digital technologies in food and drink; as well as unlocking private-sector investment.

9. **The Department of Business and Trade should target investment from major manufacturers of machinery and equipment and software providers such as Siemens or Schneider Electric, who produce machinery and software needed within the food ecosystem.** Significant inward investment from these companies would strengthen the UK food manufacturing base and support greater pull-through from primary production.

Innovation

10. **The UKRI *Transforming Food Production* challenge should be relaunched and broadened to become *Transforming Food Security*.** This would fund research across the food ecosystem, with a particularly enhanced focus on food manufacturing on a similar level to agriculture, as well as, where appropriate, investments in storage, logistics and retail.

11. **UKRI should expand the scope of the newly formed Agri-tech centre and strategy to become a Food Security centre**. As with Recommendation 6, this would support research, innovation and partnerships across the food ecosystem, including in manufacturing, rather than only in agriculture, and would have a particular mandate to build networks and support innovation in SMEs.

12. **Government should establish a new Food Security Research Centre.** This could be formed on a hub-and-spoke model, with a hub located at an existing centre of excellence such as at Fera (Sand Hutton York), University of Lincoln, Sheffield Hallam University or University of York, with nationally distributed 'hubs' to provide access to cost-effective modular research facilities.

13. **UKRI should ensure funding is better targeted to support more projects at Higher Technology Readiness (TRL) levels** (i.e. in the final stages of operational testing to be brought into businesses.) The current focus from government is on long-term, blue-sky research: while this is important, there needs to be a better balance in the available funding.

Regulation

14. **Government should construct a clear long-term policy view that will reduce regulatory uncertainty across the food ecosystem and provide the confidence for investment in a lower risk environment.** The sector is held back by uncertainty and short-termism and requires stability. This should be led by the Cross-Departmental Working Group set out above and feed into the National Food Security Strategy, in order to create a regulatory environment that increases resilience to shocks and ensures food will be healthy, safe, affordable and sustainable.

15. **There should be an independent review of regulation across the food ecosystem, to ensure streamlining, proportionality and reduce unintended consequences, with a focus**

on outcomes rather than process. The review should be led by Cabinet Office, engage extensively with industry (including SMEs) and report within 12 months, with its recommendations enacted by a Food Security Regulatory Reform Bill.

16. **Any new regulations introduced by DEFRA, the Food Standards Agency or Environment Agency should be approved by Parliament under the affirmative procedure before coming into effect**, **if they have forecasted impact of either:**
    - £10 million or the economy as a whole; or
    - £100,000 or more for a single company.

    This would mirror the recommendation set out in Policy Exchange's report, *What do we Want from the King's Speech (2023)* and ensure there is proper democratic scrutiny of new regulations with a high burden on industry.

17. **The Food Standards Agency should fast-track approvals for any product that has already been approved by trusted regulatory regimes in countries outside of the UK.** This would allow more rapid approval of low-risk products and free up resources for other applications.

18. **The Food Standards Agency should introduce a paid for 'fast-track' route for its market approval authorisations – with a reduced fee for SMEs.** The money raised should be reinvested back into enhancing FSA capabilities and resource to ensure a faster regulatory approvals process for all, including those not using the new fast-track route. In order to benefit non-users, this would require an exemption from the usual Treasury rules on only charging cost recovery and no corresponding reduction in funding for the remaining service.

19. **The definition of 'Novel Foods' should be reviewed and updated to provide a more flexible and proportionate definition that supports the development of new products and new food sources.** The current regulations have significant unintended consequences that deter companies from making small variations within manufacturing formulations.

20. **A 'Canada-style' Common Compliance Date for new regulations impacting the food ecosystem should be coordinated across government and the devolved administrations.** The Canadian regulators coordinate policy changes that result in food label changes, between all relevant departments and only allow changes after a minimum 24 month transition period, and on a specific future date once every 2 years as part of their 'predictable labelling policy'.

21. **The Government should reduce regulations on the ability of food suppliers to modify their inputs during periods of geopolitical disruption.** This should include the ability to switch ingredients with a pre-approved list of substitute goods (e.g. to avoid the cumbersome process experienced by manufacturers during the early days of the Ukraine conflict when trying to switch between rapeseed oil and sunflower oil), as well as provisional preparation for the unilateral, temporary relaxation of tariffs and other trade restrictions on specific goods during another disruption. The Government should explicitly clarify who can authorize such emergency measures in order to reduce delays in implementation.

22. **DEFRA, working with the Devolved Governments and the Food Standards Agency, should convene work to create a contingency framework for major food supply crises, that would formalise and expand its exemptions for labelling modifications during such times**. A

transparent process should be agreed which would suspend specific regulatory provisions (e.g., certain labelling requirements) in emergency situations, such as that which occurred when Russia invaded Ukraine. This would be subject to formal risk assessments and would not impact vital food safety information (e.g. allergens).

23. **Reporting requirements for Scope 3 emissions under the Greenhouse Gas Protocol Corporate Standard should be made more flexible to better recognise both (a) proportionality requirements of companies of different sizes; and (b) the challenges involved in measuring these for supply chains that are based in developing countries.** Decarbonising the food sector is an important part of our transition to Net Zero, but overly burdensome reporting requirements absorb time and money that could be better spent on innovation and investment. The Food Data Transparency Partnership (FDTP) has been established between Government and Industry and provides a forum to discuss and resolve these issues – it is essential that it is given sufficient time to do so, and that Government and regulators pay sufficient heed to its conclusions.

24. **Defra should work with producers and retailers to establish a fit for purpose, producer-led Extended Producer Responsibility (EPR)** by the end of the next parliamentary term to drive up recycling of plastic packaging. Defra should also work with Devolved Administrations to implement a single, interoperable UK Deposit Return Scheme (DRS) approach as soon as possible, aligning scope and labelling requirements in all four nations.

Trade

25. **The Government should take a holistic approach to trade policy and food security.** Although export promotion should remain key to UK trade policy, a greater consideration of the role of imports and intermediate suppliers will help increase the resilience of the UK food system and supply chain.

26. **The Department for Business and Trade should build on the Windsor framework with FCDO to continue to deliver reduced border friction between Britain and the EU with simplified customs procedures post-Brexit**. Adoption of digital certification and use of technology could further support this transition, alongside greater mutual recognition and harmonisation of procedures where appropriate.

27. **The Foreign, Commonwealth and Development Office should make strengthening global food security an increasing focus of our development spend and actively work with businesses** to ensure greater cross-fertilisation of projects and expertise between businesses, government and non-governmental organisations. This would include strengthening and supporting more resilient supply chains, food and climate adaptation support and measures to improve sustainability. These measures would improve both UK and global food security.

Introduction

0.0 The concept of food security

Since the World Food Summit of 1996, food security has been defined at individual, household, national, regional and global levels as "being achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". Food production globally and domestically is diverse, to offer energy and protein with a high nutritional value and micronutrients. It may also support the income of those engaged in the production, processing and marketing chains at national and international level, and ultimately to a country's GDP[5].

Food security is not limited solely to the quantitative aspects of food supply, and therefore as a concept goes beyond the simple notion of food self-sufficiency. The literature on food security has historically identified three fundamental dimensions: **availability** of food, **access** to food, and effective and safe **utilisation** of food[6]. A fourth dimension of **sustainability** has become increasingly dominant in policy thinking as set out in the 'Health & Harmony' command paper[7]; the global growth in demand for food products requires a significant shift away from purely "production at all costs" agricultural practices towards more balanced, ecological methods of intensification if environmental impacts are to be mitigated[8].

Two principal factors can be considered to underpin many elements of food security:

- ***Availability*** refers to the fact that food should be available, in the wide variety of products and ingredients we expect, when we want them and without disruption.
- ***Affordability*** refers to the fact that, at an individual household level, healthy and sufficient should be available, including to the poorest and most vulnerable in society, and that supply shocks or cost increases should never cause families to go hungry.

In this report, food security will be considered to encompass both of these elements – and where there are tensions between them, these will be explored and drawn out.

0.1 The food security landscape in the UK

Ensuring the UK's food security requires action across the whole of the food production, manufacturing and distribution system, from agriculture to retail. To date, however, activity and analysis has focused primarily on primary production – an essential part of the story, without question, but not the whole picture. Most recently, for example, the Government's Food Security Summit held on 13 May 2024 focused heavily on boosting domestic production, under the slogan *From Farm to Fork.* In this report we will therefore be placing the focus upon the food and drink manufacturing sector – and its place in the wider food ecosystem – to consider how actions in this

[5] The World Organisation for Animal Health, 'Contribution of veterinary activities to global food security for food derived from terrestrial and aquatic animals', May 2011, link
[6] Ibid.
[7] Department for Environment, Food & Rural Affairs, 'Health and Harmony: the future for food, farming and the environment in a Green Brexit', February 2018, link
[8] CABI Publishing, ‚Dairy herd health', 30th November 2012, link

neglected area could enhance UK food security and support UK economic growth and prosperity, complementing existing Government and industry actions in the area of agriculture.

UK food manufacturing is a key contributor to the food security landscape as a supplier of food products to consumers but also as both a key investor and customer for UK agriculture and a driver for trade and access to overseas supply routes. Food manufacturing drives domestic food production by adding value to domestic agricultural produce alongside imported raw materials and by supporting export opportunities. International trade remains an important dimension of our food security; however, in an uncertain world where supply chains are vulnerable to disruption, successful domestic production and manufacturing offers national resilience, as does cultivating supply chains that are resilient to geopolitical and climate-change related events.

The UK Food Security Report (UKFSR)[9] is an analysis of data on food security in the United Kingdom, published under Section 19 of the Agriculture Act 2020, with review and presentation to parliament at least once every three years, with the next report therefore due to be published in 2024. The UKFSR is structured around five principal 'themes', each addressing an important component of modern-day food security in the UK. They are as follows: **global food availability**, which describes supply and demand issues, trends and risk on a global scale, and how they may affect UK food supply; **UK food supply**, which looks at the UK's main sources of food at home and overseas; **supply chain resilience**, which outlines the physical, economic, and human infrastructure that underlies the food supply chain, and that chain's vulnerabilities; **household-level food security**, which deals with issues of affordability and access to food; and **food safety and consumer confidence**, which details food crime and safety issues.

Importantly, the UKFSR is not a policy document: its purpose is to understand the landscape and the issues at stake, and to set out and interpret the best available evidence regarding food security. It aims to provide policymakers across the UK nations with the best possible information and analysis they need to maintain the UK's food security, in all its many aspects. Perhaps because of this, its impact on policy appears to have been limited.

The final report of the **UK National Food Strategy independent review (NFSIR)**[10] was published in 2021 and had four strategic objectives relating to many issues including food security:

1. Escape the junk food cycle to protect the NHS.

2. Reduce diet-related inequality.

3. Make the best use of our land.

4. Create a long-term shift in our food culture.

The subsequent **Government Food Strategy (GFS)**[11] was published in June 2022, but made only one commitment to food security: to maintain "broadly the same level in future" the UK's current rate of

[9] Department for Environment, Food & Rural Affairs, 'United Kingdom Food Security Report 2021', 5th October 2023, link
[10] National Food Strategy, 'National Food Strategy Independent Review', 15th July 2021, link
[11] Department for Environment, Food & Rural Affairs, 'Government Food Strategy', 13th June 2022, link

self-sufficiency of 75% of commodities we can produce[12]. Food security, though, is more than just self-sufficiency: the UK is reliant on food imports, mostly from the EU.

At the NFU conference in February 2024, the Prime Minister announced the development, in conjunction with stakeholders and academics, of a suite of food security indicators covering both inputs and outputs, to be published annually with set targets. A second 'Farm to Fork Summit' was held at number 10 Downing Street on 14th May 2024 and included the publication of the first draft of this **Food Security Index (FSI)**[13]. Effective utilisation of this new FSI, alongside analysis of the evidence provided by the latest UKFSR, has the potential to provide a basis for policy development and effective monitoring of the UK food security landscape.

0.1.1 UK domestic food production

Domestically the UK produces 60% by value of all the food we need and for the foods that we do produce in the UK, we produce around 75% of what we consume[14]. We produce more lamb and liquid milk than we consume and our production in the poultry and soft fruit sectors has increased in recent years, with an extended UK season displacing imports. The UK is largely self-sufficient in wheat, most meats, eggs, and some sectors of vegetable production.

Successful domestic production gives us national resilience in an uncertain world where supply chains are vulnerable to disruption and where we can effectively authenticate emissions intensity. However, although opportunities exist for greater self-sufficiency of sustainably produced domestic food, the sheer number and diversity of inputs required for food production in the UK highlight the risks of an attempt to transform its food system to meet all demands with domestic production. This would be both prohibitively expensive and almost certainly unfeasible to achieve comprehensively. International trade remains an essential dimension of our food security: securing global supply is important[15] and policy frameworks should reflect this need to safeguard both aspects.

0.1.2 UK food imports and supply chains

The UK is and will remain vulnerable to the effects of supply chain disruption as a result of both geopolitical shocks and impacts related to climate change. Its supply chain is primarily linked to Europe but with some essential elements being sourced in Asia, Africa, and Latin America, including vegetable oils, fresh fruit and vegetables, and basic grains (Fig 1)[16].

Figure 1: Origins of food consumed in the United Kingdom, 2022.

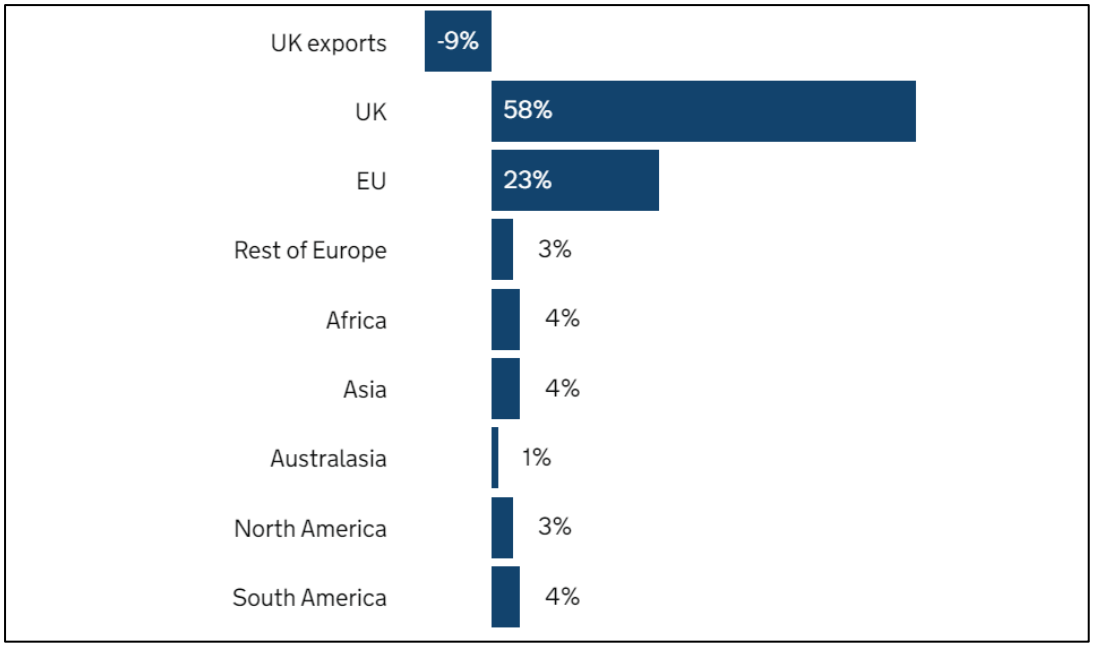
[12] Environment, Food and Rural Affairs Committee, 'Food Security', 28th July 2023, link

[13] Department for Environment, Food & Rural Affairs, Prime Minister's Office, 10 Downing Street, The Rt Hon Steve Barclay MP and The Rt Hon Sir Mark Spencer, 'Government unveils major package of farming and food sector support', 14th May 2023, link

[14] Department for Environment, Food & Rural Affairs, 'Food statistics in your pocket', 15th February 2024, link

[15] Department for Environment, Food & Rural Affairs, 'Developing a National Food Strategy: independent review 2019', 27th June 2019, link

[16] HM Revenue and Customs. 'Trade data', last accessed 2nd August 2024, link



Although the UK food industry is complex and largely adaptable, there are tensions that exist between the consequences of measures to ensure security of supply and affordability of food for consumers. Food security measures might include diversification of supply, stockpiling or significant import substitution with domestic production.

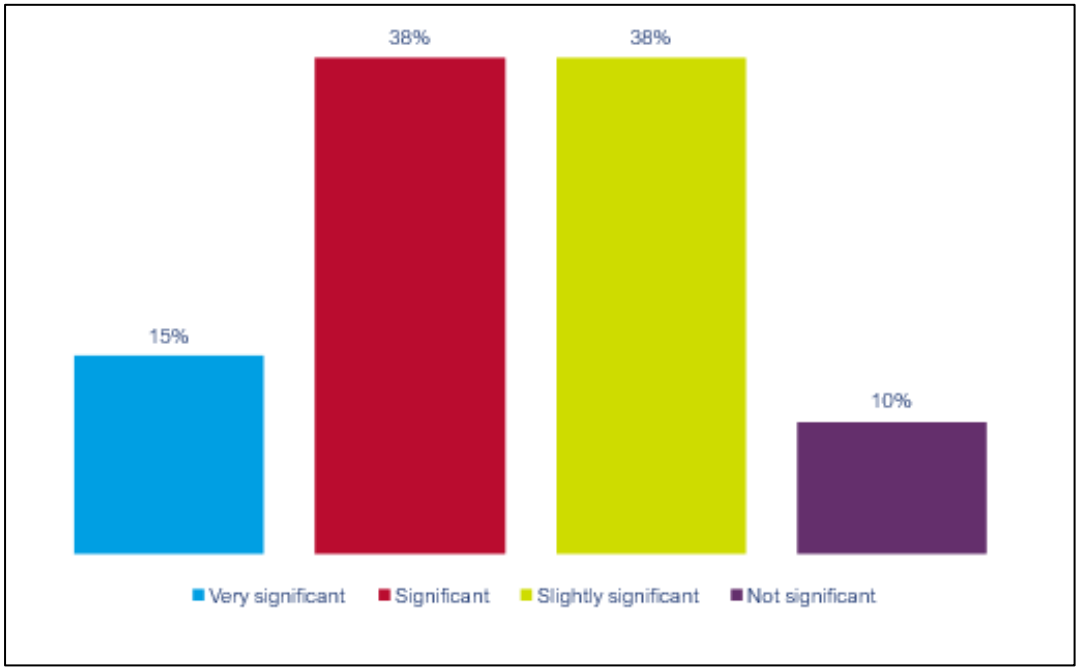
Supply chains for UK food have been particularly disrupted in recent years, throwing the need to develop policies for food security into sharp focus. The COVID-19 pandemic and Russian invasion of Ukraine both disrupted the UK's food supply and export system. COVID-19 tested the UK food supply system perhaps more than at any other time in over 70 years. Businesses across the food supply chain had to adjust rapidly to greatly increased consumer demand as the nation came to terms with national lockdown and the closure of businesses, schools, and the hospitality sector. As a result, people were spending more time at home and eating out less. COVID-19 changed lifestyles, as it altered the frequency, volume and the way people bought their food.

Despite a challenging start, the food industry showed its resilience during the pandemic. However, the impact of war in Ukraine caused more significant long-term concerns that were directly felt by the consumer, with a surge in food and energy prices, difficulties in accessing ingredients for food production and high levels of inflation that impacted household budgets. These global events have put food security back at the top of the government agenda, as noted in both the prime minister's speech and a speech by the Labour shadow farming minister at the NFU conference in February 2024[17].

Food and drink manufacturers are now repositioning their business models in response to these disruptions. Recent FDF survey data shows that 53% of UK food and drink manufacturers see mitigating supply chain risks or geopolitical events as either significant or very significant for their businesses (Fig 2)[18].

[17] National Farmers' Union, 'NFU24: Prime Minister addresses NFU conference', 20th February 2024, link
[18] Food and Drink Federation survey of members for Policy Exchange, 2024

Figure 2: Is mitigating supply chain risks from natural disasters or geopolitical events a significant concern to your business?



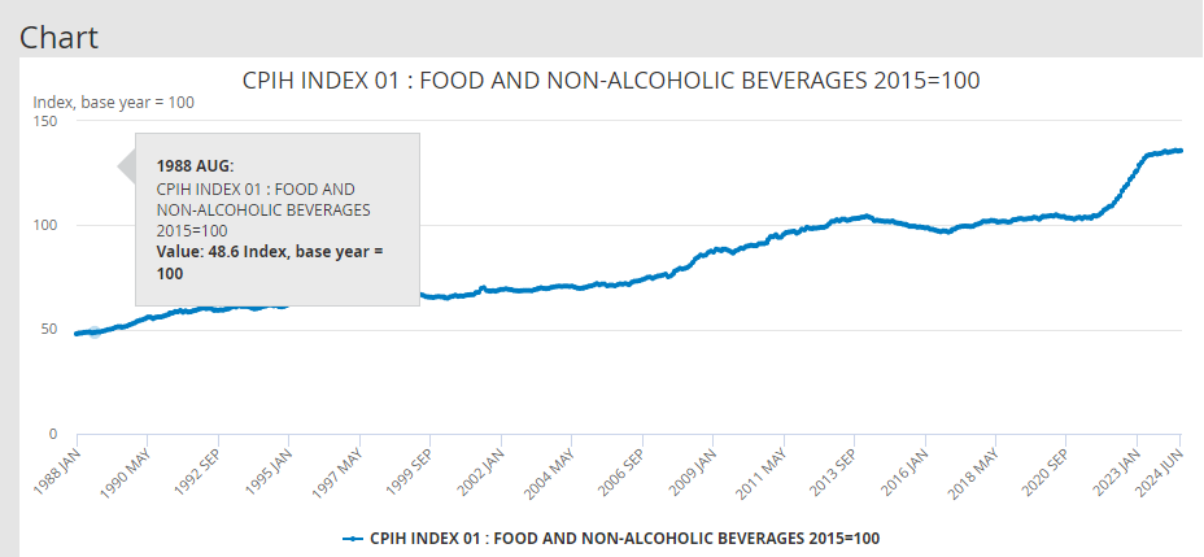
However, this represents a significant threat to a food system that has delivered affordable food to UK consumers on the basis of being able to source least-cost ingredients in a just-in-time process from an easily accessible global market; there are implications for the price of food for consumers.

