AGILE INITIATIVE | OXFORD MARTIN SCHOOL | UNIVERSITY OF OXFORD

EVIDENCE SYNTHESIS REPORT

Managing Demand: Energy Security, Food Security and National Security

Environment and National Security: Exploring the Risk Pathways

November 2026



About

This document is one of a series of reports from the Agile Initiative's Environment and National Security: Exploring the Risk Pathways project. The Evidence Synthesis Reports provide the detailed evidence underpinning the shorter Priority Policy Questions: Summary of Key Findings reports.

The project also produced a Forward-looking Research Agenda containing an overview of the whole project, a conceptual framework illustrating the links between environment and security, a summary of the current UK government policy position, a research agenda listing almost 200 evidence gaps, analysis of potential interventions, and guidance on how to communicate the key issues effectively based on insights from behavioural science.

The Evidence Synthesis Report Series

- The role of critical natural infrastructure in supporting national security
- Managing demand: energy security, food security and UK national security
- Climate risks and opportunities for shipping and UK maritime trade
- Weaponisation of nature
- Societal resilience and mental capital

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Summary

Q1a

How will communities react to changes in food/energy access and price?

Q1b

How will communities react to policy responses to reduce demand for food and energy?

Q2

How might efforts to increase UK food and energy production result in increased pressure on the environment and feedback to other aspects of the food and energy systems?

Q3a

To what extent are the UK food and energy systems currently resilient?

Q3b

What conditions need to be 'true' for the UK food and energy system to be resilient under current climate change projections?

Energy security and food security are foundational to national security. Price shocks or shortages can cascade rapidly across households, businesses, public services, and government, particularly where current food and energy systems are already vulnerable to disruptions. This report shows that energy and food systems are closely interlinked and should be addressed as part of an integrated UK resilience strategy, not as separate policy silos.

While resilience strategies usually address 'robustness' to maintain the status quo and 'recovery' to bounce back, a new concept of 'reorientation' aims for system transformation to make systems more resilient before disruption occurs. Managing demand is a key strategy for this, as less demanding systems are less vulnerable to disruption.

The UK population's preference for freedom of choice and aversion to market interference can, however, constitute a barrier to change [Q1a]. Not surprisingly, radical policies are less favoured. Interest groups with entrenched corporate control over the food and energy systems can lobby against proposals for energy reduction and changes to food composition, also influencing the public response [Q1b].

More positively, emphasising the multiple benefits of such policies can increase acceptability. Key options to engage society in reducing demand include a major public awareness and education campaign to increase food system 'literacy', together with changes to the food and energy environments that shape purchase and consumption decisions. This would need cross-government and cross-party consensus.

Upheaval in international markets can lead to calls for more UK production to increase resilience. However, efforts to boost domestic food production through intensification typically rely on fertilizers, other synthetic inputs, and heavy farm machinery all of which negatively affect soils, biodiversity, and GHG emissions [Q2]. This challenge can be mitigated by continued reduction in fossil fuel reliance, boosted by electrification, efficiency and sufficiency, and changing diets together with increased use of alternative farming practices. This should be complemented by efforts to halve per capita food waste by 2030, all as part of the overall 'reorientation' strategy.

The UK's food and energy systems are both currently reliable, and widespread or long-lasting disruptions are rare. However, there are also persistent significant levels of fuel poverty exacerbated by energy price spikes, which limit access to energy, and many households are food insecure due to low economic access to healthy diets [Q3a]. Both systems have seen price inflation due to environmental, geopolitical, pandemic, and other macroeconomic shocks.

The conditions needed to enhance resilience [Q3b] therefore relate to either the food system drivers (which influence peoples' activities) or outcomes (which the food system delivers to society). Policy drivers can include opportunities (e.g. subsidies) or disincentives (e.g. taxes), causing people to change their behaviour to achieve desired outcomes. The nature of, and balance across these outcomes collectively defines societal well-being, i.e., the conditions that define the nature of the system resilience.



Introduction

Why food and energy matter for national security

Energy and food security are not peripheral to national security; they are foundational to it. Both sectors are designated as UK Critical National Infrastructure.[1]

Energy powers homes, hospitals, transport, industry, communications, food supply chains, and emergency responses to crises. Food systems sustain health, labour productivity, social stability, and public confidence. When these systems are reliable, resilient, and adaptive, they support everyday life and strengthen national preparedness. When exposed to price shocks, infrastructure failure, ecological degradation, or geopolitical disruption, risk can cascade rapidly across households, businesses, public services, and government. The central argument of this report is that the UK's national security increasingly depends on treating energy and food systems as connected resilience priorities, not separate policy silos.

The food system has a substantial environmental footprint and a significant energy demand from fertiliser production, agricultural activities, food processing, refrigeration, retail, cooking, and waste management. Energy demand extends further to transport, communications, and industrial and domestic uses. Energy shocks can therefore become food shocks, while food system pressures can feed back into energy demand and wider environmental stress. Enhancing national security requires better management of overall demand for both energy and food, as reducing demand alleviates environmental degradation while improving system resilience.[2]

Resilience is the capacity to resist, cope with, and/or recover from shocks and/or stresses. It comprises physical, economic, behavioural, cognitive, and emotional dimensions. Options to mitigate shocks and/or stresses include 3 'Rs':

Robustness: the capacity of the food and energy system actors to adapt their activities to resist disruptions to desired system outcomes.

Recovery: the ability of food and energy system actors to adapt their activities to be able to return to pre-existing system outcomes following disruption.

Reorientation (Transformative Resilience): the ability of food and energy system actors to adapt their activities based on accepting alternative system outcomes as a strategy *before or after* disruption. It is based on the premise that changing institutional settings, as well as societal expectations or demands of system outcomes, can enhance food and energy system resilience by making them inherently less vulnerable to shocks and stresses, as they are less demanding on the natural resource base upon which they fundamentally depend. It therefore involves moving away from the *status quo* and adopting a vision of what is an acceptable set of different outcomes, although this may be socially, politically and/or culturally challenging. Nonetheless, the 'reorientation' concept is particularly useful as, in addition to reducing environmental pressure, it could also lead to better health and social outcomes, e.g. due to changed diets or better-insulated homes.

Strategies to enhance resilience entail employing combinations of the 3 Rs. But deciding on resilience strategies requires addressing four framing questions:[3]

1. **Resilience of what?**
   The UK's food and energy systems.

2. **Resilience to what?**
   Environmental change in all its manifestations.

3. **Resilience from whose perspective and for whom?**
   Government, businesses, communities, vulnerable households.

4. **Resilience over what time frame?**
   This depends on the flow of influence over time from driver to activity to outcome, and the potential feedback, for the specific system of interest. It could be days (e.g. for just-in-time fresh food delivery) to years (e.g. for established fruit orchards).

Rethinking how to deliver energy security

Traditionally, energy security has referred to whether a state can maintain reliable access to the energy it needs and withstand disruptions to supply, primarily framed around fossil fuels, import dependence, price volatility, and geopolitical disruption.[4] These risks have persisted, but the energy transition is reshaping what security requires. A renewables-based system faces different vulnerabilities, including access to clean technologies, flexible electricity grids, protection of energy infrastructure, demand-side management, cybersecurity, climate-related infrastructure risks, human security, and supply chains for critical minerals such as lithium, cobalt, and rare earth elements.[5]

This report defines energy security as the capacity of the UK to reliably meet current and future energy demand, manage domestic and external energy dependencies, and withstand or recover quickly from shocks to energy supply, infrastructure, and markets. Affordability and sustainability are treated as related but distinct goals that shape whether energy security delivers wider public value. This framing is relevant because the energy transition can reduce some traditional security risks (e.g., exposure to volatile fossil fuel markets) while creating new ones (e.g., dependence on clean technology supply chains and skilled labour). The policy challenge is to reduce fossil fuel exposure while building institutions, infrastructure, and supply chains for a reliable clean energy system.

