Natural England Research Report NERR031

England’s natural environment in 2060 - issues, implications and scenarios

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Natural England Research Report NERR031

England's natural environment in 2060 - issues, implications and scenarios

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Natural England

Published on 26 November 2009

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ISSN 1754-1956

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Project details

This report is an initial assessment of the implications for the natural environment of a range of plausible futures in 2060. This work has been conducted to support Natural England's general approach to strategic thinking and in particular, the development of its long-term vision for the natural environment.

A summary of the findings covered by this report, as well as Natural England's views on this research, can be found within Natural England Research Information Note RIN031 – England's natural environment in 2060 - issues, implications and scenarios.

This report should be cited as:

Creedy, J.B., Doran, H., Duffield, S.J., George, N.J., and Kass, G.S. 2009. England's natural environment in 2060 - issues, implications and scenarios. *Natural England Research Reports, Number 031*.

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Acknowledgements

The authors would like to thank the numerous Natural England staff, external stakeholders and academics who participated in interviews and workshops and, who reviewed material.

Non-technical summary

As the world in which we live and work is constantly changing, we need continually to stimulate new thinking and ideas about how we can address the risks and take advantage of the opportunities that change will bring. Thinking constructively about the future helps us to make conscious choices that ground our short-term decisions in a set of robust longer term goals, creating direction and momentum to deliver a sustainable future.

Natural England's role is to ensure that the natural environment is conserved, enhanced and managed for the benefit of present and future generations. With a focus on the future, we have a statutory obligation to be ready to respond to longer term future challenges and opportunities. In describing key issues and implications emerging from four scenarios, this report assists us in providing an initial assessment of how we think the next fifty years might unfold in relation to England's natural environment.

Key issues emerging from the scenarios

In combination, the scenarios highlight six key questions about how England's natural environment might be affected between now and 2060:

- **What can the environment do for the individual?** How will the relationship between people and the natural world change as they increasingly look to the natural environment to provide benefits for their wellbeing?
- **How will changing landscapes be valued?** Will society resist or embrace landscapes as they change over the next 50 years?
- **What will be the geographic context of change?** How and where can the natural environment best provide services and distinctive places for people?
- **How will resource pressures be governed?** Will markets, voluntarism or regulation dominate?
- **What is the scale of response?** Will action on the environment be on a local, national or global scale?
- **How does the future look?** How might people think about their own futures?

After looking at common themes and significant differences across the scenarios, we have identified two issues that are central to helping society make better and more informed decisions about the natural environment.

Firstly, **in all four scenarios, the natural environment has value in some form**. The question of values boils down to 'where will the balance sit between valuing the environment for its own sake and for the social and economic benefits it can bring?' All the scenarios hint at both these positions but it is a question of degree, rather than a discrete position at one or other extreme. In all scenarios, nature's value is grounded in the benefits it delivers to people (ecosystem services). Here, nature is very much at the service of humanity and it is conserved, enhanced and managed primarily for the benefit of people. But at the same time, there are those who value nature for its own sake, regardless of the benefits it brings to them. Here, the human/nature relationship has no clear functional purpose and nature serves both itself and humanity. Its conservation, enhancement and management enable natural systems to maintain their integrity into the long-term.

Secondly, **in all four scenarios, the future state of the natural environment is determined largely by the choices that people make, shaped by their values and the broader context in which they live**. The scenarios describe the effects of different ways that choices can be made, leading to the second key question: 'what will drive decision-making?' The nature of the choices and the systems in place to make those choices vary across the scenarios but essentially they are shaped by:

- the availability of resources - for example, energy supplies, food or water;
- scientific and technological capabilities - for example, innovation for low-carbon energy, industrial food production and information technology;
- societal preferences around trade-offs - for example, balancing renewable energy generation against nature conservation; and
- the scale and nature of decision-making - for example, spatially (from global to local), over time (from short to long-term) and through relationships (directed to voluntary).

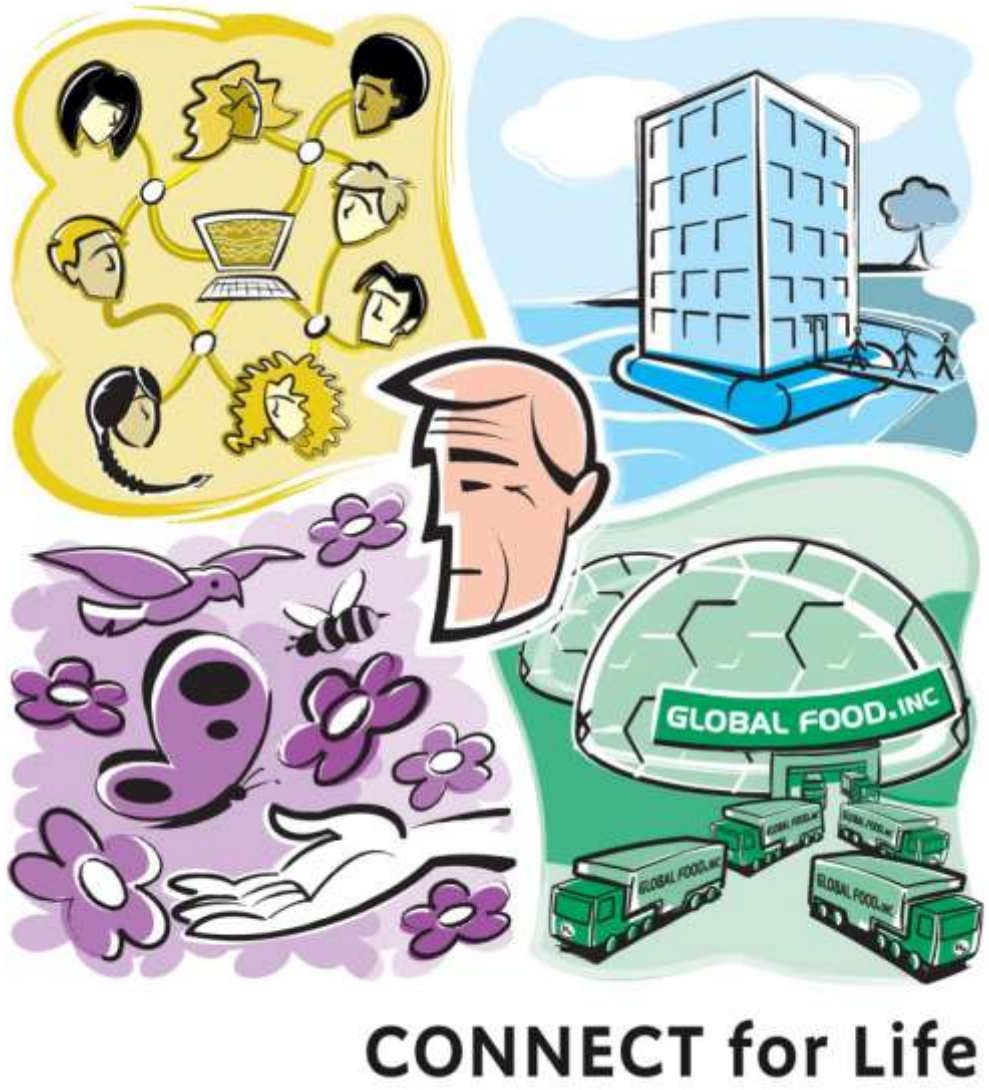
So, as changes take place over the next 50 years, the extent to which implications for the natural environment are (or are not) taken into account depends on the willingness and ability of society to:

- Take a **systems approach** that enables it to understand and manage better the broad, cross-cutting and complex situations in which it finds itself, rather than tackling individual issues in isolation.
- Adopt a **futures approach** that enables it to anticipate how unknowable futures give rise to a range of risks and opportunities.
- Build **institutions and processes** that help society make choices in the face of uncertainty and take robust decisions about which risks it approaches or avoids and which opportunities it pursues or forgoes.

In this report, we provide a synthesis of the key issues emerging from the scenarios in terms of how we might live and the implications for the natural environment. We have not specified the likelihood, nor judged the desirability of those futures. The scenarios provide the basis for challenging and forward-looking debate and discussion.

Brief outlines of each scenario

CONNECT for Life



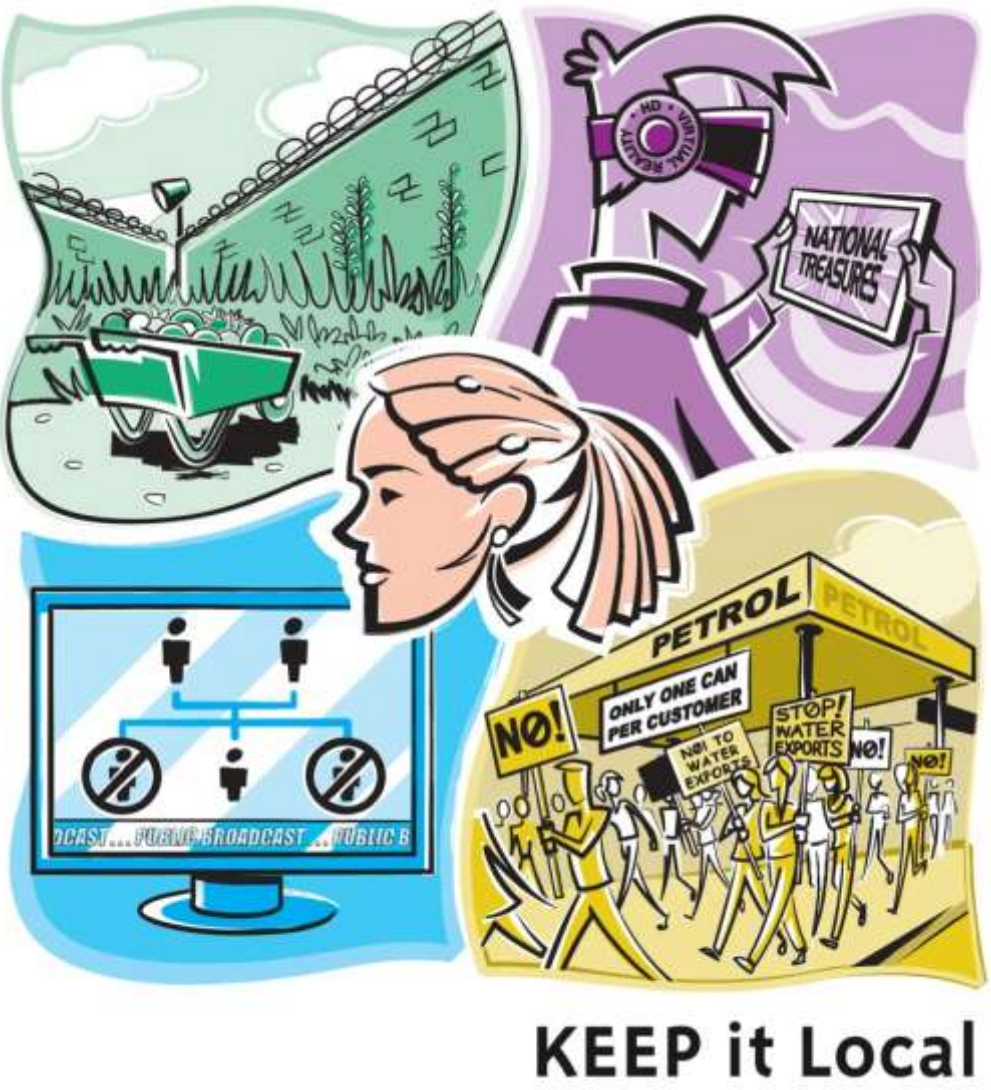
Life in 2060: *People now connect through vast global networks. Decisions and economies are based locally, but through billions of worldwide connections they create a bigger and more effective system - a global super-brain. Social and environmental values have strengthened a lot over the years - loyalty lies with communities connected for common purposes across the globe; national government has relatively little influence.*

How this scenario emerged: *In the early decades of the 21st century there was a major focus on using information and communication technologies (ICT) to improve productivity. At the same time, however, less focus was given to the potential of social networking and internet-enabled democratic decision-making to improve social and environmental outcomes. As social networks became sufficiently large and self-supporting, 'traditional' beliefs and ways of doing things became outdated and unproductive. These then faded as hyper-connected communities became the main focus.*

GO for Growth

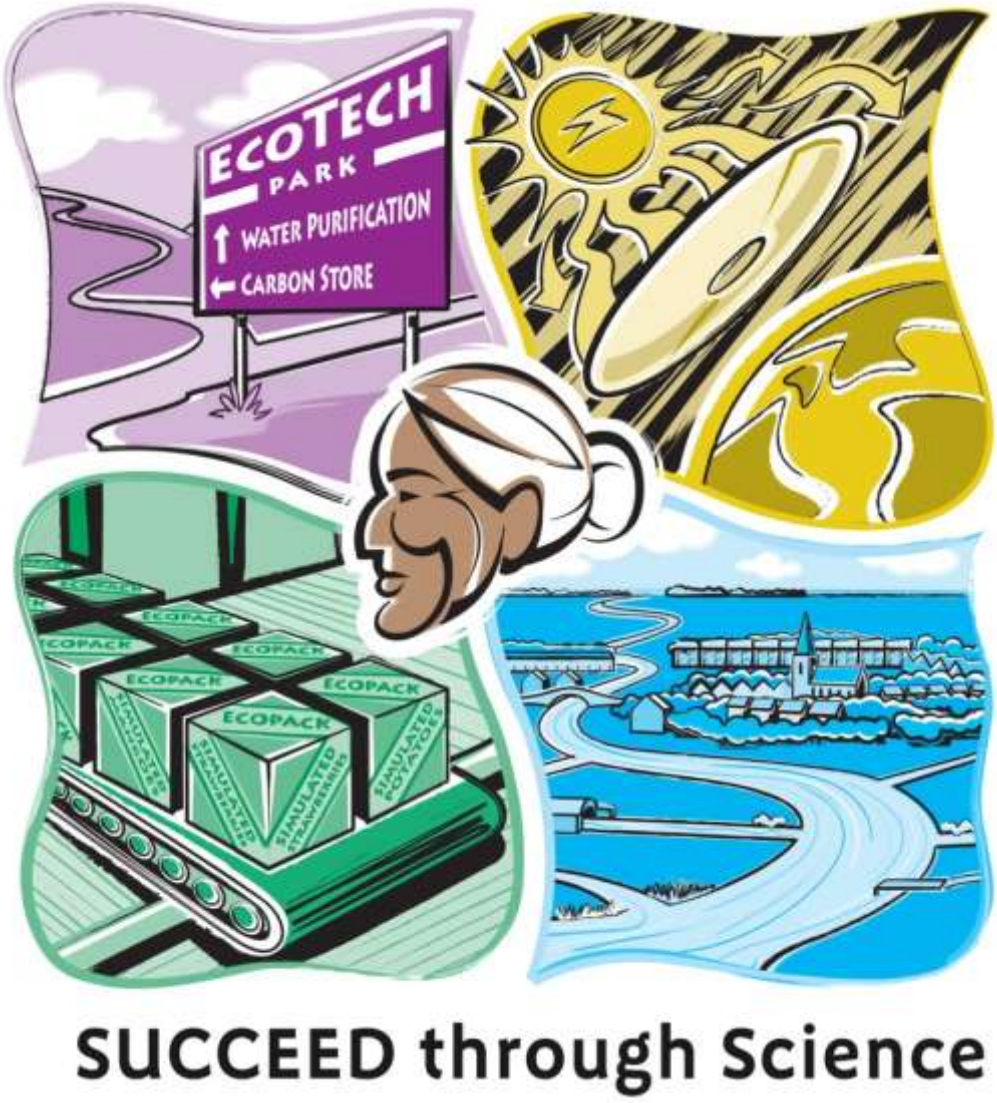
Life in 2060: *Making money is a priority and economic growth continues to be driven by consumption and new technology. Few people worry about the environment and almost everyone continues to consume at will. The country has reacted to devastating events by spending money on food from abroad and developing technology. There is growing concern this may not always solve the problems facing Britain.*

How this scenario emerged: *Trends dominant in the first part of the 21st century continued. Society remained focused on consumption-based growth through a market economy enabled through accelerating innovation.*



Life in 2060: *Society now revolves around nations feeding and providing for themselves. England's land is largely used either for food production or for housing. Critical decisions (for example, around security and infrastructure) are made nationally, with other decisions made regionally and locally. People are very protective of their local area and belongings, but have a strong sense of national identity. Resources are limited and are tightly controlled, but consumption remains high.*

How this scenario emerged: *In the early 21st century, society emphasised consumption while paying little attention to working within environmental and resource limits. However, in the 2020s and 2030s, those limits were breached and a series of social and environmental crises emerged. This forced nations to adopt more protectionist positions, slowing and unravelling globalisation.*



Life in 2060: *The global economy continues to be driven by innovation and everyone relies on business to keep the country growing. London and the South East are important, but the rest of the country is also booming as both cities and their surroundings produce so much. People trust technology to enable growth within environmental and resource limits, but some worry it may not always have the answer.*

How this scenario emerged: *The early 21st century emphasised improving productivity in the global market economy. However, this served only to focus attention on driving innovation to achieve short-term economic gains. Long-range consequences for society and the environment received little serious attention. However, new entrants in the global economy recognised that their own long-term competitive advantage required a more forward-looking approach that would safeguard social and human capital in the longer term.*

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1 Introduction

Purpose of this report

1.1 Natural England's purpose is to ensure that the natural environment is conserved, enhanced and managed for the benefit of present and future generations, thereby contributing to sustainable development. With a focus on the future, this statutory obligation requires us to be ready to respond to longer term future challenges and opportunities. The 'natural environment' is taken to include all land, flora and fauna, freshwater and marine environments, geology and soils. It ranges from inner city gardens, to farmland, remote wilderness and the high seas.

1.2 The world in which we live and work is constantly changing and evolving. We need to think imaginatively and creatively about the future, highlighting risks and opportunities and enabling us to challenge our current goals and approaches.

1.3 This report is an initial assessment of how we think the next fifty years might unfold in relation to England's natural environment. It provides a starting point for exploring the implications of how life in 2060 might affect biodiversity, landscape and people's engagement with the natural environment. To help us do this, this report describes a unique, robust and powerful set of scenarios that paint plausible pictures of how the next five decades might play out. They are not predictions of what we think will happen, nor are they statements of what we think should happen. They map out the changes that could happen given the key factors that could shape the future of the natural environment.

Why have we produced this assessment?

Exploring a range of plausible futures will help Natural England anticipate and appreciate some of the long-term challenges and opportunities facing the natural environment. This will help us to:

- Develop an integrated Vision and Strategy for the natural environment setting out how the natural environment should look and function in 2060 (see futures page on Natural England's web site): URL: **www.naturalengland.org.uk/ourwork/securefuture/default.aspx**.
- Identify the challenges, choices and trade-offs that will need to be addressed in the future.
- Stimulate new ways of thinking and developing innovative responses.
- Explore how other emerging shorter term strategies and policies (for example, policy position statements) might perform in the future, highlighting the risks and opportunities we may face over the next few decades.

How this report is structured

1.4 **Chapter 2** presents a synthesis of the key issues emerging from the scenarios, highlighting the key similarities and differences between the scenarios and major strategic implications arising for the natural environment over the period to 2060. It explores issues arising across the scenarios from descriptions of how we might live in 2060. Further, it outlines the key issues for the natural environment, drawing on implications for biodiversity, landscape and people's engagement with the natural environment. It also considers the implications across different geographic zones that make up England's terrestrial and marine environment.

1.5 **Chapter 3** provides a more detailed description of 'how we might live' in 2060. This describes the key features of everyday life in the different worlds painted by the scenarios, for example, population, energy, food, transport and leisure.

1.6 Each scenario is then explored in relation to its 'implications for the natural environment'. This aims to describe how the natural environment might look and function in each scenario. This is presented in relation to Natural England's core functions of public engagement, biodiversity and landscape and by geographic areas: uplands, lowlands, marine, coastal and settlements. Further detail on the implications for each geographic zone under each scenario is included in Appendix 1. The scenario storylines and indicative timelines to 2060 are also set out in Appendix 1.

1.7 **Chapter 4** identifies the next steps, including Natural England's future plans for further assessment of the implications and how we plan to use this with our key partners.

1.8 Throughout this report, the descriptions and assessment of their implications illustrate a range of plausible outcomes in 2060. Given the rapid pace of change happening around us there will be many differences between the world today and the world in 2060. While we have exercised judgement in identifying the plausibility of the scenarios, it is not the intention of this report to explore either the explicit mathematical probability or the desirability of these changes. None of the scenarios will be a wholly accurate picture of how the future will actually play out. The world in 2060 may well comprise elements from each of the scenarios, with a scattering of unforeseen events and developments along the way. As such, the scansions and the assessments of the implications are not intended for detailed planning over the next five decades. Rather, they are intended to stimulate debate and creative thinking around the long-term, complex challenges we may face in the coming decades.

2 Challenges for England's natural environment

Introduction

2.1 This chapter provides a synthesis of common themes and significant differences emerging from our consideration of how the future might play out between now and 2060. In particular, drawing on our scenarios, we have highlighted the key issues arising that we need to be conscious of in shaping our future strategies, advisory and advocacy work. We have also highlighted any differences that could affect the natural environment, where further analysis of risks and opportunities may be necessary. In both instances, analysis of the possible implications of the scenarios helps us to make better and more informed decisions, and to ask if the goals we set ourselves, and the means we adopt to achieve them, are valid into the future.

How we might live

2.2 Table 1 summarises the main elements of the 'How we might live' sections of each of the scenarios explored in Section 3. Table 2 sets out their main similarities and differences. Looking across the scenarios, a number of key themes emerge:

- **Values take centre stage** - The values that people hold drive their connections with the natural environment. There is a range of values apparent across the scenarios, with the ethic of care and valuing nature for its own sake featuring more (in *Connect for Life*) and less prominently (in *Go for Growth*). In all scenarios, however, a utilitarian view of nature (where the environment is seen as necessary to support lifestyles) features strongly. In *Succeed through Science*, the environment is valued mostly for its contribution to the economy, whereas in *Connect for Life*, the environment is valued more for its own sake, recognising the connection between people and the natural world. Also, in all scenarios, dilemmas intensify where efforts to tackle one environmental issue (such as climate change through the development of tidal power) increase pressures on other environmental assets (such as internationally protected habitats and species).
- **Resources become constrained** - Both land and marine resources become more difficult to obtain, with access to fresh water being a particular issue across all scenarios. The response to these constraints differs across the scenarios: for example, in *Keep it Local,* there is a need to be far more self-sufficient. In all, however, there is greater emphasis on increasing resource efficiency by harnessing new technologies. In *Keep it Local* and *Connect for Life* there is also an emphasis on using and consuming less.
- **Identity and cohesion fragment** - Different levels of governance (from global to local) and varied cultural norms are key issues in all scenarios. In most scena*rios, the powe*r of the nation state dwindles in the face of global economic and cultural forces, except in *Keep it Local*, where there is strong national identity and central control, along with more local discretion.
- **Urban/rural distinctions blur** - Settlements incorporate accessible open space as a trend towards more eco-homes and green towns or use of land for food, while the countryside sees more development. In *Succeed through Science* and *Connect for Life*, towns and cities go green to adapt to climate change and provide broader green infrastructure services. In *Keep it Local*, greening happens as more urban land is turned over to food production. In *Go for Growth*, greening happens where people are willing to pay for it.