0.1.3 Consumer affordability & inflation

Food security is a practical reality at household level that includes affordability and quality as well as available quantity. The FSA Consumer Insights Tracker[19] reported the top two concerns for consumers in February 2024 were food prices (88%) and food poverty and inequality (76%). Consumer affordability is currently in sharp focus as the UK experiences a cost-of-living crisis. The highest annual rate of food inflation for over 45 years was seen in March 2023 at 19.2%[20] and this impacts food security policy (Fig 3) – though it should be noted that food inflation has since fallen sharply and, at time of writing, stands at less than 2%.

Figure 3: Food and non-alcoholic beverages price index 1988-2024[21]

[19] Food Standards Agency, 'Consumer Insights Tracker February 2024', 12th March 2024, link
[20] Office for National Statistics, 'Cost of living latest insights', 14th February 2024, link
[21] Office for National Statistics, 'CPIH Index 01: Food and non-alcoholic beverages 2015=100', 17th July 2024, link



The FSA latest trends report[22] revealed that the number of households classed as food insecure increased from 15% in mid-2021 to 25% at the end of 2022. The percentage of people highly concerned about food affordability almost doubled between the end of 2020 and end of 2022, from 26% to 51%. The latest FSA monthly consumer survey[23] reported that most food insecurity measures have been stable since summer 2023, although those who reported feeling worried about not being able to afford food for themselves or their household, has gradually declined over this time, from 28% in July 2023 to 22% in February 2024. However, these latest findings from February 2024 suggest that food prices remain the most common concern for consumers (88%), followed by poverty and inequality (76%) and that one in 10 people (9%) reported skipping meals because they could not afford to buy more food. In both surveys, younger adults, households with lower incomes, households with children and those with a disability or long-term health condition were more likely to be impacted by food insecurity.

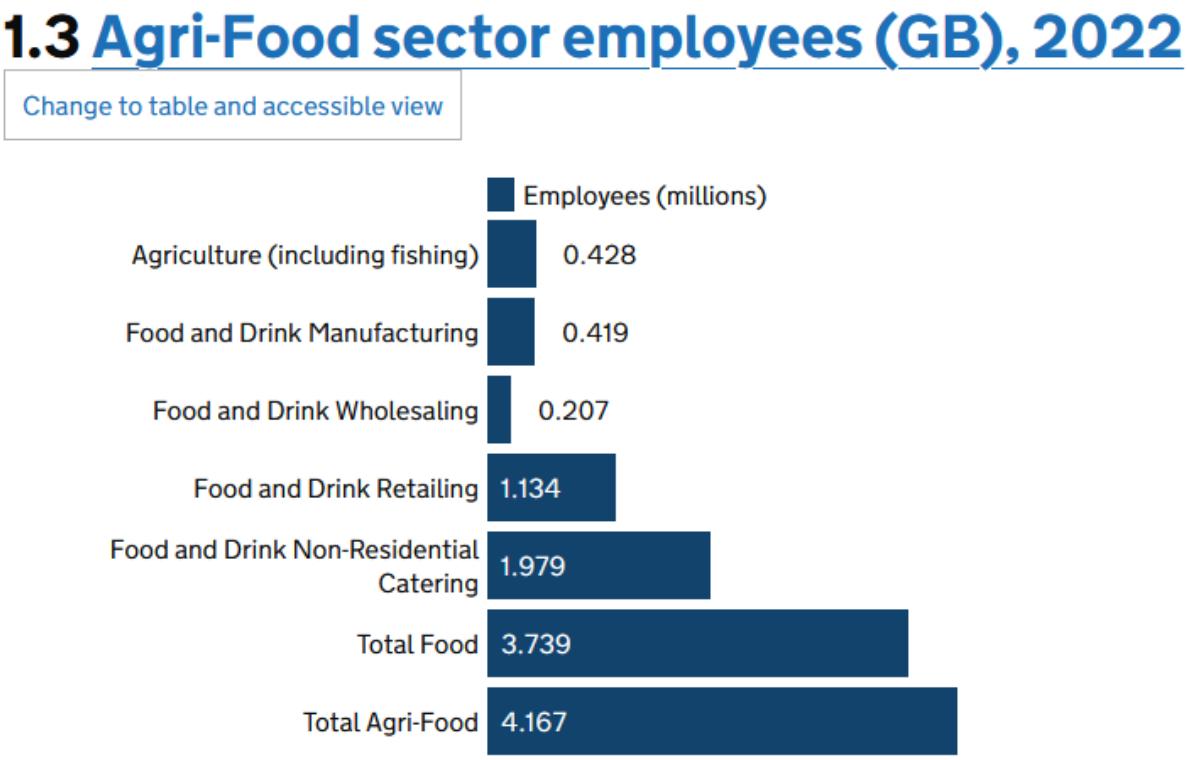
0.2 Food security and the role of the UK food manufacturing sector

Food manufacturers are a major player in the agri-food sector[24],[25]. A similar number of people are employed within food manufacturing as in agriculture (Fig 4)[26] and in 2021, food and drink manufacturing contributed 11% of the Gross Value Added (GVA) of the agri-food sector as a whole (Fig 5). Food manufacturers provide employment opportunities including apprenticeships, invest in research and development and give local areas a sense of pride and identity. Food manufacturers succeed commercially alongside the farmers and fishermen who supply them with high quality produce and equally, farming cannot be successful without manufacturers' demand for domestic

[22] Food Standards Agency, 'Food and You 2: 2020-2023 trends', 7th December 2023, link
[23] Food Standards Agency, 'Consumer Insights Tracker', last updated 29th July 2024, link
[24] Office for National Statistics, 'Non-financial business economy, regional (Annual Business Survey) Statistical bulletins, 24th June 2024, link
[25] This link does not work
[26] Department for Environment, Food & Rural Affairs, 'Food statistics in your pocket', 15th February 2024, link

production[27]. Food manufacturing also plays a critical role in the successful delivery of societal objectives such as Net Zero, healthy eating and environmental sustainability.

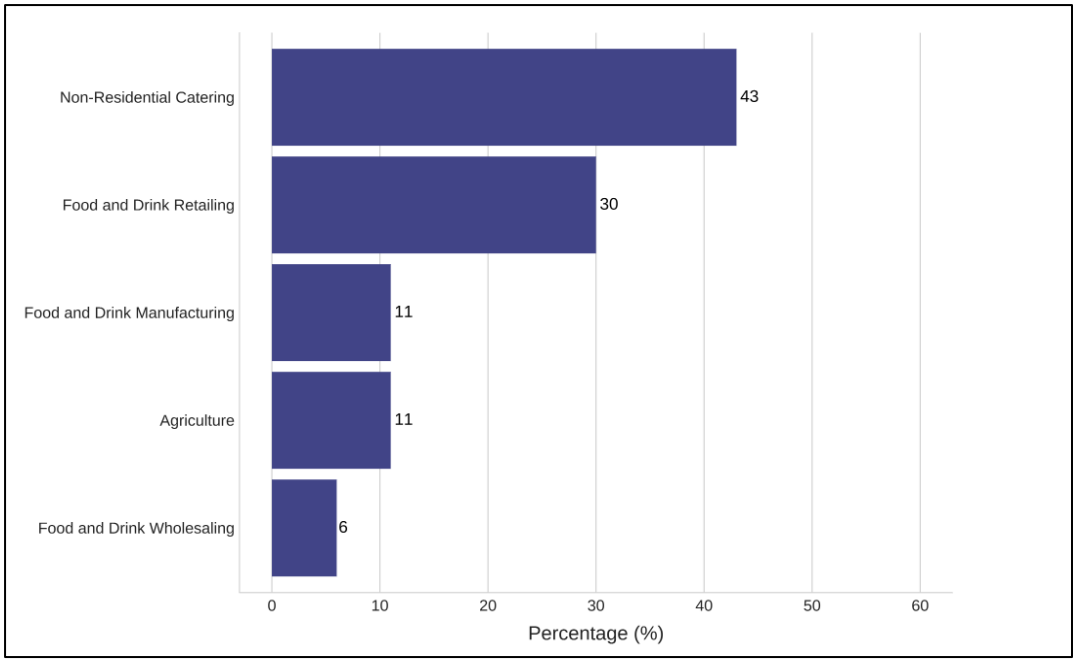
Figure 4: Agri-food sector employees and self-employed individuals, 2022 (%)



Source:

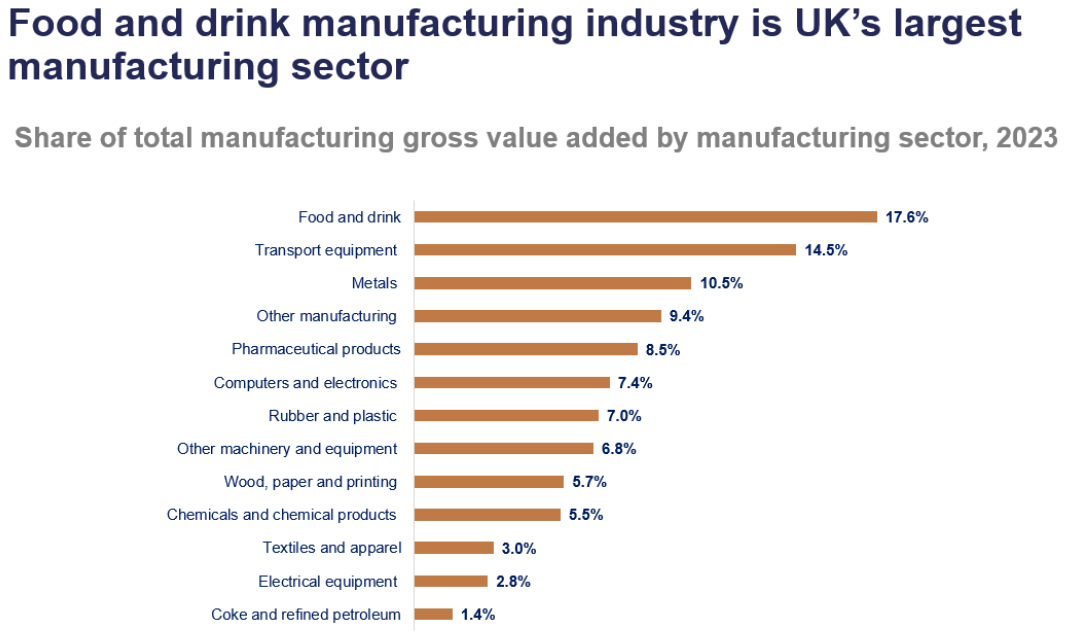
Figure 5: Gross Value Added of the agri-food sector, 2021 (£ billion)

[27] Department for Environment, Food & Rural Affairs, 'United Kingdom Food Security Report 2021', 5th October 2023, link



Food and drink is the largest manufacturing sector in the UK, representing more than 17% of overall GVA compared with 12% for chemicals, pharmaceuticals and bioscience combined and 5% for automotive[28] (see Figure 6). The manufacture of food generated 21% of total manufacturing sales in 2022, with an estimated industry turnover of nearly £142 billion, as well as providing exports valued at over £26 billion[29]. Prioritising support for UK food and drink manufacturing alongside UK agriculture has the potential to provide significant economic growth and prosperity to the UK in addition to safeguarding food supply.

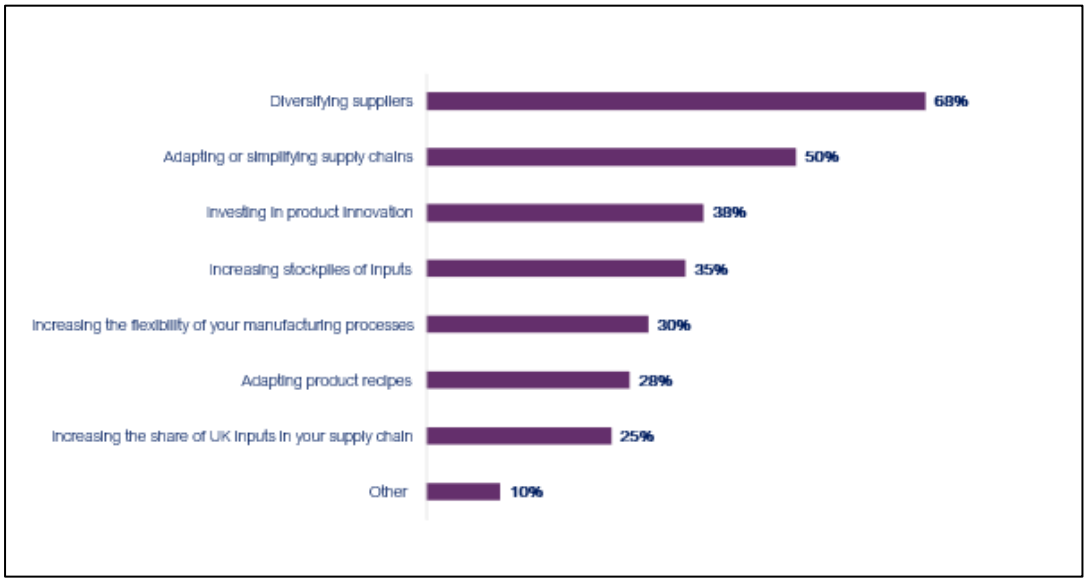
Figure 6: Share of Total Manufacturing Gross Value Added by Sector, 2023



[28] Office for National Statistics, 'GDP Output Approach: Low-Level aggregates, 28th June 2024, link
[29] Department for Business & Trade, 'Advanced Manufacturing Plan', 6th December 2023, link

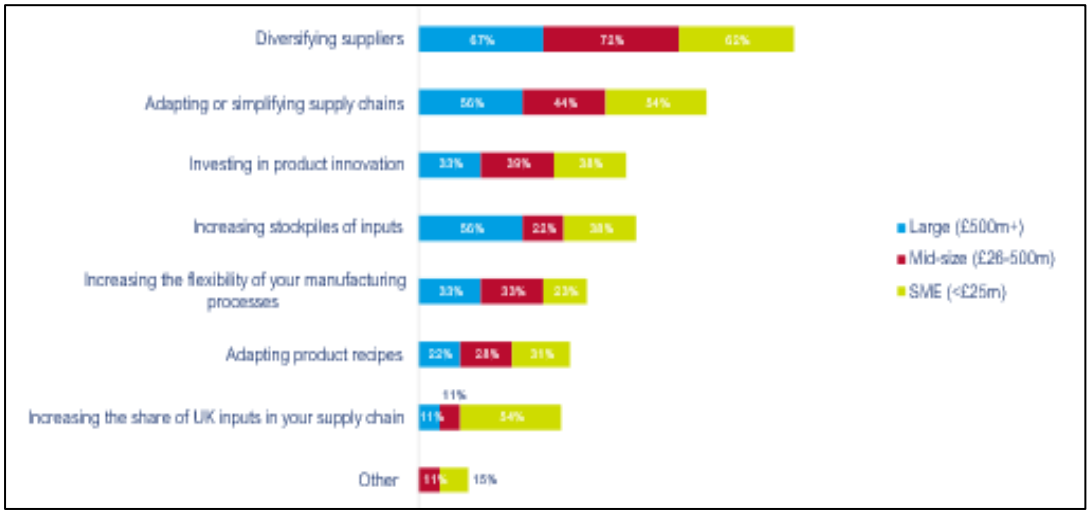
The diversity of the UK food manufacturing sector is striking, with a wealth of SMEs but also global companies and this brings differing pressures and priorities, which must all be considered when setting policy. For example, overall, 68% of UK food and drink manufacturers are currently focused on mitigating supply chain risks by adopting measures such as diversifying suppliers, simplifying supply chains, investing in product innovation, increasing stockpiles of inputs, adapting product recipes or increasing the share of UK inputs (Fig 7)[30].

Figure 7: Actions being taken by food and drink manufacturers to mitigate supply chain risks.



However, further data analysis suggests that different sized businesses are responding in different ways, with larger businesses tending to increase their stockpiles of inputs, and SMEs tending to increase the share of UK inputs to their supply chain (Fig 8)[31].

Figure 8: Response of different sized food and drink manufacturing businesses to supply chain risks.



[30] Food and Drink Federation survey of members for Policy Exchange, 2024
[31] Ibid.

0.2 Food manufacturing: costs and regulation

Growing sales to the UK market is the top priority for food manufacturing businesses (Fig 9)[32].

Figure 9: Growth priorities for food and drink manufacturing businesses

However, food manufacturing has faced additional costs in recent years, inevitably reducing available funds for future investment. Resilience in the industry has been eroded by substantial price pressures on all areas of production, from ingredients and packaging to labour, energy supply, transportation and logistics. Businesses interviewed for this report consistently cited these areas as impacting their costs of production, and these pressures are further explored in this report.

The burden of regulation has also been substantial as the sector has been exposed to a complex and changing landscape of labelling and reporting requirements that include food safety together with environmental legislation and regulation. Sustainability is essential for a society with net zero and wider environmental commitments, but the growing demands of extended producer responsibility regulations, packaging, scope 3 greenhouse gas emissions and forest risk commodities tracking requirements that span the global supply chain are not providing a supportive environment for innovation and investment, diverting resource from investment to bureaucratic requirements to demonstrate compliance.

0.3. Food security, energy security & the environment: an interactive policy landscape

Policy tensions exist between food security, energy security and the environment. The issues of world food security and domestic food production must be balanced with the global need to address climate change, the environment & energy security. The simple productivist and technical approach of the post-Second World War 'Green Revolution' that continued through the years 1960-80, is no longer adequate in achieving this balance[33].

[32] Ibid.

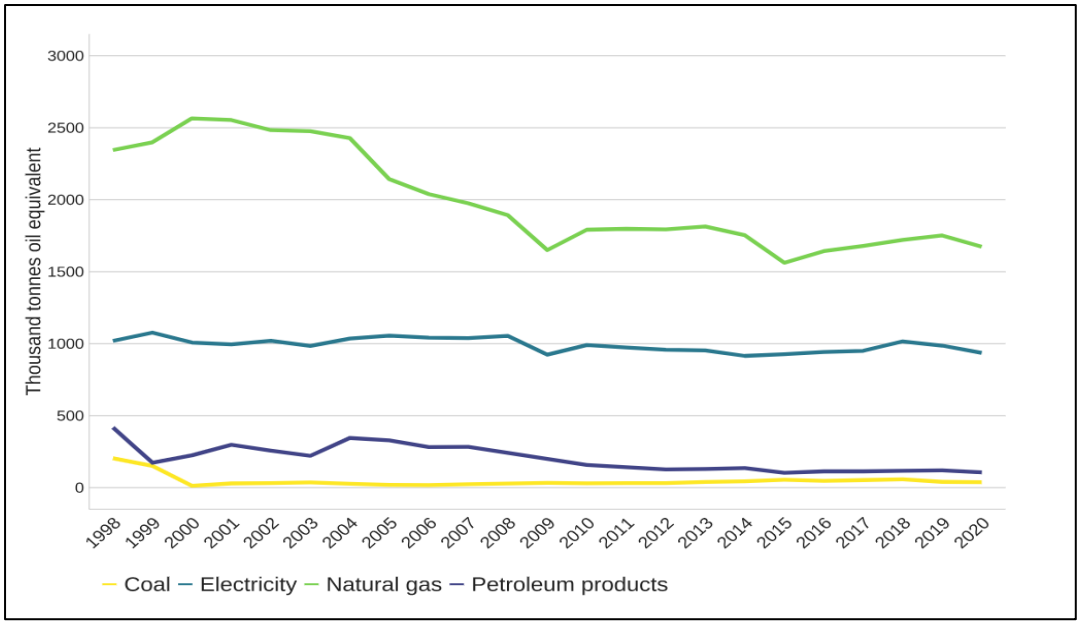
[33] The World Organisation for Animal Health, 'Contribution of veterinary activities to global food security for food derived from terrestrial and aquatic animals', May 2011, link

0.3.1 Energy security, food security and climate change

The need for energy security has been recognised by government, parliament and the media as a significant issue. Food security presents a similarly fundamental need and yet awareness is not established in the same way[34]. Understanding these food security needs and how they fit with energy security and environmental sustainability as discussed above is important before embarking on fragmented policy interventions in the food arena.

It should not be overlooked that energy also represents a significant proportion of operating costs for any manufacturing business (Fig 10)[35], and this is certainly the case for food manufacturing, as well as for critical inputs to agriculture such as fertiliser.