Why food security is fundamental to national security

It is misleading to reduce food security to simply national self-sufficiency or calorie supply. A country can have stocked supermarket shelves while still experiencing food insecurity if households cannot afford healthy diets, supply chains are fragile, farming is exposed to volatile input costs, or supporting ecosystems are degrading. In 2023/24, 7.5 million people (11%) in the UK were in food insecure households.[6]

The UK imports around 50% of its vegetables and 85% of its fruit.[7] Defra frames food supply chain resilience as the stability from production through to consumption, including physical, human, and economic infrastructure: transportation networks, retailers, ports, warehouses, cold chains, energy supply, labour, data systems, and households.[8] A resilient food system requires functioning energy systems, logistics, storage, skilled workers, and rapid adaptability. This is because energy shocks become food shocks through energy use for fertiliser manufacture, farm machinery, food processing, refrigeration, transport and cooking, while food choices then feed back into energy demand through logistics and cold chains, land use and waste management.

The UK's exposure to international disruption is significant: risks include climate shocks in food-producing regions, export restrictions, energy and fertiliser price spikes, conflict, shipping disruption, and currency volatility. The UK Government's national security assessment on biodiversity loss and ecosystem collapse warns that the UK cannot currently produce enough food for its population based on current diets and would struggle to maintain food security without major improvements in food system and supply chain resilience if ecosystem collapse drives geopolitical competition for food.[9] There has been only limited attention to food resilience so far, focussed on food supply rather than the consumer and public end of the food system.[10]



The energy-food nexus and cascading risks

The connection between energy security and food security is direct and structural. Modern food systems are energy systems in disguise: natural gas produces nitrogen fertiliser; diesel and electricity power tractors, irrigation, controlled-environment agriculture, food processing, refrigeration, warehouses, shops and hospitality outlets, domestic and institutional kitchens, and logistics such as ports, shipping, and hauling. Energy shocks rapidly become food shocks: a gas price spike raises fertiliser costs; an oil shock raises farm, shipping, and haulage costs; electricity outages disrupt refrigeration and processing; cyber or physical attacks on energy infrastructure cascade into food distribution, retail, and public services.

The UK would struggle to maintain food security without significant increases in food system and supply chain resilience if ecosystem collapse drives geopolitical competition for food, and the national security implications are clearest when risks cascade.[9] Climate shocks reduce harvests; export bans raise global prices; higher food and energy prices increase domestic poverty, pressure public finances, and create political instability.[9] IRENA's 2026 policy advisory on the Middle East crisis makes this connection explicit, warning that disruption to oil and gas flows through the Strait of Hormuz affects both energy markets and food systems, transportation, wider supply chains, inflation, and economic activity.[11] Russia's 2010 heatwave illustrates this: destroyed wheat harvests contributed to an export ban, raised international prices, increased UK food bank use, and contributed to unrest in Egypt, Tunisia, and Mozambique. In other words: climate and ecological shocks do not stay neatly in the environmental box; they travel inconsiderately through markets, infrastructure, households, and politics.

A more resilient UK security strategy should therefore treat low-carbon energy, resilient food systems, ecosystem protection, and supply chain preparedness as connected national security priorities. Renewable energy deployment, grid resilience, storage, electrification, energy efficiency, low-carbon fertiliser, sustainable domestic horticulture, diversified imports, strategic food planning, and ecosystem restoration should not be siloed. Together, these measures reduce vulnerability to fossil fuel price shocks, geopolitical chokepoints, climate impacts, ecological degradation, food import disruption, and food price inflation, thereby creating a "virtuous cycle" that supports climate goals, public health, nature recovery, food security, and economic resilience.[8]



Combined food and energy system conceptual model

Food and energy systems mediate the relationship between a changing climate and people's dinner plates; from the food on them to the energy used to cook it. Gradual changes and sudden shocks ripple across the socio-technical systems through which production, distribution, and consumption occur. It is therefore important to understand how these systems operate to assess how they might either withstand or succumb to risk.

Food and energy systems are often treated differently in both academic and non-academic literature. This report seeks to align these system understandings and establish compatible working conceptual models that views outcomes through a series of activities, drivers and feedbacks.

Both systems have similar outcomes: affordability, security and environmental impact. In the food system, activities include producing, processing, distributing, retailing, preparing, and consuming food.[12] Similar activities in the energy system are here thought of as production, transmission, delivery and consumption.[13] However, it should be noted that energy service consumption does differ in its complexity when compared to food consumption. Finally, these processes are shaped by a series of endogenous and exogenous factors that impact the system and its behaviours; these are understood as drivers.[14] Drivers of both systems are understood to be a series of social, environmental and economic factors.

Figure 1a presents an overarching model (i.e. a conceptual framework) for integrating food and energy issues and locates within it this report's five policy questions. Figure 1b shows how food and energy systems are both influenced by environmental and other drivers, and lead to outcomes of societal importance. While their respective activities differ in practice, they can be conceptually grouped in functions.

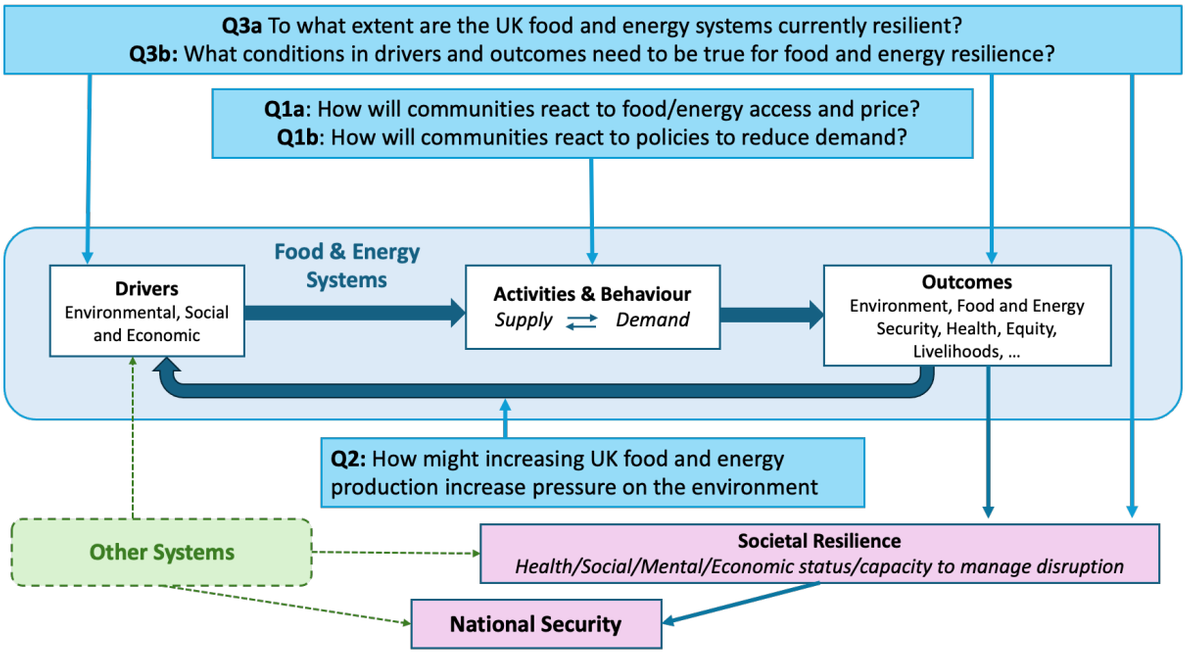


Figure 1a: Overarching model for food and energy policy questions

Given these similarities, this report adopts a shared conceptual model that enables discussion across both systems (Figure 1b). Whilst not a definitive representation of either system, this model serves as a tool for thinking about the interconnectedness of each component. This allows us to discuss the impacts of a changing climate throughout the entire suite of drivers, activities and outcomes that make up these systems.