- **Economic growth and wellbeing diverge** - Measures of prosperity differ across the scenarios. In *Keep it Local*, land and natural resources are wealth. In *Succeed through Science*, measures of prosperity relate to innovation, with the environment as a necessary ingredient. In *Connect for Life*, prosperity is synonymous with a healthy environment and a 'good society'. In *Go for Growth*, the wellbeing benefits of the natural environment decline while economic growth advances, but even here resource constraints have slowed growth.
- **Climate change stimulates varied responses** - While the impacts of climate change are pervasive in all scenarios, it is how people respond that largely determines its significance. In *Keep it Local* and *Go for Growth*, there are no specific policies to reduce greenhouse gas emissions and the focus is on reactive adaptation to climate extremes. However, in *Keep it Local*, threatened critical national assets such as energy and transport infrastructure are defended. Under *Connect for Life* and *Succeed through Science*, concerted international action has been taken to reduce emissions, and adaptation is advancing, using a combination of natural systems, lifestyle changes and technological interventions.
- **Science and technology shape the future** - Advances in science and technology are key factors in shaping all the scenarios, but the pace and direction of such innovations varies widely. In *Succeed through Science*, innovation drives growth within environmental limits (although these limits are often under strain) and some early attempts are made to control climate change by removing carbon dioxide from the atmosphere. In *Go for Growth*, global markets drive innovation to both stimulate and satisfy consumption. In *Connect for Life*, hyper-connectivity and immersive technologies are central but with less emphasis on technical fixes for environmental problems. In *Keep it Local*, technology is oriented towards ensuring both national and resource security.
- **Changes in food production alters land use** - In all scenarios, there are changes in the nature of food production that have implications for land use. In *Go for Growth*, the emphasis on global food markets, high-yield production and synthetic products means that less land is needed for growing staple crops, although niche products are still grown. In *Connect for Life*, again, there is extensive use of large-scale food production in industrial units, with some field units working intensively with inherently benign technologies. Much land is freed up for other uses, particularly the provision of ecosystem services. In *Succeed through Science*, there is a more mixed picture with a balance between imports, high-yield field crops (under sustainable management) and synthetics. In *Keep it Local*, food production for domestic consumption is a dominant land use, focused principally around population centres.

Table 1 How we might live in each of the scenarios

How we might live	*Connect for Life*	*Go for Growth*	*Keep it Local*	*Succeed through Science*
Growth and prosperity	Modest: sustained increases in economic and welfare indicators	Following rapid increases, economic growth slowed; welfare indicators declining	Static economic and welfare indicators especially as resources are less widely available	Rapid increases in economic and welfare indicators
Global relations	Deep and broad global connections through widespread and advanced ICT	Global free trade, open markets and competition	Focus is on England; protectionism, but some strategic alliances	Global free trade, open markets and competition

Table continued...

How we might live	*Connect for Life*	*Go for Growth*	*Keep it Local*	*Succeed through Science*
Settlements	Concentration in London and South East; rapid urban and counter-urban development; high urban densities with green infrastructure	Concentrated in south of England; migration from cities; gated communities common; high urban densities for resource conservation	Locally revitalised; spread more around UK; more greenspace, but mainly for food production	Mainly in and around London and the South East; rapid urban-village development; green infrastructure at core of urban design; urban/rural divide blurred
Population and demographics	Growth through immigration, ageing and larger families	Growth through immigration and ageing	Steady but ageing; one-child policy; immigration tightly controlled	Growth through immigration and ageing
Social structures and cohesion	Connected in wide networks; participation in civic life	Increasing disparity between affluent and less affluent	Families smaller; strong national pride	Small households; but broad and deep social and family connections
Governance	Global arrangements for global issues, with national and local implementation	Decisions focused through minimally regulated markets with minimal safety nets	Strong central government planning; local decisions on lower-level issues; increasing tension between central control and local autonomy	Market-driven, with shared arrangements between global and national business, government and civil society as needs arise
Resource availability	High resource efficiency; closed cycles (cradle to grave); emphasis on efficiency and environmental impact	Increasingly constrained; particularly oil and minerals; emphasis on economic efficiency	Tightly constrained and controlled; emphasis on security of supply	Widely available; high resource efficiency, but vulnerable to system breakdowns; emphasis on efficiency and environmental impact
Response to climate change	Progress made on reducing emissions and ambient CO_2 concentrations; focus on adaptation through natural systems and lifestyle changes	Little if any policy on reducing emissions; main emphasis on adaptation to events that can disrupt economic growth	No specific policy to reduce emissions; emphasis on reactive local adaptation but central planning for increasing resilience of critical national assets	Progress made on reducing emissions; emphasis on market approaches to low-carbon energy and 'natural' carbon stores; adaptation through natural systems and technology

Table continued...

How we might live	*Connect for Life*	*Go for Growth*	*Keep it Local*	*Succeed through Science*
Mobility and transport	Strong demand; smart IT-enabled networks; low personal vehicle ownership	Strong demand; congestion common; minimal public transport	Limited; focus is local	High demand, but intelligent networks maintain function; low-carbon vehicles
Food and farming	industrial and field units with inherently benign technology	Land and fish markets minimal regulation; imports, synthetics; niche 'authentic' foods	Much land in local food; fisheries protected; few imports; some technology deployed for enhancing yields	Multiple sources; ecologically sound land management and crops; synthetics and imports
Employment skills	Innovation, entrepreneurship, partnerships, cohesion and environmental care	Finance, negotiation, deal-making, innovation, entrepreneurship	Security, craft, self-sufficiency, commerce	Innovation, entrepreneurship, collaborative working and environmental care
Pace and direction of innovation	Moderate pace geared towards connectivity, resource efficiency and environmental wellbeing	Rapid pace to drive and meet consumer demand; resource efficiency in response to constraints	Moderate pace; ICT ubiquitous; innovation focused on security, food and resource efficiency	Rapid innovation to meet consumer demands within ecological limits; ecosystems managed for goods and services
Environmental values	Mainly intrinsic and utilitarian with symbolic and aesthetic values: biodiversity and ecosystems central to wellbeing	Mainly utilitarian and aesthetic: what can command value in the market, for example, attractive landscapes	Mainly utilitarian but symbolic value of iconic landscapes and species	Mainly utilitarian and aesthetic but with some intrinsic value: ecosystems valued where goods and services provided
Leisure and tourism	Widespread; much leisure time with focus on shared, IT-enhanced experience and wellbeing	Finance and time constraints restrict options for many; affluent elderly travel globally	Limited; locally-focused with occasional wider travel	Big business; activity-based outdoor packages around customer-driven 'offers' for example, nature, culture, adventure, etc

Table 2 Similarities and differences between the scenarios

Similarities between the scenarios	• Population ageing • Resources constrained • Growth in development outside of towns and cities • Technology advancing (especially ICT, resource efficiency and food production) • Utilitarian environmental values prevalent • Broad range of food production methods in operation • Direct physical impacts of climate change
Differences between the scenarios	• Economic and wellbeing indicators vary in pace and direction across the scenarios • Three scenarios (*Connect for Life*, *Go for Growth* and *Succeed through Science*) have a global focus; *Keep it Local* is locally focused • Three scenarios (*Connect for Life*, *Go for Growth* and *Succeed through Science*) have settlement concentrations in southern England; *Keep it Local* has settlements more dispersed • Climate policy differs across the scenarios (*Go for Growth* and *Keep it Local* have no specific emissions reduction polices with reactive localised adaptation dominating; *Succeed through Science* and *Connect for Life* see progress on emissions reductions and adaptation) • Three scenarios (*Connect for Life*, *Go for Growth* and *Succeed through Science*) have a strong demand for mobility and transport, but means of managing this differs; *Keep it Local* has lower levels of mobility • Wide differences in employment skills between the scenarios • Extent of non-utilitarian environmental values differs • Working times, leisure and tourism differ markedly

Implications for the natural environment

Issues across key aspects of the natural environment

2.3 Based on consideration of how we might live in 2060 and recognising the centrality of human activities in shaping environmental change, Table 3 summarises briefly what could happen in each scenario in relation to three key aspects of the natural environment: people's engagement with the natural environment, biodiversity and landscape.

- ***People's engagement with the natural environment*** - In all the scenarios, as resource pressures change behaviour, people become more aware of the natural environment and benefits it provides through ecosystem services. In *Connect for Life* and *Succeed through Science,* the natural environment is valued for both its benefits in delivering natural resources and for recreation and amenity value and to a varying degree for aesthetic and cultural reasons. In *Go for Growth* and *Keep it Local,* the focus is on using the natural environment to provide and support the basic necessities of life. In *Succeed through Science*, science and technology are increasingly deployed as the basis for protection of the natural environment. As such, there are early signs that people may come to rely on these advances to protect the natural environment, and concepts of what is 'natural' changes significantly.
- ***Biodiversity*** - *Connect for Life* is the only scenario to see significant improvement in habitat and species protection. The other scenarios focus on the ecosystem services biodiversity provides with an emphasis on managing negative effects to maintain this provision. *Go for Growth* is the scenario where there is the most decline in both habitats and species. More specific elements of biodiversity, where these support ecosystem services, are maintained in *Succeed through Science* although with increasing vulnerability to widespread technological failures and breakdowns.
- ***Landscape*** - This changes under all the scenarios as land is used to provide more energy and food. However, it is played out at different scales. *Go for Growth* and *Succeed through Science* will see a newly industrialised landscape with smaller scale pockets of change under *Keep it Local*. Where landscape has valuable natural resources (*Keep it Local*), or has a value for amenity and public good (*Connect for Life*), some form of designation or protection will remain.

Table 3 Implications for the natural environment by key aspect

Theme	*Connect for Life*	*Go for Growth*	*Keep it Local*	*Succeed through Science*
Biodiversity	Area of semi-natural habitat increased. High species abundance and functioning land and marine ecosystems	The speed of the long-term decline in terrestrial and marine biodiversity is increasing. Islands of biodiversity in private estates. Increased pressure from invasive species and biotechnology	Reduced area of semi-natural habitat. Iconic species and habitats protected in specific locations	Biodiversity supporting ecosystem services is protected and enhanced. Technology used to avoid and reduce negative impacts. Natural systems increasingly managed but increased risk of unintended ecological consequences
Landscape	Significant change to accommodate development. Sense of place important with emphasis on the protection of ecosystem services. A blurring of urban and rural landscapes	Significant change due to large-scale energy, transport and adaptation infrastructure projects and more industrialised agricultural practice	Significant change relating to land use and infrastructure for the production of energy, food and fibre. Iconic landscapes protected in specific locations	Significant and rapid changes in land use as new technologies are adopted and replaced; in some locations, post-industrial legacies increase in number and extent

Table continued...

Theme	*Connect for Life*	*Go for Growth*	*Keep it Local*	*Succeed through Science*
People's engagement with the natural environment	Large numbers of people engaging frequently with the environment, often enabled through, or enhanced with, high-definition virtual reality and immersive presence	Decreasing active engagement. Few have the leisure time but, more generally, the natural environment is regarded as a resource for economic growth. Increasing view of the natural environment as a source of threat	Local pride in biodiversity and iconic landscapes. Increased awareness of the direct benefits of the natural environment particularly for food, energy and water	The natural environment is valued for the tangible benefits it can bring. Indirect benefits, including cultural and aesthetic considerations, are recognised, especially when a financial benefit can be obtained

Issues across geographic zones

2.4 Based on the tables set out under each scenario in Section 3 and the more detailed description given in Appendix 1, this section highlights the key similarities and differences across the four scenarios in relation to how they may play out in different geographic zones:

- ***Uplands*** - The importance of the uplands increases across all the scenarios, in particular, for water and energy production and supply. In *Connect for Life* and *Succeed through Science,* carbon sequestration is also a key function. In all the scenarios, there is increased amenity pressure; the difference is in the intensity and area impacted. In *Keep it Local,* iconic areas are protected, but are subject to short, but intense bursts of recreation use. In *Go for Growth* large areas are inaccessible to the public, resulting in intense pressure on the remaining publicly accessible land.
- ***Lowlands*** - In the lowlands there is pressure from development, food production, energy and transport infrastructure across all the scenarios. It is the level of impact of this cumulative development that differs. In *Succeed through Science,* an attempt is made to avoid or reduce the impact through application of new science and technology; and more dispersed settlements in *Connect for Life* mean that pressure in some areas may be reduced. In *Keep it Local*, national decisions are taken on critical infrastructures only; all other decisions are made locally. This reduces pressure where local assets are identified, but as each community strives to develop in its own locality, cumulative impacts and conflicts with national decisions increase. *Go for Growth* sees the least planned and coordinated approach, with most decisions left to minimally regulated markets.
- ***Settlements*** - Greenspace and water areas increase in all the scenarios as part of climate change adaptation. There are differences however, regarding how this increase comes about. In *Connect for Life* and *Succeed through Science*, adaptation is planned and coordinated, with efforts made to avoid adaptation measures that would worsen climate change. In *Keep it Local* and *Go for Growth*, however, adaptation is more reactive and uncoordinated; responses may worsen climate change. In all scenarios except *Go for Growth*, open space also increases for more general amenity. In *Go for Growth*, however, this is more restricted to those who can afford it (for example, in gated communities) and for *Keep it Local*, greenspace increases but more for the purposes of localised food production.
- ***Coasts*** - Some form of hard sea defences remain in all the scenarios to protect strategic assets (energy and transport infrastructure). In *Connect for Life* and *Succeed through Science,* natural processes and realignment of the coast are used to a greater degree to protect assets including infrastructure and (in *Connect for Life*) natural values. In *Go for Growth* and *Keep it Local*, where benefits outweigh costs in terms of profitability or the strategic value of the assets, protection is developed with little attention to the environmental impact. In other areas, however, protection is withdrawn.

- ***Marine*** - In all scenarios, ocean acidification has advanced, contributing to a series of marine ecosystem changes, manifest in many different ways, with precise cause and effect relations difficult to pinpoint or understand. In *Connect for Life* and *Succeed through Science,* there has been some indirect slowing of acidification through reductions in levels of CO_2. Fisheries are valued in *Connect for Life* and *Succeed through Science*, being supported by globally focused quotas and fiscal policy respectively. Fishing pressure beyond sustainable limits has resulted in significant declines in white fish and crustacean populations in *Go for Growth*, whilst in *Keep it Local*, territorial waters are managed and protected as strategic national assets.
- ***Wetlands*** - In all the scenarios, wetlands are managed for their ecosystem services - clean water supply and/or carbon sequestration. In all scenarios except, *Go for Growth,* this results in an increase in the extent of wetland habitats.
- ***Woodlands*** - The area of woodland increases significantly under *Connect for Life* and *Keep it Local*, is static (or moderately increasing) in *Succeed through Science* and is reduced in *Go for Growth*. Trees are used in all scenarios (to varying degrees) to assist in adapting to climate change. In all scenarios, except *Succeed through Science*, woodland is managed for the provision of renewable energy. Woodland is also used for amenity in all scenarios but to differing degrees. *Succeed through Science*, *Keep it Local* and *Connect for Life* see extensive increases in woodland used for amenity - but this is in conjunction with other uses, and rarely as a sole use. In *Go for Growth*, woodland is used for amenity, although the range of people for whom access is permitted is restricted.

Summary of implications for the natural environment

2.5 Taken together, across the key aspects and the geographic zones, a number of issues arise:

- **Nature in the service of humanity** - Over the next 50 years, across all the scenarios, there are significant changes in the relationship between people and the natural environment. The four scenarios describe an increasing emphasis on the 'purpose of nature' - people increasingly ask what can the environment do for me? Consequently, people increasingly look to the natural environment to provide benefits for human wellbeing. In all scenarios, there is, therefore, an increase in focus on conserving, managing and enhancing the natural environment for the ecosystem services it can deliver. There is emphasis on the more material (provisioning, regulating and supporting) services, while the extent to which cultural services are valued varies considerably.
- **Landscapes change, but are still valued** - In all scenarios, visible changes to landscapes occur that can have subtle effects or can significantly alter landscapes. In all scenarios, some landscapes are regarded as aesthetically pleasing, based on the range of values apparent in each scenario. The provision of energy is particularly influential in terms of an increase in woodland for biofuels and carbon sequestration, especially in the *Connect for Life* and *Keep it Local* scenarios. Rapid technological advances as part of the *Go for Growth* and *Succeed through Science* scenarios result in 'newly industrialised' landscapes with highly visible energy production methods (for example, onshore wind farms) and industrialised food complexes. The appearance of settlements also changes across the scenarios as a result of housing to accommodate population increases, adaptation to climate change or food production. More greenspace and water areas appear in all scenarios, with increases in opportunities for accessing these open spaces varying. In *Go for Growth*, access is restricted to those who can afford it, while in *Keep it Local*, there are fewer opportunities for access for recreation and amenity, as much open space is taken up with food production.

- **Changing geography of England** - in this report we have explored the potential implications for the natural environment in each of seven geographic zones. In all of these, across the four scenarios, we see potentially significant changes as the natural environment is asked to 'work harder' to provide services for people. In particular:
    - ***Uplands*** see a more active future as ecosystem services becomes entrenched as the basic paradigm for environmental management.
    - ***Lowlands*** become a pressure-cooker where the increasing competition for land plays out in the face of population growth, changes in settlement patterns, and energy and food production and water supply.
    - ***Settlements*** become more 'porous' as open spaces become more common within settlements and as settlements become more dispersed throughout the country.
    - ***Coasts*** in many places become the new wild spaces; especially where natural flood defence systems are put in place or where flood and coastal protection is withdrawn entirely.
    - ***Marine*** areas undergo change as ocean acidification begins to bite and as people turn more to the sea for a wider variety of food supplies. The seas are also used for a wider range of infrastructure uses, the governance arrangements around this varying across the scenarios.
    - ***Wetlands*** are increasingly used for water supply, flood risk management and for providing cooling for settlements in the face of climate change. The extent to which wetlands are maintained as wildlife havens or public amenities varies across the scenarios.
    - ***Woodlands*** undergo a general expansion across the scenarios, but the location and purpose of these varies considerably. In settlements, trees become important for cooling under climate change and in the wider countryside, trees help secure ecosystem services and become a direct source of timber and energy.
- **Governance responds as land use pressures grow** - Resources become constrained across the scenarios and this drives an increased emphasis on maintaining and protecting the ecosystem services that deliver people's basic needs, particularly fresh water. This puts increased importance (and pressure) on wetlands and uplands to be managed to deliver water resources. Similarly, population growth and changes in settlement patterns add to the competition for land and sea. As land use competition intensifies, tensions increase, particularly where habitats and landscapes are protected and managed for less material purposes such as for recreation and species protection. Indeed, only in *Connect for Life* is there active management of habitats and species for their intrinsic value. The nature of the governance arrangements put in place to respond to these pressures varies considerably. Global markets dominate in *Go for Growth* and *Succeed through Science*, with a greater emphasis on partnership approaches in *Succeed through Science*. In *Keep it Local*, strong, nationally-focused government is the focus of decision-making on critical issues (such as food, water and energy supplies and security), although there are tensions with local autonomy on other issues. In *Connect for Life*, decision-making is through the hyper-connected world of local communities working within the global context.
- **Scale of response matters** - In the face of these changes, there are marked differences in relation to the spatial scale over which responses occur. In *Go for Growth*, *Connect for Life* and *Succeed through Science*, responses occur within a global context; the key differences being that in globalised market scenarios (*Go for Growth* and *Succeed through Science*) there is emphasis on developing and implementing standard approaches. In *Connect for Life*, however, while still global in its outlook, responses are developed locally, but informed by experience and practice elsewhere, enabled through hyper-connectivity and openness of knowledge-sharing and innovation. In *Keep it Local*, the responses are very much focused on local and national scale, with much discretion at local level except where critical national infrastructures are of concern.
- **How the future looks** - This report has tried to describe the possible journeys to 2060, what life in 2060 might be like and what the implications might be for the natural environment at

that time. Yet in each of the worlds described by the scenarios, it is also apparent how people might think about their own futures; that is beyond 2060. In *Go for Growth*, this future is mainly short-term: where the next deal can be done; where the next profit comes from...in this world patience is not a virtue. In *Keep it Local*, the future is about surviving, not quite day to day, but certainly over the short to medium-term. Most people are active in providing the basics for life, although there is some investment in the future through innovation, strategic trade partnerships and protection of critical national infrastructure. In *Succeed through Science* and *Connect for Life*, the future is very much to the fore. Both scenarios see a virtue in preparing and providing for the longer term future. For *Succeed through Science* it is to maintain the pace and direction of innovation, and for *Connect for Life* it is to sustain natural systems and processes into the longer term.

Drawing the threads together

2.6 Two key related issues are apparent looking across the factors described above.

2.7 Firstly, **in all four scenarios, the natural environment has value in some form**. The question of values boils down to 'where will the balance sit between valuing the environment for its own sake and for the social and economic benefits it can bring?' All the scenarios hint at both these positions, but it is a question of degree, rather than a discrete position at one or other extreme. In all scenarios, nature's value is grounded in the benefits it delivers to people (ecosystem services). Here, nature is very much at the service of humanity and it is conserved, enhanced and managed primarily for the benefit of people. But at the same time, there are those who value nature for its own sake, regardless of the benefits it brings to them. Here, the human/nature relationship has no clear functional purpose and nature serves both itself and humanity. Its conservation, enhancement and management enables natural systems to maintain their integrity into the long-term.

2.8 Secondly, **in all four scenarios, the future state of the natural environment is determined largely by the choices that people make, shaped by their values and the broader context in which they live.** The scenarios describe the effects of different ways that choices can be made, leading to the second key question: 'what will drive decision-making?' The nature of the choices and the systems in place to make those choices vary across the scenarios, but essentially they are shaped by:

- the availability of resources - for example, energy supplies, food or water;
- scientific and technological capabilities - for example, innovation for low-carbon energy, industrial food production and information technology;
- societal preferences around trade-offs - for example, balancing renewable energy generation or flood risk management against nature conservation; and
- the scale and nature of decision-making - for example, spatially (from global to local), over time (from short to long term) and through relationships (directed to voluntary).