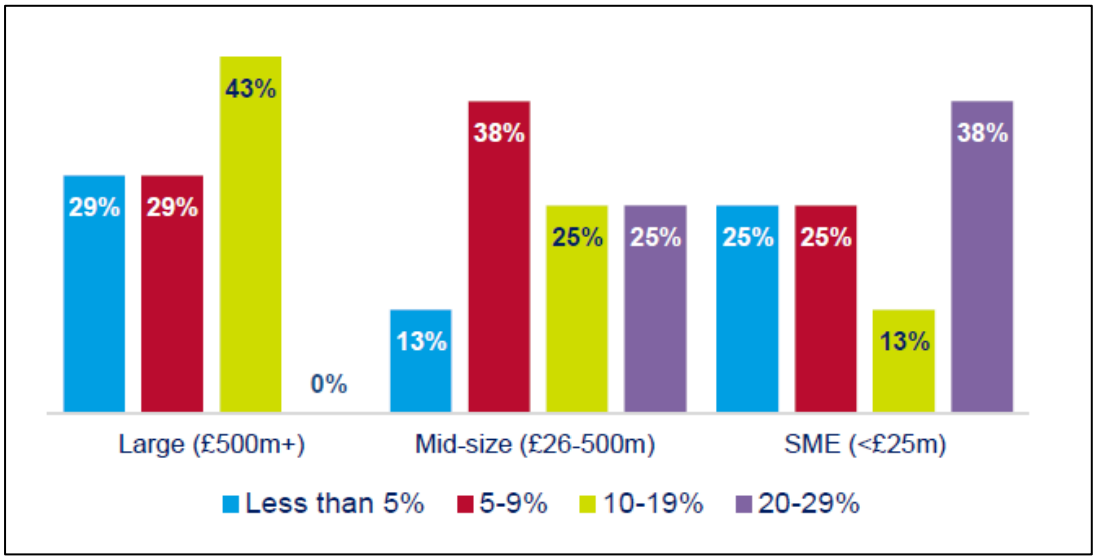
Figure 10: Energy demand by energy type in the food and drink manufacturing sector.



Whilst wholesale energy prices and rates to businesses have fallen significantly since December 2023, a global food manufacturing company interviewed for this report described how "*we use a lot of gas in the food industry; decarbonising supply chains and finding a way to reduce energy costs are important for the future."* On average, energy accounted for around 10% of the operating cost base in Q1 2023, in line with figures reported in Q3 2021 (12%) and Q4 2021 (8%) – significantly below Q3 2022 (22%). The energy share of operating costs displays variations within same-size companies and also between companies of different sizes (Fig 11), suggesting that the main driver of costs is how energy-intensive the sector is in which a manufacturer operates[36].

[34] CABI Publishing, ‚Dairy herd health', 20th November 2012, link
[35] Food and Drink Federation, 'State of Industry report Q1 2023', link
[36] Ibid.

Figure 11: Energy as a percentage of operating cost base for different sized food manufacturing companies



Food production activities also have a significant impact on virtually all aspects of the environment, including air, land and soil, water and biodiversity. The impact of livestock may be direct, for example through grazing, or indirect, such as the expansion of soybean production for animal feed replacing rainforests in South America[37], all of which have been the subject of both environmental campaigns and, more positively, commitments and improvements in practice by some UK companies. The agri-food sector emerges as one of the top two or three most important influences on the environment, both at local and global levels. Some experts consulted for this study perceived a lack of attention being paid to the "missing middle" of the food supply chain including processors, distributors, and wholesalers (among others) with regards to a lack of regulatory measures demanding more sustainable practices, energy use, and implementation of new technologies supporting sustainability.

Following the Defra 'Health and Harmony' consultation in 2018 (updated 2020)[38], Government set out its intention to work with industry to provide 'public money for public goods' in the farming sector. On November 11, the 2020 Agriculture Bill entered the Statute Book, marking the end of the UK's involvement in the Common Agricultural Policy (CAP). Unlike previous Agriculture Acts, it enshrined environmental policy as the driving force behind agriculture and food production.

The Agriculture Act (2021), therefore essentially acts as 'enabling legislation', to provide a legal basis for the Government to introduce further pieces of regulation, which will address different and very specific issues. The importance of food security, and the significant contribution of the food and drink manufacturing sector, have been largely overlooked as the ATP was both drafted and is now rolling out.

[37] Food and Agriculture Organization of the United Nations, 'Livestock's long shadow: environmental issues and options', 2006, link .
[38] Department for Environment, Food & Rural Affairs, 'Health and Harmony: the future for food, farming and the environment in a Green Brexit', February 2018, link

0.4 Attracting investment into UK food manufacturing

The ability of UK manufacturers to access funds for investment and growth is a concern[39]. The force behind successful UK SME & growth business creation prior to the Covid 19 pandemic had been funds secured via venture capital trusts (VCT) and enterprise investment schemes (EIS). UK tech sector investment was third in the world and first in Europe at the close of 2022, raising £24billion[40]. This source of funding has been negatively impacted by the pandemic but also by inflation and shocks to the economy since 2021.

The importance of the UK food and drink manufacturing sector in supporting food security and the UK economy has been too often overlooked. It plays a vital role in driving production and value in UK agriculture, as both a major customer and investor, and as well as a receiver of and adding value to raw imports.

Science and technology are badged as UK strengths, but the pull-through to our food industry from blue-sky research at university level can be limited in the UK – and again, where there has been Government support, this has been too often focused exclusively on agriculture (as discussed in Chapter Two). In this respect, the role of innovation and investment in the food manufacturing sector is a 'sleeping giant' which must be unlocked if we are to restore an effective balance in domestic food policy.

0.5 The global dimension

The final chapter focuses on existing and future potential vulnerabilities and risks to UK food security and ways in which these can be minimised and mitigated. This will require a balanced approach: the development of policy that builds UK resilience to supply chain disruption through a flexible, agile and robust trading ecosystem, and which allows the UK to prosper through international trade in food and drink, alongside a commitment to maintain and enhance domestic agricultural production in the face of environmental and energy demand conflicts.

[39] Policy Exchange, 'More Help to Grow', 2023, link

[40] Department for Digital, Culture, Media & Sport, 'UK tech sector retains #1 spot in Europe and #3 in world as sector resilience brings continued growth', 21st December 2022, link

CHAPTER 1: Attracting Private Capital Investment into UK Food Manufacturing

1.0 Introduction

UK food and drink manufacturing is important for food security - both in its own right and as a critical customer of UK farming and supplier to UK retail. The importance of UK food and drink manufacturing as a consumer of domestic primary production and its consequent ability to drive productivity has been underexploited in what is the largest manufacturing sector of the UK. The total value of UK manufacturers' product sales was £106.3bn in 2022, an increase of £10.2bn (10.6% from 2021). The manufacture of food remained the largest division, representing 24.7% of the total sales in 2022 with an estimated industry turnover of nearly £142bn, as well as providing exports valued at over £24bn [41].

Despite this enormous contribution to the UK economy, the sector has not benefitted proportionately from government support and has been exposed to the full force of the acute, overlapping and often uncoordinated regulatory and supply chain pressures that have characterised recent years. An appropriately smart and agile regulatory regime and targeted investment could help provide assurances for business to invest in their own future and also attract private investment into the food manufacturing sector to raise productivity improvements[42].

1.1 The current investment landscape for British food manufacturing

Attracting inward investment is not primarily about the level of Government support: in a competitive industry, largescale subsidies are not needed outside of specific areas such as R&D and Innovation. What is needed, however, is that the Government considers the sector a strategic priority, and that it is willing to consistently champion its success into the future, including through skills support, R&D and a targeted and proportionate approach to regulation. To date, this has been lacking in the food ecosystem – particularly for food and drink manufacturing and other aspects of the ecosystem outside of agriculture. Consistent, clear communication of the fundamental importance of the food ecosystem to UK food security is essential in signalling to investors that the UK remains open to business.

Even within the food ecosystem, despite its significant contribution to the UK economy, the food and drink manufacturing sector has largely been overlooked with regard to being identified as a priority by Government. In the Autumn Statement 2023, £4.5 billion funding was announced for strategic manufacturing sectors over five years from 2025 as part of the government's strategic manufacturing plan; however, food and drink manufacturing has not been regarded as a strategic priority[43].

Automotive: *Over £2 billion is being made available for the automotive sector to support the manufacturing and development of zero emission vehicles, their batteries and supply chain.*
Aerospace: *£975 million is being made available for the aerospace sector support the*

[41] Office for National Statistics, 'Monthly Business Survey turnover in production industries', last accessed 4th August 2024, link
[42] Policy Exchange, 'Re-engineering Regulation. A Blueprint for Reform', 8th August 2022, link
[43] Department for Business and Trade, 'Advanced manufacturing plan', 26th November 2023, link

development of energy efficient and zero-carbon aircraft technology.
Life sciences: *£520 million is being made available for life sciences to build resilience for future health emergencies and capitalise on the UK's R&D strengths.*
Green industries: *£960 million is being made available for a Green Industries Growth Accelerator which will support investments in manufacturing capabilities for the clean energy sectors where the UK can gain the clearest strengths: Carbon Capture Utilisation and Storage (CCUS), hydrogen, offshore wind, electricity networks, and nuclear.*
Source: HM Treasury. 'Autumn Statement 2023'

Food and Drink manufacturing has been similarly omitted or downplayed in most equivalent industrial strategy documents over the last decade. Global food and drink manufacturers face intense competition for investment internally, in which the UK operations contest with their European and foreign counterparts for funds for new production lines, products and packaging. A positive business environment with regulatory certainty will ensure that UK food and drink manufacturers are globally competitive and thousands of jobs are retained in the UK.

Where food and drink have been identified as a priority, the focus has typically been on agriculture - despite the fact that the food and drink ecosystem is closely interlinked. For example, following a strategic review of the sector by an innovative government/industry partnership, a significant investment in UK Agri-tech was deployed[44], but this investment did not include the food and drink manufacturing sector. Focusing on only one part of the food ecosystem cannot deliver the enhancement in food security that the UK requires: this instead requires the strategic championing of the food ecosystem as a whole.

1.2 Factors affecting current investment in food and drink manufacturing

1.2.1 The current economic climate

The pandemic years were challenging for the sector: the FDF state of the industry report 2023 stated that total business investment by the industry reduced by 22.7% between 2021 and 2022[45]. The industry's total business investment was still £3.1billion and over half of members identified new products and healthier food as investment opportunities. However, due to supply chain issues, market volatility and increased costs, 60% of manufacturers reported in Q3 2023 that they had to pause or cancel investments to innovate for new products or manufacturing processes.

On average, total production costs increased by 9.2% over the year to March 2024, while selling prices rose by 4.3%. For the year to March 2025, manufacturers expect their costs to rise by 2.1% and prices by 1.1%[46]. In 2023, ONS data shows that investment in UK food and drink manufacturing fell by a third compared with 2019; pressures are very real. This is in sharp contrast to investment in

[44] Department for Business, Innovation & Skills, Department for Environment, Food & Rural Affairs, Department for International Development, 'UK agricultural technologies strategy', 22nd July 2013, link
[45] Food and Drink Federation, 'State of Industry report, Q1 2023', 2023, link

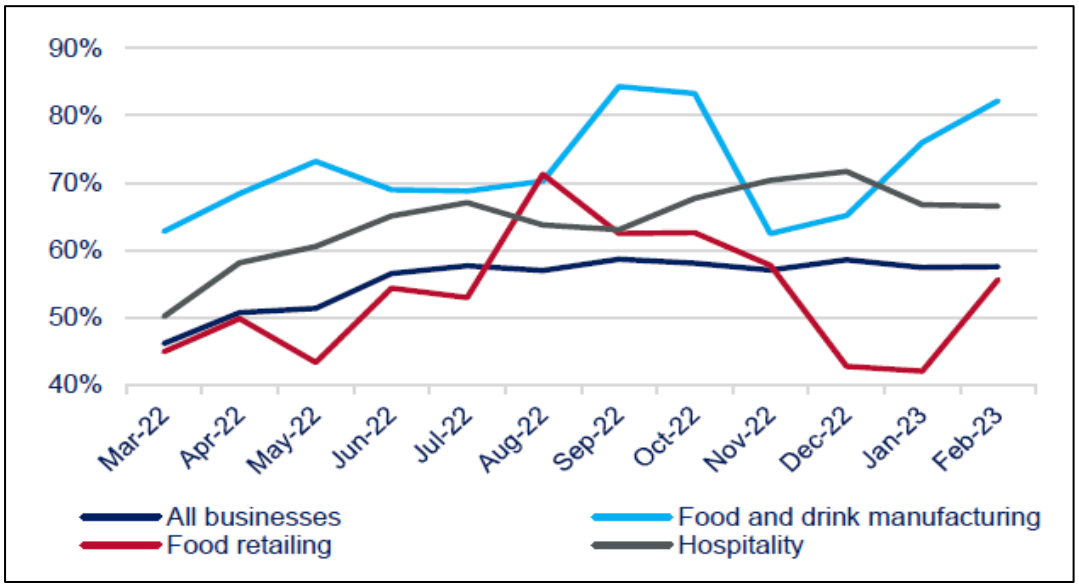
[46] Food and Drink Federation, 'State of Industry Report Q1 2024', 20th May 2024, link

the UK as a whole and the rest of manufacturing , which increased by five per cent in the same period[47].

More recently, however, the sector has been rebounding. The Lloyds Bank UK Sector Tracker showed that food and drink manufacturers outperformed all other sectors in March 2024, with an output growth indicator of 59.8 (vs. 51.1 in February) – though it should be emphasised this was only one month's data.[48]

Despite this, resilience in the industry has been eroded by the last couple of years of substantial price pressures on all factors of products, from ingredients and packaging to labour, energy supply, transportation and logistics: food manufacturing reduced prices in six out of seven months up to March 2024, but reported costs rising over that time[49]. Businesses interviewed for this report consistently cited these areas as impacting their costs of production. This inevitably reduces the funds available for investment, and overcoming these challenges is essential if we are to enhance the UK's food security.

Figure 12: % of businesses stating they absorbed costs



[47] Food and Drink Federation, 'Government must back UK food manufacturing to deliver food security and economic growth over the next decade', link

[48] Lloyds Banking Group, 'Food and drink manufacturing leads output and demand growth in March', 18th April 2024, link

[49] Ibid.

Figure 13: GVA, Growth by Subsector

Growth by subsector

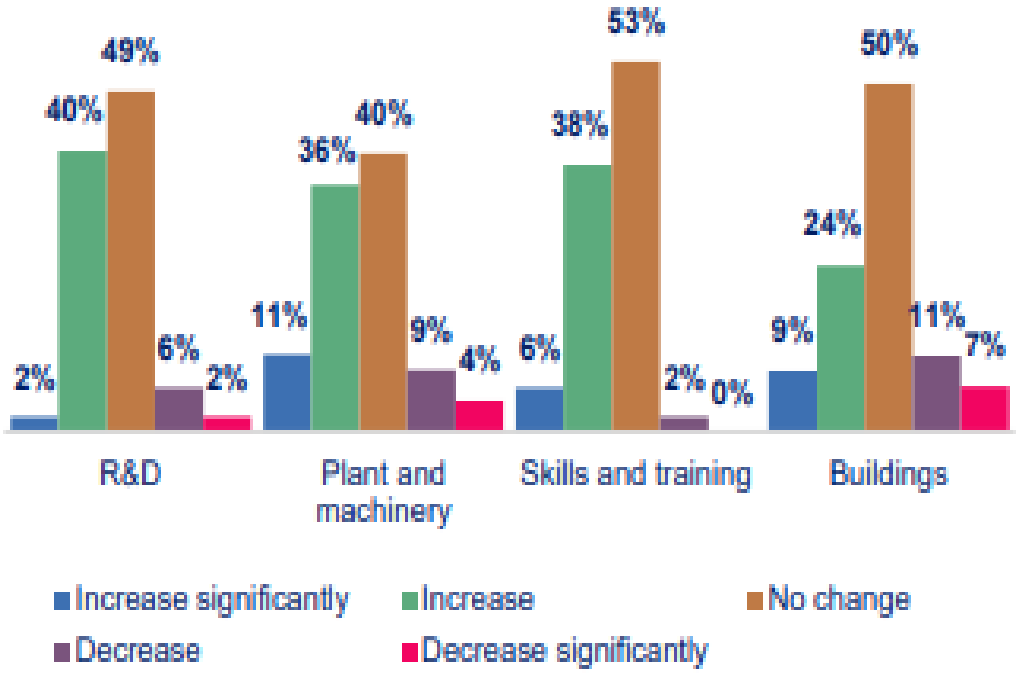
	Q1 2024 on Q4 2023	Q1 2024 on Q1 2023
Food	3.8%	1.3%
Meat	0.7%	1.4%
Fish, fruit and vegetables	7.7%	5.1%
Oils and fats	0.0%	0.0%
Dairy	-0.1%	1.2%
Grain mill and starches	-0.6%	3.3%
Bakery	-1.1%	-0.8%
Other food products	10.2%	0.4%
Non-alcoholic drinks	2.7%	5.7%

One global food manufacturing company interviewed for this report described their current challenges, finding growth hard, with a lack of sale contracts longevity and a generally low margin industry. Other food industry experts interviewed confirmed that current economic and supply chain pressures are impacting their investment decisions for the near to mid-term future, with one manufacturer clearly stating *"Ukraine and energy prices - yes, they had a big impact"*. This was particularly the case for SMEs, which make up 97% of the food and drinks sector. One SME manufacturer reported that retailers were asking manufacturers to see their books, saying *"…retailers were only willing to allow manufactures to pass on the cost of the raw materials. What they weren't prepared to do was to enable manufacturers to maintain % margins. This has led to dilution of overall profitability of the food industry in the UK"*. Another stated that *"…security of local raw materials, security of being able to produce in a competitive way and energy costs...are our concerns"*.

Against this backdrop, Fig 14 paints a mixed picture in terms of future outlook for investment. At least 40% of manufacturers are planning to keep their investment expenditure on R&D, plant and machinery, skills and training, and buildings unchanged over the twelve months to March 2025, and over 40% aim to increase it. On the face of it, these figures might seem encouraging. However, against the backdrop of persistent declines in industry's investment for the past four years, these figures suggest intentions for investment are subdued, and unlikely to return to pre-pandemic levels soon enough[50].

Figure 14: Business' expectations of planned capital investment expenditure changes over the next 12 months.

[50] Food and Drink Federation, 'State of industry report Q1 2024', 20th May 2024, link



Source: FDF State of Industry Survey

In summary, high input costs, inflation, labour shortages and supply chain volatility are currently re-focusing resources across the food sector and impacting growth and investment decisions. A number of food manufacturers consulted for this report stated that investments into novel technologies, quality assurance sampling or into upgrading of manufacturing equipment are being postponed as more pressing issues around the security of supply chains need to be addressed first.

Policy debate around innovation targets, sustainability goals, and increasing the proportion of healthy foods through technology needs to factor in a period of constrained investment capacity. Overall, investments in technologies to increase competitiveness in the short to medium term are expected to decline, in particular by SMEs, while large players will continue to lead innovation and implementation in that area, although at a slower pace.

1.2.2 The Regulatory Environment

Regulations set the rules of the game for market participants in a given industry. They mediate the relationship between individuals and businesses, ensure competition within a level playing field, and help to mitigate risk and encourage economic growth. In the food and drink industry, they also underpin a reputation for high product quality and safety; such standards are of immense value to UK exporters. Regulatory frameworks can incentivise certain types of activity and behaviour depending on how they are constructed. When working well, they might encourage innovation, competition, consumer interests and high standards. At other times, they might entrench the interests of incumbent firms at the expense of competition, disincentivise risk-taking and investment, and prevent the best products from being offered to consumers.

The UK's regulators are well-regarded internationally. Nevertheless, in the food and drink sector specifically, the regulatory burden on companies is extremely high, with multiple government departments and regulators having overlapping jurisdictions both in terms of policy remit and geographically. Our departure from the European Union, as the former Environment, Food and Rural Affairs Secretary Michael Gove said, provided an opportunity for a nimbler approach to regulation whilst also maintaining the highest standards in food manufacturing and produce[51]. Yet in reality, the industry is likely to be faced with an expanded regulatory burden in the future, not a diminished one, and this will have a direct impact on the productivity of the sector, as well as its international competitiveness. Food Security was also not taken sufficiently into account by most government departments and regulatory bodies, as it does not form part of their statutory duties. Global food and drink manufacturers often face intense competition for investment internally, in which the UK operations contest with their European and foreign counterparts for funds for new production lines, products and packaging. If the UK does not get the regulatory regime right, companies may choose to site new investment in Europe rather than the UK – or to offshore existing manufacturing.

In addition, many of the companies we interviewed for this report indicated that Government action was insufficiently coordinated and did not consider the operating realities of the industry.

Uncertainty around future environmental regulations, and existing conflicts and duplication between energy, food and environmental legislation, is damaging industry confidence to invest. One manufacturer interviewed stated that *"uncertainty and duplication of regulations is disruptive and undermines the confidence necessary for investment".* Another held the view that *"environmental labelling schemes – it's great and we need to start it. But trying to do it in a voluntary scheme before we know what the rules are or the measurements, it's really difficult".*

The food industry is inherently carbon-intensive and hence regulation on the food industry for decarbonisation purposes must take this into account, including recognising the need for decarbonising inputs such as from farming. This is also a view held by the manufacturers who were interviewed; *"we need to incentivise farmers to make the necessary environmental changes. They feel like they need to do more to get less and that legislation is not joined up. Farming is a long-term endeavour and there is too much of a focus on short term".*

Overall, it is likely that the food industry may be reluctant to make major investment decisions for innovative change in the near future as they wait for current economic pressures to ease and more regulatory clarity on sustainability requirements before investing in novel technology or processes. Hence, while investment around online sales and distribution of food as well as data capture may continue at pace, investment in production, processing and manufacturing, that require high capital investment or novel less-established technologies, may not be as rapid.