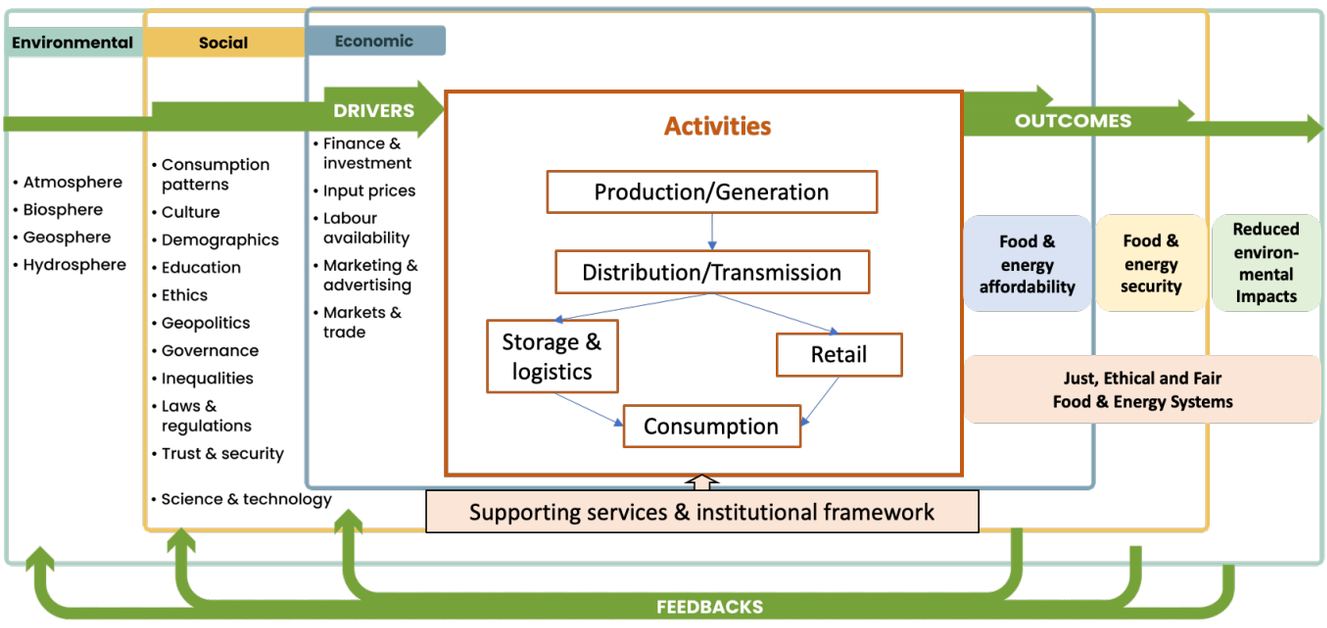


Figure 1b: Food and Energy Systems Drivers, Activities and Outcomes.
Adapted from Gilmour A, Ingram J & Zurek M. (2025). Conceptualizing the Irish and UK food systems. *Frontiers in Sustainable Food Systems*. 9: 1-9pp.

Question 1: Community reactions to prices and policies

Q1a

How will communities in the UK react to changes in price and access of food and energy?

Summary

> Communities primarily react to chronic food price increases by prioritising affordability over nutrition, leading to dietary compromises. During acute shocks, panic buying and stockpiling can overwhelm vulnerable 'just-in-time' supply chains, eroding social cohesion and increasing the risk of civil unrest. Concurrently, soaring energy bills force households to reduce their energy consumption. These compounding financial pressures severely degrade mental and physical health across communities, undermining societal resilience.

This question addresses 'communities' (as requested by policymakers) and uses the term to refer to individual citizens. Consequently, it discusses only responses in terms of personal and residential energy use and food consumption at the household level and not commercial or business consumption. Clearly, the degree of impact on a given citizen or household will vary depending on their social and economic circumstances.

In recent years there have been many fluctuations and perturbations affecting the cost and access to energy and food. The protracted cost of living crisis since the early 2020s has affected peoples' ability to afford enough food and energy[15] or forced them to choose between heating and eating. In 2024, 41% of UK adults said it was very or somewhat difficult for them to afford to pay their energy bills.[16]

The origins of the cost-of-living crisis are complex, but many factors compounded to increase the prices of energy and food. The increase in energy prices started in 2020-2021 due to a mix of factors including currency exchange rates, supressed international investment during the pandemic, demand increases in Asia from a cold winter, the closure of a major North Sea gas storage facility and reduced UK wind output.[17] Russia's invasion of Ukraine and the subsequent constraints on natural gas supply from Russia[18] and exports of sunflower oil and cereals from Ukraine[19] added a further shock to these already strained systems. Since spring 2026 this has been exacerbated by the US-Iran war, causing destruction of energy infrastructure and closure of the Strait of Hormuz, a major conduit for transport of oil, gas, fertiliser and food.[20]

The subsequent shift in access and price of energy and food led to a series of responses from communities.

Reaction to chronic food system stressors

Citizens overwhelmingly prioritise food price over nutritional value, animal welfare, or environmental impact with the cost-of-living crisis exacerbating household financial pressures.

Behaviours and impacts detrimental to physical and mental health have been observed:[21,22]

- **Dietary compromise**: communities swap healthy, sustainable produce for cheaper, calorie-dense ultra-processed foods (UPFs), canned goods, and frozen foods. This creates a negative feedback loop in which poorer households suffer increased rates of dietary-based illnesses and obesity, therefore further affecting their financial stability.
- **Parental buffering**: parents in low-income households frequently skip meals to ensure sufficient food for their children, sacrificing their own nutritional needs.
- **Physical health degradation:** nutritionally deficient diets exacerbate existing chronic health issues and stunt physical growth and development in children, leading to lifelong physical health defects.
- **Mental health degradation**: consistent stress of balancing finances and managing food insecurity has a negative impact on individual mental health.

More than a decade of austerity, welfare reform, and impacts from Brexit and COVID-19 have driven a significant increase in reliance on emergency food aid among UK communities:

- **Demand for food bank parcels has almost doubled** in the last five years.[21]
- **1 in 6 food aid recipients are in paid employment**[21]
- **Some demographics are particularly vulnerable**, including people with disabilities and elderly members of some ethnic minorities, who may have limited access to food charity for mobility, linguistic, or cultural reasons.[23]

Chronic food system stressors actively undermine UK national resilience through several critical pathways:

- **Increased rates of chronic disease from dietary compromise directly impact UK economic resilience** by simultaneously absorbing billions of GBP in annual NHS funding and removing millions of people from the workforce through long-term sickness.[7,24]
- **Persistent stress from managing food insecurity severely degrades mental resilience**, driving higher rates of anxiety, depression, and social isolation.[25]
- **Childhood malnutrition limits physical growth, cognitive development, and educational attainment**, locking in multi-generational poverty cycles.[26]
- **Heightening food insecurity significantly increases the risk of civil unrest** by eroding social cohesion and public trust in institutions.[27]

Reaction to acute food system shocks

Panic buying and stockpiling can be triggered by sudden-onset crises that are characterised by supply restrictions and either perceived or real scarcity, such as the COVID-19 lockdowns.[27,28, 29]

This can rapidly overwhelm concentrated 'just-in-time' supply chains[29,30] and disproportionately affect low-income households that might lack the financial liquidity or physical space to bulk buy products.

Sudden shortages of popular products can quickly erode social cohesion and trust in authorities, when combined with existing food insecurity and its resulting effects.[27] 85% of food systems experts consider there is at least a 1 in 20 chance of civil unrest from 'bread riots' in the next decade.[31] Farmers are significantly more pessimistic, with more than 60% agreeing there is at least a 20% chance of such a scenario.[32]

A potential causal chain to civil unrest has been identified, with distribution problems triggering acute shortages of popular carbohydrates such as wheat, bread, pasta, and cereals as the most likely catalyst:[27, 31]

- Disproportionate impacts on vulnerable populations exacerbate social disparity and generate a sense of inequitable distribution.
- Resulting loss of confidence in public institutions undermines the state's legitimacy.
- Desperation and hunger act as the final catalyst, rapidly transitioning to a breakdown in law and order and escalating into crime and violent looting.