2.9 So as changes take place over the next 50 years, the extent to which implications for the natural environment are (or are not) taken into account depends on the willingness and ability of society to:

- Take a **systems approach** that enables it to understand and manage better the broad, cross-cutting and complex situations in which it finds itself, rather than tackling individual issues in isolation.
- Adopt a **futures approach** that enables it to anticipate how unknowable futures give rise to a range of risks and opportunities.
- Build **institutions and processes** that help society make choices in the face of uncertainty and take robust decisions about which risks it approaches or avoids and which opportunities it pursues or forgoes.

2.10 In this report, we have described how the future might unfold, the factors that might shape it, how we might live and the implications for the natural environment. We have not specified the likelihood, nor judged the desirability of those futures. The scenarios provide the basis for challenging and forward-looking debate and discussion.

3 How might the future develop?

The nature of futures thinking

Scenario preparation

3.1 This set of scenarios and their implications for England's terrestrial and marine natural environment has been prepared over 14 months using in-house expertise complemented by specialist consultancy input in defining the process we have followed. Consultancy support for scenario preparation was provided by SAMI Consulting (St Andrews Management Institute) and the Centre for Urban and Regional Ecology (CURE) at Manchester University.

3.2 Firstly, desk research was undertaken to analyse historical and current trends, factors and pressures that could affect the natural environment to 2060. It drew upon a range of information, insight and evidence covering social, technological, economic, environmental and political factors. This was complemented by interviews conducted with a range of senior staff and stakeholders, which captured concerns and issues important to the future of the natural environment. The research and interviews shaped the identification of 14 global drivers of change to 2060 (Appendix 1), which were (in alphabetical order): climate change; converging new technologies; demographics; energy; food security; world economic power shifts; governance; health and wellbeing; infectious diseases; marine; mobility; money; wealth; economy; resources; values and people. A separate and more detailed report '*Global drivers of change to 2060'* is available on the futures page of Natural England's web site, URL: **www.naturalengland.org.uk/ourwork/securefuture/default.aspx**, contains descriptions of the drivers, factors that could on push them in the opposite direction and the range of possible outcomes that they could prompt, including possible response within the UK.

3.3 The basic storylines for the scenarios were created over a series of three workshops involving staff and key stakeholders (see Appendix 2). The major factors likely to affect the natural environment were discussed. Three big questions emerged:

- Will the world have found a way to live sustainably?
- Will technology have provided a 'get out of jail free' card or will lifestyle changes still be necessary?
- What will be the world order? Will it be dominated by free market globalisation?

3.4 Combinations of possible answers to these questions were explored, along with an appreciation of how the 14 factors influencing change might evolve over the next 50 years. From this, four qualitatively different scenarios were identified to analyse further; the combinations chosen being plausible but also challenging. Detailed descriptions for each were prepared. We did not adopt a quantitative, modelling or forecasting approach, given the immense complexity and long time scales involved.

3.5 The four scenarios explored a range of distinctive options facing society: the role of technology, the levers that could move the world towards sustainability and the nature of society in England by 2060. The scenarios were presented as a series of stories, told from the point of view of a person in 2060, looking back on events over the previous 50 years.

3.6 The draft scenarios were tested and refined through broad engagement with both Natural England staff and external stakeholders including members of the public, through a series of

workshops and other processes including peer reviewers from outside the UK (see Appendix 2). In addition to providing a critique of the scenarios, this engagement provided an opportunity to develop timelines for the scenarios up to 2060, and, to explore the scenarios in a range of natural environments covering the span of Natural England's interests.

3.7 Appendix 2 lists the people involved in shaping the scenarios and we are grateful to them all for their input, hard work and creativity.

Major changes to 2060

3.8 In identifying how things might change over the period to 2060, we found it important to recognise and acknowledge that the future is inherently uncertain and that surprises are inevitable. As such, an essential factor in the development of our scenarios was to explicitly, and without prejudice, explore a range of ambiguities and uncertainties, such as random factors and unpredictable behaviours. Several factors of change to 2060 were identified and assessed according to their relevance to the question 'What could affect England's natural environment to 2060?' and the uncertainty of their outcome over the timescale. These 'critical uncertainties' directly influenced the identification of the four scenarios.

3.9 Between now and 2060 there are likely to be major generational shifts in society, together with many changes in technology, lifespan and climate change. For this reason major 'givens' relating to these topics were consistently built into the four scenarios, the responses to them being different in each:

- Technological development - both information technology and the fast moving converging (nano-bio-info-cogno) technologies. However, the pace and direction of science, innovation and technology differ across the scenarios.
- Changing population and demographics, in the UK and across the world. How these play out, and the effects of policies on these factors, is different in the four scenarios.
- Climate change - on its predetermined track for the next 50 years. While the degree of climate change is assumed to be constant, the response to such changes is tested across the scenarios. In particular, recognising that England is projected to experience more frequent and more severe extreme weather events over the next 50 years, two major shocks have been introduced in each scenario: a Europe-wide drought in 2020 and severe east coast flooding in 2050. The main purpose of this was to explore how society might respond to such events in each scenario, thereby helping to illustrate the main values and forces at work in those potential futures.

3.10 The scenarios were developed along consistent 'narrative threads' in which the stories start out grounded in the present, highlighting current emphasis on certain strategic issues but also pointing out where other emerging trends or issues are ignored or downplayed. The stories then develop along those tracks until a 'response' occurs in which the dominant policies and emphases are challenged and new pathways open. These pathways are then followed through to the outcomes in 2060 described here.

3.11 The evolution of the scenarios is set out in Figure 1.

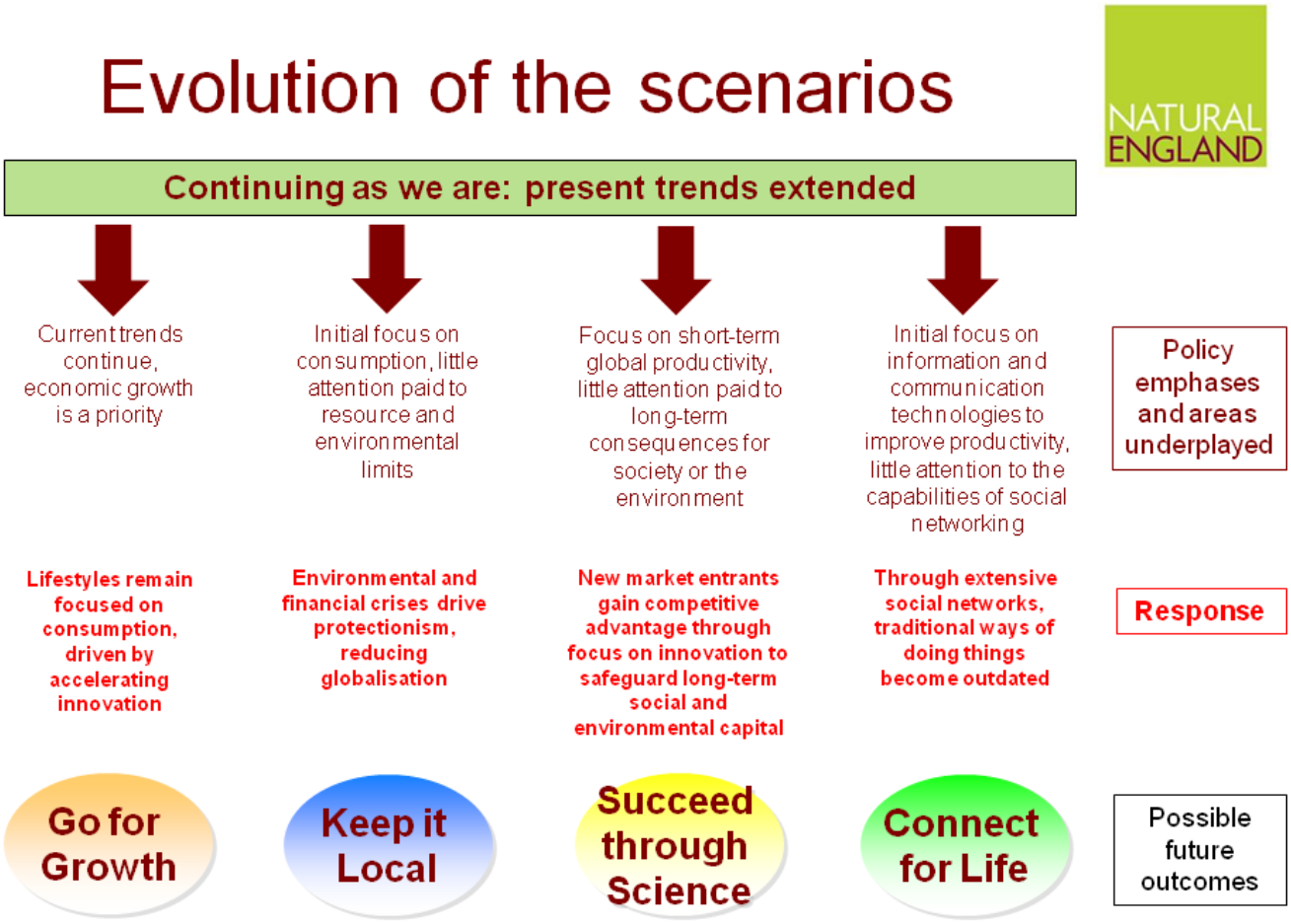

Figure 1 Evolution of the scenarios

Conceptual framework

3.12 When developing our long-term scenarios, we found it important to take account of:

- The need to think about long-term changes in human and environmental activity and their interaction over time.
- The importance of making a timeline explicit and vivid in order for the long-term scenarios to have credibility.
- The need to look at underlying cultural factors, including how radically they might change over the span of two generations.
- The need to look backwards for twice as long as forwards to assess the extent of potential changes.
- The potential for many current political and economic assumptions to be no longer valid as there may be one or more shifts in world-views.

3.13 The scenarios focus on the full range of factors that might affect the natural environment in England between now and 2060, including how people engage with it. But the scenarios developed in this project were influenced strongly by the central role of people's values, culture and behaviours in shaping how the future may develop. With this in mind, the Ethnographic Futures Framework (EFF) was adopted as the central unifying structure to explore how the drivers may develop over the next 50 years and then to develop and structure the scenarios. The EFF asks a number of questions, which fall under five headings:

- **Define:** What new concepts, ideas, and world-views will emerge to help us make sense of the world?
- **Relate:** How will we live together and relate to each other and the world around us?
- **Connect:** What arts, media and technologies will we use to connect people, places, and things?
- **Create:** What will we create and build?
- **Consume:** How will we use resources?

3.14 The EFF complements the timeframe of the scenarios to 2060, as the values, cultures and behaviours of people are central to determining potential outcomes in long-term scenarios. The focus on the EFF lies in where the effects of changes in the future are felt. This is different from the more usual 'drivers of change' approach, which focuses on where changes originate. This approach was adopted because it aligns well with Natural England's purpose to ensure that the natural environment is conserved, enhanced and managed for the benefit of present and future generations - people being at the heart of our purpose.

CONNECT for Life

Scenario outline

3.15 A brief outline is provided below. A full storyline and summary timeline are provided in Appendix 1.

3.16 ***Life in 2060:*** *People now connect through vast global networks. Decisions and economies are based locally, but through billions of worldwide connections they create a bigger and more effective system - a global super-brain. Social and environmental values have strengthened a lot over the years - loyalty lies with communities connected for common purposes across the globe; national government has relatively little influence.*

3.17 ***How this scenario emerged:*** *In the early decades of the 21st century there was a major focus on using information and communication technologies (ICT) to improve productivity. At the same time, however, less focus was given to the potential of social networking and internet-enabled democratic decision-making to improve social and environmental outcomes. As social networks became sufficiently large and self-supporting, 'traditional' beliefs and ways of doing things*

became outdated and unproductive. These then faded as hyper-connected communities became the main focus.

How we might live

3.18 The UK is growing modestly in economic terms, with sustained increases in economic and welfare indicators since 2010. However, there have been variations in economic growth across the country, with more sustainable success in those regions that have invested in supporting natural systems. The population has also grown through larger families, immigration, and longer life expectancy through advances in medicine and technology.

3.19 However, population growth has not been evenly spread. In London and the South East it has accelerated. This has resulted in continued urban development, particularly in areas with high-density eco-efficient, self-powered homes for young people and economically active migrants. However, there have been a number of waves of counter-urbanisation, and areas outside towns and cities have also seen their populations and their economies grow. Widespread and embedded computing power has been the driver behind this influx, such that IT is now seen as an infrastructure and not a technology. Services such as education, housing, healthcare, transport and security are available to all; few go without. They are provided through a range of structures and models, driven by local needs and priorities, often through a mixture of public, private and community organisations.

3.20 Most people and communities are connected globally through advanced computer networks, for a range of purposes, such as sharing knowledge and experience, entertainment, personal connections, business and collective decision-making. Nevertheless, people still wish to meet face-to-face and, as towns and cities have grown, there is still strong demand for localised travel. This is met through a range of measures such as advanced mobility schemes where computer networks optimise pick-up and drop-off arrangements for people. As a consequence, personal car-ownership has declined, and public transport and personable mobility devices are more popular.

3.21 Since the Common Agricultural Policy and Common Fisheries Policy were replaced with the European Food Policy in the 2020s, food production has grown in accordance with rising populations. The result is that a high proportion of food is now produced in industrial complexes, where technological advances such as biotechnology and the careful matching of crops and irrigation to growing conditions, have enabled land-based agriculture to keep pace with rising demand. Rearing animals for meat and dairy has declined significantly because of concerns about resource and environmental constraints, but some niche products are still available. Protein sources are varied and much comes from plant, fungi and algae, with growing interest in synthetics.

3.22 The natural environment has been recognised as providing the essentials of life and for maintaining the economy. Land managers and owners therefore have a vested interest in making sure the environment is well-maintained, and that we continue to benefit from the ecosystem into the long-term. To help keep trading simple and efficient, the characterisation and valuation of these services have become widely standardised. In many instances, however, this has meant services from one part of the world look and function increasingly similar to those provided elsewhere. But value is created in demonstrating (and branding) goods and services which are produced through sustainable production systems that respect nature and connect people across the globe.

3.23 Upland areas are largely managed as water-collection areas, as it is recognised that river and groundwater abstraction and desalination carry additional costs to the environment, society and the economy. Advanced computing power has enabled precision monitoring and forecasting of rainfall and water movements, and highly efficient water transfers across catchments to meet fluctuating needs.

3.24 Similarly, energy sources have been largely transformed to avoid greenhouse gas emissions, and now come from a wide diversity of power sources, such as solar, nuclear, wave and tidal, and biomass. Some fossil fuels are still used, but greenhouse gases are captured and stored. Energy systems operate in precise and reliable dynamic networks. Some operate in local areas only, but others have developed into large-scale international energy systems, with the European power grid coming on stream in 2040.

3.25 As the electricity supply and vehicle fuels have become increasing decarbonised, the focus of the European and international carbon-trading markets has shifted to those areas where substitution for low-carbon energy has proven most difficult. By 2060, this is focused particularly on aviation, where alternative power sources have been difficult to develop and deploy. In addition, as part of a broader global strategy for removing carbon dioxide from the atmosphere in an effort to stabilise climate change, upland and woodland areas are increasingly managed to make the most of their sequestration potential.

3.26 People can readily acquire the basic necessities of life - food, water, energy, accommodation and communications - and have recognised the need to share economic activity, thus bringing a balance between work and home life. Few people work more than 40 hours per week and 40 weeks per year, and many retire much earlier than in 2010. The additional productivity created by advances in IT and adoption of an approach that seeks to maximise the economic and social benefits that flow from well-functioning ecosystems ('ecosystem services') has enabled many to earn more and save more, so more have the opportunities to participate in civic life and enjoy their leisure. But that leisure is not driven by the desire to consume material goods, but rather to broaden experience and improve wellbeing. Young people are schooled in the requirements of maintaining wellbeing. Through embedded and commonplace networked high power computing, 'soft' skills are promoted above knowledge content (as this can easily be downloaded). Education has become more focused on learning for life, with skills recognised and valued in innovation, entrepreneurship, partnership building, community cohesion and environmental care.

3.27 By 2060, people will have developed a close connection with the environment, recognising and celebrating their place in the natural world. They will have an informed, big-picture appreciation of the natural environment, which, combined with greater empowerment from a grassroots level, contributes to its protection. Greater connectivity has spurred interest in and understanding of environmentally positive behaviours, with much focus on self-motivation. This takes place within a clear set of social norms and expectations to act in such ways. Indeed, many people actively campaign against those they feel are acting against the interests of the planet. Such campaigning is usually peaceful, but occasionally, it can spill over into intimidation and violence. Some have seen this as the potential rise of a planet-focused eco-fascism and are seeking ways to nip it in the bud.

3.28 On the whole, the greater sense of connection with the natural world has led to - and feeds off - increased numbers if people visiting and enjoying the countryside. They take part in a broad range of shared activities, such as outdoor adventure and appreciation of the cultural heritage of the countryside (such as through art, history and music). Increasingly, these experiences are enhanced through technology with the creation of images, information and music based on or inspired by the landscape. Consequently, aesthetically pleasing landscapes and wildlife attract a premium and, where these can be provided alongside other uses (especially food, energy, housing and carbon sequestration), land managers increasingly reap rewards from retaining and adding to their value, even in the face of climate change. While landscapes change, and wildlife changes with them, these shifts are often seen and valued as symbols of the dynamic forces at work in the natural world.

Implications for the natural environment

3.29 Decisions about land management and use, whether for food, development or any other purpose, are made according to the ecosystem services they can provide. Wherever possible they are used to deliver more than one objective. Space is at a premium because of this need to support

multi-functionality and ecosystem services at the same time as food production, homes and infrastructure. As a result, local decisions are often required to resolve competition between needs. This leads to experimentation, fine-tuning and frequent switches in land use and management techniques. This can sometimes conflict with the need to adapt to climate change, and can lead to local impacts that are sometimes unforeseen and which require further networking and changes to rectify them.

3.30 Because of the strong environmental values in this society and the need to keep environmentally damaging intensive, or extractive, approaches to a minimum, intelligent infrastructure networks are used to trade and transfer key resources from one place to another using low-impact transport.

3.31 Most people hold strong non-materialistic values but some remain more materialistic. As a result, there are often long debates about needs and priorities, leading to pressure to come up with new solutions (technological and otherwise) that deliver choice and variety but which also seek to meet the needs of the environment and future generations.

People's engagement with the natural environment

3.32 On the whole, people are aware of the benefits that the environment gives them. They value ecosystem services and support their safeguard, not least in tackling and adapting to climate change. Most people understand that the environment is changing, as is their role within it - that is, what their likely impact is and how their work may benefit it. Partly because of the health benefits that the natural environment gives them, people's health is generally good.

3.33 While many make wider use of virtual reality, the increased population and dispersed settlements, coupled with the reduced travel outside the UK and the need to use land to deliver multifunctional benefits, mean that public access still puts pressure on land. For example, people living in the uplands want to use their environment more and can threaten some of its qualities through their demands to use sites such as lakes or reservoirs for recreation, or to walk through sensitive peatlands, increasing the risk of erosion. With even larger numbers of people in urban areas, pressure on greenspace and water areas is high, and again the intensity of regular use can threaten the ecosystem services they provide.

3.34 There are frequent changes of use and management as people seek the best solutions to allow land to be used for people as well as a range of other purposes. However, there is still a sizeable minority of people and communities who still feel committed to more materialistic values, and they can cause quite significant local impacts to the environment or prevent others from using it.

Biodiversity

3.35 As a result of land being managed to provide the widest range of ecosystem services, the area of semi-natural habitat has increased across the country. Even though concerted international action has helped to stabilise greenhouse gas emissions, the world is still (on average) a few degrees warmer than in 2009. Falling temperatures are many decades away, meaning that adaptation to climate change is still necessary, and the progress made in mitigation, through measures such as carbon sequestration in peatland, needs to be maintained.

3.36 While there is a mosaic of multifunctional land uses providing a variety of benefits, this is not always giving optimal gains for biodiversity, as local decisions and trade-offs can overturn wider sustainability aims or have unintended consequences. Although there is international accord on the protection of biodiversity, there are sometimes not the local skills or resources to manage the most vulnerable habitats and species, and despite the best of intentions, and the widespread availability of networked global expertise and shared experience, some extinction and damage still occurs. While it is recognised that England's biodiversity will continue to change as a result of climate change and other human activity, and many new species are accepted as part of ever-changing ecosystems, some new species can still have adverse impacts on existing species and

habitats, since they can exploit the corridors set up to help climate change adaptation and adapt more aggressively to changing conditions.

3.37 As a result, many (but not all) habitats maintain high numbers and abundance of all but the most vulnerable species. This is especially true for habitats such as bogs, wetlands and woodlands that provide the most valuable ecosystem services. Indeed, key areas are legally protected to safeguard their ecosystem services as well as their biodiversity. The situation is not universally positive: coastal biodiversity, such as saltmarsh, is still at risk from flooding and rising sea levels, while storm damage and drought have reduced biodiversity in many locations. In the South East, the increases in population, changes in climate and the continued need to produce food mean that tough decisions have to be made to minimise impacts on biodiversity. More widely, the move out of cities and more leisure time means ever increasing requirements for development and land for leisure, with potential impacts on biodiversity in woodlands, other greenspace and water areas in and around settlements.

3.38 Changing social and ethical values have reduced the demand for meat derived from livestock, leading to significant shifts in land use in relation to 2009. Lower demand for beef and lamb has led to the reduction of some traditional grazing, except where this is preserved to maintain the most valuable habitats and landscapes or to satisfy the remaining demand for meat. The reduction in grazing and expansion of forestry has meant that many lowland grasslands and heathlands have reduced their area and species diversity. In some locations, sensitive habitats have been maintained through alternatives to grazing such as mowing, cutting or burning. The value of soils for ecosystem services is recognised and their condition is generally good.

3.39 On the whole, aquatic ecosystems function well, with agriculture, energy production and development all designed (as far as possible) to enhance environmental conditions and minimise environmental impact, thereby securing water quality and supply. The area of wetlands has increased. Woodlands have increased in area, and many are richer in biodiversity as a result of sensitive and diverse management practices. However demands for wood and timber mean that many forests dedicated to commercial production remain. Furthermore, local needs can occasionally mean that species numbers may decline locally or temporarily, with vulnerable species particularly affected. However, the wider environment, being in generally good condition, acts as a reservoir that can aid rapid recovery of species where local declines occur.