1.3 Attracting investment into food manufacturing within a favourable regulatory environment

[51] Department for Environment, Food & Rural Affairs, The Rt Hon Michael Gove, 'Once-in-a-generation opportunity to shape future farming policy', 27th February 2018, link

Based on panel data over 20 years in developed countries, Djokoto (2023)[52] found that foreign divestment of food manufacturing "crowded out domestic investment for developed countries in the short and long runs". The balance between investment from foreign and domestic sources is important in delivering a robust long-term strategy for the sector that allows innovation. It is imperative for policymakers and government agencies to increase domestic investment in food manufacturing to provide greater food security. Regulatory burdens can deter investment if associated with uncertainty around potential costs and risks.

Policy Exchange's *Re-engineering Regulation* project has made the case for a strategic rethink about how we regulate[53]. An effective regulatory framework would be orientated around four core principles:

- Proportionality – regulators must strike an appropriate balance between a number of competing imperatives, like safety, risk-mitigation, competition, and growth.
- Accountability – regulators must be democratically accountable, and there must be oversight for their work.
- Responsiveness – regulators must be able to respond to new challenges and feedback from market participants effectively and flexibly.
- Innovation – regulators must support their sectors to improve, adapt, and innovate in order to produce the best products and services for customers.

As it stands, there is much that can be improved with the way that we regulate the food and drink sector. Government departments and regulators are incentivised to prioritise process over outcomes; the competitiveness of the food manufacturing sector requires smarter regulation to overcome the current barriers to capital investment this burden represents. Improving the situation must involve greater communication and alignment between different regulators, more transparency over the introduction of regulations that will have an immense impact on the industry, and more needs to be done to improve the lines of communication between the regulator and the regulated.

A non-exhaustive selection of areas where unaligned and burdensome regulatory requirements are potentially damaging the UK's investment climate – and thereby its food security – are set out below.

1.3.1 Overlapping and Overreaching Regulators

Lack of co-ordination of regulatory change processes across government is a particular burden, leading inevitably to increased resource demands for food manufacturers. A strategy that has been deployed effectively in Canada to reduce industry burden and confusion is for different regulators and departments to coordinate policy changes that result in food label changes and only allow changes, after a minimum 24 month transition period, on a specific future date, once every 2 years

[52] National Library of Medicine, 'Food manufacturing foreign divestment and domestic investment in developed countries', 22nd April 2023, link
[53] Policy Exchange, 'Re-engineering Regulation. A Blueprint for Reform', 8th August 2022, link

as part of their 'predictable labelling policy'[54]. A **Common Compliance Date for new labelling regulations** could similarly be co-ordinated across government and the devolved administrations of the UK by Defra and relevant agencies such as the Food Standards Agency, as well as the Department of Health and Social Care and the Department for Business and Trade, regarding labelling and reporting.

A further concern was that in cases individual regulators were able to introduce regulations with far-reaching or highly costly requirements, without sufficient Parliamentary scrutiny or oversight. Assessing the need for such regulations requires making trade-offs between different objectives, including food security, environmental goals, consumer welfare, public health and investment attractiveness; such trade-offs are better and more appropriately made by elected representatives in Parliament, rather than regulators which typically have a statutory remit to address only a small number of these objectives.

While additional Parliamentary scrutiny would help prevent the disproportionate growth of new regulation, to resolve the existing tangle only a thorough and independent review across the food ecosystem would suffice to ensure streamlining, proportionality and reduce duplication, with a focus on outcomes rather than process. We consider that no single department or agency would have the required influence and perspective – and that accordingly such a review would need to be led by the Cabinet Office to have the required impact.

1.3.2 The role of the Food Standards Agency

The **Food Safety Act (1990)** provides the framework for all food legislation in Great Britain. The **Food Standards Act (1999)** established the **Food Standards Agency** as the agency responsible for acting in the consumers interest at any stage in the food production & supply chains, working alongside Food Standards Scotland (FSS). The FSA has a range of statutory powers and duties, carrying out different roles in the food system, from evidence generator and policy maker to regulator and watchdog, and also collaborates with government and industry bodies.

However, we heard from businesses that the FSA took too long to approve regulatory applications and was not sufficiently resourced to deliver at the speed it needed to be. One suggestion was that the FSA could introduce an option to pay privately for fast-track regulatory authorisations to facilitate approval of regulated ingredients and processes. This should take into account those that have been approved by other trusted regulators, alongside a commitment to drive better baseline regulatory processes. The FSA could mirror the approach taken up by the MHRA where approvals granted by trusted international regulators are given fast track approval. Any product that had been approved by the relevant regulator in both the EU and the USA would be eligible for the fast-track process. This could offer an opportunity to reduce friction of applications; the difference in affordability potentially challenging SME businesses could be supported by offering a lower cost tariff for SMEs vs large corporations.

[54] Government of Canada, 'Food labelling coordination', 18th August 2021, link

1.3.3 Packaging and Labelling Requirements

The domestic Food Information Regulations 2014 came into force on the 14 July 2014 and enables local authorities to enforce assimilated Regulation (EU) 1169/2011 on food information to consumers (FIC Regulations).

Such regulations become a particular issue for businesses when supply chains are disrupted and normal sources of ingredients are no longer available. Recent geopolitical shocks have placed enormous burdens on food manufacturers when under duress to fulfil their labelling obligations. Whilst there is no question of abdicating responsibility for a proportionate share of food safety, government support for both significant additional labelling costs as well as support for investment into innovation in this area would seem appropriate as part of the 'public good' of food security.

A number of manufacturers interviewed for this report had experienced recent issues with labelling during the Ukraine crisis, with one stating *"Sunflower oil, can't get it and it's too expensive. So we now have to change to rapeseed, so we have to change labels"* and another stating *"sunflower oil and seeds…we don't use that much but we did have to reformulate and relabel, because producing countries have seen a big increase in domestic prices and to manage those price movements they have put export bans on to keep volume in the country"*.

During the Ukraine crisis, the FSA and industry co-operated to adopt pragmatic approaches around the labelling regulations with regards to ingredients such as sunflower oil[55]. However, in future situations this process could be more streamlined. A pre-approved list of risk-assessed substitute goods, alongside a transparent process should be agreed to suspect specific regulatory provisions (e.g. such as elements of prevision within the ingredient labelling requirements) in emergency situations – whether geopolitical or climate related – would be of enormous benefit to companies and, for consumers, would keep shelves stocked. This approach would be subject to formal risk assessments and would not impact vital food safety information (e.g. allergens).

1.3.4 The GHG protocol and Scope 3 emissions

Key pieces of legislation such as the Climate Change Act 2008 have driven a set of regulatory and policy packages that present a significant burden for the food and drinks manufacturing industry. An example is the Carbon Budget Delivery Plan, containing proposals and policies under review which will give effect to the requirements of the 2008 Act.[56]

The GHG Protocol classifies a company's emissions into three scopes: Scope 1 (direct emissions from owned or controlled sources), Scope 2 (indirect emissions from the generation of purchased energy) and Scope 3 (all indirect emissions, not included in Scope 2, that occur in the value chain of the reporting company). Calculating Scope 3 emissions can be complex; they are both the most significant and most challenging source of emissions for manufacturing businesses to identify, quantify and address. Businesses often use the GHG Protocol as the methodology underpinning their assessment of their GHG emissions, and the protocol provides technical guidance that offers a number of calculation options giving a range of data outputs of varying specificity and quality.

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[55] Food Standards Agency, 'FSA Response to Ukraine Conflict Supply Chain Disruption: Ingredient Substitution and Labelling', 1st June 2022, link

[56] Legislation.gov.uk, 'Climate Change Act 2008', 26th November 2008, link

The UK government is therefore currently consulting on the creation of 'UK Sustainability Disclosure Standards' (SDS). A decision is expected shortly, but it is expected that it will adopt the two international standards produced by the FSB through the International Sustainability Standards Board (ISSB). Mandatory reporting of Scope 3 emissions is already in place in Europe under the EU Corporate Sustainability Reporting Directive (CSRD). It is highly likely that mandatory reporting requirements will apply to smaller companies over the coming years as part of net zero 2050 evidencing[57].

However, scope 3 emissions are extremely complex and challenging to calculate and the prospect of mandatory reporting, without significant further co-design and support in 2024, would be stifling for food manufacturers. Burdensome reporting requirements absorb time and money that could be better spent on innovation and investment. We welcome the fact that the Food Data Transparency Partnership has been established between Government and Industry and provides a forum to discuss and resolve these issues – and it is essential that it is given sufficient time to do so, and that Government and regulators pay sufficient heed to its conclusions[58].

1.3.5 Extended Producer Responsibility (EPR)

Another area in which regulations have been introduced with the best of intentions yet may well have deleterious unintended consequences concerns packaging and plastics. Shifting to more sustainable packaging is increasingly supported by consumers and NGOs, who understand this as a way to reduce negative impacts on the environment[59].

Looking at international best practice, EPR is a policy approach under which producers are given significant responsibility – not only financial and legal responsibility – but also the authority and autonomy to design and manage operations under the oversight of a strong Regulator. This concept of EPR is proven to deliver environmental outcomes at the most efficient cost. Under the current UK Government's approach for packaging EPR, whilst producers have the financial responsibility and legal accountability to meet recycling targets, all the key operational functions will reside with a public sector scheme administrator, at least initially. Without any ability to directly control any of the operational levers of the system, EPR risks becoming essentially a transfer of costs from local authorities to producers and therefore akin to a tax. Therefore, the decision to appoint a public sector body as the scheme administrator for the UK EPR Scheme should be reviewed immediately and certainly within the first year of the scheme being launched in favour of moving to a producer led model. Having a fully producer-led scheme working in tandem with the rest of the value chain is the only way that producers will be able to meet the Government's ambitious recycling targets and wider environmental goals.

Although EPR fees have been deferred for a year and manufacturers will not have to pay fees in 2024, they must still report on packaging data for 2023 and continue to pay any fees due under previous regulations. What manufacturers need to do depends on whether they are classed as a 'small' or 'large' organisation, which may perversely disincentivize upscaling if the burden from SMEs is smaller.

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[57] Irwin Mitchell, 'Is reporting Scope 3 emissions about to become mandatory for corporate real estate?', 12th December 2023, link

[58] Gov.uk, 'Food Data Transparency Partnership, last accessed 4th August 2024, link

[59] Which?, 'Supporting consumers in the transition to Net Zero', 5th October 2021, link

Extended Producer Responsibility

Manufacturers must collect and report 2023 packaging data if all the following apply:

- they are an individual business, subsidiary or group (but not a charity)
- they have an annual turnover of £1 million or more
- they were responsible for more than 25 tonnes of packaging in 2022
- they carry out any of the packaging activities below

Packaging activities:

- supply packaged goods to the UK market under their own brand
- place goods into packaging
- import products in packaging
- own an online marketplace
- hire or loan out reusable packaging
- supply empty packaging

Manufacturers may need to:

- pay a waste management fee
- pay scheme administrator costs
- pay a charge to the environmental regulator
- get packaging waste recycling notes (PRNs) or packaging waste export recycling notes (PERNs) to meet recycling obligations
- report information about which nation in the UK packaging is supplied in and which nation in the UK packaging is discarded in – this is called 'nation data'

Source: https://www.gov.uk/government/collections/extended-producer-responsibility-for-packaging-report-packaging-data

Whilst the aims are laudable, EPR may in practice impose a remarkably heavy burden on companies who are already moving quickly to reduce their waste footprint. It could also perversely lead to more food waste, rather than less – where packaging such as plastics are currently successful at extending shelf-life and there are not yet viable alternatives.

The potentially high cost of EPR is why the UK needs to emulate best practice schemes internationally where producers have the autonomy to design and manage operations more efficiently and effectively than can be achieved in the public sector. This will also help to ensure the right investment in post-collection services to drive higher recycling rates across all materials including plastics. Coupled with the need for Government to confirm acceptance of mass balance accounting for calculating recycled content derived from chemical recycling, this will help to ensure more used plastic packaging can be recycled back into new packaging.

1.3.6 Novel Foods

'Novel foods' are any foods that have not been previously used for human consumption to a significant degree within the United Kingdom (UK) or the European Union (EU) before 15 May 1997. Examples of novel foods include phytosterols and phytostanols used in cholesterol-reducing spreads, traditional foods eaten elsewhere in the world such as chia seeds, or foods produced using new

processes, such as bread treated with ultraviolet light to increase the level of vitamin D. Novel foods need to be authorised in accordance with the assimilated Regulation (EU) 2015/2283 before they can be placed on the market in Great Britain (GB). The definition is very broad meaning that even small variations in manufacturing formulations can require reauthorisation; in addition, the timeframe for authorisation exacerbates the impact of this. EU Food Law continues to apply in Northern Ireland, under the current terms of the Protocol on Ireland/ Northern Ireland (Annex II). The novel status of a product in Northern Ireland is based on the European Commission determination and before being placed on the Northern Ireland market, novel foods must go through the EU authorisation processes, causing further complication and friction of GB & NI trade.

Overall, there is significant potential to improve the UK's regulatory environment – across the food ecosystem – in order to enhance UK competitiveness and stimulate investment and innovation. Doing so would not only have economic benefits, but will be essential if we are to realise the improved and sustained investment required to enhance UK food security and deliver a more affordable, available and sustainable food supply to UK households.

CHAPTER 2: Innovation in Food Production

2.0 Introduction

Investment alone will not deliver the improvements in food security that are required in an increasingly uncertain world. With challenges posed by both the natural threats of climate change and the human factors of geopolitical uncertainty, innovation – in primary production, in manufacturing, in storage and in transportation – is an essential part of providing a more reliable, resilient and affordable supply of food.

Innovation is a stated priority of both the Government and the Opposition. However, increased investment in research and development (R&D) will not automatically flow forward into creating innovative products and services to the benefit of the UK economically and socially. While the UK is world-leading at R&D and creating start-ups around new ideas, it lags behind many other countries when it comes to getting great ideas to market. Chris Warkup, CEO, Knowledge Transfer Network (KTN) said in 2017, *"We have a brilliant science base on which to build, but brilliant science is not enough on its own. It is still important for new investment to be directed into the translational space, bridging the* ***'valley of death'*** *funding gap between discovery science and the point at which technologies are de-risked enough to be carried through to commercialisation by industry alone".* Others have reported that whilst the UK has got better at spinning out companies, it still lags behind other countries in its success at scaling them up[60].

2.1 The strengths and weaknesses of UK innovation

The UK is a world-leading innovation nation with a long and distinguished history across many areas of science and technology, from Isaac Newton's creation of the reflecting telescope in 1668, and Watson and Crick's discovery of the structure of DNA in 1953, to the development of a vaccine as part of the global effort against the COVID-19 pandemic (University of Oxford and Astra Zeneca, 2020). In 2020 the UK ranked fourth highest among the 131 countries featured in the Global Innovation Index.[61] The UK's world-leading research base includes 90 world-ranked universities, including four in the top 10 in 2022 (University of Oxford, University of Cambridge, Imperial College London, and UCL), and it is the world leader in the quality of scientific publications. Cambridge and Oxford are the most science and technology-intensive clusters in the world.

The UK's enabling environment includes its strong global brand and reputation. Adherence to ethical and social values is strong in both public and private sectors; the UK has a global reputation as a safe and honest place to do business, with generally good adherence to the rule of law. The UK's investor community is well linked to R&D and technology transfer mechanisms; the UK has a thriving entrepreneurial ecosystem and was the leading place in Europe to start a new business before recent disruptions of the departure from the European Union, Covid 19 pandemic and Russian invasion of Ukraine[62].

However, despite a world-leading research base, for UK start-ups, failure is much more likely than success and most patented ideas are not translated into products and launched services. In 2019, the one-year survival rate of UK businesses was 88.3%; only 39.6% of businesses survived to their fifth year. 97% of patents never make any money, despite representing large costs of regulatory

[60] Policy Exchange, 'Unleashing Capital', 8th November 2022, link
[61] HM Government, 'UK Research and Development Roadmap', July 2020, link
[62] Ibid.

process and timely delays in development. British innovations too frequently either fail to take off or move overseas, benefitting other countries instead. Reasons for this include:

- Complex and fragmented ecosystem of support
- Comparatively low levels of success in commercialisation
- Low risk appetite in UK businesses
- Slow government procurement
- Relatively low use of patents
- Gaps in skilled workforce especially STEM
- Misaligned incentives, poor leadership[63]

In July 2023 the Office of National Statistics increased its estimates of R&D spending by UK businesses from around 1.7 to 1.9% of gross domestic product (GDP) to 2.9% in 2021.This is well ahead of the government target of 2.4%, although still below most of our leading competitors. In 'Selling less of the family silver' David Connell and Bobby Reddy discussed how the UK has therefore apparently exceeded long term Government R&D targets whilst failing to grow and retain many financially successful new R&D-based businesses. They acknowledged the complexity of the problem and asserted the importance of refocusing policy objectives on "outcomes" in terms of the growth, longevity and profitability of UK firms as opposed to intermediate "outputs" in terms of R&D spending targets.[64]

2.2 Innovation in the Food Ecosystem

It is now more than 10 years since the UK Agri-tech Strategy was published in July 2013[65], with a vision for innovation to develop the opportunities and strengths of the UK agricultural technologies sector as a whole. Leadership Council Membership was an example of 'co-design' between government and industry, developing a strategy through consultation and partnership within the Agri-tech communities to agree a set of actions to deliver a vision: "*That the UK becomes a world leader in agricultural technology, innovation and sustainability; exploits opportunities to develop and adopt new and existing technologies, products and services to increase productivity; and thereby contributes to global food security and international development.*"

The Government therefore invested £160million to apply the principles of the Catapults and Catalyst to the Agri-tech sector. A group of Core Academic University partners have benefitted from very significant investment into estates and facilities infrastructure as part of the setting-up of four Agri-tech centres[66]:

- CIEL - Centre for Innovation Excellence in Livestock
- CHAPS - Centre for Crop and Plant Innovation
- Agri-Epi-Centre for Agri - Engineering innovation
- Agrimetrics - Data and information

[63]Ibid.

[64] 'Selling less of the family silver. Better UK innovation and industrial policies for economic growth ' David Connell and Bobby Reddy, July 2024 Link

[65] Department for Business, Innovation & Skills, Department for Environment, Food & Rural Affairs, Department for International Development, 'UK agricultural technologies strategy', 22nd July 2013, link

[66] This is now becoming a new UK Agri-Tech Centre after the merger of Agri-EPI, CIEL and CHAPS.

Although the work of the centres has been positive and addressed a decline in academic central science infrastructure, the transformational participation of private industry expected to provide investment flowing through the centres has generally been regarded as having fallen below expectations. Government support for research activity has not effectively followed the support for capital infrastructure investment. The challenge of defining rules of engagement for 'pre-competitive' vs proprietary research has been difficult and the process and regulatory barriers have remained frustratingly high. The focus has generally remained firmly on investing in university-based innovation. A new Agri-tech centre is being set-up in 2024[67] combining three of the original centres and change is expected but not yet clearly defined in the public domain.

To date, the Agri-tech Strategy has largely overlooked food and drink manufacturing. The Science and Technology Framework[68] also largely ignores food and drink manufacturing, in its 2030 vision that sets out 10 key actions to support innovation (updated 2024). Indeed, food manufacturing seems to fall into the space between Agri-tech funding and manufacturing funding, potentially missing out on both – even though the UK food manufacturing annually introduces around 11,000 new products to the market[69], investing in excess of £3.5billion[70]. The sector self-funds three quarters of its research and development[71]. The Food and Drink Federation's State of the Industry Report (Q1 2024) found that 85% of respondents undertake innovation in house using their own company expertise while only 10% collaborate with UKRI / Innovate UK or Catapult Centres[72].

This lack of support may be one factor why, in the UK over the past decade, the food manufacturing industry has lagged behind other industry sectors according to Hullova et al (2019)[73]. They reported that food manufacturing companies have focused too much on minimisation of production costs and have focused less on adopting new technologies and training their workforce.

2.3 Current policy mechanisms and levers which support innovation

The UK has a highly fragmented, complex, and interdependent innovation ecosystem. This can be confusing to navigate and requires a significant investment of time, both for innovators/academics and for the private sector/customers. Much research takes place within the UK's world leading universities and Public Sector Research Institutions, but also occurs within industry.