Alongside food banks, the COVID-19 pandemic also prompted the development of and a shift to using local food actors (LFAs) and alternative food networks (AFNs).[33] Such initiatives have demonstrated the potential to increase social capital and improve community wellbeing but have typically been difficult to access for lower-income households and hence only benefit those who are already food secure. However, it is unclear who has the authority to ration or prioritise supply, what safeguards apply, and how low-income and vulnerable households should be protected when networks of faith groups, community organisations etc. provide food assistance.

Reaction to increasing energy prices

Fossil fuel price rises in recent years have mainly been driven by conflict, albeit with other factors also involved.

- **The most prominent price spike affecting the UK was during the winter of 2022/23**, due to the Russian invasion of Ukraine. This hugely increased natural gas, heating oil and electricity prices; prices of petrol and diesel were much less affected.

- **Although gas and electricity prices have reduced from that high point, the average annual cost of domestic fuels in real terms was 30% higher in 2025 than in 2021**, whereas the average cost of motor fuels was 16% lower.[34] Petrol and diesel prices at the pump have risen by 19% and 26% respectively since the start of 2026 due to the US/ Iran conflict.[35]

- **International oil prices remain volatile –** these are 'per unit' costs. Because households respond to changing prices by adjusting their consumption and/or investing in more efficient (or more profligate) homes/energy systems/ appliances/vehicles, their changing annual energy expenditure will not necessarily match unit price changes.



To understand responses to price, since the 1970s many academic papers have provided both short and long-term energy price elasticity estimates for different countries using varied models, data and estimation techniques. However, the literature offers an unhelpfully wide range of estimates for the price elasticities of demand for energy.[36]

Organisations, rather than individuals, are responsible for about half of UK energy use; their response to higher prices is outside of the scope of this question.

Household energy prices

The gas and electricity price rises in winter of 2022/23 led to an expected quadrupling of household energy bills in Q1 2023 compared with Q1 2022. To reduce the impact on households and businesses, the UK government spent an estimated £44bn on fossil fuel subsidies, £36bn of which went to households, primarily through the Energy Price Guarantee and Energy Bill Support mechanisms.[37]

Winter 2022/23 saw reductions in GB domestic electricity consumption of 8.4% and gas consumption of 10.8% compared to the previous winter. Even with subsidies in place to reduce the energy cap (Figure 2), households were paying more to get less energy, with average bills £34/month higher than the previous winter. For lower income households on pre-payment meters, reductions in gas use were around twice the national average at 20% and households experienced an increase in 'self-disconnection' where they had no access to gas, or electricity, or both.[38] Inadequately heated homes are associated with serious detriment to physical and mental health.[39]

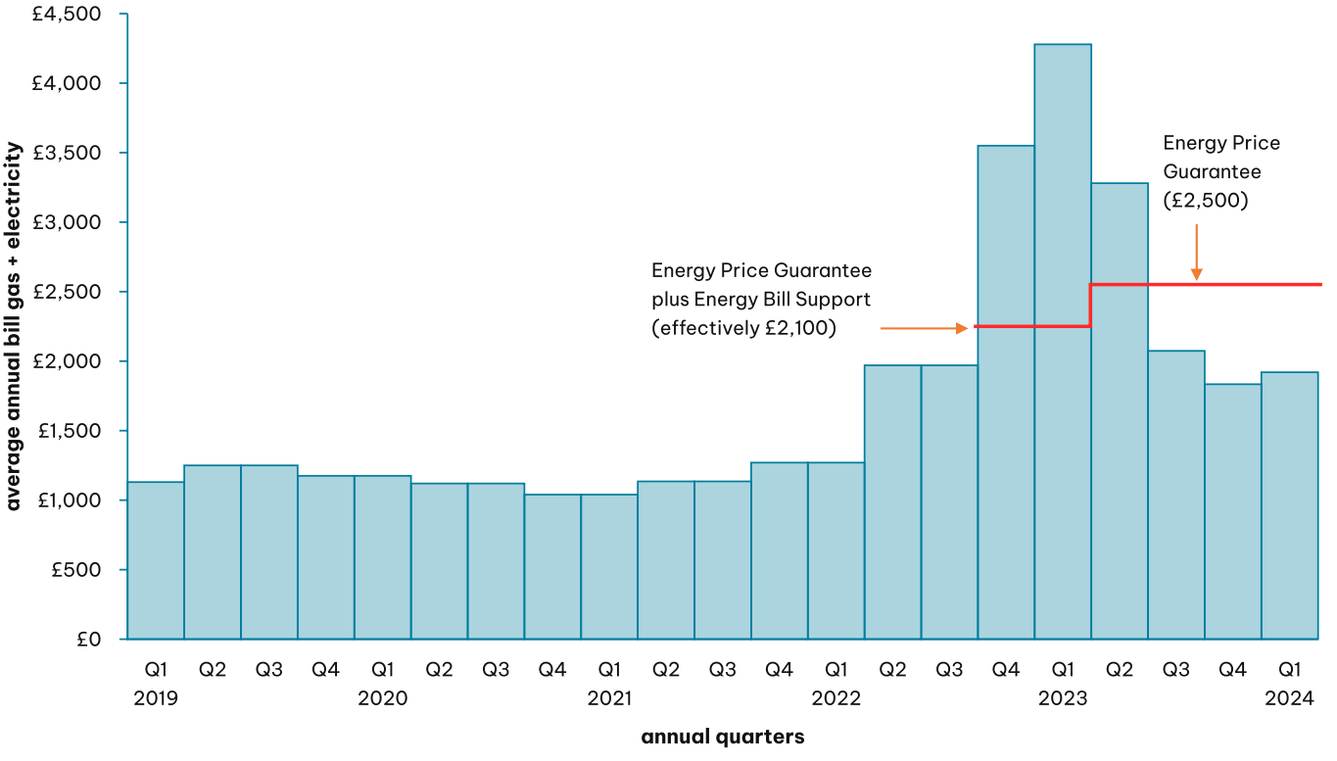


Figure 2: Rapidly increasing quarterly energy prices in 2022/23 led to residential sector government subsidies which cost £36bn (keeping actual maximum bills beneath the red line from Q4 2022)

Even after government support, DESNZ estimated that ~238,000 more households fell into fuel poverty between 2022 and 2023 (the definition varies between UK countries). Using a different measure of fuel poverty (or affordability) – whether a household needs to spend more than 10% of its income on energy, after housing costs - DESNZ stated that the percentage of households in England exceeding this threshold more than doubled from 18.0% in 2020 (4.3 million households) to 36.4% in 2023 (8.9 million households).[37]

The impact of energy prices depends not only on income but also on the energy efficiency of homes and energy-using equipment. In the decade prior to this price crisis, energy saving policies were considerably weakened.[40] The scrapped energy efficiency policies could have delivered permanent bills reductions.[41] The 'able to pay' have more options to avoid high electricity prices, with seemingly more people rushing to install micro-renewables in response to the most recent Strait of Hormuz crisis: March was a record month for solar installations.[42]

Low-income households are more likely than medium and high-income households to save energy through energy saving actions but less able to invest in retrofit measures.[43] Income is an important variable, because low-income households also have less scope to reduce demand and need more help meeting rising costs.[17]

Energy prices and food security

Energy price volatility has knock-on impacts on food security. Agricultural prices are linked to energy price shocks through linked markets, fuel for use in primary production activities such as farm machinery, fertiliser production and forestry, and other activities such as transportation, processing, storage and even cooking.[44] These price stresses put pressure on household budgets and can translate to underconsumption and choices between heating and eating, which are related to negative health consequences.[45]

Q1b

How will communities in the UK react to policy responses to reduce demand for food and energy?

Summary

> Demand reduction policies for food and energy that tackle the entire supply chain, not just the consumer, are the most valuable. People generally perceive fair, supportive policymaking more favourably than punitive taxes and bans. But there is a recognition that, although politically unpalatable, some of this policymaking is necessary and can deliver demand reductions. Emphasising the multiple benefits, e.g. for health, and ensuring suitable alternatives can help.