3.40 The need to protect marine biodiversity and the seas as a global resource in the face of continued impacts such as acidification has led to stringent international protection measures, including an extensive network of marine protected areas. There are attempts to hold back the full impacts of acidification through reductions in CO_2 emissions. More sustainable fishing practices are secured through globally focused quotas and enforcement of catches and stocks. Aided by the production of vegetarian-based non-fish meal, some less environmentally sensitive waters, predominantly inshore, are used for fish farming.

Landscape

3.41 All landscapes have been altered by the need to maximise ecosystem services and to accommodate the rising population and the accompanying demand for food and development. Although landscapes are very different from today, their overall quality is felt to be good and they are notable for their variety as a result of their reflection of local decision-making and sense of place in different communities (which includes relatively new settlements). The idea of protected landscapes has undergone a radical shift in emphasis towards providing ecosystem services and reflecting global, rather than national values. As a result, former designations such as National Parks are no longer seen as necessary owing to the prevailing values but also owing to local people's desire to develop and protect landscapes that are meaningful to them.

3.42 Energy production is renewable, relying on advanced technology and as a result its overall effect on landscape quality is low. However local decisions in areas of high demand such as the South East mean that some local energy facilities do affect some landscape quality.

3.43 Rural landscapes are occasionally affected by large-scale food production, but this has tended to be sited in areas that most people perceive to have lower landscape value. The growth of new settlements has meant that the distinctions between rural and urban areas have blurred, with concepts of 'countryside' differing widely across England. Town and cityscapes are characterised by extensive greenspace and water areas. Upland landscapes have been transformed with mosaics of woodland, grassland, peatland and human settlement, often with development and agriculture occurring at higher altitudes than 50 years earlier. Some upland areas have deliberately been allowed to develop in a more 'wild' state, with minimal management.

3.44 A small number of communities, land owners and managers continue to pursue more economically focused goals, and some attempt to preserve former landscapes and land uses.

Implications by geographic zone

3.45 The table below summarises the implications of this scenario within the key geographic zones.

Table 4 Implications for the natural environment by geographic zone

Geographic zone	*Connect for Life*
Uplands	Local decision making within global context. Managed for ecosystems services such as water supply and carbon sequestration. Increase in woodland for renewable energy. Hot spots of amenity pressure
Lowlands	Greater heterogeneity and land use. Rural/urban distinctiveness less apparent. Reduction in area of previously grazed habitats
Settlements	More dispersed settlements. Increased areas of green-space and water areas to assist climate change adaptation. Increased amenity pressure
Coasts	Managed and unmanaged coastal realignment using natural processes is common. Pockets of hard defences remain. Small scale wave and tidal energy schemes are widespread
Marine	Some indirect slowing of ocean acidification through reductions in greenhouse gas emissions. Fisheries are globally valued: consumer power, combined with improved understanding of ecosystems has led to more sustainable fishing practices. Some fish farming also occurs. This global protection, including a sizeable network of marine protected areas, has helped safeguard marine biodiversity
Wetlands	Area of many wetland habitats increased for the ecosystem services they provide, the exception being previously grazed habitats. Increased amenity pressure on water areas close to centres of population
Woodlands	Increased areas for ecosystem service provision and adaptation to climate change. Replaced some lowland habitats that were previously grazed. Increased use of trees in settlements to aid climate adaptation and green infrastructure

GO for Growth

Scenario outline

3.46 A brief outline is provided below. A full storyline and summary timeline are provided in Appendix 1.

3.47 ***Life in 2060:*** *Making money is a priority and economic growth continues to be driven by consumption and new technology. Few people worry about the environment and almost everyone continues to consume at will. The country has reacted to devastating events by spending money on food from abroad and developing technology. There is growing concern this may not always solve the problems facing Britain.*

3.48 ***How this scenario emerged:*** *Trends dominant in the first part of the 21st century continued. Society remained focused on consumption-based growth through a market economy enabled through accelerating innovation.*

How we might live

3.49 Holding its own against stiff international competition, the UK is growing economically. However, the pace of growth has slowed in recent decades as resources, particularly oil and minerals, have become increasingly difficult to obtain. Similarly, growth has not been even around the country. London and the South East continue to be the economic centre for the country, but population has also shifted towards the South West to follow the sun. Overall, the southern half of England is where most people and most economic activity are situated.

3.50 However, continued flows of people into the country, combined with greater life expectancy through advances in medicine and technology, have pushed up the population. This has forced urban development to continue apace. There are more tightly packed homes for single people, as family structures have continued to shrink. However, there are large areas of affluence that are effectively off-limits to those not able to afford to live or work there. Open space in towns and cities is much reduced. The drive for economic activity means long working hours, and few people have either the time or the inclination to spend a long time outdoors. Outside the more affluent areas, where private security services are common, safety and security have become major concerns. Those unable or unwilling to function in this society have become increasingly

disaffected, and crime in many such areas has grown. Intervention by response units is sporadic and infrequent, and is deployed only as a last resort.

3.51 The countryside, meanwhile, continues to lose its long-standing populations as publicly funded services decline and people seek their fortunes in towns and cities. However, there has been an influx of newcomers to rural areas (enabled through high-definition virtual reality and affluence) who have bought into privatised services such as education, housing, healthcare, transport and security.

3.52 As towns and cities have grown, and as the rural affluent frequently travel 'to town', there has been a huge increase in pressure on transport systems. Public transport declined many years ago, as affluence enabled and encouraged more to own the means of their own mobility. Vehicles are more fuel efficient in an effort to reduce costs, but congestion and gridlock are now widespread as competition for road-space is becoming ever fiercer. Government policy has been to encourage mobility and growth and there is pretty much a free-for-all in development and markets for land, with little (if any) transparency in the transactions that go on.

3.53 Since the end of the Common Agricultural Policy and Common Fisheries Policy in the 2020s, markets in land and fish have effectively become deregulated. Agriculture, horticulture, forestry and fishing have to compete with urbanisation, energy, raw materials and transport uses. Only where the market can sustain a business does success last for any length of time. There is a huge and rapid turnover of firms as competition, innovation and new enterprises keep the economy driving forward.

3.54 Consequently, significant parts of the UK food market are supplied through industrial-scale synthesis and high-tech production, and much is imported from across the globe; flexible and adaptable biotechnology is in widespread use to maximise returns as growing conditions change. Protein is derived from a range of sources driven by consumer demand. Livestock production and fishing have declined, and survive by serving niche markets with specialised 'authentic' products. Based on the relative market strengths of different products, there has been growth in synthetic production, vegetable-based production, fish farming (in fresh and salt water) and algae production.

3.55 Given the pressures on land and sea and the lack of policy intervention (beyond keeping markets functioning) the demand for goods and services that aren't bought and sold in the market has declined. In rural areas, this means that land owners and managers have no incentive to promote and manage landscape unless it attracts a premium. However, in some areas there is still a desire for aesthetically pleasing landscapes. As these can attract a premium, with the wealthier members of the population willing and able to pay to access them, some areas retain their attractive appearance. However, the advancing climate change is altering the landscape, and very little is being done in response. A change to the landscape is often perceived as a sign of progress in itself.

3.56 Apart from the hot-spots, some landscapes are maintained for other goods and services where they can compete in the market. For example, upland areas are maintained as water-collection areas where they can compete in the deregulated and competition-driven water market against river and groundwater abstraction, reservoirs and desalination schemes. Similarly, where the wind resources are best (on high ground and out to sea), they are exploited at a large scale to keep energy costs down and reliability of supply up, thus bolstering their market share in the face of stiff international competition from wave, tidal, solar, gas, coal and nuclear power. However, as a cost-cutting measure, many new buildings are more energy-efficient or power themselves. While there are efforts to reduce energy costs through investment in more efficient energy generation, there is little incentive specifically to reduce emissions of greenhouse gases. More emphasis is put on individuals to adapt to climate change, with occasional state intervention in reacting to climate shocks.

3.57 As rapid innovation and fierce competition at a global scale have brought many prices down, people can readily acquire the basic necessities of life - food, water, energy, accommodation and communications. But in aspiring to greater material wealth and premium products and services, people are spending a greater proportion of their time working or learning; many regularly working well over 60 hours per week and 50 weeks per year, and many retire much later and, increasingly, only if they can afford to do so. Young people are schooled in the requirements of business and commerce. 'Soft' skills are promoted above knowledge content (as this can easily be downloaded). Young people are focused on their abilities in finance, negotiation, deal-making, innovation and entrepreneurship.

3.58 Time for the pleasures of life has become a scarce commodity. Anxiety and stress are widespread, and space, time and 'real' experiences are now much sought after. Celebrity lifestyles increasingly lead people to aspire to instant pleasure, but this is only available to a hard-working few. Consequently, in this entrepreneurial world, 'real reality' and stress therapy are now good business opportunities. Many companies have sprung up offering all-inclusive real reality packages - whisking the time-poor, cash-rich off for a short break away from it all: all-inclusive and tailored to their needs, with automated planning (based on records of activities and expenditure) but aimed at making the most out of the limited time available... but at a cost. The affluent elderly, who have been able to retire, are increasingly the most likely people to have time on their hands. Their desire for adventure, challenge and experience takes them across the globe.

Implications for the natural environment

3.59 These are characterised by increasingly rapid, fragmented and unregulated change to the natural environment driven by the market economy, by the direct impacts of climate change and society's attempts to adapt to them, and by increasing pressure from invasive species and genes that are alien or have been modified.

3.60 Ecosystem services that have hard monetary value have become commodities that can be bought and sold, but those that cannot be given an economic value or with lower monetary value - with solely aesthetic, spiritual, cultural or historical value - are seriously degraded. Adaptation to climate change is more about how humans adapt rather than ensuring that the natural environment can adapt, and there is no incentive for using the natural environment for mitigation.

People's engagement with the natural environment

3.61 Virtual engagement is the norm, driven by technological advances in holographic technology, imagery and the evolution of the internet, enabling users to visit any part of the world in any era.

3.62 The perception that the natural environment is a threat increases due to more severe and direct climate change impacts, such as flooding and drought and invasive alien species or genes. The tourism in the natural environment that survives has adverse impacts, as it is unregulated and exploitative.

3.63 Access to the remaining areas of natural environment is increasingly a preserve of the wealthy. Those who own the land engage with it; those who do not increasingly cannot afford to.

3.64 Some traditional rural practices have flourished, such as keepering for game and fish or woodland management for amenity and energy production. However, the increasing mechanisation and corporatisation of agriculture and woodland management are leading to the disengagement and shrinking of the pool of traditional skills.

Biodiversity

3.65 While biodiversity is not generally valued in its own right, it is protected or conserved where it is seen as vital for delivering products and services that can attract profit.

3.66 The diversity and abundance of species has declined rapidly as a result of the impacts on habitats from infrastructure development and climate change.

3.67 England's natural environment is under increasing pressure from invasive alien plants, animals and pathogens. These have arrived, or have become increasingly invasive, through climate change-induced changes in range and species balance, accidental introductions through global trade and intentional release by 'new environmentalists'.

3.68 Although biotechnological advances have enabled food production to be increased using reduced land area and inputs, some genes have escaped into the environment and are creating hybrids with native species, affecting genetic as well as species diversity.

3.69 Coastal habitats are changing significantly, with many lost to rising sea levels and not being replaced. Storm surges are increasing in frequency and severity, and are penetrating further inland. More widely, extreme weather events such as droughts and floods are causing further deterioration of biodiversity through the inundation of sensitive habitats.

3.70 Ongoing and increasing ocean acidification has contributed to a series of functional and structural changes to marine ecosystems, precise cause and effect relationships being difficult to pinpoint or understand. Fishing pressure beyond sustainable limits has resulted in significant declines in white fish and crustacean populations; in many areas, plankton and small species of fish with no commercial value dominate. A high level of development, including offshore wind farms and increased marine aggregate extraction, has led to a decline in marine biodiversity.

3.71 Although biodiversity is in severe decline across the wider landscape, it is maintained in a few large tracts of land under private or corporate ownership that support biodiversity through their primary aim of shooting, fishing, hunting, 'wildlife parks', or that provide a key ecosystem service (for example, water provision). Some smaller areas receive protection from 'new environmentalists' or by hobby farmers and landowners whose wealth has come from other sources. All these owners, large and small, tend to manage the land in terms of their own different visions of what the natural environment should look like. This lack of continuity from traditional farming and other land management has exacerbated some impacts such as undergrazing of lowland grassland and heathland, and loss of traditional woodland management, leading to further loss of biodiversity. It also leads to commercially driven hotspots of visitor usage, with further impacts on already vulnerable habitats; for example, from fire during long hot summers.

3.72 Many publicly supported conservation organisations have disappeared, replaced by bodies using the natural environment for commercial gain. As with land ownership, biodiversity is supported in part by those non-governmental organisations (NGOs) promoting hunting, fishing and shooting, but suffers because of pressure from others to encourage greater access for amenity sports and leisure activities such as off-roading, power boating and gyro-coptering.

3.73 In horticulture, aquaculture and forestry, as with agriculture, widespread and loosely regulated adoption of biotechnology and nanotechnology has led to the introduction of invasive engineered species and genes into the environment. The prevalence of invasive species and genes is increased through the release of new plant species by those wealthy individuals and landowners who see them enhancing the environment or increasing the profitability of their enterprises. These are displacing longer-established species through competition or hybridisation, and are severely reducing the diversity and resilience of ecosystems.

3.74 Continuing major infrastructure, including energy development, is further fragmenting the remaining islands of semi-natural habitats. Ecosystem services are valued only when they have major and instant economic value (such as food or energy production), or when they can counter immediate risks to people (such as flood management).

Landscape

3.75 Landscapes are primarily valued in economic terms. Though some quality landscapes remain, many are degraded and under pressure from leisure use and the impacts that also affect biodiversity, such as agricultural intensification and infrastructure development.

3.76 Corporate ownership of land allows some landscapes to maintain their value, but increasingly their quality and nature varies according to their wealthy owners' wishes, and they are still subject to the impacts of climate change.

3.77 Large-scale energy, transport and mitigation infrastructure projects have led to significant changes to all landscapes: energy in the uplands, transport in the lowlands connecting expanding urban areas, and adaptation around towns, cities and the coast through flood and coastal defences. In some areas, there has been an increase in tree-cover to provide shading and cooling.

3.78 The remaining freely accessible public space is suffering degradation due to the increased pressure of providing amenity and leisure in smaller areas for more people.

Implications by geographic zone

3.79 The table below summarises the implications of this scenario within the key geographic zones.

Table 5 Implications for the natural environment by geographic zone

Geographic zone	*Go for Growth*
Uplands	High level of corporate ownership of land and resources which are managed for financial gain. Ad hoc technological development for energy and water provision (where competitive). High amenity pressure at specific times on more limited public space
Lowlands	Competition for land high. Largely unregulated growth for energy, development and leisure. Multifunctional land use in decline as use for tourism and recreation confined to defined areas and hotspots
Settlements	Extensive urban growth. Overall a decrease in open space and increase in housing density. The exception being gated communities with designed open space; some increase in greenspace for climate adaptation, but uncoordinated
Coasts	High value coastal assets are protected through extensive hard sea defence systems (where benefits outweigh costs). Natural habitats reduced through coastal squeeze. Natural realignment occurring when financially unviable to protect land or settlements
Marine	Ongoing and increasing ocean acidification; several significant changes to marine ecosystems provide evidence of things going 'wrong'. Continued over-exploitation of fisheries has progressed down the food chain; in some locations, marine-based protein is harder to come by, affecting many people who rely on the sea for their food. An increase in infrastructure in inshore and offshore waters has contributed to a reduction in marine biodiversity
Wetlands	Managed for water provision, flood prevention and biofiltration. Little change in area overall. Intense pressure on very limited publically accessible open water habitat
Woodlands	Area of woodland decreased, remainder intensively managed for renewable energy. Increased pressure for amenity use. Some increases in urban trees where offers price incentive - for example, increase in property values

KEEP it Local

Scenario outline

3.80 A brief outline is provided below. A full storyline and summary timeline are provided in Appendix 1.

3.81 ***Life in 2060:*** *Society now revolves around nations feeding and providing for themselves. England's land is largely used either for food production or for housing. Critical decisions (for example, around security and infrastructure) are made nationally, with other decisions made regionally and locally. People are very protective of their local area and belongings, but have a strong sense of national identity. Resources are limited and are tightly controlled, but consumption remains high.*

3.82 ***How this scenario emerged:*** *In the early 21st century, society emphasised consumption while paying little attention to working within environmental and resource limits. However, in the 2020s and 2030s, those limits were breached and a series of social and environmental crises emerged. This forced nations to adopt more protectionist positions, slowing and unravelling globalisation.*

How we might live

3.83 Regional and central government maintain control over the big issues of the day, such as where energy and water come from. There is much emphasis on establishing a strong national identity to make sure of the success of the UK in the de-globalised world.

3.84 Economically, the UK is ticking over. The pace of growth has slowed dramatically in recent decades as resources, particularly oil and minerals, have become increasingly difficult to obtain. World markets have shrunk as globalisation has contracted and countries look to become more self-sufficient. Trade has continued, but it has become focused around strategically important resources. Around the UK, regional and local economies have become revitalised as more effort is put into localised production and consumption of goods and services. As the effects of climate change have increased, it has become increasingly difficult to keep London and the South East as the centre of gravity for the country, especially as the population is now more spread out.

3.85 However, immigration has virtually ground to a halt, with tight controls on new entrants focused on making sure the UK has essential skills. Family sizes have also decreased in the face of

resource constraints. However, the population has continued to get older, so the overall population has grown slightly but is now levelling off.

3.86 This has taken some pressure off urban development, and more space is available in towns and cities. However, the restricted availability of resources such as water and fertiliser, and the drying up of global markets, has increased pressure to grow food. Many urban areas have turned greener, but this is due to the creation of allotments and city-farms rather than parks and gardens. Homes remain densely packed as keeping land available for food takes priority. Outside more affluent areas, where private security services are common, safety and security have become major concerns. Those unable or unwilling to function in this society have become increasingly marginalised, and crime in many areas has grown. Security response is rapid and a strong presence is maintained to quell disquiet where and when it arises.

3.87 Outside towns and cities, the countryside has seen population growth as people move to work on the land. Local communities develop as co-operatives, with many smaller-scale decisions made locally.

3.88 With fuel increasingly difficult to come by, more people live a more localised and settled life, so pressure on transport systems has declined. Public transport is thriving as many people still need to travel to work. Government policy has discouraged mobility for its own sake and development is tightly controlled.

3.89 The Common Agricultural Policy and the Common Fisheries Policy came to an end in the 2020s as EU member states retreated from collective action at European level. Agriculture, horticulture, forestry and fishing are now planned more directly within countries, alongside urbanisation, energy, minerals and transport. As in many other countries, the UK allows these services to run on market principles, but markets are tightly regulated. Innovation has slowed overall but, in some sectors, there is rapid technological development. In particular, there are big efforts to increase resource efficiency and to bolster security.

3.90 The UK food market is mainly supplied by indigenous production, with strategically planned deployment of synthetic and high-technology production, where yields can be maximised as growing conditions change with the climate. Livestock production and fishing have declined as diets shift towards better nutrition and resource conservation rather than consumer choice. The Government is talking about, but hasn't yet introduced, rationing.

3.91 In all but the most iconic and symbolic landscapes, where national identify is forged and reinforced, land owners and managers have little or no incentive to promote and manage landscape. This means that, despite less overall mobility, people are encouraged to visit tourist hotspots, which face considerable pressures at certain times of the year. As climate change continues, much effort is put into trying to retain the iconic landscapes of old. In these areas, rural populations have grown to help bolster food production, but working holidays have also become popular as people flock to "*Save our National Treasures*".

3.92 Elsewhere, there are significant efforts to extract as many resources from the land and sea as possible. Based on its five-yearly *National Resource Inventory*, the Government has laid out a plan setting out what is expected of each area. Upland areas are maintained as water-collection and wind-energy zones; minerals are extracted where they are found; and lowlands are allocated as food-growing and habitation areas.

3.93 Energy supply is focused on maximising reliability, but lower national income and the closure of international financial markets mean that new, large-scale projects are not feasible. Nevertheless, driven by firm policy and state support, older infrastructure has been strengthened as coal mines have reopened, and gas and electricity networks strengthened. Small-scale wind, tidal and solar power technologies have been deployed where they can offer reliable supplies. Nuclear power has declined because uranium is now more difficult to obtain due to less than favourable international trading arrangements. Some critical resources are still traded internationally through a series of strategic alliances, but these are vulnerable to security threats and public pressure to

retain resources for the domestic population. There has been some investment in renewable energy, but this has been more a reaction to resource scarcities than to climate change. Indeed, as a global issue, there is little incentive to reduce greenhouse gas emissions, and more emphasis on enabling the country to adapt to climate change. There is more localised and unplanned adaptation, but also occasional state intervention to protect vital resources against climate shocks.

3.94 Despite the decrease in international trade, the increased efforts towards national self-sufficiency have meant that people can readily acquire the basic necessities of life - food, water, energy, accommodation and communications. However, aspirations to greater material wealth and premium products and services are still prominent and not so easily fulfilled. Many people spend a large proportion of their time working or learning, with much emphasis on growing sufficient food for the nation. Many regularly work well over 60 hours per week and 50 weeks per year. A one-child policy was introduced in 2040, and young people are schooled in the requirements of survival. 'Practical' and 'functional' skills are promoted above knowledge content, as this can easily be downloaded. Education is focused on building capabilities in maintaining productivity - in particular, security, craft, self-sufficiency and commerce. There is selective education, with the more able students deployed into academic and managerial careers. The remainder are oriented towards practical and less-skilled jobs.

3.95 Time for the pleasures of life has become scarce as survival and maintaining productivity have come to dominate most people's lives. Levels of physical fitness are generally high, owing to increased physical activity and more nutritionally-balanced diets. However, anxiety is the norm and is cultivated to bolster the emphasis on security. People still aspire to the life-styles of the rich and famous, but with time so scarce most leisure is on a get-it-while-you-can basis. Nevertheless, people still come together for community and national celebrations and occasional collective activities. The growth of the *Save our National Treasures* working holidays is one example. Few have had the means to retire, but some are recognised for a particularly productive life, when the local community celebrates long service and looks after their heroes.

Implications for the natural environment

3.96 At a national level, key strategic decisions are being pushed through by central government with clear zoning of primary purpose at a national scale, with nationally set targets for critical aspects such as energy and food production. Regional and local decision-making predominates in many other areas. Technological advances have slowed because of resource shortages, but these in turn have created a drive for innovation through resource efficiency.