2.3.1 Accelerators and catapults

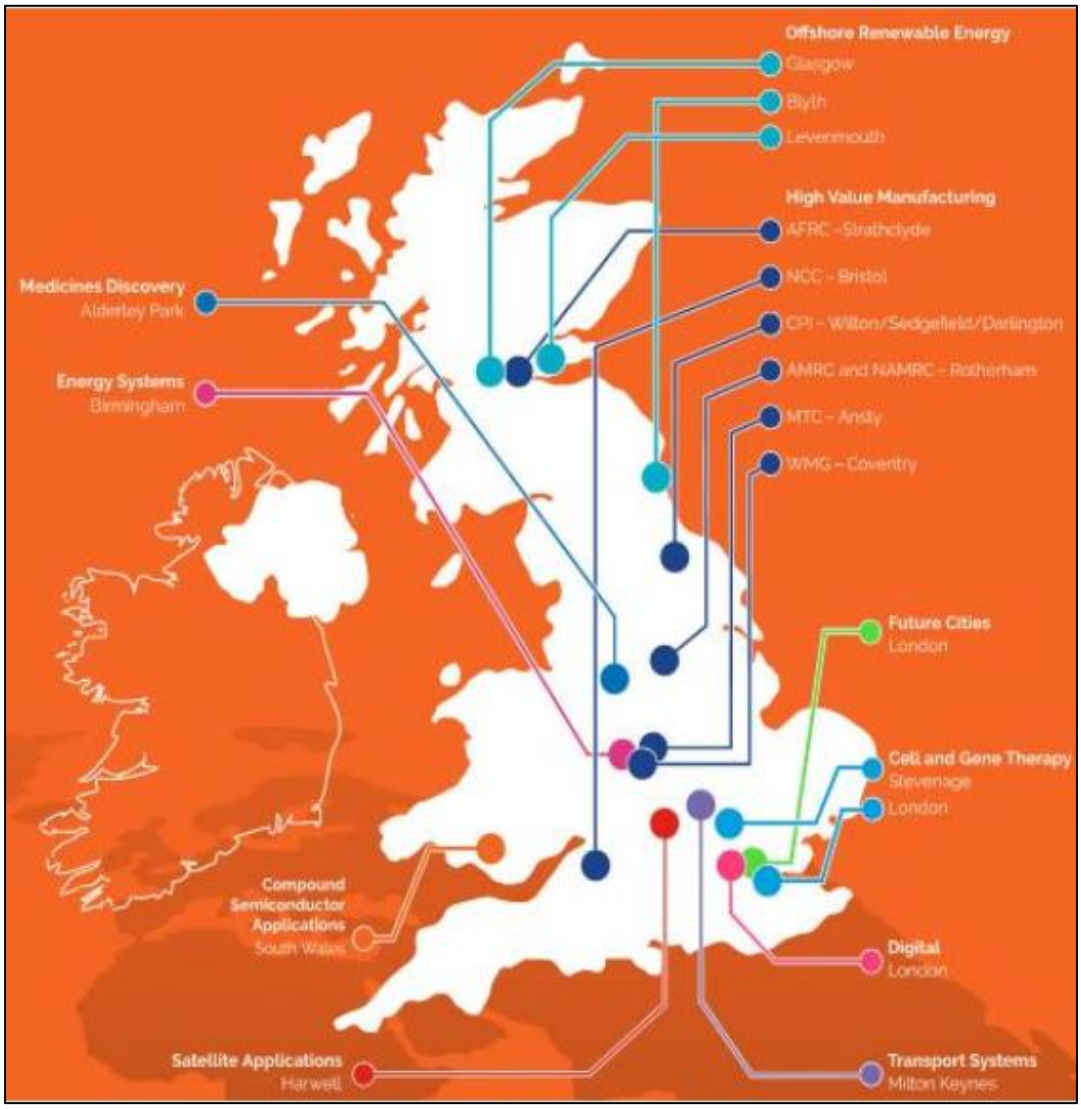
This complex landscape includes business support and bridging institutions such as accelerators and catapults, which exist to support and drive innovation. These include:

- UKRI: A non-departmental public body sponsored by DSIT, made up of nine organisations aiming to convene, catalyse and invest in close collaboration

[67] Food Manufacture, ''UK's largest agri-tech centre' opens as study flags big funding gap', 18th April 2024, link
[68] Prime Minister's Office 10 Downing Street, Department for Science, Innovation & Technology, 'The UK Science and Technology Framework', 9th February 2024, link
[69] University of Cambridge, Cambridge Industrial Innovation Policy, 'The UK Innovation Report 2023', March 2023, link
[70] Office for National Statistics, 'Business investment by industry and asset', 28th June 2024, link
[71] The Food and Drink Federation, 'Written evidence from the Food and Drink Federation (ISG 139)', 29th September 2016, link
[72] Food and Drink Federation, 'State of Industry Report Q1 2024', 20th May 2024, link
[73] Research Policy, Volume 48, Issue 1, 'Critical capabilities for effective management of complementarity between product and process innovation: Cases from the food and drink industry', February 2019, link

- Innovate UK: The UK's national innovation agency, providing companies with access to expertise and resources
- The Institute of Innovation and Knowledge Exchange (IKE Institute)
- Over 100 universities, many of which carry out internationally recognised research
- Catapult Network: A network of nine leading technology and innovation centres across the UK which carry out a huge range of supporting and enabling activities across many industries including High Value Manufacturing (HVM)[74] (Fig 15)

Figure 15: The Catapult Network



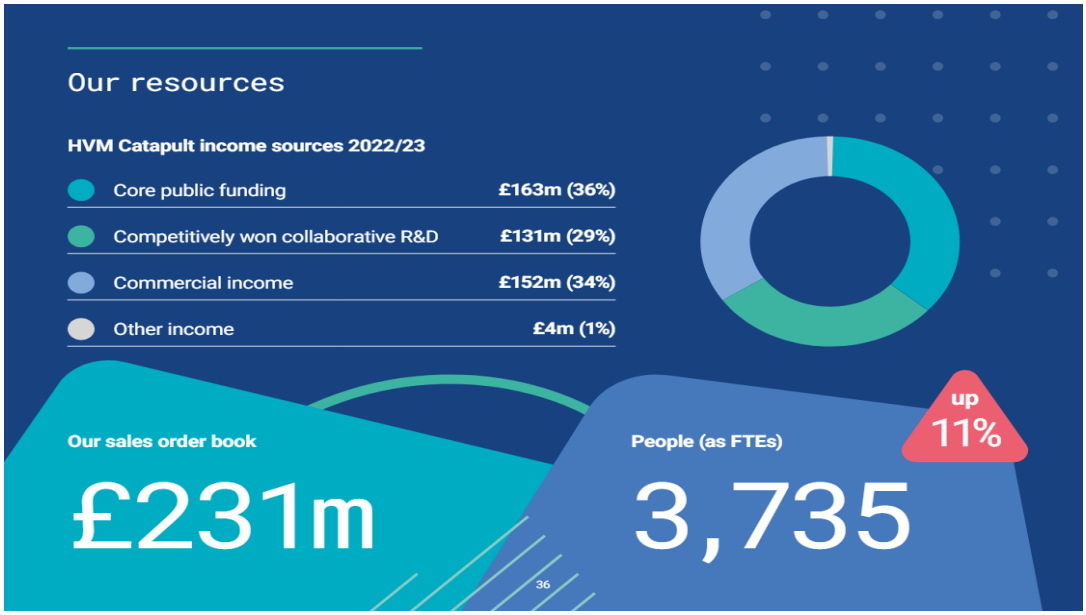
Government support of £163million of core funding in 2022/3, in addition to £131million of competitively won funding and £152million of commercial income (Fig 16), has benefitted the HVM Catapult members and recently, a further £50million of support for Catapult activity was announced in the Chancellor's Autumn Statement 2023[75]. However, there has been relatively little prioritisation

[74] Department for Business, Energy & Industrial Strategy, Innovate UK, 'Catapult Programme: A Framework for Evaluating Impact', November 2017, link

[75] The Catapult Network, '50 million boost for Catapult activity and capability in Chancellor's Autumn Statement 2023', November 2023, link

of food manufacturing from the HVM Catapult[76]; including the food manufacturing sector more effectively in this support would be of huge advantage in supporting innovation.

Figure 16: High Value Manufacturing Catapult income 2022/3



2.3.2 A food security research framework?

The case of innovation in Life Sciences has been a great UK success story and offers a potential model for supporting innovation in the food ecosystem in the UK. Some sector-specific adaptation would be required to translate the model from the existing strengths of UK innovation, which tends to be based in the university led Cambridge-Oxford technology axis. The food ecosystem is more disparate; innovation needs to be more effectively distributed regionally throughout the UK. In addition, it would be necessary to ensure that the model covered the whole of the food ecosystem, including both agriculture and food and drink manufacturing, rather than focusing primarily on Agri-tech.

Existing, well established food science and technology centres, such as the Centre of Excellence for Food Engineering at Sheffield Hallam University; the National Centre for Food Manufacturing at University of Lincoln; Lincoln Institute for Agri-food Technology (LIAT), which incorporates the world's first Centre of Excellence in Agricultural Robotics; the University of Nottingham Food Systems Institute; the Institute of Global Food Security at Queens University Belfast (QUB) and Fera at York, could be brought into collaboration to support decentralisation of investment but also specifically target investment to innovation partnerships that are effectively joined up, as in Ireland, the Israel and South Korea. A central 'National Food Security Research Centre' could be created, from a base at Fera (Sand Hutton York), with nationally distributed 'hubs' at the other sites to provide access to cost-effective modular research facilities. This could de-risk investment in innovation for SMEs and attract large companies to invest in UK based innovation. Both FSA and Defra have decentralised administration centres in York. This national centre could also provide

[76] The Catapult Network, 'High Value Manufacturing Catapult annual review 2022-23', link

cutting edge diagnostics for food safety, allergens etc and world-leading data science expertise. The centre would have the potential to refresh the long-term interactions between primary agricultural production and food manufacturing and retail, linking research in Agri-tech, biotech and data science.

Innovation case study: UK Pharma, The Vaccines Task Force, the COVID-19 Pandemic & Office for Life Sciences Innovation

In contrast to food manufacturing, UK Life Sciences have received targeted and tailored support to drive globally leading success. In May 2023, the Chancellor of the Exchequer Jeremy Hunt announced a £650 million growth package to stimulate the UK's life sciences sector and grow the economy. A call for proposals was released on the government's Long-Term Investment for Technology and Science (LIFTS) initiative; £250 million of government support to spur the creation of new vehicles for pension schemes to invest in the UK's high-growth science and technology businesses, benefitting the retirement incomes of UK pension savers and driving the growth of critical sectors like Life Sciences.

The government also signalled its ongoing commitment to the transformational new East-West Rail line between Oxford and Cambridge including a direct link to the Cambridge Biomedical Campus.

The manufacturing arm of the UK's life sciences sector is also receiving a funding boost. A Biomanufacturing Fund worth up to £38 million in new funding has been announced to incentivise investment and improve the UK's resilience to any future pandemics, via a competitive process. This comes on top of a further £6.5 million made up of new funding and funding from Innovate UK, to ensure that the Life Sciences sector continues to have the right people it needs to deliver its high skilled work. £10 million new cash has also been announced to fund projects to drive innovation in cutting edge medicine manufacturing that can bolster the UK's health resilience, such as those which use nucleic acid technology and intracellular drug delivery to help improve vaccines, as part of Innovate UK's 'Transforming Medicines Manufacturing Programme'.

Richard Torbett, Chief Executive, Association of the British Pharmaceutical Industry (ABPI), said:
"Today's announcements show that the government recognises the huge opportunity waiting to be grasped if the UK can unlock the economic potential of its life science industry – already worth £94.2 billion in 2021. These measures demonstrate the government has listened to industry and will help put the UK on track to meeting its life science vision".
Source: https://www.gov.uk/government/news/chancellor-reveals-life-sciences-growth-package-to-fire-up-economy

2.3.3 Sector campaigns and initiatives

Food and Drink Sector Council

In 2021, the FDSC championed maximising the sector opportunities in the UK Government's Innovation Strategy, having more advocates in funding committees and a strong voice for the sector in UKRI, Innovate UK and on the research councils. The FDSC also supported UKRI introducing a £1 billion 'Better Food Challenge Fund', as proposed by Henry Dimbleby's report[77]. The sector needs to become more competitive in accessing these public sector R&D bids by encouraging the formation of more consortiums and encouraging data sharing among partners. The food sector needs more data to work with and should engage more with the UK Government's National Data Strategy with the aim of better utilising data to improve decision making and unlock productivity gains. Dimbleby's report recommended a 'National Food System Data programme' to identify data gaps and collect and share data into useable information dashboards to inform businesses on planning and

[77] National Food Strategy, 'National Food Strategy Independent Review', 15th July 2021, link

government on policy. Although broadly supported by industry there are remaining concerns from businesses about what data government needs, how that data will be used and protected. There is an additional cost to businesses with reporting large amounts of data, and industry wants to make sure that it is it is being used to support the sector and not add an unnecessary burden (for example, in our dialogue with business, it was raised that the government collected large amounts of data from businesses in the food sector, but there was never any evidence shown as to how the data was useful or even used by government.)

'Made Smarter'

'Made Smarter' (2017) is a national movement backed by world-renowned business and UK government to connect UK manufacturing industries to the digital tools, leadership and skills needed to drive sustainable growth[78]. The aim is to amplify the cutting-edge UK expertise in innovation and technology to transform daily UK manufacturing business operations. In the review, the following strategic challenges were highlighted; increased pace of adoption of industrial digital technologies, faster innovation of these technologies, and a need for stronger and more ambitious leadership. As a result, three game-changing recommendations were produced, summarised as:

- Adoption. Build a national digital ecosystem that will be significantly more visible and effective and that will accelerate the innovation and diffusion of industrial digital technologies. This included a National Adoption Programme to be piloted in the North West – but then expanded to other regions – that focused on increasing the capacity of existing growth hubs and providing more targeted support. Critical to success will be the upskilling of a million industrial workers to enable digital technologies to be adopted and exploited through a single Industrial Digitalisation Skills Strategy. The Government has since committed to expanding this nationwide.

- Innovation. Refocus the existing innovation landscape by increasing capacity and capability through 12 Digital Innovation Hubs, 8 large-scale demonstrators, and 5 digital research centres focused on developing new technologies as part of a new National Innovation Programme.

- Leadership. Establish a national body, the Made Smarter UK (MSUK) Commission, comprising industry, government, academia, further education, and leading research and innovation organisations, which would be responsible for developing the UK as a leader in industrial digitalisation technologies and skills, with a mandate to develop the UK's own Industry 4.0 domestic and global brand.

The Made Smarter review identified a potential £55.8 billion in value to UK food manufacturing through the adoption of existing digital technology over the next decade[79]. The associated SME support scheme, launched in 2018 to implement digital technologies, had, by the end of 2022 reached just over 200 businesses, who reported success in increasing their revenue and exports while reducing energy bills, carbon emissions and waste[80].

[78] Made Smarter, 'Home page', last accessed 4th August 2024, link
[79] Made Smarter, 'Made Smarter national roll-out to turbo charge digital transformation for SME manufacturer's', link
[80] UK Research and Innovation, 'Made Smarter Innovation', 21st February 2024, link

Case Study: Lakes Ice Cream

An ice cream manufacturer is ready for the summer rush after using technology to transform, with the support of Made Smarter.

Lakes Ice Cream, based in Kendal, makes 1.2m litres of ice cream each year and distributes all over the UK.

It has invested in data and system integration tools that link key business operations: order processing, manufacturing, stock control, sales, distribution, and accounting.

The technology has replaced traditional manual, time-consuming and paper-based processes, sped up communications within the business, and freed the small team of 15 employees to focus on more high-value and skilled tasks, such as developing new recipes, flavours and products.

Recently the FDF has indicated a need for more basic innovation to support overall growth and enable efficiency and sustainability gains in the future, in particular for SMEs, such as the Food and Drink Innovation Gateway[81]. This is envisaged as supporting the implementation of existing technologies such as digitalisation, automation, and more sustainable processes, rather than novel technologies. Such schemes have the potential to support food security not only by enhancing SME manufacturing, but by increasing the pull-through from UK agriculture.

Case Study: Firstplay Dietary Foods

An independent specialist food manufacturer with global ambitions has increased production capacity 10-fold after investing in automation technology with the support of Made Smarter.

Firstplay Dietary Foods, based in Stockport, makes a range of low protein products for people with Phenylketonuria (PKU) and other metabolic conditions which leaves people unable to eat protein without risking brain damage.

With a growing international demand from patients and dieticians, due to the increased number of countries delivering newborn screening, the business has invested £120,000 in new digital machinery, increasing its blending capacity, while replacing a manual weighing and packing process with automation.

As a result, the business has increased production capacity 10-fold, reduced human error and waste, and is forecast to increase turnover by 30%.

In addition, two operators are now focussed on more value-add activities such as sales and complex packing tasks.

2.4 Global best practice in food innovation

A number of countries globally have demonstrated very significant success in the food security and innovation space. The countries described below have implemented effective strategies to maximise innovation opportunities from universities and government support both through supportive

[81] Food and Drink Federation, 'Welcome to the Food and Drink Innovation Gateway', last accessed 4th August 2024, link

regulatory and fiscal environments but most of all through effective industry-government partnerships.

Ireland

Ireland has used innovation to maintain competitiveness in global markets, provide jobs and achieve sustainable growth in their economy. Over 25 years, Ireland has gone from a base of 800 R&D active firms, with a research spend of €300 million, to almost 1,800 R&D active enterprises spending €3.47bn in 2021. In that year, Ireland had the highest proportion of business Research Development and Innovation in Europe. Through attracting the interest of European funding, Ireland has successfully converted innovation into globally adopted and diffused products and processes. The Irish Government has focused closely on its strengths, driving Ireland's R&D presence forward in MedTech, pharma, and technology. The Government allocated close to £800 million to R&D activities in these sectors in 2020. In addition, Ireland maintains a 25% tax credit on expenditure incurred on qualifying R&D activities undertaken by companies in Ireland that are subject to corporation tax. By ensuring financial incentivisation for research and a focus on funding to attract global eyes and interest, Ireland set themselves apart from UK in diffusion of knowledge and innovation.

National Food Innovation Hub and Moorepark Technology Ltd, Ireland

Teagasc (https://www.teagasc.ie/) is the state agency providing research, advisory and education in agriculture, horticulture, food and rural development in Ireland. Teagasc invested in new infrastructure to support innovation within the Irish food and drink industry in 2022 and in recent years, Teagasc, along with the Department of Agriculture, Food and the Marine (DAFM) and other funders, has invested heavily in the research and development capabilities available to Irish food companies. By improving infrastructure, Teagasc hopes to help companies reach their innovation potential and meet consumer trends. DAFM has invested in the development of a National Food Innovation Hub at Teagasc Moorepark, as well as supporting a €10 million upgrade alongside shareholders from the Irish dairy industry to the adjoining Moorepark Technology Ltd (MTL). These investments have created a unique research environment for national and international food companies. The Hub provides confidential office and laboratory space for food companies to establish a research base. Meanwhile, MTL provides a pre-commercial-scale environment for the development of food and beverage products, using the latest thermal, separation, dehydration and biotransformation technologies.

South Korea

South Korea has a Ministry of SMEs and Start-ups (MSS) with a strong emphasis on entrepreneurship. Uniquely, the MSS is active in reforming policy, tax and regulations requirements, through an SME Ombudsman who identifies regulations that unreasonably burden SMEs or impact new industries linked to the Fourth Industrial Revolution, in order to systematically remove barriers to innovation. From a tax perspective, start-ups currently receive a 50% discount on corporate tax bills and start-ups in special regions outside of major cities can be eligible for a complete write-off.

New IFF Co-creation Centre to Redefine Food & Beverages in South Korea

A new International Flavours & Fragrances 'IFF' facility opened its first dedicated food and beverage lab in Gangnam, Seoul, South Korea in November 2023, offering end-to-end product design capabilities, including a dairy and beverage ultra-high temperature pilot plant. The IFF approach to open innovation is comprehensive, offering a team of venture professionals dedicated to identifying and connecting with start-ups to harness the most cutting-edge scientific and creative breakthroughs available. This new co-creation centre reinforces the company's commitment to be the startup partner of choice to bring together flavour and ingredient expertise with food design capabilities to deliver the best-in-class innovations to customers in South Korea. Significantly adding to South Korea's vibrant food and beverage landscape, the new centre will support beverage, culinary, snack and dairy manufacturers with greater speed-to-market through insights-led innovation. Manufacturers will have access to advanced lab technology, and the expertise and knowledge of IFF's team of food designers. The centre features dedicated customer co-creation design spaces and a dairy and beverage ultra-high temperature (UHT) pilot plant for small-scale product pilot testing. It also houses a professional culinary kitchen, where IFF's team will develop savoury seasoning solutions for instant noodles, snacks, and local sauces.

Israel

From start-up to scale-up Israel has the highest density of start-ups per capita in the world[82]. In recent years, the success of Israeli companies in attracting later stage funding has meant that Israel has moved from being a start-up nation to a 'scale-up nation'. To date, Israel has produced over 71 unicorns globally, of which 29 still remain headquartered in Israel. Israel's ability to scale up innovation is the result of generous public provision of early funding, bridging the gap between R&D and the consumer market and a non-protectionist attitude to intellectual property rights (IPR) from its universities. In addition to financial investment, Israel's consistent investment in skills has allowed it to develop talent with an entrepreneurial mindset and technical strength. Several higher education institutions in Israel focus heavily on innovation and technology, exposing students to VCs, entrepreneurs and business leaders. The Zell Entrepreneurship programme over 20 years has produced 138 companies, of which 84 are active, and 22 have been sold or merged, raising over £9.5 million[83]. Israel has supported innovation by developing human capital with a focus on technical and entrepreneurial skills as early as primary school and throughout higher education, particularly relating to technical skills of graduates. A global mindset with links to Silicon Valley and the presence of multinational companies to allow knowledge absorption through exposure to new markets and capabilities, Israel's consistent investment in innovation has allowed it to become a global hub. Bridging the gap between R&D and consumer market through early government investment allows companies in Israel to overcome the space between initial research and successful innovation. Israel has a long history of investment in innovation and a strong vision focusing on areas of strength such as Agri-tech and health, with a well-established and well-recognised innovation ecosystem. Two examples of successful Israeli food manufacturing startups include Sufresca and Bluetree Technologies.