Reaction to food and energy demand management policies can be gauged by both the extent to which the policy intervention is able to reduce demand and its public and political popularity. This report presents evidence of effective and ineffective demand reduction policies in terms of these two factors.

Effective food demand reduction policies

Choice architecture interventions

Choice architecture interventions have consistently demonstrated potential to be highly effective and socially acceptable tools for reducing meat consumption.[46] These interventions subtly manipulate the physical or virtual decision structure of a food environment, shifting behaviour through automatic cognitive processes.[47,48] The three key intervention types are:

- **Changing the default option:** making a sustainable or plant-based meal the default, requiring consumers to actively opt out to consume meat. There have been highly successful field experiments in Denmark, the Netherlands and the US, though long-term effectiveness remains to be assessed.[49]
- **Increasing relative availability:** increasing the number of meat-free meals on a menu or in-store, providing more opportunity for sustainable choice without removing meat as an option.[49]
- **Reducing portion sizes:** gradually decreasing the proportion of meat in a dish so individuals reduce consumption without feeling deprived.[50]
  - Reduced portions contributed more than half of all UK meat consumption reduction between 2008–2019, at 9.7g per meat-eating occasion, and focus groups show strong preference for 'balanced diets' over complete elimination.[51]
  - This is a particularly powerful option as it is equally effective in men and lower-income groups, who are more resistant to alternative interventions such as meat-free days.[50]

Advertising restrictions

Restricting advertising of High Fat, Salt, and Sugar (HFSS) products can be highly effective in reducing demand when coverage is comprehensive. TfL implemented a complete ban on HFSS advertisements across London's transport network, with a 6.7% reduction in weekly household HFSS consumption.[52] However, the success of such interventions can be limited by several factors that must be taken into consideration:

- **Fragmented coverage:** a trial in Bristol of HFSS advertisement bans on City Council advertising spaces did not lead to a reduction in consumption as other private advertising spaces were not included.[53]
- **Brand loopholes**: brands that predominantly sell HFSS products can continue to advertise alternatives such as coffees and salads – it is recommended that specific brands are restricted in future policies.[52]
- **Revenue and lobbying**: deprived areas can be reluctant to enact HFSS advertising bans due to fears over lost revenue.[54] Additionally, counter-lobbying from food industry actors can water down or delay policy interventions.[55]
- **Digital advertising**: HFSS advertising is much harder to control on social media platforms.[54,56]

Sugar tax

The Soft Drinks Industry Levy (SDIL) led to a 34.3% reduction in total sugar sales from soft drinks between 2015 and 2020.[57] This is a mandatory tax imposed on the production of soft drinks with added sugars, with revenue raised used to fund health and activity initiatives for low-income families. In contrast, the 'Voluntary Sugar Reduction Programme', which aimed to encourage the food industry to reduce sugar content by 20% in food products such as breakfast cereals, yoghurts, and biscuits, was largely unsuccessful, leading to only a 3.4% reduction.

This suggests that mandatory policies can be more effective than voluntary initiatives, despite the potential for low public support.

Ineffective food demand reduction policies

Meat tax and meat-free mandates

Direct taxes on red and processed meat to reflect the 'true cost' of environmental impacts are viewed by some economists as an optimal solution for reducing emissions.[58] However, as of 2026, no major OECD country has implemented a comprehensive national meat tax. The closest real-world example is Denmark's saturated-fat tax, which targeted meat and dairy products.

Despite early promise, the policy was abolished after 15 months due to political and public backlash.[59] In the UK, temporary banning of meat in institutional settings, such as 'Meat-Free Mondays', has faced significant resistance when mandated instead of being implemented as a voluntary initiative.[60] There are several reasons for the political toxicity and immense public opposition to meat taxes and mandates:

- **Consumer perspective of meat**: unlike sugar, consumers view meat as an essential and natural component of a balanced diet.[61]
- **Fears of inequity**: there is a belief that meat taxes place an unfair burden on low-income households who already struggle to pay for their weekly food shop.[61]
- **Fear of overreach from the 'Nanny State'** and traditional British reluctance to interfere in markets.[62]

Education and information campaigns

Educational and passive information campaigns receive strong public backing but have consistently been shown to be the least effective interventions in reducing consumption of high-carbon food products.[46] They include awareness campaigns, school curriculums, and standalone eco-labels or carbon footprints, aiming to provide consumers with facts about the environmental or health impacts of their food that will consciously shift them to more sustainable choices.[46,63] Their lack of effectiveness has been largely attributed to the fact that food shopping is predominantly a low-involvement decision-making process, whereas highly informed choices require complex information that can overload consumers.[63,64]

Examples of energy demand reduction policies

Energy demand reduction policies can vary from technical efficiency regulations, which tend not to get high levels of public attention or negative response, to politicians giving advice on energy savings. Political sensitivity around demand measures is higher for some areas than others, with private car travel and retrofit standards for owner-occupied homes (two of the largest energy end-uses) being particularly contested. Additionally, there can be strong lobbying against energy reduction policy proposals from industries and interest groups, which influences 'public' response.

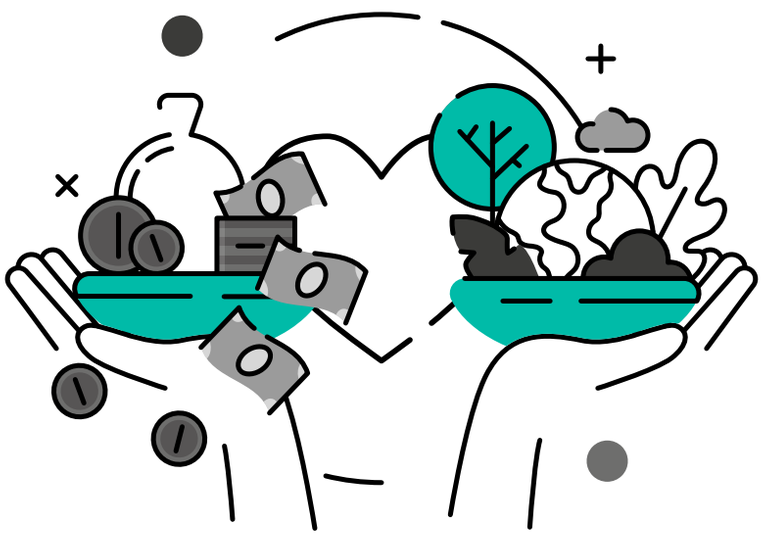
Policy has traditionally favoured supply-side policymaking[65] so historical evidence for public response to comprehensive demand-side policymaking is partial and based on less ambitious demand reduction policies.

Research tells us that simple and individual nudge measures are unlikely to be effective for energy demand because of the complexity of demand patterns.[66] Tackling demand often involves tackling multiple issues beyond simple energy demand.[67] However, in terms of public perception, the framing of demand reductions is important; people generally prefer supportive policies that facilitate them making low-energy decisions rather than more bans or punitive taxes measures.[68] Detailed survey and polling data shows how the public view a range of demand reduction policies.[69,70]

Unsurprisingly, more radical policies are less favoured but policies emphasising the multiple benefits of demand are favoured.[70] For example, many schemes in the UK have helped people pay for home upgrades, but the government have failed to commit to a boiler phase out date.

More ambitious policies can gain strong support in some cases, as shown by recent work that combined a citizens' jury with detailed modelling to investigate the acceptability and effectiveness of demand reduction policies across home energy, transport, food and purchasing.[71] The jury agreed policy changes that would deliver whole economy energy reductions of 37% between 2025 and 2050, equating to an 82% reduction in GHG emissions. Two enabling factors have been identified:

- Multiple benefits such as health can be a powerful reason for shifts in both transport and diets.[72,73]
- Strong policies like bans and taxes can still work where options to shift demand exist; London's congestion charge reduced car journeys by around 15%.[73]



Question 2: Environmental Impacts

Q2

How might efforts to increase UK food and energy production result in increased pressures on the UK environment?