3.97 Space is at a premium as the strong national drive for food and energy self-sufficiency has placed a heavy demand on land, with the natural environment of secondary concern. However, a few iconic species and landscapes receive greater protection. The lack of access to financial and other resources hinders cost-effective technological advances, and their deployment in many sectors means that the natural environment is being increasingly used to help adaptation to climate change and deliver our energy.

3.98 National targets for energy and food production mean that land is used for as many purposes as possible at the regional and local scale.

People's engagement with the natural environment

3.99 There is greater awareness of the benefits that the natural environment can bring for food, water and energy provision and for adaptation to climate change, driven by government education programmes and an increase in the proportion of people working in land-based industries. Greater national pride in English iconic landscapes and species and local pride in local landscapes and biodiversity help protect some landscapes and habitats. However the need for self-sufficiency takes precedence in all but these areas.

3.100 Lifestyle diseases such as obesity and diabetes are in decline due to improvements in diet and greater exercise. In part, this is driven by cost and scarcity of food and the greater staff intensity of producing it, but also by better understanding of the causes of these diseases and government policies to improve the health of the nation for strategic and cost reasons.

3.101 Seasonality of food has returned, as has the importance of local production, leading to regional differences in diet and cropping.

3.102 The colonisation of urban green and blue space by wildlife once only found in the wider countryside has led to greater engagement and provides a sense of local pride to many urban communities. However the downside to food scarcity is that some areas of this urban green space are off-limits to the wider community.

3.103 As the area of natural environment decreases, it is under greater pressure from internal tourism, which is focused on the protected iconic landscapes. This pressure is increased by the decline in overseas travel resulting in more people holidaying within the country.

Biodiversity

3.104 The overall area of semi-natural habitat has declined significantly as more land is used for food and bio-energy production and, to a lesser degree, for energy, mineral and aggregate extraction.

3.105 Since the country opted out of its international obligations for biodiversity protection, substantial, once-protected areas of important habitats, such as lowland heath and chalk grassland, have been lost to intensive agriculture and agro-forestry.

3.106 Species that rely on these semi-natural habitats have declined dramatically due to these widespread losses and the increased fragmentation of remaining sites. However, the area of farmland and urban green space across the country has increased, and certain generalist groups of plants and animals have done well, as have the few specialist species that thrive in these environments.

3.107 There are localised losses through the reopening of open-cast and deep collieries and the expansion of extractive industries. Although restoration schemes make sure that the sites are returned to productive use, this has little benefit for biodiversity. In the marine environment, nationally and internationally protected areas have been de-designated to allow extractive industries and inshore aquaculture, resulting in irreversible degradation of some areas.

3.108 Biodiversity has benefited in certain situations where the natural environment has been used for climate change adaptation, such as: new water and green space in and around urban areas to counter ‘heat island’ effects and flooding; upland reforestation using a range of native and non-native species to improve water quality and prevent flooding; and the use of wetlands in lowland catchments and on the coast to reduce flooding from heavy rainfall and coastal surges.

3.109 However, these gains are based on the need to adapt to climate change and the focus for biodiversity conservation is on iconic species of national or local importance.

3.110 Biotechnological advances in agriculture, horticulture and arboriculture have increased yields and decreased inputs and the use of pesticides, and have kept pace with the increasing need for self-sufficiency. Less use of artificial fertiliser has led to improvements in water quality and some remaining wetland habitats have also improved, though others have suffered from increased siltation through run-off from newly cultivated land. The reduction in use of pesticides has benefited many plant and animal species.

3.111 Despite agriculture and horticulture being highly intensive, the adoption of more benign cultivation techniques, genetically modified (GM) crops and reduced pesticide inputs has improved the soil quality of cultivated land. On peat and previously unimproved land, intensive cultivation has led to significant carbon loss, as has the draining of substantial areas of lowland wetland.

3.112 The focus on production has led to the widespread use of GM across many sectors for food and energy production. The spread of modified genes into the natural environment is leading to loss of biodiversity through competition of both species and genes.

3.113 Urban biodiversity has done well, due to the greening and 'blueing' of many urban centres. Although driven by their primary purpose of assisting the adaptation to climate change and food production, they have provided additional habitat, and many generalist species once found only in the countryside are now found within built-up areas.

3.114 Ongoing and increasing ocean acidification has contributed to a series of functional and structural changes to marine ecosystems, precise cause and effect relationships being difficult to pinpoint or understand. In some locations, short-term efforts have been made to counter acidification, but with little success. Following withdrawal from the EU Common Fisheries Policy, territorial waters are managed and protected as strategic national assets. There has been a shift from a dependency on fin fisheries, to crustacean, with inshore fisheries in some areas supported by special stewardship measures. Increased development pressure has led to some declines in marine biodiversity and whilst the marine environment is increasingly zoned for multiple uses, tensions between national and local priorities make this difficult to enforce.

Landscape

3.115 All landscapes have been altered by demand for energy and food, and locally by extractive industries. Oil, coal, wind and tidal energy production has changed many landscapes, and the industrialisation of landscape has become accepted through necessity.

3.116 While many natural, historic and cultural features have been lost from the landscape, the new industrial working landscapes remain diverse across the country and are regarded in many cases with local and (in some cases) national pride.

3.117 Rural landscapes have also seen an increase in development and intensification of land use, but as management practices vary widely across the country, the diversity of habitats has increased. Many urban landscapes have benefited from the creation of green spaces and water areas to help adapt to climate change.

3.118 A few of the iconic landscapes have been largely preserved. These lie mainly (but not exclusively) in the uplands, where alternative uses for food and bioenergy do not take precedence. Some lowland National Parks and Areas of Outstanding Natural Beauty.

3.119 (AONBs) have been de-designated or their criteria weakened. Their landscapes have altered considerably as a result of the introduction or reintroduction of intensive agriculture or forestry.

Implications by geographic zone

3.120 The table below summarises the implications of this scenario within the key geographic zones.

Table 6 Implications for the natural environment by geographic zone

Geographic zone	***Keep it Local***
Uplands	Iconic uplands protected in specific locations. Key purpose is for water supply and wind energy production driven by national policy
Lowlands	Reduced area for biodiversity due to increased demand for food and energy production. Reduced offsite impacts of agriculture. Greater diversity of habitat due to prevalence of small-scale locally distinct operations
Settlements	Significant increases in greenspace and water areas in many settlements for climate change adaptation and food production (with by-product of amenity)
Coasts	Protection of strategic assets such as key infrastructure and energy plants by hard and soft engineering
Marine	Ongoing and increasing ocean acidification; several significant changes to marine ecosystems provide evidence of things going 'wrong'. Territorial fishing waters are managed and protected as strategic national assets. Increased pressure at a local scale to meet food and energy needs has led to some loss in marine biodiversity.
Wetlands	Increased in area to assist adaptation and provision of clean water. Benefited from reduced offsite impacts of agriculture. Increased amenity pressure on water areas close to centres of population
Woodlands	Area and extent of management increased. Driven by need for renewable energy, urban cooling and food production

SUCCEED through Science

Scenario outline

3.121 A brief outline is provided below. A full storyline and summary timeline are provided in Appendix 1.

3.122 ***Life in 2060:*** *The global economy continues to be driven by innovation and everyone relies on business to keep the country growing. London and the South East are important, but the rest of the country is also booming as both cities and their surroundings produce so much. People trust technology to enable growth within environmental and resource limits, but some worry it may not always have the answer.*

3.123 ***How this scenario emerged:*** *The early 21st century emphasised improving productivity in the global market economy. However, this served only to focus attention on driving innovation to achieve short-term economic gains. Long-range consequences for society and the environment received little serious attention. However, new entrants in the global economy recognised that their own long-term competitive advantage required a more forward-looking approach that would safeguard social and human capital in the longer term.*

How we might live

3.124 England is thriving. Since recovering from the recession in the 2010s, the path of development has shifted towards 'green growth' and it increasingly recognised that conserving resources and supporting the natural environment are integral to this. However, it has not been even around the country. London and the South East continue to be the economic and technological centre of gravity for the country.

3.125 Bolstered by the UK's success in global markets, continued flows of people into England, combined with greater life expectancy enabled through advances in medicine and technology, have pushed up the population. This has meant urban development has continued apace. There are more high-density eco-efficient homes, mainly for small households situated in urban green villages that meet strict design standards for sustainability.

3.126 The countryside, meanwhile, has also seen an increase in population as many people establish their working bases in less-dense settlements, enabled through advanced computing and communications technologies. The influx of more affluent, previously urban, populations has brought with it more market-based services such as education, housing, healthcare, transport and security, with public services only for those less able to afford more personalised services. There are marked differences in the standard of public and private healthcare and welfare provision and a two-tier system has widened the gaps between those able and unable to buy into private schemes.

3.127 As towns and cities have grown, and as the rural affluent frequently travel 'to town', there has been much more pressure on transport systems. Public transport declined many years ago as affluence enabled more personal mobility. Congestion and gridlock are, however, now things of the past, as advanced communication and computing power, combined with advanced vehicle technologies, have enabled individuals to better plan and meet their own transport needs.

3.128 The emergence of the European Sustainable Food Policy in the 2020s shifted market incentives to enable the natural environment to provide its basic underpinning processes and functions, and ecologically sound food production. There is emphasis on seeking multiple functions and uses from any patch of land or sea. This attempts to combine land and sea uses - such as food and fibre production - with settlements, amenity, energy, raw material extraction and transport. Only where a business can demonstrate long-term sustainability does success last for any length of time. There is a huge and rapid turnover of firms as competition, innovation and new entry keep the economy driving forward.

3.129 Significant parts of the UK food market are supplied by industrial-scale synthesis and high-tech production, and much is imported from across the globe. Flexible and adaptable biotechnology is widely used to maintain returns as growing conditions change. Protein is derived from a range of sources driven by consumer demands. Livestock production and fishing have declined, and survive by serving niche markets with specialised 'authentic' products. Based on the relative market strengths and sustainability of different products, there has been growth in synthetic production, vegetable-based production, fish farming (in fresh and salt water) and algae production.

3.130 Mutually supporting policy and markets drive innovation, underpinned by well-functioning natural systems. There are few goods and services derived from natural systems that aren't bought and sold in the market. As a result, landowners and managers have significant incentives to promote and manage landscapes where they can attract a premium. In many areas, there is still a desire for aesthetically pleasing landscapes, and as these can attract a premium and the wealthier are able to access and pay for them, many areas retain their attractive appearance. However, as climate change increases, the landscape continues to change and significant efforts are made in response to maintain the ecosystems services from them.

3.131 Upland areas are maintained as water-collection areas where this service can compete in the lightly regulated but competition-driven water market against river and groundwater abstraction and desalination schemes. Similarly, where the wind resources are best (on high ground and out to sea), these are exploited at a large scale to keep energy costs down and reliability of supply up, so bolstering their market share in the face of stiff international competition from other low-carbon sources. Alongside market-based responses (such as carbon trading) to reducing greenhouse gas emissions, there is also considerable emphasis on adapting to climate change, with advanced science and technology deployed to improve predictions of climate shocks and the responses to them. Following decades of debate and research, some attempts have been made recently to develop technological approaches, such as geo-engineering, to soften the effects of climate change.

3.132 As rapid innovation and global competition have brought many prices down, people can readily acquire the basic necessities of life - food, water, energy, accommodation and communications. Many still aspire to material wealth and premium products and services, but value is derived from

quality and sustainability. There is rapid innovation and turnover of goods, and emphasis on making products as near to zero-waste as possible.

3.133 The drive to innovate means that people spend a considerable proportion of their time working or learning. However, they recognise the restorative power of leisure and recreation, so working hours have changed little over the decades. With increases in population and productivity, retirement ages have stopped going up, and many retire with many years of high-quality life ahead of them. Young people are schooled in the requirements of sustainable business. 'Soft' skills are promoted above knowledge content (as this can easily be downloaded). Young people are focused on their abilities in innovation, entrepreneurship, collaborative working and environmental care.

3.134 Time for the pleasures of life is readily available and tourism is big business. Many companies have sprung up to offer all-inclusive activity-based experiences that meet a wide range of customer needs. Travel packages for nature, adventure and culture are common, tailored to each customer's preferences using automated planning based on records of their activities and spending. All these packages seek to maximise enjoyment and recreation while at the same time supporting the natural systems of the destinations.

Implications for the natural environment

3.135 There have been widespread changes to the natural environment driven by the need to maximise ecosystem services, through economic growth fuelled by scientific and technological innovation and through direct management of the natural environment as a result of scientific and technological advances. On the whole this means that the quality of the natural environment has improved, particularly where environmental issues such as climate change have required direct intervention, where priority ecosystem services such as those provided by water and wetlands have had to be sustained, or where innovation has reduced the impacts or the extent of potentially adverse practices such as intensive agriculture. This reliance on science and technology can occasionally have unexpected adverse effects.

3.136 However some areas and some aspects of the natural environment have seen a decrease in quality. Economic growth has meant that industrial and residential development are taking ever more space in both rural and urban areas, with profound impacts on landscapes and the space available for some biodiversity. Shifting patterns of innovation can affect the security of long-term management. With society's values highly pragmatic and science-led, the areas, habitats and species that do not provide services or cannot be protected through scientific advances are diminishing. However engagement with the natural environment benefits overall from people's increased leisure time and appreciation of the value that it provides, boosted by an increase in green and blue infrastructure.

Public engagement with the natural environment

3.137 The benefits that the natural environment can provide as tangible ecosystem services (such as water provision, flood management and urban cooling) are widely understood and valued. The early limited success of geo-engineering is strengthening some people's view that technological solutions can be found to environmental problems. For some, this has led to them questioning the need to continue with other efforts to develop a low-carbon economy.

3.138 While some people and communities value nature for inspiration, understanding and wonder, society as a whole values the environment predominantly for the essentials of life that it can provide. The species, habitats and diversity that make up the natural environment are generally viewed as being valuable as contributing to the functioning of ecosystems that provide benefits to people.

3.139 Greater leisure time has increased opportunities for people to use the natural environment. Technologically enhanced leisure and amenity activities dominate people's time outdoors. This has enabled many to enjoy a richer experience, for example through virtual reality-enhanced

visualisations of landscapes that tell stories about cultural and historical heritage, or details of biodiversity and ecosystems. For a small minority, such mediated experiences represent a further distancing of people from their natural world. Consequently, a market has developed for 'real reality' where people seek authentic connection with the natural environment.

Biodiversity

3.140 Technological advances in the industrial production of food and the advance of biotechnology mean that the overall intensity and area of agricultural production has declined. Some areas previously needed to produce our food have been taken up by development and infrastructure.

3.141 Some biodiversity has benefited following mitigation measures such as carbon sequestration by improved management of upland peat, use of wetland such as fen and reedbed and woodland planting.

3.142 Changes in agriculture have had mixed impacts on biodiversity. Lower inputs and increased level of precision have reduced off-site impacts such as diffuse pollution and greenhouse gas emissions. This has benefitted adjacent water courses and wetland habitats and the wider environment. However the precise nature of farming now means that the availability of some food for wildlife and some habitats such as field margins has been reduced. Numbers of livestock have reduced to help conserve resources following the rise of synthetic food.

3.143 This has reduced grazing pressure on both lowland and upland habitats, where alternative management regimes have not been implemented, leading to changes in species composition. The technological and standardised nature of land management has reduced the diversity of local practice, with enterprises focusing on one or two key crops. To meet consumer demands, however, there is still a need for a wide variety of crops, and many new species and varieties are now grown, with many taking advantage of changing climatic conditions.

3.144 Biotechnology has been widely adopted across agriculture, horticulture and forestry. Plants are grown for food, medicines and synthetic materials. Although this is tightly regulated, occasional escapes of genes and other unexpected side effects have occurred. However, due to the understanding of the potential impacts on ecosystem services, restitution and clean-up mechanisms have kept their impact to a minimum. Some keystone species have been conserved through cloning and mass-release programmes, and in some cases the resilience of such species has been augmented through manipulation of genomes. For example, honeybees have been supplied with insecticide and fungal resistance.

3.145 The environment is increasingly being managed as a system controlled through technology. In many instances this is successful, but there are still occasional system breakdowns where the consequences can be significant.

3.146 Non-agricultural land is used increasingly for amenity and leisure, and the demand for access to the most popular areas is putting pressure on key sites through both the number of visitors and the infrastructure required to service them. However, advanced knowledge systems and technology help manage visitor numbers more effectively, meaning that valued ecosystem services are not compromised.

3.147 Although the overall increase in development for housing, industry and transport infrastructure has been designed to minimise its impact in any one location, it has still fragmented many habitats. However, as part of adaptation measures to ensure that ecosystem services can be maintained in the face of climate change, there are attempts to manage this through linking habitat fragments.

3.148 Climate change and global trade have brought with them a number of new species, and some of these can be invasive and damage ecosystems and the services they give. Scientific and technological advances have enabled these risks to be spotted earlier and controls have become more effective. Nevertheless, some new species have become invasive with unintended adverse

impacts on the natural environment, but many have become accepted as a natural consequence of climate change.

3.149 Geo-engineering approaches have begun to reduce greenhouse gas concentrations in the atmosphere, but given the time lags involved between emissions and the effects being felt, the impact on climate change has been slow. Consequently, unforeseen short-term impacts from climate change, such as rapid temperature shifts and extreme rainfall events, continue to place additional pressure on adaptation measures and biodiversity in general.

3.150 Whilst there has been an indirect slowing of ocean acidification through reductions in CO_2 emissions, and whilst trials have sought to remove greenhouse gases from the atmosphere, there continue to be effects on marine ecosystem function and structure. Fisheries are managed through legislation and supported by sustainable practices enabled by technology. Aided by innovation around the production of vegetarian-based fish-meal, extensive fish farming occurs. Well-planned multifunctional use, including marine protected areas, helps to safeguard marine biodiversity.

Landscape

3.151 Landscapes everywhere have been altered through widespread industrial, commercial and residential development. Much development is designed to fit into the landscape, using technologies that help them adapt to climate change.

3.152 As the pace of technological change accelerates, so does the rate of landscape change. Once, the push for biofuels led to the widespread planting of energy crops, but with the advent of widespread nuclear fusion, electrical transport becomes the norm overnight. Small- scale industrial enterprises enabled through advances in IT, transport, manufacturing and distribution systems are now part of many landscapes. As a result there are a variety of post- industrial landscapes developing across the country.

3.153 The pace of innovation is so fast that there is very little land unused, as innovators, new entrants and entrepreneurs rapidly purchase any land released for development.

3.154 Protected landscapes still exist, especially where their aesthetic and educational value is broadly accepted, but the scope of protection has been broadened to include a wide range of ecosystem services, including water provision and filtration and also carbon sequestration.

Implications by geographic zone

3.155 The table below summarises the implications of this scenario within the key geographic zones.

Table 7 Implications for the natural environment by geographic zone

Geographic zone	***Succeed through Science***
Uplands	Managed for the ecosystem services they provide including water supply and carbon sequestration. Increased amenity pressure on unprotected sites
Lowlands	Increased housing, transport and industrial development. Designed to avoid and reduce environmental impacts, but nevertheless, fragmentation of habitats, noise and light pollution occur
Settlements	Significant increases in greenspace and water areas in many settlements for climate change adaptation, food production, green infrastructure and amenity
Coasts	Coastal realignment prevalent. Offshore islands, reefs and wetlands offset rising sea levels. Port development, shipping and amenity pressure increasing
Marine	Some indirect slowing of ocean acidification through reductions in greenhouse gas emissions. The true value of fish stocks is recognised through fiscal policy, with fisheries managed through legislation and supported by sustainable practices enabled by technology. Extensive fish farming occurs. Well-planned multifunctional use, including marine protected areas, helps to safeguard marine biodiversity
Wetlands	Maintenance and enhancement of ecosystem functions are the principal objectives. Increases in habitats such as fen, reed bed and bogs to sequester carbon for mitigation. Increasing use of open water habitats for amenity
Woodlands	Modest growth through increases for carbon sequestration, soil management and climate adaptation. Area decreased in some locations owing to land-take for development (despite common use of green infrastructure). Also, technological solutions to climate adaptation begin to be adopted, slowing growth in tree cover

4 Next Steps

Deepening the analysis and synthesis

4.1 The findings of this report will support a Natural England hosted debate with key stakeholders and academics on the future challenges and opportunities for the natural environment, to be held on 3 December 2009. Following this event, Natural England will continue to explore the implications of the scenarios for the natural environment, deepening our appreciation of how they might play out across different time spans in relation to critical challenges for the natural environment and how we might live.

4.2 We will identify the range of actors involved across the public, private and civil society sectors and point to the scope for response to these challenges. We will also use the scenarios to explore a range of practical indicators that will help identify in which direction the future might be headed.

4.3 We will seek out opportunities to work with others to achieve this; particularly brokering this work into the National Ecosystem Assessment, the Living with Environmental Change programme and the European Environment Agency's Environmental Outlook process.

Applying the scenarios

4.4 Within Natural England, the scenarios are already providing the backdrop against which Natural England's vision for uplands has been drawn. The uplands vision and supporting atlas were launched on 12 November. Similarly, they are helping to shape the vision for the wider natural environment in 2060 by enabling consideration and evaluation of different futures on the natural environment. This is helping to identify the challenges, choices and trade-offs that will need to be addressed in the vision. Analysis of the vision will inform the development of an accompanying strategy to 2060 which is adapted to the potential opportunities and challenges ahead.

4.5 Elsewhere, the scenarios are providing key insights around critical challenges for the natural environment and we will extend this process to bring these challenges to bear both internally among our communities of practice and delivery, but also externally with partners and key stakeholders.

4.6 In this way, the scenarios are strengthening our capacity to think and act strategically.

4.7 Insights from the scenario analysis combined with those from other sources, including horizon scanning, will provide us with an integrated perspective of the long-term challenges for the natural environment. This will highlight challenges for both the natural environment and for Natural England's ways of working, enabling us to reflect critically on the opportunities and risks arising, and think robustly about how we develop further our strategies, polices and plans.

4.8 The integrated perspective that this will generate will support, challenge and make more robust wider strategy and policy development. This will also ensure that delivery is effective even in the face of change by encouraging alignment of our delivery with our longer term goals.

4.9 By exploring how they might perform in different circumstances, the scenarios will help Natural England and our partners and stakeholders, test the robustness of their goals and approaches. Through development of guidance and case studies, and by working with groups and individuals, we will share knowledge and understanding of the scenarios widely across our own staff and with others. The scenarios will also assist Natural England in its advocacy and partnership-building.

Keeping the scenarios up to date

4.10 Given the constancy of change and the inevitability of surprises, the factors influencing the future will continue to evolve. Some will fade, others will become more or less influential and new ones will emerge. It will be important, therefore, that the scenarios are kept fresh. As such, as our programme of strategic futures work rolls forward, we will re-examine the validity and continued fitness for purpose of the scenarios.