[82] International Flavors & Fragrances, Inc., 'Propelling Growth Through Innovative Partnerships', last accessed 4th August 2024, link

[83] The Judean, 'Israeli' startup's natural food preservative might be innovation of the century', 2nd April 2023, link

Sufresca: The invisible packaging to extend shelf life.

For decades, companies have grappled with the idea of edible packaging. Now, Agri-tech startup Sufresca looks set to be one of the first to market, with its creation of an invisible edible coating designed to extend the shelf life of fresh fruit & vegetables. The biodegradable coating is made from wholly natural ingredients and creates a breathable coating that acts as a partial barrier for the exchange of gases. This slows down the speed at which food matures post-harvest and thereby slows decay. In fact, the startup says it can extend shelf-life by several weeks, dramatically cutting down on both in-store and household waste. And, because the solution can be sold straight to processors as a liquid, it's simple to integrate into supply chains. The start-up has accessed crowd-funding to grow to market from an original discovery at Hebrew university. (Grocer, May 2023; https://thejudean.com/index.php/news/science-technology/940-israeli-startups-natural-food-preservative-might-be-innovation-of-the-century)

Bluetree Technologies: The selective tool that filters out sugar from soft drinks

With the soft drinks industry seeking ways to slash sugar, BlueTree Technologies developed a selective tool that, it claims, can reduce sugar content without the need for alternatives and without any impact on taste. Founded in 2020, the company uses a mixture of filtration and absorption to filter out the disaccharide sucrose. The other half – the monosaccharides, such as fructose – it leaves in, as this has most responsibility for sweetness, aroma and mouthfeel. Its selective tool allows the sugar removal to be ultra-targeted, says the company, calculating just the right level of removal to create lower-sugar recipes without affecting consumer experience. More than $2million raised through 'Ourcrowd' crowdfunding has financed this innovation now working together with one of Israel's largest food manufacturers (Grocer, May 2023 Grocer; https://www.thegrocer.co.uk/technology-and-supply-chain/the-eight-most-exciting-innovations-from-israeli-foodtech-startups/679369.article)

Singapore

Singapore has created a supportive food ecosystem based on collaboration and leveraging shared resources. 'FoodInnovate' is a multi-agency initiative to grow Singapore's food manufacturing industry through innovation[84]. Established by Enterprise Singapore, the Agency for Science, Technology and Research, the Economic Development Board, IPI Singapore, JTC Corporation and Singapore Food Agency, FoodInnovate aims to help Singapore food companies create and commercialise food products more quickly and sell to a larger market. FoodInnovate develops new food products with advanced technologies through a network of shared production facilities, jointly set up by EnterpriseSG and Singapore Polytechnic's Food Innovation Resource Centre; this enables the testing of new ideas and introduction of new products quickly to market without individual companies investing in expensive equipment, such as High Pressure Processing (HPP) technology. HPP technology can extending a product's shelf-life while preserving its nutritional value and quality and is suitable for products such as juices and pastes, as well as ready-to-eat (RTE) and ready-to-cook items. A shared facility to rent equipment to test new food products in small batches is an example of available supporting infrastructure that has characterised innovation in Singapore.

[84] Enterprise Singapore, 'FoodInnovate', last accessed 4th August 2024, link

2.5 UK innovation in food production: opportunities and challenges

Innovation can contribute to food security in several ways, including by:

- Increasing primary food production
- Reducing food waste
- Increasing food shelf-life
- Increasing efficiency in manufacturing techniques
- Enabling nutritional content to be preserved in manufacturing
- Improving food transportation

In the section we present just some of the areas in which innovation is, or could, support enhanced food security.

Food processing technologies

Investment in technology innovation in the food system has in the past often centred around resource optimisation, novel foods and ingredients, and increased use of data analytics in all aspects of food production, distribution and consumption. These trends have been highlighted by recent studies and media reporting, such as the rise of technologies for the production of proteins from alternative sources and the increase of various online food marketplaces and platforms to sell and deliver food (Short et al., 2021, 2022a, 2022b). Given the current UK and global economic context, the pace of implementation of such innovations may slow down as other issues around more fundamental innovation need to be addressed first by actors within the food system.

Recent innovations in food processing technologies have been driven by consumers wanting healthier, 'fresher' or fresh-like products with less chemical preservatives and processing steps compromising texture, natural ingredients, and flavour. Experts consulted for this study mentioned a number of so called non-thermal, or low temperature processing technologies that have been tested and implemented over the past decades to varying degrees, for inactivating microorganisms. These include:

- High pressure processing
- Ionising radiation
- Ultrasonics
- UV radiation
- Ohmic heating
- High voltage arc discharge
- Pulsed electric fields
- Pulsed light
- Dense phase carbon dioxide
- Cold plasma

While some of these technologies are well established, such as UV radiation for antimicrobial surface treatment, most are still at a stage where additional measures must subsequently be applied to make food products safe. Many high-energy radiation technologies need to be carefully adapted to each food type to avoid unwanted side effects at the molecular level that might impact taste or texture. Moreover, while some of the technologies allow antimicrobial effects at lower

temperatures enabling better preservation, issues with reaching all parts of the product still remain, depending on complexity of shape or microstructure.

At present the readiness level of many of these technologies, although often in development for decades, does not yet allow commercially viable up-scaling for mass production. In addition, they are mostly considerably more expensive and complex compared with conventional heat treatment technologies, which makes them more suitable at present for niche applications. Support by government could mitigate the risks of development, such as through specific funding streams that run through the HVM catapult. Currently, such technologies can be found in the premium foods segment, but with further support and growth of this market, further improvement, up-scaling and wider adoption could be expected in the mid- to long-term future[85] [86].

Case study: Fresh & Naked

'fresh & naked' use electrolysed water to clean baby salad leaves without damaging them or affecting their flavour; '…it's essentially just ordinary salt water but the way we use it is quite innovative,…we just give the leaves a fresh misting of it, but because the water droplets are negatively charged, they spin off in a sharp direction when they hit the leaf and kill any bacteria on the surface.' This, along with close monitoring throughout the production line, ultimately leads to a bagged salad that is safe to eat after a quick wash, but also stays fresh for over a week. The eight-day shelf life of fresh & naked salads offers customer convenience but equally reduces wastage, both at the home where eighty percent of food waste occurs, but a later sell-by date potentially reduces wastage in supermarkets too

Waste reduction is just one part of fresh & naked's broader aim to be as sustainable as possible. This begins in the fields, with a real focus on regenerative agriculture; reducing soil tillage as much as possible and avoiding the use of artificial fertiliser, while still only cropping the same piece of land 1.2 times a year, (below the national average). *(4th August 2022; GreatBritishChefs)*

Packaging Innovation

As previously discussed, reduction of single-used plastics is a complex issue that merits consideration of circular economy models and the implementation of 4R strategies (reduce, reuse, recycle, and recover) as well as wider sustainability and decarbonisation goals[87] However, recent reports have shown that SUP reduction via recycling or reuse is currently not delivering at any significant scale, mainly due to issues around consumer behaviour and industry practices. The absence of a policy requiring councils across the UK to collect a consistent set of materials has also been a problem. Innovations such as compostable and bio-degradable plastics, after many years in use in parts of the

[85]Foods, 'Revisiting Non-Thermal Food Processing and Preservation Methods—Action Mechanisms, Pros and Cons: A Technological Update (2016–2021)', 20th June 2021, link

[86] Food Standards Agency, 'Emerging Technologies that will impact on the UK food system', 3rd June 2021, link

[87] Foods, 'Bioplastics for Food Packaging: Environmental Impact, Trends and Regulatory Aspects', 5th October 2022, link

food system, are not delivering the environmental benefits they were designed to deliver [88] [89] [90]. Consequently, developing novel materials with properties that match those of currently used plastics and that are commercially viable at scale has become a matter of increasing urgency and there is a significant opportunity here for UK manufacturing. Specific research initiatives and dedicated centres of excellence have been launched in the UK and elsewhere to find such alternative materials such as the UKRI funded Smart Sustainable Plastic Packaging Challenge (SSPP), and the Sustainable Plastics Technology Research unit at Wageningen University in the Netherlands.

Despite recent initiatives and decades of earlier research to produce plastic alternatives including "bio-plastics", many successful small-scale trials and some emerging consumer acceptance of such alternative materials, considerable challenges remain[91] [92]. These include:

- lack of chemical/physical robustness to deliver properties required for current food safety standards,
- difficulties sourcing input materials at scale,
- production with unfavourable sustainability parameters,
- lack of studies on long term impact on consumer health,
- high costs of production at industrial scale
- willingness to pay

These challenges also apply to recent novel food packaging concepts, such as active and intelligent packaging, or biodegradable and edible films for extending shelf life.

Biotechnology: Gene Editing (GE) and Precision Breeding (PB) technologies

Biotechnology presents transformational opportunities to produce healthy and affordable food that has less impact on the environment. The development of the CRISPR/Cas9 gene editing methodology, introduced in 2013, now implied when using the term Gene Editing (GE) or, more commonly, Precision Breeding (PB), enables a much more precise and faster manipulation of DNA sequences to produce favourable traits in plants and animals. In recent public and legal definitions, GE or PB organisms are often described as "organisms that have genetic changes that could have been achieved through traditional breeding or which could occur naturally"[93] to attempt differentiation from Genetic Modification (GM) which potentially includes insertion of 'alien' DNA/RNA from other species.

The rapid evolution of GE technology over the past decade has put considerable pressure on regulators to clarify whether GE/PB is treated in regulatory terms equally to genetic modification

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[88] Greenpeace, 'Trashed. How the UK is still dumping plastic waste on the rest of the world', 17th May 2021, link
[89] Greenpeace, 'URGENT: Big Oil is Trying to Shut Down Greenpeace USA', last accessed 4th August 2024, link
[90] Frontiers in Sustainability, 'The Big Compost Experiment: Using citizen science to assess the impact and effectiveness of biodegradable and compostable plastics in UK home composting', 3rd November 2022, link
[91] Green Chemistry Issue 3, 'Expanding plastics recycling technologies: chemical aspects, technology status and challenges', 7th December 2022, link
[92] Bio-Based Materials: Contribution to Advancing Circular Economy, 'Towards a Circular Economy of Plastics: An Evaluation of the Systematic Transition to a New Generation of Bioplastics', 17th March 2022, link
[93] Department for Environment, Food & Rural Affairs, 'Summary of responses to a consultation on the regulation of genetic technologies', 29th September 2021, link

(GM) or differently. Over the past five years, some countries have responded quickly by creating frameworks/guidelines for the permitted use of GE/PB, while other countries maintain that GE/PB is to be treated like GM. This lack of harmonisation has considerable impact on the plant breeding industry and trade between countries. From a systemic perspective, it is hoped that the GE/PB production of novel plant and animal varieties can in the future help alleviate some of the pressures on the food system with regards to productivity, sustainability, and resilience[94].

Until very recently, GE/PB crops, animal feed and food were regulated in line with EU regulation as GMO, but now change with the royal assent of the Precision Breeding Act in March 2023. After approval in the UK, experts estimated that imported GE/PB crops, animals and foods might reach the UK market within the next two years. A recent consumer survey by the FSA has shown that 75% of respondents have not heard of precision breeding. Once respondents understood the technology, 50% supported the sales of GE/PB foods and products in the UK and 29% objected[95]. Most of the potential of GE/PB is currently seen in specific plant traits playing a role in resistance to climate conditions, water uptake, pest resistance, and the production of novel or improved nutrients. Education is required for both consumers and policymakers across sectors to exploit this innovation opportunity, as described in the following section.

2.6 Data, digital monitoring and AI in food and drink manufacturing

Most digital technologies and robotics utilised to date within food production have improved efficiencies along the food value chain, but they are now increasingly being seen as potential solutions to reduce environmental impacts by improving resource and energy efficiency and reducing waste, alongside the further improvement of food safety through traceability and improved consumer insights with better data-driven predictive decision making.

A report by the FSA (2021)[96] into emerging technologies that will impact the UK food system in terms of productivity, environment, society and security, showcases several new technologies in different stages of adoption. However, despite the fact that the food industry is the biggest manufacturing sector in the UK with around 12,000 businesses[97], experts perceived a lack of government mechanisms and investment to support technology innovation and implementation in the sector, which may cause particular challenges for SMEs.

A report analysing digitalisation within the industry by McNamara (2022)[98] suggested that the food and drink manufacturing sector is generally slow to adopt digitalisation. Often quoted reasons for this, even before the current crisis, included tight margins, lack of skills, lack of capital and resulting risk averseness around innovation.

Although elements of the sector are cutting edge with global food and drink manufacturers leading the way, there is considerable variation across the industry. A recent survey of food industry

[94] Genome Editing, Springer Link, 'Regulatory Constraints and Difference of Genome-Edited Crops Around the Globe', 9th November 2022, link
[95] Food Standards Agency, 'Consumer perceptions of precision breeding', 1st December 2022, link
[96] Food Standards Agency, 'Emerging technologies that will impact on the UK food system Rapid Evidence Assessment', 10th May 2021, link
[97] Food and Drink Federation, 'Key facts and stats', last accessed 4th August 2024, link
[98] Smart Industry, 'Industry Briefing: Digitalization in Food & Beverage', link

stakeholders showed that 40% of respondents do not use any sophisticated digital technologies at all, while only 33% reported using digital technologies in manufacturing processes, quality control and oversight, indicating a much lower implementation rate than one might expect. The majority of respondents (65%) stated that the main hurdle for technology adoption is selection of the right technology that is fit for purpose, followed by high capital investment, complexity of technology and lack of necessary skills. This particularly affects SMEs which make up most of the food and drinks sector[99] and leads to concerns that there could be entrenchment of a two-tier evolution of technology innovation with large, often multi-national players leading the way and SMEs lagging behind[100] [101]. Moves to reduce the administrative burden for SME food research and innovation, by allowing greater flexibility in quarterly budget forecasting, sub-contracting and raising the threshold for independent accounting reports would significantly benefit the industry. SME applicants could also benefit from higher intervention rates i.e. a raise from 70 to 90% for follow-on funding that is nearer to market.

As previously highlighted, current pressures on the food system are making food manufacturers and processors particularly wary of investment into innovation and technology adoption. They may be inclined to invest in established data capture, optimisation, and some automation solutions; however, they are not ready for novel and untested innovations and methodologies. Food industry experts consulted for this study supported this current need to focus on more established technologies rather than innovation around less tested novel technology. One global food manufacturing company interviewed explained *"more needs to be done on automation. Sensor technology is the biggest increase to automation currently and robotics. Data and AI have potential in supply chain management and forecasting…spotting disruption before it happens to predict demand changes etc. with big data analysis"*.

Views from various stakeholders interviewed also supported the view that SME food manufacturers in particular have urgent and important technology investments required to achieve supply chain security and comply with sustainability regulations; therefore innovation in development of novel technologies and processes - and also potentially a transition to healthy and nutritious foods - has been delayed due to pressures arising from the uncertain external environment. SME companies also saw the opportunity to manage labour shortages with automation and install *"management and planning systems for process planning, because of the number of skews and allergens"*.

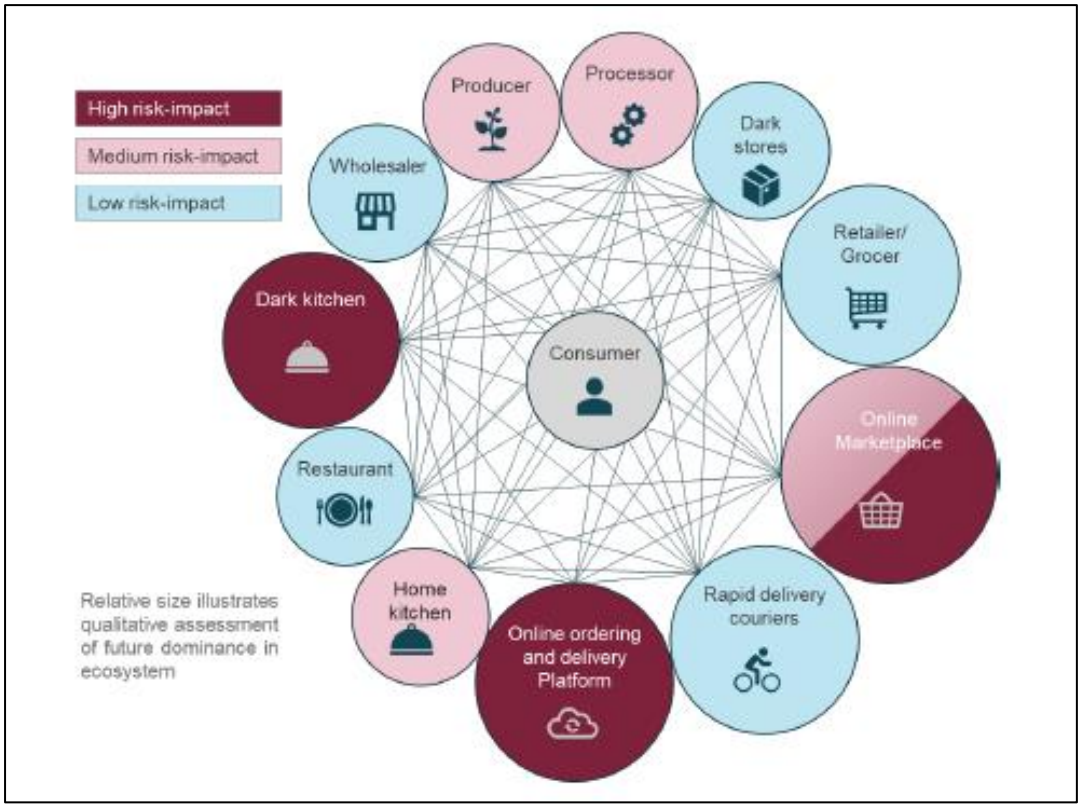
Of overall investment in AI applications in food manufacturing, such as in machine vision, predictive maintenance, Internet of Things (IoT) and e-nose fingerprint technology for detection of volatile compounds in food (food safety and quality application) only 10% are spent on AI algorithms, 20% on enabling technologies and 70% on embedding AI applications into specific business processes and agile ways of working[102]. One global food company interviewed for this report explained how they saw big potential in the further application of AI. *"Within R&D we see big potential in AI. We can multiply productivity, which means we can then focus on the big things."* Operationally, they saw automation driving efficiency and sustainability, with AI describing 'position in the manufacturing process'; *"At the moment people are making the connections of data on how to run the line etc. AI*

[99] New Food, 'Emerging tech trends report', 18th May 2022, link
[100] Food Manufacture, 'Digital transformation: where now for food processing firms?', 10th June 2022, link
[101] Trace Gains, '2023 UK Market Forecast', 28th December 2022, link
[102] Boston Consulting Group, 'Artificial Intelligence and AI at Scale', last accessed 4th August 2024, link

could be making these connections. The UK is the perfect spot for these expansions". A second global food company are exploring the potential of early warning systems using sensors and AI applied to sound profiling-alerting to potential breakdowns. However, smaller food manufacturing companies interviewed were often less clear about this potential; *"we see little application in this sector"* or *"no revolution in AI as a food manufacturer, it's more about smart automation and reducing unskilled labour. We just put in a very smart multi-fingered robot.. that picks up ..and sorts into containers for sale".*

Digital technologies have enabled new business models and digital platform-based modes of interaction between consumers and different parts of the food system in recent times. Although this offers a much more dynamic food system, it also presents novel risks in food safety and authenticity that can emerge very rapidly, requiring more flexible and responsible risk management[103] (Fig 17). The food system consequently requires novel enforcement tools and guidelines for online operators. The FSA has already started engaging with this sector, providing guidance for digital food distribution platform operators and investigating the potential impact of new technologies[104].

Figure 17: Representation of the dominant future value interaction network of the food system enabled by digital technologies. Colours indicate potential food safety/authenticity risks. Relative size of circles represents a qualitative estimate of their future role in the food system



[103] Food Standards Agency, 'Food in the digital platform economy- making sense of a dynamic ecosystem', 8th February 2022, link

[104] Food Standards Agency, 'Emerging technologies that will impact on the UK Food System', 10th May 2021, link

Case Study: British Sugar – embracing digitisation in food manufacturing

British Sugar has a long history of investing in innovative and efficient technology, not only within its four factories but also through utilising the latest digitisation capabilities. In 2022, the company launched the first private network of its kind in the UK across its four factories, enabling site teams and managers to take the control room with them. Accessing it via mobile devices to get real-time updates on what's happening across all four factories; previously the sites could only be monitored and managed via a central control room. This network also provides platform for implementation of industrial internet of things (IIOT) technology in the field of predictive maintenance and after a successful proof-of-concept, British Sugar is working on expanding the use of IIOT sensors and cloud analytics for its predictive maintenance use case.

Alongside this, British Sugar is currently working with several industry partners to investigate how machine learning and generative AI can help to automate knowledge capture and make sure processes are as efficient as possible. This involves capturing over 100+ years of knowledge from subject matter experts, coupled with operational data and documentation to produce automated analytics, 24/7 digital assistance, real-time and data-driven decision making for the site teams.