Summary

Efforts to boost domestic food and energy production will inevitably intensify pressures on the UK's natural environment by risking more agricultural pollution and loss of natural habitat to agriculture and renewables. This will risk negative feedback loops where environmental degradation undermines the resources on which both sectors depend. Managing overall demand will help to alleviate this.

The UK's food and energy systems both rely on imports with big overseas environmental footprints, but this question focuses on the impacts on the UK environment if domestic production increases.

How might food and energy production in the UK increase?

Food (and associated animal feed) production in the UK depends on many factors. Demand grows in line with population coupled with increasing wealth, but can be reduced by cutting food waste or shifting to diets that require less animal feed. Supply can increase with productivity or decrease with climate stress, lack of available land for expansion, high fuel and fertiliser costs or other pressures on farm profitability. UK production does not necessarily match trends in UK demand; surplus can be exported, or demand can be partly met by increasing imports. All these factors can be influenced by both government policy and market drivers.

Current government policy is to maintain or increase food production in England, partly in response to security concerns, while increasing exports, including of livestock products.[74] At present, the total quantity of meat produced in the UK is increasing by 6% in 2020-2024 compared to the previous five years, but crop production fell by 8% in the same period.[75] Within this overall total, production of lamb fell by 4%, but beef increased by 2%, pork by 7%, and poultry by 9%. These trends do not align with the Climate Change Committee (CCC) pathway to meet net zero, which requires a reduction of 25% in overall meat consumption by 2040, with increases in pulses, fruits, and vegetables.[105] In future, trends in crop production will depend on the balance between technological improvements, fertiliser, and other input prices and climate stress, as well as demand for livestock feed and bioethanol. Aims to halve per capita food waste by 2030 would reduce the quantity of production needed to meet demand.

UK domestic energy production is also changing, with policy committed to a continued shift from fossil fuels to electricity from renewables. Production from existing North Sea oil and gas fields will continue but new exploration will not be licensed, although there is a live debate about licensing oil and gas fields that have already been discovered. The UK closed its last coal mine in 2024. The medium-term contribution of nuclear energy will decline as old plants close, though two new power stations are planned. Electricity will increasingly come from wind, increasing from 31GW to between 70-79GW, and solar increasing from 16.6GW to between 45 and 47GW.[76] To counter the dispatch challenge of renewables, flexibility, batteries, and interconnectors will become increasingly important.

Consequences for the natural environment and national security

The policy of maintaining or increasing UK food production offers both risks and opportunities, depending on how it is managed. If food production is sustainable and replaces some imports from other countries, this could reduce overseas environmental damage, including to critical global ecosystems such as the Amazon[77] (though some imported products are hard to grow in the UK). However, if unsustainable methods are used, there could be severe impacts on the environment, undermining resilience.

Efforts to boost domestic yield through intensification would have negative environmental impacts if this involves clearance of natural vegetation or increased reliance on synthetic fertilisers, pesticides, herbicides and fungicides.[78,79,81] These measures could increase greenhouse gas emissions from fertiliser use, pollute water supplies, and accelerate the ongoing decline in wild pollinators and pest predators in the UK, undermining the economic viability and resilience of crop production.[77] Conversely, shifting to sustainable and resilient farming practices can reduce the impacts per unit of food produced, but may require a greater land area.

Reducing livestock production is essential for sustainability.[80,81] Livestock not only emits greenhouse gases directly, notably from cattle and sheep digestive systems and from all animals' manure, but also from fertilizer used in feed production. Both sources contribute to global warming. This puts pressure on food and energy systems, as heat stress reduces yields[82,83] and increases the demand for supply-chain storage refrigeration, adding stress to the energy system and potentially increasing GHG emissions further if it cannot be met with clean energy. Livestock production can also increase water demand and water pollution (from manure runoff), and has a high demand for land (for grazing and/or feed crops) that could otherwise be used for nature-based solutions to sequester carbon, or to support the shift to more sustainable crop production.

Similarly, misplaced deployment of renewable technologies, for instance ground-mounted solar on ecologically sensitive areas, can reduce biodiversity.[84,85] This impedes necessary ecosystem services: pest regulation, pollination, and soil fertility, in turn driving the need for intensified agriculture.[78] Wind farms can have severe negative impacts on birds and marine mammals,[90] potentially disrupting important ecosystems.

The use of heavy machinery and clearing practices in intensified farming and onshore wind farm construction can cause several environmental impacts: topsoil degradation**,** via compaction, erosion and loss of organic matter[79,86] the destruction of habitats, the loss of food and roosting sites, and the loss of plant diversity.[87,88]

However, smart placement of renewable technologies and sustainable farming practices can reduce the impacts on the natural environment.[89] Siting offshore wind infrastructure away from important bird habitats is vital to reduce adverse impacts, and there can be benefits for some species of fish.[90] Similarly, impacts of solar farms can be mitigated by avoiding ecologically sensitive areas,[91] limiting the scale to be culturally acceptable to the local community, and designing them to deliver multiple benefits (e.g. combining with agriculture and/or biodiversity habitat) to ease the growing pressure on land-use in the UK.

How can demand management limit environmental impacts?

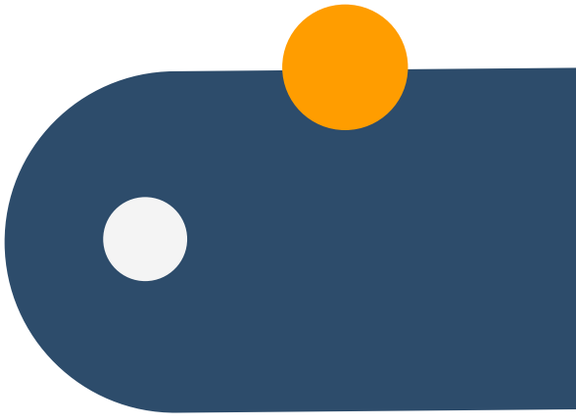
Global food demand is currently projected to increase by 35% by 2030 as increased wealth leads to a shift towards more calorie-rich diets. Whilst both food and energy use are driven by population growth, shifts in UK consumption habits can help reduce the pressure on food and energy systems. For example, meat and dairy can be substituted by less resource-intensive plant-based alternatives.

One way to mitigate the pressure of any system on the environment is through challenging the notion that demand will always increase. There are many changes to the food and energy system that would allow us to supply the required services (warmth, cooling, nutrition) with lower levels of production. The basic principle is that less resource-intensive systems have smaller impacts, and demand can also be reduced through avoiding waste and overconsumption.

As the food and energy systems both shift in the progression towards net zero, pressures on the natural environment will change. It is important to note that the decision to move towards net zero is unequivocal and its pressures are incomparable to the weight of the current system on the natural environment.

Total UK energy use has been declining over the past 20 years, despite increases in GDP and population.[92] This change has been largely delivered to date by increased energy efficiency.[67] As the economy electrifies, energy will be used more efficiently, reducing total energy demand further.[93] Further gains can be secured with the combination of active attempts to curtail unnecessary demand, which could realise 52% reductions in energy demand by 2050 compared with 2020 levels without affecting wellbeing in the UK.[94]

Should imports of food and energy be disrupted however, domestic production might still need increase. Under these circumstances, shifts in consumption patterns can still play a role. For food, adopting the 'Reorientation' (Transformative Resilience) approach including shifts to less calorie intensive, less wasteful but equally or more nutritious diets can relieve pressures. An increasingly electrified and renewable energy system is inherently more efficient and therefore can be smaller. To mitigate the risks of energy supply disruption, continued investment in renewables is a better option than short-term expansion of North Sea oil and gas production.[95]



Question 3: Conditions for Resilience

Q3a

To what extent are the UK food and energy systems currently resilient?

Summary

UK food and energy systems have proven resilient to recent shocks and stresses at the national level but increases in both food and energy prices have been very challenging for many households and their associated communities. The UK is, however, exposed to future disruption in food and energy supply due to uncertainties in global availability and hence prices.