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Appendix 1 Scenario drivers, storylines, characteristics and implications

Factors that could influence change (see separate report for full details)

- **Climate Change** - Physical changes expected by 2060 include sea-level rise and coastal vulnerability, higher temperatures and ocean acidification. These are assumed to be predetermined over a timescale of the next 50 years.
- **Converging New Technologies** - The range of applications is endless - super soldiers and athletes, change in manufacturing and food production, and the blurring between life and the inorganic world.
- **Demographics** - Growth in Africa and most of Asia: the global population (currently 6.8 billion) is expected to peak at around 10 billion before the end of this century.
- **Energy** - We are approaching peak global oil and gas production, while demand, especially from the emerging economies, is increasing rapidly.
- **Food Security** - As population and wealth increases, global demand for food is growing faster than global supply.
- **World Economic Power Shifts** - By midway through the 'Pacific Century', China will be the new economic superpower, with India coming up behind, and the geopolitical landscape will have changed to follow economic power.
- **Governance** - There is the potential for a 'Clash of Civilisations' as demographic changes and shifts in economic power have political repercussions.
- **Health and Wellbeing** - Health is under threat due to preventable lifestyle disease, both mental and physical.
- **Infectious Diseases** - Infectious human and plant diseases are on the increase.
- **Marine** - The oceans are getting ever more polluted, and acidification of our oceans is a critical issue.
- **Mobility** - People like to travel, and the amount of travel increases with other forms of communication. Migration will also increase as globalisation encourages labour mobility, and populations shift following conflict, environmental degradation or climate change.
- **Money, Wealth, Economy** - By 2060, we will all be wealthier, in the sense of being able to do more clever things with fewer person-hours of work on our part. But this wealth may not translate into being able to command ever-greater quantities of natural resources, because the supply is constrained.
- **Resources** - Water shortages are particularly likely to lead to conflict and issues over food security.
- **Values and People** - Millennial and post-millennial children will be raised and educated in an environment of pervasive, immersive information and media technologies: better connectivity through ICT may promote bottom-up civic engagement.

Scenario storylines

5.1 The scenarios are presented as a series of stories told from the point of view of a fictional person in 2060, who is looking back on events over the previous 50 years. The characters range in age from 25 to 100 years old, covering four generations - the oldest having grown up in today's society but surviving well into the future, and the youngest being born well into the future and having no direct knowledge of life today. Nevertheless, the characters are intended to represent only themselves as interesting people alive in the different worlds of 2060; they are not intended to represent any particular group or set of stakeholder interests. The stories are accompanied by summary timelines to 2060.

CONNECT for Life

Storyline

Life in 2060: *People now connect through vast global networks. Decisions and economies are based locally, but through billions of world-wide connections they create a bigger and more effective system - a global super-brain. Social and environmental values have changed a lot over the years - loyalty lies with communities connected for common purposes across the globe; national government has relatively little influence.*

How this scenario emerged: *In the early decades of the 21st century there was a major focus on using information and communication technologies (ICT) to improve productivity. At the same time, however, less focus was given to the potential of social networking and internet-enabled democratic decision-making to improve social and environmental outcomes. As social networks became sufficiently large and self-supporting, 'traditional' beliefs and ways of doing things became outdated and unproductive. These then faded as hyper-connected communities became the main focus.*

Jacob Wilcox, Somerset, aged 52 (born 2008)

"My father said that when he was at university, one day he was writing letters by hand, the next he was emailing people all over the country. It must have been pretty exciting living in such a fast-moving world - just imagine seeing NetOne, what we call the first generation internet, come on stream!"

"He was quite adventurous and even travelled to different continents. He went to Asia where he saw the effects of overcrowding and real hunger first-hand. He met lots of people and used NetOne to link up with groups across the globe - some as friends, but all with similar political interests."

"My father wanted to help change the world, so he joined a movement that lobbied the EU and the UN to create a set of tough targets for 2050. But they came to nothing. It was 2019 - European voters still worried about cars, holidays, immigration and terrorism and the effect of inflation. Even though NetTwo had evolved by then, and people were using it to create a new wave of bottom-up activism, it drives me mad that very few cared enough about the environment to change. I suppose most people thought 'why should I change if no one else is bothering?' The issues were so huge everyone waited for governments and technology to fix things - but they didn't."

"I remember the summer of 2020, when the whole of Europe was hit with soaring temperatures and crop failures. My father said people started to take notice then because they could see that oceans were dying as they progressively acidified and carbon emissions were still rising. As I grew older, more electricity was generated locally through solar cells and water recycling became common. New strains of crops were developed and environmentally friendly food became the norm."

"Although there were local developments' globally, there were big breakthroughs such as nuclear fusion and cheap hydrogen-powered vehicles. Europe started to change, but by the 2040s, the world's population was rapidly approaching 9 billion and we couldn't cut human CO_2 emissions everywhere. Food supply was dwindling as fish couldn't survive in the acid oceans and all the best land had already

been taken. In 2050, floods hit people all over the world. There was a lot of suffering because 70 per cent of the world's population lived in cities back then and many were at sea level."

"It was tough, but we kept our spirits up. Most of us were born this century, and we seem more optimistic than previous generations. We connect with people socially, politically and economically and value our close relationship with nature. Technology helps, but only so much. We stop and think about whether we really needed something and the effects it may have now and in the future, here and in the rest of the world."

"To help deal with the challenges, I joined a Transition Cities group to look at ways of living on and around water. We ran a virtual congress last year with more than 50 million people, including city mayors. We can't keep the floods out, so we're developing proposals for large- scale floating buildings and artificial land. We're still trying to get these off the ground!"

"I do all this online and live in a much tighter community. NetThree came on stream a few years ago and the high-definition virtual reality makes you feel like you're really 'there'. With more food and other things produced locally, we don't really need to travel very far, and if we do, it's by bike or H-car."

"I hope society continues to work together. New forms of ownership were common by 2030, and we've largely solved our food problems by using mega-industrial scale manufacturing, even though there are 10 billion of us on the planet. I just hope, for my son's sake, the world can cope."

Summary timeline and headlines

2015 *NetTwo Goes Live*

Business Awards focus on collaboration, innovation and personalised choice

2019 Worldwide lobby for 2050 development targets

2020 *Europe Runs Dry - widespread drought reaches fifth week*

Upland land owners reap the benefits involved in managing land for water collection and distribution as livestock farming plummets

2025 'Risk free' genetically modified crops are in everyone's supermarket trolley

Planning permission granted for first food sky scrapers in East Anglia and Kent

2030 Communities brought together by on-line networking are now more influential than shareholders says beleaguered CEO of resource company

Fear of being labelled a 'plous' (purchasing loads of useless stuff) is destroying the high street retailers

Cities go green to keep cool - urban greening carried out in earnest

Keep the floods out - knock down the defences and let the dunes and marshes return says Prime Minister

2035 World energy crisis solved Nuclear Fusion Breakthrough

2040 World population reaches 8.5 billion

2050 *Flood! London and East Coast underwater*

75% of population aspire to live in cluster settlements - small town, open space living booms in popularity

2055 *NetThree Goes Live*

2059 Transition Cities Global Virtual Congress says floating buildings and artificial land are the way forward

Can't fly, won't fly - businesses say goodbye to expensive and time consuming air travel

2060 Most people finally eating the recommended nine portions of fruit and veg a day says Chief Medical Officer

Global legislation and regulations dominate delivered by local organisations

Last vestiges of EU swept away as decision-making moves to micro states to deliver global legislation, brokered by national governments

GO for Growth

Storyline

Life in 2060: *Making money is a priority, and economic growth continues to be driven by consumption and new technology. Few people worry about the environment and almost everyone continues to consume at will. The country has reacted to devastating events by spending money on food from abroad and developing technology. There is growing concern this may not always solve the problems facing Britain.*

How this scenario emerged: *Trends dominant in the first part of the 21st century continued. Society remained focused on consumption-based growth through a market economy enabled through accelerating innovation.*

William Campbell, London, aged 75 (born 1985)

"Working in London at the turn of the century, we were driven by money, just as we are today. Private companies had taken over most services by the time I was a teenager so, for me, the world has always revolved around wealth. Personally, it's meant I've had a happy life, with everything I need."

"We've benefitted from progress. Back in 2010, people were still sceptical about robots but now they staff coal mines, factories and hospitals; they produce food and generally keep things going. They also weren't keen on the idea of chips to boost brainpower, but I've had treatment to increase my memory and pass on knowledge. I think everyone should get enhanced - it helps drive the country's economy."

"What's shocked me most over the years are the big unpredicted events, both natural and man-made, that really changed the world. I remember the September 11 attacks in 2001, the Indian Ocean tsunami in 2004, and the Credit Crunch in 2008. But the heat-wave of 2020, and the widespread drought it caused, was on a completely different scale. Food supplies shrank very quickly, but our country was fortunate as we could buy food from abroad to deal with shortages."

"In 2025, a few years after the drought, we invested heavily in biotechnology to mass-produce food that could tolerate little water. Things seemed to be going well, but when oil prices reached $300 a barrel that year we finally realised energy wasn't always going to be on tap. Lots of cars were converted to run on electricity and we had to build 20 nuclear power stations in just a few years. By 2040, electricity from nuclear power was cabled to the UK from countries including Turkey and Slovakia."

"Manufacturing was advancing dramatically, and in 2042, the International University won several Nobel prizes for developing nanotechnology to improve food, medicine and energy. More businesses adopted this new way of making things, particularly as it merged with developments in brain science, computers and biology."

"In 2050, the London and east coast floods shocked everyone. I was still working in the City and joined a consortium to build up the sea defences along the North Sea. As a nation, we celebrated our progress at the 2051 Festival of Britain. This opened up our heritage and landscape to the world through high-definition virtual reality which attracted 6 billion visitors from across the globe."

“Our sense of achievement suffered a blow last year when some of Britain’s poorer areas needed famine relief after the sea began to dry in parts of Europe, and food-production units ran out of raw materials. Food supplies were badly affected again. We were lucky that countries with a lot of resources, like Russia, bailed us out and we avoided starvation, but this really brought home how the world is changing. We’ll have to pay back the Russians soon, though, or our gas supplies will be cut off.”

“We’ve always done well as a nation, but I’m worried we won’t be able to feed ourselves over the next 50 years as the population continues to grow, particularly through immigration. Many problems have been sorted out, like cheap energy, but things could get a lot worse very quickly.”

Summary timeline and headlines

2010 *Credit Crunch Ends*

2020 European drought

National water grid agreed and first pipeline constructed from Wales to the South East

Two day gridlock on M25 leads to government pledge to double road capacity on motorways

2025 *Oil $300 per barrel*

Water shortages become the greatest source of global conflict with mass migration of ‘water refugees’

2030 ’Fancy fish and tasty chip sticks’ fast food outlets (with farmed fish and potato substitute chips) involved in mass buyout of traditional Fish and Chip shops

China becomes the new economic superpower - in part due to it being the largest owner of global land and resources in the world

First UK wildlife reserve opens to visitors as national parks come under corporate ownership

Arctic open for oil production

2035 New nuclear power stations generate their first electricity

Second homes banned; single people restricted in purchasing properties with more than two bedrooms

2040 European Power Grid lights up London

Full scale scale trials of geo-engineering to capture CO_2 emissions begin

2042 International University wins Nobel prize in bid to stop bio-terrorists disrupting world food supplies

2050 London and east coast floods

2050 *Food parcels from Russia stop Britain’s suffering*

KEEP it local

Storyline

Life in 2060: *Society now revolves around nations feeding and providing for themselves. England is split into land for food and land for housing. Key decisions are made nationally, with many other decisions made regionally and locally. People are very protective of their local area and belongings, but have a strong sense of national identity. Resources are limited and are tightly controlled, but consumption remains high.*

How this scenario emerged: *In the early 21st century, society emphasised consumption, while paying little attention to working within environmental and resource limits. However, between the 2020s and 2030s those limits were breached and a series of social and environmental crises emerged. This forced nations to adopt more protectionist positions, slowing and unravelling globalisation.*

Betsy James, Nottingham, aged 25 (born 2035)

"When my Gran tells me stories of travelling around the world by plane and having food, cars, furniture and clothes imported, I'm always left wondering why people didn't think about the effects this might have on the globe. People wanted children, but most of them didn't seem to care about looking after the world their kids would grow up in."

"Gran says some people made an effort at the beginning of the century, growing their own food and using their cars less, but it wasn't until the hot summer of 2020 that society suddenly became more aware of how vulnerable we are. People realised the 'global economy' didn't provide all the answers and they had to try and make England self-sufficient."

"That was the first year people understood that food wasn't unlimited either. Many more started growing their own wherever they could, digging up National Parks, green spaces in cities and nature reserves. The Government didn't do anything to control this, so people turned to their local councils for help. Gradually, more things that mattered were decided locally and central government became irrelevant to most people."

"Gran had to move house because the local government wanted to use her land to build a dam to store water and generate power. Everyone thought more about energy, buying cars that didn't use scarce oil, taking local holidays and adding solar panels to their roofs. They realised they had to start relying on themselves. English businesses thrived, supplying us with the things we needed on our doorsteps. We don't have pineapples now, but at least we don't have to rely on unreliable imports from unstable parts of the world that seem to get worse every year."

"Gran grew her own food, which also fed my mum and dad, so the Government didn't come down on her like they did on other people. She taught my parents how to farm and they were allowed two children to help with the work. I feel lucky to have a sister."

"Gran says she feels sorry for me living in today's world, where we are threatened by raiders who come from the east coast every time they get flooded. She remembers England differently - people would travel around spending time in different regions for fun and most communities weren't gated. Now we have to protect our homes and local area, and never get to travel very far. I have to take her word for it as I've never been more than 50 kilometres from Nottingham. But then again, we've all got high-definition virtual reality (HDVR) now. Years ago, people couldn't even see what was going on in other parts of the world but I use HDVR all the time. I guess that's one of the biggest changes, along with nuclear energy and using robots for defence when the raiders come."

"We're still looking at ways we can use technology to develop strength and intelligence, but it's not quite there yet. I'd like the national government to protect our country, stop water exports to Europe, and give us more time away from the allotment. I can't grumble too much. At least I've got enough to eat and we're safe most of the time. It's just that the world Gran grew up in just seems much more relaxed."

Summary timeline and headlines

2010 Car use and air travel in the UK falls for the first time

2020 European drought

'Local resources for local people' campaigns spring up all over the country. The government sets up an arbitration system to deal with regional and local conflict and ensure basic resources for everyone

National Water Grid launched by the Department of Water and Natural Resource Provision (DWRP)

2025 *Europe suffers the double hit of the CAP and CFP ending and global availability of food falling due to widespread soil erosion, water shortages, pollution and plant and animal diseases. GM crops for energy and food becomes widespread*

Policing our borders and resources is a national priority. Exports of 'essential' foods such as wheat, milk and meat are banned

First 'production' targets set for Britain's natural resources - for water, energy and food, fibre and materials, recreation, space for settlements based on the National Resource Inventory

2030 Everyone is expected to grow food at home and protected areas and landscapes are cultivated for the first time in the South East and South West

2035 UK reaches 90% self-sufficiency with imports from only a handful of EU partners. A major source of employment in the UK is now in land and sea resource industries

2040 *Food raids becoming a problem and politically is the crime issue at the forefront of policing*

2050 London and east coast floods

SUCCEED through science

Storyline

Life in 2060: *The global economy continues to be driven by innovation, and everyone relies on business to keep the country growing. London and the South East are important but the rest of the country is also booming as both cities and their surroundings produce so much. People trust technology to enable growth within environmental and resource limits but some worry it may not always have the answer.*

How this scenario emerged: *The early 21st century emphasised improving productivity in the global market economy. However, this emphasis focused on driving innovation to achieve short-term economic gains. Long-range consequences for society and the environment received little serious attention. However, new entrants in the global economy recognised that their own long-term competitive advantage required a more forward-looking approach that would safeguard social and human capital into the long-term.*

Sangeeta Chaudhry, Leicester, aged 100 (born 1960)

"When people find out I'm 100 years old, they expect stories of dramatic change, but it's comforting that a lot of the change has been gradual. I already car-shared when I was in my twenties; people talked about carbon trading when I was in my forties; I've always gone on holiday; and London and the South East have always generated the most money."

"What's changed is the pressure to innovate - and that's got even more important as the environment began to suffer and competition with other countries reached fever pitch. We used to leave it to the scientists, but now we're all at it - wherever I go, I hear talk about the latest invention that hadn't even been thought of a few years' back."

"Huge developments have taken place in producing food, managing the environment, building and manufacturing. At the turn of the century, people talked a lot about 'sustainable energy', but they weren't very good at capturing the power of the sun, wind, waves, tides and fusion. Over time, society cracked it. The Severn Barrage started up in 2035 and is doing well."

"My grandchildren call me primitive when I tell them how we used to dig the soil, plant, water and 'fertilise' seeds, and wait for them to grow. They can't believe plants went from fields to factories, then from shops to homes. It was a strange process, but it was normal back then."

“Food is produced industrially now and we have EcoPack food grown in huge facilities. It may be vitamin-enriched with added anti-ageing and brain enhancement, but it just doesn’t taste the same as natural food - I’d do anything for a real mango!”

“The food riots in London in 2020 showed what effect a hot summer could have. The Government fell and was taken over by a party that promised to work with business to train more scientists and develop new foods, artificial land and oil replacements. Big, old and slow companies were against this, but the new Government was backed by new technology-savvy entrepreneurs who were better able at squeezing money out of the City as they regained confidence after the long Credit Crunch. They created strong global, local, public and private partnerships, and convinced people our future depended on producing more and innovating to help save resources - innovation became the new mantra.”

“In 2030, the United Nations set up the Forum for EcoInnovation, and this became really important. They brought together China, America, Brazil and Europe to co-operate on a joint energy project to turn the Sahara Desert into a solar power factory and started setting prices for natural resources and controlling carbon trading.”

“Locally, Leicester became a much greener place, with a million trees planted to cool the city. National Parks became like giant machines; in 2040, the Yorkshire Dales became the Dales EcoTech Park, which is now a big water purifier and carbon store.”

“We’ve had some shocks over the years. We predicted the 2050 floods and made preparations - but we hadn’t prepared enough. The floods were still overwhelming and thousands of people really suffered. Coastlines flood, but the effects are a lot less than they could have been without the natural defences we’ve put in place.”

“So many people live in England now. Technology and science have created successes in so many areas, but will they be enough to keep us safe? China cleaned up its act through heavy enforcement - I hope we don’t have to go down that route.”

Summary timeline and headlines

2010 *Global carbon deal reached*

2020 European drought

London food riots - UK government falls. The new government’s key policy is the green growth agenda and resource innovation

2030 UN Forum for EcoInnovation established to turn the Sahara into a solar power factory

High tech, industrial scale food production of protein, fish and vegetables overtakes traditional food and farming systems

Top 10 British companies all involved in land (and sea) banking for resources (particularly water, wind and attractive landscapes)

2035 *Severn Barrage produces power*

Planning permission is only granted for zero carbon housing. All land use strategies centre on multifunctional land use to deliver as many benefits to people as possible

2040 *Yorkshire Dales National Park becomes the privately owned Dales EcoTech Park with a primary purpose of water collection and storage and carbon sequestration. People can visit if they are prepared to pay*

National Water Grid becomes fully operational

First large scale geo-engineering project to capture carbon dioxide becomes operational

2050 London and east coast floods

2060 Nanotechnology provides our energy

People live on floating buildings and artificial land

Scenario characteristics and implications

CONNECT for Life

Scenario by ethnographic futures framework category

Define

- First loyalties to digital social network and communities of interest.
- Value social, political, and economic connections.
- Political paradigm: open-source networked governance.
- Economic paradigm: co-operative competition and virtual companies - notions of individual property versus commons are blurred.
- Environmental paradigm: evolving web of life - we are simply one node on the web interacting with the rest.

Relate

- 'We': partnerships - private responsibility linked to public action: use social networking to bridge special interests, self-organise cohesive, coherent communities as creative engines for innovation and arts that bridge from the local to the global.
- Government: power, function and effectiveness are driven towards the global and local ends of the scale, leaving pale ineffectuality at the level of national government.
- A new global balance and emerging partnerships as Asian/BRIC economies strengthen and move to center stage.
- An enhanced sense of connection to, and responsibility for, the national landscape and global environment.

Connect

- Pervasive computing creates a seamless, immersive digital data / media environment which overlays the real world and which everyone accesses constantly; effective translation software enhances global networking - global 'Creole' also evolves; massive artificial intelligence co-ordinated flash mob / swarm performance art.

Create

- Economy: open-source production and de-materialisation transformed the rules of the market economy (reference Kelly) blurring notions of Intellectual Property Rights (IPR).
- Branding: your network makes the stuff you like the most - connection is aspiration.
- Energy: radically decentralised grid production of energy and massively efficient design.
- Food: networks help organise efficient bundling of local produce and leverage co-operative shipping so that homegrown can be global.

Consume

- Consumption is more about interaction, experience and ephemera, and less about the material.

- Homes are on the move - new-build housing demand is being met by small, eco-friendly modular units that can easily be moved to a new site, hooked together to form virtual condos, and expanded.
- People still love to travel, but more of it is virtual - collecting hyper-reality tours of World Heritage sites hosted by friends from your Facebook network is the new ‘25 Random Things’ craze.

Table A Timeline: CONNECT for Life

	2010	2020	2030	2040	2050	2060
Marine	Current actions have no impact on marine environmental improvement, even though targets are in place	EU takes marine responsibility		Emergence of sail-powered shipping for coastal/international cargo transport and travel		Floating buildings and artificial land
	Micro-plastic 'nurdles' and waste pollute the marine environment and disrupt organisms	Marine ecosystems collapse. Oceans acidified, polluted, fished out, warmed				More intense sea use and management/development
Coastal	Planning for coastal change (shoreline management plans) start to indicate long-term defence is not affordable. Need new solutions but public against it	Fens, Broads, Somerset levels flooded in 2020 storm surge. Lives lost	Fenland reverted to new coastline: East coast major realignment (by default)	Local communities displaced by coastal flooding find solution in floating villages - this leads the way for London	East coast flood event 2050. Areas with sustainable flood risk management cope better	Floating buildings and artificial land
	Realignment scheme linked to flood defences in Humberside	Humberside copes with flooding due to flood risk management. No lives lost - hurrah!		Offshore wind farm in Norwich	First annual Red Bull extreme turbine hang-gliding event on coast	More intense sea use, management/development
Wetlands						

Table continued...