Now, with a proof-of-concept generative AI assistant, optimised for mobile use, site teams can ask and get the detailed answers they need in 10 to 20 seconds, rather than in 10 to 20 minutes as could previously have been the case. British Sugar has already seen many benefits as a result of the increased digitisation across its sites, and as future technologies and capabilities come to fruition, the business will continue to evolve and adapt to suit the demands of operating its highly efficient sites.

CHAPTER 3: The Global Dimension

3.0: Introduction

Although questions around the food market and food industry in the UK are typically cast as agricultural and regulatory, the past half-decade has demonstrated the need for a strategic review of UK food policy with an eye towards international politics. The international environment is increasingly unstable, with a major war in Europe ongoing, a likely war in the Middle East in 2024, and as of this writing, storm clouds gather in the Taiwan Strait. Government efforts on global food security need to create links between domestic policy, the commercial and business world, and government objectives to create a coherent framework in which free markets and resilient supply chains are able to deliver food security.

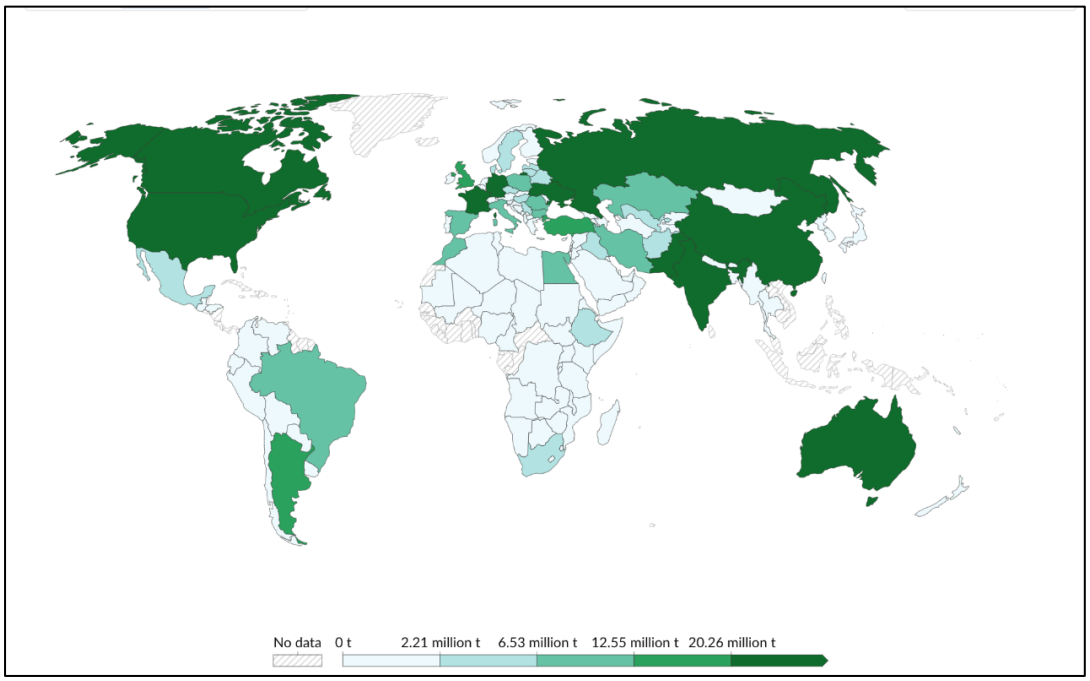
Climate change also provides an ongoing and increasing threat to food security, along side extreme weather events – and consequent impact on primary food production – forecast by scientists to increase in both frequency and severity over the coming decade. A regional drought or flooding can not only raise prices globally, making food less affordable, but necessitate the rerouting of supply chains or the substitution of ingredients within manufactured products. While geopolitical crises are an increasing risk, pressure on the global food ecosystem from climate change is a near certainty.

In light of a deteriorating geopolitical and environmental environment, this section accomplishes three tasks. First, it defines the problem set, both in terms of broader geopolitics and in the context of the strategic challenge the UK faces – to develop a policy that secures the UK from volatility in the food supply while also shaping the international environment to its benefit. Second, it identifies the most probable failure points, both the likely crises that could disrupt UK food supply and the manner in which complementary crises can increase systemic stress. Third, it reviews several potential solutions, including regulatory changes, an investment-led innovation approach, and a revamped trade policy that has a strategic bent.

3.1: The Problem Set

The COVID-19 pandemic and Russian invasion of Ukraine both disrupted the UK's food supply and export system. However, the distinctions between the two crises' impact on the food industry demonstrates the more fundamental character of the problem set the UK faces – namely, that a future supply disruption can be far more stressful than either of these events because of the cumulative failure points in the system.

Figure 18: Global Wheat Production



3.1.1: From the Pandemic to All-Out War

Although the COVID-19 pandemic made the geographic element of supply chain resilience apparent for the British public and policymakers, in many respects it also instilled a false sense of security. Supply chains were under stress for the pandemic's opening months, while the aftereffects of its disruptions lasted until early 2022.[105] However, the domestic UK agricultural industry made up the gap, while critical food inputs, namely various oils and other ingredients crucial for British food production in an industrial context, were not thoroughly disrupted.[106] Hence while supply chains were under pressure, the individual consumer did not feel an enormous strain, apart from panic-buying during the first month of the pandemic. By contrast, the disruptions that followed the Russian invasion of Ukraine in February 2022 were far more demonstrative of the threat to British food supply chains.[107] Ukraine is one of the world's largest agricultural producers, with a key role in the European market, which is and will remain the UK's most crucial food trade partner.[108] In turn, prior to 2022, Ukraine was the world's leading exporter of sunflower oil, commanding a 45-55% global market share.[109] Russia's assault took the vast majority of Ukrainian exports off the market for the war's initial months, and has made it difficult for Ukrainian farmers to return to work, even as Ukraine has established maritime export corridors and the EU has enabled overland exports through

105 Harvard Business Review, 'Global Supply Chains in a Post-Pandemic World', 2020, link; Ernst and Young, 'How COVID-19 impacted supply chains and what comes next', 6th January 2023, link

106 Centre for Rural Policy Research, University of Exeter, Transforming UK Food Systems Strategic Priorities Fund, '*Covid-19 and the UK Food System: Learning Lessons and Building Back Better*', November 2022, link

107 The House of Commons Library, 'The effect of war in Ukraine on UK Farming and food production', 18th July 2022, link

108 Food and Drink Federation, 'Record UK food and drink exports driven by growing EU demand', 15th September 2023, link

109 Bloomberg UK, 'Sunflower Oil Shortage Turns to Glut With Buyers Standing Aside', 22nd November 2023, link

Poland.[110]Moreover, alternative supply sources for various vegetable oils were difficult to come by, both for regulatory reasons and, equally relevant, because of a global fertiliser crunch.[111] Russia was one of the world's leading producers of fertiliser, meaning alternative vegetable oil suppliers struggled to expand production and meet new demand.[112] The result was a broader inflationary crisis globally, and particularly in Europe and the UK, as the food industry struggled to source alternatives.[113]Additionally, regulatory issues prevented the easy substitution of new vegetable oils. UK food regulations require producers to list a number of specific ingredients on packaging, a reasonable step for transparency and consumer protection that imposes limited cost on the producer. However, these regulations complicated emergency product substitutions, since major food producers in the UK had to re-label all products, demanding a much more comprehensive production modification.[114]

3.1.2: The Climate Threat

Climate effects compound the reality of growing and sustained geopolitical volatility. These include both *direct effects* on crop yields and broader food production capacity in the short and long-term, *indirect effects* on the food supply chain through natural disasters, and *secondary climate effects* that undermine societal stability in vulnerable areas critical to the food supply chain.

The direct implications of climate change on crop yields are well-established at this point. The most recent modelling demonstrates that, in the absence of mitigation measures, climate change will significantly curtail crop yields. Maize crop yields will decline by over a fifth if current trends continue.[115] Equally relevant, increasing temperatures in contemporary agricultural areas will curtail production. Increasing temperatures do provide some help by allowing the northern and southern hemispheres to cultivate crops in areas that would otherwise be far too cold. However, the most up-to-date projections indicate that the net result will be a loss of between four and five percent of global crop yields.[116] In turn, soil degradation and biodiversity loss will accelerate these issues.[117] Not only will it reduce crop yields and decrease food stability, but it will also erode one of the ecosystem's most reliable carbon sinks, intensifying broader climate effects.[118]

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110 European Council, Council of the European Union, 'Ukrainian grain exports explained', 8th February 2024, link

111 World Economic Forum, 'This is how war in Europe is disrupting fertilizer supplies and threatening global food security', 1st March 2023, link

112 International Food Policy Research Institute, 'The Russia-Ukraine war after a year: Impacts on fertilizer production, prices, and trade flows", 9th March 2023, link

113 The Guardian, 'UK food prices soar by record 10.6% as Russia-Ukraine war pushes up costs', 28th September 2022, link; The Telegraph, 'How escalating conflict in Ukraine deepens Britain's food price woes', 10th June 2023, link; Financial Times, 'UK food inflation falls in December as shops roll out seasonal offers', 2nd January 2024, link; House of Lords Library, 'Cost of living: Food price inflation', 10th February 2023, link

114 Food Standards Agency, 'FSA Response to Ukraine Conflict Supply Chain Disruption: Ingredient Substitution and Labelling', , last updated 1st June 2022, link

115 NASA, 'Global Climate Change Impact on Crops Expected within 10 years, NASA Study Finds', 2nd November 2021, link

116 Nature Climate Change, 'Warming reduces global agricultural production by decreasing cropping frequency and yields', 10th October 2022, link

117https://www.eea.europa.eu/signals-archived/signals-2019-content-list/articles/soil-land-and-climate-change

118https://www.sciencedirect.com/science/article/pii/S0012825222000058

Although a wave of crop failures is certainly possible, the direct impact of climate change on the food supply system is likely, at least in part, to be broad and structural – a shrinking global supply of food, alongside a growing global population and more irregular harvests will drive up prices as supply contracts. Of equal importance, however, are natural disasters and other impacts on the broader food supply chain beyond production. The vast majority of food imports and exports are maritime, much like broader global commerce.[119] Major ports are clearly vulnerable to climate disruption, both in the short and long term. In the short-term, south and southeast Asia is most at risk. There is already evidence of climate change triggering more intense storms, including monsoons and typhoons.[120] While these are standard characteristics of the south and southeast Asian climate system, more frequent, more intense events could ultimately damage or destroy a major export facility, with attendant disruption throughout the food supply chain. Also relevant is broader sea level rise. Major modern ports are by no means climate-proofed, meaning they will need to be adapted to rising sea levels, or risk having their major infrastructure taken offline.[121] If this were to occur concurrently with other natural disasters, the result would be a large-scale food supply contraction that occurs even if crop yields and other sorts of food production remain stable or expand.

Finally, climate change has secondary effects on social stability. There is some evidence that Middle Eastern volatility since the late 2000s has been driven by climate effects.[122] Similar evidence can be found in Africa, arguably in the Darfur Conflict.[123] Naturally, state collapse and major warfare will always have direct proximate causes of a political or economic character, and the genesis, course, and settlement of any conflict will owe far more to political realities than to climate effects in a direct sense. Nevertheless, there is clearly an *indirect* structural link between climate change and broader societal disruption. The reality is, given the UK's reliance upon the European market for food imports, and the European market's connections to the rest of the world, large-scale disruption in parts of Africa, Latin America, and south and southeast Asia will impact the UK's food security rather directly.

3.1.3: The British Food System

The point of the above is to demonstrate the likelihood of second order effects that stem from a major food supply disruption, akin to what occurred after February 2022. Basic inputs must be changed, leading to demand pressure that well outstrips initial alternative supply, while regulatory procedures designed for a normally functioning international supply chain system add unintentional costs and delays, all fuelling inflation.

The UK is and will remain food-import dependent, with its supply chain primarily linked to Europe. Other essential food supply chain elements, however, are sourced in Asia, Africa, and Latin America,

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119The Center for Strategic and International Trade, 'From Farm to Ship Fork: The Role of Maritime Insurance in Facilitating Global Food Trade', 10th June 2024, link

120World Meteorological Organization, 'Climate change and extreme weather impacts hit Asia hard', 23rd April 2024, link

121 The United Nations Conference on Trade and Development, 'Climate change impact on seaports: A growing threat to sustainable trade and development', 4th June 2021, link

122 Center for American Progress, Stimson Center, The Centre for Climate and Security, 'The Arab Spring and Climate Change', February 2013, link

123 Brookings, 'Foresight Africa viewpoint: Does climate change cause conflict?', 20th January 2017, link

including vegetable oils, fresh fruit and vegetables, and basic grains. While the UK food industry is complex and largely adaptable, the sheer number of inputs required for food production in the UK demand attention to the risks of British food import dependence. This cannot be remedied *per se* – the UK cannot and should not attempt to transform its food import system to meet all demands with domestic production, since this attempt would be both prohibitively expensive and almost certainly unfeasible.

Figure 19: UK Food Supply Ratio

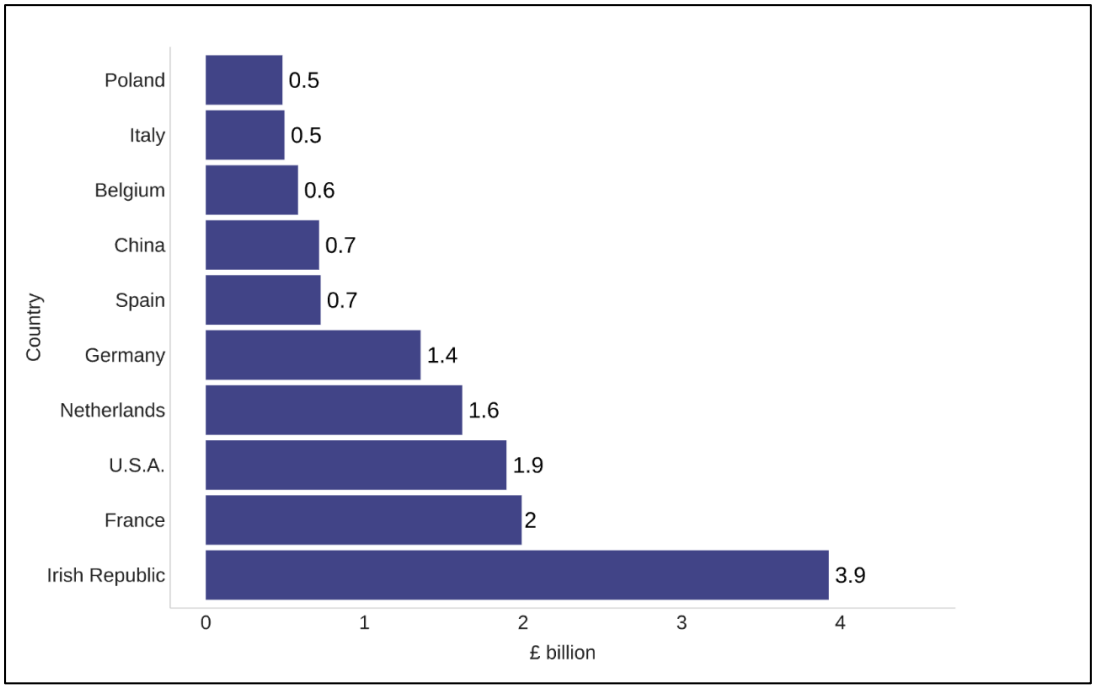
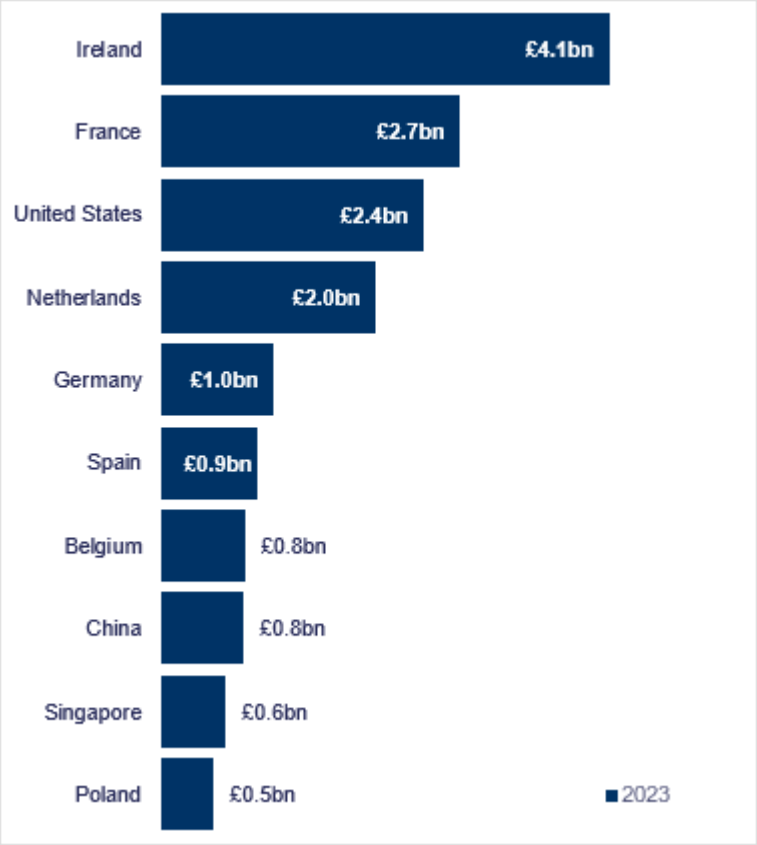


Figure 20: UK Top 10 Country Food and Drink Export Values (Country of Destination)



Non-tariff food trade barriers have been disruptive to UK food exports since Brexit, since the EU remains the UK's critical food trade partner.[124] Regulations that govern rules of origin and sanitary inspections compound an already stressed supply chain and a Heavy Goods Vehicle driver shortage.[125] The legislative framework makes the UK less agile than international partners in responding to shocks or crises in the supply chain. For example, to suspend or change the duty on a single product line requires a full Statutory Instrument to be laid in parliament with the following implications.

- Submissions for SIs to be laid in parliament must be made by the first Friday of the month for a date in the following month. Where SIs are subject to the negative procedure, they will not enter into force until 21 days after the laying date in parliament. Overall, this can create a lead time of a number of months to change the tariff on one line.
- Due to the length and difficulty of this process (commissioning lawyers, writing Explanatory Memorandum, updating reference documents) tariff legislation is often grouped together, delaying the implementation of pressing policy.
- Whilst the UK moved to suspend the duty on sunflower oil following the war in Ukraine, it took several months as the measure was packaged together with other changes.

Other countries e.g. EU or NZ have more power to make changes in tariff systems before later updating legislation allowing them to more readily adapt to unexpected changes. The UK should adopt a similar approach to improve its response to emergency situations.

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124 www. Parliament.uk, 'Chapter 3: Non-tariff barriers', 2018, link
125 HR Forecast, 'UK and EU truck driver shortage: Causes, consequences, and solutions', 23rd May 2023, link

However, despite non-tariff barriers, there is some evidence that the UK's broader tariff reorganisation after Brexit has offset non-tariff barrier disruption.[126] Nevertheless, absent a carefully designed food trade policy, there is a long-term risk that, considering the UK's more constrained food supply system than the EU's, non-tariff barriers will have a deleterious effect on UK food exports. The food industry is also central to the UK's broader trade policy. UK export promotion specifically identifies UK food products as a paradigmatic case considering that the food sector, as of 2021, was the UK's largest manufacturing industry.[127] The UK's 12-point export plan theoretically should bolster food exports, particularly considering UK Export Finance's specific focus on the food sector.[128] As of this writing, however, there have yet to be major changes in UK food export regulation, nor has the UK's broader trade and export strategy trickled down to that of the food industry.

3.1.4: Policy Considerations and Advantages

The UK *can* pay much greater strategic attention to the structure of its food supply chain as it relates to international events and its food industry. The potential for disruption in Europe, the Middle East, and the Indo-Pacific – and as will be detailed in the subsequent section, the potential for multiple crises to occur concurrently – compels a much more coherent food policy.

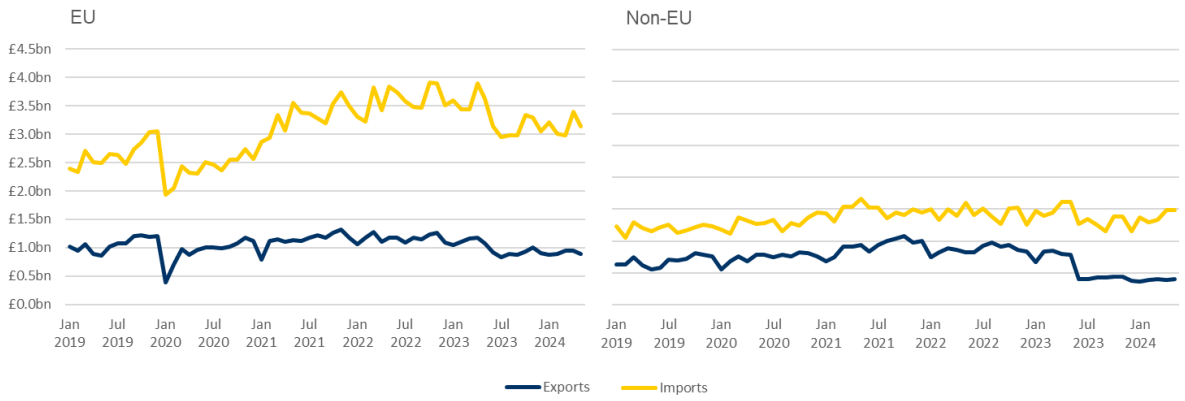
There are two fundamental considerations at play.