The UK food and energy systems have been exposed to significant shocks and stresses in recent years but overall, at the national level, both systems exhibit a high degree of resilience. Neither food nor energy have needed to be rationed due to extreme deficiencies. However, the UK is still exposed to potential global food supply shocks due to simultaneous failure of multiple 'breadbasket' regions, and continued disruption to global energy supplies.

The UK energy system a has very resilient infrastructure and disruptions are rare.[96,97] However, it is less resilient in terms of affordability and energy market design. The UK is currently extremely vulnerable to shock-exacerbated fuel poverty, with millions of households at risk of self-disconnection as a problematic response to price spikes.[38] When the understanding of the energy system is expanded, new vulnerabilities come into focus.

Similarly, supermarket shelves have largely remained well stocked although there were temporary deficiencies in certain items during the pandemic, mainly due to logistical interruptions. Certain components of the national diet are however more susceptible to disruption. With 50% of fresh fruit and vegetables being imported, any interruption of supply either due to restricted primary production or logistics will threaten the availability and hence affordability of a healthy diet. However, resilience may be significantly lower at the community and household levels than at the national level. This is very largely linked to access to food and energy, which is closely related to poverty.

While both systems are arguably currently resilient to recent shocks and current stresses, future resilience is uncertain. Key issues to consider are over what time period resilience is sought, and which strategies need to be designed and implemented to mitigate their future risks.

Climate change poses a significant threat as global average temperature will rise by 4°C during the 21st century if current greenhouse gas emissions continue. UK winters are projected to become warmer and wetter on average with increased likelihood of floods, although cold dry winters will still occur, and summer droughts will be more severe.[98] By 2050 extreme heatwaves could occur every other year.[99]

For the energy system, unstable weather means increased risks to energy supply, transmission, and distribution systems.[97] On the demand side, increasing temperatures will likely reduce heating demand in winter but increase cooling demand in the summer, overall reducing the need for space conditioning energy demand.[100] For the food system, while increasing temperature will favour production of some products, a net suppression of domestic food production is anticipated due to extreme temperature events, flooding, drought and soil erosion.[83]

Q3b What conditions need to be 'true' for the UK food and energy system to be resilient under current climate change projections?

Summary

The UK cannot secure food and energy systems only by expanding supply, so suitable conditions need to be established to allow fair, planned, and well-communicated demand management. Essential conditions for resilient future food and energy systems include collaborative leadership; maintaining public support; centring people; transparent governance with clear outcomes and long-term signals; and adaptive regulation. These conditions will reduce exposure to shocks, reduce pressure on the environment and infrastructure, and maintain or increase public confidence, thereby enhancing national security, but failing to establish these conditions will create and exacerbate grievance and deprivation.

'Conditions' are those factors which affect the way the food and energy systems operate and hence the outcomes society derives from them. From a systems viewpoint they therefore relate to the 'drivers' which influence the way people undertake their activities which in turn lead to the outcomes from those activities (see fig 1b). The conditions which need to be 'true' for the UK food and energy system to be resilient can be classified into natural, physical, socio-economic, and governance domains. The four categories can overlap, with some conditions involving elements of all four.

The UK cannot secure food and energy systems through supply expansion alone. Conditions need to be established to allow fair, planned, and well-communicated demand management as part of national resilience. These conditions will be essential for future food and energy systems to be resilient: collaborative leadership; work to maintain public support; centring people; transparent governance with clear outcomes and long-term signals; adaptive regulation.[101,102] Insufficient establishment will create and exacerbate grievance and deprivation, but done well, it will reduce exposure to shocks, reduce pressure on natural infrastructure, maintain/increase public confidence and thereby enhance national security.

Conditions need to enable both the food and energy system to undergo significant qualitative shifts to mitigate and adapt to climate change. Increasing the pace of these changes will be essential to building system resilience and navigating trade-offs between land-use, habitat restoration, and climate mitigation with increasing domestic supply of food and energy.[7,76]

Natural conditions

The UK food and energy systems are contained within, and draw upon, the natural world. For food specifically, the Government's recent national security assessment judges that biodiversity loss, alongside climate change is "amongst the biggest medium to long term threats to domestic food production" and that "the UK does not have enough land to feed its population and rear livestock: a wholesale change in consumer diets would be required".[103]

Nature is quick to degrade and slow to recover. The development of natural conditions is generally distinct from the physical, socio-economic, and governance conditions discussed below, in that they degrade over years and recover over decades. For example, UK arable soils erode roughly two orders of magnitude faster than they form.[104] Further, because reservoirs, breeding programmes, woodland, peat restoration, and other land use changes all take decades to deliver, acting late is not the same as acting slowly.

Soil and peat restoration is essential. Increasing water levels by 10 cm in drained peatland cuts emissions by at least 3 tCO_2e per hectare per year.[105] Food production on peat should use wetter farming and paludiculture to raise the water table. The CCC's pathway increases the proportion of lowland peat in natural or rewetted condition from 9% today to 31% by 2040 and 56% by 2050.[106] On mineral soils, reduced tillage and ley-arable rotations rebuild carbon without costing yield, yet carbon gains can saturate over time, and there **is** no productivity gain to fund the restoration.[107] Even under a century of heavy manure inputs at Rothamsted, carbon accrual fell from 0.69 to 0.16 tC per hectare per year and eventually to zero.[108] Soil restoration must be financed as a public good and begun early, because the returns are slow, limited, and easily reversed.

Water must be available where and when it is needed, and food and energy can compete for water. England faces a public water supply deficit of up to 5 billion litres a day by 2055, with a further billion for the wider economy, and abstraction is already unsustainable in 15% of surface water and 27% of groundwater bodies.[109] No major reservoir has been completed in England since 1992, and the nine now planned would add around 670 million litres a day only by 2050.[110] Energy also draws on water for cooling[111] and the decarbonisation pathway chosen dictates that demand, with high-CCS routes markedly more water-intensive than high-renewables ones.[112] Where cooling water is returned warm, thermal discharge limits are important to avoid damage to freshwater biodiversity.[113]

Food systems will need to transition towards regenerative agroecological systems that restore soil health, water quality, and biodiversity.[27,79,114] Biological regulation must be improved with targeted agri-environment options to measurably raise populations of pollinators,[115] while integrated pest management needs to be widespread.[116]

For energy, a high-renewables system has to be engineered for wind drought (a roughly a 1-in-40 chance each winter of three or more continuous weeks of low North Sea wind) when output runs at about half a typical winter week just as colder conditions increase demand.[117] Storage, flexibility, interconnection and demand reduction are needed.[118] The land needs of renewables are modest and manageable by careful siting. Solar consistent with the Clean Power range requires up to 0.4% of UK land.[119] More competition for land arises from the area needed for peat rewetting, woodland, energy crops, and wildlife habitat. Here, livestock is the clearly most important lever: 85% of the land footprint of UK food supply, at home and overseas, serves meat and dairy production.[120] On the CCC's net zero pathway, cutting livestock releases 68% of all land freed by 2040 compared to 7% from yield improvement.[105] It is therefore clear that the natural conditions required for resilience include addressing livestock production.