	2010	2020	2030	2040	2050	2060
Lowland	Biomass crops	Areas of the landscape are reserved for industrial food production; other areas for access	Maximise calories and biomass per hectare	Inland fish farming developed to address crop failures after drought		Managed wilderness areas, theme parks and Wiigle (Wii plus Google owned) parks
		Biotech used for creating building materials, energy and food locally				
Uplands	E-power (for example, Obama supporters; petitions on No. 10 website; Flash mobs) starts to have an impact	Upland farmland subsidies withdrawn - fewer sheep, no arable	Cattle (for example, Bluegreys) on upland. Different grazing pressures	Herdwick sheep on the fell. More red deer	Lynx to keep deer populations under control	Diversified upland communities
	Development of online social networks (for example, permaculture chat rooms, terrorist cells) globally	People can live remotely	Local upland communities reinvigorated; changing local politics	Landowners shoot deer, not upland grouse. Fewer grouse moors	National heritage rationalised. Not everything is worth preserving	We all work from home now
		Drought/heatwave 2020 seen as a wake-up call	Woodland planting for water retention, especially upland cloughs	Venison burgers at McDonald's	Houses adapted to flooding	e-Parliament. Palace of Westminster closed
		Heatwave/drought causes upland wildfires in the summer. Flash floods deposit sediment in water bodies	Ecological management of flood risks, reinstate natural corridors (uplands, flood plains, rivers)	Planning regulations for eco-homes and not stone byres	Keep blanket bogs wet	Utility companies prosper. Waste and energy are valued

Table continued...

	2010	2020	2030	2040	2050	2060
		Uplands are recognised as water generators for the UK	Kielder used for national water grid	Flood mitigation along rivers. Semi-natural banks, beavers flourish		
		More renewable energy generation (offshore and upland wind, hydro, biofuel)	Reduced dependence on cars for transport	Increasing investment in fire response and prevention		
		Upland used for recreation. Increased health benefits		Public acceptance of building reservoirs in uplands		
				Sustainable tourism. Local food, low carbon transport, eco-build hotels		
Urban	Explosion in urban agriculture	Heatwave 2020	Biodiversity confined to reserves and cities	Society becomes less urbanised. Based on current locations but smaller centres	75% of population live in clusters with open space - more time and interest in local affairs and the environment	
	Mayor of London's climate change adaptation strategy leads to urban greening	Populations move from flood plains	Municipalisation of services (water, reservoirs, etc)	Wealthy enclaves preserve their nice landscapes	London floods 2050 - especially central London	
	Rise of illegal rural low-carbon communities	Rise inaesthetic eco-design	Urban greening in earnest			
	Cities buy up hinterland					
All						Carbon dioxide levels still not reduced

Implications by geographic zone

Uplands

Upland ecosystems function well, although the emphasis on ecosystem services and local community-based decision-making means that the scope for re-establishing more natural ecosystems has not been fully realised. Some iconic species and habitats have disappeared or are close to doing so as a result of climate change and other species have taken their place. Peatlands, grasslands and water are all in generally good condition although areas close to public hotspots can deteriorate without careful management.

The amount of upland woodland and tree cover has increased drastically due to their value for carbon sequestration, water and soil management. With the development of other low-carbon energy sources, wind turbine technology is now obsolete and apart from a few traditionalists who generate wind energy on a small scale, wind farms have disappeared. Upland areas are still grazed but overgrazing is largely a thing of the past, except where traditionalist farmers and communities persist in keeping to old ways. Generally stock farming is an extensive mosaic of species and breeds for local small-scale production of wool, milk or meat for niche markets.

Lowlands

The lowlands are much more varied than today as a result of more dispersed settlements, local decision-making and the decline of traditional intensive agriculture. Large swathes of arable land have been replaced by a patchwork of extensive farmland, settlement, industrial food or energy production, woodland and water. In some areas, where alternative management regimes have not been put in place, the reduction in grazing by livestock has affected lowland habitats. Nevertheless, to serve niche markets, there are pockets of small-scale livestock rearing for meat, wool or milk.

This varied agriculture produces a variety of crops. Technological advances in sustainable energy production mean that large-scale biofuel crops are unnecessary but other new uses such as vineyards have spread. Arable land is also often close to towns and cities and within them, as urban design incorporates a range of ‘green infrastructure’. This helps to meet local needs that cannot be met through industrial production and niche markets, or simply to preserve traditional ways of doing things.

Concepts of urban and rural are blurred, with planned zones for different uses largely a thing of the past except to locate major infrastructure for food or energy production or other ecosystem services. Settlements are more dispersed, dotted with areas of greenspace and water areas, and urban areas contain many more trees, as well as many other features such as rooftop installations that regulate temperature and produce food as well.

Rural areas contain relatively recent satellite settlements, towns and more villages and hamlets - areas such as the East of England are more densely populated than before largely because of the space freed up due to the growth of industrial farming. As a result, there is a new type of countryside full of people and activity. Peace and solitude are hard to find - even if there is no more intrusion from heavily used trunk roads and motorways - and the extensive waterway network is used for both commercial and recreational transport.

Although the quality of the natural environment is good, some protected areas are still necessary, either to protect the highest-quality ecosystem services (such as water supplies for the South East) or the most vulnerable biodiversity.

Coast

The coasts of eastern and southern England have changed radically in many places. Although international action on climate change has made good progress, the sea-level is still rising and is due to continue to rise for many decades. While the use of managed realignment is widespread and the need to work with natural processes is widely recognised, some communities at high risk seek to use traditional hard solutions to safeguard their land and homes, with adverse effects on the landscape and the areas

around them. Despite advanced prediction and monitoring and sophisticated solutions to coastal flooding, the strength of some events can prove too much for hard and soft defences alike and there is occasional significant damage to biodiversity and landscapes as communities find it hard to cope with large-scale events such as tidal surges and storms.

Despite this, coasts overall are in good condition, though new technology such as the latest wave and tide generation plants have changed the character of some areas, with the most valuable ecosystem services safeguarded wherever possible. Where this is not possible, mitigation or compensation is put in place to ensure that those ecosystem services affected can continue somewhere else.

The few remaining nuclear power plants are ready for decommissioning after which fission-based nuclear generation will come to an end. With trials of marine food production under way, there are likely impacts on the coasts from the infrastructure that will be needed to transport the food inland. Ports have been adapted to carry relatively light traffic of specialist raw materials that cannot be obtained any other way.

The coast is widely used for recreation, and again this can lead to some adverse impacts especially if local communities cannot cope with influxes of people.

Marine

Although CO_2 levels have begun to stabilise, ocean acidification is still severe and shows little or no signs of reversal. It has contributed to a series of marine ecosystem changes. These are manifest in many different ways, with precise cause and effect relationships that are difficult to pinpoint or understand. Many organisms have found it more difficult to deposit calcium from seawater to form their skeletons or shells. Major red tides have started to appear along the coast as ecosystems fall out of balance, making seafood dangerous to eat. Dead zones have expanded in oceans and heightened surface water temperatures have prompted an invasion of non-native species causing both damage to ecosystem function and structure, and disruption to economic interests (biofouling and displacement of edible species). There have been some early efforts to hold back the full impact of acidification through reductions in CO_2 emissions.

Fisheries are globally valued. Consumer power, combined with improved understanding of ecosystems has led to more sustainable fishing practices with globally focused quotas and enforcement of catches and stocks. In addition, there has been a growth in ‘catch-share’ where local fisheries are managed more by local co-operatives who ‘share the catch’. Aided by production of vegetarian-based non-fish meal, extensive farming of a wide variety of fish species occurs in inshore areas and some offshore areas.

A comprehensive network of offshore power production occurs, including wind, tidal power and other innovations such as hydrogen-powered vessels and hydrothermal power.

The protection, planning, monitoring and enforcement of the marine environment are globally focused, including a coherent and sizeable network of marine protected areas that has been in place for some time.

Woodland

In both rural and urban areas, the area of woodland has increased owing to new planting to provide ecosystem services. This includes providing timber, but also woodland corridors to help climate change adaptation. However, the latter is not always successful as it can be difficult to get every community to join up and agree to the planning and siting. Also, evidence remains unclear on the effectiveness of woodland corridors. As a result of new planting and of climate change the mix and distribution of species has changed and is still changing. The emphasis on native tree species as defined in the early 20th century is seen as increasingly outdated because of the effects of climate change on tree species distributions. Woodland has sometimes replaced habitats such as lowland heath and grassland. It is valued for its role in managing catchments, storing carbon, providing places for people to connect with nature (though with agriculture more extensive there are other opportunities as well), and as a valuable

local source of renewable energy that supplements other provision. Deer are managed rigorously and are a local source of food.

Wetlands

Wetlands are valued for their ecosystem services (in particular providing clean and plentiful supplies of water and storing carbon) and are generally in good condition; though, as with woodlands, it can sometimes be difficult to establish large-scale networks over wide areas. The area of wetland has increased overall, but some habitats such as grazing marsh are less prevalent following the decline in grazing; these have been replaced with lagoons or saltmarsh. The continued impact of rising sea-level rise means that some coastal wetlands in low-lying areas continue to undergo more frequent saline intrusion, turning them into lagoons or saltmarsh. Nevertheless, this transformation is managed to safeguard the ecosystem services they give. However, particularly sensitive wetland areas and wetland species can be affected by human pressure, particularly near towns and cities.

GO for Growth

Scenario by ethnographic futures framework category

Define

- First loyalties to survival of lifestyle (self-indulgence).
- Value materialism and wealth.
- Political paradigm: interest-group democracy.
- Economic paradigm: greed is good - consumers 'R' us (rampant consumerism) - work for a profitable purpose.
- Environmental paradigm: winners take all - if we can pay for it, it's ours, no matter where in the world it is; the approach is centred on technology rather than the ecosystem.

Relate

- 'Me': maximising the gratification of my lifestyle - monitoring celebrities and hoping for 15 minutes of fame.
- Government: national government and local authorities still squabbling, and so are increasingly ineffective at coping with emerging problems on any scale.
- On the international stage, inequity increases as competition rules the global political/economic system and large multinational corporations maintain overwhelming influence.
- Environment: Conservation? Sustainability? Why bother? But do keep the parks and beaches pretty, please.

Connect

- Virtual tourism and recreation; virtual environment beamed into your world; arts are virtual; genetic engineering used for art and entertainment, for example, reproducing a mammoth or a polar bear; no public broadcasting; just think to request a news download direct to your brain (implant).

Create

- Economy: a free market economy supports and is driven by accelerating technological innovation - paradigm that constant growth creates and distributes wealth.
- Branding paramount - some products are green, but if celebrities don't adopt them, they're not cool enough to be hot.
- Energy security is a significant issue - coal is still in use, wind and wave power has grown, as have nuclear installations.

- Food: UK agriculture is booming, amplified by warmer growing season and advances in biotechnology.

Consume

- Consumption at an all-time high around the world.
- Homes don't consume much power, but high-tech fixes like recycling by mining landfills do.
- Lifespan has an agreed 'termination date', but people are healthier - cosmetic and preventive surgery common using spare organs grown from stem cells.

Table B Timeline: GO for Growth

2010	2020	2030	2040	2050	2060
Marine		Increasing and ongoing acidification of the oceans	Wild marine fish disappear. Fish and chips shops close		Marine reserves as tourist hot spots (plastic fish may be needed)
					Fish farming exploits marine natural environment
					Majority of marine environment degraded, species poor
Coastal	Chelsea harbour AONB lost		Coast defences for towns and the rich	Major inundation of south and east coasts	Renewable energy in coastal sites - wave power and tidal
	Retreat from coastal areas				Fens as 'soft' sea defences
	Government repeals legislation protecting wetlands			Norfolk and Suffolk flood. All population moved to new urban centres and other settlements	
				Waitrose introduce new Bittern burgers from new Fenland marshes	

Table continued...

	2010	2020	2030	2040	2050	2060
Wetlands		Very low flow in rivers	Increased abstraction from rivers			
		Return of malaria (wetland drainage)	Water storage infrastructure			
Lowlands	Beginning of ecosystem services thinking (2000)	Heath and forest fires	Beech eliminated from southern England by sudden oak death (?)	Changes in species assemblages (for example, bees) affecting ecosystem services	Designated areas (national parks) thrive	Arable deserts
		Increasing fragmentation of habitats	First large scale wind farm on a protected south-east landscape (South Downs)	Charges for access to nature	Niche farms, gorgeous countryside, crested newts - but it's all vulnerable to disruption	Islands of biodiversity - protected by being isolated
		Increasing rural NIMBYism, restricting development	High taxes for ecosystem services reach the limit of peoples' willingness to pay	Loss of culturally important species		Theme park countryside 'The Lake District Experience'
		GM accepted	Increase in number and size of designated sites	Red squirrel extinct		Intensive agriculture around towns
		Waitrose scrap new budget range	Intensive agriculture in non-designated areas	More vineyards		Import food from Africa
			Accepted that eco-design may cost more	Allotments tended by robots		
			Vineyards on chalk	Poachers		

Table continued...

	2010	2020	2030	2040	2050	2060
			Intensive food production around new urban areas			
			Intensification of agricultural base with robots and GM crops			
			Grassland lost to arable			
			Niche food producers and extensive farming			
Uplands		Water grid created nationwide	New reservoirs built	Last arctic alpine plants lost from northern England		Upland wind farms and hydro, with adverse effects
			Grouse disappear			Uplands used for niche products and 'big game'
						Wind farms, loss of tranquillity and views
Urban	Increasing urban inequality	Heatwave has impact on urban design	100% carbon neutral homes	Measuring ecosystem services in urban areas	Design urban areas for health and green access for people	
		High-quality gated communities	Increasing urban density	New towns (some biodiversity)	Urban disjoint	
		Increasing middle class affluence	Off-grid housing			

Table continued...

	2010	2020	2030	2040	2050	2060
		Urban areas over-run by foxes				
		Urban riots				
All	Beginning of ecosystem services thinking (2000)	Green belts lost	High taxes for ecosystem services reach the limit of people's willingness to pay	High cost of oil funds a green revolution	Some action and success in reducing greenhouse gases	High CO_2 levels, disaster certain. Scientists say, "We told you so."
	Political imperative for economic growth (2000)	Rich folk move north	Negative cost element of eco-systems design are accepted	Perfect storm (food, water, resource crunch)		UK lives by export of services
	Climate change forces migration of British ex-pats north away from Southern France and Mediterranean	Urban colonisation of green belts	Wars (outside UK) over uranium	Nuclear fusion		No green belts
	More air conditioning	Peak oil	Key question: can we source what we need from overseas (food, resources, sinks for our urban footprint)?	Polarisation between rich and poor increases		More dense urban areas
	Leisure involves consumption and technology	New generation of nuclear power	New urban centres with green 'amenity' infrastructure	More polarised society		New settlements and infrastructure
			Mass migration from South East			Bigger cities

Table continued...

2010	2020	2030	2040	2050	2060
		Carbon capture and storage grows			Economic focus shifts to new locations
					Places valued for resources
					Renewables driven by loss of fossil fuels
					Life is good for rich, for those who can afford it
					South East is arid, marginalised zone

Implications by geographic zone

Uplands

Diverse and rapidly evolving energy production in the uplands has brought about significant change in landscapes. Corporate ownership of wide tracts of upland by globally integrated utility companies for water and energy is common. The remaining freely accessible areas are affected by increased housing and transport development, and by the pressure of increasing amenity needs. Traditional rural communities and social systems have largely disappeared, replaced by incomers with different skills and values.

There have been potential knock-on benefits for biodiversity and landscape through the introduction of management compatible with the management of water, such as the reduction in numbers of grazing animals, and the restoration of peat in those catchments controlled by private estates or corporations. Similarly, some upland tracts are owned and/or managed privately for hunting, adventure sports, or to satisfy individual concepts of 'wilderness'.

However, this relies on the necessary economic incentives, personal or corporate interest, and an available skill base. Where such interests and skills have been used to enhance existing ecological and landscape character, the natural environment has become more adapted to change and erosion and soil loss have been reduced.

Lowlands

Efficient highly intensive biotechnology-based agriculture, particularly around urban areas, has reduced the overall space required for food production. Non-agricultural areas tend to be occupied by energy, housing or other infrastructure development. There is little room or need for the natural environment unless it delivers a functional purpose or unless individual initiative chooses to favour it.

In some areas of the urban fringe, land is owned for investment purposes and little or no management is undertaken. However, the majority of the urban fringe is now used for amenity or intensive agriculture. Amenity land is largely held by private enterprises for traditional country sports (hunting, shooting), outdoor activities (off-roading, adventure pursuits) and wildlife experiences.

Landscape character has remained different across the country as market forces drive changes in land use to deliver the greatest financial gain. This has resulted in concentrations of uses in particular areas, such as food production on high-quality agricultural land and industrial areas, and development close to transport routes and hubs. Multifunctional land use has declined as the importance of the social, wellbeing and cultural requirements of land has declined.

Coast

Extensive hard sea defences protect high-value coastal assets such as highly productive farmland, large settlements and power stations. There is little collective action along wide stretches of the coast where the costs of defence outweigh the benefits. But local defences established by individuals and corporate bodies who can afford to pay for them are common. However, these often cause problems further along the coast.

The extent of many coastal habitats has diminished through coastal squeeze: encroachment of development from the landward side and from sea-level rise on the other side. The exception has been where there is evidence that features such as coastal wetlands or eroding cliffs can benefit adjacent valuable assets (such as accretion of sediment for tourist attractions such as beaches). In some areas, coastal protection has been withdrawn on financial grounds (for example, where insurances risks are regarded as excessive) and natural systems have been able to re-establish.

Increased frequency and magnitude of storm surges, flooding and sea-water incursions have meant that some coastal ecosystems are protected where this can provide a cost-effective means to protect economic interests.

Marine

Ongoing and increasing acidification of the oceans has contributed to a series of marine ecosystem changes. These are manifest in many different ways, with precise cause and effect relationships difficult to pinpoint or understand. Many organisms have found it more difficult to deposit calcium from seawater to form their skeletons or shells. Widespread algal and diatom blooms (red tides) occur along the coast as ecosystems fall out of balance; rendering seafood dangerous to eat in some places and at some times of the year. Increased surface water temperatures prompt the introduction of non-native species, affecting ecosystem function and structure, and economic interests, such as through the bio-fouling of commercial vessels and displacement of commercial edible species.

Intensive fishing pressure has affected species down the food chain - white fish and crustacean populations have declined significantly. Species diversity is very much lower than 50 years previously - in many areas, plankton and many small species of fish with no commercial interest are the dominant organisms. While some fish farming continues, as wild fish populations decline, fish meal is more difficult to come by and no alternative has been developed.

The marine environment is affected by a high level of development including inshore and offshore wind farms, increased marine aggregate extraction and shipping associated with new ports. There is little remaining capacity for further development and some have begun to call for a strategic planning approach to use of the seas. Increased development has led to declines in marine biodiversity (including nursery fishing grounds and global bird populations). Vessels are still highly dependent on fossil fuels and increased volumes of shipping have increased emissions of sulphur dioxide. Similarly, with increases in global trade, the numbers of non-native species from ballast waters have increased, along with more plastic waste and a greater risk of oil and chemical pollution incidents. The level of development restricts amenity use which is now available for fewer people.

Woodland

The overall area of woodland has decreased due to competition from other land uses. Its financial value as a source of renewable energy means that remaining areas are increasingly managed as industrial-scale commercial plantations, using fast-growing genetically modified species - techniques more akin to intensive agriculture than traditional woodland management.

Woodland and forest are under increasing pressure from climate change-induced drought and wildfires. Global trade and climate change is introducing an increasing array of pathogens, resulting in dramatic changes in the species composition and structure.

As in the uplands, relatively large tracts are in private or corporate hands. In these areas biodiversity and landscape benefits can occur, but this depends on the interests of the owners. Large, wealthy landowners manage their land commercially for game, deer or boar hunting, as an amenity for adventure sports, or for private use - all which can potentially benefit biodiversity.

Wetlands

Open-water habitat has increased as the combination of water shortages and climate change-driven flood events have led to the ‘corporatisation’ of water. Utility companies have invested in new reservoirs and have developed a network of pipelines to move water from the North West to the South East.

The use of wetland for financial benefit has increased. Creating reedbed and fen for bio-filtration and flood mitigation has led to an increase in their area, but their management is for their primary use so biodiversity and landscape benefits are limited.

KEEP it Local

Scenario by ethnographic futures framework category

Define

- First loyalties to survival of self and immediate locale.
- Value self-sufficiency, locally and individually, with a focus on self-reliance, and success within limits.
- Political paradigm: centralise and regulate to protect.
- Economic paradigm: shrinking pie - use what's to hand.
- Environmental paradigm: what's ours is ours, and ours to use - disconnected from nature.

Relate

- 'They': trust your community, and guard against outsiders.
- Government: national government authoritarian - regulatory structures attempt to control and plan use of scarce resources, while local 'work-arounds' to national dictates keep things working by informal flexibility at the community level.
- Globalism disintegrates into factionalism and protectionism (with roots in the economic depression of 2008-2013) - the EU falls apart and Great Britain splinters - multinational corporations (MNCs) hire armies.
- Environment: provides resources for self-sufficiency - respected and stewarded only in relation to human needs - biomes and biotopes damaged where they straddle borders.

Connect

- National intranet puts government communications in every home; increase in state network propaganda and poster art, but likewise increase in local community publications and billboards; increase in Morris-style artisanal products; opposition voiced via graffiti and counter-slogans; digital libraries.

Create

- Economy: protectionist and increasingly national as globalisation splinters under pressure from fiscal and natural resource constraints.
- Only local products are trusted.
- Energy: whatever's available - resulting in a mix of old energy tech (coal/peat), alternatives (wave/wind/solar) and high-tech innovations (hydrogen).
- Food: grown everywhere by agricorps and co-operatives and individuals in allotments. Trust lands are distributed for food and biotech production.

Consume

- Consumption has fallen due to constriction of resources, goods and services: rationing of both power and IT bandwidth common - consumers opt for goods that last longer.
- People spend more time at home and in the community and outside in their gardens and allotments.
- More products are consumed at point of origin - '100 mile diet' now de rigueur; people are healthier - more outdoor time and more exercise.