First, if we assume, as is prudent considering accelerating Eurasian competition, that volatility in international supply chains, and particularly food supply chains, is the new normal, then how should food questions be placed within an integrated foreign policy? The UK will be wealthy enough to purchase food and, assuming it has an accessible merchant marine, capable of transporting it to its territory for industrial processing. However, the UK has the resources and international position to consider seriously a longer-range strategic plan that in-builds resilience into its food supply system, and by extension, improve resilience in the countries upon which it depends for food supply stability.

Second, because geopolitical volatility and the climate crisis are likely to converge over the coming 15 years, as climate effects modify the global food system, and the world's advanced economies transition towards a green future, British food policy must generate a system of trade, regulation, and diplomatic levers to generate a structure that favours British interests and fosters stability.

126 Hinrich Foundation, 'Non-tariff barriers and the mystery of UK food price inflation', 14th March 2023, link
127 Department for International Trade, Department for Business & Trade, 'Made in the UK, Sold to the World', 17th November 2021, link
128 UK Export Finance, 'Eight-figure funding package propels Scottish fish processing business into new international markets', no date, link

Figure 21: UK Food and Drink Trade Value, EU vs Non-EU



The UK has a distinct advantage over its two major partners, the US and EU, given its relative size and ability to modify its strategy and regulatory approach rapidly. The US is one of the world's largest food producers, particularly when it comes to corn, Sorghum, certain beans, and oil crops, and is also home to a thriving livestock industry.[129] However, US food regulation is unwieldy, with multiple over-regulated areas and regulatory gaps.[130]The EU's situation is even more complex. The European Food and Drink Industry is the EU's leading employer.[131] Moreover, the EU as a whole is the world's largest food and drink exporter and its second-largest importer.[132] The US is one of the EU's largest food trade partners, with a generated monetary value only behind that of the UK.[133] However, the EU's food regulation process, much like most EU regulation, is labyrinthine, and has faced pushback from member states. Moreover, as the Polish agricultural protests have demonstrated, the EU has struggled to modify its food regulatory policy in light of geopolitical shifts. The result is a pair of UK partners that are immensely valuable both to the UK and to each other, but which also lack the ability to craft a policy with sufficient granularity to ensure mutual competitiveness and strategic benefit.

3.2: Failure Points

There are three major failure points in the current Eurasian supply chain system that impinge upon the UK's food supply and food industry: a European crisis, a Middle Eastern disruption, and an Indo-Pacific conflagration or period of prolonged tension. These are likely to run together between now and 2030, compelling the UK to develop a holistic policy.

3.2.1: Europe

As of this writing, the Ukraine War is set to enter its third year. It is unlikely to end – or more accurately, to grind into a tense ceasefire – before late 2024 at the earliest.[134] Moreover, regardless

129 Food and Agriculture Organization of the United Nations, 'Agricultural production statistics 2000-2021', link

130 Institute of Medicine (US) and National Research Council (US) Committee to Ensure Safe Food from Production to Consumption, 'Where Current US Food Safety Activities Fall Short', 1998, link

131 European Commission, 'Agri-food Industrial Ecosystem', last accessed 4th August 2024, link

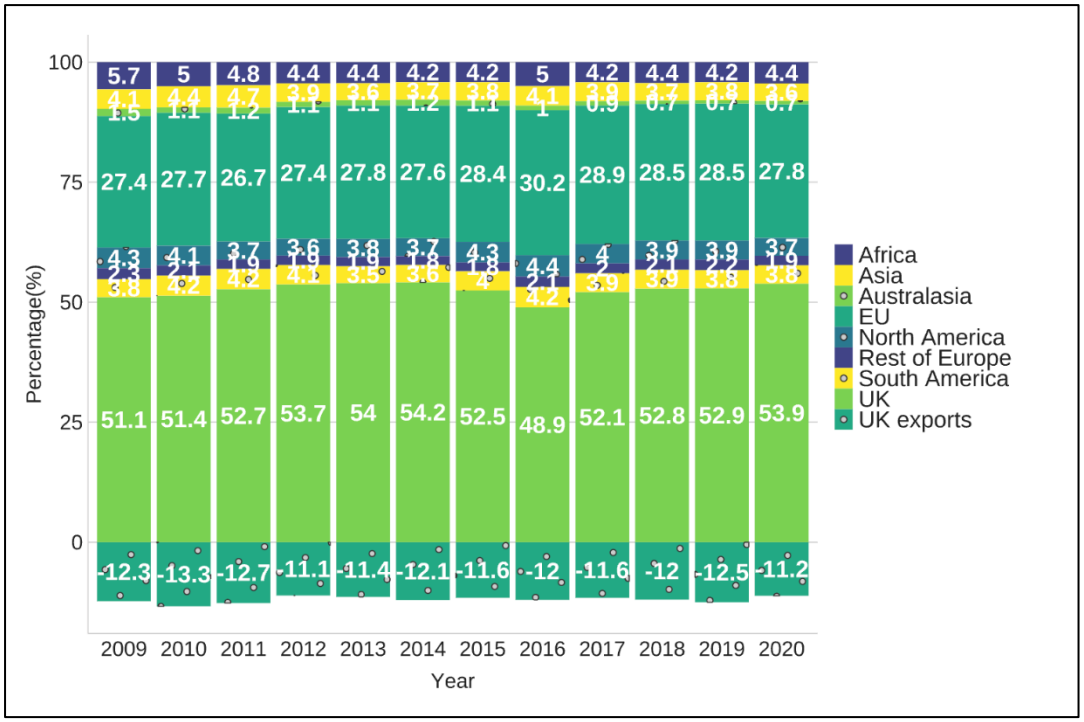
132 European Commission, 'Processed agricultural products in the EU', last accessed 4th August 2024, link

133 European Commission, 'Agri-food trade statistical factsheet', 15th April 2024, link

134 The New York Times, 'Putin Quietly Signals He Is Open to a Cease-Fire in Ukraine', 23rd December 2023, link; Los Angeles Times, 'Ukraine's Zelensky rules out a cease-fire, saying Russia would use it to rearm', 11th January 2024, link

of the precise result of the war, Russia will remain a threat to Europe and the UK near-indefinitely.[135] This situation has obvious geopolitical implications for defence and foreign policy. But it also has significant implications for food security. The danger to the food supply chain stems both from disruption within Europe and from Russian power projection in the Mediterranean and North Africa. Europe is the UK's primary food supply partner, both for imports and exports.[136] Russian disruption can resurrect the 2022 food supply shocks, while if Russia can wrest from Ukraine its most lucrative food-producing regions and its southern coast, it can undermine Ukrainian exports once again.[137] Meanwhile, Russia's position in the Black Sea, founded upon its control of Crimea and southeastern Ukraine, give it the ability to disrupt Turkish-NATO relations.[138] This will have a downstream impact on any trade with Turkey, reinforcing tariff problems that the British food industry has already encountered when attempting to switch inputs after February 2022.[139]

Figure 22: UK Food Consumption by Origin, 2009-2020



In the worst case, Russian pressure on Ukraine and NATO, combined with a surge in populist sentiment, can fragment the European economic system, of which the UK is a part by virtue of

135 The Guardian, 'The threat from Russia is not going away. Europe has to get serious about its own defence', 10th July 2023, link; Royal United Services Institute, 'Europe Must Urgently Prepare to Deter Russia Without Large-Scale US Support' 7th December 2023, link; Carnegie Endowment for International Peace , 'The West's Inaction Over Ukraine Risks Dangerous Conclusions in Moscow', 18th December 2023, link

136 US Department of Agriculture Economic Research Service, 'Since Brexit, United Kingdom's Agricultural Trade With European Union Remains Strong; Opportunities for U.S. Exports Emerge', 5th December 2023, link

137 Center for Strategic and International Studies, 'Why Is Russia Blocking Ukraine's Food Exports?', 15th September 2023, link; United States Institute of Peace, 'Russia Expands Its War on Ukraine — to Global Food Supplies' 20th July 2023, link

138 Politico, 'Russia and Turkey vie over Black Sea, as Erdoğan prepares to visit Putin', 30th August 2023, link; The RAND Corporation, 'Consequences of the War in Ukraine: Two Areas of Contention—Turkey and the Balkans', 6th March 2023, link

139 National Farmers' Union, 'Trade with Turkey – NFU welcomes updated trade deal talks', 24th July 2023, link

history, commerce, and geography. This will trigger a wave of tariffs and other protectionist measures that make it increasingly difficult for the UK to access the European market, with knock-on effects that further undermine British food supply

Additionally, there is a reasonable chance that Russia, considering its desire to fragment the West and undermine its position in Europe's neighbouring regions, will use its influence in north and central Africa to undermine stability.[140] The UK does not fundamentally rely upon Africa in its food supply chain, but the incidental impact of removing potential secondary suppliers in Africa will narrow British options in a future crisis.

3.2.2: The Middle East

Although the UK is most reliant upon Europe, the Middle East is relevant for the UK's food supply chain primarily because of commercial geography: the overwhelming majority of goods that flow between Europe and Asia, including British food exports and crucial vegetable oil and alternative imports.[141] The Middle East is primed for a much broader crisis that is likely to take several years to resolve.[142] Iran's campaign for regional power has placed the UK and its allies directly in the crosshairs of its strategy, which demands long-term pressure, rather than an individual conflict that overturns the strategic situation.[143] The contours of the coming conflagration are apparent today, as Iran menaces Israel in Lebanon and Syria, disrupts Jordan, and pressures the Suez-to-Indian Ocean trade route through its Houthi proxies in Yemen.[144]

Figure 23: Price Changes in Essential Food Inputs

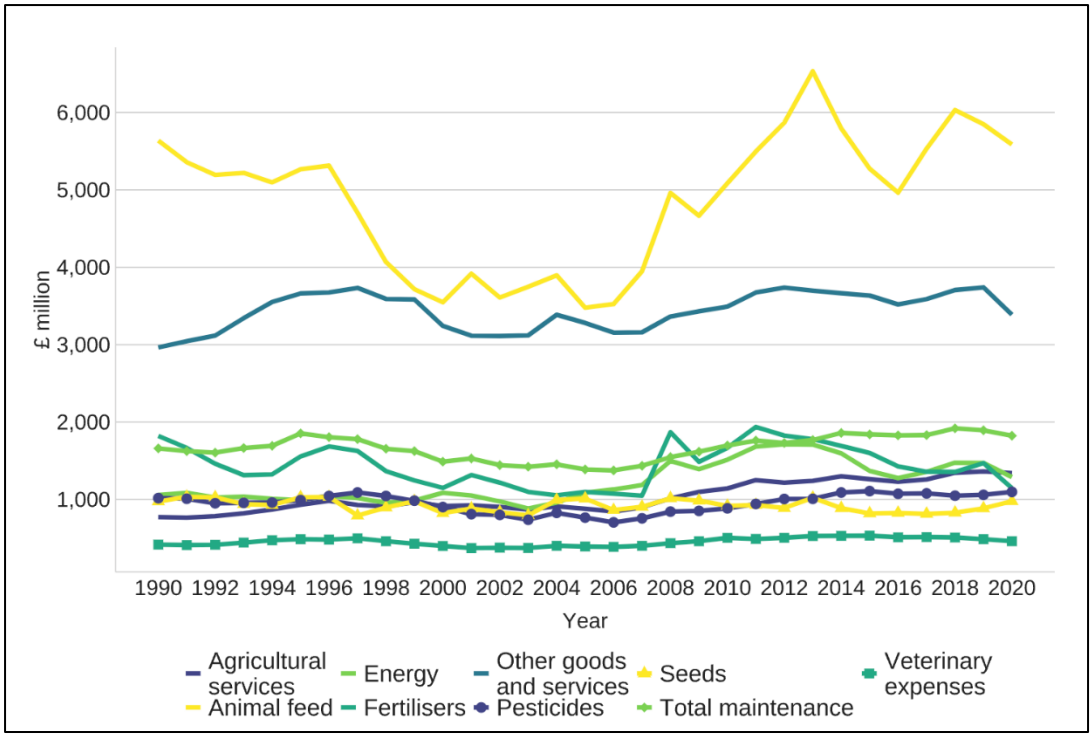
140 Council on Foreign Relations, 'Russia's Growing Footprint in Africa', 28th December 2023, link; Africa Center for Strategic Studies, 'Inflection Point for Africa–Russia Relations after Prigozhin's Death', 6th September 2023, link; *Carnegie Endowment for International Peace*, 'Russia's Growing Footprint in Africa's Sahel Region', 28th February 2023, link

141 Institute of Grocery Distribution, 'Red Sea attacks – implications for UK food and grocery businesses', 3rd January 2024, link; Financial Times, 'Red Sea crisis raises fears for global trade', 12th January 2024, link

142 United States Institute of Peace, 'Is the Middle East on the Verge of a Wider War?', 8th January 2024, link

143 Policy Exchange, '*The Iran Question and British Strategy*', July 2023, link

144 American Enterprise Institute, 'Preventing a Wider Middle East War', *3rd* November 2023, link



Multiple rounds of Middle East escalation are probable in the coming year, especially considering the difficulty the US and UK have in deterring Houthi action against Red Sea shipping and degrading the Houthis militarily without an extended air campaign.[145] This makes the Red Sea, for the first time in well over a century, a largely unstable, and potentially unusable, trade route, with direct ramifications upon British food supply chain elements that originate and terminate in Asia.[146]A prolonged Middle East crisis will have broader effects on global shipping markets and other supply chains as well, both as major shipping companies reroute their cargo around Africa and insurance premiums increase.[147] Both will drive inflation, with a downstream effect on the food industry regardless of any direct disruption.

3.2.3: The Indo-Pacific

The Indo-Pacific, the centre of global economic gravity, is under active contestation between China and the US and its allies.[148] China menaces Taiwan, an island-republic it claims as part of its territory, which is located at the heart of the First Island Chain and dominates the region's major north-south trade lanes.[149]A major conflict over Taiwan would rapidly spread throughout the region and lead to

145 The Wall Street Journal, 'U.S. Strikes Give Yemen's Houthis the Enemy They Long Sought', *13th* January 2024, link; BBC News, 'What we know about strikes on Houthis and strategy behind them', 13th January 2024, link

146 Bloomberg UK, 'US and UK Strike Yemen's Houthis After Red Sea Ship Attacks', 12th January 2024, link; Bloomberg UK, 'Red Sea Shipping Crisis Could Reignite Inflation, Warns Tesco', *11th* January 2024, link

147 Reuters, 'War risk insurance rates edge up after surge in Red Sea ship attacks', 4th December 2023, link; S&P Global 'Israeli tankers exposed to high insurance rates, less competitive in spot trade', 21st November 2023, link

148 Oxford University Press, 'The Long Game. China's Grand Strategy to Displace American Order', 11th May 2023, link

149 Brookings, 'Geostrategic competition and overseas basing in East Asia and the First Island Chain', February 2023, link; Australian Institute of International Affairs, 'The Taiwan Frontier and the Chinese Dominance for the Second Island Chain', *13th* August 2020, link; The Wilson Center, 'US Strategic Interest in Deterring Aggression Against Taiwan Is Paramount', 22nd September 2023, link.

obvious economic deterioration globally, particularly as regional shipping grinds to a halt and the global semiconductor supply collapses with TSMC either disabled or destroyed.[150] Any Asian food suppliers, particularly important for vegetable oils, rice, fresh fruit and vegetables, and wine, will be off the market indefinitely, if not physically damaged.[151]However, there are a number of crises that one can envision well below the threshold of large-scale great power war that will nevertheless trigger a major food supply crisis. The most apparent, and most relevant, is a blockade crisis scenario, under which China imposes a maritime blockade of Taiwan that leads to a prolonged standoff akin to the 1962 Cuban Missile Crisis. This blockade may well lead to war, although a graduated escalation provides all parties options to step away from the brink.

Regardless, even the initiation of a period of heightened militarised tension in east Asia will impinge upon food supplies.[152] Maritime transport insurance premiums will skyrocket, particularly because the world's largest shipping companies are all headquartered in east Asia, whether in Taiwan, mainland China, Japan, or the Republic of Korea.[153] Any secondary crises – a dust-up between China and Vietnam, or a flair up of violence on the Korean peninsula, for example – will intensify the transport pressure.[154]Moreover, China holds a dominant position in international shipping, with the world's largest merchant fleet.[155] It is reasonably easy to envision Beijing, during a major crisis, declaring that it will only protect and permit Chinese-flagged and Chinese-owned ships to do business within the First Island Chain, the string of island and archipelagos that runs from Japan through Taiwan and curves around to demarcate the South China Sea.[156] This would severely complicate shipping costs well before a major conflict began. Additionally, Beijing and Washington would engage in several rounds of economic warfare, levelling broad tariffs against each other in multiple contexts.[157] This would, to be sure, open up some opportunities for the British food industry, particularly since China remains a major export partner for US agriculture – American goods would need to move elsewhere, creating a market gap for British buyers and partners.[158] However,

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150 Time, 'The Chips That Make Taiwan the Center of the World', 5th October 2022, link; The Economist, 'Taiwan's dominance of the chip industry makes it more important', *6th* March 2023, link; Bloomberg UK, 'Xi, Biden and the $10 Trillion Cost of War Over Taiwan', *9th* January 2024, link

151 See World Integrated Trade Solutions data, most recently from 2021, accessed via: link; see also Food Standards Agency, '*Our Food 2021: An annual review of food standards across the UK*, 27th June 2022, link

152 The Rhodium Group, 'The Global Economic Disruptions from a Taiwan Conflict', 14 December 2022, link

153 DFreight, 'Asian Shipping Industry: Powerful Companies in Global Trade', 6 February 2023, link; UN Conference on Trade and Development, 'Review of Maritime Transport 2023: Facts and Figures on Asia', 27th September 2023, link

154 Newsweek, 'North Korea Watchers Issue Ominous 2024 Warning', 12th January 2024, link

155 South China Morning Post, 'China's maritime ambitions boosted, claims largest shipping fleet title from Greece', 14th August 2023, link; Center for Strategic and International Studies, 'Hidden Harbors: China's State-backed Shipping Industry', July *8th* 2020, link

156 The Times, 'Chinese fleet of militarised ships 'a threat to trade'', 26th December 2022, link

157 Carnegie Endowment for International Peace, 'The U.S.-China Trade War Has Become a Cold War', 16th September 2021, link; UCLA Anderson Review, 'In U.S.-China Trade War, Bystander Countries Increase Exports', 23 August 2023, link

158 For the broader impact of US-UK food trade modifications, see Agriculture and Horticulture Development Board, '*A UK/US Free Trade Agreement and its impact on UK agriculture*', March 2021 link; The Guardian, 'US wants UK to open up its agriculture markets as part of new trade deal', *3rd* October 2023, link

supply chain derailment, along with general inflation from a real Sino-American trade war, would pose a major threat to the UK food system's stability.[159]

3.2.4: Multiple Crises

Each of the crises can occur independently, as the past two years demonstrate. However, as Eurasian contestation accelerates, the odds increase of multiple concurrent crises in each region. One can see this beginning today, first with the Ukraine War and then with the now-building Middle Eastern crisis that began after 7 October 2023. Beijing is almost certain to conduct several demonstrations of military capacity against Taiwan during the first half of 2024, and most likely will conduct a similar set of exercises in October to December to coincide with the US presidential election.

Eurasia's three regions, therefore, are in varying states of crisis highly unlikely to dissipate in the next 12 months, and still unlikely to dissipate in the next five years, even if a major regional war does not occur in any of these incidents. The result is a volatile Eurasian environment that undermines British food supply chain stability, and necessitates an eye towards food supply resilience and alternatives that can be activated quickly during a major disruption.

3.3: Solutions

Four lines of effort are needed to enable a geopolitically oriented food industry policy in the UK: a focus on *supplier switching and diversification*, an emphasis on *investment for research and development*, a focus on *long-range sustainability and international aid*, and better *integration with trade policy*.

3.3.1: Trade

Holistic trade policy

A Holistic Trade Policy: Export promotion should remain key to UK trade policy, and particularly for the food industry. However, adding a major focus on imports and intermediate suppliers will help increase the resilience of the UK food system.

Cross-border processes

DBT & Defra should build on the Windsor framework with FCDO to deliver reduced friction for EU trade with simplified customs procedures post-Brexit; achieving greater mutual recognition and harmonisation of procedures. As described above, regulation in areas such as novel foods is further complicated by NI trade. Adoption of digital certification and use of technology could further support this transition.

International Aid: The UK has an international aid relationship with a number of primary and secondary food suppliers throughout Africa, Latin America, and elsewhere. The UK could use this aid relationship to begin to phase in inducements for food production regulations that align with long-term strategic and sustainability considerations and may increasingly represent balanced trading opportunities that could support a National Food Security Strategy through new supply routes to the

159 *American Journal of Transportation*, 'How the trade war has led to higher food prices', 27th July 2022, link; Energy Economics Volume 120, 'The US-China trade war and the volatility linkages between energy and agricultural commodities', April 2023, link

UK, whilst helping these developing countries strengthen their agricultural sectors, rise up the value chain and create environmental benefits.