Physical conditions

The current UK food system is dependent on concentrated physical logistics, notably 'just-in-time' supply chains that are efficient but highly vulnerable to shocks.[29,121]

- **A transition to a system based on 'just-in-case redundancy' is vital**, with multiple long and short supply chains, diverse crops, as well as decentralised production and processing - ensuring that disruptions can be absorbed.[120,122]
- **To help facilitate this, economic and policy conditions must enable local authorities to empower civic participation in localised food system initiatives**, developing agency over their own food sovereignty.[7,30,120] The effectiveness of such interventions has been demonstrated, but their development must be integrated via participatory design into coordinated long-term Government planning to ensure successful scaling up.[7,123]

As domestic food production is increased, it will be important to integrate renewable energy and waste-to-energy processes that decouple associated pressures on the energy system.[27,124] In doing this, integrated land use planning to include renewables will become increasingly important. Agrivoltaics for instance could deliver significant capacity whilst supporting high-grade farmland outputs.[125]

The electricity grid will need significant upgrades across the country, as electricity supply is expected to double by 2050 to meet demand for electrification of heating, transport and industrial processes.[126] The electricity system is sized to meet peak demand; by reducing peak compared with average demand, overall size, cost and environmental impact fall. Peak demand typically occurs in winter evenings between 5 and 8pm. Technologies and strategies that can reduce this include efficient heating technologies;[127] more investment in building controls and insulation;[128] flexibility, particularly for EV charging and space heating;[129] and increased storage.[130]



Investment in monitoring and managing these new systems will be crucial to ensure resilience. For example, increased monitoring can ensure early and rapid response to acute system shocks. For food, this might mean the implementation of emergency welfare measures after certain food insecurity thresholds are reached.[131] Similar approaches can be deployed using smart meter data to more effectively identify and target support for fuel poverty.[38] Enhanced digitisation and data management will be vital for running these systems and managing resources effectively.[132]

Socio-economic conditions

The first socio-economic condition for resilience is that food and energy are affordable for communities. Decreases in affordability are a threat to resilience at the household level, although the way in which their effects are mitigated may differ between the food system and the energy system.



Ensuring resilience at the household level means that social protection policies should be explicitly linked to inflation and the cost of a healthy diet and responsive to food system crises.[7,21] Potential interventions include ensuring that benefit levels such as Universal Credit must explicitly factor in the actual cost of a healthy diet;[26] monitoring of food insecurity data;[27] and targeted welfare boosts during crises.

Fuel poverty is associated with the energy efficiency of the house and an inability to invest in its improvement; raising incomes might lift a household out of poverty but rarely out of fuel poverty.[133] As a result, short term action on bills should be combined with long term actions to alleviate the causes of fuel poverty, such as household energy efficiency programmes, retrofit skills investments, and retail energy market regulation review.[17]

The second socio-economic condition for resilience is a fundamental shift in consumer demand:

- **For food**, this means a moving away from high-emissions red meat and processed foods towards more sustainable and healthier, plant-rich diets,[7,134] which would enable a reduction in land for grazing and feed production to free up space for more domestic food production without converting natural land.[135]
- **For energy**, this means increasing efficiency of energy use and avoiding service demand where possible through facilitating measures such as smaller cars, car sharing, active transport and home insulation.[40] Example actions include providing low-cost capital for building investments and suitable alternatives to private car use.

Significant market reforms will be necessary to ensure that these conditions can be achieved. Food environments must be structurally redesigned to promote healthy, sustainable food as the most affordable, appealing, and convenient default option for all citizens.[7,24,80] Alongside this, energy markets emerged alongside the specific political, economic and engineering conditions of the 1980s and now need to be reformed.[136] Markets need to be made amenable to the increased role of flexibility in the system, peer-to-peer trading and self-supply.[40]

Governance conditions

Transformations in the way the food and energy system is governed will be vital for implementing radical solutions to emerging climate and national security threats.[137] So, irrespective of what material or socioeconomic interventions are devised, successful implementation will depend on having conducive governance conditions in place.

Food system governance is hampered by a siloed approach, with responsibilities and authority split across several different departments.[7,24,27] Cross-governmental coordination incorporating issues from agriculture, health, the environment and trade will be important.[7,80] Transformation will be highly challenging unless long-term, integrated food systems thinking is implemented,[27] and so there is a requirement for legally binding policy frameworks that foster cross-party consensus, survive election cycles, and mandate clear targets, duties and oversights.[24]

Similarly, governance ought to help coordinate across the energy system across different energies: heat, electricity and transport, and within electricity: generation, distribution, demand, flexibility, and storage.[101] As energy electrifies it will shift to being less centralised; this will be an important consideration for governance.[138,139] It is known that place-based net zero transitions will challenge existing governance models in a number of key ways[140] particularly the transition to heat.[141] For this reason, multilevel governance models will be essential to maintain resilience in future attempts to mitigate climate issues.[126]



Policy implications and recommendations

Here we summarise the key policy constraints and trade-offs identified and recommend strategic actions to address them.

Key policy constraints

Political constraints

- **Fragmented and short-term governance**: heavily siloed policymaking across departments without a unified statutory framework, with an absence of legally binding long-term framework.
- **Polarisation**: fundamentally different worldviews drive this fragmentation (e.g., technical efficiency vs systemic transformation).[142]

Social constraints

- **Public resistance to punitive measures**: citizens highly value freedom of choice and are strongly opposed to restrictive demand management via taxes or bans.
- **Embedded ideologies and customs**: meat and dairy consumption is deeply embedded in cultural norms and identities, with a prevailing view that it is natural, normal, and healthy.
- **Information overload and food literacy**: consumer food purchases are low-involvement decisions, constrained by time, and food literacy. More complex information will face limited comprehension.

Economic constraints

- **Affordability:** the ongoing cost-of-living crisis renders many sustainable options unaffordable to low-income households and means punitive policies can disproportionately affect them.
- **Corporate power:** large agribusiness companies dominate the food system, with significant financial power and intense lobbying that can resist or dilute changes.

Key policy trade-offs

Governance and autonomy

- **Localised autonomy vs Collaborative governance**: community ownership and engagement in local schemes can improve social capital and has strong transformative potential, but this must be facilitated within a coherent national Government policy.
- **Policy effectiveness vs Freedom of choice**: mandatory interventions are often the most effective demand management policy response but face significant public and political opposition.[61,143]
- **Simplicity vs Accuracy**: information interventions such as labelling are easier understood when simple, but this risks misrepresenting complex system impacts.[144]

Economic equity and livelihoods

- **Taxation vs Affordability**: taxes on meat and dairy can reduce demand and hence emissions, but the disproportionate effect on low-income households must be countered by respective subsidies for healthy, sustainable food.[58,145]
- **Climate targets vs Farmer livelihoods**: achieving Net Zero through reduced demand will impact rural economies, so a just transition must reward farmers for delivering sustainable public goods.[146]

Health and environment

- **Climate targets vs Processed food risks**: many food alternatives to meat and dairy products are classified as UPFs, with high sodium, fat, and sugar content.[147] This risks trading environmental benefits for negative health impacts.[148]



Environmental footprint and resources

- **Land sparing vs Land sharing**: intensive farming produces higher yields but damages local ecology; extensive/organic farming supports local biodiversity but requires more land, potentially increasing overall emissions. Meeting UK climate goals requires dedicating 27–31% of the UK's current agricultural land to bioenergy or new woodlands.[149]

- **Domestic mitigation vs 'Carbon leakage'/offshoring**: reducing domestic meat and dairy production without cutting consumer demand simply offshores emissions reductions to countries that may have lower environmental standards, via imports.[105,]

Recommended strategic actions

- **Coordinated governance and management**: establish a new body tasked with coordinating between the food and energy sectors to manage demand. It needs to (i) craft explicit policy options to manage demand; and (ii) commission a rapid evidence review and applied research on options to measure demand and monitor impact.

- **Vulnerability assessment of integrated food and energy issues**: commission studies to assess integrated food and energy vulnerabilities to identify critical linkages (and hence weak points) so as to devise response options that play to both agendas.

- **Develop early warning systems:** develop early warning systems for thresholds in both independent and integrated food and energy systems to mitigate fundamental risks to national security from disruptions to the food and energy systems.

- **Review economic metrics of food and energy security** and tie welfare measures to them.

- **Public awareness**: launch a major public awareness campaign to engage society more effectively in the drive for sustainable and resilient food and energy systems by managing demand. This could be aligned with a drive to increase food systems literacy across the UK population, with the objective of improving the long-term effectiveness of educational interventions.

- **Science-Policy-Society interface**: support and engage with the Royal Society's Open Science 'Science, Society and Policy' initiative to ensure public policy relies on robust scientific evidence while remaining responsive to societal values and community expectations for managing demand.

- **Cross party consensus**: nurture consensus on policy interventions which support an integrated food and energy strategy.

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