Table C Timeline: KEEP it Local

	2010	2020	2030	2040	2050	2060
Marine	Need to protect British fish for British people	Huge expansion of inland freshwater fisheries	Caged aquaculture	Wind turbines and gun boats		
	Offshore renewables boom	Local ownership of fish stocks				
	Pollack war (no more cod); fishery protection fleet grows	Widespread failure of sea fisheries due to over-fishing and acidity				
	Terminal crash in fish stocks					
	Declining fish stocks; acidification of the oceans					
Coastal		Coastal exclusion - coastal access legislation repealed	Coastal pollution (eutrophication)		Traditional and intensive farming, with traditional fertilisers	Seal levels rise - coastal squeeze
					Floods = fertiliser!	
Wetlands			Rivers for irrigation and water supply - not for recreation	Housing on flood plains is threatened		Agriculture flourishes on flood plains

Table continued...

	2010	2020	2030	2040	2050	2060
Lowlands	Biofuels create pressure on landscape and on farming for food	Access scrapped	Destruction of national parks - become wild spaces	Environment degraded - more crop failure - emigration	Denbigh's vineyards stretch along the whole of the North Downs	Biodiversity is lost
	Flooding a regular occurrence - inland as well as coastal	Drought 2020			South-east England sweeps all awards for champagne	Designated land is spoilt
	Food prices rise	Fires on Exmoor and Dartmoor				Windy places prosper
	Wet summers - crop failure? Effect on tourist industry?	Fuel prices rise				
		Mass food production				
		No bees				
		Nuclear energy				
		Wind, biomass, hydro, solar, wave and tidal				
Uplands	Climate change	Individual landowners and corporations are all-powerful (for a time)	Destabilising crisis leads to land reform - local ownership or at least more local control	Climate change brings new crops such as tea	Surplus production of food, fuel and fibre is sold to other communities	Landowners win out in this scenario

Table continued...

2010	2020	2030	2040	2050	2060
Growing population	Major change in land ownership following major events of 2020	North-west uplands sell water to lowlands in the south and east	Utility companies prosper	More local markets demanding food, fuel and fibre	More improved and semi improved land on the 'Moorland Fringe'
Food security concerns	Heatwave 2020	Response to major fires - land abandonment, tree planting on skeletal soils, increased flood risk, loss of water resources	Resumption of small scale mineral extraction; for example, coal	Increased need for new workers to service new (upland) industries	Greater diversity of agriculture
Hugh Fearnley-Whittingstall becomes local mayor	Extensive moorland fires. Natural systems take a long time to recover, reducing options for the future	Use of genetically modified plants and animals. Use of exotic species for food	Warmer climate gives easier living conditions. Better in the North West than in the South East	Loss of lowland to flooding creates demand for upland and urban land use	Uplands: wind farms (and solar); more reservoirs; more houses
Release of publicly owned land for 'Dig for Victory' campaign	Major reservoir construction by the public sector	Population increases lead to food security concerns		Construction of new towns and villages in uplands	Uplands visually more diverse, cluttered, less tranquil
Rising energy prices and production costs	Cloud seeding used to try and increase rainfall	Improvement of agricultural upland where possible. Food, fibre and fuel		More water transport	Re-industriali-sation of the uplands
CAP reform - national protectionism		Change in planning policy (for example, PPS 7) allows development in the countryside			Re-peopling of the uplands

Table continued...

	2010	2020	2030	2040	2050	2060
			Rising price of oil leads to increasing number of wind farms, hydro-electric schemes and wood fuel use			Growth in state/council gardens and small farms
						Local barons
						Greater development along existing routes. More routes
Urban	Green infrastructure master plans	Combined heat and power schemes take off	Food shortage - dig up gardens	Age and urban/rural conflict	Local resource based industries and place flourish	Barter exchange
	Housing growth - green infrastructure	Global migrants seeking water and food sources	Four heat waves in a decade	Food chains shorten: food miles at a new low		Warlords
	Retrofitting of existing buildings	Heatwave 2020	Market gardens again	Intra-UK migration towards areas of food plenty		
		Pressure for immigration	Resilient local communities with cultural diversity	Local governance		
		Zero carbon housing	Urban heat island affecting movements of population - conflict in rural areas competing for land	Nature of cities change. Garden cities, like Havana		
				Rise in local protection and security		

Implications by geographic zone

Uplands

Upland landscapes that help symbolise England and strengthen national identity are protected, but reduced in area. Even within these landscapes the use of the uplands for wind energy has become accepted and valued.

Quarrying for minerals and aggregates is having a significant local impact on biodiversity and landscape.

Water is a basic resource that is traded, and the uplands are managed to generate this although many are multifunctional, planted with fast-growing trees for bio-energy, catchment management and amenity use.

Where water management is not affected, the uplands are heavily grazed by sheep and goats with little regard to the landscape or biodiversity.

Lowlands

Intensive agriculture and biomass energy production provide little room for biodiversity and have led to significant changes to most landscapes except in the small number of areas protected for their landscape and biodiversity value. Where landscapes are not valued for their iconic and symbolic value, many lowland environmentally sensitive areas and National Parks have been drained, fertilised and replanted.

Driven by the high cost and lack of availability of inputs, agriculture is low-input or organic, using new crop varieties and biotechnology developed for local conditions that fix nitrogen, require less phosphorous, and are resistant to drought.

While some technological advances such as through biotechnology have occurred, the agricultural system is more labour-intensive as technology has not managed to fully counter the reduced availability of fossil fuels.

The reduction in artificial fertilisers and pesticides and the use of more complex cropping systems has provided greater habitat diversity. However, as food production takes precedence and the agricultural system is still intensive and mechanised, increases in species diversity and abundance are limited.

The use of arboriculture for food and energy is widespread. Together with more orchards and vineyards, this has contributed to the increased diversity of lowland landscapes.

Local processing plants and infrastructure associated with bio-energy generation and biofuel production are common and oil wells have been established in parts of eastern and southern England.

There is increased use of rivers, ponds, lakes and wetlands to manage urban heat island impacts, improve water management (flooding, filtration, recycling) and provide food through freshwater aquaculture. These areas have secondary uses as amenity land where appropriate and have benefited urban biodiversity.

Coast

Strategic assets such as highly productive agricultural land, large settlements and energy infrastructure have been nationalised to ensure national targets for food and energy production are met. High-value agricultural land is also being defended with major flood defence schemes covering much of eastern England; both hard and soft sea defences are employed depending on the site and the outcome of cost-benefit analysis driven by the need for economic benefit.

Owing to the decline of international money markets as globalisation contracted, smaller-scale, nationally funded schemes are prevalent. Estuarine tidal energy generation schemes are commonplace with impacts on the landscape and biodiversity not only due to the schemes themselves (which include small

barrages, tidal lagoons and tidal reefs) but also the infrastructure needed to support them. Barrages can also provide additional estuary crossings and flood defence. Where schemes affect ecosystem services of greater value, such as flood protection or food production (for example, fish nurseries), the effects are mitigated. There is little (if any) attempt to mitigate (or compensate for) the effects on biodiversity for its own sake.

More widely, coastal infrastructure has increased considerably to support the offshore energy, aquaculture and increasing extractive industries.

Marine

Ongoing and increasing acidification of the oceans has contributed to a series of marine ecosystem changes. These are manifest in many different ways, with precise cause and effect relationships that are difficult to pinpoint or understand. Many organisms have found it more difficult to deposit calcium from seawater to form their skeletons or shells. Widespread algal and diatom blooms (red tides) occur along the coast as ecosystems fall out of balance; rendering seafood dangerous to eat in some places and at some times of the year. Increased surface water temperatures prompt the introduction of non-native species, affecting ecosystem function and structure, and economic interests, such as through the bio-fouling of commercial vessels and displacement of commercial edible species. In some locations, short-term efforts have been made to counter acidification, including ocean seeding with iron filings, but with little success.

Following withdrawal from the EU Common Fisheries Policy, territorial fishing waters are managed and protected as strategic national assets, the navy reinforcing when required. Domestically, there are many local fisheries managed through local co-operatives who 'share the catch'. There has been a switch from a dependency on fin fisheries to crustacean, with inshore fisheries in some areas being supported by special stewardship measures; local seal culling being undertaken where fisheries have dwindled and local shark fisheries started in some areas.

There is a mixed portfolio of energy options including wind, wave and tidal. Short-distance shipping has also increased. Together, increased development has led to some declines in marine biodiversity. While the marine environment is increasingly zoned for multiple uses, tensions between national and local priorities make this difficult to enforce. In many areas, local food and energy zones have emerged with fish farming increasing in some areas.

Few people have extensive time for leisure activities so amenity use of the sea is rare.

Woodland

Across the country the area of woodland has increased due to new planting. However this sometimes replaces habitats such as lowland grassland and heath and upland moor which is not being grazed by sheep or goats. There has been a return of active management for most woodland for timber production and renewable energy with secondary amenity or deer farming uses. However, this increase in forestry leads to a wide variation of management practices, not all of which necessarily results in improvements for species abundance or richness.

The increase in woodland area is also driven by planting within and surrounding urban centres to counter urban heat island effects; in the uplands for improved catchment management and the lowlands for flood risk management, both promoting climate change adaptation.

Wetlands

Much lowland wetland has been drained and improved for food production, reversing earlier efforts towards rewetting driven by conservation and climate change mitigation drivers.

Some coastal wetlands have increased where coastal realignment has been pursued, as have habitats such as fen, reedbed where they can reduce urban heat island effects, ameliorate flooding, and improve water quality.

In the quest for food security, intensive freshwater aquaculture using low-input species such as carp and *Tilapia* have placed pressure on local systems through pollution and escapes.

With agriculture using fewer inputs, nitrogen and phosphate pollution are much reduced and there is less inland and coastal eutrophication. The increase in mineral workings and the general industrialisation of food and energy production, has increased localised pollution, partly as a result of lower environmental safeguards in areas which do not provide other ecosystem services. But this is not serious because of the need to reduce waste to help conserve resources.

Rivers are under increasing pressure from escaped non-native and biotechnologically enhanced fish from intensive inland and coastal aquaculture.

SUCCEED through Science

Scenario by ethnographic futures framework category

Define

- First loyalties to survival of business and sustainable economic growth.
- Value innovation and entrepreneurial invention.
- Political paradigm: efficient partnerships - national/local, public/private, etc..
- Economic paradigm: waste = cost - productivity and sustainability are a virtuous feedback loop (still a market model).
- Environmental paradigm: our environment helps leverage innovation (but biodiversity is not valued for itself).

Relate

- “I”: on my own - individual responsibility and the innovative entrepreneur - stewardship and good works emerge primarily as philanthro-capitalism.
- Government: more cohesive national - community co-ordination, and more public-private-academic partnerships within countries.
- Globally, inequities lessen as some technological innovations provide affordable fixes to conditions of extreme poverty, but many countries still struggle to compete and languish on the wrong side of the innovation / competition divide.
- Environment: a resource for innovation and productivity - wasting resources affects the bottom line.

Connect

- Pervasive telecommunications and media and ubiquitous sensors used to monitor resource availability, quality and waste; unique art forms developed from recycling, and biotech.

Create

- Economy: booming market capitalism accelerated by breakthrough, transformative ‘green’ innovation.
- Branding: ‘negative waste’ products best-sellers.
- Energy: production is mixed scale - large multi-source power plants still feed the grid, but everyone has their own wind turbines / solar PV / etc. as well..
- Food: oceans have property rights, like the American open range: fish are branded like cattle; no carrots or potatoes in East Anglia, reflecting the true cost of water in this region (water abstraction licences include societal cost in ‘true cost’ accounting).

Consume

- Conspicuous consumption focused on quality, extended shelf / use-life; carbon quotient (neutral required; negative best).
- Housing conforms to much stricter conservation codes, new builds with recycling and energy production built-in - retrofitting a booming business.
- Deep contradiction between implicit consumerism of market economy, and post-consumerist sustainable lifestyles - although waste has become socially unacceptable.

Table D Timeline: SUCCEED through Science

	2010	2020	2030	2040	2050	2060
Marine	Declining fish stocks; acidification of the oceans	Marine protection zones, need for social mechanisms to make them work in practice	Fisheries crash further, possible tipping point	Fish landings cease		
	Trend towards old technologies (fishing by line, organic)	Sustainable fish quotas	Great barrier reef gone			
	Seabird colonies declining	Fish farming (and knock on environmental impact)	Marine aquaculture			
		Food riots sparked by collapse of large scale fish farms through new diseases and ocean acidification	Recognised true value of fish stocks through fiscal policy			
		Sand eels gone. Seabird colonies desert UK	Sailing ships re-emerge			

Table continued...

	2010	2020	2030	2040	2050	2060
		Scottish (and some English) tourism suffers from lack of seabirds, but readjust to exploit opportunities for example, recreation	Small-scale localised aquaculture			
			Fish feed markets adjust. Fish feed imports grow. Fish feed innovation speeds up			
Coastal	Severe flooding in East Anglia 2010	Landowners 'paid' for 'farming' flood water	Sea walls and land reclamation for agriculture (in focused areas only)	Large scale relinquishing of land on east coast for flood protection	Sea walls breached. Loss of agricultural land. Floods	Thames estuary salt marsh expands again
	Average land values in East Anglia drop due to increased flood risk	Social rest as coastal towns evacuated	Severn Barrage destroys biodiversity	Thames estuary salt marshes expand	Coastal towns abandoned	Value sediment over biodiversity
		Improved climate models and flood risk prediction	New 'policy line' for flood risk areas	Floods predicted for 2050 Preparations started to minimise impacts	New flood abatement technologies cure London from ever flooding (2056)	
					Investment in coastal defences, tidal barriers	

Table continued...

	2010	2020	2030	2040	2050	2060
					Towns on stilts in response/preparation for floods	
					London flood risk drops	
					Flood 2050. 30cm sea level rise. Climate/flood risk models prove unreliable	
Wetlands		OFWAT allows catchment management for water price review	Wetland biodiversity increases			
			Freshwater aquaculture		More wetlands for carbon sequestration	
Lowlands		More water storage reduces land for other uses	Peak oil; price of oil drives up cost of fertilisers and other farm inputs	High food prices encourage investment in intensive production (greenhouses, hydroponics, GM)		
				Sales of English wine outstrip French		
Uplands	Energy techno-fix	Last snow settling in UK - Ben Nevis clear!	Pumped water storage for hydro-electric schemes	First fusion based power station opens	Corporate users and public bodies have diversified interests (especially for resources - hydroponics)	Individual hill farmers lose out

Table continued...

2010	2020	2030	2040	2050	2060
Uplands Entry Level Scheme - basic level of agriculture environment grant scheme	Management for non food services	Increased demand for drinking water	More reservoirs	2050 floods. Local movement to avoid lowland floods	Wind farms and scrub
	Wind farms over more uplands. Micro-generation using water	Crop failure leads to corporate or community hydroponics	Blanket bog as summer water storage	Population shift triggered by drought	Intensified farming for raw materials, timber, feedstock
	New CAP. As hydroponics expand, uplands are used as holding area for water	Drought. Political decision for uplands - rich users or poor users?	National grid for water	Flooding. Mass migration	Biodiversity is valued only if functional
		Short term wildlife benefits from rich enclaves - winners and losers	Hi-tech industries and the military take over the uplands		RSPB says that birds don't matter
		Photovoltaic straw for thatched cottages			Big estate owners like the Duke of Westminster continue to enjoy special places with AONB protection
		Wildlife corridors move vertically into uplands, taking populations from the south			TV mass entertainment for the poor

Table continued...

2010	2020	2030	2040	2050	2060
					Change in way uplands are viewed
					Industrial model is changing and needs new skills. What do we do with the unskilled population?
					Energy vs landscape issues. Energy intensive society. More technology and optimisation of the landscape
					No real change in values. This is the current model where the techno-fix worked
					Population of the South East moves North
					Local food security. Manage woodland to fuel local public buildings
					Wind turbines over the Lake District
Urban	Cheaper energy for those impacted by wind farms	Eco-housing development	Better air quality in cities	Localised micro-generation	High-technology places like Cambridge prosper. Places lacking skills (like Stoke) or low lying (north-west Norfolk) or both (Great Yarmouth) in decline

Table continued...

	2010	2020	2030	2040	2050	2060
		Heat wave drives up demand for air conditioning	Leicester is the first city to be 'greened'	Net migration out of cities - first time in a century	Northern England coastal resorts become major holiday destinations for people across Europe	Industrialisation and urbanisation near sources of energy (wind, hydro, biofuels)
			Nuclear power stations	More multi-functional land use in urban areas - but quality?	Patchwork of urban/rural zones not large conurbations	
			Peak oil drives up all energy prices		The first 'organic housing' goes mainstream in urban areas (carbon capture, food production etc)	
			Urban green space grows		A different architecture? Green buildings; sustainable urban drainage systems, high-rise, underground, urban density to allow for walking to work and recreation	
All	Charges and taxes to reflect environmental costs (landfill tax, Emissions Trading Scheme)	More natural reserves for biodiversity	'Land allocation' new legislation to designate food and energy and water service production areas; and protect limited areas for amenity and biodiversity	Declining water quality as increased rainfall flushes out legacy pollution	Improved water quality management	Society recognises environmental limits

Table continued...

	2010	2020	2030	2040	2050	2060
	Building regulations looking at whole life energy consumption	Heatwave 2020	Increase in intensification and specialisation of land	Fizzy North Sea kills Sun Fish (as CO_2 escapes)	More reservoirs in national parks and AONBs	Environmental services valued
	Taxes on green field development; subsidy for brown field sites	Uplands burn	High tech food production	Ecosystems Service Authority set up. Regulatory free for all in ecosystems speak	Water storage increased. Surface and sub-surface	Fusion on stream
	Innovation good		Increased investment in electricity producers and grids to power ventilation			UK does well with wind and tidal power
	High energy prices spur innovation		Carbon capture and storage - Low C economy			Greenhouse gases stabilised
	Obama - muddling through		Increased understanding of ecosystems science and services			Photovoltaic cells across the Sahara
	Attitudes shift towards sustainability		Increased marketing and competition in ecosystem services			Locations with marketable services do well
	Complexity science					

Implications by geographic zone

Uplands

The importance of the uplands for their ecosystem services has been identified and their management reflects this. Carbon sequestration through the management of peat and replanting of woodland is common, which also benefits water management, open water and wetlands. However the management of the uplands focuses predominantly on ecosystem services, with precision management meaning that any biodiversity and landscape gains are unintentional.

As the need for animals has reduced with food produced elsewhere, grazing levels have declined significantly, resulting in changes to the landscape and biodiversity in places through more woodland cover, less erosion and less uniformity.

In the upland landscape like elsewhere the impacts of rapidly changing industrial technology are visible, especially the legacy of former development.

Like biodiversity, leisure is of secondary importance to other ecosystem services in many areas. However in those uplands not providing key ecosystem services, amenity and leisure schemes and their associated infrastructure have increased dramatically, increasing pressure on the remaining high-quality landscapes and biodiversity. Within the areas where key ecosystem services have taken precedence there is carefully restricted amenity use.

Lowlands

Less land is required for food and energy production and more development has occurred for housing, energy, industry and transport infrastructure, especially in the South East.

Agriculture, forestry and horticulture are now highly mechanised and precision-based using IT, robotics and biotechnology. Some biodiversity has benefited from the reduction in inputs, but the increased precision of the agricultural system has increased the efficiency of the production system. This has reduced the availability of food and habitat for many farmland species, and reduced the capacity of the natural environment to sustain a wide variety of species. Technological advances mean that choices of crops and varieties is linked to the latest long-range weather forecasts, so landscapes where annual crops dominate can be different each year.

Towns and cities have seen significant increases in the extent of greenspace and water areas to assist urban cooling and flood risk management, as the natural environment is playing a central role in assisting the adaptation to climate change. Urban greenspace and water areas have been designed to deliver numerous functions. Secondary benefits have arisen for biodiversity through greater the greater connectivity, habitat creation, and amenity that these new areas provide.

Coast

Coastal realignment has occurred along many stretches of low-lying coast. Artificial offshore islands, reefs and wetlands have been designed to modify tides and storm surges to protect major settlements, highly valuable agricultural land, and key infrastructure where coastal realignment is not possible. These new areas have altered many seascapes and provided new habitat for many species.

Inshore waters are increasingly used for cargo transport and for leisure and amenity. This, together with international shipping, has resulted in more port construction.

Marine

Prompted by early efforts to hold back the full impact through reductions in CO_2, and although CO_2 levels have begun to stabilise, ocean acidification is still severe and shows little or no signs of reversal. It has contributed to a series of marine ecosystem changes. These are manifest in many different ways, with precise cause and effect relationships that are difficult to pinpoint or understand. Many organisms have found it more difficult to deposit calcium from seawater to form their skeletons or shells. Major red tides

have started to appear along the coast as ecosystems fall out of balance making seafood dangerous to eat, dead zones have expanded in oceans and, heightened surface water temperatures have prompted an invasion of non-native species causing both damage to ecosystem function and structure and disruption to economic interests (biofouling and displacement of edible species). In some locations, there have been some early efforts to hold back the full impact of acidification, focusing primarily on removal of greenhouse gases from the atmosphere. Trials in the 2030s, involving seeding of oceans with iron filings and formation of clouds using seawater to deflect the sun's rays, proved unsuccessful and, on occasion, counterproductive.

The true value of fish stocks is recognised through fiscal policy, with fisheries managed through legislation and supported by sustainable practices enabled by technology (less damaging gear types, by-catch reduction, cost-effective monitoring increased) and effective enforcement and protection. Aided by innovation around the production of vegetarian-based non-fish meal, extensive fish farming occurs, including of plankton and of new/different species. Breeding and genome manipulation of some species is also taking place. Despite careful controls, this has, on occasion, affected many native species through competition and hybridisation.

Development of offshore renewable energy schemes takes place, such as deep-water wind and tidal stream power. Carbon capture and storage facilities are also operating. Shipping technology has also advanced with a succession to clean technologies including hydrogen- powered vessels operating on both long and short-distance routes. Use of the marine environment is spatially planned, with specific zones enabling multiple uses, including provision for marine nature reserves.

Woodland

The area of woodland has remained static over the last 50 years, increasing in some areas to improve ecosystem services such as carbon sequestration, flood risk management and urban cooling but decreasing elsewhere as the result of competition for land for development and infrastructure. Within the urban environment the use of trees to help adapt to climate change is now widely accepted, though new generations of buildings are so efficient that they are becoming less important.

Wetlands

Areas of open water and wetlands have increased and are managed for their ecosystem services, such as providing water for cooling cities, sequestering carbon, and alleviating or preventing flooding. Consequently, species and habitats that support continued delivery of those services are well cared for. Those that contribute little or nothing to the delivery of the services receive no specific protection and their survival is accidental. As a result, some extinctions are occurring and some sensitive habitats, such as fen, are deteriorating.

Appendix 2 Contributors to the preparation, testing and refining of the scenarios

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Natural England works for people, places and nature to conserve and enhance biodiversity, landscapes and wildlife in rural, urban, coastal and marine areas.

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